

0721P YANMAR GAS POWERED AIR CONDITIONING

Branded worksection

This branded worksection *Template* has been developed by NATSPEC in conjunction with **YANMAR** (the product partner) and may be used whilst the Product Partner is licensed to distribute it. The copyright remains with NATSPEC. As with all NATSPEC worksections, it is the responsibility of the user to make sure it is completed appropriately for the project. The user should also review its applicability for local conditions and regulations. Check www.natspec.com.au for the latest updated version.

Worksection abstract

This branded worksection *Template* is applicable to YANMAR gas powered, air cooled, variable refrigerant flow (VRF), packaged air conditioning plant using outdoor units with nominal cooling capacities of 14 to 85 kW(r). It includes YANMAR heat pump, heat recovery and heat pump with hot water heating.

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.

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:

- 0718p YANMAR gas powered chillers.
- 0721 Packaged air conditioning for water cooled systems and close tolerance (computer room) plant.
- 0732 Air filters for filters that are non-standard on packaged units.
- 0931p YANMAR gas powered micro cogeneration.

Material not provided by YANMAR

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

Documenting this and related work

You may document this and related work as follows:

- If special filters are required (i.e. non-standard) you may need to include 0732 Air filters or amend this worksection.
- Variable refrigerant flow systems require special piping arrangement and fittings. Conform to YANMAR recommendations.
- The drawings should show arrangements around the units for inspection, cleaning maintenance and removal of components. AS/NZS 3666.2 requires the coils to be inspected monthly and cleaned when necessary.
- This worksection contains text, including *Optional* text, which may be adapted for use in Design and Construct projects. See NATSPEC TECHreport TR 03 for information on specifying Design and Construct.

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:

- Gas powered air conditioning offers lower overall greenhouse gas emissions compared to electrically powered equipment supplied from fossil fuelled power stations.
- High energy efficiency packaged air conditioning equipment for reducing operating costs and greenhouse gas emissions using this worksection as a framework.
- Heat recovery between heated and cooled conditioned areas and heat recovery to hot water for domestic space heating and other heating applications.
- NCC provisions and published Minimum Energy Performance Standard (MEPS).
- Durable components.
- Additional fan and coil corrosion protection for aggressive environments.
- Energy conserving coil pressure drops.
- Provisions to reduce transmitted noise and vibration.

Refer to the NATSPEC TECHreport TR 01 on specifying ESD.

1 GENERAL

YANMAR's Energy Systems division began operation in 1984, and today has installed more than 375,000 air conditioning, chiller and cogeneration systems worldwide. Using a YANMAR-designed, lean-burn Gas Engine, which was developed from the company's world-class diesel engine technology, these environmentally friendly systems are designed for reliability, efficiency, energy conservation, comfort and long-term savings.

1.1 RESPONSIBILITIES

General

Requirement: Provide YANMAR gas powered, air cooled, Variable Refrigerant Flow (VRF) packaged air conditioning plant, as documented.

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

VRF systems: Supply indoor and outdoor units of VRF systems designed and rated by YANMAR to operate together.

DESIGN

The *Optional* text in this clause may be used by changing to *Normal* style text, when the contractor is to design and select the packaged air conditioning equipment and use with 0701 Mechanical systems to describe design parameters for mechanical systems, as a whole, including the basis for calculating the packaged air conditioning equipment capacities and definition of areas to be served by the documented types of packaged air conditioning equipment.

General

Requirement: Design packaged air conditioning plant, as documented.

Packaged air conditioning equipment selection

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

General: Select packaged air conditioning equipment for the loads calculated, in conformance with 0701 Mechanical systems, for the spaces served under the documented conditions, as follows:

- Coil total cooling capacity: Greater than calculated total cooling load.
- Coil sensible cooling capacity: Greater than calculated sensible cooling load.
- Coil heating capacity: Greater than calculated total heating load.
- Coil supply air quantity: Equal to calculated total supply air quantity.

Packaged air conditioning equipment 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.

System design and installation

Requirement: Conform to the recommendations YANMAR GHP engineering data manual.

Documentation

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

Drawings: Show the following on the drawings:

0171 General requirements includes requirements for access for maintenance.

- If spaces within the plant fall within the scope of BCA G1.2, document provisions for conformance with NCC: [complete/delete]

BCA G1.2 sets out safety requirements for a cooling chamber which is large enough for a person to enter.

- Provisions for conformance with AS/NZS 3666.2: [complete/delete]

AS/NZS 3666.2 requires the coils to be inspected monthly and cleaned when necessary.

1.2 COMPANY CONTACTS

YANMAR technical contacts

Website: www.yanmarenergy.com.au/contact.html

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.

- 0741 Ductwork.
- 0744 Ductwork insulation.
- 0791 Mechanical commissioning.
- 0792 Mechanical maintenance.

1.4 STANDARDS

General

Gas engine driven heat pump air conditioners: JIS B 8627-1 and EN 16905-1.

Refrigeration systems: To AS/NZS 5149.1, AS/NZS 5149.2, AS/NZS 5149.3 and AS/NZS 5149.4.

AS/NZS 5149.1, AS/NZS 5149.2, AS/NZS 5149.3 and AS/NZS 5149.4 deal with safety and environmental aspects of refrigeration systems. They are based on the corresponding ISO 5149 series standards but with Australian amendments including a performance option in Appendix ZZ of each part of the standard.

See NATSPEC TECHnote PRO 007 on refrigerant options.

Microbial control: To AS/NZS 3666.1 and the recommendations of SA/SNZ HB 32.

e.g. Coil drain trays and filters.

See NATSPEC TECHnote DES 022 for more information on requirements for microbial control in buildings.

Ductwork and insulation: To AS 4254.2.

Air filter performance and construction: To AS 1324.1.

1.5 MANUFACTURER'S DOCUMENTS

Technical manuals

Website: www.yanmarenergy.com.au/downloads.html

1.6 INTERPRETATION

Abbreviations

General: For the purposes of this worksection the following abbreviations apply:

- kW(e): kilowatts electrical input.
- kW(r): kilowatts refrigeration capacity.
- kW: kW(e) or kW(r) as the context requires.
- VRF: Variable Refrigerant Flow.

Also referred to as variable refrigerant volume (VRV), a trade name.

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

Definitions

General: For the purposes of this worksection the following definition applies:

- Variable refrigerant flow (VRF) system: A direct expansion refrigeration system consisting of multiple indoor units connected to a single outdoor unit. VRF system has the same meaning as multiple split system.

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

1.7 SUBMISSIONS

Certification

VRF systems: Submit evidence of the inspection of the system and approval of the installation by Yanmar Energy Australia Pty Ltd.

Fire performance

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

INSPECTION

If inspections are required, include them here by changing this *Optional* text to *Normal* style text.

Notice

Inspection: Give notice so inspection may be made of the following:

- Arrival of units on site.
- Pipework pressure/vacuum test.

Amend to suit the project adding critical stage inspections required. **Hold points**, if required, should be inserted here.

2 PRODUCTS

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 FIRE PERFORMANCE

Fire hazard properties

Equipment enclosure insulation: To AS 4254.2 clause 2.7.1.

Refrigeration pipe insulation: Tested to AS/NZS 1530.3: Fire hazard Indices as follows:

- Spread-of-Flame Index: 0.
- Smoke-Developed Index: ≤ 3 .

2.3 EQUIPMENT

Operating conditions

Requirement: Provide equipment that operates without excessive head pressure, unstable operation or icing within ambient temperature ranges as follows:

- Cooling: -10°C to 46°C. If cooling is required in winter and the winter outdoor ambient temperature is below 0°C, provide YANMAR air guard.
- Heating: -10°C to +26°C.

Amend upper and lower temperature to suit the actual conditions of the project site, if necessary. Cooling operation to -10°C is possible with optional YANMAR air guard. YANMAR can also supply -20°C to +26°C Cold Climate models on request. Check with YANMAR that proposed equipment is suitable for operation under the site conditions.

Marking

Refrigerant: Show the type of refrigerant at the charging point and on indicator panels.

Refrigerants

Requirement: Provide R-410A refrigerant.

R-410A is listed Safety Group A1 AS/NZS ISO 817, that is, R-410A has low toxicity and no flame propagation. Refrigerants not listed in AS/NZS ISO 817 are not covered by AS/NZS 5149.1, AS/NZS 5149.2, AS/NZS 5149.3 or AS/NZS 5149.4 so should be avoided.

According to AS/NZS 5149.1, R-410A has an Ozone Depletion Potential of 0 and a Global Warming Potential of 2090. Although Global Warming Potential is higher than some alternatives, it is compensated for by the lower overall greenhouse gas emissions of gas powered plant compared to electrically powered plant supplied from fossil fuelled power stations.

Safety Group, Ozone Depletion Potential and Global Warming Potential for refrigerants are listed in AS/NZS 5149.1 Annex B. See NATSPEC TECHnote PRO 007 on refrigerant options.

2.4 VRF SYSTEMS**General**

Requirement: Conform to YANMAR's requirements for the respective package air conditioner components.

Integration

Requirement: Provide YANMAR indoor and outdoor units, designed and automatically controlled to operate as an integrated whole, under the documented operating conditions and over the whole capacity range of the system.

Capacity

Indoor units: Select each indoor unit to achieve the documented duty for the space served.

Outdoor units: Select to suit the combined capacities of the connected indoor units over the entire operating range of the system.

Outdoor units

Speed control: Provide gas engine speed control to vary compressor speed between 800 and 2800 RPM for system capacity control.

Heating and cooling modes

Document the required mode.

Two pipe refrigeration systems: Provide control devices to allow the system to change from cooling to heating mode.

Three pipe refrigeration systems: Provide control devices to allow simultaneous heating and cooling of different indoor units.

System controls

Requirement: Provide an integrated automatic control system to operate the refrigeration system safely and efficiently, to achieve the documented performance and functions.

Controller: Provide a microprocessor control unit to control the operation of the whole system and respond to call-up by individual controllers located within the spaces served by the indoor units and as follows:

- Two pipe refrigeration systems: Operate all indoor units in response to space controllers in either cooling mode or in heating mode.
- Three pipe refrigeration systems: Arrange to allow simultaneous heating and cooling.

Room controllers

Controllers: Provide a separate controller within the space served by each indoor unit to control that indoor unit. Provide the following minimum functions in each controller:

- Unit on/off.
- Temperature set point for that unit.
- Evaporator fan speed.
- Timer control for that unit.

Master control: For two pipe systems, designate one room controller as the master control for changeover between cooling and heating modes.

Refrigeration piping

Requirement: Conform to YANMAR's recommendations for VRF systems.

Refrigeration components: Provide YANMAR pipeline components designed to make sure oil returns from all indoor units under all operating conditions.

Joining: Provide YANMAR joining system.

2.5 VRF OUTDOOR UNITS

General

Requirement: Provide YANMAR VRF packaged outdoor units consisting of air cooled refrigerant condensers, gas powered engine driven scroll compressors, heat exchanger and associated piping and electrical connections, and engine and refrigeration controls, all mounted within the outdoor unit enclosure.

YANMAR 14 kW(R) to 35.5 kW(R) units have one compressor, 45 kW(R) and above have two compressors.

Type

Requirement: Provide outdoor units, as documented and as follows:

- Heat pump: YANMAR G, K or J series.
- Heat pump with heat recovery: YANMAR J series with YANMAR YBSVP series branch selector units.
- Heat pump with hot water: YANMAR J series with exhaust gas to water heat exchanger.

Heat recovery and hot water units: Provide automatically controlled rejection of excess heat to condenser or engine radiator.

Heat pump with hot water recovery

Heat exchanger: Provide a Type 316 stainless steel ASTM A240/A240M heat exchanger to transfer heat from the engine cooling system to heat recovery water.

Heat recovery is available up to 70°C when operating in both cooling mode and reverse cycle heating. If using heat recovery for domestic hot water heating, conform to the PCA - NCC Volume 3 - Plumbing Code of Australia.

2.6 VRF INDOOR UNITS

Type

Requirement: Provide YANMAR VRF indoor units consisting of coils, piping, supply air fan, accessories and electrical connections, mounted within an insulated enclosure.

Type

Requirement: Provide indoor units as documented and as follows:

- Cassette type: YANMAR YZCP-PVE series.
- Ducted: YANMAR YZDP-PVE, YZDP-MVE and YZSDP-PBVE.

YZSDP-PBVE are slim ducted units.

- Wall mounted: YANMAR YZAP-PVE series.
- Under ceiling: YANMAR YZHP-MVE series.

2.7 BRANCH SELECTOR UNITS

General

Requirement: If simultaneous heating and cooling on the same circuit are documented, provide YANMAR YBSVP series branch selector units and install to YANMAR's recommendations. Provide brazed refrigeration connections and single phase power supply.

Location: Install in an accessible location and so that noise generated by the unit does not cause disturbance.

2.8 EQUIPMENT ENCLOSURES

General

Requirement: Provide enclosures, materials and finishes that are weatherproof and corrosion-resistant, assembled and reinforced to prevent flexing and drumming.

Material and finishes

Material: Conform to the following:

- Metallic-coated steel:
 - . Base and legs: ≥ 1.6 mm.
 - . Panels: ≥ 1.0 mm.

Outdoor equipment enclosure finishes: Polyester powder coat to all metallic-coated steel interior and exterior surfaces to AS 4506.

Indoor equipment finish: YANMAR standard finish.

Moisture retention: Design and install so that all parts are free draining with no pockets for condensation and/or rainwater retention.

Access

General: Provide access to the interior of the unit for routine inspection and maintenance and for removal of major components. Provide doors and panels with handles and captive fasteners and, where they are for access to the conditioned air stream, provide soft gaskets for an airtight seal. Provide weatherproof doors and panels on outdoor enclosures. Do not use self-tapping screws on removable panels.

Access: As a minimum, provide access to the following:

- Condensate tray (locate underside of access panel within 300 mm of tray).
- Supply fan motor and drive.
- Engine-compressor section.
- Condenser section.
- Filter section.

Access panel fasteners:

- Units < 1000 L/s: Metal thread screws or camlock fasteners.
- Units ≥ 1000 L/s: Camlock fasteners.

Handles: Provide handles to permit easy and safe removal and replacement of panels.

- < 450 mm diagonal panel dimension: 1 handle.
- ≥ 450 mm diagonal panel dimension: 2 handles.

Insulation

Requirement: Insulate enclosures to prevent external surface condensation under all operating conditions. Fix insulation to panels with waterproof adhesive applied to at least 50% of the panel area.

Material properties: Conform to the following:

- Thermal conductivity: ≤ 0.035 W/m.K.
- Insulation R-Value: ≥ 0.7 m².K/W.

This is a nominal value intended to prevent condensation on typical systems in temperate climates. Higher R-Values may be required for more demanding situations (e.g. humid tropics). NCC does not mandate insulation performance on air conditioning equipment that is required to also comply with minimum MEPS standards, so without this provision, piping in these systems would not be insulated. R-Values to BCA Section J for new MEPS systems are much higher than 0.7m².kW.

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

- Facing: Reinforced aluminium foil.
- Moisture absorption: Non-hygroscopic.
- Fire hazard properties: To **PRODUCTS, FIRE PERFORMANCE**.
- No CFC or HCFC used as blowing agents in the manufacturing process.

Condensate trays

General: Provide a tray under each cooling coil extending downstream to collect water carry over, and under any other components on which condensation may occur. Grade trays and sumps to the outlet to prevent water retention. Provide radiused corners and arrange to facilitate cleaning.

Material: Fabricate wetted parts from aluminium to AS/NZS 1734 or stainless steel sheet grade 304L.

Yanmar can also provide an optional water discharge kit in stainless steel (Part No RGA850H1)

Protection

General: Provide easily removable powder coat finished metallic-coated steel mesh protection to outdoor fans and exposed faces of outdoor coils.

2.9 SUPPLY FAN**Performance**

Requirement: Select fans and fan motors so the air flow can be increased not less than 5% above the documented design air flow rate, against the corresponding increased system resistance by fan speed change alone and without unstable operation.

Fans with multi-speed motors: Select for required duty at second highest speed.

This requirement is conservative but results in quieter operation and some capacity for air flow increase compared with selections based on highest speed.

Construction

Forward curved impellers: Metallic-coated steel blades and wheel.

Backward inclined impellers: Backward inclined, steel or extruded aluminium, aerofoil or single thickness blades, and non-overloading power characteristic.

Casing: Metallic-coated steel sheet, riveted or spot-welded with joints sealed. Provide 1.2 mm minimum thickness scroll and 2 mm minimum thickness side plates.

Bases: Formed from pressed metallic-coated steel sheets, bolted to casings. Provide at least 4 brackets for mounting.

Inlet bells: Shaped for aerodynamically efficient air entry and small clearance from impeller.

Shaft: Steel treated with solvent removable petroleum based protective coating.

Bearings: Self-aligning sealed for life ball or roller type.

Finish: Brush and prime spot welds with organic zinc-rich organic primer to AS/NZS 3750.9.

Drive

Type: Direct or belt drive, as documented.

Direct drive: Multi speed or electronic variable speed.

Include type of speed control in **SELECTIONS, Outdoor unit schedule** and **SELECTIONS, Indoor unit schedule** or leave to contractor's selection. Electronic variable speed control of single phase motors does not necessarily produce constant speed at a given set point. If speed control is critical, consider belt driven fans with adjustable pulleys.

Belt drive: To suit a minimum 125% of motor power and capable of transmitting the full starting torque without slip. Provide adjustable motor pulley. Provide pulleys with shaft keys or taper lock bushes.

AS 2784 Appendix A lists recommended belt power ratings. Smaller units may only require one belt under AS 2784. Consider specifying minimum 2 belts for critical applications.

2.10 CONDENSER FANS**Type**

Propeller fan: Direct drive with single thickness fixed pitch aluminium or ultraviolet light protected polypropylene blades.

Aerofoil axial flow fan: Direct drive with adjustable pitch aerofoil section blades of ultraviolet light protected glass reinforced plastic or polypropylene, or aluminium.

Centrifugal fan: Conform to the following:

- Drive: Direct or belt driven, as documented.
- Impeller: Forward curved or backward inclined, as documented.
- Construction: Conform to **SUPPLY FAN**.
- Belt drive: If belt drive is documented, conform to **SUPPLY FAN**.

Multiple fans: If multiple fans operate in sequence for capacity control, provide baffles in the condenser to prevent air short circuiting through idle fans.

Guards: Provide easily removable powder coat finished metallic-coated steel guards over condenser fans.

Power consumption: $\leq 0.015 \text{ kW(e)/kW(r)}$ total heat rejected by the condenser when tested to AHRI 460.

2.11 FAN MOTORS

General

Power rating of supply fans: At least the power required by the fan when the air flow is increased by 10% above the design air flow rate documented, against the corresponding increased system resistance as installed.

Single phase motors: ≤ 0.37 kW only.

0.37 kW as an upper limit for single phase motors is arbitrary. Amend if desired.

Speed: < 25 rev/s.

Bearings: Sealed for life ball bearings.

Minimum degree of protection:

- Supply fans: IP54.
- Condenser fans: IP55.

A lower standard may be acceptable for units located indoors or protected from rain.

Insulation to AS 60034.1:

- Single phase motors: Minimum Class B.
- Three phase motors: Minimum Class F.

2.12 ENGINE DRIVEN COMPRESSORS

Engine

Requirement: Provide YANMAR spark ignition gas engine driven compressor.

Engine maintenance interval: Designed for maintenance at no greater frequency than 10,000 hours or 5 years, whichever comes first.

Gas type: Natural gas or LPG, as documented.

Gas train: Provide a gas train to AS/NZS 5601.1 for a type B appliance.

Defrost: Achieve defrost using engine waste heat not reverse cycle defrosting. Provide a plate heat exchanger to transfer engine heat to the refrigerant to raise system operating pressures and reduce defrost cycle time.

Compressors

Type: Open drive scroll compressors with flexible ribbed belt drive.

Standard: To UL 984.

Performance: To JIS B 8627-1, EN 16905-3 and EN 16905-4.

Accessories: Provide the following:

Suction and discharge service valves are often not supplied for smaller units. Delete if not required.

- Packed and capped backseating refrigerant suction, liquid and discharge service valves.
- Access fittings for evacuation and refrigerant charging.
- Fine mesh suction filters.

Lubrication: Provide oil separator, pump or pressure differential oil system, filter and oil cooler.

Capacity control: Vary system capacity by varying engine speed. Provide electronic expansion valves and variable speed d.c. condenser fan motors.

Crankcase heaters: Provide integral positive temperature coefficient type crankcase heaters if required for safe compressor operation.

2.13 COILS

Design

Coil face velocity: ≤ 2.5 m/s.

Fin pitch: ≤ 550 fins/m.

Cooling coil air pressure drop: ≤ 150 Pa when wet.

Construction

Tubes: Copper to AS/NZS 1571 or AS 1572 designation C12200.

Fins: Aluminium alloy plate fins ≥ 0.12 mm thick to AS 2848.1, designation 3003 or 8011.

Coil frames:

- Aluminium alloy to AS 2848.1, designation 5005.
- Metallic-coated steel sheet coating class Z275.

Condenser coil: To provide at least 5 K subcooling.

Access

General: Arrange coils and casing so that both sides of coils are readily accessible for inspection and cleaning.

Additional coil corrosion treatment

This is advisable for aggressive atmospheres such as marine environments. See NATSPEC TECHnote DES 010 for more information on corrosivity.

General: If the atmospheric corrosivity category documented in *0171 General requirements* is C3, C4, C5 or T, provide YANMAR Blygold proprietary coil corrosion protection coating as follows:

Consult Yanmar for suitability for Category C5 and T locations.

- Type: Factory applied coating resistant to dilute acids, dilute alkalis, solvents, inorganic salts and salt laden air.
- Application: Apply after coil fabrication.
- Performance: When tested to ASTM B117, show no sign of attack after 11000 hours in salt spray.

These treatments include aluminium impregnated polyurethane and phenolic coatings.

2.14 FILTERS

General

AS/NZS 3666.1 clause 2.4 Note 1 recommends not less than 20% efficiency to Test Dust No. 1 and not less than 85% to Test Dust No. 4 (to AS 1324.2). AS 1324.1 performance ratings overlap these figures and cannot be easily applied.

Filters: Type 1 to AS 1324.1 with class and performance rating, as documented but not less than:

- Test Dust No. 1 to AS 1324.2: $\geq 20\%$ efficiency.
- Test Dust No. 4 to AS 1324.2: $\geq 85\%$ arrestance.

Filter class to AS 1324.1: As documented.

Filter performance rating to AS 1324.1: As documented.

Minimum dust holding capacity: As documented.

The last three items above may be documented in **SELECTIONS, Indoor unit schedule**.

Filters and media: Supply filters and media that are odourless, non-toxic, non-migrating, non-evaporating, non-hardening, resistant to microbial growth, and which do not shed fibres in service.

Access: Make sure individual filter inspection and maintenance can be readily carried out without disturbing the filter bank.

2.15 REFRIGERATION SYSTEM

Components

See NATSPEC TECHnote PRO 007 on refrigerant options.

Copper pipe: To AS/NZS 1571.

Pipe insulation within unit: Insulate pipes that operate below ambient temperature with elastomeric foam to BCA J5.8.

Refrigerant expansion device: Electronic expansion valve (EEV).

Refrigeration circuits: Provide each refrigeration circuit with a filter dryer and manual reset high pressure and auto reset low pressure cutouts. Provide a suction accumulator if compressor is liable to damage by liquid slugs.

Reverse cycle units: Provide refrigerant reversing valve and an effective outdoor coil defrost facility that prevents room temperature dropping more than 2 K during defrost.

Make sure that the system selected will defrost under extreme ambient conditions. In NCC climate zones 1, 2 and 5 this should not be a problem but if the winter ambient temperature approaches freezing, YANMAR air guard should be provided otherwise defrost times will be long and low indoor temperatures may result unless suitable precautions are taken. Even in less extreme situations reverse cycle units may not be able to start heating under low outdoor ambient in the morning without YANMAR air guard.

2.16 REFRIGERATION PIPE INSULATION

Material

Insulation R-Value: To BCA J5.8.

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

Type: Chemically blown closed cell nitrile rubber or polyethylene in tubular form.

Physical properties:

- Maximum thermal conductivity: 0.04 W/mK at 0°C.
- Moisture absorption: Non-hygroscopic.
- Water vapour diffusion resistance μ : ≥ 5000 to EN 13469.

Fire performance: To **PRODUCTS, FIRE PERFORMANCE**.

2.17 CONDENSATE DRAINS

Material

Requirement: As documented.

- Copper: To AS 1432 Type B.
- PVC-U: To AS/NZS 1477, installed to AS/NZS 2032.

Size: The greater of unit drain connection size and DN 20.

2.18 CONTROLS AND ELECTRICAL

Components

General: Provide factory wired control panel for each unit containing the following:

- Plug-in relays.
- Terminal strips numbered to correspond to wiring diagram.
- Starter and overload protection for each motor.
- Short circuit protection: Provide each compressor and each 3-phase motor with short circuit protection by one of the following:
 - . High rupture coefficient (HRC) fuses.
 - . Circuit breaker with interrupting capacity selected to suit the anticipated short circuit current.
 - . Starter contactor with manual reset thermal or magnetic overload.
- Provide automatic lead/lag changeover for units with multiple compressors.
- HRC fuse or circuit breaker short circuit protection for each crankcase heater (if fitted) and control circuit.
- Terminals for remote indication of run and fault conditions.
- Permanent, weatherproof, wiring diagram fixed on or next to the control panel.

Safety controls: Arrange so that tripping of one item does not shut down other items that are not directly dependent on its operation.

Isolating switch: Provide system isolator for each system.

Condenser head pressure control: Provide d.c. motor electronic condenser fan speed control to maintain minimum condenser head pressure at all operating ambient conditions.

This may be required to prevent low pressure tripping if units are to operate in cooling mode under low outdoor ambient conditions.

Pump-down control: If documented, provide solenoid valve and automatic pump-down control.

3 EXECUTION

3.1 BUILT-UP PLENUMS

This suits traditional proprietary bolted and/or welded tray section construction.

Casing

Construction: Metallic-coated steel panels, folded to 450 mm maximum width with 50 mm edges and 15 mm returns.

Joints: Weld or fold and bolt together using galvanized nuts, bolts and washers. Seal joints airtight and watertight with silicone sealant.

Material thickness: 1.6 mm minimum. Provide 50 x 50 x 5 mm galvanized steel bracing angles.

Access

General: Provide at least one air tight and gasketed access door or access panel conforming to 0741 Ductwork.

Preferably show the doors or access panels on the drawings. For smaller units access panels may be adequate otherwise doors are preferred.

Size: Large enough to permit removal of components inside.

Casing insulation

See NATSPEC TECHnote DES 005 for information on specifying insulation to prevent condensation.

Insulation material: Semi-rigid or batt form in conformance with **MATERIALS** in 0744 Ductwork insulation.

Insulation facing:

- Facing in filter access section of units ≥ 1000 L/s: Apply to all sides, ceiling and floor, 0.55 mm thick perforated metallic-coated steel sheet with perforations of 2.5 mm diameter providing 10% open area.

Other perforation rates may be appropriate to achieve required acoustic performance.

- Facing in other locations: Factory applied perforated aluminium foil laminate conforming to **INTERNAL - LAMINATE FACED** in 0744 Ductwork insulation.

Installation of perforated steel facing:

- Supports: 0.55 mm metallic-coated steel Z sections sized to suit insulation thickness.
- Fixing: Space supports at 600 mm maximum centres with the lowest at 150 mm above the floor and with section flanges on the facing side turning down. Fix supports to sheet metal housings with rivets, with heads on the outside and to masonry housings with expanding masonry anchors. Overlap facing 25 mm minimum at all joints and fix to supports with rivets at 150 mm maximum centres. Trim edges at openings with Z sections.
- Cold bridging: In cold deck chambers, prevent cold bridging between housing panels and support sections.
- Perimeter: Trim with 40 x 40 x 0.55 mm angles riveted to facing at 300 mm maximum centres.
- Floor: Provide Z section supports sufficient to support the weight of a person without deforming the perforated steel facing. Space at maximum 200 mm centres.

Service lights

Units ≥ 500 L/s: Provide an 18 watt compact waterproof fluorescent luminaire in each compartment with an access door or removable panel.

The lower limit for service lights are arbitrary and may not be appropriate for some units. Modify the L/s value or specify in terms of unit dimensions e.g. for units > 1200 mm wide internally.

Switching: Connect to a common switch located outside the chamber. If exposed to weather, provide a weatherproof switch. Label the switch and provide a pilot light to indicate when the lights are on.

3.2 REFRIGERATION PIPING

General

Requirement: Conform to YANMAR's recommendations including proprietary branch and header kits to indoor units. Provide refrigeration piping designed and installed so that the complete system meets the documented performance under the documented operating conditions.

Design

Standards: Conform to YANMAR's recommendations for the refrigerant used.

Method of calculation: YANMAR Smart Select software.

Layout

General: Install pipework in straight lines and uniform grades without sags. Use wide gradient bends and maintain refrigerant joints within 30° of the horizontal plane.

Pipe support

General: Provide hangers, brackets, saddles, clips, and support system components, incorporating provisions for adjustment of spacing, alignment, grading and load distribution. Support pipework from associated equipment or building structure. Support valves, strainers and major line fittings so that no load is placed on adjacent tubes or transmitted to them during operation and maintenance.

Support type: Proprietary metallic-coated steel channel section with clamps and hangers sized to match external diameter of pipe being supported.

Vertical pipes: Provide anchors and guides to maintain long pipes in position, and supports to balance the mass of the pipe and its contents.

Saddles: Do not provide saddle type supports for pipes DN 25 or over.

Uninsulated pipes: Clamp piping supports directly to pipes.

Insulated pipe support:

- Spacers: Provide spacers at least as thick as the insulation between piping supports and pipes. Extend either side of the support by at least 20 mm.
- Spacer material: Rigid insulation material of sufficient strength to support the piping and suitable for the temperature application.
- Vapour barriers: For cold pipes apply aluminium foil tape over the circumference of the spacer to form a vapour barrier.
- Metal sheathing: Provide a 0.55 mm thick metallic-coated steel band between the aluminium foil tape and the support, for the full width of the spacer.

Pipe support spacing table

Nominal pipe size, DN	Maximum spacing (m)	
	Horizontal	Vertical
10	1	2
≥ 15, ≤ 20	1.5	2.5
25	2	3
32	2.5	3
40	2.5	4
50	3	4
65	3	4

These spacings represent common practice. See NATSPEC TECHnote DES 019 for more information on pipe support spacing.

Pipes

Piping: Provide copper tubes as follows:

- ≤ DN 15: To AS/NZS 1571, 0 temper.
- > DN 15: To AS/NZS 1571, 1/2H temper. Use annealed (0 temper) copper only for pulled bends.

0 temper = fully softened condition (annealed). 1/2H = intermediate temper (half hard).

Pipe wall thickness:

- Pipes ≤ DN 50: To AS 1432 type B.
- Pipes > DN 50: ≥ 1.6 mm.

Bends

Pulled bends: Form bends without flattening or wrinkling with an inside radius minimum 3 pipe diameters using the correct tool size for the pipe diameter.

Pipe fittings

Copper alloy fittings: To AS 3688, dezincification resistant, welded, brazed or compression type only.

Pre-formed fittings: Pre-formed refrigerant capillary line tees, bushes, couplings and elbows. Wherever possible, make reductions at elbows, tees, line devices or equipment connections with reducing fittings, otherwise provide reducing bushes or reducing couplings.

Compression fittings: Flareless twin ferrule, torque free, mechanical grip fittings which can be gauged using a precision ground and hardened metal gap inspection gauge.

Screwed joints: Use only if equipment items are not available with flare, flanged or brazed capillary connections.

Brazed joints

General: Provide pre-formed capillary fittings or form capillary unions by expanding one pipe end. Prevent flux and brazing alloy from entering pipes. Use dry nitrogen to purge air from pipes before brazing. During brazing, maintain a flow of dry nitrogen through pipes to prevent oxidation.

In addition to using nitrogen, where possible clean internal accessible joints before proceeding with further assembly work, to provide the maximum possible internal cleanliness.

Brazing alloy: To AS/NZS 1167.1 Table 2 alloy B4 \geq 15% silver content.

Brazing alloy for jointing dissimilar metals: To AS/NZS 1167.1 Table 1 alloy A18 or an alloy with an equivalent silver content (\geq 34%) and impurity levels.

Sleeves

General: Provide pipe sleeves where pipes pass through building elements.

Valves

General: Provide valves to AS/NZS 5149.2. Make provision for charging and withdrawal of refrigerant. If a gauge is not permanently connected (for example commissioning connections), seal the outlet of the isolating valve with a flared seal cap nut.

Valve types

Service valves: Back-seating type with gasketed cap.

Solenoid line valves: Solenoid coil and valve parts replaceable without disturbing valve body or refrigerant piping.

Refrigeration pipe insulation

General: Insulate all refrigerant piping that may sweat. Apply insulation un-slit where possible. If slit, refix slit faces with adhesive applied to full area.

Joining: Use only an adhesive or jointing system recommended by the insulation manufacturer.

Timing: Leak test piping before insulating joints, fittings and valves.

VRF fittings: Insulate proprietary VRF fittings with the fitting manufacturer's split case preformed insulation.

3.3 CONDENSATE DRAINS

General

See AS/NZS 3666.1 clauses 2.8 and 2.9 for drainage requirements and recommendations.

Condensate drains: Provide trapped drain lines with uniform and continuous fall to connect condensate trays to the nearest building drain point. Provide drains from the following:

- Each indoor coil.
- Each outdoor coil unless casing freely drains to a roof or other location where condensate and/or rain water will not cause damage or pond.
- Each safety tray.
- Other moisture and rainwater collecting areas.

Preferably show the location of building drain points on the drawings. There may be local statutory restrictions on where condensate can be discharged.

Pipe support spacing: To AS/NZS 3500.1 Table 5.6.4.

AS/NZS 3500.1 Table 5.6.4 includes copper and PVC-U, and other materials.

Sealing: Seal drain pipes where they penetrate casing.

Termination: Terminate drains to allow visual inspection of condensate flow.

Traps: To withstand more than 2 times fan static pressure and constructed from either:

- Transparent, kink-resistant hose.
- PVC-U trap with removable caps and a visible air break.

Falls and drains: Check that the condensate tray falls conform to AS/NZS 3666.1 and in particular that trays and sumps are graded to the outlet to prevent moisture retention. Test drains by pouring a measured quantity of water into upstream end.

Insulation

It may be necessary to insulate drains in high humidity environments (e.g. tropical locations). If the condensate drain discharges into a waste line that has intermittent flows from other sources the waste may also require insulation. If so, use this *Optional text* by changing to *Normal* style text..

General: If drains run in ceilings above occupied areas or other locations where condensation could cause damage or nuisance, provide minimum 13 mm thick insulation to **REFRIGERATION PIPING** and **REFRIGERATION PIPE INSULATION**.

Condensate pumps

Requirement: If gravity condensate drainage cannot be arranged, provide proprietary packaged automatic condensate pumps to lift condensate to a point where it can drain by gravity. In all other respects, conform to **CONDENSATE DRAINS, General**.

Because of the added cost, complexity, maintenance and risk if they fail, condensate pumps should be considered a last resort.

3.4 SAFETY TRAY

Location

General: If leaks or condensation can damage or become a nuisance to the building or its contents, provide a safety tray under packaged unit and indoor unit of split systems.

Reverse cycle units: If reverse cycle outdoor units do not have drain connections, locate safety tray below unit and pipe drain to waste.

Construction

General: Metallic-coated steel sheet, 1.2 mm thick folded and stiffened, edges turned over and with all joints sealed. Sides at least 50 mm high.

Size: Extend tray at least 150 mm beyond unit casing and any components that may leak or drip condensation.

Drainage: Provide fall in tray and provide drain at lowest point. Run drain to visible waste.

3.5 UNIT INSTALLATION

General

Requirement: Supply all necessary components, including but not limited to the following:

- Means of attachment to the structure.
- Anti-vibration mounting.
- Appropriate flexible connections.
- Trim and sealing around openings.
- Electrical connections.
- Drainage connections.
- Field connection of refrigerant lines in split systems.

Alignment: Install units level, plumb and to YANMAR's recommendations.

Fixing: Bolt units in place with minimum 4 anchors or suspension rods.

Outdoor units

Arrangement: Provide clearance around units for air flow and maintenance access. Make sure discharge air does not short-circuit to condenser intake.

Alternatively, adjust outdoor coil air entering temperature to compensate for elevated air temperature due to recirculation.

Plinths: If located on grassed or similar permeable surfaces, provide concrete plinths under outdoor equipment.

For plinths see 0171 *General requirements*. Preferably show plinths on the drawings. Consider security of outdoor equipment.

Vibration isolation: Provide to each outdoor unit at least four mountings, located to give uniform deflection under the applied load.

Isolation efficiency: $\geq 90\%$.

Outdoor units mounted on concrete slabs: Mount on neoprene waffle pads.

Outdoor units mounted on steel structures or roofs: Mount on YANMAR YGAS series vibration isolators.

Duct connections

Supply duct: Provide internal or external flexible duct connection. Conform to **FLEXIBLE CONNECTIONS** in *0741 Ductwork*.

Return, outside air and condenser duct connections: Provide external flexible duct connection.

Vibration isolation

General: Provide to each assembly at least four mountings, located to give uniform deflection under the applied load.

Isolation efficiency: $\geq 90\%$.

Suspended units:

- Suspended from lightweight structures: Metal spring or rubber-in-shear isolation mountings with at least 25 mm static deflection. Provide each mounting with a levelling screw and locknut.
- Suspended from heavyweight structure: Double deflection neoprene or rubber in shear mountings static deflection greater than or equal to 15 mm.

Floor mounted units: Mount on neoprene waffle pads.

Engine exhaust

Requirement: Provide a flexible connection at the chiller and route to a safe location to YANMAR's recommendations.

e.g. to discharge away from air intakes and trafficable areas.

Material: Type 316 stainless steel to ASTM A240/A240M.

Outdoor unit within 1.5 m of openable window or air intake: Connect exhaust with a YANMAR adaptor to an external SUS exhaust system no longer than 10 m and no more than 4 bends.

Drains: Provide drains to YANMAR's recommendations in DN 20 PVC-u and pipe to waste for the following:

- Exhaust condensate neutraliser connection.
- Engine exhaust.

3.6 COMMISSIONING**General**

For information on the commissioning process refer to NATSPEC TECHnote GEN 010 and NATSPEC TECHnote GEN 020. Consider the use of *0127 Commissioning – information* and *0164 Commissioning*.

Packaged equipment: In addition to the requirements of *0791 Mechanical commissioning*, conform to YANMAR's recommendations. Record results.

Refrigerant charge: On completion, fully charge the system using the refrigerant charge mode and procedure for refrigerant in pipework.

Refrigeration systems: Conform to the recommendations of the Australia and New Zealand Refrigerant Handling Code of Practice Part 2- Systems other than self-contained low charge systems, except as follows:

- Pressure test: Pressure test to 4.1 MPa and hold for 24 hours.
- Evacuation and dehydration: Pull a vacuum to a pressure of less than 200 microns of mercury. After isolating the vacuum pump, allow the system to stand for 60 minutes to ensure the vacuum is maintained at or below 600 microns of mercury.

Evacuation: If using the deep vacuum method to the Australia and New Zealand Refrigerant Handling Code of Practice Part 2, pull a vacuum to the lowest pressure achievable with the available equipment.

The objective of the specified requirement is to make the most of the evacuation process. The achievable vacuum will depend on the pump used, system size, amount of water in the system and so on. Below 610 Pa (absolute) water freezes so additional heat will be required to remove it.

3.7 MAINTENANCE**General**

Packaged equipment: In addition to the requirements of *0792 Mechanical maintenance*, conform to YANMAR's recommendations. Record results.

Engine: Provide YANMAR approved maintenance at intervals recommended by YANMAR.

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 PACKAGED AIR CONDITIONING EQUIPMENT

Outdoor unit schedule

Property	AC1	AC2	AC3
Indoor units served			
Type			
Gas type			
Cooling: Total capacity (kW)			
Cooling: Outdoor coil entering air dry bulb (°C)			
Reverse cycle heating: Heating capacity (kW)			
Reverse cycle heating: Outdoor coil entering air dry bulb (°C)			
Refrigeration: Number of compressors			
Condenser: Rated power input (kW)			
Condenser: Rated gas consumption (kW / MJ)			
Refrigerant type			
Circuit Protection (A)			
Refrigeration: Minimum motor power per compressor (kW)			
Condenser: Fan type (see Legend)			
Condenser: Type of drive			
Condenser: Motor power (kW)			
Condenser: Maximum sound level of outdoor unit (dB(A) at 3 m)			
Options			
Additional condenser fan corrosion protection			
Additional condenser coil corrosion protection			
Condenser head pressure control			
Pump-down control			
Packaged air conditioning legend			
Condenser fans:			
- Prop: Propeller.			
- Axial: Axial flow aerofoil.			
- FC: Forward curved centrifugal.			

Property	AC1	AC2	AC3
- BI: Backward inclined (single thickness blade) centrifugal. - AF: Aerofoil backward inclined blade centrifugal.			

<p>AC1, AC2, AC3: These designate each instance or type or location of the item scheduled.</p> <p>Edit codes in the Schedule to match those on drawings.</p> <p>Indoor units served: List the indoor units connected to this outdoor unit e.g. AC1-1, AC1-2, AC1-3.</p> <p>Type: e.g. Heat pump, Heat recovery, Heat pump hot water.</p> <p>Gas type: e.g. Natural gas, LPG.</p> <p>Condenser</p> <p>Type of drive: Direct or Belt.</p> <p>Options</p> <p>Additional condenser fan corrosion protection: Insert Required or Not required.</p> <p>Additional condenser coil corrosion protection: Insert Required or Not required.</p> <p>Condenser head pressure control: Insert Required or Not required.</p> <p>Pump-down control: Insert Required or Not required.</p> <p>Adapting Outdoor unit schedule and Indoor unit schedule for Design and Construct projects</p> <p>If the contractor is to calculate the required performance and to select the equipment, the SELECTIONS schedules can be used to set generic selection parameters. Note that the documents should include sufficient information for items to be determined by the contractor, for example from documented performance parameters and drawing information. For these items, insert suitable text, e.g. To the documented requirements. The Outdoor unit schedule and Indoor unit schedule can then form the basis of the contractor's submissions with the text replaced by design values:</p> <ul style="list-style-type: none"> • Total capacity (kW). • Sensible capacity (kW). • Indoor coil entering air dry bulb (°C). • Indoor coil entering air wet bulb (°C). • Heating capacity (kW). • Indoor coil entering air dry bulb (°C). • Number of compressors. • Minimum motor power per compressor (kW). • Supply air (L/s). • External resistance (Pa). • Number of fans, minimum diameter (mm). • Condenser fan: Motor power (kW). • Maximum sound level of outdoor unit (dB(A) at 3 m). (Covered by noise performance parameters).

Indoor unit schedule

Property	AC1-1	AC1-2	AC1-3
Associated outdoor unit designation			
Space served			
Type			
Cooling: Total capacity (kW)			
Cooling: Sensible capacity (kW)			
Cooling: Indoor coil entering air dry bulb (°C)			
Cooling: Indoor coil entering air wet bulb (°C)			
Reverse cycle heating:			

Property	AC1-1	AC1-2	AC1-3
Heating capacity (kW)			
Reverse cycle heating: Indoor coil entering air dry bulb (°C)			
Supply fan: Supply air (L/s)			
Supply fan: External resistance (Pa)			
Supply fan: Minimum fan efficiency (%)			
Supply fan: Number of fans, minimum diameter (mm)			
Supply fan: Impeller type (see Legend)			
Supply fan: Type of drive (direct or belt)			
Noise level at 1.5 m from outlet (dB(A))			
Unit: Maximum electrical power input (kW)			
Air filters: Filter Class to AS 1324.1			
Air filters: Filter Performance Rating to AS 1324.1			
Air filters: Minimum dust holding capacity for a nominal 600 x 600 mm cell to AS 1324.2 Test Dust No 4 at 125 Pa (g)			
Options			
Additional supply fan corrosion protection			
Condensate drain material			
Packaged air conditioning legend			
Supply fans:			
- FC: Forward curved centrifugal.			
- BI: Backward inclined (single thickness blade) centrifugal.			
- AF: Aerofoil backward inclined blade centrifugal.			

AC1-1, AC1-2, AC1-3: These designate each instance or type or location of the item scheduled.

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

Associated outdoor unit designation: e.g. AC1.

Space served: For convenience indicate the name or location of the area served e.g. Ground Floor or East Zone.

Type: e.g. Cassette, Ducted, Ducted slim, Wall mounted, Under ceiling.

Supply fan

AS/NZS ISO 12759 provides information on determining fan efficiency under a number of conditions including off-duty point.

Impeller type (see Legend): This legend gives abbreviations for various types of fans etc.

Type of drive: Direct or belt.

Minimum motor power (kW): The fan may fall within the minimum total motor shaft power requirements of BCA J5.4. If so, make sure motors do not exceed the maximum allowed by the NCC.

High efficiency motor required: Yes or no. See also *0784 Motors and starters*. Some items such as compressors may not be available with high efficiency motors. Check with suppliers before specifying.

Unit: Maximum electrical power input (kW): Includes all internal equipment including fans and pumps.

Air filters

Filter Class to AS 1324.1: Insert A, B or C as follows:

Class A Fully disposable (entire cell replaced, including frame).

Class B Replaceable media (reusable frame).

Class C Reusable media and frame (after cleaning).

Filter performance rating to AS 1324.1: See *Guidance* in **DRY MEDIA FILTERS (TYPE 1) AND VISCOUS IMPINGEMENT FILTERS (TYPE 2)** in *0732 Air filters* for details of selection to AS 1324.1. To meet AS/NZS 3666.1 clause 2.4 recommendation, rating should be G4, F5, F6, F7, F8 or F9.

Minimum dust holding capacity: This is a typical filter size. Adjust to suit the filter type. Note that Test dusts No 2 and 3 are not to be used for air conditioning applications.

Options

Additional supply fan corrosion protection: Insert Required or Not required.

Condensate drain material: Copper or PVC-U.

REFERENCED DOCUMENTS

The following documents are incorporated into this worksection by reference:

AS/NZS 1167		Welding and brazing - Filler metals
AS/NZS 1167.1	2005	Filler metal for brazing and braze welding
AS 1324		Air filters for use in general ventilation and airconditioning
AS 1324.1	2001	Application, performance and construction
AS 1324.2	2003	Methods of test
AS 1432	2004	Copper tubes for plumbing, gasfitting and drainage applications
AS/NZS 1477	2017	PVC pipes and fittings for pressure applications
AS 1530		Methods for fire tests on building materials, components and structures
AS/NZS 1530.3	1999	Simultaneous determination of ignitability, flame propagation, heat release and smoke release
AS/NZS 1571	1995	Copper - Seamless tubes for airconditioning and refrigeration
AS 1572	1998	Copper and copper alloys - Seamless tubes for engineering purposes
AS/NZS 1734	1997	Aluminium and aluminium alloys - Flat sheet, coiled sheet and plate
AS/NZS 2032	2006	Installation of PVC pipe systems
AS 2848		Aluminium and aluminium alloys - Compositions and designations
AS 2848.1	1998	Wrought products
AS/NZS 3500		Plumbing and drainage
AS/NZS 3500.1	2018	Water services
AS/NZS 3666		Air-handling and water systems of buildings - Microbial control
AS/NZS 3666.1	2011	Design, installation and commissioning
AS 3688	2016	Water supply - Metallic fittings and end connectors
AS/NZS 3750		Paints for steel structures
AS/NZS 3750.9	2009	Organic zinc-rich primer
AS 4254		Ductwork for air-handling systems in buildings
AS 4254.2	2012	Rigid duct
AS 4506	2005	Metal finishing - Thermoset powder coatings
AS/NZS 5149		Refrigerating systems and heat pumps – Safety and environmental requirements.
AS/NZS 5149.1	2016	Definitions, classification and selection criteria (ISO 5149-1:2014, MOD)
AS/NZS 5149.2	2016	Design, construction, testing, marking and documentation (ISO 5149-2:2014, MOD)
AS/NZS 5149.3	2016	Installation site (ISO 5149-3:2014)
AS/NZS 5149.4	2016	Operations, maintenance, repair and recovery (ISO 5149-4:2014, MOD)
AS/NZS 5601		Gas installations
AS/NZS 5601.1	2013	General installations
AS 60034		Rotating electrical machines
AS 60034.1	2009	Rating and performance (IEC 60034-1, Ed 11(2004) MOD)
SA/SNZ HB 32	1995	Control of microbial growth in air-handling and water systems of buildings
AIRAH/IRHACE		Australia and New Zealand Refrigerant Handling Code of Practice
AIRAH/IRHACE 2	2007	Systems other than self-contained low charge systems
BCA J5.8	2019	Energy efficiency - Air-conditioning and ventilation systems - Pipework insulation
AHRI 460	2005	Performance rating of remote mechanical-draft air-cooled refrigerant condensers
ASTM A240/A240M	2018	Standard Specification for Chromium and Chromium-Nickel Stainless Steel Plate, Sheet, and Strip for Pressure Vessels and for General Applications
ASTM B117	2018	Standard practice for operating salt spray (fog) apparatus
UL 984	1996	Standard for hermetic refrigerant motor-compressors
EN 13469	2012	Thermal insulation products for building equipment and industrial installation – Determination of water vapour transmission properties of performed pipe insulation.
EN 16905		Gas-fired endothermic engine driven heat pumps

EN 16905-1	2017	Terms and conditions
EN 16905-3	2017	Test conditions
EN 16905-4	2017	Test methods
JIS B 8627		Gas Engine Driven Heat Pump Air Conditioners
JIS B 8627-1	2006	General Requirements
The following documents are mentioned only in the Guidance text:		
AS/NZS ISO 817	2016	Refrigerating systems - Refrigerant classification
AS 2784	2002	Endless wedge belt and V-belt drives
AS/NZS 3666		Air-handling and water systems of buildings - Microbial control
AS/NZS 3666.2	2011	Operation and maintenance
AS/NZS ISO 12759	2013	Fans - Efficiency classification for fans
BCA G1.2	2019	Ancillary Provisions - Minor Structures and Components - Refrigerated chambers, strong-rooms and vaults
BCA Section J	2019	Energy efficiency
BCA J5.4	2019	Energy efficiency - Air-conditioning and ventilation systems - Fan systems
NATSPEC DES 005	2018	Preventing condensation on ducts and air handling plant
NATSPEC DES 010	2015	Atmospheric corrosivity categories for ferrous products
NATSPEC DES 019	2018	Pipe support spacing
NATSPEC DES 022	2010	Microbial control
NATSPEC DES 031	2014	Specifying R-Values
NATSPEC GEN 006	2007	Product specifying and substitution
NATSPEC GEN 010	2009	Mechanical commissioning strategies
NATSPEC GEN 020	2018	Building commissioning
NATSPEC GEN 024	2015	Using NATSPEC selections schedules
NATSPEC PRO 007	2016	Refrigerant options
NATSPEC TR 01	2018	Specifying ESD
NATSPEC TR 03	2018	Specifying Design and Construct for Mechanical services
PCA	2019	National Construction Code Series Volume 3 - Plumbing Code of Australia
YANMAR	2016	GHP engineering data manual
ISO 5149 series		Refrigeration systems and heat pumps - Safety and environmental requirements