NABERS Energy Tenancy Lighting Assessment Rules for Offices

[June] 2010

Draft Version 9.1

Draft date: 5 June 2010

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GLOSSARY AND ABBREVIATIONS

Ballast	Device connected between the power supply and one or more discharge lamps primarily to limit the current of the lamp(s).
BLF	Ballast lumen factor = ratio of the light output of the reference lamp operated with the test ballast, to the light output of the reference lamp operated with the reference ballast
CFL	Compact fluorescent lamp
CFLi	Compact fluorescent lamp with integrated ballast
CFLn	Compact fluorescent lamp with non-integrated ballast
Control gear	Lighting ballast or transformer
Daylight sensor	A sensor which detects levels of daylight ingress and dims or switch luminaires (adjacent to windows) accordingly. See section 2.4 for full definition.
ELV	Extra low voltage, typically not exceeding 50 V AC
Functional space	A functional space as defined under NABERS Energy.
HID	High intensity discharge lamp (high pressure sodium, metal halide or mercury vapour)
Illuminance	The quantity of light falling on a surface, expressed in lux (lumens per square meter)
IPD	Illumination power density
Lamp	Source of artificial optical radiation
LED	Light emitting diode
Lighting controls	Devices which actively respond to changes in the work environment, such as daylight levels and user occupancy
Luminaire	Apparatus which distributes, filters or transforms the light transmitted from a light source, including lamp(s), control gear and all components necessary for fixing and protecting the lamps.
Motion sensor	A sensor which detects motion and switch lights on if persons are present. See section 2.4 for full definition.
NABERS	National Australian Built Environment Rating System
Nominal	The manufacturer's rated value for a lighting component
NLA	Net lettable area
Retrofit T5 adaptor	A kit that will modify a T8 or T12 luminaire to suit a T5 lamp without the need for internal re-wiring of the luminaire
Starter	A starting device for fluorescent lamps which provides for the necessary preheating of the electrodes and causes a surge in the voltage applied to the lamp
Time Scheduler	A passive device used to switch lights on and off at preset times
Transformer	Magnetic transformer or electronic step-down converter used to reduce voltage for ELV halogen lighting systems.
W	Watts

1. INTRODUCTION

1.1. About the Tenancy Lighting Energy Calculator for Commercial Building Tenancies

The purpose of this Guide is to direct accredited assessors in the conduct of lighting assessments using the Tenancy Lighting Energy Calculator developed for the Commercial Building Energy Efficiency Disclosure (CBEED) scheme. The Guide describes the process for gathering the required information for the NABERS energy tenancy lighting assessment and input into the online Tenancy Lighting Energy Calculator.

1.2. Scope of Lighting Assessment

The Tenancy Lighting Energy Calculator - Version 1.0 has been designed for calculating the illumination power density (IPD) of open plan office space within the tenancies of a commercial office building.

Commercial office space typically includes a lighting installation that is inherited from the original construction of the building, or from a refurbishment. This legacy lighting system is often augmented to meet the needs of each tenant, with replacement or additional luminaires installed to meet the requirements of small enclosed spaces, such as private offices and meeting rooms, or feature lighting installed in entrance foyers, conference rooms, etc.

However, it is the open plan office lighting system that underpins the overall lighting solution, and which is typically the primary determinant of the lighting energy consumption for a tenancy.

For this reason, and for reasons of simplicity, it is only the open plan office space of the tenancy area that is assessed for the Tenancy Lighting Energy Calculator. While included in the net lettable area, small private offices, meeting rooms, reception areas, entrance foyers, conference rooms, hallways, etc are not included in the lighting assessment.

Note also that emergency lighting is not included in the assessment, nor is the energy consumption that heat from lighting equipment may induce in the building's air-conditioning system.

The outcome of the lighting assessment is the nominal illumination power density (IPD) of the open plan office lighting system. The calculations used in the Tenancy Lighting Energy Calculator are summarised in Attachment 1.

2. COLLECTION OF INPUT DATA

2.1. Areas to be Assessed

Within the lease area, it is only the open plan office space that is to be assessed. Small private offices, meeting rooms, reception areas, entrance foyers, conference rooms, hallways, etc are not to be assessed.

If the open plan office portion of the lease area represents less than 50% of the tenancy NLA, this shall be noted in the comments field of the Tenancy Lighting Energy Calculator.

Each 'functional space' (as defined by NABERS) shall be assessed separately, other than functional spaces of less than 200m^2, which are not required to be assessed. This method allows for lighting system and control system variation from floor-to-floor to be identified, thereby providing more relevant information to a prospective owner or tenant than a whole building average.

Within any assessment, on site lighting system data collected for one functional space may be applied to assessment of other functional spaces that have been verified as having identical lighting systems. If lighting system data collected for one functional space is applied to assessment of another functional space, this shall be noted in the comments field of the Tenancy Lighting Energy Calculator for that functional space.

Note that it is the existing, in-situ lighting system that is to be assessed, unless it is brought to the assessor's attention that alternative lighting will be installed prior to the completion of the sale, lease or sublease transaction (e.g. as a result of a 'make good' clause in an existing contract).

2.2. Luminaire Density

The luminaire density may be determined by one of the following two methods.

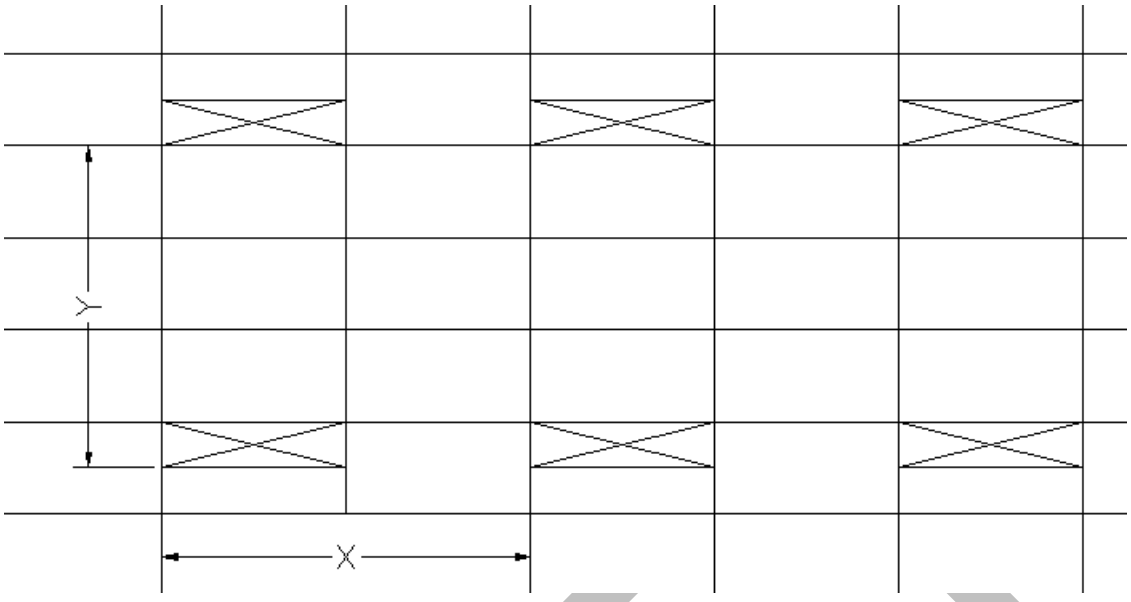
2.2.1. Method 1 - Ceiling Grid Method

This method only applies to open-plan office lighting systems effectively comprising a single luminaire type, installed in a consistent ceiling grid array. Note that, because only the basic lighting system is required to be assessed, occasional feature lighting such as a compact fluorescent, halogen down light, or wall washer luminaire can be ignored. If such luminaires are frequent, the assessment shall be undertaken as detailed in section 2.2.2.

For these lighting systems, the luminaire horizontal spacing is used as the key input to the Tenancy Lighting Energy Calculator.

Note that, because ceiling grid sizes vary, the spacing between luminaires must be measured. Measurement of luminaire spacings in the X and Y directions are taken from luminaire-centre to luminaire-centre, or from one side of the luminaire to the same side of the adjacent luminaire, as depicted in Figure 1.

Figure 1 – measurement of luminaire spacing



The X and Y spacings are entered into the Tenancy Lighting Energy Calculator and are used in the calculation of IPD.

2.2.2. Method 2 - Representative Area Method

This method applies to open-plan office lighting systems where more than one type of luminaire is used, or where there is no consistent ceiling grid array. In these cases, the ceiling grid method is not appropriate.

This method requires an assessment of a representative area which best represents the open-plan office lighting system. The representative area should be a minimum of 200m^2. If this is not possible, a smaller area can be used and noted accordingly in the comments field of the Tenancy Lighting Energy Calculator.

The following should be recorded:

- The size of the representative area in m^2.
- The details of each luminaire type used (see section 2.3).
- The number of each luminaire type in the representative area.
- A drawing showing the location of the representative area.

2.3. Luminaire Details

2.3.1. Luminaire Description

The space being assessed may contain one or more types of luminaire. Identical luminaires have the same lamp and ballast configuration, and therefore draw the same amount of electrical power. The identification of lamp and ballast details is covered in the following sections.

The Tenancy Lighting Energy Calculator requires that each luminaire type be described in a text field. Examples of this description are as follows:

- "Twin 36W with magnetic ballast" – a luminaire with twin 36W lamps and magnetic ballast.
- "Single 18W with electronic ballast" – a luminaire with a single 18W lamp and electronic ballast.

One of each luminaire type should be inspected in order to determine the lamp and ballast details. Luminaires with an identical outward appearance to the unit inspected can be regarded as having the same lamp/ballast configuration as the inspected unit, unless there is evidence to suggest otherwise. A luminaire which is noticeably different in outward appearance should be treated as a different type and be inspected accordingly. Photographs of all luminaire types identified should be retained and submitted with the assessment form.

Assessors must exercise caution in inspecting lamps. Lamps should be de-energised and cool before inspecting and should not be handled.

Note, as discussed in 2.3.2, some luminaire reflectors can give the impression of more lamps than are actually present. Care should be taken to sight the lamps correctly.

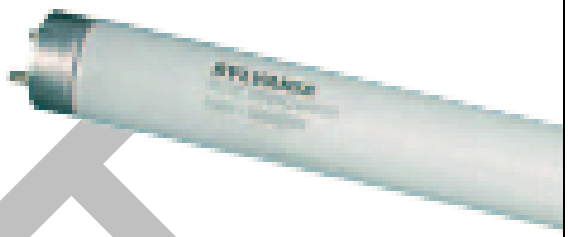
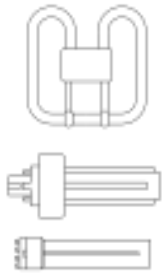
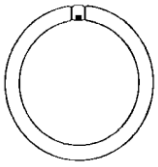
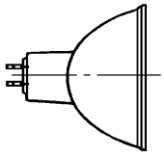
Note also that the Tenancy Lighting Energy Calculator does not require luminaire ballasts to be visually inspected. (Refer sections 2.3.5 and 2.3.6 for methods of assessing luminaire ballasts.)

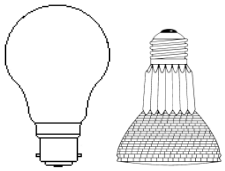
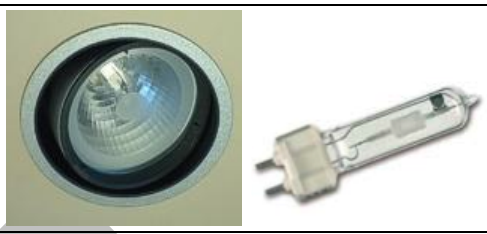
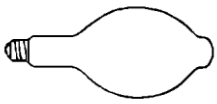
2.3.2. Lamp Details

Lamp Type

For each luminaire type, lamp details are required. In the calculator, the lamp type is selected from a drop-down menu which lists common lamp technologies. The commonly available lamp choices are listed in Table 1 and appear in order of popularity for office buildings. See section 2.3.3 for discussion of lamp types not listed in the table.

Table 1 - Common lamp types

Lamp Type	Description	Typical Lamp Nominal Sizes and Wattages	Notes and Examples
T8 or T12	**Linear fluorescent** with diameter 8/8 inch (26mm) or 12/8 inch (38mm). Can be halophosphate, triphosphor or quad phosphor. Can operate on magnetic or electronic ballast.	T8 600mm = 18W T8 900mm = 30W T8 1200mm = 36W T8 1500mm = 58W T8 1800mm = 70W T12 600mm = 20W T12 900mm = 30W T12 1200mm = 40W T12 1500mm = 65W T12 1800mm = 77.5W	
T5	**Linear fluorescent** with diameter 5/8 inch (16mm). Only operates on electronic ballast.	T5 550mm = 14W T5 850mm = 21W T5 1150mm = 28W T5 1450mm = 35W	 T5 lamps are noticeable narrower than T8 lamps. See section 0 for discussion of retrofit T5 adaptors.
CFLn	A single-ended **compact fluorescent lamp** with non-integral ballast (i.e. ballast is separate from lamp). Can operate on magnetic or electronic ballast.	Length ~150mm Various wattages	 
CFLi	A single-ended **compact fluorescent lamp** with integral ballast.	Length ~150mm Various wattages	
Circular fluorescent	A fluorescent lamp in a circular shape	Diameter ~300mm 22W, 32W, 40W	
Incandescent / halogen-low voltage	Lighting systems operating on 12 Volts with step-down transformer	Diameter ~50mm 50W, 35W, 20W	

Lamp Type	Description	Typical Lamp Nominal Sizes and Wattages	Notes and Examples
Incandescent / halogen-mains voltage	Mains voltage general purpose lamps and down lights	Various sizes and wattages	
Metal halide	Becoming more popular as down lights and spotlights	Reflector diameter ~100mm 20W, 35W, 50W, 70W (office applications)	
Mercury Vapour	Not common in office applications	Various sizes and wattages	
Other lamp types	Lamp types not listed above, including LED and lamps with T5 retrofit adaptors. Discussed in section 2.3.3.		

Identification of the lamp type should be undertaken by visual inspection. If the assessor is unable to identify a lamp type, then they should seek advice from a lighting professional or from recent, verifiable documents pertaining to the current lighting system installed.

Lamp Nominal Wattage

The lamp nominal wattage is required and this should be marked on the lamp itself.

Lamps per Luminaire

The number of lamps per luminaire is determined by visual inspection, i.e. how many lamps are present in each luminaire. For open plan fittings, this is typically 1 or 2, but may be higher.

The luminaire diffuser may need to be removed in order to accurately assess the number of lamps. Assessors must exercise caution in inspecting and removing the diffuser. Lamps should be de-energised and cool, and the diffuser itself should be cool, before it is removed.

Some luminaires may have positions for a larger number of lamps than are installed. If de-lamping is consistent, e.g. all luminaires are operating with two lamps when there are three lamp positions, the luminaires may be considered as having two lamps. However, it must be noted in the comments field of the Tenancy Lighting Energy Calculator that the luminaires are de-lamped.

2.3.3. "Other" Lamp Types

If a lamp type is discovered that does not appear in Table 1, the lamp type should be classed as "Other". In this case the following details will be required:

- The type of lamp present, e.g. LED.

- The Total Luminaire Power (rather than Lamp Nominal Wattage).

For "Other" lamp types, the value for Total Luminaire Power must include the power draw of the lamp(s) plus the losses of any ballast(s) or driver(s) present (whether internal or external to the luminaire). This should be determined from the nameplate or alternatively can be measured in situ using a handheld power meter.

For "Other" lamp types, the ballast/transformer type and the number of lamps per luminaire is not required to be recorded.

These requirements also apply to T5 retrofit adaptors, discussed in section 2.3.4.

2.3.4. Other Lamp Types – T5 Retrofit Adaptors

If the assessor identifies a T5 retrofit adaptor in a luminaire, then "Other" should be selected as the lamp type, and "T5 retrofit adaptor" recorded.

The Total Luminaire Power shall be determined by measurement of the entire luminaire/ballast arrangement using a handheld power meter. Note that the ballast type and number of lamps per luminaire are not required to be recorded.

What is a T5 Retrofit Adaptor?

A T5 retrofit adaptor is an aftermarket adaptor arrangement that will allow fitting of a T5 lamp into a T8 fitting. The characteristics of these devices are as follows:

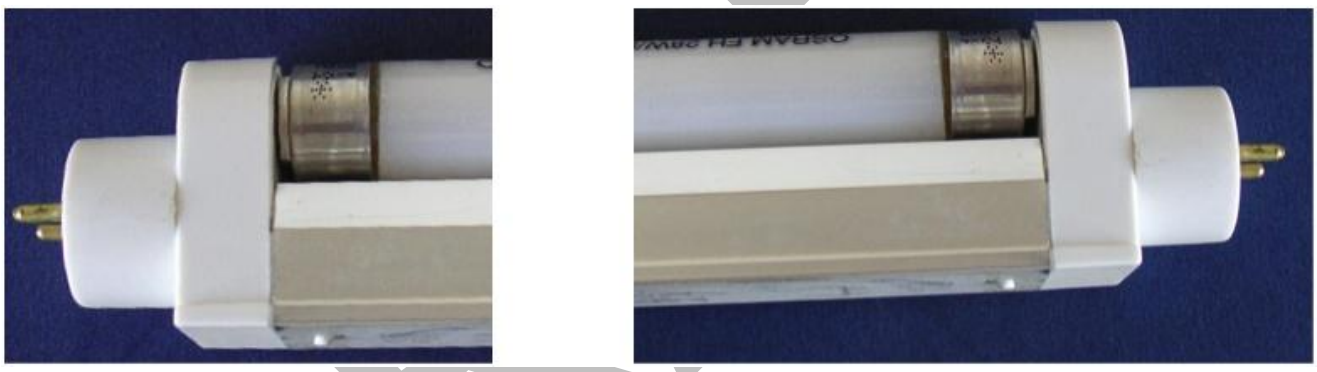
- Physical form that will allow fitting of T5 a lamp in a T8 fitting (a T5 lamp shorter and narrower than a T8 lamp – see Table 1).
- Incorporate electronic ballast, which is required to drive T5 lamps.
- Typically do not require electrical modification – i.e. leave the incumbent T8 ballast in place.
- Typically do not require physical modification of the luminaire.

A T5 retrofit adaptor should be able to be easily identified (once the luminaire diffuser has been removed) by the extension arrangements that effectively lengthen the T5 lamp to allow it to be installed into the T8 fitting. Examples of the two known arrangements for these devices are shown in Figure 2 and Figure 3.

Figure 2 – T5 retrofit adaptor showing T5 lamp and extension arrangements

Note in Figure 2 that the electronic ballast is housed in the left hand extension arrangement.

Figure 3 – T5 retrofit adaptor showing T5 lamp and extension arrangements



Note in Figure 3 that the electronic ballast is housed in the silver spine located under the T5 lamp.

2.3.5. Ballast Details for Fluorescent Lamps

This section deals with ballasts for linear fluorescent (T5, T8, T12), CFLn and circular fluorescent luminaires.

The ballast type will determine the total power drawn by the luminaire. Ballasts which are not integral to the lamp will draw power in addition to the lamp's nominal power rating. Note that the nominal power rating of a CFLi includes the power losses of its integral ballast.

For fluorescent lamps with separate ballast, the ballast type shall be determined as follows:

1. When determining the number of lamps, determine if one or more starters are visible (see example in Figure 4). If so, the ballasts are deemed to be magnetic (also known as ferro-magnetic, iron-core or wire-wound ballasts).

2. If starter(s) are not visible, observe the lights switching on. This must be conducted on lights switched off for at least 5 minutes before being switched back on. If the lights are observed to flicker when switched on, the ballasts are deemed to be magnetic.

3. If starters are not observed, and the luminaires do not flicker on startup, check if the lamps are T12 (i.e. rapid start lamps). If T12 lamps are observed, the ballasts are deemed to be magnetic.

4. If starters are not observed, the luminaires do not flicker on startup, and lamps are not T12, then the ballasts are deemed to be electronic.

Figure 4 - Example of starter placement (RHS of photograph)

Note that some ballasts will drive more than one lamp in the luminaire and some luminaires will contain more than one ballast. This is not relevant to the Tenancy Lighting Energy Calculator. It is not necessary to identify how many ballasts are present in the luminaire, just what type of ballast is present and how many lamps are present.

2.3.6. Ballast Details for Incandescent, Halogen, Metal Halide and Mercury Vapour Lamps

Low voltage incandescent or halogen lamps will be supplied by a magnetic or electronic transformer. In this context, transformers used with low voltage lamps are also referred to as ballasts.

HID lamps (metal halide and mercury vapour) will also be supplied by a magnetic or electronic ballast.

For information, magnetic transformers are significantly heavier and bulkier than electronic units (see Figure 5 below).

Figure 5 – electronic transformer (top) and magnetic transformer (bottom)

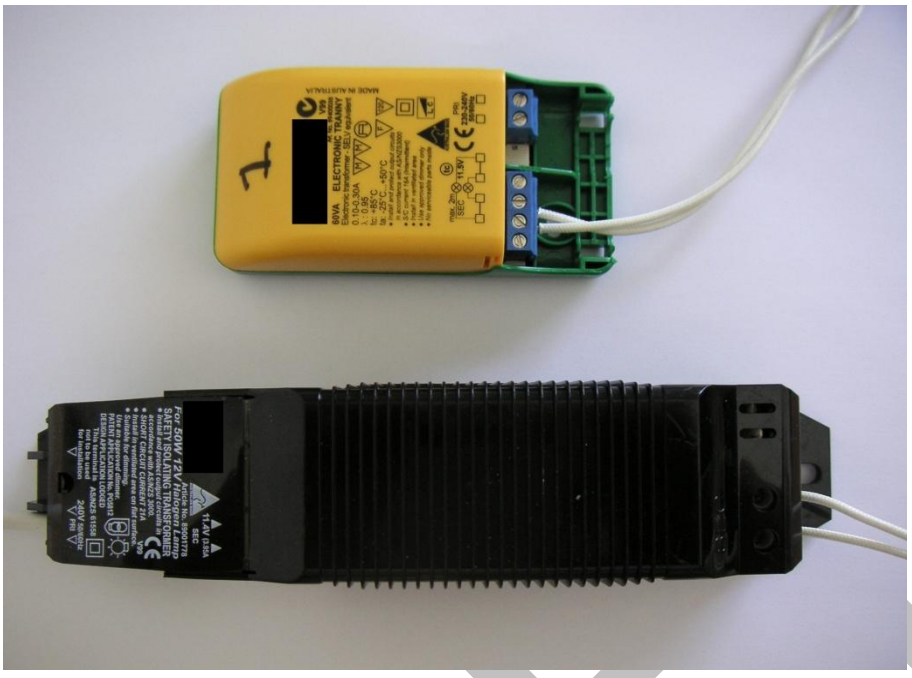


Figure 6 – magnetic transformer in situ in ceiling space

The Tenancy Lighting Energy Calculator does not require the installed ballast or transformer to be visually inspected. The ballast or transformer shall be assumed to be magnetic unless the assessor has been able to verify its type by other means.

2.4. Lighting Controls

Lighting controls do not impact the quantitative results of the Tenancy Lighting Energy Calculator. However, the presence of lighting controls is reported, to provide information to

prospective owners and tenants on the potential to control lighting energy use in the space. For the purposes of these Rules, lighting controls consist of:

- time schedulers;
- motion sensors; and
- daylight sensors.

A time scheduler is a device used to switch the lights on and off at preset times. The user interface for a time scheduler is usually found on an electrical switchboard or on a wall within the tenancy. An example is given in Figure 7.

Figure 7 - Example of user interface for a time scheduler

The presence of a time scheduler, in the tenanted space, in a switchboard or in the building's Building Management System? must be confirmed visually by the assessor and should be confirmed as operational.

Motion sensors detect motion and switch lights on if people are present, and off if people have not been detected for a period of time. For the purpose of these Rules, the definition of a motion sensor is similar to that used in the Building Code of Australia, i.e. a motion detector shall:

- be capable of sensing movement such as by infra-red, ultrasonic or microwave detection, or by a combination of these means;
- be capable of detecting a person before they have entered 1m into the space, and movement of 500 mm within the useable part of the space;
- not control more than an area of 500m^2 with a single sensor or parallel sensors, and not control more than 75% of the lights in spaces using high intensity discharge;

- be capable of maintaining the artificial light when activated for a maximum of 30 minutes unless it is reset, and without interruption if the motion detector is reset by movement; and

- not be overridden by a manual switch to permanently leave the lights on.

Exceptions to the above motion sensor standards should be noted in the comments field of the Tenancy Lighting Energy Calculator.

Daylight sensors detect levels of daylight ingress and dim or switch luminaires (adjacent to windows) accordingly. For the purposes of these Rules, the definition of a daylight sensor is similar to that used in the Building Code of Australia, i.e. a daylight sensor shall:

- control only the first one or two rows of luminaires adjacent to windows;

- for switching on and off:

    - be capable of having the switching level set point adjusted between 50 and 1000 Lux;

    - have a delay of more than 2 minutes, and

    - have a differential of more than 100 Lux for a sensor controlling high discharge lighting and 50 Lux for a sensor controlling other than high discharge lighting;

- for dimmed or stepped switching, be capable of reducing the power consumed by the controlled lighting in proportion to the incident daylight on the working plane either:

    - continuously down to a power consumption that is less than 50% of full power; or

    - in no less than 4 steps down to a power consumption that is less than 50% of full power; and

- where a sensor has a manual override switch, the manual override switch must not be able to switch the lights permanently on or bypass the lighting controls.

The above definitions do not have to be rigorously checked in each instance, but should be applied where there is any doubt about the effectiveness of the controls

The presence of lighting controls shall be noted in the comments field of the Tenancy Lighting Energy Calculator. Any differences in operation from the above definitions should also be noted.

2.5. Horizontal Illuminance Measurements

Low IPD values can be achieved by reducing illuminance levels. Measured illuminance levels can be highly variable depending on where the lighting system is in the maintenance cycle, height of workstation dividers, surface reflectance and a host of other influences. However, an illuminance level does give an indication of whether the reported IPD is likely to be sustainable and gives prospective owners and tenants a better perspective of the lighting system.

Assessors will record horizontal illuminance in at least 10 positions within a representative area. Readings should be taken at the task plane (desk top) as outlined in the NABERS Indoor Environment for Offices - Validation Protocol for Accredited Ratings. The location of the illuminance readings should be recorded and submitted with the assessment. Notes shall be taken as to the variation in lighting system between functional spaces.

The presence of desk lamps in the open plan office area should be noted in the comments field of the Tenancy Lighting Energy Calculator, as this can be an indication of poor tenant satisfaction with illuminance levels.

3. SAFE CONDUCT OF ASSESSMENTS

Assessors should carry out assessments with all due care, in accordance with any applicable occupational heath and safety standards, and in a manner that ensures the assessment is carried out safely and with minimal disruption to the owner or tenant of the relevant building or area.

Attachment 1 SUMMARY OF CALCULATIONS

The calculation methodology for the Tenancy Lighting Energy Calculator is a subset of the calculations developed for the commercial lighting component of the NSW Energy Savings Scheme (www.ess.nsw.gov.au). The calculations are summarized as follows:

$$\text{Illumination power density} = (\Sigma \text{ luminaire power for each luminaire}) \div \text{Area}$$

The luminaire power for each luminaire is determined by looking up a series of equations, which are based on the lamp type and ballast or transformer type. These equations have been derived from Australian Standards, from previously published reports and from manufacturer catalogue data. They are reproduced in Table 2. Note that the number of lamps present in each luminaire will also affect the luminaire power.

Table 2 - Calculation of Luminaire Power (per lamp)

Lamp Type	Luminaire Power (per lamp, in Watts)	
	Electronic Ballast	Magnetic Ballast
Linear fluorescent T8 or T12	NLP + 1	NLP + 7
Linear fluorescent T5	1.1 x NLP + 2.0	N/A
CFLn	NLP + 2	NLP + 6
CFLi	NLP	
Incandescent / halogen – mains voltage	NLP	
Incandescent / halogen – low voltage	NLP ÷ 93%.	NLP ÷ 80%.
Metal halide	1.096 x NLP + 0.9	1.0456 x NLP + 14
Mercury vapour		1.033 x NLP + 11

NLP = nominal lamp power

Notes:

- Luminaire power does not deteriorate over time, although the power factor of fluorescent luminaires may deteriorate as the power factor correction capacitor deteriorates.
- Fixed dimming and fluorescent ballasts with a low ballast lumen factor (BLF) are not considered at this time.