# BCA Part J5 Insulation Report

AMCA Interpretation of Specification J5.2 & J5.4

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#### **Executive Summary**

This report clarifies an interpretation of the application of insulation requirements nominated in Part J5 of BCA 2008 as applied to air conditioning systems. The BCA insulation requirements are referenced as follows:

#### J5.2 Air-conditioning and ventilation systems

- (a) An *air-conditioning* unit or system must—
  - (ii) have any supply and return ductwork insulated and sealed in accordance with <u>Specification</u> <u>J5.2</u>; and

#### J5.4 Heating and chilling systems

(a) Systems that provide heating or chilling for *air-conditioning* systems must—

(i) have any *piping*, vessels, heat exchangers or tanks containing heated or chilled fluid, other than those with insulation levels covered by Minimum Energy Performance Standards (MEPS), insulated in accordance with <u>Specification J5.4</u>; and

This report is only an AMCA interpretation for 'Deemed to Satisfy' compliance with the above requirements. Acceptance from the building certifier must be sought before adopting the recommendations noted in the report.



### **Table of Contents**

1.1	Introduction	4
1.2	Specification J5.2 - Ductwork Insulation and Sealing	5
1.2.1 1.2.2	Ductwork Sealing Ductwork Insulation	5 7
1.3	Specification J5.4 - Insulating Of Piping, Vessels, Heat Exchangers and Tanks	16
1.3.1	Insulation	16
1.4	Appendices	22
1.4.1 1.4.2 1.4.3 1.4.4	Appendix A – Insulation Suppliers Technical Data. Appendix B – R-Value Calculations Appendix C - BCA 2008 Climate Zone Maps Appendix D – Pipe Heat Loss Calculations	22 23 24 25



#### 1.1 Introduction

This report has been written in response to concerns of AMCA members on how to conform to the insulation requirements of the BCA Section J. Section J affects all parts of our businesses from quoting projects, tendering work to sub contractors, producing drawings to constructing projects and certifying compliance to Section J. BCA Section J came into effect in BCA 2006 for Class 5 to 9 buildings. All buildings that have had a Construction Approval based on BCA 2006 onwards must comply with the requirements of Section J.

On 9 October 2007, the AMCA members called a meeting at the AMCA NSW Office to discuss compliance with BCA Section J. Out of this meeting it was decided to form a working group to interpret the BCA Specification J5.2 *Ductwork Insulation and Sealing* and Specification J5.4 *Insulating of Piping, Vessels, Heat Exchangers and Tanks*. This report is dedicated to these two specifications, as the insulation of ductwork and piping are a significant cost risk on all mechanical services projects. This report is the result of this working group's findings.

This report is a consensus position of AMCA members on the Deemed to Satisfy (DTS) interpretation of the BCA 2008 Thermal insulation requirements. It is intended that this report be read in conjunction with the BCA 2008. The report directly quotes BCA 2008 and then makes AMCA comments and interpretations on these Clauses. A series of different mechanical services installation scenarios have been produced as drawings to help illustrate the wide range of effects Section J has on our industry. Where a contractor deviates from the DTS interpretations in this report they must undertake an Alternative Solution to meet the performance requirements as detailed in Clause A0.8 of BCA 2008.

The Appendices of this report contain useful reference material. Appendix A contains the Bradford Enviroduct catalogue, Fletchers Insulation Catalogue, Bradflo Flexible duct information. Appendix B contains calculations by Younis Tehfe of Triple M on R values for duct and pipe insulation. These calculations are used to verify the R values in the report. The R-values are calculated are not based solely on a function of insulation thickness. There are other layers (e.g. air film) included in the calculations. Appendix C contains a copy of the BCA 2008 Climate Zone Maps. Appendix D contains calculations by Younis Tehfe of Triple M on heat loss through pipes with varying insulation thicknesses.

This report was prepared for AMCA by the BCA Working Group; Shane Durkin of Hastie Australia, Younis Tehfe of Triple M and Flavian Vallance of Frigrite. The report and its drawings remain copyright of AMCA NSW.

#### Disclaimer:

While every effort has been made to ensure that the information in this report is true, accurate and correct, the AMCA does not accept any responsibility or liability for any loss incurred as a result of using the interpretations of the BCA 2008 contained in this report. It is up to each mechanical contractor and individuals to make their own interpretations of the BCA 2008. All interpretations are subject to the Building Certifier agreeing with the interpretations for the final certification of the building.

BCA 2008 is extensively quoted in this report however readers should always ensure they are referring directly to the current version of the BCA.



#### 1.2.1 Ductwork Sealing

In clause 2 of Specification J5.2 of BCA 2008 states:

(a) Heating or cooling ductwork and fittings must be sealed against air loss-

(i) by closing all openings in the surface, joints and seams of ductwork with adhesives, mastics, sealants or gaskets in accordance with the duct sealing requirements of AS 4254 for the static pressure in the system; or

AMCA Comment: Whilst in clause (a) the BCA specifies "must be sealed", clause 2.2.1 of AS 4254 refers to Table 2.2.1 and this is based on static pressure classification with a foot note which states "NOTE: Below 500Pa, ductwork is to be sealed only where required by the designer." Also clause 2.2.5 of AS 4254 states "Leakage is a function of static pressure....The amount of leakage in a system is....related to the system size. Air tightness in ducts cannot and need not be absolute, but ducts must be sufficiently airtight to ensure economical and quiet operation of the system."

Since the majority of ductwork distribution systems run at below 500Pa, duct sealing is to comply with Table 2.2.1 of AS 4254 Seal Class C which only requires the transverse joints to be sealed.



- (a) Heating or cooling ductwork and fittings must be sealed against air loss-
  - (ii) for flexible ductwork at an operating static pressure of less than 500 Pa, with a sealant and draw band encased with adhesive tape.

AMCA Comment: AS 4254-1995 specifies in Clause 2.2.3 that adhesive tapes can be used as sealing media. It also specifies in clause 2.8.4 to seal flexible duct with 50mm wide tape. Based on this, adhesive tape can be used as the sealant for compliance with the above clause. Please refer to the sketch below for compliance requirements:



In clause 2 of Specification J5.2 of BCA 2008 states:

(b) The requirements of (a) do not apply to ductwork and fittings located within the last conditioned space served.

AMCA Comment: The interpretation of the 'last conditioned space' is the last controlled space. The last controlled space is a zone or area controlled by a thermostat / temperature sensor. Refer to the drawings AMCA-BCA-1 and AMCA-BCA-5 later in this report for further clarification. It should be noted that where an area is subject to future fitout, the 'last conditioned space' may change its size and location. The project team will need to assess this for their particular project, and where doubt exists this clause should be ignored and compliance with the requirements of (a) sought.



#### 1.2.2 Ductwork Insulation

In clause 3 of Specification J5.2 of BCA 2008 states:

(a) Ductwork and fittings for heating or cooling must be thermally insulated with insulation complying with AS/NZS 4859.1 to—

(i) achieve the *Total R-Value* specified in <u>Tables 3a</u> and <u>3b</u>; or

*AMCA Comment:* Tables 3a and 3b require the local government area of a particular project to be known to determine the Climate Zone and insulation requirements applicable to that project. Please refer to BCA 2008 Climate Zone Maps in the appendices to determine the applicable climate zone for your project.

Below are extracts from the BCA 2008 Climate Zone Maps showing the major urban areas.





In Table 3a of Specification J5.2 of BCA 2008 states:

## Table 3a DUCTWORK AND FITTINGS—MINIMUM TOTAL R-VALUE (for systems of no more than 65 $kW_r$ and 65 $kW_{heating}$ capacity)

Minimum <u>Total R-Value</u> for ductwork and fittings in						in each <u><i>climate zone</i></u>		
Ductwork element	Evaporative cooling system	Heating-only system or Combin refrigerated cooling-only system refrigerate			Combined he refrigerated co	heating and cooling system		
	All <u>climate zones</u>	1, 3, 4, 6 and 7	2 and 5	8	1, 3, 4, 6 and 7	2 and 5	8	
Ductwork	0.6	1.0	1.0	1.5	1.5 (see note)	1.0	1.5	
Fittings	Fittings 0.4							
Note: The minimum Total R-Value required may be reduced by R0.5 for combined beating and refrigerated cooling systems in								

- climate zones 1, 3, 4, 6 and 7 if the ducts are-
- (a) under a suspended floor with an enclosed perimeter; or

(b) in a roof space that has insulation of not less than R0.5 directly beneath the roofing.

AMCA Comment: Table 3a is used where the cooling or heating capacity of air handling unit, air conditioning unit or fan coil unit that the ductwork and fittings are associated with is no more than 65kW.

*AMCA Comment*: Fittings are defined by the AMCA as elements that contain and direct the movement of air including, bends, branches, transitions, reducers, offsets, spigots, single damper blades and push pull dampers.

AS1668.2-1991 specifies in Clause 1.4.2 the definition of air handling plant. Items such as variable air volume boxes, electric duct heaters, motorised and manual volume control dampers and access panels are interpreted to be air handling plant (therefore they are not fittings) and are excluded from the insulation requirements above.

Below are examples for Table 3a for typical scenarios. Note that certification of the R value must always be sought from the insulation supplier/contractor on a project by project basis to confirm compliance before proceeding with installation.





In Table 3b of Specification J5.2 of BCA 2008 states:

## Table 3b DUCTWORK AND FITTINGS - MINIMUM TOTAL R-VALUE (For systems greater than 65 kW<sub>r</sub> and 65 kW<sub>heating</sub> capacity)

	Minimum <u>Total R-Value</u> for ductwork and fittings in each <u>climate zone</u>			in	
Location of ductwork and fittings	Evaporative cooling system	Heating system or refrigera cooling system		ted	
	All <u>climate zones</u>	1, 3 and 4	2 and 5	6 and 7	8
Within a <u>conditioned space</u> other than where the space is the only or last space served.	Nil	1.0	1.0	1.3	1.5
All other locations	0.9	1.8 (see note)	1.5	1.8	2.0

Note:

The minimum <u>Total R-Value required</u> may be reduced by R0.5 for heating system or refrigerated cooling system ductwork and fittings in all other locations in <u>climate zones</u> 1, 3 and 4 if the ducts are—

(a) under a suspended floor with an enclosed perimeter; or

(b) in a roof space that has insulation of not less than R0.5 directly beneath the roofing.

AMCA Comment: Table 3b is used where the cooling or heating capacity of an air handling unit, air conditioning unit or fan coil unit that the ductwork and fittings are associated with is more than 65kW.

The AMCA interpretation of the conditioned space includes the ceiling void above the ceiling where the plenum is used to convey return air back to the air conditioning plant. Refer to the following drawings for further clarification of the conditioned space.

*AMCA Comment*: Fittings are defined by the AMCA as elements that contain and direct the movement of air including, bends, branches, transitions, reducers, offsets, spigots, single damper blades and push pull dampers.

AS1668.2-1991 specifies in Clause 1.4.2 the definition of air handling plant. Items such as variable air volume boxes, electric duct heaters, motorised and manual volume control dampers and access panels are interpreted to be air handling plant (therefore they are not fittings) and are excluded from the insulation requirements above.

Following are examples for Table 3b for typical scenarios. Note that certification of the R value must always be sought from the insulation supplier/contractor on a project by project basis to confirm compliance before proceeding with installation.











In clause 3 of Specification J5.2 of BCA 2008 also states:

- (a) Ductwork and fittings for heating or cooling must be thermally insulated with insulation complying with AS/NZS 4859.1 to—
  - (ii) for flexible ductwork of not more than 3 m in length from an outlet or the like, achieve a minimum <u>Total R-</u> <u>Value</u> of 1.0.

AMCA Comment: Refer to the sketch below for an interpretation of the requirements of the above clause



(b) Insulation on ductwork conveying cold air must be protected by-

- (i) a vapour barrier on the outside of the insulation; and
- (ii) where the vapour barrier is a membrane, overlapping adjoining sheets of the membrane by 50 mm and bonding or taping the sheets together.

AMCA Comment: The above clause is specific with respect to its compliance requirement.

(c) Ductwork insulation must-

(i) be protected against the effects of weather and sunlight; and

AMCA Comment: The above clause is specific with respect to its compliance requirement.

- (c) Ductwork insulation must—
  - (ii) abut adjoining insulation to form a continuous barrier; and
  - (iii) be installed so that it maintains its position and thickness, other than at flanges and supports.

*AMCA Comment*. The use of internal insulation in ductwork achieves compliance with the above clause 3 (c) (ii) based on the understanding that the requirement is not required at flanges as per clause 3 (c) (iii).

In clause 3 of Specification J5.2 of BCA 2008 also states:

(d) The requirements of (a) do not apply to-

(i) heating and cooling ductwork and fittings located within the last *conditioned space* served; and

AMCA Comment: AMCA Comment: The interpretation of the 'last conditioned space' is the last controlled space. The last controlled space is a zone or area controlled by a thermostat / temperature sensor. Refer to the drawings AMCA-BCA-1 and AMCA-BCA-5 later in this report for further clarification. It should be noted that where an area is subject to future fitout, the 'last conditioned space' may change its size and location. The project team will need to assess this for their particular project, and where doubt exists this clause should be ignored and compliance with the requirements of (a) sought.

(d) The requirements of (a) do not apply to-

(ii) air registers, diffusers, outlets, grilles and flexible fan connections.

AMCA Comment: A cushion/plenum box provided with an air register, diffuser, outlet or grille is deemed by the AMCA to be part of the air register, diffuser, outlet or grille. Thus, the requirements of clause 2(a) are not applicable to the cushion/plenum box.



## 1.3 Specification J5.4 - Insulating Of Piping, Vessels, Heat Exchangers and Tanks

#### 1.3.1 Insulation

In clause 2 of Specification J5.4 of BCA 2008 states:

(a) Insulation must—

(i) be protected against the effects of weather and sunlight; and

(ii) be able to withstand the temperatures within the *piping*; and

AMCA Comment: The above clause is specific with respect to its compliance requirement.

(a) Insulation must-

(iii) for *piping*, achieve the *<u>Total R-Value</u>* in <u>Table 2</u>; and

*AMCA Comment:* Table 2 requires the local government area of a particular project to be known to determine the Climate Zone and insulation requirements applicable to that project. Please refer to BCA 2008 Climate Zone Maps in the appendices to determine the applicable climate zone for your project.



Specification J5.4 - Insulating Of Piping, Vessels, Heat Exchangers and Tanks

In Table 2 of Specification J5.4 of BCA 2008 states: (Climate Zone 8 omitted for clarity)

Location			Minimum <u>Total R-Value</u> for eac <u>climate zone</u>	
			1, 2, 3 and 5	4, 6 and 7
1.	Hea	nting water <i>piping</i> for systems of no more than 65 k	W <sub>heating</sub> capacity	
	(a)	Located internally	0.2	0.2
	(b)	Located within a wall space, an enclosed sub-floor area or an enclosed roof space	0.3	0.45
	(c)	Located outside the building or in an unenclosed sub-floor area or an unenclosed roof space	0.3	0.6
2.	Hea	iting water <i>piping</i> for systems of more than 65 kW <sub>he</sub>	eating capacity	
	(a)	Located internally	0.5	0.6
	(b)	Located within a wall space, an enclosed sub-floor area or an enclosed roof space	0.6	0.7
	(c)	Located outside the building or in an unenclosed sub-floor area or an unenclosed roof space	0.7	0.8
3.	Coo cap	ling water <u>piping</u> for systems of more than 65 kW c acity	apacity but less th	an 250 kW <sub>r</sub>
	(a)	Located internally	1.0	0.9
	(b)	Located within a wall space, an enclosed sub-floor area or an enclosed roof space	1.1	1.0
	(c)	Located outside the building or in an unenclosed sub-floor area or an unenclosed roof space	1.2	1.1
۱.	Coo	ling water <u>piping</u> for systems of more than 250 kW <sub>r</sub>	capacity	
	(a)	Located internally	1.5	1.2
	(b)	Located within a wall space, an enclosed sub-floor area or an enclosed roof space	1.6	1.3
	(c)	Located outside the building or in an unenclosed sub-floor area or an unenclosed roof space	1.8	1.4
	te:			

AMCA Comment: Table 2 has three location categories for pipework and is interpreted as follows:

Located internally – Where the pipework is internal to the building, but subject to temperatures of a conditioned space it does not serve.

Located within a wall space, an enclosed sub-floor area or an enclosed roof space - Where the pipework is internal to the building, but subject to temperatures of an unconditioned space.

Located outside the building or in an unenclosed sub-floor area or an unenclosed roof space - Where the pipework is outside the building or exposed to direct sunlight.



Specification J5.4 - Insulating Of Piping, Vessels, Heat Exchangers and Tanks

The following tables are a guide to insulation thickness for compliance with Table 2 of Specification J5.4. Please refer to the appendices for further information. Certification of the R value must always be sought from the insulation supplier/contractor on a project by project basis to confirm compliance before proceeding with installation.

		Location	Insulation thickness for each <u>climate zone</u>		
			1, 2, 3 and 5	4, 6 and 7	
1.	He	ating water <i>piping</i> for systems of no more than 65 kW	heating capacity		
	(a)	Located internally	25mm	25mm	
	(b)	Located within a wall space, an enclosed sub-floor area or an enclosed roof space	25mm	25mm	
	(c)	Located outside the building or in an unenclosed sub-floor area or an unenclosed roof space	25mm	25mm	
2.	He	ating water <i>piping</i> for systems of more than 65 kW <sub>heat</sub>	<sub>ing</sub> capacity		
	(a)	Located internally	25mm	25mm	
	(b)	Located within a wall space, an enclosed sub-floor area or an enclosed roof space	25mm	25mm	
	(c)	Located outside the building or in an unenclosed sub-floor area or an unenclosed roof space	25mm	25mm	

Table AMCA-2 – Suggested Insulation Thickness for Compliance – Polystyrene SPI

		Location	Insulation thickness for each <u>climate zone</u>		
			1, 2, 3 and 5	4, 6 and 7	
3.	Cooling water <i>piping</i> for systems of more than 65 kW capacity but less than 250 kW <sub>r</sub> capacity				
	(a)	Located internally	38mm*	38mm*	
	(b)	Located within a wall space, an enclosed sub-floor area or an enclosed roof space	38mm*	38mm*	
	(c)	Located outside the building or in an unenclosed sub-floor area or an unenclosed roof space	50mm	38mm	
4.	Со	oling water <u>piping</u> for systems of more than 250 kW <sub>r</sub>	capacity		
	(a)	Located internally	63mm*	50mm*	
	(b)	Located within a wall space, an enclosed sub-floor area or an enclosed roof space	63mm*	50mm*	
	(c)	Located outside the building or in an unenclosed sub-floor area or an unenclosed roof space	75mm	50mm	

AMCA Comment: The AMCA recommends large pipe (DN100 and above) is to follow the table above with respect to recommended insulation thickness. Where a (\*) symbol is noted in the table above, small pipe (less than DN100) could be insulated to industry standard as listed in Table ACMA-3. Small pipes present significant difficulties in applying 63 and 50mm insulation with a negligible difference in heat loss and energy efficiency benefit. Refer to Appendix D for details of the calculations behind the use of Table AMCA-3.



AMCA BCA Part J5 Insulation Report Specification J5.4 - Insulating Of Piping, Vessels, Heat Exchangers and Tanks

Pipe Size	Suggested Insulation Thickness for Chilled Water Pipework – Climate Zone 5 (mm)	Suggested Insulation Thickness for Chilled Water Pipework – Climate Zone 6 (mm)
DN200 and above	63	50
DN150	63	50
DN125	63	50
DN100	63	50
DN80	38 (Accepted Industry Standard)	38 (Accepted Industry Standard)
DN65	38 (Accepted Industry Standard)	38 (Accepted Industry Standard)
DN50	25 (Accepted Industry Standard)	25 (Accepted Industry Standard)
DN40	25 (Accepted Industry Standard)	25 (Accepted Industry Standard)
DN32	25 (Accepted Industry Standard)	25 (Accepted Industry Standard)
DN25	25 (Accepted Industry Standard)	25 (Accepted Industry Standard)
DN20	25 (Accepted Industry Standard)	25 (Accepted Industry Standard)

Table AMCA-3 -	Suggested Insulation	Thickness for S	Small Pine Size	s – Polystyrene SPI
10010711010110	ouggoolou moulullon		5111an 1 1p0 0120	

Approval for the use of the insulation thicknesses listed in Table AMCA-3 must be sought from the building certifying authority before proceeding with installation.



Specification J5.4 - Insulating Of Piping, Vessels, Heat Exchangers and Tanks

In clause 2 of Specification J5.4 of BCA 2008 also states:

#### (a) Insulation must-

(iv) for vessels, heat exchangers and tanks, achieve a minimum *Total R-Value* of-

- (A) 2.5 if the content is low temperature brine or glycol; or
- (B) 1.8 if the content is chilled water; or
- (C) 1.3 if the content is heated water; or
- (D) 2.5 if the content is steam.

AMCA Comment: The above clause is interpreted not to include vessels, heat exchangers and tanks that are part of equipment specified with minimum energy performance requirements in clause J5.4 of Part J5 of the BCA. Equipment such as chillers and boilers are excluded from the requirements of this clause based on this interpretation.

The following suggested insulation thicknesses are to be used as a guide for compliance with the above clause:

- (A) 100 mm Polystyrene if the content is low temperature brine or glycol; or
- (B) 70 mm Polystyrene if the content is chilled water; or
- (C) 50 mm Glasswool if the content is heated water; or
- (D) 125 mm Rockwool if the content is steam.

Certification of the R value must always be sought from the insulation supplier/contractor on a project by project basis to confirm compliance before proceeding with installation.

(b) Insulation on *piping*, vessels, heat exchangers and tanks containing chilled fluid must be protected by a vapour barrier on the outside of the insulation.

AMCA Comment: The above clause is specific with respect to its compliance requirement.



Specification J5.4 - Insulating Of Piping, Vessels, Heat Exchangers and Tanks

(c) The requirements of (a) do not apply to piping-

(i) located within the *conditioned space* where the *piping* is to provide the heating or cooling to that space; or

*AMCA Comment*. Pipework serving radiant panels, chilled beam type systems and air conditioning units do not need to be insulated to comply with BCA 2008, where the pipework is within the conditioned space it serves.



(c) The requirements of (a) do not apply to piping-

(ii) encased within a concrete slab or panel which is part of a heating or cooling system.

AMCA Comment: This will be applicable where in floor heating and/or cooling systems are used

