

NABERS Indoor Environment

For the next generation of sustainability leaders



A guide to the NABERS
Indoor Environment rating tool
for building owners, managers & tenants

[November 2015]

About this Guide

This guide is for facility managers, building managers or office managers and tenants who are responsible for commercial office spaces and wish to understand more about managing the indoor environments they control.

Indoor environments are the result of many factors. Some of them are controlled by the design of the building envelope and building services but many of them are strongly influenced by management decisions and actions.

This guide explains how these factors can be measured, assessed and benchmarked against market performance standards using the NABERS Indoor Environment rating tool, and how this assessment process can yield valuable information about how to improve the quality of your indoor environment.

For more information on the NABERS Indoor Environment rating tool contact the NABERS team on 02 9995 5000 or visit our website under www.nabers.gov.au.

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OEH 2015/0790
November 2015

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1. NABERS Indoor Environment – the next frontier for Australian buildings

1.1 Proving your sustainability and leadership credentials

Productive employees are essential for creating competitive businesses.

Healthy people are essential for creating vibrant societies.

Evidence is mounting that indoor environment quality factors, such as air quality, temperature, lighting and other factors impact on our health, comfort and productivity.

As Australians spend an increasing amount of time indoors, it's important that we get these factors right if we want our businesses to remain competitive and our society to remain vibrant into the future.

The Property Council of Australia has estimated that, for offices, a 1% improvement in productivity would be equivalent to the whole energy cost of a building or, nationally \$2 billion annually.

That's why office based businesses need good quality information about the indoor environment quality of their building and tenancy.



*Images courtesy of ISPT.
Sydney Central, 477 Pitt Street, Sydney*

1.2 Our solution - technical information made easy

Our tools rate the performance of buildings and tenancies using objective measurements and communicate the results in a clear and simple way.

The NABERS Indoor Environment (IE) tool uses the latest measurement technology and indoor environment quality (IEQ) standards to measure:

- Thermal services, including temperature, mean radiant temperature, humidity and air speed
- Acoustic comfort, including the ability of the building to minimise external noise as well as the noise levels within the tenanted space
- Indoor air quality, including ventilation effectiveness and levels of pollutants
- Maintenance of air systems and cleaning practices for the building in general
- Lighting to maximise daylight while minimising glare and reflectivity
- Office layout, including the spatial arrangements of walls, partitions, furniture and equipment in relation to fixed elements like windows and heating, ventilation and air conditioning.

It takes this information and converts it into a score on a six star scale, where one is poor performance, three is average and six is market leading.

It also provides a report that breaks down performance in each area. The report helps users understand which aspects of their indoor environment quality are performing well and which need improvement.

Our ratings are aligned to responsibilities

Indoor environment quality is the result of building characteristics, maintenance practices, tenant equipment and occupant behaviour. Some of these factors are controlled by the building owner, such as HVAC, while others are influenced by the tenant, such as the selection of the wall paint or furniture.

That's why we've created three NABERS IE ratings. One for the base building services, one for tenants, and one that rates the whole building. Ratings are aligned with responsibilities, so your rating indicates your performance on the things you have control over.

Our tool was built by experts

The rating tool was developed by drawing on a broad range of industry expertise, including technical consultants specialising in commercial property, indoor environment and air conditioning. Development of the tool was overseen by a Technical Working Group that included IEQ specialists and individuals with industry experience of the built environment as well as knowledge of the NABERS program.

Standards incorporated into the tool include:

- American Society of Heating, Refrigerating and Air-conditioning Engineers (ASHRAE) 55: 2013 *Thermal environmental conditions for human occupancy*
- American Society of Heating, Refrigerating and Air-conditioning Engineers (ASHRAE) 62.1: 2004 *Ventilation for acceptable indoor air quality*
- Australian Standard/New Zealand Standard 2107: 2000 *Acoustics – Recommended design sound levels and reverberation times for building interiors*
- Australian Standard/New Zealand Standard AS/NZS 1680.2:2008 *Interior and Workplace Lighting*
- Australian Standard/New Zealand Standard AS1668:2012 *Ventilation and air conditioning in offices.*

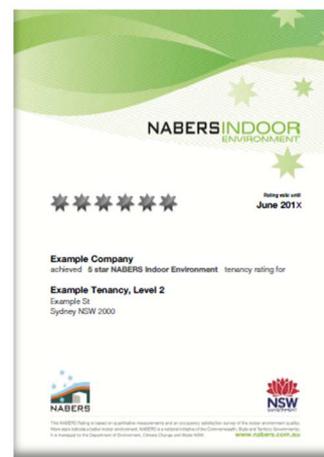


Images courtesy of ISPT.
Sydney Central, 477 Pitt Street, Sydney

1.3 Benefits of getting a NABERS IE rating

You will better understand your office

The NABERS IE rating tool gives you an accurate, reliable and easy-to-use assessment that enables you to measure your individual performance across several key indicators, identify opportunities for improvement and compare your performance with others in the Australian market. As it is a performance benchmarking tool, rather than a health-based risk assessment, it provides a measure of the overall indoor environment quality, and can provide an indication of potential WHS issues that may need further investigation.



The rating provides a common language which can assist in coordinating multiple parties in setting goals and evaluating performance and market achievements in occupant health, comfort and wellbeing.

NABERS IE can also be used in conjunction with other NABERS tools such as NABERS Energy to ensure buildings are operating at both a high level of energy efficiency while simultaneously providing high quality services to occupants.

For building owners – a high NABERS IE rating will help you attract tenants

A high NABERS IE base building rating demonstrates a clear commitment to providing a good indoor environment to your tenants. This is a selling point for attracting and retaining tenants.

Tenants identify excellent indoor air quality and thermal comfort as significantly more important than other building attributes (Colliers International Office Tenant Survey 2010).

For office based businesses – a high NABERS IE rating will help you attract and retain staff

A NABERS IE tenancy rating demonstrates a commitment to providing a high quality workplace. It identifies you as an employer of choice in the marketplace – helping you to attract and retain staff.

You will prove your sustainability credentials

A NABERS IE rating provides an industry respected, demonstrable advantage in the market that proves your leadership credentials. It shows you understand and care about the social, as well as environmental aspects of sustainability.

You can use your NABERS IE data in your Green Star Performance rating

A NABERS IE rating can be used to meet a number of the indoor air quality, lighting, thermal comfort and occupant satisfaction criteria for a Green Star Performance rating. Specifically, the results from a NABERS IE rating can be used to meet:

- Indoor air quality credit - Outdoor pollutant control criteria for carbon monoxide performance (1 point)
- Indoor air quality credit - Outdoor pollutant control criteria for carbon dioxide performance (1 point)
- Lighting comfort credit - General illuminance criteria (1 point)
- Thermal services credit - NABERS IE annual monitoring (2 points)
- Thermal services credit - NABERS IE spot measurements (1 point)
- Acoustic comfort credit - Internal noise levels criteria (1 point)
- Occupant satisfaction - Occupant satisfaction survey (1 point)
- Occupant satisfaction - Occupant satisfaction levels (3 points)

Please note that the components measured vary by rating type, therefore not all NABERS IE ratings will cover all of the credits listed above. Please refer to the different ratings and the components measured by rating type in Section 3.



*Images courtesy of ISPT:
Urban Workshop, 50 Lonsdale, Melbourne*

2. What is NABERS?

NABERS' vision is to support a more sustainable built environment through a relevant, reliable and practical measure of building performance.



2.1 Built on performance

The National Australian Built Environment Rating System (NABERS) is the industry standard for measuring and benchmarking the environmental performance of existing Australian buildings.

NABERS is managed nationally by the Office of Environment and Heritage NSW (OEH) on behalf of Australian, state and territory governments.

The NABERS approach to rating the environmental performance of buildings is world leading and unique. It utilises real, measured impacts and communicates these in a clear and simple way.

Through NABERS, the Australian property industry has a credible standard to judge environmental initiatives and confidently communicate results through a well-established star rating scale. This deep knowledge of building performance and potential for improvement has transformed the Australian property industry, which is now acknowledged as an international leader in the greening of buildings. It has led to a real, measured and significant reduction in environmental impact.



2.2 NABERS Indoor Environment Goal

The goal of the NABERS IE tool is to facilitate improved occupant comfort and wellbeing in the office sector. NABERS achieves this by providing an independent, reliable and respected measure of indoor environment quality (IEQ) that will drive improvements by recognising offices that provide outstanding services to occupants.

NABERS IE can also be used in conjunction with other NABERS tools such as NABERS Energy to ensure buildings are operating at both a high level of energy efficiency while simultaneously providing high quality services to occupants.

2.3 What do the NABERS stars mean?

NABERS ratings are awarded using a scale of 1 to 6 stars. The star rating is calculated using a benchmarking process that compares the performance of your building or tenancy (or both) to the Australian office market.

The highest rating of 6 stars represents market leading performance, while 3 stars represents median performance within the market.

The NABERS star rating scale

	6 stars	Market leading indoor environment
	5 stars	Excellent indoor environment
	4 stars	Good indoor environment
	3 stars	Median indoor environment
	2 stars	Below average indoor environment
	1 star	Poor indoor environment

3. How NABERS IE works

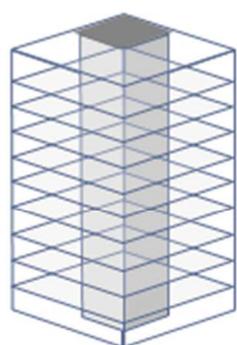
3.1 Overview

The NABERS IE rating tool assesses a building or tenancy's indoor environment performance against a set of benchmarks that reflect industry standards, scientific research and current market performance. It is designed to assess the overall performance of the indoor environment and is not a tool for assessing specific health risks in a building.

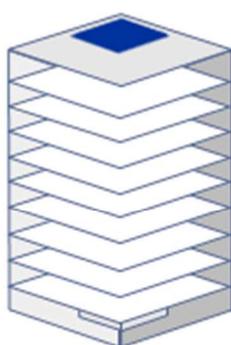
It provides three different rating types (base building, whole building and tenancy) to reflect the different roles and responsibilities within a building. Separate rating types enable the different stakeholders within a building including, building owners, managers and tenants to benchmark how well their indoor environment is performing and identify opportunities for improvement.

To assess the level of comfort or wellbeing and ultimately satisfaction in a building, NABERS uses two measurement approaches - an occupant satisfaction survey (qualitative) and collection of on-site data (quantitative). These two approaches allow the tool to measure to what extent the building characteristics, maintenance practices, tenant equipment and occupant behaviour impact the quality of the indoor environment. The occupant satisfaction survey assesses how a building is performing from the perspective of its occupants, while the on-site quantitative measurements capture data on specific parameters that are indicators of overall building performance.

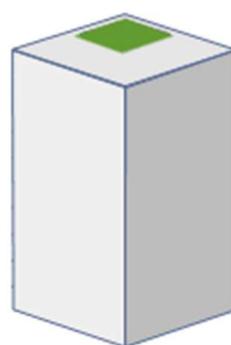
Three rating types



Base building



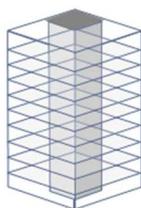
Tenancy



Whole building

Your ability to control and manage these indicators of performance can depend on whether you own, manage or lease the office space – this usually determines the extent of your influence over the design and maintenance of the building envelope and the building services, including how they contribute to, or detract from, the indoor environment quality.

The type of rating you need depends on whether you are responsible for a building or for a tenancy, or both:



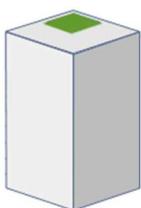
Base building

Base building ratings are for building managers who generally control and manage the building's thermal comfort, its ability to maximise air quality and minimise external noise, as well as building cleaning services. See Section 4



Tenancy

Tenancy ratings are for building occupants, i.e. tenants who generally control and manage the design and materials used for their office fit-out and lighting, and their internal noise levels. Through their choice of materials and through some activities, such as cleaning, tenants also have a measure of control over indoor air quality. See Section 5



Whole building

Whole building ratings are for organisations that both manage and occupy their office space, or in some cases where a single tenant occupies the majority of a building. See Section 5

3.2 Which parameters does NABERS IE assess?

To assess the level of comfort, wellness and ultimately satisfaction in a building, NABERS measures five key indoor environment parameters. Each parameter is scored separately, helping you to identify those with good performance and those where performance can be improved. The parameters are weighted differently depending on their impact on occupants.

The 5 parameters measured by NABERS IE



Thermal Services

Measured by the air temperature, radiant temperature, relative humidity and air speed provided to the space.



Acoustic Comfort

Measured by the level of noise disturbance in the office space for tenancy ratings and the building's ability to minimise external noise for base building ratings.



Indoor Air Quality

Measured by the effectiveness of ventilation provided and levels of pollutants (carbon monoxide, particulate matter (PM10), formaldehyde and Total Volatile Organic Compounds (TVOCs)).



Lighting

Measured by the level of overhead light (horizontal illuminance) provided at the occupant's desk level to provide an indication of the potential for eye strain, and therefore the occupant's ability to work effectively.



Office layout

Measured by the occupant satisfaction survey for tenancy and whole building ratings to assess the effectiveness of the spatial arrangements of walls, partitions, furniture and equipment in relation to fixed elements like windows and heating, ventilation and air conditioning.

For each different rating type – i.e. a base building, tenancy or whole building rating – there is a slightly different set of parameters to be assessed, based on the ones you are responsible for (Table 1). For example, many tenants who lease their office space do not have control over the thermal comfort of their office environment because it is the responsibility of the building management, and so thermal comfort is not measured in a tenancy rating.

Table 1: Data required according to rating type and weighting

Indoor environment parameter	Rating type					
	Base building		Tenancy		Whole building	
	Data	Weighting	Data	Weighting	Data	Weighting
 Thermal services	M	40%	X	X	M S	30%
 Indoor air quality	M	40%	M S	40%	M S	30%
 Acoustic comfort	M	20%	M S	25%	M S	15%
 Lighting	X	X	M S	25%	M S	15%
 Office layout	X	X	S	10%	S	10%

M = on-site measurements required

S = occupant satisfaction survey required

X = not measured

To assess the quality of services delivered to the office space, the base building rating is calculated based on the collection of on-site data for thermal services, indoor air quality and acoustic comfort. It does not include an occupant satisfaction survey (Table 1).

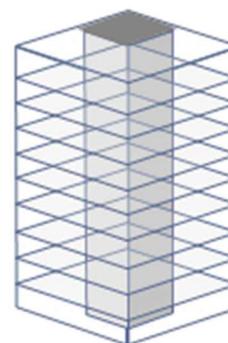
To evaluate the level of occupant satisfaction, NABERS IE uses both an occupant satisfaction survey and collection of on-site data to measure and benchmark the quality of the office space for tenancy or whole building ratings (Table 1).

4. How base buildings are rated

4.1 Scope of the base building rating

The base building performance is influenced by factors inherent to the design and operation of the building. These include temperature and humidity control, radiant temperature from the façade, delivery of fresh outside air and acoustic performance of the façade. How well the building is maintained and operated will directly impact the thermal comfort of the space, noise levels from HVAC systems, and levels of air pollutants – which in turn impacts an occupants comfort and satisfaction with the space.

To ensure a meaningful comparison, a NABERS IE base building rating measures attributes that typically cause occupant dissatisfaction with the office environment and that are controlled by building services – such as feeling hot/cold, draughts/stuffiness, ‘stale air’ and noise from HVAC systems or external sources e.g. traffic.



Base building

A NABERS Indoor Environment base building rating assesses:



Thermal services



Indoor air quality



Acoustic comfort

These parameters are measured as they are heavily influenced by the attributes of the base building and the actions of building management. However, obtaining a base building rating will also require cooperation from tenants because you will need access to tenancy spaces to conduct measurements.

The **base building rating tool** is typically for building managers or facility managers. Tenants or owner-occupiers wanting to rate their indoor environment need to use the tenancy rating tool or the whole building rating tool – refer to Section 5.

4.2 How the base building environment is assessed

The base building rating process requires taking quantitative measurements only.

Quantitative measurements, which are recorded during a site visit, are required for the attributes listed in Table 2.

Table 2: Attributes measured for base building ratings

Parameter assessed		Weighting
	Thermal services	40%
	Spot measurements (temperature, mean radiant temperature, relative humidity and air speed)	40%
	Annual temperature monitoring (optional)	60%
	Indoor air quality	40%
	Ventilation effectiveness	55%
	Particulate matter	30%
	Carbon monoxide	15%
	Acoustic comfort	20%

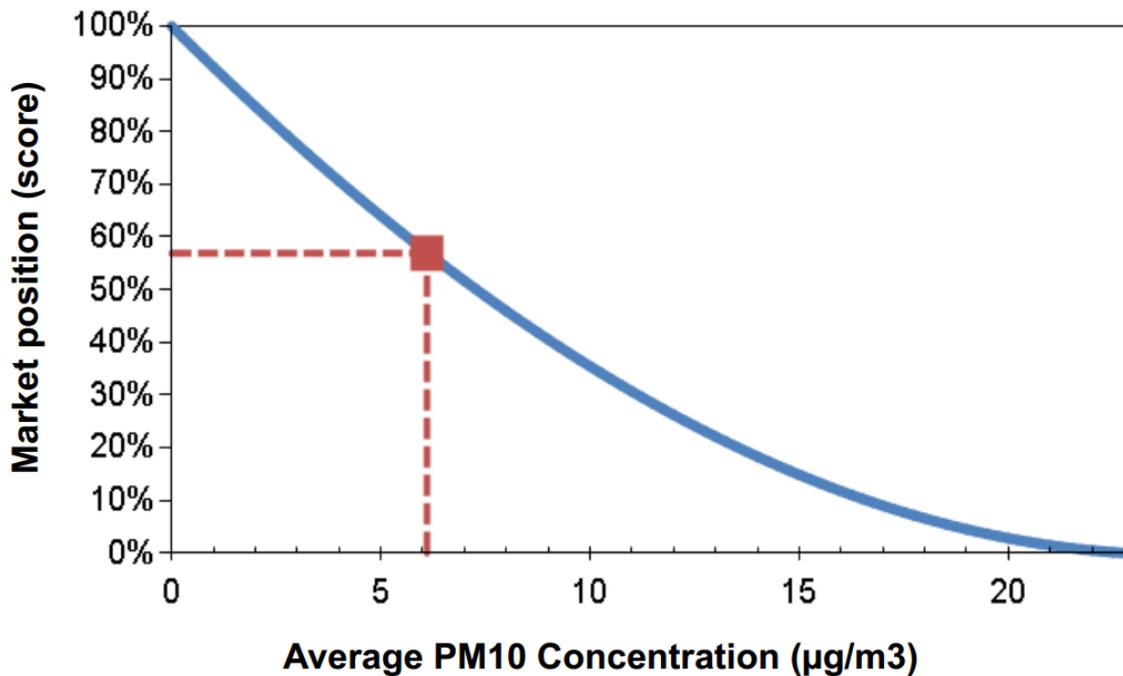
Thermal services and indoor air quality are weighted equally and of highest importance for a base building rating because of their impact on occupant health, comfort and wellbeing. The weighting is also a reflection of the extent to which the base building is able to influence and control the parameter.

Lighting and office layout are not included in this rating because these parameters are typically controlled by the tenant and not the building manager.

Scores for each individual component measured (e.g. particulate matter) are calculated based on the building's performance compared to other offices. For example in Figure 1, a score of $6\mu\text{g}/\text{m}^3$ in particulate matter would outperform 57% of Australian office buildings, therefore achieving a score of 57% for that component.



Figure 1 – Example of particulate matter results



The NABERS IE base building rating is then calculated from the overall scores awarded for the building for air quality, acoustic comfort and thermal services and benchmarked against market performance.

Although the rating does not require annual temperature monitoring to proceed, without these measurements the annual temperature component will be given a score of zero. You can significantly improve your rating by collecting annual hourly temperature data. However, ratings without this data can provide a useful benchmark of performance from which to compare subsequent ratings.

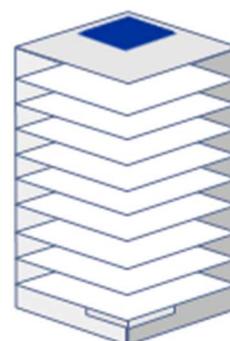
For more information about data requirements refer to Section 6.



5. How tenancies and whole buildings are rated

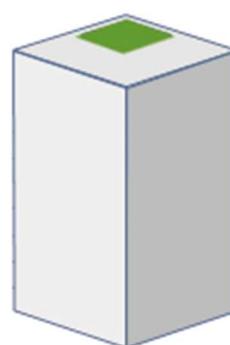
5.1 Scope of the tenancy and whole building ratings

Tenancy and whole building IEQ performance is largely influenced by the tenant's fit-out and use of the space, including the materials used and level of personal control. This includes the position of office partitions, the location of office equipment like printers, lighting and noise levels and the level of control occupants have over these factors. For whole building ratings, NABERS IE also assesses thermal services and the level of comfort for occupants. How the office space is designed and fitted-out will directly influence the noise levels experienced by occupants, the levels of indoor air pollutants and the quality of the lighting – which in turn impacts an occupants comfort and satisfaction with the space.



Tenancy

To ensure a meaningful comparison, NABERS IE tenancy and whole building ratings measure attributes that can be key indicators of occupant satisfaction or dissatisfaction with the office environment and that are controlled by the tenant – such as feeling distracted by office chatter or noisy office equipment, loss of concentration from elevated levels of carbon dioxide from overcrowding or poorly designed fitout interfering with the HVAC system, and headaches or eye strain from inadequate lighting.



Whole building

Both the tenancy and whole building rating tools are primarily for use by tenants:

- The **tenancy rating tool** is for tenants who **do not** have control over their office heating, ventilation and air conditioning (HVAC)*. In most cases this means tenants who lease their office space – so they are the occupants but not the managers of the central services provided to the space.
- The **whole building rating tool** is for tenants who **do** have control over their office HVAC. This generally applies to tenants who own and occupy their office space, or who manage and occupy their office space (i.e. their lease gives them control over managing the whole building including its central services).

In effect, the only difference between the two tools is that **the whole building rating measures thermal comfort and the tenancy rating does not.**

A NABERS IE tenancy rating assesses:

			
			
Indoor air quality	Acoustic comfort	Lighting	Office layout

A NABERS IE whole building rating assesses:

				
				
Indoor air quality	Acoustic comfort	Lighting	Office layout	Thermal services

*HVAC can include natural ventilation and passive heating and cooling. The building might use natural/passive systems only or mechanical systems only (i.e. air conditioning).



5.2 How the tenancy or whole building environment is assessed

The process for both tenancy and whole building ratings involve quantitative measurements (recorded during a site visit) and a qualitative assessment (obtained using an occupant satisfaction survey) as set out in Table 3.

Table 3: Attributes measured for tenancy and whole building ratings

Indoor Environment Parameter	Attributes measured	
	Site visit measurement (quantitative)	Measured using an occupant satisfaction survey (qualitative)
 Thermal comfort (whole building rating only)	Air temperature Mean radiant temperature Relative humidity Air speed	Perceived thermal comfort
 Air quality	Ventilation effectiveness Indoor pollutant levels	Perceived comfort in relation to air quality
 Acoustic comfort	Sound levels in the occupied space	Perceived comfort in relation to sound levels
 Lighting	Horizontal light levels	Perceived comfort in relation to light levels
 Office layout	Not applicable	Perceived satisfaction in relation to the physical layout of the office space

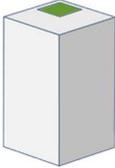
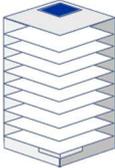
For more information about data requirements refer to Section 6.

To reflect the varying importance to occupant satisfaction, health and wellbeing the parameters for tenancy and whole building ratings are weighted (Table 4). For example, indoor air quality, which is directly influenced by the choice of materials for the office fit-out and the cleanliness of the space is the most important factor a tenancy controls which impacts occupant health, wellbeing and comfort and is awarded the highest weighting.



For a whole building rating, thermal services and indoor air quality have the biggest impact on occupant health, comfort and wellbeing and are therefore given the highest weighting. Both lighting and acoustics are weighted equally for both ratings. Office layout is given the lowest weighting as there is no quantitative metric available and is only assessed through the occupant survey and indirectly through both the lighting and acoustic comfort parameters.

Table 4: Weightings for tenancy and whole building ratings

	 Thermal Services	 Indoor Air Quality	 Lighting	 Acoustics	 Office Layout
 Whole building	30%	30%	15%	15%	10%
 Tenancy	n/a	40%	25%	25%	10%



Individual weightings

A number of the parameters are calculated from one or more variables, which are weighted to reflect their individual importance. For example, the indoor air quality score is calculated from the individual weighted scores for ventilation effectiveness (measured by the difference in outdoor and indoor carbon dioxide levels), particulate matter, formaldehyde, TVOCs and carbon monoxide (whole building ratings only). These are weighted based on their potential impact to occupant satisfaction, health and wellbeing (Table 5).

Table 5: Individual weightings for tenancy and whole building ratings

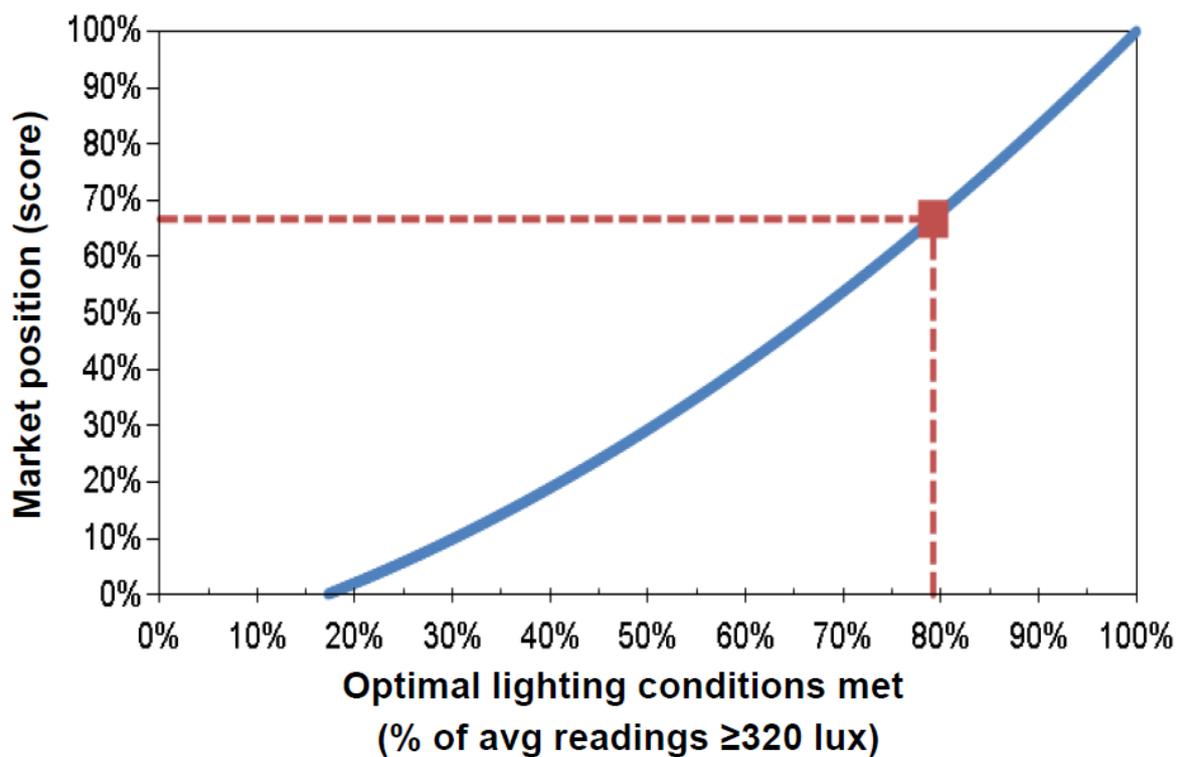
Indoor environment parameter	Weighting		
	Site visit measurement		Occupant satisfaction survey
	Tenancy rating	Whole building rating	(Tenancy & Whole building)
 Thermal services (temperature, mean radiant temperature, relative humidity, air speed)	not included	30% (Annual temperature monitoring) 20% (One day spot measurements)	50%
 Indoor air quality	50%	50%	50%
Ventilation effectiveness	20%	20%	
Particulate matter (PM ₁₀)	10%	10%	
Formaldehyde	10%	10%	
Total Volatile organic compounds (TVOCs)	10%	5%	
Carbon Monoxide (CO)	not included	5%	
 Acoustic comfort	50%	50%	50%
 Lighting	50%	50%	50%
 Office layout	-	-	100%



Individual component scoring

Scores for each individual component measured (e.g. lighting) are calculated based on the building's performance compared to other offices. For example in Figure 2, a tenancy where the lighting meets optimal conditions in 80% of locations, would outperform 67% of Australian office buildings, therefore achieving a score of 67% for that component.

Figure 2 – Example of lighting results



6. Data required for your IE rating

6.1 Overview

The data requirements for a NABERS IE rating vary depending on whether you are undertaking a base building, tenancy or whole building rating (Table 6).

Table 6: Data required according to rating type

Indoor environment parameter	Rating type		
	Base building	Tenancy	Whole building
 Thermal services	●	n/a	● ●
 Air quality	●	● ●	● ●
 Acoustic comfort	●	● ●	● ●
 Lighting		● ●	● ●
 Office layout		●	●

- = site measurement (quantitative)
- = occupant satisfaction survey (qualitative)

Assessment tasks and timing

Base building ratings require quantitative data only (site measurements).

Tenancy and **whole building** ratings require quantitative AND qualitative data (site measurements and occupant satisfaction survey).

The occupant satisfaction survey must be completed **before visiting the site** to conduct measurements. This is to make sure the site visit does not influence the survey results.

Site measurements must be completed within **four weeks of the completion** of the survey.



The majority of the site measurements can be taken within one working day, with measurements taken during the morning and afternoon. You will need to grant permission for your Assessor (or their sub-consultant) to gain access to your office and plant rooms so they can perform the site measurements.

Information you need to give your Assessor

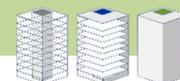
To help your Assessor plan and organise your assessment, you will need to provide the following information:

- ❖ floor plans showing tenanted office spaces including the arrangement of open plan office areas as well as private rooms, and
- ❖ lease documents showing hours of operation and vacancy schedules.

This information helps to determine which floors are relevant for your rating.

If you are undertaking a base building or whole building rating, the Assessor will also require:

- ❖ details of the number, location and type of ventilation systems, e.g. mechanical, mixed-mode or natural ventilation, and how each system distributes air to the tenanted spaces, and,
- ❖ if available, output in excel format from the Building Management System (BMS) hourly temperature readings for all relevant floors. If temperature readings from BMS reports are used you will also need to supply copies of the calibration reports for the BMS sensors.

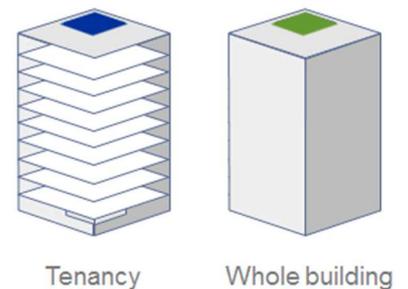


6.2 Occupant satisfaction survey – Qualitative measurements

An occupant satisfaction survey is required for tenancy and whole building ratings only.

Occupant satisfaction is measured for:

- ✓ thermal comfort (for whole building ratings only)
- ✓ air quality
- ✓ acoustic comfort
- ✓ lighting, and
- ✓ office layout.



The occupant satisfaction survey assesses how a building is performing from the perspective of its occupants and provides immediate feedback. It measures the level of satisfaction with various aspects of the indoor environment that cannot be fully assessed through quantitative measurements and is used to correlate with quantitative measurements taken on-site. The results can be used to identify potential problems in the office layout and tenancy fit-out or to identify issues, such as thermal comfort or cleaning and maintenance of air systems, which can be discussed with building management.

Your Assessor will liaise with you to create the distribution list and discuss timing for the survey. Your Assessor will also calculate the minimum response rate required. The survey must be completed before the site visit.

Your Assessor will ask you to distribute the survey by email to your staff at the beginning of the survey period. To encourage a better response rate, you should send out reminder emails to your staff four to eight business days after the initial email. You could also consider providing incentives for staff to complete the survey – your Assessor can help with this.

The survey must be undertaken by one of the recognised NABERS survey providers. Your Assessor will contact them on your behalf. The provider will conduct the survey, analyse the responses and provide results.

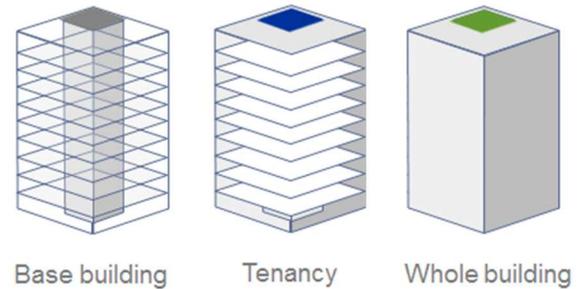


6.3 Site visit – Quantitative measurements

A site visit is required for all indoor environment ratings: base building, tenancy and whole building.

Measurements taken on-site are required for:

- ✓ thermal services
(base and whole building ratings only)
- ✓ air quality
- ✓ acoustic comfort, and
- ✓ lighting
(tenancy and whole building ratings only).



The site visit activities can be accommodated within typical occupancy hours, e.g. 9am-5pm Monday to Friday, excluding Public Holidays.

Measurements should reflect the 'normal' working environment and should avoid unusual events such as construction elsewhere within the building that may affect measurements on the sampled floors, or externally adjacent construction or smoke haze from bushfires that can unduly influence the quality of the external air supplied to the building.

In most cases, all site measurements can be taken within one day but this may not be possible for larger offices or if there are problems on site on the day of the visit. Your Assessor can perform measurements over more than one day, but not over more than five working days. Samples will need to be collected in the tenanted spaces as well as one sample from the plant room. It is important to advise your tenants when the sampling will take place.

Your Assessor will determine the number of floors to sample and the sampling locations required based on the size of your building/tenancy. The maximum number of floors required under a NABERS rating is 6 and the maximum number of samples per floor is 5 – this is based on a building that is larger than 40,000 m² with more than 14 occupied floors. An example of the sampling requirements is illustrated in Figure 3.



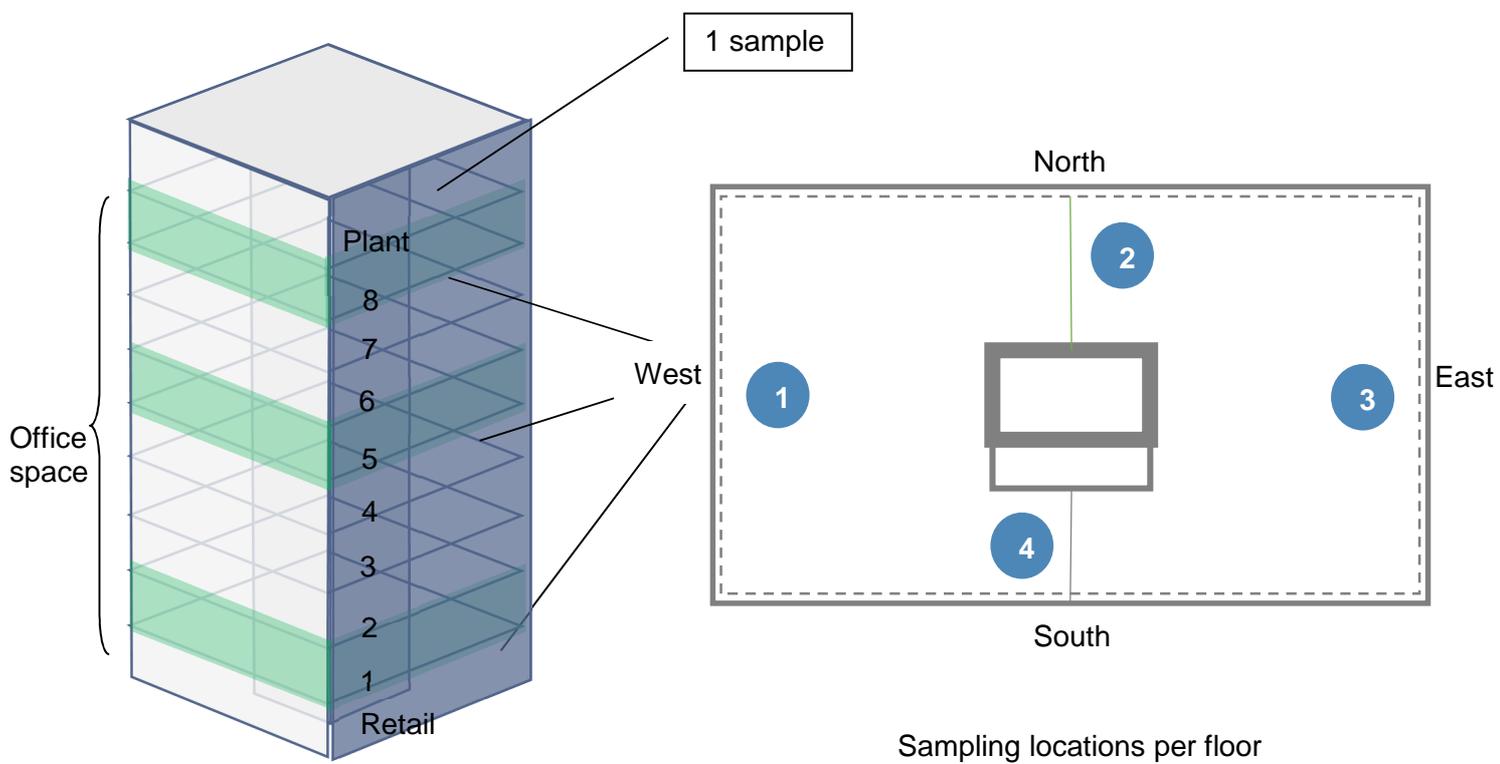
Figure 3: An example of the number of floors to sample and the sampling locations

Rating type: Base building

Total area of office space: 10,000 m²

Occupied office floors: 8

→ 3 floors to assess with 4 samples per floor, and 1 sample from the plant room.



7. About the indoor environment parameters

7.1 Thermal services

Rating type: Base building and whole building ratings

Attributes: Temperature, mean radiant temperature, air speed and relative humidity



Thermal services is directly linked to people's productivity and is very important for their comfort and wellbeing. People are highly sensitive to thermal comfort conditions, and while we know comfort levels vary depending on individual preferences, an international standard ASHRAE 55:2013 *Thermal Environmental Conditions for Human Occupancy* (ASHRAE 55) provides a well-accepted approach for determining 'comfort' ranges for temperature based on air speed, relative humidity, mean radiant temperature, clothing factors and metabolic rate.

Accommodating different ventilation systems

The NABERS IE tool takes into account the different types of ventilation systems used to regulate thermal comfort within office buildings: mechanical (i.e. air conditioning), mixed-mode and natural ventilation and assesses the level of comfort for both systems against the international standard ASHRAE 55.

Assessment

The thermal services quantitative assessment involves moment-in-time measurements taken during the site visit, and may (if available) include annual temperature data. If annual temperature data is not available the rating can still proceed, however, the annual temperature component will receive a zero score.

For whole building ratings, the Occupant Satisfaction Survey contributes 50% to the overall thermal services score.

The assessment data required for thermal services includes:

- ✓ air temperature
- ✓ relative humidity
- ✓ mean radiant temperature, and
- ✓ air speed.

Mechanically ventilated buildings (including mixed-mode buildings)

NABERS has adopted the international standard ASHRAE 55 to calculate the thermal services score for mechanically ventilated buildings using the well accepted 90% acceptability limits. To determine whether conditions are within the 90% acceptability limits recommended by ASHRAE 55, NABERS uses the Predicted Mean Value (PMV) model to assess the combined effect of temperature, mean radiant temperature air speed and humidity on occupant thermal comfort.

Naturally ventilated buildings

NABERS has adopted the international standard ASHRAE 55 to calculate the thermal services score for naturally ventilated buildings to determine whether conditions are within the 80% acceptability limits using the Adaptive Method model. The Adaptive Method model assesses the combined effect of temperature and mean radiant temperature on occupant thermal comfort with respect to the prevailing outdoor temperature conditions.

The Adaptive Method model assesses thermal comfort based on four variables: temperature, mean radiant temperature (MRT), air speed (if air speed is greater than 0.3m/s) and the outdoor air temperature.



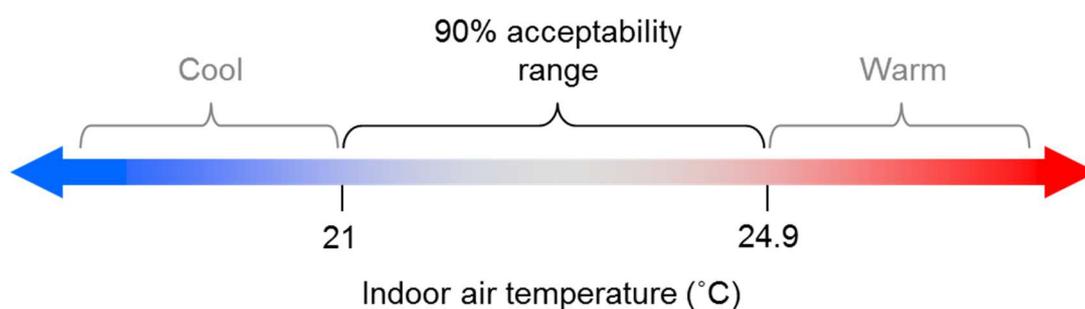
Air Temperature

Air temperature is a measure of how much cooling or warming you get from contact with the air. The air temperature in an office is affected by a number of variables such as the outdoor air temperature, number of occupants, size and use of the space, air conditioning and ventilation rates.

Comfortable range for annual temperature

For the assessment of the annual monitoring of temperature component, NABERS has adopted the international standard ASHRAE 55:2013 *Thermal Environmental Conditions for Human Occupancy*. Where only temperature is measured, based on the Australian office market, the PMV model prescribes a temperature limit band of 21 – 24.9°C in which 90% of the occupants will feel reasonably comfortable.

Figure 4: Indoor air temperature range that meets ASHRAE 55 90% acceptability limits



Some buildings may have lease conditions that specify specific thermal comfort conditions, particularly for temperature, which were previously used by a NABERS IE rating to assess performance against these conditions. However, to ensure consistency NABERS has adopted the internationally recognised ASHRAE methodology in order to provide a constant measure and comparison of building performance.

Improve your rating by taking measurements more frequently

To help improve your NABERS IE rating, collect annual temperature data. NABERS places more importance (weighting) on annual hourly temperature data as it provides greater confidence in the results, corresponding to a higher overall score for thermal services.

To account for situations like equipment failure, NABERS allows some flexibility in the collection of annual hourly temperature data and considers data that is 90% or more complete during the year as an annual data set.

NABERS also allows hourly temperature data to be included on a proportional basis based on the available data set to recognise potential issues or problems with equipment or data capture that may arise.



Mean Radiant Temperature

The mean radiant temperature (MRT) is a measure of how much cooling or warming you receive from the exchange of radiant heat to all the objects in the room where warm objects radiate heat toward cold ones. The mean radiant temperature is the average temperature of all the objects around a single point (e.g. a person sitting at their desk). For example, a window in direct sun will raise the mean radiant temperature an occupant experiences, while a window in the shade will lower the mean radiant temperature.

Sampling locations where the difference between the mean radiant temperature and the air temperature are minimised are likely to result in satisfactory conditions.

Air speed

It is important to ensure sufficient air flow to remove the build-up of carbon dioxide, odour and humidity created by occupants. The indoor conditions can become 'stuffy' or 'stale' when the air flow has been reduced as a result of a physical restriction, a poorly located office partition or poor diffuser design and setting. Alternatively, air flow rates may be too high in some areas, for example, to compensate for inadequate air flow in other parts of the office, subjecting selected occupants to draughts.

Draughts occur when the local air movement cools an occupant uncomfortably, and are the most common form of local thermal discomfort. The level of discomfort from draughts depends on the temperature, air velocity and the amount of fluctuation in the airflow. Occupants are particularly sensitive to draughts around their head and ankles.

Relative humidity

Relative humidity indicates the percentage of water vapour in the air compared with the vapour pressure of water when saturated at the same temperature.

Appropriate levels of relative humidity are important within an office environment. Where humidity is too low occupants can experience problems with static electricity, as well as dry eyes, nose, throat or skin. Excess humidity can cause fatigue, increase the rate of 'off-gassing' of VOCs and formaldehyde from building materials, and can create favourable conditions for the growth of micro-organisms.

The optimum humidity range for human comfort is within 35% to 65% relative humidity. A satisfactory range for relative humidity depends on your geographic location.



7.2 Air quality

Rating type: Base building, tenancy and whole building ratings

Attributes: Ventilation effectiveness, indoor pollutants



Indoor air quality is a major concern to building managers, tenants, and employees because it can impact the health, wellbeing, and productivity of building occupants. Research shows a strong relationship between good indoor air quality and people's performance at work.¹

Indoor air quality is not a simple, easily defined concept, but is a constantly changing interaction of complex factors that affect the types, levels, and importance of pollutants in the indoor environment. These factors include:

- ✓ sources of pollutants or odours
- ✓ design, maintenance and operation of building ventilation systems
- ✓ moisture and humidity (covered under thermal comfort, above); and
- ✓ occupant perceptions and susceptibilities.

In addition, there are many other factors that affect comfort or the perception of indoor air quality, for example stress or overcrowding in an office.

A NABERS IE rating considers the ventilation effectiveness and indoor pollutant levels as key variables in assessing the quality of the indoor air.

For tenancy and whole building, NABERS IE also uses an occupant satisfaction survey to assess how satisfied the building occupants are with their perceived indoor air quality and the impact that this has on their ability to undertake their work. Scores will be calculated based on how responses compare to other buildings. For example, if survey results for indoor air quality are better than 80% of buildings, the score obtained will be 80%.

¹ Wargocki, P, Wyon, D P, and Fanger, P O. 2000. Productivity is affected by the air quality in offices, Proceedings of Healthy Buildings 2000, Vol. 1, pp 635-640.

Improving air quality

Improving indoor air quality involves integrating three main strategies:

- ✓ managing the sources of pollutants, for example removing them from the office space or controlling the timing of their use
- ✓ diluting pollutants and removing them from the building through ventilation; and
- ✓ using filtration to remove pollutants from the air.

Ventilation effectiveness

The design, installation, maintenance and operation of the building's ventilation system are critical for occupant wellbeing. The ventilation system must be able to provide adequate outdoor air and to dilute and remove the indoor pollutants.

Approach

NABERS uses carbon dioxide as a proxy to measure the ventilation effectiveness based on the Australian Standard 1668.2:2012 *The use of ventilation and air conditioning in buildings* where the minimum ventilation rate should be no less than 10 L/s. Under NABERS this equates to a difference between measured indoor and outdoor carbon dioxide that is less than 400ppm. That is, if outdoor levels of carbon dioxide are found to be 350ppm, then indoor levels must remain below 750ppm. Scores are determined based on the percentage of locations at which these conditions are met. For example, if the ventilation conditions of AS 1668.2:2012 were met in 91% of locations sampled, which is better than 75% of Australian offices – the score achieved is 75%.

Carbon dioxide is typically generated from tenant activity, i.e. the occupant density. It is cleared away by ventilation from the base building systems. Therefore it is measured for all rating types.

It is measured relative to outdoor carbon dioxide levels, since indoor levels are also influenced heavily by the outdoor conditions at the time.

For a base building rating the measurements are taken near a supply air diffuser in tenanted office areas to assess the impact from the HVAC system, while for a tenancy and whole building rating the measurements are taken in the occupied space to assess the impact of tenant activities.



Indoor pollutants

Indoor pollutants are substances that when present in the ambient air reduce human comfort or health. They can increase the risk of illness and lower the productivity of building occupants. Pollutants can generally be grouped as gaseous pollutants, particulates and biological pollutants. Indoor pollutants can be generated from office occupants, furniture and equipment, or can originate from external sources, such as vehicle exhausts or bushfires.

A NABERS IE rating measures up to four key indoor pollutants:

- ✓ particulates (PM₁₀)
- ✓ formaldehyde
- ✓ total volatile organic compounds (TVOCs), and
- ✓ carbon monoxide.

The pollutants measured depend on which type of rating you are undertaking:

- Formaldehyde and TVOCs are measured only for tenancy and whole building ratings because they are the result of tenant activities and equipment or materials used.
- Carbon monoxide is measured only for base building and whole building ratings because it generally originates from external sources and depends on the building design and the location of the air intake ducts.

For the indoor pollutants measured under NABERS IE, the average concentration from all samples collected is compared to the Australian office benchmark to determine the relative performance against its peers. Standards are applied where relevant however, many standards, such as those from the World Health Organisation are based on outdoor levels and therefore not appropriate for use in comparing indoor levels in offices. As a result the benchmarks used for all indoor air pollutants are generally well below international health-based standards.

Real time measurements and laboratory analysis

To allow flexibility to measure TVOCs and formaldehyde whilst ensuring technical robustness, NABERS IE permits two quantitative methods: real-time monitoring using equipment that meet specific accuracy requirements and laboratory analysis. A laboratory assessment may provide more accurate results for use in more in-depth WHS assessments, while real-time monitoring can be conducted in a shorter time-frame and for reduced costs and still meet the NABERS accuracy requirements.



Types of indoor pollutants

Particulates PM₁₀

- Rating type: Base building, tenancy and whole building ratings.
- Measurement sites: Particulates (PM₁₀) are measured in the tenanted office spaces.
- Standard: The average PM₁₀ concentration from all samples collected is compared to the Australian office benchmark to determine the relative performance against its peers.

NABERS measures PM₁₀ levels, as this single measurement provides an indicator for even smaller particles that come from a range of indoor and outdoor sources, including mould, pollen, combustion sources, printers etc. They are controlled by the cleanliness of the tenant, the equipment installed, and also the filtering ability of the ventilation systems. High levels could indicate a range of things, including poor ventilation and filtration, inadequate source control or activities/equipment/material generating excessive quantities.

As indoor particulate levels are highly sensitive to external sources, measurements should be undertaken during 'normal' conditions. Avoid sampling during unusual events, such as bushfires or nearby construction, to ensure the NABERS IE rating reflects the building's normal functioning conditions.

Formaldehyde

- Rating type: Tenancy and whole building ratings.
- Measurement sites: Measurements are taken in the tenanted office spaces.
- Standard: The average Formaldehyde concentration is compared to the Australian office benchmark to determine the relative performance against its peers.

Formaldehyde is the result of tenant activities, equipment and materials used in the office fit-out. Office furniture products that use adhesives, resins and composite wood products are the most significant source of formaldehyde in an office indoor environment.

It is included in NABERS IE as it is a known carcinogen and exposure can cause irritation to the eyes, throat and nasal passages.



Total volatile organic compounds (TVOCs)

Rating type:	Tenancy and whole building ratings.
Measurement sites:	Measurements are taken in the tenanted office spaces.
Standard:	The average TVOC concentration is compared to the Australian office benchmark to determine the relative performance against its peers.

Total volatile organic compounds (TVOCs) are a combination of hundreds of organic chemical compounds, including formaldehyde, and are a result of tenant activities and equipment and materials used. They have varying toxicities. Where high TVOC readings are detected in an office, it is recommended that further sampling and investigation is undertaken to identify the individual VOCs present.

TVOCs are produced from cleaning agents, office equipment and furniture, particle boards, floor waxes and polishes, floor coatings, adhesives and paints. Interior wall paints can be a significant source of TVOCs in an office indoor environment, particularly as VOC emissions can continue even six months after application. As paints are often applied in occupied spaces, people are more likely to be exposed to vapours from freshly painted surfaces.

To reduce TVOC emissions, it is recommended that low VOC paint is used and low VOC materials, fittings and furnishings are chosen for any tenancy fit-out or refurbishment.

Carbon monoxide

Rating types:	Base building and whole building ratings.
Measurement sites:	Measurements are taken in the plant room at the outside air intake for the building.
Standard:	The average carbon monoxide concentration is compared to the Australian office building carbon monoxide benchmark to determine the relative performance against its peers.

Carbon monoxide is used in NABERS to measure the cleanliness and location of the building's air intake ducts. It is measured in the plant room at the outside air intake for the building to ensure the location is away from potential pollution sources, such as chimneys, roadways or loading docks.

As such carbon monoxide generally originates from external office sources, such as car exhausts, and can enter the building through poorly located air intake ducts or from car parks through lifts or stairwells. It can also be produced in an office building from combustion appliances, such as gas stoves.

Carbon monoxide is only used for base building and whole building ratings because a tenant will typically have no impact on these levels. Where there is no HVAC system in the building or systems are located on the roof of the building, the measurement is conducted outdoors in the vicinity of the air ingress points.



7.3 Acoustic comfort

Rating type: Base building, tenancy and whole building ratings



Attributes: Ambient sound levels

Acoustic conditions directly affect occupant satisfaction and productivity. One research study shows that over 50% of occupants in office cubicles think that noise levels interfere with their ability to get their job done.²

Acoustic comfort plays an important role in occupant satisfaction, wellbeing and productivity because noise can significantly distract office occupants. The main sources of noise in an office are due to low partition heights, ringing phones, noisy copy machines and office chatter.

Acoustic comfort is measured for all rating types because this is influenced by both the mechanical systems and façade insulation in the base building, as well as materials chosen and occupant behaviour in the tenancy.

Tips for reducing noise-related discomfort

- ✓ Locate fax machines, copiers and other noisy office equipment in a separate area surrounded by cubicle walls.
- ✓ Group people according to their key work tasks – e.g. front line customer service representatives who spend a lot of time on the phone should be located away from those who require quiet work spaces.
- ✓ Panel systems, carpeting and ceiling tiles that absorb sound and provide privacy can also help to control noise levels.

Base building ratings

Acoustic comfort is measured to assess how efficiently the building envelope isolates external noise and noise contributions from base building services, i.e. air conditioning. Measurements are undertaken in the space under normal working conditions excluding tenant noise – a vacant floor can be substituted for a tenanted floor to make this easier as long as the services provided by the base building, e.g. HVAC system, are operational.

As NABERS IE is a performance rating, the results are compared to the Australian base building acoustic comfort benchmark to determine the relative performance against its peers. For example, in an office building average sound levels were 38 dB, based on the Australian

² Jensen, K., and E. Arens. 2004. Acoustic Quality in Office Workstations, as Assessed by Occupant Surveys. Proceedings, Indoor Air 2005, Sept. 4-9, Beijing, China

base building acoustic comfort benchmark, this average level is better than 71% of offices - the score achieved is therefore 71%.

Tenancy and whole building ratings

Acoustic comfort is measured in the occupied space under normal working conditions, excluding intermittent non-standard spikes such as a loud group of people joking and laughing, someone shouting for attention, sirens or something being dropped or broken.

The following are examples of what may be considered to be a normal part of the work environment and should be included in the final readings:

- use of office equipment such as printers and photocopiers
- person-to-person or phone conversations held at normal speech levels
- typical street or external noises, such as trains or traffic, and
- doors opening and closing.

NABERS assesses acoustic comfort for whole building and tenancy ratings against the Australian Standard 2107:2000 *Acoustics* which recommends a noise range of 40-45 dB for office spaces. Noise levels in the tenancy are assessed against the 40-45 dB range and the final score is calculated based on the percentage of samples that meet these requirements compared to other office buildings. For example, the building met the ambient sound levels recommended by AS 2107:2000 in 52% of locations sampled which is better than 30% of offices when compared with the Australian benchmark – the score achieved, is therefore 30%.

The tenancy and whole building acoustic comfort criteria includes more than just sound level measurements, as acoustic satisfaction for occupants also requires speech privacy and comfortable sound levels. Acceptable speech privacy means a person cannot understand conversations overheard from other areas. If there were no ambient sound, overheard speech would be perfectly intelligible and very annoying because of its information content, unpredictability, and uncontrollability. A moderate level of ambient sound can cover speech sounds or any other intermittent noise, and thereby provide privacy to the speaker and prevent distraction to unwilling listeners. However, ambient sounds that are very loud become annoyances and should be kept within comfortable limits.

NABERS IE also uses an occupant satisfaction survey to assess acoustic satisfaction for occupants and the impact that this has on their ability to undertake their work. Scores are calculated based on how responses compare to other buildings. For example, if survey results for acoustics are better than 50% of buildings, the score obtained will be 50%.



7.4 Lighting



Rating type: Tenancy and whole building ratings

Attributes: Horizontal illuminance

Lighting that suits the work being performed is essential, to reduce energy wastage and ensure occupant wellbeing.

On average employees spend 8–10 hours every weekday in the office. Quality office lighting is necessary, as studies have shown that light and glare can impact people physically, physiologically and psychologically, affecting both productivity and general wellbeing.

Good office lighting that suits the requirements of the occupants can reduce the chances of eyestrain and headaches. There are many different kinds of office lighting, for example, overhead and wall lighting and table and floor lamps, which can be used depending on the type of work being performed by the office occupants. For architects who assess design drawings, for example, a desk light with manual controls is important.

Under NABERS, lighting is only measured for tenancy and whole building ratings because the base building has very little, if any, influence on the light levels.

The light level is measured in the horizontal plane within the office space and compared against Australian Standard 1680.2:2008 *Interior and workplace lighting*. Scores are calculated based on the percentage of the samples that meet the horizontal light requirements of the standard, compared to other office buildings. For example, if a tenancy met the horizontal light recommended by AS 1680.2:2008 in 62% of locations sampled, which is better than 44% of offices when compared with the Australian benchmark – the score achieved is 44%.

NABERS IE also uses an occupant satisfaction survey to assess how satisfied the building occupants are with the amount of light and visual comfort of the occupied space and the impact that this has on their ability to undertake their work. Scores will be calculated based on how responses compare to other buildings. For example, if survey results for lighting are better than 80% of buildings, the score obtained will be 80%.

This information can assist in identifying the causes of any lighting dissatisfaction, for example from lighting glare or flickering lights.

7.5 Office layout

Rating type: Tenancy and whole building ratings

Your office layout can significantly impact staff productivity. Layout attributes that influence perceived level of comfort include the spatial arrangements of walls, partitions, furniture and equipment in relation to fixed elements like windows or heating, ventilation and air conditioning outlets.



As the office layout is difficult to quantitatively measure, the data used in the NABERS IE rating is based on the results from the occupant satisfaction survey.

The results from the occupant satisfaction survey provide information on the level of satisfaction with the general office layout.

Scores are calculated based on how the responses compare to other buildings. For example, if results for office layout are better than 50% of buildings, the score obtained will be 50%.

Tips for improving your office layout

- ✓ Use ergonomic furniture and accessories, proper lighting, and a functional design to minimise discomfort and distraction and to help your employees work more productively.
- ✓ Encourage employees to customise their workstations with accessories that help them work comfortably — keyboard trays, anti-glare screens, task lighting and footrests — and to adjust their chairs to the proper height and angle.
- ✓ Take a look at where employees sit and the location of office equipment, and consider ways to improve the overall flow of your office. Put printers, fax machines and other shared equipment in areas that are easy to access, and seat work teams or departments together in shared areas or cubicles. Try to open spaces and align desks so it's easy to move around the office.
- ✓ Adjustable and mobile furniture is a good option for growing businesses with limited space; you can reconfigure cubicles and workstations and rearrange your office to accommodate growth, partition departments, or separate equipment areas and other noisy parts of the office.

8. Identifying and addressing potential issues

It is important that occupants and building managers establish and maintain a good working relationship so that any issues that arise are well understood and solutions are easy to implement.

The Property Council of Australia's (PCA) Guideline *Managing Indoor Environment Quality* is a useful supporting document that provides an overview of how to manage and address potential maintenance and design problems relating to the quality of the indoor environment in office buildings.

The PCA recommends:

- using good building design and layout to avoid, for example, the obstruction of air outlets, excessive occupant densities or poor zoning of equipment or activities
- ensuring proper system commissioning to avoid future indoor environment problems
- ensuring good operation and management of the HVAC system
- controlling pollutants by preventing their entry into the building, diluting and flushing pollutants using the ventilation system and removing or replacing pollutant sources
- ensuring good cleaning methods and procedures remove dust and other pollutants and minimise the introduction of pollutants through cleaning products or pest control
- maintaining high standards in management practices – keeping log books and maintenance records up to date, and recording, managing and acting on complaints appropriately, and
- establishing and maintaining good communication between tenants and building management to support an effective working relationship.

For more information visit www.propertyoz.com.au.



9. Acknowledgements

Thank you to all the people involved in developing the NABERS Indoor Environment for offices rating tool.

The development of the tool would not have been possible without the assistance from the Technical Working Group members. A special thank you goes to these Technical Working Group members:

Adam Garnys	CETEC Pty Ltd
Bruce Precious	The GPT Group
Chris Horan	QED Environmental Services
Christhina Candido	Sydney University
Christopher Chuah	ISPT Pty Ltd
Claire Bird	Viridis E3 Pty Ltd
Claire Pomroy	Arup
Gary Whatling	Jones Lang LaSalle
Haico Schepers	Arup
Joseph Scholz	QED Environmental Services
Jonathan Dalton	Viridis E3 Pty Ltd
Jungsoo Kim	Sydney University
Kate McAlpine	Sydney Airport Corporation Limited
Leena Thomas	University of Technology, Sydney
Richard de Dear	Sydney University
Shaun Condon	Investa Property Group
Vyt Garnys	CETEC Pty Ltd

Members as at October 2015.

Thank you also to the team members at the NSW Office of Environment and Heritage (OEH) who managed the project.

10. Glossary

Acoustic comfort	A person's psychological state of mind about the general level of noise in their office surroundings under normal working conditions, excluding intermittent non-standard spikes. Acoustic comfort is measured for NABERS IE in order to determine how well a building minimises external noise, such as traffic, and how well it deals with controlling internal noise.
Air speed	An attribute of thermal comfort and is measured for NABERS IE because it provides an indication of the effectiveness of the building's ventilation system.
Air temperature	A measure of how much cooling or warming you get from contact with the air. The air temperature in an office is affected by a number of variables such as the outdoor air temperature, number of occupants, size and use of the space, air conditioning and ventilation rates.
Carbon dioxide	A colourless, odourless gas. It is a normal constituent that is present in the atmosphere at 330-350 ppm. Carbon dioxide is measured for NABERS Indoor Environment because the concentration of carbon dioxide within an office building provides an indication of the effectiveness of the building's ventilation system.
Carbon monoxide	A colourless, odourless, toxic gas that is the product of incomplete combustion. It is measured for NABERS IE because it gives an indication of whether air intakes are located in the right position and whether there is adequate ventilation in office areas.
Formaldehyde	A colourless gaseous compound that can be found in combustion sources and used in pressed wood products such as particle board and medium density fibreboard (MDF) and certain textiles, foams and glues.
Indoor air quality	A broad term used to describe the pollutants which are present within the indoor environment. There are a number of indoor pollutants which can be measured to determine the overall indoor environment quality. These pollutants include: carbon dioxide, carbon monoxide, particulates, formaldehyde and total volatile organic compounds (TVOCs).
Indoor environment quality (IEQ)	The quality of a building's environment in relation to the health and wellbeing of those who occupy space within it. IEQ is determined by many factors, including the layout of the space, lighting, air quality, thermal conditions and noise levels.
Lighting	The method or equipment used to provide illumination – which can be artificial or natural or a combination of both. Lighting is measured in lux.
Lux	A standard unit for measuring light levels. The amount of light per square metre, incident on a surface.
Mean radiant temperature	Is a measure of how much cooling or warming you get from the exchange of radiant heat to all the objects in the room. It is the average temperature of all the objects around you.
Mechanical and mixed-mode buildings	A building with mechanical HVAC has heating, cooling and air provided by systems installed in the building – usually powered by electricity or natural gas. Mixed-mode buildings use both mechanical HVAC and natural ventilation and cooling systems.

Naturally ventilated buildings	A building where there is no mechanical cooling and no forced ventilation is considered to be a naturally ventilated building.
Occupant satisfaction survey	A prescribed NABERS survey that measures how well building services and design features are working and focuses on the needs of the occupants to optimise employee productivity and effectiveness.
Office layout	The office design or office arrangement plan and includes fixed walls, partitions, windows and doors as well as locations of equipment and HVAC outlets.
Particulates (PM ₁₀)	Solid or liquid matter with aerodynamic diameters ranging from 0.05 to 100 µm. Particulates are measured for NABERS IE in order to determine whether outdoor air intakes are transporting contaminants into the indoor office environment and to identify whether adequate cleaning and maintenance of air intakes is occurring.
Relative humidity	A measure of the amount of water vapour contained in the air at a particular temperature. Relative humidity provides an indication of the effectiveness of the HVAC system and humidifiers in removing any condensation that has the potential to cause equipment malfunction and impact on the health and wellbeing of employees.
Total volatile organic compounds (TVOCs)	Carbon-containing compounds that easily go from a solid to a gaseous form at normal temperatures. Sources in an office include paints, paint strippers, and other solvents; wood preservatives; aerosol sprays; cleansers and disinfectants; moth repellents and air fresheners.
Thermal services	A person's psychological state of mind about their thermal environment, i.e. whether they are feeling comfortable with the temperature level in their office space
Ventilation rate	The amount of outside air that is supplied to the interior space.



NABERS is a national initiative managed by the New South Wales Government

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