

**0752P ARMAFLEX FRV IN MECHANICAL PIPING INSULATION****Branded worksection**

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**Worksection abstract**

This branded worksection *Template* is applicable to the insulation and sheathing of piping, tanks, vessels and flues. It covers materials including elastomeric foam, FBS-1 Glass Wool and rock wool.

**Background**

For mechanical thermal insulation, see the guide standard AS 4426. The worksection uses BCA Spec J5.2c minimum material R-Values which are mandatory for Class 2 to 9 buildings. Specific projects may require full analysis of insulation to determine appropriate economic or environmental thermal performance. See NATSPEC TECHnote DES 023 for guidance on services pipe insulation thickness.

**Guidance text**

All text within these boxes is provided as guidance for developing this worksection and should not form part of the final specification. This *Guidance* text may be hidden or deleted from the document using the NATSPEC Toolbar or the hidden text *Hide* and *Delete* functions of your word processing system. For additional information visit FAQs at [www.natspec.com.au](http://www.natspec.com.au).

**Optional style text**

Text in this font (blue with a grey background) covers items specified less frequently. It is provided for incorporation into *Normal* style text where it is applicable to a project.

**Related material located elsewhere in NATSPEC**

Related material may be found in other worksections. See for example:

- *0711 Chillers – combined and Water heating boilers.* See the respective worksections for insulation of these items.
- *0721 Packaged air conditioning* contains a short clause on elastomeric (e.g. ArmaFlex) insulation suitable for refrigerant lines on split systems. If *0721 Packaged air conditioning* is used and there is no other insulated piping, this worksection may be omitted.
- *0744 Ductwork insulation* for insulation of ducts and Air handling plant worksections for air handlers.
- *0751 Mechanical piping.*

**Material not provided by Armacell**

This branded worksection *Template* includes generic material which may not be provided by the Product Partner including:

- Products other than ArmaFlex insulation and insulation-related materials i.e. glass wool and rock wool.

**Documenting this and related work**

You may document this and related work as follows:

- Detail removal provisions for insulation on items requiring regular maintenance.
- Weatherproofing details for external piping.
- This worksection contains text, including *Optional* style text, which may be changed to *Normal* style text for use in design and construct projects. See NATSPEC TECHreport TR 03 for information on specifying Design and Construct for mechanical services.

The *Normal* style text of this worksection may refer to items as being documented elsewhere in the contract documentation. Make sure they are documented.

**Specifying ESD**

The following may be specified by retaining default text:

- Different insulation materials and installation methods to facilitate varying environmental and WHS factors to maximise performance and material life cycle.
- Criteria for evaluating alternatives not covered, primarily in terms of environmental factors (e.g. durability, thermal and noise reduction performance).
- Materials and methods for durability, a major issue with duct insulation.
- Insulation to improve thermal performance for reducing operating costs and greenhouse gas emissions.

Refer to the NATSPEC TECHreport TR 01 on specifying ESD.

## 1 GENERAL

Armacell is a global innovator in foam technologies and the world leader in the market for flexible technical insulation solutions. Our market coverage is second to none, with 23 manufacturing sites in 16 countries; including a facility located in Dandenong, Victoria.

Half a century ago, Armacell were the first to develop an elastomeric insulation product. Armacell since then has had a focus on continuous innovation, supported by research and development teams across the globe, ensuring the ARMAFLEX range continues to deliver excellence in performance and quality.

Armacell provides insulation solutions for mechanical piping, tanks in both commercial and industrial applications including solar, ducting, refrigeration and hot or cold water.

### 1.1 RESPONSIBILITIES

#### General

Requirement: Provide thermal insulation, as documented, and as follows:

- ArmaFlex® FRV flexible thermal insulation for hot and cold piping, tanks, vessels, pumps and plant operating at no more than 105°C for tubular form or no more than 85°C for flat material.
- Glass wool or rock wool preformed pipe insulation for hot piping, tanks, vessels, pumps and blankets to plant operating at more than 105°C for tubular form and more than 85°C for flat material.

Edit this to suit the project as appropriate.

*Documented* is defined in 0171 General requirements as meaning contained in the contract documents.

#### Alternative insulation methods and materials

General: Do not submit alternatives for materials or methods that have lesser quality or characteristics in terms of the following:

- Cold bridging.
- Corrosion resistance.
- Durability during and after installation.
- Fire and thermal performance.

This clause permits the contractor to offer new or novel solutions while maintaining the documented performance.

## DESIGN

The *Optional* style text in this clause may be changed to *Normal* style text when the contractor is to design and select the piping insulation. Use 0701 Mechanical systems to describe design parameters for mechanical systems, as a whole.

This worksection uses BCA insulation performance as a minimum requirement, so additional performance may not be needed unless it is desired to exceed BCA requirements.

#### General

Requirement: Design mechanical piping insulation, as documented.

Selection parameters included in the **SELECTIONS** schedules should not be repeated here. The schedules' *Guidance* text includes suggestions for modification to suit design and construct projects.

#### Piping insulation design, application and calculations

Standards: Conform to the recommendations of one or more of the following:

- AIRAH Design Application Manuals.
- ASHRAE Handbooks.
- CIBSE Guides.

Methods of calculation: Manual or software that employs the data and methods in the applicable standard.

#### Documentation

This is a partial list of items only. Edit to suit the project. Drawings relating to whole systems should be included in 0701 Mechanical systems.

Drawings: Show the following on the drawings:

- Piping insulation material, R-Value, vapour barrier and sheathing.
- Insulated piping support details.
- Details of fire-resisting penetrations.

- Means for removal and replacement of insulation around components requiring access for maintenance.
- [complete/delete]

## 1.2 COMPANY CONTACTS

### Armacell technical contacts

Website: [www.armacell.com.au](http://www.armacell.com.au)

## 1.3 CROSS REFERENCES

### General

Requirement: Conform to the following:

- 0171 *General requirements*.

*0171 General requirements* contains umbrella requirements for all building and services worksections.

List the worksections cross referenced by this worksection. *0171 General requirements* references the *018 Common requirements* subgroup of worksections. It is not necessary to repeat them here. However, you may also wish to direct the contractor to other worksections where there may be work that is closely associated with this work.

NATSPEC uses generic worksection titles, whether or not there are branded equivalents. If you use a branded worksection, change the cross reference here.

- 0701 *Mechanical systems*.

*0701 Mechanical systems* deals with matters common to more than one Mechanical worksection.

## 1.4 STANDARDS

### General

Standard: To AS/NZS 4859.1.

AS/NZS 4859.1 applies to general criteria and technical provisions of materials for thermal insulation of buildings. Also refer to AS 4426, a guide for selection, installation and finish of thermal insulation of pipework, ductwork and equipment.

### Installation of glass wool and rock wool insulation

General: Conform to the

*ICANZ Industry code of practice for the safe use of glass wool and rock wool insulation*.

The *ICANZ Industry code of practice for the safe use of glass wool and rock wool insulation* has been jointly developed by AMWU, CFMEU, CEPU, and ICANZ (formerly FARIMA).

Copies of the code are available from the respective unions, insulation manufacturers and ICANZ.

Marking: Deliver glass wool and rock wool products to site in packaging labelled FBS-1 BIO-SOLUBLE INSULATION.

See the NATSPEC TECHnote PRO 002 for more information on FBS-1 labelling.

## 1.5 MANUFACTURER'S DOCUMENTS

### Technical manuals

Brochures:

- ArmaFlex FRV insulation brochure.
- ArmaFix<sup>®</sup> pipe support brochure.
- Armacell Accessories brochure.

Installation Instructions:

- ArmaFlex Application Manual.

Certification and accreditations:

- OceanaMark Certificate for conforming to AS/NZS 4859.1: Certificate No: OMK30055 Environmental conformance statements.
- Zero ODP conformance statement.
- Ecospecifier product assessment certificate.
- FM Approvals Certificate of Compliance: Approval identification 3056788.
- Safety data sheet.

Website: [www.armacell.com.au](http://www.armacell.com.au)

## 1.6 INTERPRETATION

### Definitions

General: For the purposes of this worksection, the following definitions apply:

- Fbs-1 (fibre-bio-soluble) mineral wool: Insulation composed of bio-soluble glass or rock fibres.

Hazardous substances are not permitted in PRODUCTS, **GENERAL, Prohibited materials** of 0171 General requirements. FBS-1 is not listed in the Safe Work Australia Hazardous Substances Information System (HSIS).

See [hsis.safeworkaustralia.gov.au/consolidatedlists](https://hsis.safeworkaustralia.gov.au/consolidatedlists) to search for hazardous substances under the Safe Work Australia Hazardous Substances Information System.

See NATSPEC TECHnote PRO 002 for information on mineral wool.

- Material r-value: The thermal resistance ( $m^2.K/W$ ) of a component calculated in conformance with AS/NZS 4859.1 clause 2.3.3.8. Material R-Value does not include air space or surface resistances.

For pre-formed pipe insulation it is calculated to AS/NZS 4859.1 from its thermal conductivity and dimensions.

Edit the **Definitions** subclause to suit the project or delete, if not required. List alphabetically.

## 1.7 SUBMISSIONS

### Fire performance

Fire hazard properties: Submit evidence of conformance to PRODUCTS, **FIRE PERFORMANCE, Fire hazard properties**.

### Products and materials

Thermal insulation performance: Submit evidence of conformance to AS/NZS 4859.1.

This is primarily to verify claimed material R-Values for BCA compliance. BCA uses material R-Value, not total R-Value so the effect of surface resistance is not taken into account.

For curved surfaces such as pipes the calculated material R-Value also needs to take the diameter as well as thickness into account.

BCA uses the term material R-Value but does not define it. The R-Value of curved insulation of pipes is greater than that of the same thickness of the same material when flat. For example, 40 mm thick insulation with a thermal conductivity of 0.04 W/(m.K) has an R-Value of 1.0 flat but almost double that (R-Value 1.91) on a DN 25 copper pipe. See NATSPEC TECHnote DES 023 for method of calculating the R-Value of insulation on curved surfaces.

### Samples

General: Submit samples of each type of insulation, including at least one transverse joint, bend and one hanger on a section of pipe at least 1.5 m long. If the piping system to be insulated using the respective type of insulation includes flanges, provide an insulated flange in the sample.

This permits contractor to offer new or novel solutions while maintaining the documented performance. Consider expanding the list to include the proposed arrangement of removable insulation on pumps and valves, method of insulating tees etc. For valves include the size of valve e.g. DN 50 and DN 80.

Cutaway sections: For each sample, provide cutaway sections to permit inspection of application details including insulation materials, adhesives, fixings and sheathing.

Alternative insulation methods and materials: If offering alternatives for materials or methods, submit evidence that they are of equal or superior quality and characteristics than that documented. Include comparisons of the following:

- Thermal and other performance.
- Suitability for the operating temperature range.
- Durability during and after installation.
- Corrosion resistance.
- Cold bridging.

This permits the contractor to offer alternatives subject to these limitations and is a check list for making comparisons.

## 2 PRODUCTS

Specify sound absorption coefficients, if required.

Insulation is required to:

- Control noise.
- Control corrosion in metal pipes (see AS 4426 Appendix B on protection against corrosion).

- Control condensation on the outside of pipes (see AS 4426 normative Appendix C on protection against condensation).
- Achieve a specific condition for a fluid at the point of delivery.
- Prevent freezing of fluid in the system.
- Save energy (economic thickness).
- Reduce greenhouse gas emissions.
- Protect personnel working amongst piping and plant.

The extent of insulation should be clear from the drawings and/or the schedules. Specify the criterion used to determine the amount of insulation.

## 2.1 GENERAL

### Product substitution

Other products: Conform to PRODUCTS, **GENERAL**, **Substitutions** in 0171 General requirements.

The 0171 General requirements clause sets out the submissions required if the contractor proposes alternative products. Refer also to NATSPEC TECHnote GEN 006 for more information on proprietary specification.

### Product identification

General: Marked to show the following:

- Manufacturer's identification.
- Product brand name.
- Product type.
- Quantity.
- Product reference code and batch number.
- Date of manufacture.

Edit the list to suit the project or delete if not required.

## 2.2 INSULATION PERFORMANCE

### General

Insulation of drains from cooling coils: If included in the **Piping insulation schedule**, provide insulation with a Material R-Value  $\geq 0.5 \text{ m}^2\cdot\text{K}/\text{W}$ .

Condensate drains from cooling coils may require insulation to prevent nuisance condensation on the outside, for example in false ceilings over humid rooms or in the tropics. If required, include condensate drains in the **Piping insulation schedule**. (Not to be confused with condensate drains in steam systems covered by BCA Spec J5.2c Table 2b.)

Insulation material R-Value: To BCA Spec J5.2c and the **R-Values for ArmaFlex FRV pipe insulation table** and the **ArmaFlex FRV sheet and roll insulation R-Values table**, as applicable.

BCA Spec J5.2c covers heating water, chilled water refrigerant steam and condensate piping, vessels, heat exchangers. It specifies material R-Value and so excludes the effect of surface air films and hence surface finish. The BCA Spec J5.2c material R-Values are relatively high and will generally be adequate both as minimum economic thicknesses and to prevent condensation on cold surfaces in most environments. Consider their adequacy for critical installations or extreme conditions.

Central hot water heating piping in domestic (Class 1 buildings) is covered in BCA 3.12.5.2.

See NATSPEC TECHnote DES 023 for more information on BCA provisions.

See NATSPEC TECHnote DES 031 for information on specifying R-values.

### R-Values for ArmaFlex FRV pipe insulation table (at 23°C)

Nominal pipe size (mm)	Insulation wall thickness (mm)						
	9	13	19	25	32	38	50
6	0.45	0.68	1.1				
10	0.40	0.61	0.98	1.5			
12	0.38	0.61	1.0	1.4	1.9	2.3	
15	0.36	0.54	0.86	1.4	1.7	2.2	
20	0.35	0.52	0.82	1.3	1.7		
22	0.34	0.50	0.79	1.2	1.6	2.0	2.8
25	0.33	0.48	0.76	1.2	1.5		

Nominal pipe size (mm)	Insulation wall thickness (mm)							
	0.32	0.48	0.74	1.2	1.5	1.8	2.6	
28	0.32	0.48	0.74	1.2	1.5	1.8	2.6	
32		0.47	0.73	1.1	1.4			
35	0.31	0.47	0.72	1.1	1.4	1.7	2.5	
42	0.31	0.45	0.69	1.1	1.4	1.7	2.3	
48	0.31	0.44	0.68	1.0	1.3	1.6	2.3	
50	0.31							
54		0.44	0.66	1.0	1.3			
60	0.30	0.43	0.65	0.98	1.2	1.5	2.2	
67			0.64	0.96				
73		0.45	0.68	0.94		1.5	2.1	
76						1.5		
89		0.44	0.66	0.92	1.2	1.4	2.0	
114		0.43	0.64	0.89	1.1	1.4	2.0	
140				0.86		1.3	2.0	

ArmaFlex FRV sheet and roll insulation R-Values table (at 23°C)

Wall thickness (mm):	9	13	19	32	38	50
R-value:	0.26	0.37	0.54	0.86	1.0	1.3

## 2.3 MATERIALS

### General

Materials in contact with stainless steel: NH/ArmaFlex.

### Fire hazard properties

Spread-of-Flame Index: 0 tested to AS/NZS 1530.3.

Smoke-Developed Index: 6 tested to AS/NZS 1530.3.

Materials with reflective foil facing: Test to AS/NZS 1530.3 clause A6.

Vertical pipe chase test, NFPA 274:

- Peak rate of heat release: < 300 kW.
- Total heat release (THR600): < 83 MJ.
- Total smoke release (TSR600): < 500 m<sup>2</sup>.

See NATSPEC TECHnote DES 003 for more information on fire hazard properties of insulation and pliable membranes and NATSPEC TECHnote DES 020 for fire behaviour of building materials and assemblies.

This list does not include combustibility. In keeping with BCA this clause does not prohibit the use of combustible insulation materials provided they meet the other fire properties.

AS/NZS 1530.3 is a mandatory standard in the BCA. Smoke-Developed Index and Spread-of-Flame Index are determined under AS/NZS 1530.3. Flammability Index is determined under AS 1530.2. See BCA C1.10 and BCA Spec C1.10. The BCA does not directly address piping insulation materials although for Class 2 to 9 buildings, it does reference AS 4254.2 in relation to ductwork insulation.

Specifiers wishing for more stringent fire performance could consider requiring that insulation meets the requirements of NFPA 274, a standard test method developed specifically to provide a more accurate assessment of the fire hazard, not just performance of installed pipe insulation that accounts for products that melt or shrink away from a flame source, or have a reflective foil facing. This is a limitation of AS/NZS 1530.3.

While, AS/NZS 1530.3 clause A6, recommends that reflective surfaces of test specimens (which would otherwise generally pass this test) be blackened and diagonally scored in order to simulate soot deposition onto reflective surfaces in a real fire situation, according to AWTA it may not provide a true indication of fire performance.

Note also that AS/NZS 1530.3 clause 4.12.2(c) requires three test specimens of laminated reflective surface materials incorporate a vertical joint.

Note that BCA C1.10(b) states 'Paint or fire-retardant coatings must not be used to make a material or assembly comply with required fire hazard properties.'

### Insulation materials

Standard: To AS/NZS 4859.1.

#### ArmaFlex elastomeric foam insulation

Product: Preformed, flexible, elastomeric cellular thermal insulation in sheet and tubular form.

- ArmaFlex FRV.

Type: Physical and technical properties:

- Closed cell structure.
- Operating temperature range:
  - . Tubes: -50°C to +105°C.
  - . Sheet: -50°C to +85°C
- Free of ozone-depleting gases in manufacture and composition.
- Thermal conductivity:
  - . For thickness  $\leq 25$  mm:  $\leq 0.035$  W/(m.K) at 23°C.
  - . For thickness  $\geq 32$  mm:  $\leq 0.037$  W/(m.K) at 23°C.
- Water vapour diffusion resistance  $\mu$ :  $\geq 5,000$  to EN 13469.
- Thickness: 9 mm, 13 mm, 19 mm, 25 mm, 32 mm, 38 mm and 50 mm.
- Length: Pipe insulation supplied in 2.0 m lengths. Sheet insulation supplied in 1 m width.

#### Insulated pipe supports

Requirement: Provide ArmaFix pipe supports conforming to the following:

- Application: Hot and cold pipe supports.
- Density of PUR: 100 to 120 kg/m<sup>3</sup>.
- Compressive strength of PUR:  $> 1.0$  MPa.
- Thermal conductivity:  $\leq 0.035$  W/(m.K).
- Operating temperature: - 50°C to + 105°C.

#### Glass wool and rock wool

Product: Glass wool or rock wool resin-bonded to form tubular sections.

Surface finish: Factory bonded aluminium foil laminate with Flammability Index of 3 tested to AS 1530.2.

Consult manufacturer's thermal test data, with particular attention to mean temperature and density as these are the primary determinants of thermal conductivity.

AS 4426 Figure 2.1 plots typical relationship between conductivity and temperature. Refer to manufacturers' literature for actual test data.

#### Adhesives and sealants

Product: ArmaFlex 520.

#### Aluminium foil laminate sheet

Application: Use only for hot piping, tanks, vessels, pumps and plant operating  $> 105^\circ\text{C}$  for tubular form and  $> 85^\circ\text{C}$  for flat material.

Standard: To AS/NZS 4200.1.

Material: Glass fibre reinforced aluminium foil-paper laminate.

Duty classification to AS/NZS 4200.1: Heavy duty.

AS/NZS 4200.1 describes 6 duty classifications. For extra-heavy duty (the top of the range), tensile strengths are 13 kN/m in the machine direction and 10.5 kN/m lateral direction. Heavy duty values are 12.5 and 7.5 kN/m respectively. The standard also documents conductivity, permeance, flammability, emittance and absorbency. The BCA cites AS/NZS 4200.1:1994.

#### Aluminium foil laminate tape

Operating temperature: Suitable for use on surfaces with temperature up to  $65^\circ\text{C}$ .

Application: Use only for glass wool and rock wool.



Mechanical properties:

- Maximum tape thickness: 0.14 mm.
- Minimum breaking strength: 35 N per 25 mm.
- Minimum adhesive strength: 5.5 N per 25 mm.
- Maximum low speed unwind force: 17 N per 25 mm.

AS 4254.1 and AS 4254.2 do not include physical properties for tapes. These properties are for AS 1599 (withdrawn) tape serial number F11, referenced by AS 4254-2002.

Adhesive: Non-toxic, high tack, synthetic pressure-sensitive type.

Liner: Silicone coated paper.

Backing: Aluminium foil laminate.

### **Metal sheathing**

Material: As documented and as follows:

Document in the **Piping insulation schedule**.

- Metallic-coated sheet steel, 0.55 mm minimum thickness coating class Z275.
- Aluminium sheet, 0.55 mm thick.

Consider stucco finish on aluminium to conceal imperfections.

## **3 EXECUTION**

### **3.1 INSULATION GENERALLY**

#### **General**

Requirement: Do not apply insulation to piping joints until piping pressure testing is complete.

Preparation: Before installing insulation, remove weld slag, rust, grease and other foreign matter from the surface of the pipe making sure it is clean and dry from extraneous chemicals such as corrosive cleaners or building material's dust. For black steel pipe, apply one coat of water-borne primer for steel to AS/NZS 3750.19.

Supports: Do not apply insulation at supports until the spacers and metal sheathing (if any) has been installed.

Subcontracting arrangements for this work may need to be resolved.

Joints: Install insulation with the least number of joints practicable.

Use of multiple layers: If insulation is applied in more than one layer, stagger longitudinal and transverse joints.

#### **Cold piping**

General: Insulate the following including their valves and fittings:

- Chilled water piping.
- Cold refrigerant (including suction) piping.
- Cooling coil condensate drains if the contents are below the dew point of the adjacent air.

#### **Hot piping**

General: Insulate the following:

- Steam, condensate, heating, warm and hot water piping.
- Piping hazardous to personnel, including blow down piping.
- Piped services where trace heating is incorporated.

Exceptions: Except where necessary for personnel protection, do not insulate:

- Sludge and drain piping carrying hot fluids.
- Condensate waste piping in steam systems.

#### **Pump and valve insulation**

General: Insulate all pumps, flanges, unions and valves as for attached piping.

An alternative (not recommended) to insulating pumps is to omit insulation and instead cone down insulation at valves and unions. Omitting insulation can cause problems with: sweating, overheating of plant rooms, hot surfaces that are a personnel hazard and energy waste.



Serviceable items: Arrange insulation so that it can be easily removed and refitted without damage and without reducing its insulating and vapour barrier performance. Locate joints in the insulation and sheathing to coincide with joints in the pipes, flanges, unions and valves. Secure sections with captive fasteners or latches.

The method of insulating servable items requires careful attention as incorrect insulation methods are likely to result in insulation not being replaced after maintenance is performed.

Foamed in place insulation will not meet the requirement for removal and refitting without damage.

### Insulation at pipe supports

Requirement: Conform to **Supports** in *0751 Mechanical piping* and the following:

- Insulated spacer material: ArmaFix pipe supports installed to manufacturer's recommendations.

Insulation of pipe supports incorporating metal sheathing is required to maintain energy efficiency, avoid thermal bridging and condensation issues.

### Insulation of buried pipes

Insulation material: ArmaFlex FRV, spiral-wrapped with polyethylene sheathing or a similar waterproof material in conformance with AS/NZS 3500.4.

Heater water piping that is buried in the ground shall be insulated by means of an inert waterproof material. Where insulation is cut for joining purposes, the join shall be wrapped with a durable inert waterproof tape.

Sealing: Seal all but joints and longitudinal joints and seams with ArmaFlex Adhesive 520. Seal the insulation to the pipe at both ends and each termination.

Valves and fittings: Insulate and seal as for pipe. Install valves in pits.

Sleeving: Install the insulated pipe in a PVC-U soil pipe. If the water table is above the sleeve pipe, seal all joints watertight. If the water table is permanently below the sleeve pipe, provide 10 mm drain holes at 600 mm centres along the bottom centre of the sleeve pipe.

## 3.2 PIPING INSULATION SYSTEMS

### General

Requirement: Provide ArmaFlex elastomeric foam to:

- Cold piping systems.
- Hot piping  $\leq 105^{\circ}\text{C}$ : in tubular sections.
- Hot piping  $\leq 85^{\circ}\text{C}$ : Tubular section or in flat sheet.

Hot piping  $> 105^{\circ}\text{C}$ :

- FBS-1 Glass wool tubular sections.
- FBS-1 Rock wool tubular sections.

Document the chosen systems by pipe system and location in **Piping insulation schedule**.

Delete the whole table if the relevant project information is included in the **Piping insulation schedule** or shown on the drawings.

## 3.3 COLD PIPING INSULATION

Mechanically fix insulation to plastic piping. See AS 4426 Figures 6.6-6.9 and clause 6.4 and Appendix C.3.

See the **SUPPORTS** clause in *0751 Mechanical piping* for details of spacers and vapour barriers for insulated pipes.

### ArmaFlex FRV elastomeric foam insulation

General: Before installing the insulation, make sure all pipes and fittings are clean and dry and free of extraneous chemicals such as corrosive cleaners or building materials' dust.

Pipe supports: Use ArmaFix pipe hangers and pipe supports or pipe supports made from the same material as the pipe insulation with the inclusion of a PUR/PIR bearing segments to support the pipe weight. Construct the hangers and supports from a suitable material to prevent compression. Glue the pipe supports and hangers to the adjacent insulation to provide a vapour seal, and the completed assembly of suitable construction to prevent thermal bridging. Seal seams with ArmaFlex 520 adhesive.

Hangers: Insulate hangers clamped directly to the pipe over and fully adhered to the hanger. Provide insulation between rods for hangers with double rods. Seal seams with ArmaFlex 520 adhesive.

Saddles: Insulate saddles on all insulated lines at clamps, hangers, or locations where insulation may be compressed.

Ventilation: Install insulation in an adequately ventilated area. Maintain a minimum gap of 100 mm between insulated pipe and adjacent surfaces.

Crowding of insulation can affect condensation control

Pre-formed insulation tubes: Insulate each continuous run of piping with full-length tubes of insulation. Use single cut pieces only to complete the end of the run. Do not use cut pieces or scraps abutting each other. Push, do not pull, insulation onto pipe.

Joins: Overlap insulation 5 mm to 10 mm at butt-edge seams and compress the edges into place. Make sure there are no gaps.

Adhesive: Glue the ends of the insulation sheets or tubes directly unto the pipe surface. Apply adhesive in a width at least equal to the insulation thickness. For the final wet sealing of the tube or sheet, use fingers to pull the joint apart and apply a thin, even film of adhesive to the two butt joint edges with a small brush. Apply firm and even pressure to the glued joint using fingers and thumbs to finish.

Sealing: Provide a continuous vapour seal to joints and seams with ArmaFlex 520 adhesive applied to both surfaces of butt-edges of the insulation. Do not stretch insulation during the process

No additional external water vapour barrier is necessary with ArmaFlex, as the vapour barrier is built into the insulation material.

Multiple insulation layers: Stagger longitudinal and transverse seams when applying multiple layers of insulation.

Wall and ceiling openings: Except where fire-stop materials are required, provide continuous pipe ArmaFlex FRV insulation through wall and ceiling openings.

#### Fittings, valves and flanges

Requirement: Insulate all valves, flanges and fittings with ArmaFlex FRV sheet or tube material of the same thickness that is used for the insulation of the main pipework. Mitre, pre-adhere and longitudinally slit inside throat to fit over all tees and elbows or bends over 90° in accordance with Armacell installation instructions. Seal seams with ArmaFlex 520 adhesive.

### 3.4 HOT PIPING INSULATION

Mechanically fix insulation to plastic piping. (Check temperature limits on plastic piping.) See AS 4426 clause 6.5 and Figs 6.10 to 6.23.

Check from manufacturer's data that polyester insulation is suitable for the proposed pipe and ambient temperature.

See the **SUPPORTS** in 0751 Mechanical piping for details of spacers, and the like for insulated pipes.

#### Material

Surface ≤ 105°C: Conform to **Armacell elastomeric foam insulation** in **COLD PIPING INSULATION**.

Other hot piping: To **GLASS WOOL AND ROCK WOOL**.

### 3.5 GLASS WOOL AND ROCK WOOL

Mechanically fix insulation to plastic piping. (Check temperature limits on plastic piping.) See AS 4426 clause 6.5 and Figs 6.10 to 6.23.

See the **SUPPORTS** clause in the 0751 Mechanical piping worksection for details of spacers, and the like for insulated pipes.

#### General

Application: Fit insulation tightly to piping surfaces without gaps. Close butt ends of insulation sections. Minimise number of joints. Seal longitudinal seams in foil laminate and fix insulation at maximum 500 mm centres with polypropylene, metallic-coated sheet steel or aluminium straps. Locate straps at least 50 mm from the end of the insulation.

### 3.6 SHEATHING OF PIPING INSULATION

#### Location

General: Provide sheathing as follows: Provide metal sheathing to all piping insulation:

- Exposed to weather.
- Subject to mechanical damage.
- On valves, pipeline components and pumps in sheathed pipework.

#### Metal sheathing

For details relevant to metal sheathing, see AS 4426 Figure 6.28 and clauses 6.5.13 and 6.5.14, clauses 7.5.1-7.5.11 and Table 7.1, clause 7.6 and Figures 7.2 and 7.3.

Installation: Cut and roll the metal sheathing to the correct size. Lap longitudinal and transverse joints a minimum of 40 mm and arrange longitudinal laps to shed water. Cone down at terminations and transitions.

Fixing: Select from the following:

This allows the contractor to select the method. Alternatively delete options not required. Other sheathing includes aluminium sheathing in trenches and damp locations and stainless steel in special applications such as food factories.

- Clamp sheathing at 500 mm maximum centres with 12 x 0.55 mm straps in the same material as the sheathing.
- Fix sheathing with screws or rivets at 150 mm maximum centres. Protect the vapour barrier with reinforced cloth tape to prevent screws and rivets penetrating it.

Bends: Provide as follows:

- Pre-drilled lobster back bends containing at least 3 segments.
- Mitred elbows where the size of the piping or the radius of pipe bends do not allow the use of segmented bends. Provide each segment with an inner and outer swage formed at the transverse edges.
- Fix longitudinal joints with pop rivets of correct length so that the vapour barrier is not damaged.

Weatherproofing: Weatherproof external joints and fixings with silicone sealant.

Serviceable items: Provide removable boxes or cover plates to equipment requiring maintenance. Provide proprietary toggle action catches for removable boxes. As a minimum provide to the following:

- Insulated strainers.
- Valves at pumps.
- Flow regulating valves.
- Control valves.
- Flexible connections.
- Demountable joints.
- Flow measuring devices.

If the integrity of the vapour barrier cannot be maintained, provide drained stainless steel or copper drip trays as an alternative to insulating cold valves and fittings. Subcontracting arrangements for this work may need to be resolved. Provision of these trays is often a cause of dispute.

### 3.7 TANK, VESSEL AND HEAT EXCHANGER INSULATION

This clause does not require insulation on tanks operating between 20 and 40°C. In special cases where it may be required, adjust the temperatures. For minimum Total R-values, see BCA Spec J5.2c clause 2.

#### System

Requirement: As documented in the **Tank, vessel and heat exchanger insulation schedule**.

#### Thermal performance

Insulation material R-Value: To BCA Spec J5.2c .

The table is based on BCA Spec J5.2c .

#### **Cold (< 20°C) tanks, vessels and heat exchangers**

Material: ArmaFlex elastomeric foam sheets.

#### **Hot (≥ 40°C, ≤ 85 °C) tanks, vessels and heat exchangers**

Material: ArmaFlex elastomeric foam sheets.

#### **Hot (> 85°C) tanks, vessels and heat exchangers**

Material: Glass wool or rock wool blanket.

Polystyrene insulation could melt if service temperature can exceed 40°C. See also AS 4426 clause 6.5.13.2.

#### Removable covers

General: Provide removable insulated covers, attached with toggle action catches or self-tapping screws, to serviceable items.

Vapour barrier: If the insulation incorporates a vapour barrier, provide gaskets to maintain the vapour barrier at the cover.

### 3.8 COLD TANK, VESSEL AND HEAT EXCHANGER INSULATION

#### ArmaFlex elastomeric foam insulation

General: Adhere to the total area of tank. Oversize at butt joints so that the insulation is under compression. Seal joints with adhesive.

### 3.9 HOT ( $\geq 40^{\circ}\text{C}$ , $\leq 85^{\circ}\text{C}$ ) TANKS, VESSELS AND HEAT EXCHANGERS

#### ArmaFlex elastomeric foam insulation

General: Adhere to the total area of tank. Oversize at butt joints so that the insulation is under compression. Seal joints with adhesive.

### 3.10 HOT ( $> 85^{\circ}\text{C}$ ) TANK, VESSEL AND HEAT EXCHANGER INSULATION

#### Method

General: Wrap insulation around the whole of the tank or vessel with joints tightly butted.

Installation: Form ends with cut segments of insulation to match the contours of the tank or vessel.

Fixing: 12 x 0.55 mm metallic-coated sheet steel straps at 500 mm maximum centres.

### 3.11 SHEATHING OF TANK, VESSEL AND HEAT EXCHANGER INSULATION

#### Location

Requirement: Provide metal sheathing to all tank, vessel and heat exchanger insulation:

- Exposed to weather.
- Subject to mechanical damage.

#### Metal sheathing

See AS 4426 Figure 6.28 and clauses 6.5.13 and 6.5.14, clauses 7.5.1-7.5.11 and Table 7.1, clause 7.6 and Figures 7.2 and 7.3.

Material: As documented and as follows:

Document in the **Piping insulation schedule**.

- Metallic-coated sheet steel, 0.55 mm minimum thickness coating class Z275.
- Aluminium sheet, 0.55 mm thick.

Consider stucco finish on aluminium to conceal imperfections.

Installation: Cut and roll the metal sheathing to the correct size. Lap longitudinal and transverse joints a minimum of 40 mm and arrange longitudinal laps to shed water. Cone down at terminations and transitions.

Fixing: Select from the following:

This allows the contractor to select the method. Alternatively delete options not required. Other sheathing includes aluminium sheathing in trenches and damp locations and stainless steel in special applications such as food factories.

- Clamp sheathing at 500 mm maximum centres with 12 x 0.55 mm straps in the same material as the sheathing.
- Fix sheathing with screws or rivets at 150 mm maximum centres. Protect the vapour barrier with reinforced cloth tape to prevent screws and rivets penetrating it.

Bends: Provide pre-drilled lobster back bends containing at least 3 segments. Provide mitred elbows where the size of the piping or the radius of pipe bends do not allow the use of segmented bends. Provide each segment with an inner and outer swage formed at the transverse edges. Fix longitudinal joints with pop rivets of correct length so that the vapour barrier is not damaged.

Weatherproofing: Weatherproof external joints and fixings with silicone sealant.

Serviceable items: Provide removable two part boxes or cover plates to equipment requiring maintenance. Arrange boxes so that there is either insulation or an air gap between the box and metal part being insulated. Provide proprietary toggle action catches for removable boxes. As a minimum provide to the following:

- Insulated strainers.
- Valves at pumps.
- Flow regulating valves.
- Control valves.
- Flexible connections.

- Demountable joints.
- Flow measuring devices.

If the integrity of the vapour barrier cannot be maintained, provide drained stainless steel or copper drip trays as an alternative to insulating cold valves and fittings. Subcontracting arrangements for this work may need to be resolved. Provision of these trays is often a cause of dispute.

**3.12 FLUE AND EXHAUST PIPE INSULATION**

For hot air ducts, see AS 4426 clause 6.5.13. For gas flues, see clauses 6.5.14 to 15.

**General**

Requirement: Insulate the full length of flues and exhausts within buildings, and as documented.

Consider whether insulation is required externally. If so, describe extent or show on drawings.

**Insulation**

Material: Glass wool or rock wool, suitable for continuous operation at the flue or exhaust pipe temperature.

Glass wool is generally suitable for up to 340°C and rock wool is generally suitable for up to 750°C. Check manufacturer's for individual products.

Insulation material R-Value: ≥ 1.5 m².K/W.

This would typically be met by 50 mm thick insulation but thickness varies with diameter, material properties and temperature.

**Application**

Requirement: Wrap insulation around flues or exhausts. Hold in place with 12 x 0.55 mm zinc-coated steel straps at 600 mm maximum centres.

**Sheathing**

General: Sheath insulation.

Sheathing: 0.55 mm (minimum) zinc-coated steel sheet or 0.8 mm (minimum) aluminium sheet.

Joints: Lap joints in sheathing at least 30 mm and rivet or screw at 150 mm maximum centres.

Edges: Neatly cut around nozzles and cone down to flanges.

Terminations: At terminations, return edges of sheathing to protect edges of insulation.

**4 SELECTIONS**

**Schedules** are a way of documenting a selection of proprietary or generic products or systems by their properties. Indicate their locations here and/or on the drawings. Refer to NATSPEC TECHnote GEN 024 for guidance on using and editing schedules.

**4.1 PIPING INSULATION**

**Piping insulation schedule**

Property	IS1	IS2	IS3
Piping system			
Location			
Insulation material			
Insulation finish			
Vapour barrier			
Sheathing			

IS 1, IS 2, IS 3: These designate each instance or type or location of the insulation system scheduled e.g. Cold piping in plant rooms. Edit to align with the project's codes or tags.

Edit codes in the **Schedule** to match those on drawings.

Piping system: e.g. Chilled water, Condensate drains

Location: e.g. In plant rooms, Other than in plant rooms, In concealed locations, Exposed to weather.

Insulation material: e.g. Polystyrene. BCA sets out the thermal performance of the various pipe insulation systems so it is not necessary to repeat R-Values here unless to exceed BCA.

Insulation finish: e.g. Aluminium foil laminate. Refer to **PIPING INSULATION SYSTEMS** for options.

Vapour barrier: Required, Not required, Integral.

Sheathing: Required or refer to **SHEATHING OF PIPING INSULATION** for material options.

If drains from cooling coils are to be insulated include them here and define the extent (e.g. above ceilings of non-air conditioned rooms) or show the extent on the drawings.

## 4.2 TANK, VESSEL AND HEAT EXCHANGER INSULATION

### Tank, vessel and heat exchanger insulation schedule

Tank, vessel or heat exchanger	Insulation material	Finish
	ArmaFlex FRV	
	ArmaFlex FRV	
	ArmaFlex FRV	

Complete to suit the project. BCA sets out the thermal performance of the various pipe insulation systems so it is not necessary to repeat thicknesses here.

Tank, vessel or heat exchanger: e.g. Chilled water storage tank.

Insulation material: Refer to **PIPING INSULATION SYSTEMS**.

Vapour barrier: None or refer to **PIPING INSULATION SYSTEMS** for cold pipes

Finish: Refer to **PIPING INSULATION SYSTEMS**.

Sheathing: None or refer to **SHEATHING OF PIPING INSULATION** for material options.

#### Adapting the Tank, vessel and heat exchanger insulation schedule for design and construct projects

Insert the information described in the above guidance.

#### Common systems

Temperature  $\geq -20^{\circ}\text{C}$ ,  $< 2^{\circ}\text{C}$ :

- Typical applications: Brine, some refrigerant lines.
- Material: ArmaFlex FRV.

Temperature  $\geq 2^{\circ}\text{C}$ ,  $< 20^{\circ}\text{C}$ :

- Typical applications: Chilled water, some refrigerant lines.
- Material: ArmaFlex FRV.

Temperature  $\geq 20^{\circ}\text{C}$ ,  $< 40^{\circ}\text{C}$ :

- Typical applications: All tanks.
- Material: ArmaFlex FRV.

Temperature  $\geq 40^{\circ}\text{C}$ ,  $< 85^{\circ}\text{C}$ :

- Typical applications: Medium temperature heating water.
- Material: ArmaFlex FRV.

Temperature  $\geq 85^{\circ}\text{C}$ :

- Typical applications: High temperature hot water, steam, condensate.
- Material: Glass wool or rock wool.

See AS 4426 Figures 6.24-6.27 and AS 4426 Figure 7.2, AS 4426 Figure 7.3, AS 4426 clause 6.5.11.

#### Insulation material properties

Typical maximum operating temperatures for various materials are shown in the following based on information in AS 4426. Consult manufacturer's information as the temperature can vary between manufacturers and among grades and forms. (The following relates to forms commonly used for pipe insulation. Other forms such as boards may have higher temperature ratings).

Nitrile rubber (Elastomeric foam insulation):

- Maximum operating temperature:  $100^{\circ}\text{C}$ .
- Typical thermal conductivity range (W/m.K): 0.03 to 0.05.
- Typical bulk density range ( $\text{kg/m}^3$ ): 56 to 110.
- Covered in *0752 Mechanical piping insulation*.

Glass wool:

- Maximum operating temperature:  $450^{\circ}\text{C}$ .

- Typical thermal conductivity range (W/m.K): 0.02 to 0.10.
- Typical bulk density range (kg/m<sup>3</sup>): 60 to 100.
- Covered in *0752 Mechanical piping insulation*.

Rock wool:

- Maximum operating temperature: 750°C.
- Typical thermal conductivity range (W/m.K): 0.03 to 0.20.
- Typical bulk density range (kg/m<sup>3</sup>): 80 to 150.
- Covered in *0752 Mechanical piping insulation*.

#### REFERENCED DOCUMENTS

The following documents are incorporated into this worksection by reference:

AS 1530		Methods for fire tests on building materials, components and structures
AS 1530.2	1993	Test for flammability of materials
AS/NZS 1530.3	1999	Simultaneous determination of ignitability, flame propagation, heat release and smoke release
AS/NZS 3500		Plumbing and drainage
AS/NZS 3500.4	2018	Heated water services
AS/NZS 3750		Paints for steel structures
AS/NZS 3750.19	2008	Metal primer - General purpose
AS/NZS 4200		Pliable building membranes and underlays
AS/NZS 4200.1	2017	Materials
AS/NZS 4859		Materials for the thermal insulation of buildings
AS/NZS 4859.1	2002	General criteria and technical provisions
BCA Spec J5.2c	2016	Energy efficiency - Piping, vessel, heat exchanger and tank insulation
ICANZ	2003	Industry code of practice for the safe use of glass wool and rock wool insulation
NFPA 274	2018	Standard test method to evaluate fire performance characteristics of pipe insulation
EN 13469	2012	Thermal insulation products for building equipment and industrial installation – Determination of water vapour transmission properties of performed pipe insulation.

The following documents are mentioned only in the **Guidance text**:

AS 1599	2006	Pressure-sensitive and water activated adhesive tape for packaging and office applications
AS/NZS 4200		Pliable building membranes and underlays
AS/NZS 4200.1	1994	Materials
AS 4254		Ductwork for air-handling systems in buildings
AS 4254.1	2012	Flexible duct
AS 4254.2	2012	Rigid duct
AS 4426	1997	Thermal insulation of pipework, ductwork and equipment - Selection installation and finish
BCA 3.12.5.2	2016	Acceptable construction - Energy efficiency - Services - Central heating water piping
BCA C1.10	2016	Fire resistance - Fire resistance and stability - Fire hazard properties
BCA C1.10(b)	2016	Fire resistance - Fire resistance and stability - Fire hazard properties
BCA Spec C1.10	2016	Fire resistance - Fire hazard properties
BCA Spec J5.2c Table 2b	2016	Energy efficiency - Piping, vessel, heat exchanger and tank insulation - Refrigerant, steam and condensate piping - Minimum material R-value
NATSPEC DES 003	2006	Fire hazard properties of insulation and pliable membranes
NATSPEC DES 020	2011	Fire behaviour of building materials and assemblies
NATSPEC DES 023	2010	Mechanical services pipe and vessel insulation
NATSPEC DES 031	2014	Specifying R-Values
NATSPEC GEN 006	2007	Product specifying and substitution
NATSPEC GEN 024	2015	Using NATSPEC selections schedules
NATSPEC PRO 002	2006	Mineral wool
NATSPEC TR 01	2018	Specifying ESD
NATSPEC TR 03	2018	Specifying Design and Construct for Mechanical services