



DISCUSSION PAPER

REVISION OF AS 1668.2-2002

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EXECUTIVE SUMMARY

This paper summarises the issues surrounding the proposed revision of AS 1668.2-2002 *The use of ventilation and airconditioning in buildings Part 2: Ventilation design for indoor air contaminant control (excluding requirements for the health aspects of tobacco smoke exposure)*.

Both the Australian Building Codes Board and Standards Australia have committed to resolving the issues surrounding AS 1668.2-2002 and AIRAH has offered to facilitate these discussions. This discussion paper is intended to identify the issues and provide a recommended way forward.

Several core issues need to be resolved so that the revised standard can be referenced in the National Construction Code BCA Volume One.

The core issues are:

- Indoor smoking and the associated environmental tobacco smoke (ETS) air contaminants should be excluded from the revised standard.
- The natural ventilation design provisions of Section 3 of AS 1668.2-2002 should be made informative (non-mandatory) in the revised standard with the mandatory deemed to satisfy requirements for natural ventilation remaining within the BCA. (For consistency, this might also be applied to the natural ventilation for carparks)
- Minimum outdoor air ventilation rates of AS 1668.2-2002 should be revisited and revised with a clear direction being provided to the subcommittee in respect to the project outcomes.
- Minimum (mandatory) outdoor air ventilation rates specified in the standard should represent minimum standards nominated to achieve the listed functional statements and performance requirements of the BCA.

1. Introduction

1.1. Purpose

This Discussion Paper has been prepared as a first step in the revision of AS 1668.2-2002. The purpose of this Paper is to identify the issues associated with the revision of the standard to scope potential solutions, and to recommend a way forward.

Comments on this Discussion Paper are sought from all stakeholders including:

- ABCB
- BCC
- Standards Australia

Currently there are two editions of AS 1668.2 available. AS 1668.2-1991 which is referenced in the Deemed to Satisfy provisions of Building Code of Australia (BCA Volume One) and AS 1668.2-2002 which is not referenced in the BCA. The existence of two different versions of the standard can cause difficulties with design and compliance.

The Australian Building Codes board (ABCB), Standards Australia and AIRAH have made a commitment to working through all outstanding issues to ensure that any revised AS 1668.2 standard will meet the needs of all stakeholders.

Ultimately the purpose of this paper is to encourage early resolution of key technical and administrative barriers to the referencing of a revised AS 1668.2 Standard within the National Construction Code BCA (Volume One). Many of the conclusions and recommendations outlined in this discussion paper have been informed by discussions with ABCB, SA, AIRAH and technical committee ME-062-02 committee members.

1.1. History

Since its introduction, the 1996 edition of the Building Code of Australia (BCA96) has referenced AS 1668.2-1991. In 2002, Standards Australia published a new edition titled AS 1668 *The use of ventilation and airconditioning in buildings, Part 2 Ventilation design for indoor air contaminant control* (AS 1668.2-2002). However, AS 1668.2-2002 has not been referenced in the BCA (volume one) which continues to reference the 1991 edition.

1.2. Need

This discussion paper is needed to highlight the specific issues, associated with the revision of AS 1668.2-2002, that need to be addressed prior to commencing the revision project to help ensure a broad consensus on the final outcome.

This paper is one tool that can help Standards Australia, Australian Building Codes Board, Building Codes Committee, AIRAH and other industry stakeholders better understand these issues and agree a way forward so that the revised standard can meet the needs of all stakeholders.

This paper and the responses to it will provide guidance for ABCB/BCC and members of Standards Australia technical committee ME-062-02 on the direction and content of the proposed revision to AS1668.2-2002.

1.3. Associated issues

The associated issues that need to be addressed are:

- Outstanding concerns and objections raised by ABCB/BCC to AS 1668.2-2002.
- Additional technical issues that may need to be addressed in the revision project.
- The most appropriate method or pathway to create a revised standard.

Once the issues highlighted in this paper are resolved a clear direction to the Standards Australia technical committee responsible for the standard can be provided, particularly regarding the expectations of building regulators for a new edition of AS 1668.2 that can be referenced within the DTS requirements of the BCA (Volume One).

Once the revised standard is referenced the 1991 and 2002 versions can be withdrawn which will remove the confusion in industry around this topic.

2. Address outstanding concerns raised by the ABCB/BCC

2.1. AS 1668.2-2002 not a BCA Reference

Any amendment to the BCA, including those that reference updated Standards, needs the support of representatives from industry and all levels of Government (Commonwealth, State/Territory and Local). In this instance, the inclusion of AS 1668.2-2002 within the BCA has not been supported.

There are a number of reasons for this, ranging from policy issues to technical considerations. The main reasons identified by the ABCB when AS 1668.2-2002 was initially promulgated were;

- Natural ventilation
- Environmental Tobacco Smoke
- Minimum ventilation rates

Each of these are considered core issues and are addressed separately as follows.

2.2. Natural ventilation

2.2.1. Background

Historically, AS 1668.2-1991 has focused on mechanical ventilation, but AS 1668.2-2002 also includes design provisions for the natural ventilation of building and enclosures.

Different natural ventilation requirements have been specified in the Standard to those that are used in the BCA. Currently, for natural ventilation, the BCA requires openings to be 5% of the floor area of the subject room. This is irrespective of the use of the room. AS 1668.2-2002 similarly requires natural ventilation openings to be based on % of floor area however a range of values, from 2.5% to 15%, is specified depending on the level of activity (metabolic rate) and the density of occupants within the space. In both cases natural ventilation openings include permanent openings, windows, doors or other devices which can be opened for ventilation benefit.

The design approach of AS 1668.2-2002 for natural ventilation is consistent with the design of mechanical ventilation systems where the minimum required outdoor air rate is based on the number of occupants and the classification of the space. The traditional 5% rule is retained for Class 1, 2 and 4 buildings and for any building where substantial crossflow ventilation is provided. A copy of section 3 on natural ventilation is provided in Appendix A.

2.2.2. The problem

Some State/Territory Building Control Administrations consider there is insufficient justification for the change to require natural ventilation rates to be based on metabolic rates of occupants and occupant density. They have also expressed concern about the general industry's ability to deal with the complexity of the natural ventilation requirements of AS 1668.2-2002.

In addition, a regulatory impact assessment would need to be carried out prior to the BCA mandating the AS 1668.2 requirements. As some buildings would require greater ventilation openings and some less the impact of these requirements across the range of buildings that the standard is applied to may be difficult to accurately assess.



It should be noted however that some stakeholders within the building industry do reference the natural ventilation design provisions of AS 1668.2-2002. Notably the Green Building Council of Australia who reference the natural ventilation design methodology of AS 1668.2-2002 within the Green Star rating system for commercial building design. The Property Council of Australia has also expressed support for the methodology, although not in terms of mandatory building regulations.

2.2.3. The solution

The proposed solution for this issue is to retain the design provisions for natural ventilation within the revised AS1668.2 standard but as an informative section rather than a mandatory requirement.

Deemed to satisfy design requirements for natural ventilation would remain within the Building Code of Australia, refer F4.6 and F4.7. The informative design methodology of AS 1668.2 would then still be available for use by industry either as requirements that exceed BCA minimum standards or as a performance based design alternative.

Recommendation: That the design provisions for the natural ventilation of buildings contained within Section 3 of AS 1668.2 be recast as informative material with the deemed to satisfy requirements remaining within the BCA (Volume One).

2.3. Environmental Tobacco Smoke (ETS)

2.3.1. Background

AS 1668.2-1991 included allowances for smoking or ETS as an indoor contaminant, built into the minimum required outdoor air ventilation rates specified for general areas. In addition some areas or types of occupancies including bars, cocktail lounges and smoking rooms were specified with higher ventilation rates (20L/s per occupant) where “intensive smoking” was expected.

AS 1668.2-2002 also included allowances for smoking or ETS as an indoor contaminant although these were removed from the general ventilation rates and were added on for areas where smoking is not prohibited. In general the 2002 standard requires 10-15 L/s of outdoor air per occupant for a defined smoking rate of 1 cigarette/hour per person. Where a higher rate of smoking is anticipated this minimum rate is required to be multiplied by the expected number of cigarettes/hour per person.

In 1991 and in 2002 smoking in the type of buildings regulated by BCA Volume One was not uncommon. In particular the hospitality sector including bars, clubs, pubs, hotels and restaurants were grappling with this issue. In 2011 smoking in these buildings is generally prohibited by legislation.

2.3.2. The problem

AS 1668.2-2002 specifically states that it does not address the health aspects of exposure to environmental tobacco smoke (ETS). AS 1668.2-2002 enables designs of buildings where smoking is permitted and where smoking is prohibited. The ventilation rates specified in AS 1668.2-2002 for buildings where smoking has been prohibited is generally less than those for buildings where smoking is not prohibited. This can depend on the other polluting activities occurring within the building.



On advice from their health authorities, a number of State/Territory Building Control Administrations have objected to these provisions in AS 1668.2-2002 which could be construed as permitting smoking in buildings.

2.3.3. The solution

State and Territory legislation determines whether smoking is permitted, or not, in various buildings. Not all buildings types have restrictions on smoking and each State and Territory have different requirements.

Current State and Territory legislation has effectively banned smoking in the types of buildings covered by BCA Volume One.

The proposed solution to resolve this issue is to remove all reference to smoking and environmental tobacco smoke from the revised AS 1668.2 standard. Where buildings in which smoking is not prohibited are required to be mechanically ventilated they will then fall outside the scope of the revised AS 1668.2 standard. These buildings would then need to be dealt with on a case by case basis.

It is noted that there would be very few building which fall under the scope of AS 1668.2/BCA Volume One and in which smoking is not prohibited. In a large part these would be residential type buildings which are typically naturally ventilated in any case. There is currently no distinction made between smoking permitted or smoking prohibited areas in the BCA deemed to satisfy requirements for the natural ventilation of rooms.

Recommendation: That the design provisions within AS 1668.2 for dealing with environmental tobacco smoke as an indoor air contaminant should be removed from the standard.

2.4. Minimum outdoor air ventilation rates

2.4.1. Background

The primary purpose of the AS 1668.2 standard is to set minimum requirements for the ventilation of buildings. One of the tools used by the standard to achieve this is to specify a minimum flow rate of outdoor air that needs to be introduced into a building or space to maintain acceptable indoor air quality. The intention is to safeguard occupants from illness or loss of amenity due to lack of air freshness within rooms or buildings. The level or concentration of indoor air contaminants are diluted or reduced by the introduction of clean fresh outdoor air, the removal of stale contaminated indoor air and air filtration.

AS 1668.1-1991 specified a range of minimum outdoor airflow rates depending on the type of occupancy (refer Table A1). These rates generally ranged from 10 to 15 L/s per person (moderate smoking) for most occupancies and 20 to 25 L/s per person where higher than normal smoking rates were anticipated. In addition the standard includes a calculation mechanism for reducing minimum outdoor airflow rates to 7.5L/s per person by the application of particulate filters (depending on rated efficiency) and further reductions down to 2.5 L/s per person by the application of particulate and odour/gas filters again depending on the efficiency of the filtration system. The ventilation system designer is responsible for deciding the appropriate engineering design solution (ventilation rate versus air cleaning system) for particular areas and circumstances.

AS 1668.2-2002 also specifies a range of minimum outdoor airflow rates depending on the type of occupancy (refer Table 4.2). These rates generally range from 5 to 25 L/s per person depending on



the use of the enclosure, the temperature of the enclosure (more odours at higher temperature) and the type of ventilation system (single or multiple enclosure served). In addition an engineered approach is included which can be applied to reduce the minimum outdoor airflow rate down to 3.5 L/s per person depending on a range of factors including additional air cleaning, unused air within recirculation streams, transfer air from other adjoining areas and the like.

This means a reduction in minimum outdoor airflow rates in some circumstances from the 1991 requirement. This apparent reduction in minimum outdoor air quantities is justified by the AS 1668.2 technical committee under the following terms:

- These 2002 rates did not include a “built-in” allowance for smoking or ETS (recognising that smoking was not permitted in many building at the time).
- The 2002 Standard introduced a mandatory requirement for particulate filtration of the air in many circumstances. This helps to clean the incoming and recirculating air and remove indoor air contaminants. Less dilution is then required for the less contaminated indoor air.
- Concerns raised by industry regarding the practicality and energy use implications of the 1991 minimum outdoor airflow rates.
- Alignment with regional and international standards which were typically specifying lower minimum outdoor airflow rates than in the past.

2.4.2. The problem

Although AS1668.2 1991 generally specified 10 litres/second per occupant as a starting point, it allowed minimum ventilation rates as low as 2.5 litres / second per occupant. AS 1668.2-2002 allows a range of ventilation rates below 10 litres/second per occupant down to a minimum of 3.5 litres / second per occupant. Some State/Territory Building Control Administrations have been advised by their health authorities that this is inconsistent with international practice and as a consequence, were unable to support the use of the new ventilation rates. A number of State and Territory Authorities have concerns as to the options expressed in the 2002 edition of AS 1668.2 which remain unresolved.

2.4.3. The solution

The specification of minimum outdoor airflow rates remains the primary responsibility of the Standards Australia technical committee.

However some direction needs to be provided to the committee regarding the intended outcomes of the AS 1668.2 revision project. The BCA is intended to represent minimum standards nominated to achieve the listed functional statements and performance requirements. Standards referenced in the BCA need to provide clear instructions addressing requirements to safeguard occupants from illness or loss of amenity. These minimum standards are not intended to represent industry best practice or to achieve optimum performance regarding comfort or productivity

The AS 1668.2-2002 standard includes a mechanism or methodology for specifying varying grades of ventilation amenity termed the “Dilution Index”. A higher dilution index represents a better class of ventilation.

There are several options that can be considered to resolve this issue.

Option 1 – Standards Australia technical committee specifies the rates - AS 1668.2 contains a clear and mandatory requirement for minimum outdoor airflow rates for all buildings within the standard.



However, the debate regarding the appropriate rate could be protracted without clear direction being provided and the end result may not be acceptable to the ABCB/BCC.

Option 2 – ABCB/BCC specifies the rates - The BCA specifies mandatory requirements for minimum outdoor airflow rates by specifying Dilution indices, calculated in accordance with the standard, for all buildings. However, ABCB/BCC may not be willing or have the expertise to specify minimum rates for all circumstances.

Option 3 - ABCB/BCC directs Standards Australia technical committee to specify minimum outdoor airflow rates for all buildings within the standard but with clear direction that the rates need to reflect minimum standards nominated to achieve the listed BCA functional statements and performance requirements not industry best practice to achieve optimum performance regarding comfort or productivity. Minimum ventilation rates should be revisited and revised:

- 1) Using AS 1668.2-1991 ventilation rates as the starting point for discussion.
- 2) Recognising that smoking and ETS will be excluded from the standard.
- 3) Recognising the air cleaning benefits of the mandatory filtration requirements of the standard
- 4) Based on minimum standards for health and amenity rather than best practice for comfort and productivity.
- 5) Recognising that a mechanism exists within the Standard for authorities (with jurisdiction) to specify higher ventilation requirements in particular circumstances or as required.

This option would allow the Dilution Index (DI) methodology to be retained to allow other users or industry stakeholders such as GBCA, PCA or indeed occupational or environmental health interests to specify a higher requirement than the BCA minimum in particular circumstances as appropriate.

Recommendation: Option 3 is the recommended option, with clear direction being provided by ABCB/BCC on the required outcomes of the AS1668.2 revision project.

3. Additional areas to be addressed in the revision project

3.1. Background

Standards Australia technical committee ME-062-02 held a meeting on 27 May 2009 to discuss the proposed revision to AS 1668.2-2002.

During the course of that meeting several issues emerged regarding areas that need to be focused on during the revision, these are in addition to the core ABCB issues discussed in section 2 of this discussion paper.

3.2. Specific issues

The following items have been highlighted for review and potential amendment/inclusion in any revise AS 1668.2.

3.2.1. General

- 1) Change title to “Ventilation of buildings”.
- 2) Correct all typographical errors that have been identified within the published 2002 document.

3.2.2. Energy efficiency

Revisit the requirements of the standard from an energy efficiency perspective. Can the standard be amended to improve or promote energy efficient ventilation practices?

Consider any potential conflict or unnecessary overlap with the BCA Section J energy efficiency provisions.

3.2.3. Exhausts

- 1) Simplify and clarify the classification of exhausts.
- 2) Consider expansion of the exhaust classification scheme.
- 3) Consider technical possibilities for odour filtration of exhaust airflows; test requirements and the potential effect on requirements for exhaust discharge point location.
- 4) Revisit the design methodology for kitchen exhaust hoods in consideration of methodology used by Gaylord.
- 5) Consider the impact of the use of lighter cooking oils on the requirements for kitchen exhaust ventilation and in particular grease filtration.
- 6) Cooking smells in commercial and residential multiple occupancies are a high profile current issue. Examine the issue including odour control technology and ventilation requirements.
- 7) Revisit minimum requirements for exhaust ventilation of laundry areas in light of current technologies (clothes driers typically exceed current specified requirement).
- 8) Clarify the interpretation/misinterpretation of Clause 5.8.2 on make-up air.

3.2.4. Recirculation

Consider ASHRAE system of classification of air to see if the concept could be applied in AS 1668.2.

3.2.5. Minimum airflow rates

- 1) Reconsider the minimum L/s.m² base rate for area based ventilation calculations in light of developments regarding off-gassing of materials and the potential application of “low gas” alternatives.
- 2) Revisit specified mandatory minimum filter efficiencies, including health considerations.
- 3) Consider if different system arrangements (e.g. recirculating or dedicated OA) require different filter specifications.

3.2.6. Supply ventilation

- 1) Revisit Dilution Index calculation methodology and its presentation within the standard to determine if it can be simplified or made more accessible to industry practitioners.
- 2) Revisit the 12 Pa pressure drop limit on make-up air grilles
- 3) Examine ventilation and non-ventilation of corridors and other small or non-permanently occupied spaces. Consider the classification of such spaces to assist with appropriate ventilation design.

3.2.7. Carparks

- 1) Update requirements to reflect the improvement in fleet average emissions.
- 2) Research emissions associated with E10 and other new fuels and impact on ventilation requirements.
- 3) Revisit natural ventilation requirements for carparks in light of the above.
- 4) Revisit mechanical ventilation requirements for carparks in light of the above.
- 5) Revisit ventilation and monitoring requirements for diesel engines, including bio diesel fuels.
- 6) Address differences between CO monitoring requirements of AS1668.2 and BCA Section J.
- 7) Revisit stack parking requirements for small residential carparks.

3.2.8. Jet fans

Consider the use of “jet fan” approaches to carpark ventilation and other ventilation systems.

3.2.9. Task ventilation

Consider the inclusion of specific design requirements for personally controlled “task ventilation” systems.

3.2.10. Demand controlled ventilation

Consider the inclusion of specific design requirements or additional guidance on the application of demand controlled ventilation where it is applied as a ventilation control strategy.

3.3. Full technical review

Because AS 1668.2-2002 is now nearly 10 years old it is appropriate for a full technical review of the standard to be completed and for industry consultation on the revision proposal to be carried out in accordance with normal Standards Australia standards review practices.

Recommendation: The issues outlined in 3.2 should be included in any review or revision of the AS 1668.2 standard.

4. Type of revision project

4.1. Managing the revision project

This project has been approved by Standards Australia management as suitable for the Standards Australia Resourced development pathway. This pathway provides Standards Australia's resources, project management expertise and infrastructure. Standards Australia Resourced projects require commitment and active contribution from stakeholders over a defined period of time.

The two main issues to consider from a project management perspective are the project timeline (or time to market) and the best method of ensuring a consensus outcome and industry relevant and accepted standard.

There are several options as to how the revision of AS 1668.2 could be approached.

4.2. Options

4.2.1. Option 1

Limit the revision project to the areas that need to be addressed to meet ABCB/BCC acceptance (refer section 2) and publish the adjusted standard as a new edition.

This option would be the quickest to market but would be unable to address several deficiencies that have been identified (refer section 3) or provide for appropriate industry consultation and feedback.

4.2.2. Option 2

Commence the revision project by outlining the objections and concerns of the ABCB/BCC and trust in the normal committee driven standards development process to address all issues.

This option does not provide a guarantee that the ultimate objectives of the revision project would be met, i.e. that the content of the revised standard would be acceptable for BCA referencing.

4.2.3. Option 3

Commence the revision project with strong guidance provided to the Standards Australia technical committee ME-062-02 on the areas that need to be addressed to meet ABCB/BCC acceptance and then proceed with a normal committee review process to address the other issues (refer section 3) identified. Ensure active involvement in the project by key industry stakeholders including ABCB, AIRAH, AMCA, CIBSE, Environmental health interests and the like.

This option will require a longer development time but does provide the most likely path for all project objectives to be met.

4.3. Recommended option

Option 3 is the recommended option.

Strong guidance should be provided by SA/ABCB as to the expectations associated with the revision project. Consultation with ABCB/BCC and other industry stakeholders should be commenced prior to the project to ensure that the scope of the revision project and expected outcomes are well understood at the beginning of the project.



Given that AS 1668.2-2002 is reaching its 10 year review period it is appropriate that the full standard is subject to the normal revision and review process. This could be facilitated by AIRAH and kindred organisations formally or informally surveying their members on industry expectations for the revision project.

Recommendation: Option 3 is the recommended option.

4.4. Next steps

Once agreed this discussion paper should be issued by ABCB to its BCC stakeholders to solicit comment and feedback and attempt to define or agree a way forward for the revision of this important standard.

In parallel a conversation should be commenced within the design and construction community regarding industry expectations for a revised AS 1668.2.

Once an appropriate approach to the three outstanding ABCB/BCC issues (natural ventilation, ETS, minimum outdoor air rates) has been agreed this should be communicated to the Standards Australia Technical committee ME-062.

The project should then proceed in line with normal Standards Australia development procedures.

ABCB should nominate a representative to the ME-062-02 committee.

Health interests should also nominate a representative to the ME-062-02 committee.



Appendix A

Attached Extract AS 1668.2-2002 Section 3

Attached Extract AS 1668.2-1991 Table A1

Attached Extract AS 1668.2-2002 Table 4.2