

# Quality of Indoor Air

## Aim of Credit

To recognise projects that provide high air quality to occupants.

## Credit Criteria

1	<b>Ventilation system attributes</b>	<p>1 point is awarded where:</p> <ul style="list-style-type: none"> <li>• The entry of outdoor pollutants is mitigated; <b>AND</b></li> <li>• The system is designed for ease of maintenance and cleaning; <b>AND</b></li> <li>• The system has been cleaned prior to occupation and use.</li> </ul>
2	<b>Provision of Outside Air</b>	<p>2 points are awarded where the nominated area is provided with sufficient outside air to ensure levels of indoor pollutants are maintained at acceptable levels.</p> <p>For mechanically ventilated or mixed-mode spaces:</p> <ul style="list-style-type: none"> <li>• 1 point is awarded where outside air is provided at a rate 50% greater than that required in AS1668.2:2012 or CO<sub>2</sub> concentrations are maintained below 800ppm.</li> </ul> <p>2 points are awarded where outside air is provided at a rate 100% greater than that required in AS1668.2:2012 or CO<sub>2</sub> concentrations are maintained below 700ppm</p> <p>For naturally ventilated spaces:</p> <ul style="list-style-type: none"> <li>• 2 points are awarded where the requirements of AS1668.4-2012 are met.</li> </ul>
3	<b>Exhaust or Elimination of Pollutants</b>	<p>1 point is awarded where the nominated pollutants, such as those arising from printing equipment, cooking processes and equipment and vehicle exhaust, are limited by either removing the source of pollutants from the nominated area, or exhausting the pollutants directly to the outside of the project while limiting their entry into other areas.</p>

## Compliance Requirements

### 1. Ventilation system attributes

#### Entry of outdoor pollutants

To consider this credit criterion met the entry of outdoor air pollutants to the space must be minimised. This may be demonstrated by Option A – Prescriptive Method or Option B – Performance Method described in the table below. A combination of methods is acceptable for multiple spaces.

<u>Option A – Prescriptive Method</u>	The entry of outdoor pollutants through the ventilation system (through all outdoor air intakes) must be minimised by locating them away from specific potential outdoor contaminants and designing them to minimise the entry of pollutants. Both the design and location must be in accordance with a recognised standard (Refer to Guidance).
<u>Option B – Performance Method</u>	An analytical model shows that an equivalent or lesser rate of introduction of outdoor air contaminants will be attained to that of the option above. This can be done through better filtration methods, or other air cleaning systems. The method for demonstrating this is the case is described in ASHRAE Standard 62.1, Appendix F.

The following requirements for maintenance and cleaning apply to all new and existing ductwork that serves the building. If no ductwork exists, these requirements are assumed to be met.

#### Designed for ease of maintenance and cleaning

For this criterion to be met, any mechanical ventilation system within the building, whether existing or new, must be designed to provide adequate maintenance access to both sides of all moisture and debris-catching components within the air distribution system.

#### Cleaning prior to use and occupation

All new and existing ductwork that serves the building has been cleaned in accordance with recognised standards. See Guidance section for a list of recognised standards.

Where construction management processes (see the credit 'Construction Environmental Management') are in place to ensure that all new ductwork, or ductwork that has been recently cleaned, remains free of moisture and debris until occupation, this ductwork can be considered to be clean. All other ductwork (existing and new) including plenums, filters and fan chambers must be cleaned in accordance with the relevant standard.

## **2. Provision of Outside Air**

#### Nominated area

For purposes of this credit criterion, the nominated area includes all primary and secondary spaces. A space can be excluded if the use of the space (for example, a laboratory) justifies specific ventilation conditions.

#### Options for demonstrating compliance

To consider this criterion met, the nominated area must be provided with a quantity of fresh air appropriate for the activities and conditions in the space. Each space must comply with one of the following:

	Compliance Requirements
<u>Option A</u> Comparison to Australian Standard	Outside air is provided at a rate greater than that required in AS1668.2:2012, or an alternative recognised standard, to each space in the nominated area. To demonstrate compliance, the HVAC system must be clearly sized to accommodate the increased outside air rates for the occupants in the space. The project must use the design occupancy where known. If there is ever any discrepancy in outside air rates once design occupancies are applied, the default figures outlined in the standard take precedent.

<p><u>Option B</u> Performance based approach</p>	<p>The system must be capable of providing enough outside air to maintain carbon dioxide levels at, or less than, the stipulated thresholds (refer to Credit Criteria) within each space in the nominated area for the design occupancy.</p> <p>The GBCA notes that the ppm benchmark is a proxy for a percentage increase in outside air levels and they are not necessarily equivalent. Two options are provided for flexibility.</p> <p>The system must continuously measure the concentration of carbon dioxide within the breathing zone during occupancy hours within each space. The system must then adjust the amount of outside air to each space up to the maximum (design) outside air quantity until the carbon dioxide levels return below the ppm threshold.</p> <p><u>Zoning the system</u> Locate CO<sub>2</sub> sensors such that they provide accurate representative readings of the CO<sub>2</sub> concentrations in occupied spaces. Multiple CO<sub>2</sub> monitoring stations throughout a space provides better information and control than a single sensor, but may not be able to identify under-ventilated areas within a building.</p> <p>In an open space, a sensor should be located to ensure that all areas in the space are well served. In a large space, a single sensor is unlikely to be sufficient. The zoning and monitoring of the system should ensure that carbon dioxide levels spatial variation is minimised. For smaller spaces, a single sensor may suffice. At a minimum, CO<sub>2</sub> sensors should be located with and/or as regularly as temperature sensors.</p> <p>A sensor must be located within each enclosed space. However, a single sensor may activate a ventilation system that serves multiple rooms.</p> <p><u>Modifying the air quality threshold</u> The nominated CO<sub>2</sub> thresholds are applicable to most spaces. If a project wishes to nominate a higher threshold, the project is required to submit a CIR justifying why the space should have a higher threshold. The justification must be accompanied with documentation from a recognised standard or peer reviewed research.</p>
<p><u>Option C</u> Natural Ventilation</p>	<p>To consider this criterion met, the space in the nominated area must be provided with good amounts of fresh air appropriate for the activities and conditions in the space.</p> <p>Where natural ventilation is present, the space must meet the requirements of AS1668.4-2012. If mechanical ventilation other than ceiling fans is present then the space cannot be considered naturally ventilated.</p> <p>Projects must also be justified how the space will perform as a naturally ventilated space under adverse weather conditions and extremes in hot and cold weather.</p>

The systems provided must not rely on its operation or adjustment by the facility management to achieve desired performance, i.e. the credit will only be awarded for fixed building attributes.

### 3. Exhaust or Elimination of pollutants

For each pollutant source, including printing and photocopy equipment, cooking processes and equipment and vehicle exhaust, the project must demonstrate that one of the below three methods has been used to reduce exposure to the pollutant source. Each method lists how the common pollutant source can be addressed.

For spaces with no pollutant sources	No sources of pollutants, such as printing or photocopy equipment, kitchen stoves or vehicles, are present within the building.																																		
For spaces that contain printing and/or photocopying equipment	<p>All printing or photocopy equipment located throughout the project is certified in accordance with one of the following test methodologies: ECMA-328, RAL-UZ 122 or GGPS.003. The test certificate must state the emission limits detailed in the standard have been met.</p> <p>Test certificate for printing equipment is the means to evidence compliance, certificates must be issued by a NATA or ISO 17025 accredited laboratories. Relevant limits are as follows:</p> <table border="1"> <thead> <tr> <th rowspan="2">Substance</th> <th colspan="2">Emission rate Print phase (mg/h)</th> <th colspan="2">Emission rate Ready phase (mg/h).</th> </tr> <tr> <th>Colour Printing Total in ready + print phase</th> <th>Monochrome printing Total in ready + print phase</th> <th>Desktop products</th> <th>Floor- mounted equipment</th> </tr> </thead> <tbody> <tr> <td>TVOC</td> <td>18</td> <td>10</td> <td>1</td> <td>2</td> </tr> <tr> <td>Benzene</td> <td>&lt; 0.05</td> <td>&lt; 0.05</td> <td></td> <td></td> </tr> <tr> <td>Styrene</td> <td>1.8</td> <td>1</td> <td></td> <td></td> </tr> <tr> <td>Ozone</td> <td>3.0</td> <td>1.5</td> <td></td> <td></td> </tr> <tr> <td>Dust</td> <td>4.0</td> <td>4.0</td> <td></td> <td></td> </tr> </tbody> </table>	Substance	Emission rate Print phase (mg/h)		Emission rate Ready phase (mg/h).		Colour Printing Total in ready + print phase	Monochrome printing Total in ready + print phase	Desktop products	Floor- mounted equipment	TVOC	18	10	1	2	Benzene	< 0.05	< 0.05			Styrene	1.8	1			Ozone	3.0	1.5			Dust	4.0	4.0		
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For spaces that are affected by all other pollutant sources	<p>Any sources of pollutants are located in such a way that:</p> <ul style="list-style-type: none"> <li>The pollutant source is exhausted directly to the outside of the project in accordance with a recognised standard; and/or</li> <li>Occupants are physically separated from the pollutant source.</li> </ul>																																		

#### For printing and photocopy equipment

All print and photocopy equipment is located in an enclosed print/photocopy area(s) that is exhausted directly to the outside, or to a dedicated exhaust riser. The exhaust riser must not recycle air to other building enclosures or to the return air duct of the ventilation system.

All enclosed print/photocopy rooms must achieve a minimum exhaust ventilation flow rate of 0.35 L/s/m<sup>2</sup> in accordance with AS 1668.2-2012 (Table B1 of Appendix B). Where supply air is being provided to an enclosed photocopier/print room, the air exhausted via the dedicated exhaust riser must be at least 10% greater than that being supplied, as per AS1668.2-2012.

To be deemed enclosed, the photocopy room must have full-height partitions on all sides and with a maximum opening of 1.2 meters wide x 2.2 meters high. For rooms with openings larger than that which is specified, CFD modelling can be used to demonstrate

that under normal conditions, the room exhaust is capable of ventilating the chemicals from the print or photocopier without the pollutants entering the adjacent space.

Print or photocopy cupboards can be shown to comply with this credit. Evidence, including modelling or a smoke trace test demonstrating that the entire open face of the cupboard is being extracted at a rate of 5 L/s/m<sup>2</sup> (Floor Area Enclosure) or higher, as per AS 1668.2-2012 must be presented.

It is a requirement of this credit that the exhaust facility is a dedicated exhaust facility and that air exhausted cannot be recycled to other enclosures. The fans must be installed as part of the base building; provision for future installation (e.g. by a tenant) does not meet the credit criteria. The project must demonstrate compliance regardless of delivery as a shell and core or integrated fitout project.

#### For cooking processes and equipment

All kitchens are to be ventilated in accordance with AS1668.2-2012. A separate exhaust system must be provided for the kitchen exhaust. The kitchen must be physically separated from the adjacent spaces or have an opening no larger than an area of 2.5m<sup>2</sup>. A 'kitchen' is defined as a space that includes cooking equipment such as stove tops or ovens. Kitchenettes or tea points with basic tea/coffee making or simple reheat equipment is not included.

Residential kitchens are not required to be physically separated, but must utilise a non-recirculating exhaust or, where recirculating, utilises filtration shown to effectively remove pollutants to maintain indoor air quality.

#### For vehicle exhaust

This requirement is applicable where a combustion engine based vehicle (of all types) is parked or otherwise operated in an enclosed area which is within the project area. Examples include a fire station, an aircraft hanger, a mechanics shop or a warehouse using forklifts

All pollutants from vehicles in an enclosed space are exhausted to a dedicated exhaust riser or to the outside in accordance with section 4 of AS1668.2-2012. This exhaust system must not recycle air to other enclosures.

In addition to the exhaust system, the space where the vehicle is located must be physically separated from the rest of the project (a door will suffice).

## **Guidance**

### **Standards noted in this credit**

Standards for the 'Ventilation System Attributes' criterion include:

AIRAH HVAC 2010 Hygiene Best Practice Guideline.

ASHRAE Standard 62.1-2013, Section 5

ACR 2006 Assessment, Cleaning and Restoration of HVAC Systems

SMACNA IAQ Guidelines for Occupied Buildings under Construction

Standards for the 'Provision of Outside Air' criterion include:

AS1668.2 Supp 1-2002 The use of ventilation and air-conditioning in buildings - ventilation design for indoor contaminant control (supplement to AS1668.2-2002).

AS1668.2 - 2012 The use of ventilation and air-conditioning in buildings - Mechanical Ventilation in buildings.

AS1668.4 - 2012 The use of ventilation and air-conditioning in buildings - Natural Ventilation of buildings.

ASHRAE Standard 62.1-2013

Standards for the 'Exhaust or Elimination of Pollutants' criteria include:

AS1668.2 Supp 1-2002 The use of ventilation and air-conditioning in buildings - ventilation design for indoor contaminant control (supplement to AS1668.2-2002).

AS1668.2 - 2012 The use of ventilation and air-conditioning in buildings - Mechanical Ventilation in buildings.

AS1668.4 - 2012 The use of ventilation and air-conditioning in buildings - Natural Ventilation of buildings.

RAL-UZ 122 Office Equipment with Printing Function (Printers, Copiers, Multifunction Devices) May 2009.

ECMA-328 Determination of Chemical Emission Rates from Electronic Equipment.

GGPS.003 Greenguard Indoor air Quality (IAQ) Standard for Office Equipment (Hardcopy Devices).

## References

American Society of Heating, Refrigerating and Air-conditioning Engineers (ASHRAE) (2007), ASHRAE Standard 62.1: Ventilation for Acceptable Indoor Air Quality, Atlanta, [www.ashrae.org](http://www.ashrae.org)

Corney, A. (2007), Refresh – Demystifying Health and Productivity Benefits of HVAC, Lincolne Scott Pty Ltd and Advanced Environmental, [www.lincolnescott.com/Refresh1/](http://www.lincolnescott.com/Refresh1/)

Der Bluer Engel, Office Equipment with Printing Function (Printers, Copiers, Multifunction Devices), RAL-UZ 122, <http://www.blauer-engel.de>.

GreenGuard (2010), GreenGuard Indoor Air Quality Standard for Office Equipment, [www.greenguard.org](http://www.greenguard.org).

Washington State Department of Health (2003), School Indoor Air Quality: Best Management Practices Manual, Washington, [www.doh.wa.gov/ehp/ts/IAQ/schooliaqbmp.pdf](http://www.doh.wa.gov/ehp/ts/IAQ/schooliaqbmp.pdf)

Laurence Berkeley National Laboratory – Indoor Environment Department <http://energy.lbl.gov/IED/viaq/viaq.html>

## Definitions

**Debris-generating components** - Cooling coils, heating coils, humidifiers and filters.

**Outdoor Air Intakes** - Windows, doors, openings, vents, grilles, and skylights are all considered air intakes for purposes of this credit and must be modelled taking into account their free area.

**Ductwork that serves the building** - All ductwork within the building that directly serves it, whether new or existing. This includes all ductwork in the base building that serves the building from the air handling unit to the supply vents.

**Mechanically ventilated spaces** - Spaces that rely on mechanical equipment, such as chillers and fans, to provide conditioned or unconditioned air for ventilation. Ceiling fans, for purposes of Green Star, are not considered to be mechanical ventilation.

**Naturally ventilated spaces** - Spaces that provide ventilation through passive means or openings in the facade that do not rely on any mechanical equipment, other than ceiling fans, to provide increased levels of thermal comfort and ventilation.

**Primary mode of ventilation** - The ventilation system that is expected to operate for at least 70% of occupied hours. If this threshold is not met, the space is considered to have two primary modes of ventilation.

**Tertiary space** - All areas which are either transient spaces, or accessed intermittently. Examples of these areas include: back of house areas, corridors, hallways, plant rooms, storage facilities, or similar.

**Occupancy** - Occupancy rates must be as per the design occupancy. Where the occupant density is unknown, projects must utilise the occupancy rates prescribed within Table A1 Appendix A of AS-1668.2.

**'Standard hours of occupancy'** is defined as 50 hours a week or the building's design occupancy.

**Cooking processes and equipment** - Commercial or institutional cooking equipment. For more definition, see section 5.3.1 of AS1668.2. As mentioned in the standard, microwave cookers and other small cooking appliance for reheating food do not need to comply with this credit.

# Documentation Requirements

## 'Design Review' Submission (Optional)

Project teams are to submit information / documentation marked with an asterisks\* for 'design review'

## As Built Submission

All project teams are to submit the following documentation:

### Submission Template\*

- A description of the buildings ventilation systems\*
- Nominated areas \*
- Occupancy hours\*
- A description of how air intakes are located away from specific potential outdoor contaminants and are designed to minimise the entry of pollutants to occupied spaces in accordance with a recognised standard.
- Confirmation if the space is naturally ventilated\*
- A description of how the system was designed for ease of maintenance and cleaning \*
- Where the 'Provision of Outside Air' criterion is claimed:\*
  - Description of the system in place, occupancy rates, and how each space is provided with sufficient outside air; and
  - Description of any modelling (if relevant) to ensure the CO<sub>2</sub> level threshold is maintained.
- Where the 'Exhaust or Elimination of Pollutants' criterion is claimed:\*
  - Describing the attributes of the ventilation system which are designed to exhaust relevant pollutant sources.

Project Teams are required to provide documentation supporting credit compliance. The following documents may be used to demonstrate compliance:

- **Mechanical As-Built drawings** for each ventilated space
- **Extract from the ventilation system specification** for each system, the project's commissioning requirements are stated in accordance with the relevant codes/guideline. The relevant sections must be highlighted
- **Extracts the Environmental Management Plan** that specify ventilation cleaning
- **Summary Report** of the ventilation system model demonstrating that criterion targets have been met
- **Extract from the Commissioning Report** demonstrating that the HVAC and CO<sub>2</sub> monitoring systems are operating as intended. For naturally ventilated areas, this is only relevant where automation systems and the like are included.
- **Extract from the printing and photocopy specification** outlining the product certification criteria for all printing or photocopy equipment located throughout the project.
- **Certificates for printing equipment** to ACMA 328, RAL-UZ 122 or GGPS.003 for all printing equipment which is included in the fitout.



Please provide feedback on the technical content of this credit:

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