



Greenhouse and Energy Minimum Standards (LED Lamps) Determination 202X

I, Jenny McAllister, Assistant Minister for Climate Change and Energy, make the following determination.

Dated

Jenny McAllister

Assistant Minister for Climate Change and Energy

Contents

Part 1 —Preliminary	4
1 Name	4
2 Commencement.....	4
3 Authority	4
4 Definitions—standards referred to in this instrument.....	4
5 Definitions—other expressions used in this instrument	5
6 Definition—reference control settings	13
7 Applicable definitions and applicable versions of standards and documents incorporated into standards	14
8 Families of models	14
9 Product category.....	15
Part 2 —Product classes and testing requirements	16
Division 2.1 —Products covered by this Division	16
10 Purpose of Division.....	16
11 Classes of products that are covered by this instrument	16
12 Classes of products that are not covered by this instrument	17
Division 2.2 —Testing requirements: general	18
13 Purpose of this Division	18
14 Testing requirements—general	18
15 Circumvention of testing.....	18
Part 3 —GEMS level requirements	19
16 Purpose of Part.....	19
17 Ecodesign requirements—energy efficiency	19
Part 4 —GEMS labelling requirements	21
18 Purpose of Part	21
19 Information to be displayed on the LED lamp itself.....	21
20 Information to be visibly displayed on the packaging	21
21 Impact of replacement determination	25
Part 5 —Other requirements	26
22 Purpose of Part	26
23 Other requirements—performance requirements	26
24 Other requirements—impact on human health	26
Schedule 1 —Product classes not covered	29
1 Aeronautical lamps.....	29
2 Other exclusions.....	29
Schedule 2 —Incandescent or halogen equivalence claims	31
1 Incandescent or halogen equivalence claims—non-directional LED lamps	31

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Part 1—Preliminary

1 Name

This instrument is the *Greenhouse and Energy Minimum Standards (LED Lamps) Determination 202X*.

2 Commencement

- (1) Each provision of this instrument specified in column 1 of the table commences, or is taken to have commenced, in accordance with column 2 of the table. Any other statement in column 2 has effect according to its terms.

Commencement information		
Column 1	Column 2	Column 3
Provisions	Commencement	Date/Details
1. The whole of this instrument	TBC	TBC

- (2) Any information in column 3 of the table is not part of this instrument. Information may be inserted in this column, or information in it may be edited, in any published version of this instrument.
- (3) To avoid doubt, for the purposes of paragraph 34(b) of the Act, this instrument comes into force on the day specified by column 2 of the table.

3 Authority

This instrument is made under section 23 of the *Greenhouse and Energy Minimum Standards Act 2012*.

4 Definitions—standards referred to in this instrument

Note: Subsection 7(2) provides that the applicable version of each standard referred to in this section is the version that existed at the date this instrument was made.

In this instrument:

AS/NZS 5341 means *Australian/New Zealand Standard 5341:2021 – LED lamps – Test methods – Energy and functional performance*.

AS/NZS 62471 means *Australian/New Zealand Standard 62471:2011 – Photobiological safety of lamps and lamp systems*.

Note: AS/NZS standards are available from Standards Australia Limited.

CIE S 025 means *CIE S 025/E:2015 – Test Method for LED Lamps, LED Luminaires and LED Modules*.

Note: In 2022, the CIE standards were available at <https://www.techstreet.com/cie/>.

IEC 62776 means *International Electrotechnical Commission Standard IEC 62776:2014 Double-capped LED lamps designed to retrofit linear fluorescent lamps – Safety specifications*.

IEC 62931 means *International Electrotechnical Commission Standard IEC 62931:2017 GX16t-5 capped tubular LED lamp – Safety specifications*.

IEC TR 60887 means *International Electrotechnical Commission Technical Report IEC TR 60887:2010 Glass bulb designation system for lamps*.

IEC TR 61547-1 means *International Electrotechnical Commission Standard IEC TR 61547-1:2020 – Equipment for general lighting purposes – EMC immunity requirements – Part 1: An objective light flickermeter and voltage fluctuation immunity test method*.

IEC TR 63158 means *International Electrotechnical Commission Technical Report 63158:2018 Equipment for general lighting purposes – Objective test method for stroboscopic effects of lighting equipment*.

Note: In 2022, the IEC standards were available at <https://webstore.iec.ch/>.

5 Definitions—other expressions used in this instrument

Note: Many of the following definitions are based on the International Commission on Illumination (CIE) International Lighting Vocabulary. Where the definition of an expression below differs from the CIE definition, the definition in this instrument takes precedence.

In this instrument:

Act means the *Greenhouse and Energy Minimum Standards Act 2012*.

average luminance for an LED lamp means the average luminance over a light-emitting area where the luminance is more than 50% of the peak luminance (cd/mm^2).

beam angle of a directional LED lamp:

- (a) means the angle between two imaginary lines in a plane through the optical beam axis, such that these lines pass through the centre of the front face of the LED lamp and through points at which the luminous intensity is 50% of the centre beam intensity; and
- (b) for LED lamps that have different beam angles in different planes—refers to the largest beam angle; and
- (c) for LED lamps with a user-controllable beam angle—refers to the beam angle as measured in the reference control settings.

Note: The beam angle is a full angle measure, not a half angle measure, and is expressed in degrees ($^{\circ}$).

cap or base means that part of a lamp which provides a connection to the power supply by means of a lamp-holder or lamp connector and, in most cases, also serves to retain the lamp in the lamp-holder.

Note: The standard code for identifying cap types can be found in IEC 60061.1: Lamp caps and holders together with gauges for the control of interchangeability and safety – Part 1: Lamp caps.

The term 'base' is equivalent to 'cap'. The term 'cap' is used in this instrument.

centre beam intensity is the value of luminous intensity measured on the optical beam axis.

chromaticity means the property of a colour stimulus defined by:

- (a) its chromaticity coordinates (u' and v'), or (x and y); or
- (b) its dominant or complementary wavelength and purity taken together.

colour consistency means the maximum deviation of the initial, spatially averaged chromaticity coordinates (x and y), or (u' and v'), of an LED lamp from the declared chromaticity centre point (c_x and c_y) or ($c_{u'}$ and $c_{v'}$), expressed as the step size of:

- (a) the MacAdam ellipse formed around the declared chromaticity centre point (c_x and c_y); or
- (b) the $\Delta u'v'$ circle formed around the declared chromaticity centre point ($c_{u'}$ and $c_{v'}$).

Colour Rendering Index (CRI, R) means the measure of the degree to which the psychophysical colour of an object illuminated by the test illuminant conforms to that of the same object illuminated by the reference illuminant, suitable allowance having been made for the state of chromatic adaptation.

colour-tuneable LED lamp means an LED lamp that can be set to emit light with a large variety of colours outside the range defined in paragraph 11(4)(a), but can also be set to emit white light within that range.

Note: The following kinds of lamps are not considered colour-tuneable:

- (a) tuneable-white LED lamps that can only be set to emit light with different correlated colour temperatures within the range defined in paragraph 11(4)(a);
- (b) dim-to-warm LED lamps that shift their white light output to a lower correlated colour temperature when dimmed, simulating the behaviour of incandescent lamps.

connected LED lamp (CLL) means an LED lamp in which the data-connection parts that are necessary to maintain the reference control settings are physically or functionally inseparable from the light-emitting parts.

Note: This includes an LED lamp for which the data-connection parts, while physically separate, are marketed with the lamp as a single product.

connected separate control gear includes data-connection parts that are physically or functionally inseparable from the actual control gear parts and are necessary to maintain the reference control settings.

Note: Connected separate control gear may have physically integrated data-connection parts in a single inseparable housing, or may be combined with physically separate data-connection parts placed on the market together with the control gear as a single product.

Connected separate control gear is also known as connected independent control gear.

control mode, in relation to an LED lamp, means the condition of lighting control parts in which those parts:

- (a) are connected to the lamp; and
- (b) are performing their functions in such a way that:
 - (i) a control signal can be internally generated or a remotely initiated trigger can be received, by wire or wirelessly; and
 - (ii) the control signal can be processed to lead to a change in the light emission of the lamp.

control signal means an analogue or digital signal transmitted to an LED lamp by wire or wirelessly, either via:

- (a) voltage modulation in separate control cables; or
- (b) a modulated signal in the supply voltage.

Note: The signal transmission is not through a network but, for example, from an internal source or from a remote control delivered with the product.

correlated colour temperature (CCT) means the temperature of a Planckian radiator having the chromaticity nearest the chromaticity associated with the given spectral distribution on a modified 1976 UCS diagram, where $u', 2/3v'$ are the coordinates of the Planckian locus and the test stimulus.

data-connection parts are parts that perform one or more of the following functions:

- (a) receiving or transmitting, and processing, wired or wireless data signals;
- (b) sensing and processing such signals;
- (c) a combination of the above.

Note: The signals mentioned in paragraphs (a) and (b) may be used to control the light emission function.

declared value for a parameter relating to an LED lamp means the value:

- (a) specified on the packaging supplied with the lamp by a person mentioned in subsection 43(3) of the Act; or
- (b) provided in an application to register the relevant model of lamp under the Act; or
- (c) that can be ascertained by following instructions on the packaging for the lamp (such as a quick reference code).

Note: This definition is relevant where, for instance, this instrument refers to 'declared optical characteristics' or 'declared voltage'.

directional LED Lamp (DLL) means:

- (a) an LED lamp for which at least 80% of total luminous flux falls within a solid angle of π sr (corresponding to a cone with angle of 120°); or
- (b) an LED lamp with a beam angle no greater than 100° in at least one plane through the lamp axis when luminous flux is measured using all forward-facing lumens.

displacement factor is expressed by $\cos(\phi_1)$, where ϕ_1 is the phase angle between the fundamental of the mains supply voltage and the fundamental of the mains current, as follows:

$$\cos(\phi_1) = \frac{|P_1|}{S_1}$$

as measured:

- (a) at full-load, in the reference control settings (where applicable); and
- (b) with:
 - (i) any lighting control parts in control mode; and
 - (ii) any non-lighting parts disconnected, switched off or set to minimum power consumption according to the manufacturer's instructions.

double-capped lamp means a lamp with two separate caps.

Note: This includes double-capped retrofit LED lamps and double-capped conversion LED lamps, as defined in IEC 62776:2014, clauses 3.1 and 3.2.

excitation purity (p_e) means the quotient NC/ND of the following two collinear distances on the chromaticity diagram of the CIE 1931 or 1964 standard colorimetric systems:

- (a) the distance between the point C representing the colour stimulus considered and the point N representing the specified achromatic stimulus;
- (b) the distance between the point N and the point D on the spectrum locus at the dominant wavelength of the colour stimulus considered;

leading to the following expressions:

$$p_e = \frac{y - y_n}{y_d - y_n}$$

and

$$p_e = \frac{x - x_n}{x_d - x_n}$$

where (x, y) , (x_n, y_n) , (x_d, y_d) are the x, y chromaticity coordinates of the points C, N and D respectively.

Note: In the case of purple stimuli, the monochromatic stimulus is replaced by a stimulus the chromaticity of which is represented by a point on the purple boundary.

The formulae in x and y are equivalent, but greater precision is given by the formula which has the greater value in the numerator.

The excitation purity has unit one.

flicker:

- (a) means the perception of visual unsteadiness induced by a light stimulus the luminance or spectral distribution of which fluctuates with time, for a static observer in a static environment; and
- (b) is expressed in the metric ' P_{st}^{LM} ', where 'st' stands for short term and 'LM' for light flickermeter method, as defined in IEC TR 61547-1.

Note: The fluctuations of the light stimulus with time include periodic and non-periodic fluctuations and can be induced by the lamp itself, the power source or other influencing factors.

A value $P_{st}^{LM} = 1$ means that the average observer has a 50% probability of detecting flicker.

full-load means the condition of an LED lamp, within the declared operating conditions, in which it emits the maximum (undimmed) luminous flux.

high-luminance LED lamp (HLLL) means an LED lamp with an average luminance greater than 30 cd/mm^2 in the direction of peak intensity.

initial, in relation to the measurement of a characteristic, means the characteristic as measured at the end of the:

- (a) ageing period (if any), within the meaning of clause 3.2 of AS/NZS 5341; and
- (b) stabilisation time, within the meaning of clause 4.4 of CIE S 025.

inorganic light emitting diode means an LED in which the p-n junction is composed of inorganic material.

LED or ***light emitting diode*** means a solid-state device embodying a p-n junction, emitting incoherent optical radiation when excited by an electric current.

Note: This definition is independent from the existence of enclosure(s) and terminals.

The term 'LED' represents the LED die (or chip), or LED package.

LED lamp means an electric lamp based on LED technology.

Note: An LED lamp can be an integrated (LEDi lamp), a semi-integrated (LEDsi lamp) or a non-integrated (LEDni lamp). An LED lamp can incorporate at least one LED module.

lifetime (L_{70B50} lifetime), for a model of LED lamp, means the time in hours between the start of its use and the time at which, for 50% of a population of LED lamps of that model, the light output has degraded to a value below 70% of the initial luminous flux.

Note: Lamps in the relevant population which cease to emit light during the testing period are not included in the calculation of L_{70B50} lifetime.

light means radiation within the spectral range of visible radiation.

lighting control parts of an LED lamp means parts that are:

- (a) either:
 - (i) integrated in the lamp; or
 - (ii) physically separate from but marketed together with the LED lamp or separate control gear as a single product; and

- (b) not strictly necessary for the lamp to emit light at full-load, or for the separate control gear to supply the electric power that enables the lamp to emit light at full-load; and
- (c) enable manual or automatic, direct or remote control of luminous intensity, chromaticity, correlated colour temperature, light spectrum or beam angle.

Example: Dimmers are lighting control parts.

lumen maintenance factor (X_{LMF}) means the ratio, for specified operating conditions, of the luminous flux of an LED lamp at a given time in its operational life to its initial luminous flux.

Note: In IEC standards, ‘lumen maintenance’ is also commonly used with the same meaning.

The lumen maintenance factor has unit one and is usually expressed in per cent.

luminance (L_v ; L) means the density of luminous intensity with respect to projected area in a specified direction at a specified point on a real or imaginary surface, calculated as follows:

$$L_v = \frac{dI_v}{dA \cos \alpha}$$

where:

I_v is luminous intensity.

A is area.

α is the angle between the normal to the surface at the specified point and the specified direction.

luminous flux (Φ_v ; Φ):

- (a) means the change in luminous energy with time:

$$\Phi_v = \frac{dQ_v}{dt}$$

where Q_v is the luminous energy emitted, transferred or received, and t is time; and

- (b) for LED lamps that can be tuned to emit different light spectra or different maximum light intensities—refers to the luminous flux as measured in the reference control settings.

Note: The luminous flux is expressed in lumen (lm).

luminous intensity (I_v ; I) means the density of luminous flux with respect to a solid angle in a specified direction, calculated as follows:

$$I_v = \frac{d\Phi_v}{d\Omega}$$

where Φ_v is the luminous flux emitted in a specified direction, and Ω is the solid angle containing that direction.

Note: The luminous intensity is expressed in candela (cd = lm·sr⁻¹).

mains or mains voltage (MV) means the electricity supply of 230 (+10% to –6%) volts of alternating current at 50 Hz.

mains LED lamp (MLL) means an LED lamp that can be operated directly on the mains electricity supply.

Note: This includes an LED lamp that operates directly on the mains, but can also operate indirectly on the mains using a separate control gear.

network means an architecture (a communication infrastructure with a topology of links), and includes the physical components, organisational principles, communication procedures and formats (protocols).

networked standby mode means the condition of a CLL in which:

- (a) the lamp is connected to the power supply; and
- (b) the lamp is intentionally not emitting light; and
- (c) the lamp is awaiting a control signal to return to a state with light emission; and
- (d) the lighting control parts are in their control mode; and
- (e) where this can be done without disassembling the lamp—when the manufacturer's instructions are followed:
 - (i) the non-lighting parts are disconnected from electric power or switched off; or
 - (ii) the power consumption of those parts is minimised.

networked standby power (P_{net}) is the electric power consumption of a CLL in networked standby mode.

Note: On-mode standby power is expressed in Watts (W).

non-mains LED lamp (NMLL) means an LED lamp that requires a separate control gear to operate on the mains.

non-directional LED lamp (NDLL) means an LED lamp that is not a directional LED lamp.

non-lighting parts of an LED lamp means parts that are:

- (a) either:
 - (i) integrated in the lamp or a separate control gear; or
 - (ii) physically separated from but marketed together with the LED lamp or separate control gear as a single product; and
- (b) not necessary for the lamp to emit light at full-load, or for the separate control gear to supply the electric power that enables the lamp to emit light at full-load; and
- (c) not lighting control parts.

Example: Speakers (audio), cameras, repeaters for communication signals to extend the range (eg, WiFi), parts supporting grid balance (switching to own internal batteries when necessary), battery charging, visual notification of events (mail arriving, door bell ringing, alert), and use of Light Fidelity (Li-Fi, a bidirectional, high-speed and fully networked wireless communication technology).

Note: 'Non-lighting parts' also include data-connection parts used for functions other than controlling the light emission function.

on-mode power (P_{on}):

- (a) means the electric power consumption of an LED lamp in full-load, with:
 - (i) all lighting control parts and non-lighting parts disconnected; or
 - (ii) if the parts mentioned in subparagraph (i) cannot be disconnected—the parts switched off, or their power consumption minimised in accordance with the manufacturer's instructions; and
- (b) for a NMLL that requires a separate control gear to operate, can be:
 - (i) measured directly on the input to the LED lamp; or

- (ii) determined using a separate control gear with known efficiency, the electric power consumption of which is subsequently subtracted from the measured mains power input value.

Note: On-mode standby power is expressed in Watts (W).

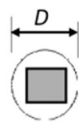
photosynthetic photon efficacy means the rate of flow of photons within the photosynthetically active radiation waveband of 400 – 700 nm from a radiation source.

Note: Photosynthetic photon efficacy is measured in $\mu\text{mol}/\text{Joule}$.

projected light-emitting surface area (A) of an LED lamp means the surface area in mm^2 (square millimetres) of the view in an orthographic projection of the light-emitting surface from the direction with the highest light intensity, where the light-emitting surface area is:

- for lamps with a non-clear envelope or with anti-glare shield—the entire area through which light leaves the lamp; or
- for lamps containing more than one light emitter—the projection of the smallest gross volume enveloping all emitters; or
- otherwise—the surface area of the lamp that emits light with the declared optical characteristics.

Note: For paragraph (c), an example is the flat or semi-spherical envelope of a light-emitting diode.



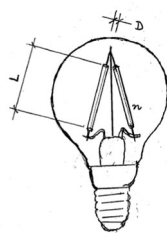
$$A = \frac{1}{4}\pi D^2$$

LED Projected light Emitting surface area

Scan from EU Reg 2029-2020.

where D is the diameter of the phosphor coating (not LED chip).

For LED filament Lamps:



$$\text{Area, } A = L \cdot W \cdot n$$

where L is the length, W is the width and n is the number of filaments

rated: a **rated** value is the declared value of a quantity, as established under the applicable test conditions set out in AS/NZS 5341.

ripple-free means a r.m.s. ripple voltage that is not more than 10 percent of the direct current component and whose maximum peak value does not exceed:

- 140 volts for a nominal 120 volts ripple-free direct current system; and
- 70 volts for a nominal 60 volts ripple-free direct current system.

reference control settings: see section 6.

remotely initiated trigger means a signal that comes from outside the LED lamp via a network.

r.m.s. means root mean square.

separate control gear, in relation to an LED lamp, means a unit inserted between the power supply and the lamp, which:

- (a) serves to supply the lamp with its rated voltage or rated current; and
- (b) may consist of one or more separate components; and
- (c) may be connected or not connected.

Note: Control gear may include means for igniting, dimming, correcting the power factor and suppressing radio interference, and further control functions. It consists of a power supply and a control unit, and can be partly or totally integrated in the LED lamp. It is commonly referred to as 'controlgear' in IEC standards.

specific effective radiant ultraviolet power (mW/klm) means the effective power of the ultraviolet radiation of an LED lamp weighted according to the spectral correction factors and related to its luminous flux.

standby mode means the condition of an LED lamp in which:

- (a) the lamp is connected to the power supply; and
- (b) the lamp is intentionally not emitting light; and
- (c) the lamp or control gear is awaiting a control signal to return to a state with light emission; and
- (d) the lighting control parts enabling the standby function are in their control mode; and
- (e) where this can be done without disassembling the lamp—when the manufacturer's instructions are followed:
 - (i) the non-lighting parts are disconnected from electric power or switched off; or
 - (ii) the power consumption of those parts is minimised.

standby power (P_{sb}) means the electric power consumption of a CLL or a connected separate control gear in standby mode.

Note: The standby power is expressed in watts (W).

stroboscopic effect:

- (a) means a change in motion perception induced by a light stimulus, the luminance or spectral distribution of which fluctuates with time, for a static observer in a non-static environment; and
- (b) is represented in this instrument by the metric 'SVM' (stroboscopic effect visibility measure), as defined in IEC TR 63158.

Note 1: The fluctuations can be periodic or non-periodic, and may be induced by the LED lamp itself, the power source or other influencing factors.

Note 2: SVM = 1 represents the visibility threshold (50% probability of detection) for an average observer.

survival factor (SF) means the fraction of the total number of LED lamps that continue to operate at a given instant under defined conditions and switching frequency.

Note: The lamp survival factor has unit one.

SVM: see the definition of 'stroboscopic effect'.

tested: a **tested** value or amount is one that is:

- (a) determined in accordance with a test conducted in accordance with the testing requirements of this instrument; or
- (b) calculated on the basis of values or amounts that have been determined in accordance with paragraph (a).

useful luminous flux $\Phi_{v,u,a}$, $\Phi_{u,a}$ (Φ_{use}) means the part of the luminous flux of an LED lamp that is considered when determining its energy efficiency, as follows:

- (a) for non-directional LED lamps—the total luminous flux emitted in a solid angle of 4π sr (corresponding to a 360° sphere);
- (b) for directional LED lamps with beam angle $\geq 90^\circ$ (except where paragraph (d) applies)—the luminous flux emitted in a solid angle of π sr (corresponding to a cone with angle of 120°);
- (c) for directional LED lamps with beam angle $< 90^\circ$ (except where paragraph (d) applies)—the luminous flux emitted in a solid angle of $0,586\pi$ sr (corresponding to a cone with angle of 90°);
- (d) for directional LED lamps where all forward-facing lumens are measured—the luminous flux emitted from the forward face of the lamp (corresponding to a cone with angle of 180°).

Note: Where paragraph (d) applies, a different efficacy factor will apply when calculating the minimum required efficacy of the LED lamp, as specified in paragraph 17(2).

Note: A number of expressions used in this instrument have the meaning given by in the Act, including the following:

- (a) category A product;
- (b) covered by;
- (c) family of models;
- (d) GEMS labelling requirements;
- (e) GEMS level requirements;
- (f) model;
- (g) product classes.

6 Definition—reference control settings

- (1) Subject to subsection (6), for a model of LED lamp that allows the end user to control the luminous intensity, chromaticity, correlated colour temperature, spectrum or beam angle of the emitted light, the **reference control settings** are the settings specified in this section.

Note: The control might be manual or automatic, direct or remote.

- (2) Subject to subsections (3), (4) and (5), the reference control settings are the settings:
 - (a) defined by the manufacturer as the factory default settings; and
 - (b) encountered by the user upon first installing the lamp.
- (3) If the installation procedure for the lamp provides for an automatic software update before the first use, or the user has the option to perform such an update—the reference control settings are the settings following that update.
- (4) Despite subsections (2) and (3), if:
 - (a) the values described as reference control settings are specified on the product packaging; and
 - (b) those values differ from the settings mentioned in subsections (2) or (3);
 the reference control settings are the settings specified on the packaging.

Note: This section might apply because, for instance, the manufacturer has set the factory default values at a lower power than the intended reference control settings for safety reasons.

- (5) Despite subsections (2) and (3), if:
 - (a) subsection (4) does not apply; and
 - (b) the approved form for application for registration of the model of LED lamp under section 41 of the Act requires or permits the applicant to specify the reference control settings; and
 - (c) the applicant has specified such settings;the reference control settings are the settings specified in the application form.
- (6) Settings will only be considered reference control settings where:
 - (a) the lamp, when in the reference control settings, is covered by this instrument; and
 - (b) the lamp obtains full-load condition when in the reference control settings; and
 - (c) for the settings mentioned in paragraph (2)(a)—the lamp will revert to those settings when restored to factory default.

Note: When measuring performance of the model in the reference control settings for the purposes of this instrument, provided that the lamp obtains the full-load conditions specified in paragraph 6(b), the lighting control parts or non-lighting parts of the lamp may be required to be switched off or disconnected, or if this is not possible, those parts may be required to be operated at minimal power.

7 Applicable definitions and applicable versions of standards and documents incorporated into standards

Applicable definitions of terms or phrases

- (1) If there is inconsistency in the definitions of words or expressions, those words or expressions will be interpreted in the following order of priority to the extent of any inconsistency:
 - (a) the Act;
 - (b) this instrument;
 - (c) a standard referred to in this instrument, or another standard referred to in such a standard.

Applicable version of standards and documents incorporated into standards

- (2) For the purposes of this instrument, the applicable version of any:
 - (a) standard or other document referred to in this instrument; or
 - (b) other document that:
 - (i) is referred to in a standard under the heading ‘Referenced Documents’ or an equivalent heading; and
 - (ii) must be applied to give effect to this instrument or a standard referred to in this instrument;is the version of the standard or other document that existed at the date this instrument was made.

8 Families of models

- (1) For section 28 of the Act, for a particular product class covered by this instrument, two or more models are in the same family of models if:
 - (a) they are members of a family that has been declared to the GEMS Regulator; and
 - (b) the requirements of this section are satisfied in relation to the models and the family.
- (2) For paragraph (1)(b):

- (a) the models must be in the same product class; and
- (b) subject to subsection (3)—a test report must have been completed for at least one model in the family before an application was made for registration for the models under section 41 of the Act; and
- (c) the models must have the same:
 - (i) declared voltage or voltage range; and
 - (ii) declared $L_{70}B_{50}$ lifetime; and
 - (iii) tested CRI, within ± 3 ; and
 - (iv) subject to subsection (4)—geometric form factor, including the IEC bulb shape classification (as set out in IEC TR 60887), where such a classification is available;
 - (v) for double-capped G13 and G5 LED lamps—cap size and tube length; and
 - (vi) reference control settings; and
- (d) in relation to the following design features:
 - (i) for dimmability—the models must be either all dimmable or all non-dimmable;
 - (ii) for light direction—the models must be either all directional or all non-directional;
 - (iii) for utilisation of LED filaments—the models must either all be designed with LED filaments or without LED filaments.

Note: For subparagraph (2)(c)(iv)—the overall size of the bulb may vary, provided that the geometric form factor remains the same.

- (3) For paragraph (2)(b):
 - (a) the model used for testing blue light and UV levels must be the model with the highest colour temperature in the relevant family; and
 - (b) the model used for any other testing must be the model with the lowest luminous efficacy (lm/W) in the relevant family, when measured in the reference control settings.
- (4) Despite subparagraph (2)(c)(iv):
 - (a) fancy round, candle shapes and decorative shapes (C, CA, CF, G, S, T, P) less than 600 lm may be included in the same family; and
 - (b) up to 10 models with different geometric form factors may be included in the same family, provided that the registrant in question has no more than 1 such family registration.
- (5) For paragraph (1)(b), a family must not contain more than 50 models.

9 Product category

For section 29 of the Act, the products covered by this instrument are category A products.

Part 2—Product classes and testing requirements

Division 2.1—Products covered by this Division

10 Purpose of Division

For subsections 23(1) and (2) of the Act, this Division specifies:

- (a) one or more classes of products that are covered by this instrument; and
- (b) one or more classes of products that are not covered by this instrument.

11 Classes of products that are covered by this instrument

Classes of products covered by this instrument

- (1) This instrument covers LED lamps that:
 - (a) satisfy the general conditions in subsection (4); and
 - (b) are of a type covered by:
 - (i) subsection (5) (single-capped lamps); or
 - (ii) subsection (6) (double-capped lamps).
- (2) The following are separate product classes:
 - (a) LED lamps that satisfy subsection (4) and are covered by subsection (5);
 - (b) LED lamps that satisfy subsection (4) and are covered by subsection (6).

Instrument covers LED lamps regardless of whether they are in a containing product

- (3) This instrument covers LED lamps that fall within subsection (1), whether or not they are placed on the market in a containing product.

General conditions

- (4) The general conditions for an LED lamp are the following:
 - (a) it has chromaticity coordinates x and y in the range:

$$0.270 < x < 0.530$$

and

$$-2.3172 x^2 + 2.3653 x - 0.2199 < y < -2.3172 x^2 + 2.3653 x - 0.1595$$

- (b) it has an initial luminous flux of < 500 lumen per mm^2 of projected light-emitting surface area;
- (c) it has an initial luminous flux between 100 and 82,000 lumens;
- (d) it contains one or more inorganic LEDs.

Single-capped LED lamps

- (5) This subsection covers lamps with LED light sources of all shapes with a single cap of one of the following types:
 - (a) BA15d, B15d, B22d, E11, E12, E13, E14, E17, E26, E27, E39, E40, GU10, GZ10, GX10, GU24, GX53, G9;
 - (b) Bi-pin lamp caps G4, GU4, GY4, GU4, GZ4, GU5.3, GX5.3, G6.35, GY6.35, GU7, G53.

Double-capped LED lamps

- (6) This subsection covers double-capped LED lamps with a nominal length of 550 mm to 1500 mm, including:
 - (a) double-capped LED retrofit lamps and double-capped conversion LED lamps (as defined in clauses 3.1 and 3.2 of IEC 62776) with G5 and G13 caps, intended for replacing fluorescent lamps with the same caps; and
 - (b) double-capped LED lamps (as defined in IEC 62931) with GX16t-5 caps.
- (7) In this section:

containing product, in relation to an LED lamp, means a different and larger product within which the lamp is supplied.

Note: For an LED lamp that falls within subsection (1) that is supplied within a refrigerator, the refrigerator is the containing product. For an LED lamp that falls within subsection (1) that is supplied in a luminaire, the luminaire is the containing product.

12 Classes of products that are not covered by this instrument

This instrument does not apply to LED lamps specified in Schedule 1.

Division 2.2—Testing requirements: general

13 Purpose of this Division

This Division sets out testing requirements for the purposes of paragraphs 25(b), 26(1)(c) and 27(1)(e) of the Act.

14 Testing requirements—general

Where a product is tested to determine whether it complies with the requirements of this instrument, the testing must be done in accordance with:

- (a) AS/NZS 5341; or
- (b) where AS/NZS 5341 provides that testing carried out in accordance with an alternative standard is an acceptable equivalent test method—that alternative standard; or
- (c) a standard that, in respect of the matter to be tested, imposes substantially identical testing requirements to AS/NZS 5341.

15 Circumvention of testing

- (1) Circumvention devices must not be used in connection with any tests conducted for the purposes of demonstrating compliance with this instrument.
- (2) In this section:

circumvention device means any control, control device, software, component or part that alters the operating characteristics of a product during any test procedure, resulting in measurements that are unrepresentative of the true characteristics that the product may exhibit during normal use under comparable conditions.

Note: Generally, circumvention devices save energy during an energy test, but not during normal use.

Part 3—GEMS level requirements

16 Purpose of Part

For paragraph 24(1)(a) of the Act, this Part specifies GEMS level requirements in accordance with section 25 of the Act for the product classes covered by this instrument.

17 Ecodesign requirements—energy efficiency

Minimum required efficacy of an LED lamp

- (1) The efficacy of an LED lamp (η_{lamp}) must not be less than the minimum required efficacy $\eta_{lamp.min}$ (in lm/W).
- (2) The **minimum required efficacy** is a function of the luminous flux Φ (in lm) and the colour rendering index R (-), as follows:

$$\eta_{lamp.min} = \left(\frac{F \times \eta}{C \times R} \right) \times \left[1 - \frac{(L \times F \times \eta)}{(L \times F \times \eta) + \Phi} \right]$$

where:

η , the threshold efficacy, is 120 lm/W.

L , the end loss factor, is 2.0 W for a CLL and 1.5 W otherwise.

C , the correction factor, is defined in subsection (3).

F , the efficacy factor, is:

- (a) for non-directional LED lamps (NDLL, using total flux)—1.00; and
- (b) for directional LED lamps (DLL):
 - (i) using flux in a cone with an angle of 90° or 120°—0.85; or
 - (ii) using measurement of forward-facing lumens (corresponding to a cone with an angle of 180°)—as follows:

Beam angle (BA)	F value
$0 < BA < 90$	0.95
$90 \leq BA < 120$	1.00

R , the CRI factor, is (CRI+80)/160 for CRI ≥ 70 , with both R and CRI rounded to two decimal places.

- (3) For subsection (1), the correction factor for an LED lamp is the sum of:
 - (a) the basic C value for the relevant type of lamp; and
 - (b) each applicable additional C value;
as given by Table 1 below:

Table 1: Correction factor C for an LED lamp	
LED lamp type	Basic C value
Non-directional (NDLL) not operating on mains (NMLL)	1.00
Non-directional (NDLL) operating on mains (MLL)	1.08

Table 1: Correction factor C for an LED lamp

<i>LED lamp type</i>	<i>Basic C value</i>
Directional (DLL) not operating on mains (NMLL)	1.15
Directional (DLL) operating on mains (ML)	1.23
<i>Special LED lamp features</i>	<i>Additional C value</i>
Colour-tuneable LED lamp	+0.10
Directional (DLL) with anti-glare shield	+0.2
High-luminance LED lamps (HLLL) (not applicable to a DLL)	+0.0058 x Luminance - HLLL - 0.0167

- (4) The efficacy of an LED lamp is the efficacy as measured in the reference control settings, where:
- (a) the lamp allows the end user to adapt the spectrum or the beam angle of the emitted light; and
 - (b) the adaptation mentioned in paragraph (a) has the effect of changing:
 - (i) the values for useful luminous flux, colour rendering index (CRI) or correlated colour temperature (CCT); or
 - (ii) the directional/non-directional status of the LED lamp.

Maximum standby power and networked standby power

- (5) The standby power (P_{sb}) of an LED lamp must not exceed 0.5 W.
- (6) The networked standby power (P_{net}) of a connected LED lamp must not exceed 0.5 W.

Part 4—GEMS labelling requirements

18 Purpose of Part

For paragraph 24(1)(b) of the Act, this Part specifies GEMS labelling requirements in accordance with section 26 of the Act for the product classes covered by this instrument.

19 Information to be displayed on the LED lamp itself

- (1) Subject to subsection (2), an LED lamp must have displayed in a legible font on its surface:
 - (a) the rated value and physical unit of the useful luminous flux (lm) and correlated colour temperature (expressed in K) of the lamp; and
 - (b) for a directional LED lamp—the rated beam angle (expressed in °).
- (2) If there is insufficient room on the surface to include all of the values required without unduly obstructing the light emission:
 - (a) if there is room for one value, the rated useful luminous flux must be displayed; and
 - (b) if there is room for two values, the rated useful luminous flux and correlated colour temperature must be displayed.

20 Information to be visibly displayed on the packaging

Lamps to which this section applies

- (1) This section applies to an LED lamp that is supplied or offered for supply in packaging containing information to be visibly displayed at a point of sale prior to its purchase.

Labelling requirements

- (2) The information set out in column 1 of Table 2:
 - (a) must be clearly and prominently displayed on the packaging; and
 - (b) without limiting the form in which the information may be displayed—may be represented in the form of graphs, drawings or symbols.

Note: Column 3 of Table 2 sets out non-binding guidance notes about the information to be included.
- (3) For an LED lamp that can be set to emit light with different characteristics, the requirements of an item in column 1 of Table 2 are satisfied in relation to values that vary with those characteristics if the packaging does one or both of the following:
 - (a) specifies those values as obtained when the lamp is in the reference control settings;
 - (b) sets out a range of values that can be obtained, provided that the values obtained when the lamp is in the reference control settings fall within that range.

- (4) Table 2 has effect:

Note: The accuracy values in Table 2 relate only to the verification of the measured parameters. The values shall not be used by the manufacturer, importer or authorised representative as an allowed tolerance to establish the values in the technical documentation or in interpreting these values with a view to achieving compliance or to communicate better performance by any means.

Table 2: Information to be visibly displayed on LED lamp packaging

Item	Column 1 Information required on packaging	Column 2 Accuracy of values displayed on packaging	Column 3 Guidance notes
1	The following: (a) the model identifier; and (b) the bar code number (if any)		The model identifier will be entered on the GEMS register. It is recommended that this information also be displayed on the lamp itself.
2	The rated useful luminous flux (Φ_{use}), displayed in a font no smaller than the display of the rated on-mode power (P_{on})	The initial useful luminous flux of each individual LED lamp in a measured sample of 10 lamps must not vary from the displayed rated useful luminous flux by more than $\pm 10\%$. However, the initial useful luminous flux of each lamp in the sample may be up to 20% more than the displayed rated useful luminous flux if the displayed rated value is one of the following: 100 lm, 150 lm, 250 lm, 350 lm, 500 lm, 650 lm, 800 lm, 1000 lm, 1250 lm, 1500 lm, 2000 lm, 2500 lm, 3000 lm or 3500 lm. The average useful luminous flux of the LED lamps in a measured sample of 10 lamps must not be less than 92.5% of the displayed rated useful luminous flux.	The luminous flux marking may also specify if it refers to the flux in a sphere (360°), forward-facing lumens (180°), in a wide cone (120°) or in a narrow cone (90°).
3	If an incandescent or halogen equivalence is claimed—the rated incandescent or halogen power equivalence	The initial luminous flux of each individual non-directional LED lamp in a measured sample of 10 lamps must not be less than the minimum luminous flux listed for the claimed power of the equivalent incandescent or halogen lamp, as set out in Schedule 2.	

Table 2: Information to be visibly displayed on LED lamp packaging

Item	Column 1 Information required on packaging	Column 2 Accuracy of values displayed on packaging	Column 3 Guidance notes
4	The rated luminous efficacy, expressed in lumens per watt	The initial luminous efficacy of each individual LED lamp in a measured sample of 10 lamps must not be less than 90% of the displayed rated efficacy. The average efficacy of the LED lamps in the measured sample must not be less than 92.5% of the displayed rated efficacy.	
5	Either: (a) the rated correlated colour temperature, rounded to the nearest 100 K; or (b) the range of rated correlated colour temperatures that can be set (expressed in K)	The average correlated colour temperature of the LED lamps in a measured sample of 10 lamps must not vary by more than 10% from the displayed rated correlated colour temperature.	
6	For a directional LED lamp: (a) the rated beam angle in degrees; or (b) the range of rated beam angles that can be set	The tested value of the beam angle must be within $\pm 25\%$ of the displayed rated beam angle.	
7	Voltage and cap type		For example, the type of power supply (such as 230 V AC 50 Hz, 12 V DC). The cap will be one of the types mentioned in subsection 11(5) or (6).
8	The rated L70B50 lifetime, expressed in hours	The displayed rated value must not be more than the value declared in the application to register the relevant model of lamp under the Act.	
9	The rated on-mode power (P_{on}) expressed in watts to the first decimal place	The initial power consumed by each individual LED lamp in a measured sample of 10 lamps must not exceed the displayed rated on-mode power by more than 10%. The average of initial power consumed by the LED lamps in the measured sample must not exceed the displayed rated	

Table 2: Information to be visibly displayed on LED lamp packaging

Item	Column 1 Information required on packaging	Column 2 Accuracy of values displayed on packaging	Column 3 Guidance notes
		on-mode power by more than 7.5%.	
10	Unless the value is zero—the rated standby power (P_{sb}), expressed in watts and rounded to the second decimal place	The average standby power (P_{sb}) of the LED lamps in a measured sample of 10 lamps must not exceed the displayed rated standby power (P_{sb}) by more than 0.10W.	
11	Unless the value is zero—the rated networked standby power (P_{net}) for a CLL, expressed in watts and rounded to the second decimal place	The average networked standby power (P_{net}) of the LED lamps in a measured sample of 10 lamps must not exceed the displayed rated standby power (P_{net}) by more than 0.10W.	
12	Either: (a) the rated general colour rendering index, R_a , rounded to the nearest integer; or (b) the range of rated CRI-values that can be set	The tested CRI value of each individual LED lamp in a measured sample of 10 lamps must be no less than the displayed rated CRI value minus 2.0.	
13	If the CRI is < 80, and the LED lamp is intended for use in outdoor applications, industrial applications or other applications for which applicable lighting standards specifically provide an allowance of CRI < 80—a clear indication to this effect		
14	Where the LED lamp cannot be dimmed, or can be dimmed only with specific dimmers or specific wired or wireless dimming methods: (a) a warning to that effect; and (b) where the LED lamp can only be dimmed with specific dimmers or dimming methods—details of where a list of compatible dimmers or dimming methods can be found		For paragraph (b)—this may include reference to technical specifications included with the package, an internet address, or a QR code.

Note: Column 2 sets out requirements that, broadly speaking, specify how closely certain values displayed on the packaging must reflect the actual performance of the lamp.

21 Impact of replacement determination

A GEMS labelling requirement of this instrument (the *revoked requirement*) is taken to be complied with if:

- (a) this instrument is revoked in accordance with paragraph 35(1)(a) of the Act; and
- (b) another GEMS determination (the *replacement determination*) is made in accordance with paragraph 35(1)(b) of the Act; and
- (c) a transitional GEMS labelling requirement (the *replacement requirement*) of the replacement determination provides that, if the replacement requirement is complied with, the revoked requirement is taken to be complied with; and
- (d) the replacement requirement is complied with.

Part 5—Other requirements

22 Purpose of Part

For subsection 24(2) of the Act, this Part specifies other requirements in accordance with section 27 of the Act for product classes covered by this instrument.

23 Other requirements—performance requirements

For paragraph 27(1)(b) of the Act, the performance requirements for an LED lamp in a product class covered by this instrument are as follows:

Table 3: Performance requirements for LED lamps

Item	Column 1 Attribute	Column 2 Performance requirements
1	Colour rendering	The general colour rendering index must be $R_a \geq 70$ for lamps that have the following characteristics: (a) cap types E40 or E27; (b) initial luminous flux $> 2,000$ lumens; (c) the capacity to operate on control gear designed for high intensity discharge lamps. Otherwise, the general colour rendering index must be $R_a \geq 80$.
2	Displacement factor (DF, $\cos \phi_1$) at power input P_{on} for MLL	The following: (a) no limit at $P_{on} \leq 5$ W; (b) $DF \geq 0.5$ at $5 \text{ W} < P_{on} \leq 10$ W; (c) $DF \geq 0.7$ at $10 \text{ W} < P_{on} \leq 25$ W; (d) $DF \geq 0.9$ at $25 \text{ W} < P_{on}$.
3	Lumen maintenance factor	The lumen maintenance factor X_{LMF} % after endurance testing in accordance with AS/NZS 5341 must be at least $X_{LMF,MIN}$ %, calculated as follows: $X_{LMF,MIN} \% = 100 \times e^{\frac{(3000 \times \ln(0.7))}{L_{70}}}$ where L_{70} is the declared $L_{70}B_{50}$ lifetime (in hours). If the calculated value for $X_{LMF,MIN}$ % exceeds 96.0 %, the $X_{LMF,MIN}$ % value of 96.0 % must be used.
4	Survival factor	Following endurance testing in accordance with clause 6.2 of AS/NZS 5341, at least 9 LED lamps out of a test sample of 10 must remain operational by way of emitting light.
5	Colour consistency	Variation of chromaticity coordinates must fall within a six-step MacAdam ellipse, or six-step u^*v^* circle centred on the coordinates declared as the centre.

24 Other requirements—impact on human health

- (1) For paragraph 27(1)(c) of the Act, the health requirements for an LED lamp in a product class covered by this instrument are as follows:

Table 4: Health requirements for LED lamps

Item	Column 1 Attribute	Column 2 Health requirements
1	Flicker	P_{st}^{LM} must be ≤ 1.0 at full-load.
2	Stroboscopic effect for MLL	The SVM must be ≤ 0.9 at full-load. However, there is no SVM requirement for lamps with all of the following characteristics: (a) cap types E40 or E27; (b) initial luminous flux $> 2,000$ lumens; (c) the capacity to operate on control gear designed for high intensity discharge lamps.
3	UV and Blue Light hazard	For LED lamps of $\leq 50V$ a.c. r.m.s. or $\leq 120 V$ ripple-free d.c.: (a) the UV hazard must be RG0; and (b) the Blue Light hazard must be either RG0 or RG1 unlimited.

Related testing requirements

- (2) For paragraph 27(1)(e) of the Act, where an LED lamp is tested to determine whether it complies with the requirements of subsection (1), the testing must be carried out in accordance with AS/NZS 5341, subject to the qualifications in subsections (3) to (5).
- (3) Compliance with subsection (1) may be demonstrated using the results of testing either the LED lamp or an LED module contained in the lamp.
- (4) A UV hazard test is not required if the LED lamp does not contain an LED chip with a peak wavelength emission of less than 400 nm.
- (5) Blue Light hazard testing is not required if:
 - (a) the blue light hazard weighted radiance, L_B , is $< 10,000 \text{ W.m}^{-2}.\text{sr}^{-1}$ (as defined in clause 4.3.3 of AS/NZS 62471); or
 - (b) the maximum luminance of the visible light-emitting surface of the LED lamp does not exceed the limit specified in Table 5:

Table 5: maximum luminance limits

Maximum CCT (K)	Maximum Luminance (Mcd.m ⁻²)
$CCT \leq 2,350$	40.0
$2,350 < CCT \leq 2,850$	18.5
$2,850 < CCT \leq 3,250$	14.5
$3,250 < CCT \leq 3,750$	11.0
$3,750 < CCT \leq 4,500$	8.5
$4,500 < CCT \leq 5,750$	6.6
$5,750 < CCT \leq 8,000$	5.0
Manufacturer's rated CCT and rated luminance may be used as a basis for this assessment.	

Exposure Draft

Schedule 1—Product classes not covered

Note: See section 12.

1 Aeronautical lamps

Aircraft lights

- (1) This instrument does not cover LED lamps that:
- (a) are designed to operate on an aircraft; and
 - (b) satisfy the requirements of:
 - (i) subsections 23.001(1), 25.001(1), 27.001(1) and 29.001(1) of the *Civil Aviation Safety Regulations 1998*; or
 - (ii) Section 3, Chapter 7 (Lighting Systems) of the Airworthiness Design Requirements Manual published by the Defence Aviation Safety Authority;
- to the extent that those requirements relate to the use of aircraft lights.

Note 1: In 2022, the Airworthiness Design Requirements Manual was available at <https://www.defence.gov.au>.

Note 2: The provisions of the *Civil Aviation Safety Regulations 1998* mentioned in subparagraph (b)(i) refer to the European Aviation Safety Agency certification specifications and US Federal Aviation Administration airworthiness standards for aircraft.

Note 3: The GEMS Regulator may request evidence that such lamps comply with the approval requirements mentioned in paragraph (b) (among other things).

Aeronautical ground lights

- (2) This instrument does not cover LED lamps that:
- (a) are designed as aeronautical ground lights; and
 - (b) meet the requirements that apply to such lights under one or more of the following:
 - (i) *Part 139 (Aerodromes) Manual of Standards 2019*; or
 - (ii) the Australian Government Defence Aviation Safety Authority Regulations, DASR 139 – Aerodromes.

Note 1: *Part 139 (Aerodromes) Manual of Standards 2019* is an instrument made under regulation 139.005 of the *Civil Aviation Safety Regulations 1998*.

Note 2: In 2022, the Defence Aviation Safety Authority Regulations were available at <https://www.defence.gov.au>.

- (3) In this clause, **aeronautical ground light** has the meaning given by *Part 139 (Aerodromes) Manual of Standards 2019*.

2 Other exclusions

- (1) This instrument does not cover the following:
- (a) LED lamps with:
 - (i) specific effective ultraviolet power > 2mW/klm; or
 - (ii) peak radiation between 180 and 280 nm;
 - (b) LED lamps for which the radiation power emitted within the range of 400 to 480 nm is 40% or more of the total radiation power emitted within the range of 250 to 800 nm;
 - (c) LED lamps:
 - (i) that have a photosynthetic photon efficacy of > 2.5 $\mu\text{mol/J}$; or

- (ii) for which the radiation power emitted within the range of 700 to 800 nm is 25% or more of the total radiation power emitted within the range of 250 to 800 nm;
- (d) LED lamps with a fixed beam angle of less than 10°;
- (e) colour-tuneable LED lamps, other than LED lamps that contain phosphor materials for light conversion, that:
 - (i) can be set to at least the colours listed in Table 6; and
 - (ii) have, for each of those colours, measured at the dominant wavelength, the minimum excitation purity set out in that table.

Table 6: Colour-tuneable LED lamps

Colour	Dominant wavelength	Minimum excitation purity
Blue	440 nm – 490 nm	90%
Green	520 nm – 570 nm	65%
Red	610 nm – 670 nm	95%

Examples: For paragraph (1)(a)—some LED lamps designed for use in applications requiring high UV-content.

For paragraph (1)(b)—some LED lamps designed for coral zooxanthellae symbioses.

For paragraph (1)(c)—some LED lamps designed for use in horticulture.

For paragraph (1)(d)—some LED lamps designed for spot-lighting applications requiring a very narrow light-beam.

Schedule 2—Incandescent or halogen equivalence claims

1 Incandescent or halogen equivalence claims—non-directional LED lamps

For the purposes of item 3, column 2 of Table 2 in section 20, the minimum luminous flux for the claimed power of an equivalent incandescent or halogen lamp is the figure set out in Table 7.

Table 7: Incandescent or halogen equivalence claims

Claimed equivalent incandescent lamp power (W)	Claimed equivalent halogen lamp power (W)	LED lamp minimum luminous flux (lm)
15	11	135
25	18	245
40	28	470
60	42	800
75	52	1,000
100	70	1,500
150	105	2,450
200	140	3,450