

TMK CONSULTING ENGINEERS

SPECIFICATION 1907135 ME_A
OCTOBER 2019



SPECIFICATION FOR MECHANICAL SERVICES

**PROPOSED MULTI-LEVEL MIXED USE DEVELOPMENT
76 – 78 COMMERCIAL ROAD, PORT ADELAIDE SA**

FOR: VITO GROUP PTY LTD



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SECTION 1 - GENERAL

1.1 SCOPE OF WORK

The Contract Conditions, Preliminaries and the Drawings form a part of the contract.

The mechanical drawings are:

1907135-M1

1907135-M2

1907135-M3

The mechanical drawings form only part of the contract and all other drawings shall be read in conjunction. Extent of work may be specified on any drawings.

The strength and rigidity of all structures and fastenings throughout shall be adequate to prevent failure, significant movement or deflection throughout the life of the installation during operation, traffic or maintenance. The Mechanical Services Contractor shall submit shop drawings or other details of frames, structures and building work for approval of the Superintendent before fabrication or installation.

Locate all equipment and services where shown on the drawings. Overall sizes shall not exceed those specified and shall otherwise conform generally to the sizes shown on the drawings. The Mechanical Services Contractor shall have stated at the time of tendering any changes that are required to these provisions and shall be fully responsible for the cost of any subsequent alterations or reselection of equipment necessary to complete the work as specified.

Be responsible for the formation of necessary openings, recesses and making good and other incidental work required for the mechanical services.

The mechanical contractor must provide a cost breakdown for the supply of the air conditioning plant. The client reserves the right to supply the air conditioning plant with the installation, commissioning, etc. by the mechanical contractor.

The work includes, but is not limited to, the "design", supply and installation, testing and commissioning of the following:

- **Single Split Air Conditioning Units**

- Provide two (2 off) reverse cycle, inverter, single split, duct mounted type air conditioning units to serve the areas as shown complete with all associated ductwork, air diffusers/grilles, pipework (refrigeration and condensate), filters, condensing unit, electrical and controls and the like for safe and satisfactory operation.
- Prepare static pressure calculations associated with all fan systems, air distribution ductwork systems etc for approval.
- Vibration isolation of all new plant, including provision of any additional plant support duct penetrations sealing, flashings / overflashings etc to complete the entire installation.
- Provide condensate pumps where necessary to enable drainage.

- **Variable Refrigerant Flow Units (heat pump type)**

- Provide sixteen (11 off) reverse cycle, inverter, single split, wall mounted type air conditioning units to serve the area as shown complete with all associated pipework (refrigeration and condensate), filters, condensing unit, electrical and controls and the like for safe and satisfactory operation.



- Provide five (5 off) variable refrigerant flow 'heat pump' type air conditioning condensing system to serve the fan coil units as designated complete with all associated pipework (refrigeration and condensate), electrical and controls and the like for safe and satisfactory operation.
- Prepare static pressure calculations associated with all fan systems, air distribution ductwork systems etc for approval.
- Vibration isolation of all new plant, including provision of any additional plant support duct penetrations sealing, flashings / overflashings etc to complete the entire installation.
- Provide condensate pumps where necessary to enable drainage.
- **Exhaust Systems**
 - Provide and install six (6 off) duct mounted toilet exhaust fans complete with ductwork, air diffusion, fire dampers, electrical and controls and the like for safe and satisfactory operation.
 - Provide and install domestic kitchen exhaust hood flue ductwork as shown complete with air diffusion, electrical and controls and the like for safe and satisfactory operation. The domestic hood to outside by mechanical contractor. Confirm flue size required with builder to suit hood.
 - Provide and install proprietary kitchen exhaust ductwork, capped at ground & roof level, including make-up air ductwork as shown.
 - Exhaust systems shall remove odours and steam rapidly.
 - Prepare static pressure calculations associated with all fan systems, air distribution ductwork systems etc for approval.
 - Coordinate with builder for locations of door grilles, undercuts, access panels, etc.
- **Drainage**
 - Condensate and waste from air conditioning units and the like shall be piped to tundishes as shown.
- **Electrical Work**
 - Provision of all necessary cabling and control interface cards, etc for all control equipment.
 - Connection to isolator adjacent each item of plant and wiring to all mechanical plant by Mechanical Services Contractor. Isolator to be provided by the Electrical Services Contractor.
 - Co-ordinate/confirm the location and size to other trades prior to installing any equipment.
- **Coordination**
 - Provide accurate and complete coordination with all other subcontractors and the Builder.
 - Preparation of coordinated shop drawings before construction and amended to as installed at the end of the project.

- **Painting and Labelling**
 - Provide corrosion protection painting to all plant and equipment. Provide labelling of all systems.
- **Training**
 - Full training of the Client in the operation and maintenance of the mechanical services systems.
- **Testing and Commissioning**
 - Testing and commissioning of all installed systems including detailed reports.
- **Operating and Maintenance Manuals**
 - Operating and Maintenance manuals complete with as-installed drawings.
- **Comprehensive Maintenance and Warranty**
 - Twelve months maintenance, warranty and defects liability for the entire installation from the date for practical completion.
 - Provide comprehensive maintenance of all systems including full warranty on all equipment and systems.

All technical questions regarding this contract shall be directed to TMK Consulting Engineers on phone 8238 4100, facsimile 8410 1405 (Level 6, 100 Pirie Street, Adelaide, SA).

All work shall be carried out under the terms of this Specification and shall conform with all relevant Statutory Authorities, relevant Australian Standards, Building Code of Australia (NCCS) and Government requirements.

The extent of the work stated above is not a complete list of each component, action or work to be undertaken in this Contract. It is up to the tenderer to obtain information as required through a site inspection, interpretation/understanding of the Specification and drawings to allow for all work required to complete the project to the satisfaction of the Architect.

The Sub-contractor shall review all tender documents and ensure that the tender includes all work, insurances, etc required to complete the tender.

1.2 CO-ORDINATION AND BUILDERS WORKS

Building works to be carried out by the Builder:

- Forming of all openings in walls, floors, ceilings, and roofs for the passage of ducts, pipes, registers, conduits and the like, and weather sealing where necessary.
- Hinged access doors and panels for means of access to control devices in false ceilings, walls, floors and the like.
- Installation of floor grilles, undercut doors, door and wall mounted transfer grilles (provide grilles under this section), including external weatherproof louvres.
- Cutting and chasing for conduits and pipework.
- Decorative painting of all ducts, pipework and the like exposed to general view.
- Make good, and paint to match the surrounding surfaces, areas on walls, floors and ceiling after the work of the mechanical services. Make good to floors, ceiling and walls after work has been installed.
- Framing of ceilings and bulkheads for diffusers, grilles, light fittings etc.



- Cranage and lifting of equipment.

The following work associated with the Mechanical Services shall be advised to the Builder:

- The size, location and number of openings through walls, floors, ceiling and roof.
- The sizes and weights of all equipment.

Building works to be carried out by the Mechanical Services Contractor:

- Removal and installation as required of all noggings.
- Seal all penetrations, fire proof at fire barriers.
- Where items are of dissimilar metals, they shall be separated by suitable material.
- The provision of all hoisting and scaffolding required for the installation of the above systems.
- Provide access panels in mechanical ductwork and built up plenums.
- Upstands and over flashing where ducts, pipes and conduits penetrate roofs.

1.3 PENETRATIONS

Do not penetrate fire walls and structural members without approval. Fire stop / seal all penetrations.

1.4 EQUIPMENT

Supply and install new proprietary materials, equipment and appliances as specified and scheduled. Install in accordance with the manufacturer's recommendations.

1.5 INSPECTION OF SITE

Arrange to inspect the site prior to pricing submission. Select equipment to meet the specified limiting conditions in this specification.

1.6 ASSOCIATED BUILDING WORK

Before commencing work or ordering equipment/materials a detailed list of associated Builders Work including suitable access requirements for plant, access panels, service points, penetrations and condensate runs is required. Additionally provide details of registers, duct layouts, and all required equipment, plant and services locations.

Any works found necessary after this action, to allow the Mechanical Services to be installed and function in accordance with the performance criteria, shall be at the Sub-contractors cost.

Submit at least two weeks before ordering plant or commencing work, two preliminary copies of Drawings showing duct layouts, plant, equipment and services locations and arrangement, wiring diagrams and details of associated building work, for agreement and the written approval of the Architect

1.7 AT TIME OF COMMISSIONING

Supply three bound sets of system Operating and Maintenance Instructions and wiring diagrams.

Be responsible for the initial start-up and operation of the complete systems and each item of equipment until the time that the whole installation is operating under commercial load to the satisfaction of the Architect

1.8 INTENT



It is intended the Works shall include everything obviously required to complete the installation to the satisfaction of the Principal.

Provide all materials and labour to completely install all new controls, panels, registers, ducts, piping, equipment and cabling as required by this Specification. All elements of the installation shall be installed in accordance with the manufacturer's recommendations unless otherwise varied by the Specification.

1.9 TERMINATION POINTS

The work covered by this specification shall be fully complete and independent within the limits of the following termination points at which it shall connect to existing system of work carried out by others.

1.9.1 General

Confirm and co-ordinate all terminations on site.

1.9.2 Electrical

Connection to isolator adjacent each item of plant and wiring to all mechanical plant by Mechanical Services Contractor. Isolator to be provided by the Electrical Services Contractor.

Wiring to all motorised dampers within ceiling space from nearest isolator adjacent fan coil units by Mechanical Services Contractor.

Co-ordinate/confirm the location and size to other trades prior to installing any equipment.

1.9.3 Controls

Control and wiring of all shall be incorporated in the tender.

1.9.4 Condensate

Drain to tundish. Tundishes for condensate drainage to be provided by the Hydraulic Services Contractor. Co-ordinate with the Hydraulic Services Contractor.

1.10 INFORMATION REQUIRED WITH QUOTATION

- a Full schedule of technical data of equipment offered, as stated in Appendix.
- b Schedule of Sub-Contractors.
- c Full schedule of Builders work.



SECTION 2 - MAINTENANCE AND COMMISSIONING

2.1 GENERAL

Be responsible for the initial start up and operation of both the complete system and of each item of equipment covered by this Specification and until the time that the whole installation is operating under commercial load to the satisfaction of the Proprietor. Make all adjustments and alterations during the commissioning period which are required to establish safe, reliable and automatic operation and to achieve the specified conditions of service, operation and performance.

Demonstrate to the Proprietor that the system is satisfactorily commissioned before the Certificate of Practical Completion can be issued. Notice of intent to issue this Certificate of Practical Completion will be given in writing with effect from 4.00 pm on the date of satisfactory conclusion of that demonstration.

2.2 SAFE WORKING PROCEDURES

Establish safe, working procedures applicable to the site and provide danger notices, danger tags, and the like, for use during the Maintenance Period.

2.3 OPERATIONAL MAINTENANCE

The Maintenance Period shall be co-extensive with the Defects Liability Period (52 calendar weeks).

During the Maintenance Period promptly rectify faulty parts and equipment.



SECTION 3 - SYSTEM PERFORMANCE

3.1 PERFORMANCE AND GUARANTEE

Guarantee that the entire connected systems shall start up, shut down, simultaneously operate automatically, steadily, safely, reliably and with optimum efficiency at full load and to provide all other intermediate ratings at part load, as required throughout the whole year to achieve the following conditions given the scheduled design data:

3.1.1 Limiting Conditions

Extreme ambient conditions under which all plant shall be required to operate.	Summer: 46°C DB/24°C WB full solar load. Winter: 0°C DB.
Outside ambient conditions for air conditioning plant design rating.	Summer: 38°C DB/21.4°C WB full solar load. Winter: 2°C DB.
Internal conditions for cooling plant full load performance	22 ± 2°C dry bulb

3.1.2 Noise

The noise levels shown are to be guaranteed for all new plant and equipment.

Noise in occupied class / office areas	Not exceeding 42 dBA
Noise in non-occupied internal areas	Not exceeding 45 dBA
Noise in amenity areas	Not exceeding 50 dBA
Maximum noise levels under all conditions of plant operations	All areas to the requirement of Australian Standard 2107 – Acoustics – Recommended design sound levels and reverberation times for building interiors.
Noise at a site boundary due to conditioning plant	Not to exceed levels specified for commercial properties and residential properties in the Environmental Protection Act.
Vibration in occupied areas due to air conditioning plant	Not exceeding levels above which the efficiency and comfort of normal function and occupancy of the particular area is impaired.
Maximum vibration levels in occupied areas	Vibration levels (acceleration m/s ²) not to exceed Curve 1 vibration levels indicated in Australian Standard 2670 – Evaluation of human exposure to whole-body vibration.



Equipment balancing criteria - maximum allowable vibration levels (maximum peak to peak displacement mm)	0.10 - under 10 r/s fans
	0.075 - 10-16 r/s fans
	0.050 - 17-35 r/s fans
	0.025 - over 35 r/s fans
	All other equipment not to exceed limits set in Australian Standard 1359 – Rotating electrical machines – General requirements and Australian Standard 2625 – Rotating and reciprocating machinery - Mechanical vibration.
Air distribution systems	0.25 m/s maximum terminal velocity in occupied zone - air conditioning systems.

All other areas to the requirement of Australian Standard 2107 - Acoustics - Recommended design sound levels and reverberation times for building interiors.

Be responsible also to notify of any plant or equipment exceeding the above parameters so that modifications can be effected.

Carry out required alterations to limit noise prior to practical completion of the works.



3.1.3 *Design Data*

The design has been based on the following design data:

REVERSE CYCLE COOLING / HEATING / VENTILATION

Lighting Load	Minimum of 10 W/m ²
Equipment Load	Minimum of 20 W/m ² unless stated otherwise
People Load	In accordance with AS1668.2 – 2012
Outside Air	In accordance with AS1668.2 – 2012
	Openable windows / doors for apartments
	7.5l/s/person for all areas unless stated otherwise, with a minimum particulate filtration efficiency of 20%, according to test dust no.1, for air filters.
Amenities Areas	In accordance with AS1668.2 - 2012, exhaust 10L/s/m ² minimum unless stated otherwise
Internal Heat Gains	70 W / person, sensible
	60 W / person, latent

3.1.4 *Air Velocities & Distribution*

Carry out all design as required and comply with the following:

- Main duct work from unit 6 m/sec maximum
- Branch duct work 4 m/sec maximum
- Duct work to outlets / grilles 3 m/sec maximum
- Necks of supplied air registers 2.5 m/sec maximum
- Through return / relief grilles 1.75 m/sec maximum
- Maximum at 1500 afl in occupied spaces 0.4 m/sec
- Minimum at 1500 afl in occupied spaces 0.1 m/sec

It is the sub-contractor's responsibility to ensure that the performance conditions stated above are achieved.

Where a discrepancy exists between the equipment scheduled and the performance parameter the sub-contractor shall confirm to the Engineer that the performance parameter is not able to be met and seek direction in writing prior to ordering or installing any of the works.

SECTION 4 - NOISE AND VIBRATION

4.1 GENERAL

Install all new plant with new vibration mountings and lead impregnated flexible connections to piping and ducting.

Noise levels within the building areas shall comply with Australian Standard AS 2107 - 'Buildings Ambient Sound Levels for Areas of Occupancy'.

All rotating machinery shall be statically and dynamically balanced and shall be designed with clearances and mechanisms to achieve the specified noise level requirements.

Motors shall not produce noise levels above those specified. All electrical contractors shall be free from undue hum and vibrations.

4.2 MOUNTING OF EQUIPMENT

All rotating machinery shall be mounted either on spring mount, rubber in shear mount or rubber pads. Ensure that rotating and vibrating equipment is mounted such that vibrations are isolated from the building structure and the ducting, piping and cabling, etc. The vibration isolation mountings and hangers must comply with the specifications below.

Any rubber used shall be neoprene which shall be protected from oil drips and mechanical damage.

The loading of the mounting shall be adequate to ensure correct operation.

When slab type isolating materials are used the material used to seal the spaces containing the isolating material shall be flexible so that vibrations are not transmitted and so that the seal is not damaged.

All components must be installed to resist seismic loads determined in accordance with AS 1170.4. Securely fix all plant and equipment to the building structure. Do not rely on gravity and/or friction to resist seismic forces.

Waffle Pad Mounts

Provide mounts consisting of a double pad of neoprene moulded into a waffle configuration with a 16 mm nominal thickness. Size the pad so that the load on the ribbed element does not exceed the manufacturer's recommendations. If necessary use a steel plate to spread the load over the pad.

Spring Isolation Mounts

Spring mountings shall be free standing and laterally stable without any housing, incorporating a 6 mm minimum ribbed neoprene non-skirt acoustical pads bonded to the base of these cups. Mountings shall have an inbuilt levelling facility capable of compensating for the rated spring design deflection and of being locked into position. Springs shall have a minimum additional travel to solid of 50% rated deflection and a diameter not less than 0.8 of loaded height. They shall be of Embelton & Co. Pty Ltd or approved equal.

Rubber Isolation Hangers

Suspension hangers shall have an active rubber element colour coded for easy identification of load capacity, with a minimum static deflection under rated load of 9 mm incorporating separate steel top and base plates completely embedded in the elastomer, which interlock in the event of fire or mechanical damage. Where necessary provide neoprene or rubber-like materials of special grades or types to withstand oils, greases, solvents etc. They shall be of Embelton & Co. Pty Ltd or approved equal.



Neoprene Isolation Mounts

Neoprene mountings shall have a minimum static deflection of 9mm. All metal surfaces shall be neoprene covered and have friction pads both top and bottom. Bolt holes shall be provided on the bottom and a tapped hole and cap screw on top. Steel rails shall be used above the mountings under equipment such as small vent sets to compensate for the overhang. They shall be of Embelton & Co. Pty Ltd or approved equal.

Rubber Isolation Mounts

Rubber mountings, colour coded for identification of load capacity, shall have a minimum static deflection under rated load of 5mm incorporating separate steel top and vase plates completely embedded in elastometer. Bolt holes shall be incorporated. They shall be of Embelton & Co. Pty Ltd or approved equal.

Seismic Spring Isolation Mounts

Spring mountings shall permit freedom of equipment motion at normal operating conditions, but restrain the equipment from excessive motion when subjected to foundation displacements in any direction. A single central vertical restraint bolt shall be used, which also locks the equipment to the mounting. Springs shall be free standing and laterally stable with acoustically isolating base cups. They shall have a minimum additional travel to solid of 50% rated deflection and a diameter not less than 0.8 of the loaded height. Housings shall be galvanised steel and comply with AS 1170.4 and NZS 4219. They shall be of Embelton & Co. Pty Ltd or approved equal.

4.3 STRUCTURAL BORNE NOISE AND VIBRATION

For all new plant and equipment ensure that the vibrations from all moving machinery are effectively isolated from the building structure.

All vibration isolators shall be of the steel spring or flexible rubber mount type.

In addition to providing isolation of all vibrating machinery from the building structure, isolate such machines to the extent of 95% from all piping and electrical connections.

4.4 TESTING

If testing by the Principal shows that noise is in excess of the specified levels, or that balancing of equipment is incorrect, or that transmissibility of mountings is excessive, correct the installation as directed and at no additional cost.

Further tests shall then be carried out to determine if the noise and vibration levels have been reduced to the limits specified.



SECTION 5 - DUCTWORK AND FITTINGS

5.1 GENERAL

All ductwork shall be installed with internal acoustic insulation or thermal insulation. Bends shall be installed at both supply and return air main ducting.

Care shall be taken to see that ductwork is air tight at the operating pressure. Machine folded joints in ductwork shall be smooth and tight, and drive slips shall be caulked at each corner. Any hand formed joints in ductwork shall be fully caulked. Caulking shall be carried out with approved non-hardening caulking compound applied to joints during fabrication and before final assembly of the joint.

All ductwork shall be firmly supported and securely fastened. Horizontal ducts smaller than 1500 mm in width shall be supported at not more than 2500 mm centres by steel rods or straps. Vertical ducts shall be supported by steel supports.

All transverse and longitudinal kitchen exhaust duct joints are to be sealed with high temperature (>100°C) duct sealant.

Weatherproof external ducts, solder or silicon seams, arch or grade to shed water, flash to seal all building penetrations.

All duct supports less than 3 mm thick shall be galvanised.

Paint duct interiors matt black where visible through grilles.

Design criteria are to be in accordance with AS 1055 "Acoustics".

Comply with Australian standards.

All flexible ducting shall be acoustic type. They shall have 50mm thick insulation and internal sheath of perforated corrugated aluminium. External sheath shall be a fire retardant impervious material. The combined materials shall have a spread of flame index number not greater than zero and a smoke developed index not greater than three. Connect to fittings with matched proprietary foam lined clamps and sleeves. All flexible ducts shall be connected to spigots with worm drive type hose clips. Mechanical banding or adhesive tape not accepted. All flexible air ducts shall comply with AS1668 Part 1.

Ensure that all ducts and fittings are streamlined and of adequate size to contain air noise to within specified limits.

Co-ordinate and confirm exact detail of adjacent structures, ceiling grids, services, fittings and fixtures in advance of construction and co-ordinate on drawings.

5.2 FABRICATION OF RECTANGULAR DUCTS

The minimum construction requirements for rectangular ducts to be as follows:

LARGEST SIDE MM	THICKNESS MM	REINFORCING SIZE & MAXIMUM SPACING
Up to 450	0.60	none required
475 to 750	0.60	25 x 25 x 4 at 1500 cts
775 to 1000	0.80	25 x 25 x 4 at 1500 cts
1025 to 1250	0.80	40 x 40 x 4 at 1500 cts
1275 to 1500	1.00	40 x 40 x 4 at 1500 cts
1525 and over	1.20	50 x 50 x 6 at 1500 cts



Standard of fabrication to ensure freedom from vibration, rattles, or drumming under all conditions of operation.

Provide all necessary reinforcement, insulation, bracing, framing and gasketting required.

Cross-break all ducts with sides exceeding 450mm and external ductwork.

Ducts must be free from deformities, fins, raw edges and other obstructions likely to affect the air flow and likely to create noise.

Angle flanges and bracing, riveted or spot-welded to ducting at 65mm maximum spacings.

There is no restriction on duct length between joints, but stiffeners between joints are to be equally spaced at not more than values tabulated above.

All joints to be in accordance with Australian Standards.

Any duct dimensions shown on Drawings are minimum internal sizes, clear of any lining.

Square elbows, may be used only where shown or specifically approved during construction, and must be fitted with air turning vanes.

Bends with throat radius less than the duct width may be used only where shown or specifically approved during construction and must be fitted with flat plate splitters. Minimum throat radius 0.35 times the duct width, or fit turning vanes.

Solder joints of air intake ducts and grade ducts to discharge moisture in a suitable manner.

5.3 SUPPORTS

All duct hangers in contact with galvanised ducts are to galvanised steel.

Support ducts with vapour sealed insulation on trapeze type hangers. Hangers to be spaced sufficiently from duct sides to clear the insulation. Hangers must not penetrate the vapour steel.

Other duct hangers may attach directly to flanges or stiffeners.

Hang duct by angles or straps in accordance with Australian Standards. Rods, straps, or angles may be used in trapeze hanger.

Not less than one set of hangers is required per length of duct.

Not less than two hangers required at each point of support.

Support equipment such as fans and other heavy equipment independently of the ductwork with rods or angles of adequate size to support the load.

Attach the hanger rods and straps to beam clamps, concrete inserts and approved anchors, built-in as required during construction. Do not cut or drill the structure without approval in writing.

5.4 DAMPERS AND SPLITTERS

Provide dampers and/or splitters at all main duct branch take-offs, elsewhere as shown on the Drawings and as required for the proper balancing of air flows.

Blades to be 1.66mm minimum, riveted to 15mm diameter minimum spindle.

The construction is to be rigid and not give rise to flutter or noise or excessive leakage in the closed position.



Fit a control level, quadrant and locking wing nut to secure the damper or splitter in the position selected. Indicate open and closed positions and provide intermediate graduations.

Damper blades 900mm maximum length between bearings.

Bearing bronze bushed and riveted to the duct sides.

Ensure that control levers and locking quadrants of all dampers are accessible.

Line the edge of all dampers and splitter blades with 4mm felt or rubber.

5.5 FIRE DAMPERS

Openings in fire rated walls or slabs shall be protected by a curtain type fire damper of Bullock manufacturer or approved equivalent. Dampers shall be provided where shown on drawings and wherever required to meet local regulations and must comply with AS1682.1-1990 and AS1668.1-1998.

Dampers shall be installed in strict accordance with the manufacturer's installation instructions, to comply with the certificates of test furnished by the manufacturer.

The damper's construction must be in compliance with the tested prototype. The body being made with galvanised steel with any welds coated with cold zinc primer type paint to prevent rusting. The damper body must be strong and rigid to prevent operational damage during transport and/or installation on site.

The dampers expansion gap must be constantly maintained with the use of the manufacture's metal expansion gap sealing system, complying with AS1682.2-1990 or an approved equivalent. Fusible links are to operate at 68°C having a UL33 rating or AS1890 rating.

5.6 FLEXIBLE DUCT CONNECTION

Flexible duct connections shall be provided at all ductwork connections to the suction and discharge openings of all fans and air handling units and elsewhere as necessary to prevent transmission of vibration.

Flexible duct connections for exhaust systems shall have woven cloth tightly sewn to approval at the longitudinal joint with an approved fireproof thread, and shall otherwise be fabricated from an approved nylon reinforced vinyl fabric.

Flexible duct connections shall be not less than 100mm long.

Flexible duct connections shall be airtight.

5.7 AIR DIFFUSERS, REGISTERS AND GRILLES

Manufacturer: Air Diffusion Agencies or approved equal

After installation of the works balance all systems.

All supply air outlets shall be provided with control dampers mounted in the outlet neck and operable from the face of the outlet, unless stream splitter dampers are required.

All return air/exhaust air grilles shall be fitted with opposed blade dampers.

Provide openings and trimming for wall openings for ducts, where required.



Only outlets for which full air distribution and noise rating data available will be accepted and which are the manufacturer's standard products. Balance air flows at all air grilles, registers, diffusers and louvres to the quantities indicated on the drawings. Adjust all directional or pattern air diffusers, registers and grilles to achieve correct, even and draught-free air distribution, or to meet specified requirements. All system balancing must be carried out at the ductwork dampers and flexible duct spigot dampers. Submit details of selection at time of shop drawings. Final neck selection shall be the responsibility of the Contractor. The Contractor through the supplier shall ensure that the correct throw is obtained.

Submit for approval representative samples of all air grilles, registers, diffusers, louvres, and their ancillary equipment to be supplied as part of the works. Any sample which fails to comply with specified requirements will be rejected, and a new sample must be submitted for approval. Manufacture of any item must not commence until the representative sample has been approved. The colour shall be selected by the Architect.

5.7.1 Supply Air Registers

Ceiling Diffusers	Square louvred diffusers. Fitted with insulated cushion head, matched to neck size, and connecting flexible ductwork. It shall be extruded aluminium construction with removable core to provide the air distribution pattern as shown in the documentation. Louvred Face Ceiling Diffusers shall be finished in powder coat to colour nominated by Architect. Diffusers shall be fitted with accessories and dampers where indicated.
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5.7.2 Return Air Grilles

Exhaust / Return Air Ceiling Grilles	Eggcrate Exhaust Air Grilles shall be of aluminium construction with minimum 90% free area. The Eggcrate Core shall be 12.5mm x 12.5mm x 12.5mm and fitted in an extruded aluminium Flanged Frame with insulated cushion head, matched to face size, and connecting flexible ductwork. Eggcrate Return Air Grilles shall be finished in powdercoat finish to colour nominated by Architect and fitted with accessories and dampers where indicated.
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5.7.3 External Grilles

External Weather Louvres	Weather Louvres shall be curved profile louvred blades and constructed in a flanged (F) or channel (C) frame to suit the installation profile. Weather Louvres shall be of extruded aluminium construction with minimum 60% free area and finished in natural anodised, powdercoat to colour nominated by Architect and fitted with accessories and dampers where indicated.
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5.8 DUCT INSULATION

5.8.1 Extent of Work

Insulate ductwork as specified below and shown on drawings.

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

- Performance.
- R-Value.
- Durability during and after installation.
- Corrosion resistance.
- Cold bridging.



5.8.2 General

Insulation shall have a maximum thermal conductivity of 0.036 w/mk at 23° and shall comply with the Early Fire Hazard Ratings as determined by AS1530 - part 3 1989 and AS1668 part 1 - 2012. The Insulation Systems, including adhesives shall have:-

- A spread of flame index not greater than 0.
- A smoke developed index not greater than 3.

Insulation must comply with the NCC 2016 – Building Code of Australia Requirements, Section J5.2: All ductwork and fittings for heating or cooling systems must be thermally insulated with insulation complying with AS/NZS 4859.1, to achieve *Total R-Value* complying with Table 3 of Specification J5.2, as follows:

Location of ductwork and fittings	Minimum material R-Value for ductwork and fittings
Within a conditioned space	1.2 (50mm)
Where exposed to direct sunlight	3.0 (100mm)
All other locations	2.0 (75mm)

Note: The thickness of insulation shown above is indicative only, and should be confirmed prior to ordering.

Incorporate insulation for flexible ductwork supplying conditioned air having the following minimum thermal properties:-

- Ductwork less than 3000mm in length R1.0.
- Ductwork greater than 3000mm in length installed within conditioned space/return air plenums R1.2.
- Ductwork greater than 3000mm in length installed within non-conditional spaces R2.0.

Limit flexible duct length to single lengths of 3000mm. Incorporate sheetmetal circular ductwork to limit flexible duct lengths.

Utilise blown insulation products manufactured only with the use of gases with an Ozone Depletion Potential (ODP) of zero. Utilise only glues and sealants of the low Volatile Organic Compound (VOC) type with emission limits after 30 days not exceeding:-

- | | |
|--------------------------|------|
| • Multipurpose adhesives | 70g |
| • Sealants | 250g |

Insulation Type

Form: Batt, board or blanket Choose from the following:

- Glass wool.
- Rock wool.
- Polyester: Thermally bonded polyester fibres.
- Polyolefin: Closed cell cross-linked polyolefin foam produced using non-CFC blowing agent.

Prohibited Materials

General: Do not provide materials:

- Containing asbestos, lead, mercury or mercury compounds.



- Containing substances listed as hazardous in the NOHSC Hazardous Substances Information System.
- Which use CFC or HCFC as blowing agents in the manufacturing process.
- Which use substances that have an Ozone Depleting Potential (ODP) greater than zero.

Internal Insulation – Metal Faced

Location

General: Apply metal facing to internal insulation in the following locations:

- 300 mm each side of fire, smoke and volume control dampers.
- Air handling plant casings and plenums.
- All other locations where insulation may be subject to mechanical damage.
- Other locations as documented.

System description

Insulation type:

- Rectangular ductwork: Semi-rigid batts.
- Circular and oval ductwork: Flexible batts.

Surface facing: Perforated metal.

Application

General: Cover parts of ducts designated to be insulated with individual pieces of insulation for each side of the duct. Where this is not possible, butt join edges of adjacent pieces. Overlap adjacent sides at corners.

Rectangular ductwork

Metal facing: Support insulation against duct surfaces with metal facing, cut and folded to the inside dimension of the duct to form overlapping joints at corners. Rivet the overlap at 300 mm maximum centres.

Facing material: 0.55 mm metallic-coated steel uniformly perforated with 2.5 mm diameter holes providing 10% open area.

End nosings: At ends of ducts hold insulation and metal facing in position with U-shaped metallic-coated steel end nosings, with edges crimped towards the surface. Rivet end nosings to ducts and rivet the overlap with the metal facing at 300 mm maximum centres, with at least one rivet per duct face.

Nosing size: 0.55 mm thick with a minimum 25 mm turn-back over the metal facing.

Fixing: Z section 0.55 mm metallic-coated steel fastened to ductwork and to facing with blind rivets. Provide adhesive cloth tape between the Z section and the duct. For duct sides over 600 mm, hold in position at 600 mm maximum centres with at least one row of rivets per duct face. Arrange to prevent condensation on cold surfaces.

Circular ductwork

Metal facing material: Metallic-coated steel uniformly perforated with 2.5 mm diameter holes providing 10% open area.

Method: Fabricate the facing in the same manner as the circular duct, with helical lock seams for longitudinal joints. Lap transverse joints in the facing in the direction of air flow with a minimum overlap of 75 mm. Wrap insulation around the facing so that the surface designed to be exposed faces the air stream, and fix with polypropylene straps. Slide the insulated cylinder into the circular ductwork sections. Where the insulation is terminated, and at joints, provide end caps or channels.

Metal facing table

External duct diameter (mm)	Metal facing thickness (mm)
≤ 650	0.6
> 650, ≤ 950	0.8



> 950, ≤ 1250

1

External Insulation – Laminate Faced

System description

Insulation type: Flexible batts or blanket.

Surface facing: Factory applied aluminium foil laminate.

Application

General: Wrap insulation around the outside of ducts, covering the parts designated to be insulated. Minimise the number of joints.

Joints: Square cut and butt together the edges of adjacent pieces of insulation.

Insulation of bends: Apply a single piece of insulation to each face of a bend or transition. Insulate bends and transitions on round and flat oval ducts with individually mitred gores cut to fit the fitting.

Vapour sealing: Seal the vapour barrier at joints with 100 mm wide aluminium foil laminate tape, applied centrally over the joint. Where the insulation is impaled over pins, seal the vapour barrier by covering pins with water-based mastic vapour barrier or reinforced aluminium foil faced tape at least 100 x 100 mm.

Flanges, stiffeners and joints: Maintain insulation thickness over flanges, joints, stiffeners and other items that protrude from the face of the duct. Use one of the following methods:

- Carry the insulation material over the protruding item without cutting or joins.
- Insulate with 150 mm wide strip of the same material as used for the duct. Fix with a row of pins and speed nuts on each side of the protruding item. Provide a continuous vapour barrier.

Polyolefin foam insulation: Apply proprietary 120 mm wide polyolefin foam flange strips over flanges, joints and stiffeners.

Fixing method

Materials other than polyolefin foam: Select from the following:

- Pin method: Provide pins to each face of the duct as follows:
 - Horizontal ducts < 380 mm wide: Pins not required.
 - Horizontal ducts > 380, < 760 mm wide: One row of pins along centreline to side and bottom duct faces at 380 mm maximum centres.
 - Horizontal ducts ≥ 760 mm wide: Pins spaced at 380 mm maximum centres.
 - Vertical ducts < 610 mm wide: Pins not required.
 - Vertical ducts ≥ 610 mm wide: Pins spaced at 380 mm maximum centres.
- Strap and pin method: Provide 12 mm wide polypropylene strapping at maximum 600 mm intervals.
 - Horizontal ducts ≥ 600 mm wide: Hold insulation in position on the underside with fixing pins spaced at 400 mm maximum centres with at least one row per duct face.
 - Vertical ducts ≥ 600 mm wide: Provide pins to all faces at 400 mm maximum centres.
- Corner angle and strap method: Provide metallic-coated sheet steel corner angles on all four sides of the duct. Retain with 12 mm wide polypropylene strapping at maximum 750 mm intervals. Provide angles as follows:
 - 25 mm nominal thickness insulation: 38 x 38 mm.
 - 50 mm nominal thickness insulation: 63 x 63 mm.
 - 75 mm nominal thickness insulation: 90 x 90 mm.

Polyolefin foam: Provide pins spaced 50 mm from all edges and spaced 200 to 300 mm apart in all directions.

External Insulation – Laminate Faced and Metal Sheathed

System description

Insulation type: Semi-rigid batts.



Surface facing: Factory applied aluminium foil laminate.

External protection: Metal sheathing.

Application

General: Comply with **External insulation – laminate faced**.

Support: Support insulation against the duct surfaces with 0.55 mm metallic-coated steel cut and folded to the outside dimensions of the insulated duct.

Joints in sheathing: Lap joints in sheathing at least 30 mm and rivet at 100 mm centres. Factory made joints may be of the grooved seam or spot welded type. Where necessary, provide for sheathing removal for maintenance or access, by providing self tapping screws that do not penetrate the vapour barrier.

Sealing: If exposed to weather, seal joints with silicone mastic sealant.

5.9 FLEXIBLE DUCT SIZES

If not specified elsewhere, the following minimum duct sizes shall be used.

AIRFLOW RANGE	FLEXIBLE DUCT SIZE FOR CONNECTING TO CUSHION HEADS ABOVE	DUCTS DIRECTLY CONNECTED TO NECKS OF DIFFUSERS/GRILLES
0-80 L/s	200mm Dia	200mm Dia
81-120 L/s	250mm Dia	250mm Dia
121-180 L/s	300mm Dia	300mm Dia
181-240 L/s	350mm Dia	350mm Dia
241-340 L/s	400mm Dia	400mm Dia
341-440 L/s	450mm Dia	450mm Dia

Where circular flexible ducts are too large, use oval flexible ducts or equivalent.

5.10 PAINTING

Paint all exterior including roof top ductwork to colour nominated by Architect.

Paint all visible ductwork to colour nominated by Architect.



SECTION 6 - PIPEWORK, VALVES AND FITTINGS

6.1 GENERAL

Supply and install all pipework, valves and fittings necessary for the correct and satisfactory connection of the piping systems covered by this Specification.

All pipework shall be run parallel to walls and grids and grouped together. Submit details of where all refrigeration pipework will pass. Show on shop drawings. No pipework shall be visible within the unit for internally mounted units.

Every precaution shall be taken to clean out all piping before, during and after erection, and to prevent foreign material being left in the pipe.

Be responsible for any damage caused by debris in pipes.

6.2 PIPE MATERIALS

- Refrigerant Supply Copper to AS1571
- For Waste Copper to AS1432
- Water Supply Copper to AS1432

Obtain inspections and approval of all pipework pressure tests. Pressure test all pipework to all relevant standards. All pipework to be hydrostatically tests to 1.5 times the working pressure. Maintain a log book and obtain approval of tests.

Use drip trays for collection of condensate. The drain size to be minimum DN 20 trapped. Provide 1/200 gradient (where possible), otherwise provide proprietary condensate pump to achieve drainage. Match equipment drain size if larger.

6.3 INSTALLATION

Include all pipe off-sets to clear plant duct work and electrical cable trays. Co-ordinate with other trades.

It is the sub-contractor's responsibility to ensure that stresses in pipework are kept within allowable limits and that forces due to expansion are not transferred to equipment. Install all pipework such that it shall not be subject to undue stresses and strains.

Deliver all pipe to site with prepared ends and end covers. Store steel pipes off the ground prior to installation.

Supply and install all necessary pipe supports and hangers required for the installation to ensure proper support to provide for gradients and anchorage. Components shall be designed to meet all possible operating conditions to which components and piping may be subjected. Where pipework and supports are of dissimilar metals, they shall be separated by a suitable lining or the piping locally wrapped with heavy duty PVC tape.

Provide and install all auxiliary structural members required for supporting or anchoring piping and accessories. Check these joints for alignment and correct fit prior to hydraulic test. Refix securely these supports where these have been moved and prove these supports are firm. Galvanised steel brackets with minimum 5 mm neoprene lining shall be used for wall attachments adequately reinforced and braced. All pipes subject to thermal expansion shall be free to move.

Isolate pipework hangers or brackets to prevent vibration and noise transmission in accordance with Section "Noise and Vibration". Provide a neoprene strip between the pipework and support saddle in all locations.



6.4 PIPING SYSTEMS INSULATION

Supply and install thermal insulation to all pipework in accordance with the following schedule.

Equipment, System	Thermal Insulation Requirements
Refrigeration pipework	All pipework insulated as scheduled below
Condensate drain pipework	First 3000mm of drain pipework adjacent in ceiling fan coil units insulated as scheduled below.

Provide piping system insulation systems as follows:-

- 25mm thick flexible closed cell, chemical blown PVC nitrate rubber sponge type material "Armaflex" manufacture or equal approved having a thermal conductivity of not greater than 0.04 W/mK at a mean temperature of 25°C.
- Where internal to the building utilise "FR/Armaflex" or equal approved comply with Australian Standard 1530 - Methods for fire tests on building materials, components and structures - Spread of Flame Index 0, Smoke Developed Index 3.
- Utilise only products manufactured using blowing gas with an Ozone Depletion Potential (ODP) of zero.
- Prior to the application of the insulation thoroughly clean free of scale, rust, grease and dirt all piping surfaces.
- Apply the insulation without longitudinal slitting, glue all joints with a waterproof adhesive and tape all joints and ends.

6.5 PAINTING AND ANTI-CORROSION TREATMENT

Paint all exterior including roof top pipework to colour nominated by Architect.

Paint all visible pipework to colour nominated by Architect.



SECTION 7 - COOLING / HEATING SYSTEMS

7.1 GENERAL

Refer to the Drawings and schedules to determine the type of units required and the performance required of the units. Ensure that the performance of the units, as required, is achieved.

All air conditioning systems are to provide and maintain comfort conditions within the rooms to scheduled parameters. The units shall be a reverse cycle system of capacity as specified and controlled thermostatically as specified. All refrigeration plant must be designed, installed and maintained to the relevant provisions of AS 1677 including pipework, fittings, wiring and accessories necessary for the proper functioning of the installation.

All systems must comply with the NCC 2016 – Building Code of Australia Requirements, Section J5: All packaged air conditioning equipment including a split unit and a heat pump must have an energy efficiency ratio, when tested in accordance with Australian Standards, complying with Table J5.4d of the NCC 2016 and must be Minimum Energy Performance Standards (MEPS) compliant as outlined by the appropriate Australian Standards. Confirm compliance with tender.

Ensure that all plant is mounted via vibration isolators as required. Install lead impregnated vinyl flexible connections. Ensure acoustic insulation to all plant to limit noise to specified limits.

Connect each unit to each control panel and make adjustment for proper operation.

Provide proprietary condensate pumps to the associated air conditioning unit (where available) or of Vada manufacture or approved equal wherever condensate drain fall is not achievable from air conditioning fan coil units.

7.2 SINGLE SPLIT AIR-CONDITIONING

System to be provided from a manufacturer with certified rating data, factory assembled, fully automatic, standard type, split air conditioning unit comprising of wall, ceiling or duct mounted evaporator sections and remote air cooled condensing sets.

Manufacturer: Daikin, Mitsubishi Electric or approved equal.

Install the system in strict accordance with the manufacturer's requirements.

Ensure that the selected system is capable of maintaining conditions at the required pipe length and elevation separation between the condenser and evaporator.

Supply and install proprietary wall, ceiling or duct mounted type, air cooled reverse cycle air conditioners where shown on the drawing equipped with the following features:

- The air conditioning units shall be proprietary, split, refrigerated air cooled, heat pump generally as shown on the drawings with one condensing unit connected to one fan coil
- The air conditioning units shall be of digital scroll type, capable of continually adjust its cooling and heating capacity to suit the temperature in the room with ability to operate at 130% of its rated capacity.
- Minimum two speed indoor fan selection for cooling or heating with push button controls
- Air flow adjustment with adjustable air vanes
- Controls installed in location to be confirmed on site (no infra red remote controls)



- For non-ducted type units, incorporate temperature sensor within return air stream of unit generally, remote at control panel where outside air is introduced to the unit or when the unit is installed in a ceiling at a height greater than 3000
- Easy filter removal for cleaning or replacement
- Minimum two speed outdoor fan
- Incorporate condensate pump within the unit casing for cassette type units.
- Interlock the operation of proprietary condensate pumps to the associated air conditioning unit. Also interlock such that upon failure of the pump, the coil cooling is inhibited
- Where fan coil units are installed in ceiling spaces incorporate an additional galvanised steel 1 piece drip tray complete with drain connection to the underside of each unit.
- Compressor delay start protection
- Inbuilt safety controls
- Thermostatic controls
- Install the air conditioner according to manufacturer's instructions
- Supply air fan, double with, double inlet forward curved centrifugal fan, fan wheel on solid one piece shaft mounted on rubber support ball bearings and be belt driven. Variable pitch pulley drive
- The evaporator coil shall have copper tubing and aluminium fins and face velocity not exceeding 2.5 m/s.
- The condensing unit section shall be equipped with direct driven propeller fan or centrifugal fan dependent on the configuration. It must be provided with Hermetically Sealed Swing Type or similar compressors complete with aluminium fins mechanically bonded to the tubes with BlyGold.
- The refrigeration system shall have refrigerant R410A and capillary or thermostatic refrigerant expansion control. The minimum number of independent circuits is stipulated in the schedule (ie. stages).
- The unit shall be equipped with all protective devices.
- The unit shall be factory painted to colour nominated by the Principal.
- Submit system pressure calculations and final fan and motor selections before ordering equipment.
- Install a 25mm condensate drain pipe from each fan coil unit to the nearest waste. Insulate condensate pipes.
- Where condensing units are above/adjacent paths/walkways incorporate drains to tundishes/soakage pits
- Sound power levels shall be below comfort conditions.



7.3 VARIABLE REFRIGERANT FLOW TYPE AIR CONDITIONING

System to be provided from a manufacturer with certified rating data, factory assembled, fully automatic variable refrigerant flow air conditioning units comprising of ducted, bulkhead, wall mounted or ceiling mounted cassette evaporator sections and heat recovery air cooled condensing sets.

Manufacturer: Daikin, Mitsubishi Electric or approved equal.

Install the system in strict accordance with the manufacturer's requirements. The capacity percentage (%) must be 100%. That is, the total capacity of the indoor units must match the total capacity of the outdoor unit.

Ensure that the selected system is capable of maintaining conditions at the required pipe length and elevation separation between the condenser and evaporator.

Supply and install proprietary wall mounted and duct mounted type, air cooled air conditioners where shown on the drawing equipped with the following features:

- The air conditioning units shall be proprietary of the variable refrigerant flow, refrigerated air cooled, generally as shown on the drawings with one condensing unit connected to multiple fan coil units
- Provide system of the "Heat Pump" type.
- The air conditioning units shall be of inverter type or similar, capable of continually adjust its cooling and heating capacity to suit the temperature in the room with ability to operate at 130% of its rated capacity.
- Incorporate isolating switch adjacent each indoor unit
- Minimum two speed indoor fan selection for cooling or heating with push button controls
- Air flow adjustment with adjustable air vanes
- Controls installed in location to be confirmed on site (no infra red remote controls)
- For non-ducted type units, incorporate temperature sensor within return air stream of unit generally, remote at control panel where outside air is introduced to the unit or when the unit is installed in a ceiling at a height greater than 3000
- Easy filter removal for cleaning or replacement, complete with airtight, gasketed access panels.
- Incorporate condensate pump within the unit casing for cassette type units.
- Interlock the operation of proprietary condensate pumps to the associated air conditioning unit. Also interlock such that upon failure of the pump, the coil cooling is inhibited
- Incorporate 1.6mm galvanised steel, epoxy or PVC coated, 1 piece drip tray under the coil sections, insulate and vapour seal the underside of the drip trays.
- Where fan coil units are installed in ceiling spaces incorporate an additional galvanised steel 1 piece drip tray complete with drain connection to the underside of each unit.
- Compressor delay start protection
- Inbuilt safety controls



- Thermostatic controls
- Outside air facility for the ceiling cassette unit with fan
- Install the air conditioning system according to manufacturer's instructions
- Supply air fan, double with, double inlet forward curved centrifugal fan, fan wheel on solid one piece shaft mounted on rubber support ball bearings and be belt driven
- The evaporator coil shall have copper tubing and aluminium fins and face velocity not exceeding 2.5 m/s
- The condensing unit section shall be equipped with direct driven propeller fan or centrifugal fan dependent on the configuration. It must be provided with Hermetically Sealed Swing Type or similar compressors complete with aluminium fins mechanically bonded to the tubes with BlyGold.
- The refrigeration system shall have refrigerant R410A and capillary or thermostatic refrigerant expansion control
- The unit shall be equipped with all protective devices
- Submit system pressure calculations and final fan and motor selections before ordering equipment
- Sound power levels shall be below comfort conditions.
- Install a 25mm condensate drain copper pipe from each unit to the nearest waste. Insulate condensate pipes
- Where condensing units are above/adjacent paths/walkways incorporate drains to tundishes/soakage pits

7.4 FILTERS

The Air Filters shall be the following type unless otherwise stated, the Dry Media Panel Type. Filters shall have a maximum face velocity of 1.75m/s. Air filters shall be cleaned and shall be altered to conform to above parameters at the end of DLP. Air filters shall have a 24% air-cleaning efficiency as determined in AS1132.5 using test dust No 1.



SECTION 8 - FANS

8.1 GENERAL

Design, supply, deliver, hoist into position, commission and test the ventilation systems for areas shown on the drawings. Comply with AS1668.

Manufacturer: Fantech

Rate ran motors at 120% fan limit load ratings.

Use ball bearings only, either sealed for life or accessible for lubrication without dismantling the fans.

Connect to air ducts where applicable, with air tight, fire proof flexible connections.

8.2 FANS

Supply and install fans for ventilating and air conditioning, to meet the specified criteria and shall be of the following types:

- (a) Mixed Flow Inline Fans
- (b) Axial Fans

Roof cowls on vertical fans shall be hinged and fitted with quick release catch for ease of maintenance. Motors shall be accessible from above.

8.3 MIXED FLOW IN-LINE FANS

Duct mounted in-line fans.

Construction

Casings to be of epoxy coated steel or reinforced injection moulded polypropelene plastic. All units are to be provided with an integral mounting foot.

Impellers are to be injection moulded plastic and of mixed-flow design.

Motors

Type – 2-speed, shaded pole or squirrel cage induction motors

Electricity supply – 220-240V, single-phase, 50Hz.

Bearings – sleeve or ball type.

Testing

Comply with AS 2936, AS/NZS 3302

Air flow tests to BS848: Part 1, 1980.

Noise data tests to BS848: Part 2, 1985

Provide anti vibration isolation mounts complying with requirements set out in section "Noise and Vibration ".

8.4 AXIAL DIRECT IN-LINE FANS

Duct mounted axial fans.

Construction

Casings are to be of mild steel, hot-dip galvanised after manufacture. Impeller blades shall be pressure die-cast aluminium, injection-moulded glass-reinforced plastic or nylon.

Motors

Type – squirrel cage induction motor

Electricity supply – single or three-phase to suit



Bearings – ball
Motors to meet Australian Standards.

Testing

Comply with AS 2936, AS/NZS 3302

Air flow tests: 315-1000mm diameter to BS848: Part 1, 1980, 1250-2000mm diameter to ISO5801:1997

Noise data tests to BS848: Part 2, 1985

Provide anti vibration isolation mounts complying with requirements set out in section “Noise and Vibration “.

8.5 ROOF COWLS

Provide fibreglass weatherproof roof cowl of proprietary manufacture fitted with gravity type backdraught dampers.

Select cowl similar or equal to Fantech Type “MRV” or “RV” in colour to match roof colour.



SECTION 9 - AUTOMATIC CONTROLS

9.1 GENERAL

Supply and install all controls and make adjustments as necessary for the satisfactory operation of all systems. Each system shall be controlled separately and locally, by operating controls and manual override. The plant shall be provided with a fully automatic control system to control the plant in the following manner.

Install auxiliary elements so that each item of plant in all systems is fully equipped for stable, safe, reliable and unattended control at all conditions of operation, both normal and abnormal. All automatic controls shall be fail safe.

Supply and install all other auxiliary elements so that each item of plant in the installation is fully equipped for safe, stable, reliable and unattended automatic operation at all practical operating conditions. Co-ordinate accurately all associated work so that the installation, connection, commissioning and service of the plant is fully integrated, reliable and safe.

A sample of all devices noted shall be submitted for approval, including temperature sensors, lockable control panel enclosures and after hour's push buttons with labelling.

All switches shall incorporate indicating lights to indicate status of operation.

9.2 CONTROL OF MECHANICAL SERVICES SYSTEMS

9.2.1 ACU – C1 & C2 (*Commercial Tenancy Units*)

Provide one (1 off) manufacturers proprietary control panel to control the air conditioning units (All proprietary control panels are to be lockable and disabled except for temperature adjustment 20 to 24°C).

Programme the air conditioning units to operate on timeclock between the hours of 8.00am and 5.30pm (adjustable). During all other others, upon activation of the on/off button the systems shall operate via a run on timer for a set period of two (2) hours (adjustable). Once activated, a second press of the on/off button shall disable the unit.

Allow for proprietary interlock cards.

9.2.2 Apartment Wall Mounted Split Units

Provide manufacturer's standard wired zoned control panel to serve the units.

Incorporate an engraved switch labelling of system designation and area served.

Set the plant initially to maintain internal space temperatures within $22 \pm 2^{\circ}\text{C}$.

9.2.3 Exhaust Fans

Interlock the operation of the toilet exhaust fans to all of the light switches / motion sensors serving the toilets. The exhaust fan shall operate whenever the lights are switched on or motion detected. Connection to the light switches / motion sensors, including all necessary relays and electrical cabling for the safe and satisfactory operation of the system is the responsibility of the Mechanical Services Contractor.



9.3 OPERATION IN THE EVENT OF POWER FAILURE

All plant and equipment shall be able to re-start automatically after a power failure in sequence as required by their own automatic control systems. Re-start shall be staggered as for normal start-up procedures. Ensure delayed starting between each air-conditioning unit.

9.4 PLANT SHUTDOWN ON FIRE ALARM

All mechanical plant to shut down on fire alarm signal. Interface at FIP by Fire Contractor. Wiring from FIP to mechanical plant by mechanical contractor.



SECTION 10 - TESTING, COMMISSIONING AND MAINTENANCE

10.1 GENERAL

On completion of the work commission the entire installation and put it into operation.

Provide proper facilities and instruments to carry out such tests as may be necessary to satisfy the Principal.

Capacity tests on plant shall be carried out at a time determined by the Principal.

Tests will be carried out during the maintenance period when the plant has been in unserviced operation for not less than one week.

10.2 COMMISSIONING

Carry out all adjustments necessary for the safe, reliable and satisfactory operation of the plant prior to the Practical Completion.

Engage the services of the supplier/manufacturer of all the equipment for testing and commissioning.

The supplier / manufacturer must provide their own fully trained, commissioning personell for commissioning of the controls. Commissioning agents will not be accepted.

All defects found during testing and commissioning shall be immediately rectified and system to be recommissioned to ensure compliance with this specification and Client's satisfaction.

10.3 AIR SYSTEMS

All air quantities shall be measured and all adjustments made to obtain the specified performances.

The total supply air quantity shall correspond to within 0% to plus 10% of the air quantities scheduled or required.

Allow for all changes to fan motor drives necessary to obtain the required performance.

10.4 MAINTENANCE AND OPERATING INSTRUCTIONS

Prepare a Maintenance and Operation Instruction Manual. Draft copies of the Maintenance and Operation Instruction Manuals shall be submitted in sufficient time for their approval. Practical Completion Certificates will not be issued until the manuals are provided and completed. Provide 3 copies.

The Manual shall comprise an A4 size plastic back hard cover 3-ring binder containing the following documents.

- (a) Project name and service on the front cover along with the Contractor's name, Subcontractor's name and the Principal's name. Include Project name and service on the spine of the binder
- (b) Title Page which includes the name of the Subcontractor and his address and contact numbers and the expiry date of the Defects Liability Period
- (c) Table of Contents
- (d) An easy to read general description of plant including installation covering all the systems and their functions
- (e) Plant Operation
 - Starting and Stopping Procedure
- (f) Automatic instructions



- Description of all control functions, with instructions for re-setting and adjusting controls and for correct starting, operation and shut down of the plant
- (g) Maintenance Instructions – Ensure to provide a “warning” note where maintenance of the plant involves a hazard to personnel and should only be carried out by qualified service technicians
 - Routine
 - Preventative
- (h) List of Equipment Suppliers including name, address, equipment model
- (i) Include manufactures instructions and literature on all equipment installed. Include copies of manufacture’s manuals and brochures
- (j) Schedule of Technical Data
- (k) Test records and commissioning data. Include all test and approval certificates (i.e. COC’s etc.)
- (l) Electrical Wiring Diagrams
- (m) Three copies of “As-Installed” drawings both in A1 and A3 size to be included in each manual. Also include “As-installed” drawing CAD files
- (n) Log book to be included in the manual with sufficient pages to record maintenance items noted below in Section “Service and Maintenance” for a period of 12 months from Practical Completion
- (o) Provide two sets of CD’s containing all text within the Operating and Maintenance Manuals

All installation Drawings shall be neatly folded and inserted in a strong plastic envelope(s) which can be fixed into binder.

10.5 SERVICE AND MAINTENANCE

Carry out regular inspections at period scheduled below and fully service all plant for the term of the Guarantee and Maintenance Period. Replace all expendable components such as filters, etc. as necessary.

Ensure that the site is left in clean and tidy condition equal to the state at practical completion. Replace all equipment in correct positions. Leave plant in correct operating order.

Undertake controls and monitoring system inspection at the end of the defects liability period to ensure correct operation of all plant. Provide a written report to the Engineer for review. It is the Subcontractors responsibility to rectify all defects at their cost.

10.5.1 *Monthly Maintenance:*

At each maintenance visit:

1. Carry out all lubrication necessary.
2. Check and adjust as necessary all drives. Replace worn belts and adjust belt tensions and alignment as necessary.
3. Check all motors for excessive operation and record current draw.
4. Check all bearings for correct operation and lubrication.
5. Check all anti-vibration supports for proper operation including deterioration of rubber and springs.
6. Check all flexible pipe and duct connections for air tightness, damage and independent movement.
7. Clean air filters and replace media as necessary. Measure and record pressure drops across the filters and check for correct operation of all air filters.
8. Check all condensate drains and clean as necessary.
9. Check refrigerant system for evidence of leaks and correct.
10. Ensure correct operation of all safety controls.
11. Repair and replace all defective items.
12. Service all equipment in accordance with the recommendations the manufacturer.



10.5.2 Quarterly Maintenance:

In addition to the above monthly Maintenance schedule, carry out, at intervals not exceeding 3 months, the following:

1. Clean and re-grease all bearings as necessary.
2. Check operation of all dampers controlling air flow and lubricate bearings and linkages as necessary.
3. Halide test entire refrigerant system and correct.
4. Inspect and clean as necessary all fans, coils etc,
5. Clean and adjust all switchgear, contactor, and starters.
6. Provide operation of all thermal overloads.
7. Check and adjust outlet air volumes. Correct any problems of draft.
8. Check and adjust fresh air volumes.
9. Check and remove/isolate noise breakout areas.
10. Check and adjust all safety controls.
11. Check condition of insulation (including acoustic) and repair as necessary.

10.5.3 Service

Undertake to provide a comprehensive breakdown of service whereby a qualified mechanic attends the plant as soon as practicable after a breakdown is reported, and carries out immediate remedial work.

Paintwork damaged through the actions of maintenance staff shall be repaired at the Subcontractors cost to provide a surface finish in keeping with previous state of the area concerned.

Where the Contractor fails to attend the plant within eight (8) normal working hours of notification of breakdown and where remedial work is interrupted during normal working hours for purposes other than obtaining spare parts from the nearest source, the Principal reserves the right to order such action as may reasonably expedite completion of remedial work at the Contractor's expense.

10.5.4 Service Reports

During each visit complete a report, and send it to the Engineer, in the form of a check list which indicates the readings of all gauges, the condition of all items, any remedial work carried out, and the wet and dry bulb temperatures of the outside air, and the return air.

Final payment of retention monies will be only certified pursuant to receipt of Service Reports which indicate that the Maintenance and Service requirements have been regularly and satisfactorily completed.

10.6 TRAINING OF STAFF

The Contractor shall instruct persons nominated by the Principal in the correct practice of operations, routine adjustment and maintenance. Instructions shall continue as needed until the Principal can operate correctly all systems.

Provide training of the Principal's Representatives on site at times and dates to be agreed during the contract. Allow to provide an initial training session for a full period of one day within 1 month of practical completion.



SECTION 11 - EQUIPMENT SCHEDULES

11.1 SCHEDULES OF EQUIPMENT – GENERAL

Tender price submitted is to include specified equipment, as stated in Section “Cooling/Heating Systems”. Alternative approved equipment will be considered, but is to be included only as an alternative price.

Note:

- 1) Mechanical contractor to make necessary adjustments as required to ensure air quantities specified are delivered. Air cooled condenser fan motor must not use more than 15W of motor shaft power for each kW of heat rejected from the refrigerant when determined in accordance with ARI 460.
- 2) Mechanical contractor to cross reference the mechanical drawings with the schedules to confirm the number of equipment.
- 3) For acoustic reasons, ensure a minimum 3.0m length acoustic flexible duct for supply and return air, with a minimum of one bend.
- 4) Estimated resistances are provided as a guide and for tendering proposes only. The actual total resistance must be confirmed against the selections by the mechanical contractor at the shop drawing stage prior to ordering.



11.2 AIR-CONDITIONING UNITS

Air Conditioning Units – Single Split Duct Mounted Unit

Unit Designation	ACU – C1 / CU – C1	ACU – C2 / CU – C2
Area Served	Commercial Tenancy	Commercial Tenancy
Type	Single split duct mounted 'inverter'	Single split duct mounted 'inverter'
Supply Air – L/s	550	800
Total Outside Air – L/s	80	170
Total Cooling Capacity – kW	5.0	7.5
Sensible Cooling Capacity – kW	4.5	6.5
Air ON Temperature Cooling – (°C) db/wb	26.0 / 17.6	27.0 / 17.9
Estimated Resistance (Pa)	200	220
Operation	Reverse cycle	Reverse cycle
Heating (kW)	3.5	4.0
Electrical - Volts	240	240
- Phase	1	1
- Amps (Max FLA)	20.0	32.0
Refrigerant	R410A	R410A

Air Conditioning Units – Variable Refrigerant Flow (VRF)

Unit Designation	ACU – 1.1	ACU – 1.2	ACU – 1.3
Area Served	Apartment 1 – Living	Apartment 1 – Bed	Apartment 1 – Bed
Type	Wall mounted	Wall mounted	Wall mounted
Supply Air – L/s	270	240	190
Total Outside Air – L/s	-	-	-
Total Cooling Capacity – kW	3.5	3.0	2.0
Sensible Cooling Capacity – kW	3.5	2.5	2.0
Air ON Temperature Cooling – (°C) db/wb	24.0 / 17.0	24.0 / 17.0	24.0 / 17.0
Operation	Reverse cycle	Reverse cycle	Reverse cycle
Heating (kW)	2.5	2.0	1.0
Electrical - Volts	240	240	240
- Phase	1	1	1
- Amps (Max FLA)	10.0	10.0	10.0
Operating Range – °C	-10 to 46 on cooling -15 to 24 on heating	-10 to 46 on cooling -15 to 24 on heating	-10 to 46 on cooling -15 to 24 on heating
Special Requirements	O/A via external openings	O/A via external openings	O/A via external openings
Refrigerant	R410A	R410A	R410A
System	Variable Refrigerant Flow – Heat Pump		
OUTDOOR UNIT	CU – 1		
Total Capacity (kW)	8.5		
Combination %	100		
Electrical			
- Volts	240		
- Phase	1		
- Amps	32.0		
Refrigerant	R410A		



Unit Designation	ACU – 2.1	ACU – 2.2
Area Served	Apartment 2 – Living	Apartment 2 – Bed
Type	Wall mounted	Wall mounted
Supply Air – L/s	240	160
Total Outside Air – L/s	-	-
Total Cooling Capacity – kW	4.0	1.0
Sensible Cooling Capacity – kW	3.5	1.0
Air ON Temperature Cooling – (°C) db/wb	24.0 / 17.0	24.0 / 17.0
Operation	Reverse cycle	Reverse cycle
Heating (kW)	2.5	0.5
Electrical - Volts	240	240
- Phase	1	1
- Amps (Max FLA)	10.0	10.0
Operating Range – °C	-10 to 46 on cooling -15 to 24 on heating	-10 to 46 on cooling -15 to 24 on heating
Special Requirements	O/A via external openings	O/A via external openings
Refrigerant	R410A	R410A
System	Variable Refrigerant Flow – Heat Pump	
OUTDOOR UNIT	CU – 2	
Total Capacity (kW)	5.0	
Combination %	100	
Electrical		
- Volts	240	
- Phase	1	
- Amps	32.0	
Refrigerant	R410A	

Unit Designation	ACU – 3.1	ACU – 3.2
Area Served	Apartment 3 – Living	Apartment 3 – Bed
Type	Wall mounted	Wall mounted
Supply Air – L/s	240	160
Total Outside Air – L/s	-	-
Total Cooling Capacity – kW	4.0	1.0
Sensible Cooling Capacity – kW	3.5	1.0
Air ON Temperature Cooling – (°C) db/wb	24.0 / 17.0	24.0 / 17.0
Operation	Reverse cycle	Reverse cycle
Heating (kW)	2.5	0.5
Electrical - Volts	240	240
- Phase	1	1
- Amps (Max FLA)	10.0	10.0
Operating Range – °C	-10 to 46 on cooling -15 to 24 on heating	-10 to 46 on cooling -15 to 24 on heating
Special Requirements	O/A via external openings	O/A via external openings
Refrigerant	R410A	R410A
System	Variable Refrigerant Flow – Heat Pump	
OUTDOOR UNIT	CU – 3	
Total Capacity (kW)	5.0	
Combination %	100	
Electrical		
- Volts	240	
- Phase	1	
- Amps	32.0	
Refrigerant	R410A	



Unit Designation	ACU – 4.1	ACU – 4.2
Area Served	Apartment 4 – Living	Apartment 4 – Bed
Type	Wall mounted	Wall mounted
Supply Air – L/s	240	160
Total Outside Air – L/s	-	-
Total Cooling Capacity – kW	4.0	1.0
Sensible Cooling Capacity – kW	3.5	1.0
Air ON Temperature Cooling – (°C) db/wb	24.0 / 17.0	24.0 / 17.0
Operation	Reverse cycle	Reverse cycle
Heating (kW)	2.5	0.5
Electrical - Volts	240	240
- Phase	1	1
- Amps (Max FLA)	10.0	10.0
Operating Range – °C	-10 to 46 on cooling -15 to 24 on heating	-10 to 46 on cooling -15 to 24 on heating
Special Requirements	O/A via external openings	O/A via external openings
Refrigerant	R410A	R410A
System	Variable Refrigerant Flow – Heat Pump	
OUTDOOR UNIT	CU – 4	
Total Capacity (kW)	5.0	
Combination %	100	
Electrical		
- Volts	240	
- Phase	1	
- Amps	32.0	
Refrigerant	R410A	

Unit Designation	ACU – 5.1	ACU – 5.2
Area Served	Apartment 4 – Living	Apartment 4 – Bed
Type	Wall mounted	Wall mounted
Supply Air – L/s	240	160
Total Outside Air – L/s	-	-
Total Cooling Capacity – kW	4.0	1.0
Sensible Cooling Capacity – kW	3.5	1.0
Air ON Temperature Cooling – (°C) db/wb	24.0 / 17.0	24.0 / 17.0
Operation	Reverse cycle	Reverse cycle
Heating (kW)	2.5	0.5
Electrical - Volts	240	240
- Phase	1	1
- Amps (Max FLA)	10.0	10.0
Operating Range – °C	-10 to 46 on cooling -15 to 24 on heating	-10 to 46 on cooling -15 to 24 on heating
Special Requirements	O/A via external openings	O/A via external openings
Refrigerant	R410A	R410A
System	Variable Refrigerant Flow – Heat Pump	
OUTDOOR UNIT	CU – 5	
Total Capacity (kW)	5.0	
Combination %	100	
Electrical		
- Volts	240	
- Phase	1	
- Amps	32.0	
Refrigerant	R410A	



11.3 FANS

Amenities Exhaust Fans

Unit Designation	AEF – C1	AEF – C2
Area Served	Unisex Amb. WC	Bin Store
Type	Duct mounted type – Mixed Flow	Duct mounted type – Mixed Flow
Exhaust Air Quantity – L/s	60	80
Max Speed – Revs/Sec	33	36
Estimated Resistance (Pa)	80	80
Number of Speeds	1	1
Fan Motor - Volts	240	240
- Phase	1	1
- Hz	50	50
- FLA	0.19	0.19
Max Sound Pressure Level (dBA @ 3m (in-duct))	40	39
Control	Potentiometer	Potentiometer

Unit Designation	AEF – 1	AEF – 2	AEF – 3
Area Served	Apartment 1 Bathroom	Apartment 2 Bathroom	Apartment 3 Bathroom
Type	Duct mounted type – Whisperjet	Duct mounted type – Whisperjet	Duct mounted type – Whisperjet
Exhaust Air Quantity – L/s	100	70	70
Max Speed – Revs/Sec	42	33	33
Estimated Resistance (Pa)	80	80	80
Number of Speeds	1	1	1
Fan Motor - Volts	240	240	240
- Phase	1	1	1
- Hz	50	50	50
- FLA	0.22	0.19	0.19
Max Sound Pressure Level (dBA @ 3m (in-duct))	23	18	18
Control	Potentiometer	Potentiometer	Potentiometer
Special Requirements	Complete with attenuators	Complete with attenuators	Complete with attenuators



Unit Designation	AEF – 4	AEF – 5
Area Served	Apartment 4 Bathroom	Apartment 5 Bathroom
Type	Duct mounted type – Whisperjet	Duct mounted type – Whisperjet
Exhaust Air Quantity – L/s	70	70
Max Speed – Revs/Sec	33	33
Estimated Resistance (Pa)	80	80
Number of Speeds	1	1
Fan Motor - Volts	240	240
- Phase	1	1
- Hz	50	50
- FLA	0.19	0.19
Max Sound Pressure Level (dBA @ 3m (in-duct))	18	18
Control	Potentiometer	Potentiometer
Special Requirements	Complete with attenuators	Complete with attenuators

11.4 ANTI-VIBRATION ISOLATION MOUNTS

Equipment	Outdoor condensing units	Duct mounted fans	Roof Cows	In ceiling fan coil units
Isolation Type	Rubber mounts	Rubber Isolation Hangers - Double Deflection or Spring Hanger	Neoprene Mount	Rubber Isolation Hangers - Double Deflection or Spring Hanger



SECTION 12 - SCHEDULE OF COSTS & RATES

Submit the cost information as set out in the schedule of Cost Summary.

Name of Tenderer

Address

Contact details

12.1 SUMMARY OF COSTS

Provide a cost summary of the mechanical services costs.

• Preliminaries	\$
• Refrigeration piping including insulation	\$
• Filters and filter plenums	\$
• Air-conditioning units	\$
• Noise and vibration control systems	\$
• Electrical work for mechanical services	\$
• Exhaust fans	\$
• Ductwork – air conditioning	\$
• Ductwork – exhaust	\$
• Diffusers, registers and grilles	\$
• Automatic control systems	\$
• Sundry	\$
• Maintenance and Operating Instructions manuals and drawings	\$
• Maintenance, warranty and defects liability	\$
• Testing, commissioning and evaluation	\$
• Corrosion protection, painting and labelling	\$
• Site establishment	\$
• Construction engineering	\$
• Other (list)	\$
Grand Total	\$



12.2 SCHEDULE OF RATES

Provide a cost breakdown of the supply and installation of the following:

• Condensate pump	\$
• 3m of Ø250 flexible duct	\$
• 1x supply air diffuser with standard cushion head	\$
• Relocate thermostat/control panel 3m (after installation)	\$
• Relocate supply/return air outlet 3m (after installation)	\$
• Rebalance air-quantity for 1 x ACU with six outlets (after installation)	\$
• Access panel	\$
• Control panel	\$

12.3 SCHEDULE OF PROPOSED SUB-CONTRACTORS

The tenderer shall list all sub contractors to be used to undertake the specified works for the Mechanical Services Contractor. Where sub contractors are not identified below then the tenderer shall provide a further comprehensive list of names and individuals proposed to undertake any of the works.

Automatic controls sub contractor

Company.....

Address.....

Contact detail.....

Testing and commissioning sub contractor

Company.....

Address.....

Contact detail.....

Electrical (mechanical work) sub contractor

Company.....

Address.....

Contact detail.....



12.4 TENDER FORMS

Air Conditioning Units – Single Split Duct Mounted Unit

Unit Designation	ACU – C1 / CU – C1	ACU – C2 / CU – C2
Make / Model		
Type		
Supply Air – L/s		
Total Outside Air – L/s		
Total Cooling Capacity – kW		
Sensible Cooling Capacity – kW		
Air ON Temperature Cooling – (°C) db/wb		
Estimated Resistance (Pa)		
Operation		
Heating (kW)		
Electrical - Volts - Phase - Amps (Max FLA)		
Refrigerant		

Air Conditioning Units – Variable Refrigerant Flow (VRF)

Unit Designation	ACU – 1.1	ACU – 1.2	ACU – 1.3
Make / Model			
Type			
Supply Air – L/s			
Total Outside Air – L/s			
Total Cooling Capacity – kW			
Sensible Cooling Capacity – kW			
Air ON Temperature Cooling – (°C) db/wb			
Operation			
Heating (kW)			
Electrical - Volts - Phase - Amps (Max FLA)			
Operating Range – °C			
Special Requirements			
Refrigerant			
System			
OUTDOOR UNIT			
Total Capacity (kW)			
Combination %			
Electrical - Volts - Phase - Amps			
Refrigerant			



Unit Designation	ACU – 2.1	ACU – 2.2
Make / Model		
Type		
Supply Air – L/s		
Total Outside Air – L/s		
Total Cooling Capacity – kW		
Sensible Cooling Capacity – kW		
Air ON Temperature Cooling – (°C) db/wb		
Operation		
Heating (kW)		
Electrical - Volts - Phase - Amps (Max FLA)		
Operating Range – °C		
Special Requirements		
Refrigerant		
System		
OUTDOOR UNIT		
Total Capacity (kW)		
Combination %		
Electrical - Volts - Phase - Amps		
Refrigerant		

Unit Designation	ACU – 3.1	ACU – 3.2
Make / Model		
Type		
Supply Air – L/s		
Total Outside Air – L/s		
Total Cooling Capacity – kW		
Sensible Cooling Capacity – kW		
Air ON Temperature Cooling – (°C) db/wb		
Operation		
Heating (kW)		
Electrical - Volts - Phase - Amps (Max FLA)		
Operating Range – °C		
Special Requirements		
Refrigerant		
System		
OUTDOOR UNIT		
Total Capacity (kW)		
Combination %		
Electrical - Volts - Phase - Amps		
Refrigerant		



Unit Designation	ACU – 4.1	ACU – 4.2
Make / Model		
Type		
Supply Air – L/s		
Total Outside Air – L/s		
Total Cooling Capacity – kW		
Sensible Cooling Capacity – kW		
Air ON Temperature Cooling – (°C) db/wb		
Operation		
Heating (kW)		
Electrical - Volts - Phase - Amps (Max FLA)		
Operating Range – °C		
Special Requirements		
Refrigerant		
System		
OUTDOOR UNIT		
Total Capacity (kW)		
Combination %		
Electrical - Volts - Phase - Amps		
Refrigerant		

Unit Designation	ACU – 5.1	ACU – 5.2
Make / Model		
Type		
Supply Air – L/s		
Total Outside Air – L/s		
Total Cooling Capacity – kW		
Sensible Cooling Capacity – kW		
Air ON Temperature Cooling – (°C) db/wb		
Operation		
Heating (kW)		
Electrical - Volts - Phase - Amps (Max FLA)		
Operating Range – °C		
Special Requirements		
Refrigerant		
System		
OUTDOOR UNIT		
Total Capacity (kW)		
Combination %		
Electrical - Volts - Phase - Amps		
Refrigerant		



AMENITIES EXHAUST FANS

Unit Designation	AEF – C1	AEF – C2
Make / Model		
Type		
Exhaust Air Quantity – L/s		
Max Speed – Revs/Sec		
Estimated Resistance (Pa)		
Number of Speeds		
Fan Motor - Volts		
- Phase		
- Hz		
- FLA		
Max Sound Pressure Level (dBA @ 3m (in-duct))		
Control		

Unit Designation	AEF – 1	AEF – 2	AEF – 3
Make / Model			
Type			
Exhaust Air Quantity – L/s			
Max Speed – Revs/Sec			
Estimated Resistance (Pa)			
Number of Speeds			
Fan Motor - Volts			
- Phase			
- Hz			
- FLA			
Max Sound Pressure Level (dBA @ 3m (in-duct))			
Control			
Special Requirements			



Unit Designation	AEF – 4	AEF – 5
Make / Model		
Type		
Exhaust Air Quantity – L/s		
Max Speed – Revs/Sec		
Estimated Resistance (Pa)		
Number of Speeds		
Fan Motor - Volts		
- Phase		
- Hz		
- FLA		
Max Sound Pressure Level (dBA @ 3m (in-duct))		
Control		
Special Requirements		

ANTI-VIBRATION ISOLATION MOUNTS

Equipment	Outdoor condensing units	Duct mounted fans	Roof Cowls	In ceiling fan coil units
Isolation Type				