

**SUPPLY & INSTALLATION  
of the  
MECHANICAL SERVICES  
for the  
LAND TRANSPORT AUTHORITY  
KARAVI WEIGHBRIDGE STATION  
at  
KARAVI, BA  
FIJI**

**IRWIN ALSOP PACIFIC LTD**  
**Building Services Consulting Engineers**  
Domain Road  
Suva  
Telephone : 3302619  
Facsimile : 3302161  
Email : [office@iap.com.fj](mailto:office@iap.com.fj)

**DATED: MAY 2019**  
**PROJECT NO: 7835**

**MECHANICAL SERVICES SPECIFICATION  
LAND TRANSPORT AUTHORITY KARAVI WEIGHBRIDGE STATION,  
KARAVI, BA, FIJI**

**CONTENTS**

<b>SECTION 1</b>	<b>GENERAL CONDITIONS OF CONTRACT.....</b>	<b>1</b>
<b>SECTION 2</b>	<b>SPECIAL CONDITIONS OF CONTRACT.....</b>	<b>1</b>
<b>SECTION 3</b>	<b>PRELIMINARY AND GENERAL.....</b>	<b>1</b>
<b>SECTION 4</b>	<b>GENERAL.....</b>	<b>2</b>
<b>SECTION 5</b>	<b>AIR CONDITIONING.....</b>	<b>7</b>
<b>SECTION 6</b>	<b>DUCTWORK AND ACCESSORIES (NOT APPLICABLE).....</b>	<b>12</b>
<b>SECTION 7</b>	<b>CONTROLS.....</b>	<b>17</b>
<b>SECTION 8</b>	<b>ELECTRICAL INSTALLATIONS FOR MECHANICAL SYSTEMS.....</b>	<b>18</b>
<b>SECTION 9</b>	<b>PAINTING &amp; LABELLING.....</b>	<b>22</b>
<b>SECTION 10</b>	<b>TESTING.....</b>	<b>23</b>
<b>SECTION 11</b>	<b>NOISE AND VIBRATION.....</b>	<b>24</b>
<b>SECTION 12</b>	<b>COMMISSIONING &amp; PERFORMANCE TESTS.....</b>	<b>25</b>
<b>SECTION 13</b>	<b>MAINTENANCE MANUALS &amp; AS INSTALLED DRAWINGS.....</b>	<b>26</b>
<b>SECTION 14</b>	<b>MAINTENANCE AND SERVICING.....</b>	<b>28</b>

**APPENDICES**

<b>APPENDIX I</b>	<b>TENDER FORM</b>
<b>APPENDIX II</b>	<b>SUMMARY OF TENDER</b>
<b>APPENDIX III</b>	<b>SCHEDULE OF TECHNICAL DATA</b>
<b>APPENDIX IV</b>	<b>SCHEDULE OF RATES</b>

**SECTION 1 GENERAL CONDITIONS OF CONTRACT**

General Conditions of Contract shall be the Conditions of Contract for Land Transport Authority Karavi Weighbridge Station, Karavi, Ba and any other Amendments and Revisions up to date of issue, provided by the Principal Consultant.

**SECTION 2 SPECIAL CONDITIONS OF CONTRACT**

Special Conditions of Contract shall be the Conditions of Contract for Land Transport Authority Karavi Weighbridge Station, Karavi, Ba and any other Amendments and Revisions up to date of issue, provided by the Principal Consultant.

**SECTION 3 PRELIMINARY AND GENERAL**

Conditions of Contract shall be the Conditions of Contract for Land Transport Authority Karavi Weighbridge Station, Karavi, Ba and any other Amendments and Revisions up to date of issue, provided by the Principal Consultant.

## SECTION 4 GENERAL

### 4.1 SCOPE OF WORK

The scope of works comprises the supply, installation, testing, commissioning, maintenance and defects liability services of materials, labour and equipment for the complete Mechanical Services installation for the Land Transport Authority Karavi Weighbridge Station, Karavi, Ba.

This shall include all necessary work required to implement the intent and meaning of this Specification and associated drawings.

Whether or not the words “supply and install” appear in this Specification or on the drawings, unless clearly excluded, all items of equipment for the complete installation are required and shall be supplied and installed.

#### Extent of Work

The work shall include but will not be limited to the following main items:-

- a) Preliminary and General
- b) Supply and installation of Split air conditioning systems.
- c) Supply and installation of insulated liquid and gas refrigeration lines between the outdoor condensing unit and indoor units.
- d) Supply and installation of insulated condensate drain lines between indoor units and discharge points as indicated on the drawings.
- e) Extension of power supply from outdoor condenser units to the weather-proof isolators mounted next to outdoor condenser units
- f) Supply and installation of toilet exhaust fans and accessories with door grilles
- g) All other items not included above ( Please specify \_\_\_\_\_ )
- h) Supply of Shop Drawings
- i) Supply of As Installed Drawings
- j) Supply of Installation Manuals
- k) Twelve (12) months Maintenance

### 4.2 ADDITIONAL REQUIREMENTS

Provision of the following additional services:

- a) Include for all reasonable and relevant tests that will be required during the progress of the works and at commissioning and/or during the Defects Liability Period. Provide all necessary materials, instruments and labour. Allow the Engineer the opportunity to witness all final tests. The Engineer shall be entitled to have any part of the works opened up or cut away for a legitimate inspection.
- b) Supply shop drawings in SI Metric to completely detail the works. Wiring diagrams shall be in the ladder format submitted for approval. Submit with the wiring schematics a sequence description of the operations. Submission to the Engineer in the first instance shall be made not less than one week prior to approval in principle is required.  
Examination by the Engineer shall not diminish the Contractor's responsibility for co-ordinating and checking shop drawings or the Contractor's responsibility for correctness of his work  
The Engineer may endorse shop drawings to indicate approval in principle subject to amendments where applicable, but no endorsements shall constitute an Engineer's instruction unless expressly stated to the contrary
- c) The supply of three sets of Operation and Maintenance manuals and As Installed drawings all bound in a sturdy loose leaf hard cover binder. Each print is to be folded and inserted into an appropriate clear plastic ring binder pocket. Reference and description shall pertain to the particular type of installation. Each manual shall contain at least the following headings:-
  - i. Section 1: General Systems Description including Warranty and Service
  - ii. Section 2: Detailed Description of Installation, Health and Safety
  - iii. Section 3: Starting and Stopping Procedures
  - iv. Section 4: Automatic Controls

- v. Section 5: Equipment Schedule with serial numbers
- vi. Section 6: Schedule of Suppliers and Sub-contractors (addresses, service division head and phone numbers, after hours phone number etc.)
- vii. Section 7: Preventive Maintenance including Manufacturer's literature and Commissioning; and Test Results
- viii. Section 8: Catalogue Data including Equipment Specification
- ix. Section 9: Drawing List and "As Installed" drawings System Commissioning and Testing Data Schedule

Instructions are to be in A4 size, black hard plastic-covered ring binders with the front cover either labelled or embossed:

#### LAND TRANSPORT AUTHORITY KARAVI WEIGHBRIDGE STATION – MECHANICAL SERVICES OPERATING AND MAINTENANCE INSTRUCTIONS

- d) During the warranty and defects liability period, carry out preventive maintenance on a monthly basis. The maintenance routines shall be designed to ensure proper operation of the equipment in accordance with manufacturer's requirements and good trade practice. The programme shall be to the instructions in the Contractor's maintenance manual for this project. The Contractor shall provide all miscellaneous materials required in carrying out the works. A copy of the monthly service sheets is to be posted to the Consultant within a week of the work

### 4.3 DRAWINGS

The scope of work is shown on the Architectural and Mechanical Services drawings M01 – M07 which should be read in conjunction with this Specification. Refer to the Architectural, Structural and Mechanical drawings for the exact positions of fixtures, fittings, plant equipment, sundry appliances and structural elements. Confirm dimensions on site before commencing work.

The following drawings shall form part of the Contract:

M01	SCHEDULE OF DRAWINGS / LEGENDS / ABBREVIATIONS / LOCALITY PLAN
M02	SPECIFICATION & SCOPE OF WORKS / SCHEDULE OF SPLIT AIR CONDITIONING UNITS / SCHEDULE OF FANS & DOOR GRILLES
M03	PROPOSED SITE PLAN MECHANICAL SERVICES LAYOUTS
M04	PROPOSED GROUND FLOOR PLAN MECHANICAL SERVICES LAYOUTS
M05	PROPOSED SITE SECTION A & SITE SECTION C MECHANICAL SERVICES LAYOUTS
M06	MECHANICAL SERVICES DETAILS

### 4.4 RULES, REGULATIONS AND CODES

All work performed under this Section of the Contract shall be carried out by Mechanical sub-contractor and shall comply in all respects with the Regulations and By-Laws of the appropriate Authorities including:

- a) The Building Regulations applying to the project
- b) The Fiji National Building Code
- c) Current issue of relevant Australian/New Zealand Regulations and Standards
- d) Fiji Electricity Authority
- e) The requirements of the Chief inspectors of the relevant Statutory Authorities
- f) Any other regulations that apply directly or indirectly to such installation in the locations. Materials, manufactured articles and workmanship shall conform to the relevant Standards.

### 4.5 FEES

The Mechanical Sub-Contractor shall make all applications, pay all fees, and obtain all certificates and receipts which shall be handed over to the Engineer at practical completion.

## 4.6 STANDARDS

The following Standards and Codes shall form part of this Specification insofar as they are appropriate. Where a nominated Standard cross references to another Standard, that Standard shall also form part of this Specification insofar as the cross-referencing is appropriate.

Applicable Standards and Codes shall be those current at the date of tender. Where this Specification expressly requires Standards higher than, or different from those applicable under the Standard, or Code documents, than this Specification shall be followed.

## 4.7 AUSTRALIAN STANDARDS AND CODES

AS 1023	Thermal Protection of Electric Motors.
AS 1100	Drawing Practice.
AS 1101	Graphic Symbols for General Engineering Piping, ducting and mechanical services for buildings
AS 1324	Air filters for use in general ventilation and airconditioning Methods of test
AS 1345	Identification of the contents of pipes, conduits and ducts.
AS 1432	Copper Tubes for plumbing, gas fitting and drainage applications.
AS 1530	Methods of Fire Tests on Building Materials, Components and Structures.
AS/NZS 1554	Structural Steel Welding.
AS/NZS 1571	Copper - Seamless Tubes for airconditioning and refrigeration
AS/NZS 1668	The use of ventilation and air conditioning in buildings
AS 1890	Thermally released Links
AS/NZS 2053	Conduits and fittings for electrical installations
AS 2184	Low voltage switchgear and controlgear - Moulded-case circuit-breakers for rated voltages up to and including 600 V a.c. and 250 V d.c.
AS/NZS 2312	Guide to the protection of structural steel against atmospheric corrosion by the use of protective coatings
AS 2625	Rotating and Reciprocating Machinery - Mechanical Vibration.
AS 2700	Colours Standards for General Purposes.
AS 2768	Electrical Insulating Materials
AS ISO 5801-2004 (R2016)	Industrial fans - Performance testing using standardized airways
AS/NZS 3000	Electrical installations (known as the Australian/New Zealand Wiring Rules)
AS/NZS 3008	Electrical Installations - Selection of Cables.
AS/NZS 3013	Electrical Installation
AS/NZS 3111	Approval and test specification - Miniature overcurrent circuit-breakers

AS/NZS 3112	Approval and test specification - Plugs and socket-outlets
AS 3135	Approval and test specification - Semi-enclosed fuses for a.c. circuits
AS/NZS 5000	Electric cables - Polymeric insulated For working voltages up to and including 0.6/1 (1.2) kV
AS/NZS 60702.1	Mineral insulated cables and their terminations with a rated voltage not exceeding 750V Cables
AS/NZS 60702.2	Mineral insulated cables and their terminations with a rated voltage not exceeding 750V Terminations
AS 3500	National Plumbing and Drainage Code.

Where there is no appropriate Australian Standard the installation shall comply with the appropriate International, British or American Standards.

#### **4.8 CONTRACTOR'S DRAWINGS**

Drawings shall be generally in accordance with the tender drawings, except where variations on the Shop Drawings are endorsed by the Engineer.

Three (3) copies of shop drawings shall be submitted for approval prior to shop fabrication. One set of shop drawings shall be maintained on site during the construction phase. These drawings shall be marked up with modifications that occur during construction.

Shop drawings shall be on the same size drawing sheets which shall be no smaller than the Tender sheet size and shall be to a scale of not less than 1:50 and larger where necessary. Format shall conform to AS 1100 Drawing Practice.

Shop drawings shall cover the following:

- a) All structural penetrations, including full dimensions to enable block-out and sleeve placement.
- b) Ductwork layouts, including sizes (duct internal airway dimensions) and details of materials, construction, supports, anchoring, expansion, fixing etc.
- c) Reflected ceiling plans showing all air outlets, sizes, air quantities etc.
- d) Outdoor condensing units and refrigeration pipework layouts.
- e) Control diagram and power wiring diagram on common sheets. Diagrams shall show the interconnection of all electrical components. All wiring shall be coded and numbered. A full cross-referenced grid system of component numbering and contact numbering shall be used.
- f) Switchboard layout drawings and detailed electrical components list on common sheets

#### **4.9 BUILDER'S WORK**

##### **4.9.1 GENERAL**

The Builder shall provide all penetrations for the Mechanical Services in the locations and to the size as shown on Mechanical Sub-Contractor's shop drawings.

Provide all steel frames, inserts, sleeves, etc., to be built into the penetrations for installation. Penetrations in structural beams shall not be varied from those shown on tender drawings without the written approval of the Engineer.

The Builder to provide tundishes as shown on Mechanical Sub-Contractor's shop drawings and final connection of condensate drain pipework to be done by the Builder.

##### **4.9.2 SEALING OF PENETRATIONS**

The Builder shall provide air tight seals around the following penetrations. The seals shall comply with the noise and fire rating requirements of the penetration and in accordance with the detailed drawing:

- a) Sealing around ductwork, pipework, etc. which pass through fire, smoke or acoustic barriers.
- b) Sealing between pipework and sleeves. The Sub-Contractor will seal between the sleeves and masonry or concrete walls.
- c) Sealing around penetrations through chambers which are subject to suction or pressurisation.
- d) Sealing around cable penetrations. All fire retardant material used shall have been tested by a NATA approved Laboratory and test results submitted for approval.

#### **4.9.3 PIPE SLEEVES**

Sleeves shall be fabricated from galvanised pipe free from all burrs and rust and sized to give a minimum 10 mm gap uniformly around the pipe and insulation. Sleeves shall project 10 mm beyond the building surface on both sides unless required otherwise.

Openings exposed to view shall be covered with an escutcheon plate as follows:

Occupied Areas - Chrome plated brass or copper

Escutcheon shall be fixed to pipe and shall be free to move with respect to the wall and sleeve.

#### **4.9.4 CLEANING**

The Mechanical Sub-Contractor's working areas shall be tidied, cleaned, floors swept, at close of works and to minimise the amount of dust and rubbish, which shall be disposed of on site as directed, and finally removed from premises without delay. Particular attention shall be given to crawl spaces, ceiling spaces and shafts. All materials shall be removed, and all areas thoroughly cleaned at the completion of the project. Failure of the Mechanical Sub-Contractor to comply with this section of the Specification to the satisfaction of the Engineer, the Principal shall assume responsibility for incomplete works at the Mechanical Sub-Contractor's expense.

#### **4.9.5 INSTALLATION**

All equipment covered in this Specification, including valves, dampers, filters, drives, etc. shall be installed in such a manner to permit ease of access for maintenance and servicing of components. Such access will be coordinated with and where necessary brought to the attention of the Architect.

#### **4.10 OBVIOUS WORK**

Contract Drawings are diagrammatic and as such show the intent of design. Where an item of work or equipment is obvious or can be inferred as normal practice in the class of work generalised herein, such shall be included, whether shown on Drawings and/or specified or not.

Allow for all bends, offsets and other measures necessary avoid interference with the structure and/or other building services.

## SECTION 5 AIR CONDITIONING

### 5.1 GENERAL DESCRIPTION

The split system air conditioners shall be air-cooled, consisting of indoor and outdoor units as scheduled. The cooling capacity of the units shall be as indicated in the schedule and based on rating conditions of:

Inside air temperature: 22°C DB 60% RH

Outside air temperature: 33°C 85% RH

The nominated indoor units shall be controlled and grouped as scheduled.

The outdoor units shall contain an inverter controlled scroll compressor suitable (R410A) refrigerant. Outdoor units shall be suitable to operate with the compatible indoor units.

The system operating outdoor temperature range shall be:

Cooling: -15° CdB to 46° CdB

### 5.2 SPLIT UNITS

The split system air-conditioners shall be manufactured by Daikin, Temperzone, Fujitsu, Panasonic, Mitsubishi, LG, or approved equal. Units shall be professionally assembled, internally wired and be handed to suit the arrangement shown on the drawings. All units shall be installed and commissioned in accordance with the Manufacturer's recommendations.

The capacity of the units shall be not less than those scheduled on the drawings.

### 5.3 AVAILABILITY

The units offered for this Contract shall be selected from the range of units available in Fiji at the time of preparation of this Specification.

The manufacturer of the units shall have a local agent who is capable of providing full service and who must carry, at all times, a full range of spare parts to service the offered units.

Units from manufacturers, who do not have an established local agent, will not be considered.

### 5.4 HOUSING

The housing for the split-packaged units shall be constructed of treated sheet steel of reinforced structure mounted on a structurally sound base. The housing shall be finished in polyester powder-coat to ensure a durable finish. The evaporator fan coil section shall be internally insulated with black matt tough-skin acoustic fiberglass. All access panels are to be provided with foam rubber gasket seals and allow access to all components. Housings shall be both weatherproof and airtight with panels being secured with cam locks.

### 5.5 EVAPORATOR UNITS

The split wall mount and ceiling cassette units shall incorporate

- \* Cabinet incorporating return air grille and adjustable supply grille
- \* Concealed mounting brackets
- \* Multiple forward curve centrifugal double inlet fans direct driven from a single phase motor
- \* Copper tube/aluminium fin coil
- \* Expansion valve or capillary expansion device

- \* Insulated drain pan
- \* Washable air filter
- \* Pre-wired electronic control panel incorporating switches for on/off, fan speed, cooling and temperature setting. This panel shall be installed on wall adjacent to unit
- \* Electronic temperature sensor in the intake of the fan coil unit
- \* Wall chases behind unit arranged so that piping is concealed and unit sits flat against wall
- \* Cassette units to be provided with outside air option.

The location of the evaporators is as shown on the drawings and to be confirmed on site.

## 5.6 CONDENSING UNITS

The condensing units are to be supplied by the same manufacturer as the supplier of the evaporator units. The performance of the condensing units is to be matched to that of the evaporators so that each system, when commissioned, will meet the minimum criteria specified in the Schedule on drawing M01.

The split wall mount condensing unit shall incorporate:

- \* Weatherproof sheet metal cabinet fabricated from aluminium or zinc coated steel sheet with baked enamel finish
- \* Axial flow fans direct from single phase motors. Air discharge shall be horizontal
- \* Galvanized mesh fan guard
- \* Copper tube/aluminium fin coil
- \* Hermetic compressor operating on R410A and fitted with crankcase heater
- \* Reversing valve and suction accumulator
- \* Thermal overload protection on all motors
- \* High pressure safety cut-out
- \* Factory wired control panel (weatherproof)
- \* Each condensing units shall be mounted as on ribbed rubber anti-vibration pads

## Refrigeration System

Split units shall incorporate all necessary components for complete functional refrigeration circuits and shall require only interconnection, leak testing, evacuation prior to commission.

Interconnection, leak testing, evacuation, and charging procedures shall be in strict accordance with the unit manufacturer's instructions with particular attention being given to the avoidance of contamination in the refrigeration systems.

Interconnecting piping shall be leak tested after completion using a refrigerant charge and sensitive leak detector scan of all joints and fittings. After satisfactory testing, the system shall be evacuated and charged with the correct quantity of clean dry refrigerant in accordance with the unit manufacturer's instructions.

## 5.7 CORROSION PROTECTION OF CONDENSING UNITS

All plants which are exposed to the elements shall be corrosion treated to prevent rusting. Components and/or parts showing signs of rusting during commissioning shall be replaced at no extra costs.

The condensing units if they have not been factory corrosion treated shall be treated as follows:

- \* Spray all surfaces including casings (inside and outside), coils, fan motors and drives, controls & electrical connections, refrigeration system components with a vapour corrosion inhibitor system as supplied by "Coroless International" using the "Cortrol 200 Spray", "Valvoline Tectyl 151A" or equal approved.

## 5.8 REFRIGERATION PIPEWORK REQUIREMENTS

Split units shall incorporate all necessary components for complete functional refrigeration circuits and shall require only interconnection, leak testing, evacuation prior to commission.

Interconnection, leak testing, evacuation, and charging procedures shall be in strict accordance with the unit manufacturer's instructions with particular attention being given to the avoidance of contamination in the refrigeration systems. Any unsealed refrigeration component or piping found on site will be rejected and shall be replaced with parts in a clean, dry, sealed condition.

Suction and liquid piping shall be sized and installed in accordance with the unit manufacturer's instructions, and shall be arranged to provide inherent flexibility in connections to the fan/coil and condenser units. Piping shall be in copper tubing equal to the following:-

- a) Up to 20 NS - bright annealed copper tube to AS 1571 or equivalent
- b) Over 20 NS - hard drawn copper tube to AS 1432 or equivalent

Pipe joints shall be either brazed capillary type using 15% silver solder or flare type compression joints are not acceptable.

Interconnecting piping shall be leak tested after completion using a refrigerant charge and sensitive leak detector scan of all joints and fittings. After satisfactory testing, the system shall be evacuated and charged with the correct quantity of clean dry refrigerant in accordance with the unit manufacturer's instructions.

## 5.9 PIPEWORK INSTALLATION REQUIREMENTS

### a) Condensate Drains

- \* Shall be run in UPVC with all joints solvent welded and shall be a minimum of 25mm diameter
- \* Installed and supported in accordance with AS3500 Plumbing Code
- \* Shall be insulated with 19mm Bradflex or Armaflex

### b) Refrigerant Lines

- \* Refrigerant suction lines are to be insulated for their entire length with 25mm wall thickness Armaflex or Bradflex closed cell nitrile foam insulation.
- \* Joints are to be glued and then taped. Taping alone is not acceptable.
- \* No longitudinal splits are acceptable.
- \* Where exposed to the weather, provide a folded removable 1.6mm thick sheet metal cover.

## 5.10 NOISE AND VIBRATIONS

Attention shall be towards prevention of noise and vibration. The Mechanical Sub-Contractor shall be responsible for the rectification of any noise or vibration within the system, which in the opinion of the Consultant, is excessive.

It is not the intent of this Specification, to specify a fixed sound level in any occupied space, but rather to require that the systems shall maintain a noise level in all space which is consistent with that generally accepted for a high quality air-conditioning system for the particular application.

Provide approved vibration isolators to all motor driven equipment.

Ensure that the installations do not cause a breakdown in the structural or acoustical isolation in any area in the building.

Take every precaution to minimise noise emanating from the plant or conveyed in the air ducts and piping.

Rectify at the Mechanical Sub-Contractor's expense any noise and vibration problems arising from bad workmanship and if the performance of the equipment is not met.

### **5.11 LABELING**

All plant, equipment, control components etc shall be labelled. Labelling shall be in the form of upper case letters on white or black, laminated plastic engraved sheet. Mechanically fix labels to equipment or adjacent using non-corrosion screws. Letters shall be easily readable from normal viewing position and in no case shall be less than:

- 10mm on switchboard
- 12mm on control equipment
- 32mm on equipment

### **5.12 PAINTING**

All exposed condenser mounting brackets shall be painted satisfactory to the Engineer.

### **5.13 SURFACE MOUNTED EQUIPMENT**

Any surface mounted equipment such as thermostats, switches etc. shall be submitted to the Engineer for approval of finishes.

### **5.14 AXIAL FLOW AND IN LINE CENTRIFUGAL FANS**

Supply and install fans as scheduled on drawing no. M01 and in the locations shown on the drawings. Fans shall be free from vibration, quiet in operation and shall be statistically and dynamically balanced as a complete assembly. All fans shall be fitted with approved spring type sound and vibration isolating mountings. Fans shall be free standing type fitted with neoprene acoustical pads. Reinforced flexible connections shall be fitted between fan and ductwork.

The fan static pressures as scheduled are for estimating purposes only. Make final accurate calculations of fan static pressures and supply certified performance curves with the operating range clearly indicated.

The air quantities as scheduled are accumulated air outlet totals only and do not include and allowance for duct leakage. Make the selection of fan capacity to adequately cover duct leakage.

### **5.15 ROOF VENTILATORS**

The roof ventilator shall be as specified or approved equivalent with no throat mounted fan to impede airflow and which shall be driven by ambient wind/stack action and/or motor. The ventilator shall have an electronic commutating motor directly connected between the stator and turbine, such that the airflow under natural power is not impeded. The noise level @ 3m shall be less than 46dB (A) and specific flow rate 46m<sup>3</sup>/hr/watt or better.

The roof ventilator shall combine natural ventilation to ensure guaranteed performance. The ventilator shall be free spinning under wind as conditions require. Roof ventilator(s) shall be of a rotary design incorporating a sealed bearing axle system. Design shall include all applicable dampers, accessories, fixings and flashings. Install to manufacturers recommendations. Security Mesh in 0.9mm 304 grade stainless steel with tamper resistant screws and frame with ≥61% FOA

The turbine ventilators shall be supported by a 15 year warranty.

**Supplier Contact:**

15 Redbank Place, Picton NSW 2571, PO Box 583 Picton, NSW 2571

(P) 1800 805 062

(F) 02 4677 0558

info@airocle.com.au

Airocle.com.au

## SECTION 6 DUCTWORK AND ACCESSORIES (NOT APPLICABLE)

### 6.1 STANDARDS

The following Standards, and other relevant Standards which may be applicable but not specifically mentioned, shall apply to all methods, materials, equipment, coatings and tests covered by the works of this Contract:

AS1132	Methods of Test for Air Filters for Use in Air Conditioning and General Ventilation
AS1319	Safety Signs for the Occupational Environment
AS1324	Air filters for use in general ventilation and airconditioning Methods of test
AS1345	Identification of the contents of pipes, conduits and ducts
AS1397	Continuous hot-dip metallic coated steel sheet and strip - Coatings of zinc and zinc alloyed with aluminium and magnesium
AS1530	Methods of Fire Tests on Building Materials, Components and Structures.
AS1554	Structural Steel Welding Code
AS4680	Hot-dip galvanized (zinc) coatings on fabricated ferrous article
AS/NZS1214	Hot-dip galvanized coatings on threaded fasteners (ISO metric coarse thread series) (ISO 10684:2004, MOD)
AS1897	Fasteners - Electroplated coatings
AS1111	ISO metric hexagon bolts and screws
AS1112	ISO metric hexagon nuts
AS1237	Tolerances for fasteners Washers for bolts, screws and nuts
AS1668	The use of ventilation and airconditioning in buildings
AS1682	Fire, smoke and air dampers
AS1807	Cleanrooms, workstations, safety cabinets and pharmaceutical isolators
AS1890	Thermally-Released Links
AS2427	Smoke/Heat Release Vents
AS2700	Colour Standards for General Purposes

### 6.2 RECTANGULAR DUCT

#### 6.2.1 MATERIAL

Ductwork shall be constructed from galvanised steel sheets cross-broken or beaded for rigidity and shall have the following uncoated thickness (Please see next page):

DUCT WIDTH (mm)	THICKNESS
Up to 600	0.6 mm
601 to 1200	0.8mm

## 6.2.2 LONGITUDINAL JOINTS

Shall be Pittsburg seam at corners and Acme or grooved seam on the flat.

## 6.2.3 CIRCUMFERENTIAL JOINTS AND REINFORCEMENT

Shall comply with the following table:

### DUCT WIDTH (MM) JOINTING METHOD REINFORCEMENT AND LOCATION FROM JOINT

Up to 600	Approved Proprietary	32 x 32 x 3 mm Angle
1201 to 1500	38 x 38 x 3mm Flanges at 2.0m	38 x 38 x 3 mm Angle 1.0 m from joint

Proprietary systems of flange fabrication, utilising pre-formed galvanised steel channel sections interlocked by pressed steel corner brackets, such as “Ductmate”, “METU SYSTEM”, may be used if approved by the Engineer

## 6.2.4 JOINT SEALANTS AND GASKETS

All circumferential joints shall be sealed. Sealants shall have permanent elasticity and adhesion. Sealants and gaskets shall be of approved manufacture. All exposed ductwork shall be made weatherproof.

## 6.2.5 DUCT FITTINGS

Use full radius bends. Where not practicable, short radius bends with splitters may be used. Mitre bends shall only be used where specifically shown on the drawings and where approved by the engineer.

Mitre bends shall have twin curvature turning vanes.

Transformations shall be at the minimum rate of 1 in 4 converging, and 1 in 7 for diverging duct work.

## 6.3 OVAL SPIRAL TUBING

Oval ductwork shall be of Duraduct manufacture or approved equal. Ducting shall be insulated spiral system consisting of an outer pressure tight metal steel a layer of fire resistant fibreglass insulation and an internal perforated liner.

## 6.4 FLEXIBLE DUCT

### 6.4.1 MATERIAL

Insulated low pressure flexible duct shall be a factory fabricated assembly, consisting of a heavily galvanised spring steel helix, to which is adhered a perforated reinforced aluminium laminate liner.

The insulation shall be 25mm thick and have a minimum thermal resistance of 0.6 m<sup>2</sup> k/w. The assembly shall be sheathed in a reflective reinforced foil laminate vapour barrier jacket. Internal and external surfaces of the duct shall conform with the Early Fire Hazard Requirements of AS 1688 – Part 1, Section 4.5.1.2 (c).

### 6.4.2 INSTALLATION

Flexible duct shall be installed a fully extended condition, free from sags and kinks, using only the minimum length required to make the connection.

All connections shall be made with a 12mm wide positive locking steel strap and sealed with 50mm wide PVC duct tape.

Flexible duct shall be supported at a maximum of 1 meter intervals using 20mm wide straps.

## 6.5 FLEXIBLE CONNECTIONS

Provide and install flexible connections between ductwork and equipment.

Flexible connections shall comply with AS 1668, Part 1 and shall be installed in a manner to permit the renewal of the fabric without disturbing the ductwork or plant.

The metal parts of connected equipment shall be separated by not less than 100mm.

Allow adequate slack in the flexible connection to permit free movement of each connected item.

## 6.6 BALANCE POINTS

Balancing points shall be located where shown on the drawings or where not shown they shall be located as follows:

- a) Fan entry and discharge
- b) Main duct downstream of branch ducts
- c) Branch ducts adjacent to the main duct
- d) Downstream of heat / cooling coils

Balancing points shall be provided as follows:

LONGEST SIDE OF DUCT	NO. OF OPENINGS
200mm	1
201 to 400mm	2
401 to 600mm	3
601 to 1200	4
Above 1200	5

Balancing points shall comprise 25mm dia. Holes sealed with rubber grommets for pressures of up to 0.5kPa and 25mm screwed sockets and plugs for pressures above 0.5kPa.

Insulated ductwork shall have extension pieces between the duct wall and the Insulation at balancing point openings.

## 6.7 ACCESS OPENINGS

Provide and install access openings in the ductwork wherever indicated on the Drawings and in the following specific locations:

- a) Volume Control Dampers
- b) Wherever Access is required for maintenance and inspection
- c) Filter removal

Access openings shall be in the form of a door, manhole or hand-holes.

Unless specified or indicated on the drawings the type and size of the access openings shall be determined by the function they are required to perform.

Access panels and doors in insulated ducts shall also be insulated.

All access panels and doors shall be fitted with gaskets and closing mechanisms to provide airtight seals under all operating conditions.

Panels in ducts where internal pressure exceeds 0.5 kPa shall open inwards and shall be fitted with holding handles.

Doors in ducts where internal pressure exceeds 0.25kPa shall open inwards

## 6.8 CLEANING OF DUCTWORK

All ductwork shall be thoroughly cleaned inside to the satisfaction of the Engineer before starting fans.

As soon as practicable after cleaning out of ductwork and before final building finishes are completed, the fans shall be operated with all outlets removed.

During installation, provide covers on open ducts and fans to prevent the ingress of building materials, rubbish or dust.

## **6.9 VOLUME CONTROL DAMPERS**

Provide and install volume control dampers wherever indicated on the drawings and as further specified.

The type of damper to be used in each location shall be shown on the drawings.

Submit details to the Engineer for approval of all dampers to be used prior to ordering or manufacture.

### **6.9.1 MULTI-BLADE ROTATING DAMPERS**

Damper blades shall be constructed of not less than 2.4mm extruded marine grade aluminium with stainless spindles.

Bearings shall be brass sleeve and bush or ball bearing.

Damper blades shall be linked together to provide blade operation without blades fouling or twisting.

Dampers shall be fitted with a hand lever and quadrant with position indicator for operation outside ducts or key operated mechanism for operation through air outlets.

### **6.9.2 SPLITTER DAMPERS**

Dampers shall be constructed of not less than 1.2mm aluminium sheet in double streamline section with an operating spindle of 12mm dia. Stainless steel. Bearing housing shall be riveted to the duct.

Dampers shall be fitted with hand levers and quadrant capable of being locked in any position. Open and closed positions shall be clearly marked.

### **6.9.3 BUTTERFLY DAMPERS**

Butterfly dampers shall be generally constructed as specified for multi-blade rotating dampers.

## **6.10 AIR DIFFUSERS, REGISTERS AND GRILLES**

Provide and install all air diffusers, registers, grilles and louvers where shown on the Drawings and as specified.

As far as is practicable all diffusers, registers, etc. shall be of the same make and fitted in a fashion which permits easy removal for cleaning and inspection purposes.

A quotation for these diffusers and VAV Boxes etc. can be obtained from Holyoake Industries (Qld) P/L Tel. 61 07 3807 7111 Fax 61 07 3807 7800.

### **6.10.1 CEILING DIFFUSERS**

Diffusers shall be Holyoake Series ceiling supply air diffuser. Diffusers shall be complete with Holyoake line cushion box.

Specifically designed for ceiling supply air diffusers.

Finish shall be baked enamel or powder coated to match the ceiling.

### **6.10.2 EGG CRATE CEILING GRILLES (EXHAUST & RETURN AIR)**

Ceiling grilles shall consist of an aluminium egg-crate core and opposed blade air volume controllers.

The Interior of the ductwork visible through the grille shall be painted matt black.

Grille finish shall be baked enamel or powder coat to match the ceiling unless otherwise specified.

### **6.10.3 DOOR GRILLES**

Door grilles shall be standard type as nominated on the drawings and as specified below:

Standard Type:

Shall comprise fixed horizontal reversed chevron section aluminium blades at 12 mm maximum spacing,

rigidly supported in aluminium frame.

Grilles shall be provided with a loose frame to give a finished appearance on both sides of the door.

Finish shall be clear anodised unless otherwise specified, and installed by the Builder.

#### **6.10.4 CEILING SLOT DIFFUSERS**

Ceiling slot diffusers shall be of extruded aluminium construction, complete with integral combination air pattern control and volume control damper. The number of slots shall be as shown on the drawings and the slot components shall be mechanically locked together to form a rigid assembly. Pattern controls shall be readily adjustable through the slots and shall be finished matt black. Slot diffusers shall be provided with matching adaptors or plenums where shown, all as manufactured by Holyoake Industries Limited.

#### **6.10.5 SIDE WALL LINEAR DIFFUSER**

Linear diffusers shall be extruded aluminium construction to size as scheduled. Blades shall be mechanically expanded into machine notched mullions spaced at 6.35mm centres. Diffusers shall be fitted with accessory claspers and shall be manufactured by Holyoake Industries Limited.

#### **6.11 VARIABLE AIR VOLUME BOXES**

Variable air volume air distribution assemblies shall be Holyoake series HCV with electronic DDC controls and matching factory furnished, attenuators as shown on the drawings. They shall be pressure independent and shall be capable of temperature controlled velocity re-set between zero and the maximum catalogued air flow.

At an inlet velocity of 10 m/s, the differential static pressure for any size shall not exceed 37Pa for the basic unit. Each assembly shall be constructed to minimise noise generation.

Basic assemblies shall consist of a casing insulated with 25mm high density fibreglass and constructed of 0.75 galvanised steel. The controlling damper shall have full air foil extruded aluminium blades with inflating edge seals. The damper shafts shall be zinc coated steel, pivoted in two piece acetal self-lubricating bearings locked in place.

The combined leakage of the closed damper and the high pressure casing shall not exceed 2% maximum rated flow at 750 Pa inlet static pressure.

Assemblies shall be furnished with flow averaging  $\Delta$  velocity sensors of the PDI type as manufactured by Holyoake Industries. Single point electronic sensors are not acceptable.

Each flow sensor shall be furnished with capped tees for independent site measurement of  $\Delta p$ . Each sensor shall be provided with a label showing its formula for flow calculation. Such calculated air flow shall be within  $\pm 5\%$  of actual, provided inlet connections are in non-deforming rigid or semi rigid duct of the same size as the assembly inlet, irrespective of inlet angles from zero to 90°.

Controllers shall be Siemens Electronic Type.

#### **6.12 AIR FILTERS**

Air filters shall be manufactured by Australian Air Filters P/L Type VA 420 or Power Guard super charged pleated panel filters Class B Replaceable Media as scheduled or indicated on the drawings.

All filters shall comply with the requirements of AS1324 – 1996.

All filters shall be mounted in stainless steel Uni-lok filter holding frames.

The air filter media shall be replaced when necessary by the Mechanical Services Sub-Contractor during the Defects Liability Period. A set of clean media shall be installed at the completion of the Defects Liability Period.

Pressure sensors/gauges shall be mounted on both sides of all filters.

## **SECTION 7 CONTROLS**

### **7.1 SENSORS**

Provide commercial or industrial grade sensors to produce stable, accurate and highly repeatable signals to the process controllers. Where transmitters or transducers are required to condition the sensor signal to an acceptable signal span and type, the resulting compound accuracy shall be not less than that specified.

### **7.2 EQUIPMENT**

#### **7.2.1 TEMPERATURE SENSORS**

Temperature sensors shall be provided as required and generally shall be mounted where shown on the drawings. Temperature sensors shall be of the resistance bulb or thermistor type with ranges selected to suit the particular application. Sensors shall be housed such that access to terminal strips and cabling can only be achieved by removal of a cover.

#### **7.2.2 CONTROLLERS (GENERALLY)**

All Control Panels shall be hard wired and mounted as shown on the drawings. Controllers shall accept a signal from the associated electronic sensor and provide an analogue output to control items. Outputs from all controllers shall be compatible with the controlled item. Control output accuracy shall be 2% output span.

The controls shall consist of local remote wired controllers for each indoor unit. Local remote wired controllers shall be of proprietary manufacture with the following features:

- a) Liquid crystal screens displaying complete operating status of the equipment
- b) Temperature setting
- c) Programmable timer to set respective times for operation start and stop
- d) Cool/heat/fan operation mode
- e) ON/OFF mode

## **SECTION 8 ELECTRICAL INSTALLATIONS FOR MECHANICAL SYSTEMS**

### **8.1 EXTENT OF WORK**

This section of the Specification covers the requirements for the electrical installation and control wiring for the Mechanical Services.

### **8.2 REGULATIONS**

The entire electrical installation shall be in accordance with the current regulations and requirements of Fiji Electricity Authority and with the relevant Australian Standards, in particular AS/NZS3000.

### **8.3 SUPPLY SYSTEM**

The supply system is alternating current, phase, nominal 415/240 volt, 50Hz, as provided by Fiji Electricity Authority.

### **8.4 BALANCE OF LOADS**

The loads shall be balanced between the individual phases of the supply.

### **8.5 RADIO INTERFERENCE**

To AS1044:

- a) Interference to radio equipment in the same area shall not exceed the limits as set out in AS1044. Provide suppression devices if necessary.
- b) Operation of the systems will not be effected by radio frequency interference at the limits set out in AS1044.

Provide suppression devices to minimise interference to radio equipment in the same area.

### **8.6 EARTHING**

The installation shall be earthed in accordance with AS/NZS3000 and the requirements of Fiji Electricity Authority. A separate earthing conductor shall be installed for each outgoing circuit, originating at the earth bar in the distribution board.

### **8.7 CABLE IDENTIFICATION**

All terminals and each end of each control wire shall be numbered.

All power and control cables at distribution boards shall terminate in an approved lug or terminal clip. Cables to terminals shall be provided with adequate fixing adjacent to the terminals.

### **8.8 EXTRA LOW VOLTAGE CABLES**

Extra low voltage control cables associated with the operation of the plant, e.g. thermostats, interlocks, thermistor sensor cables, etc., may be installed in the same enclosure as power and/or control cables operating at mains voltage, provided that the extra low voltage cable is insulated to the same standard as the mains voltage cable, and provided also that the low voltage cable is installed in such manner that induced stray voltages are prevented from affecting the operation of the controls under normal and abnormal conditions.

### **8.9 MOTOR CABLES**

Unless otherwise stated size cables for 125% of nameplate current rating, taking into account the current rating and volt-drop requirements.

The cable sizes for mechanical plant have been based on preliminary design data.

Confirm the actual electrical load of each item of equipment to the Architect/Engineer.

Sizes shall be increased where necessary for reason of voltage drop or derating.

## 8.10 SUB-CIRCUIT CABLES

All cables shall be sized as stated on the drawing(s), however, where not shown the following minimum sizes shall be used:

- |                                  |                 |
|----------------------------------|-----------------|
| a) Control Circuits, Alarms etc. | 1.5sq.mm Cu     |
| b) Flexible Cords                | 30/0.25sq.mm Cu |

Sizes shall be increased where necessary for reason of voltage drop or de-rating to comply with:

## 8.11 CABLES

### 8.11.1 MATERIALS

#### 8.11.1.1 GENERAL

Cables shall be of approved manufacture and shall comply with the appropriate Australian Standards. All cables shall have high conductivity plain annealed copper conductors and shall be of the multi-stranded type.

Cables shall be delivered to site in the original package and obtained from one manufacturer. Aluminium conductors are not acceptable.

#### 8.11.1.2 PVC INSULATED AND PVC SHEATHED CABLES (PVC/PVC)

PVC insulated and PVC sheathed cables shall be 0.6/1 kV and V.75 rating unless otherwise specified.

#### 8.11.1.3 XLPE-INSULATED AND PVC SHEATHED CABLES

XLPE-insulated and PVC sheathed cables shall be 0.6/1kV and V75 rating unless otherwise stated.

### 8.11.2 COLOUR CODING

#### 8.11.2.1 GENERAL

Cabling system shall be colour coded as follows:

#### 8.11.2.2 PVC INSULATED CABLES

Lighting	Actives	In Single Phase	Red
		In Multiple Phase	Red, White, Blue
	Switchwires		White
		Neutral	Black
	2 Way Strapping Wires	White	
Power	Actives		Red, White, Blue
	Neutral		Black

#### 8.11.2.3 PVC INSULATED AND PVC SHEATHED CABLES

Lighting	240Volt	White Sheath
	Actives	Red
	Switchwires	Red
	Wire	White-to be labelled with clip on identification Markers
	Neutral	Black
	Earth	Green / Yellow
Power	240Volt	Black Sheath
	Actives	Red

	Neutral Earth	Black Green / Yellow
Power	415 Actives Volt (3,4 or 5 core) Actives Neutral Earth	Orange Sheath Red, White and Blue Black Green / Yellow

#### 8.11.2.4 FLEXIBLE CABLES

Lighting & Power	Actives Switchwires Neutral Earth Earth	White or Grey Sheath Brown White Blue Green / Yellow
------------------	--	--

#### 8.11.2.5 EARTH CONDUCTORS

Separate earth conductors shall be insulated and colour coded green / yellow.

#### 8.11.2.6 CONTROL CABLES

Control circuits shall be orange, violet or other approved colours.

### 8.11.3 INSTALLATION METHODS

#### 8.11.3.1 GENERAL

All workmanship shall be first quality with cables installed parallel to walls, floors and ceilings, as applicable:

- a) Cables shall be run in a manner eliminating any possibility of strain on the cable itself or on cable terminations.
- b) Cables shall be installed in such a manner that adequate spacing is provided for fixing and for heat dissipation.
- c) Cables shall be kept a safe distance from items liable to become hot.
- d) Cables shall at no point make direct contact with such items.
- e) Cables shall be concealed except where nominated otherwise.
- f) Cables shall not be embedded in plaster, concrete, mortar or other finished unless they are in conduit and capable of being fully withdrawn and replaced after the building is finished without damage to finishes.
- g) Cables from different distribution systems shall not be installed in the same length of conduit, duct, and catenary wire or in the same junction box.
- h) Care shall be taken in the grouping of single core cables to reduce inductive effects on surrounding metalwork. Where parallel conductors are used, cables shall be grouped in 3 phase trefoil formations.
- i) Bending radii shall not be less than the manufacturer's recommendation and in any case shall be not less than six times the overall cable diameter.
- j) Cables shall run straight for a least 300mm immediately prior to entering switchboards and other equipment.
- k) All cables shall installed giving due consideration to the derating requirements for AS/NZS3008.1.
- l) Cables installed in a cavity external walls shall be tied against the face of the inner skin of the masonry walls and kept clear of the outer skin.
- m) With the exception of wiring harness system a loop-in-loop-out wiring system shall be used. No joints will be permitted except at outlet positions.
- n) Where unenclosed cables pass through sheet metal enclosures (this shall also include switchboards which are open at the bottom) they shall be fitted with cable glands.
- o) Copper cables 6sq. mm and above shall be terminated to bolts or studs, using soldered or compression type lugs.
- p) Compression lugs or ferrules shall be designed for the type of cable and shall be installed in accordance with the manufacturer's recommendations using the approved compression tool and die.

### **8.11.3.2 CABLES JOINT AND TERMINATION BOX**

Provide cable boxes of the correct size and voltage rating for the cables to be jointed.

At termination, the cables cores shall be extended with cable tails of equal cross sectional area. Joints shall be made with solid barrier crimp links and shall be insulated with heat shrink sleeves or encapsulated within a selected proprietary insulating setting compound.

### **8.11.3.3 CABLES IN CONDUITS**

In addition to the general requirements cabled shall be fed onto conduit in such a way as to prevent twisting and crossing. Conduits shall be completely assembled and built in before drawing in cables. Do not use inspection fittings for drawing in cables inks or damaged cables shall be replaced.

### **8.11.3.4 CABLES ON TRAYS**

Cables shall be fixed neatly in the tray in a single layer or trefoil formation for three phase circuits and shall be installed parallel with the tray edge to avoid unnecessary crossovers. The trays shall be formed and protected to prevent damage to the cables where exits are made from the tray. Cables shall be installed such that spare space capacity of not less than 30% of each tray shall be provided. Cables shall be fixed at intervals not exceeding 1200mm by means of approved fastenings of non-corrosive material. Conduits shall be fixed to trays means of saddles.

### **8.11.3.5 CABLES ON CATENARY WIRES**

Cables shall be installed on catenary wires supported at intervals not exceeding 450mm. Catenary wires shall be fixed to the building structure not to ceiling suspension members. Sub-mains cables shall be installed on a catenary wire dedicated to the sub-mains cabling. The maximum number of sub-circuits installed on one catenary wire shall be seven (7).

## **8.12 FIELD EQUIPMENT**

### **8.12.1 GENERAL**

Supply and install the following field mounted equipment.

### **8.12.2 TERMINAL BOXES**

Field terminal boxes shall be of approved manufacture and fitted with fully gasketed removal covers held in place by captive screws. Terminal boxes, including cable entries, shall be weather-proof and vermin-proof when set in their final positions. Terminal boxes located in areas where submersion is possible shall be watertight (including cable entries) and shall be capable of occasional submersion for periods of up to 24 hours without significant moisture penetration. Terminal boxes shall be fitted with approved double-sided fixed tunnel-type terminal strips for termination of all cable cores including spare cores (one core per terminal).

### **8.12.3 MOTOR ISOLATING SWITCHES**

All items of equipment shall be provided with isolating switches located adjacent to the equipment in a convenient accessible position. Isolators shall have provision for padlocking and shall be capable of interrupting 800% motor full load current. Alternatively single pole control isolators of the type specified above may be used in lieu of three or four pole isolators. Isolating switches shall be "Klockner Moeller Type T" or equivalent heavy duty type, three pole or four pole

## **SECTION 9 PAINTING & LABELLING**

### **9.1 GENERAL**

Paint with first quality materials, and to the satisfaction of the Architect, all permanent parts of the installation as detailed in this Specification. All surfaces to be painted shall be properly prepared prime coated, undercoated and finished with two finishing coats. The preparation of the surfaces and application of paint shall be in accordance with the Manufacturer's instructions.

### **9.2 SURFACES NOT TO BE PAINTED**

Chrome plated and stainless steel surfaces. Bearing surfaces, slides, adjusting screws and any surface that is required to be unpainted for the correct operation or adjustment of the equipment. Flexible duct connections, rubber or canvas hoses and flexible rubber mountings. Air conditioning and ventilation ductwork installed in concealed spaces. Plastic surfaces. Thermal and acoustic insulation.

### **9.3 PAINT MATERIALS**

All finishes and preparations shall be first quality, non-poisonous, lead free products of approved brand. All materials shall be brought onto the site ready mixed in the Manufacturer's sealed containers.

### **9.4 PREPARATION OF SURFACES**

All surfaces shall be thoroughly clean and dry, and free from dust, oil or grease. Metal surfaces shall be wire brushed to remove loose rust or scale. Castings shall be fully degreased then filled with an approved filling compound and rubbed to a smooth finish. Metal surfaces, not to be galvanised, and including steel pipes and conduits, shall be given an application of cold phosphate compound and prime coated with red zinc chromate primer before delivery to site. Copper pipes to be painted shall be etched primed before painting. Galvanised or zinc sprayed steel surfaces shall be coated with self-etching primer then prime coated with galvanised iron primer.

### **9.5 FINISHES**

#### **9.5.1 GENERAL**

All paint finishes shall be high-grade solvent base alkyde gloss enamel unless specifically mentioned otherwise in this specification. To ensure complete coverage in each finishing coat, the finishing coats shall be different shades in the nominated colour.

#### **9.5.2 DUCTWORK**

All external or exposed to view supply and return air ductwork shall be painted to a colour to be nominated by the Architect. Painting to be carried out in accordance with this Specification.

#### **9.5.3 SUPPORTS, HANGERS AND BRACKETS**

All visible supports, hangers and brackets shall be painted black.

### **9.6 LABELLING**

All plant, equipment, control components, stop/start stations, switches modulating control valves, pumps, reducing valve assemblies, etc. shall be adequately labelled to fully identify the plant, equipment, etc. to which it refers and to define the system served by the plant and its duty. Labels are to be in the form of black filled upper case lettering on "Traffolyte" or other approved white material. They are to be neatly attached beneath the equipment to which they refer using approved mechanical fixing devices.

Lettering height shall be not less than:

- a) 10mm on switchboards and control panels
- b) 12mm on control components, i.e. valves
- c) 32mm on plant and equipment, i.e. AHU

## **SECTION 10 TESTING**

### **10.1 GENERAL**

All pressure testing shall be done during or after the erection of the ductwork and pipework systems and before they are covered over or lagged. The Engineer shall be notified in writing, at least 48 hours before the test, of the date on which the test will take place. The tests shall be carried out in the presence of the Engineer. Provide all equipment, instruments, material and labour necessary for the testing. If any repairs are necessary, the test shall be repeated until entire systems are satisfactory.

A comprehensive report of all tests shall be given to the Engineer.

### **10.2 INSTRUMENTS**

#### **10.2.1 CERTIFICATION**

For each measuring instrument included in the site test apparatus provide a current calibration certificate from an approved authority, showing the Information Listed in AS 2415 Clause 4.9.

#### **10.2.2 RECALIBRATION**

Recalibrate each instrument on or before the certified date for recalibration. Recalibrate or replace faulty instruments or instruments rejected by the Engineer. If the Engineer rejects an instrument on the Ground of faulty calibration only, and the Instrument proves to be correctly calibrated, the Cost of recalibration shall be borne by the Principal

#### **10.2.3 INSPECTION**

The Engineer reserves the right to inspect the test instruments prior to use and attest their suitability.

#### **10.2.4 SCALES**

Electrical instrument scales shall be such that readings will be at least one half of the full scale deflection. Scales for other instruments such as gauges, thermometers and the like shall be calibrated over the range of test readings.

ORDER OF ACCURACY: +/-1% of full scale deflection.

## SECTION 11 NOISE AND VIBRATION

### 11.1 STANDARDS

AS 1469	Sound Pressure Levels
AS 1217	Sound Power Levels
AS 1633	Noise Suppression – Definitions
AS 2625	Rotating and Reciprocating Machinery – Mechanical Vibration
AS 2659	Guide for the Use of Sound Measuring Equipment

### 11.2 GENERAL

The requirements of noise control equipment and anti-vibration equipment for the Installation, and details for maximum noise level criteria for occupied areas of the building listed below. It shall be the Mechanical Sub-Contractor's responsibility to check the performance of all equipment offered in the Tender, and to ensure that the noise and vibration levels of the installed equipment does not exceed the maximum permitted levels as specified.

Should resonance occur in pipe runs or duct systems under any load conditions the Mechanical Sub-Contractor shall make adjustments to the runs and/or supports to effectively de-tune the system. Select and install equipment to operate within the specified limits.

Installation shall include static and dynamic balancing of equipment, adjustment of valves, vibration eliminators, acoustic treatment and the like. Any remedial work required after installation to achieve the specified levels shall be carried out by the Mechanical Sub-Contractor at no costs to the Principal.

### 11.3 NOISE LEVEL CRITERIA

Standard AS 1469 lists the maximum permissible noise levels for occupied areas of the building when all mechanical plant and equipment covered by this Specification is operating.

The maximum permissible noise levels stated shall apply at any points less than 1.5 metres above floor level, not less than 1.5 metres from any supply air outlet or 0.6 metres from exhaust or relief air inlets.

The maximum permitted noise levels are given in terms of a Noise Rating Number (NR) as defined in AS 1469.

### 11.4 OUT-OF-BALANCE FORCES

The rotating parts of all rotating machines shall be statically and dynamically balanced. The maximum total residual unbalance shall not exceed 1.5 x 10.5kg-m per kg of the mass of the rotating part.

### 11.5 ANTI-VIBRATION MOUNTS

Rotating equipment shall be installed on anti-vibration mountings of type and deflection suitable to minimise the transmission of vibration to the building structure. Anti-vibration mountings shall be as specified or as approved by the Engineer.

Prior to the purchase or manufacture of equipment, the Mechanical Sub-Contractor shall submit full details of all anti-vibration mountings, vibration isolation efficiency, mounting requirements and sample mountings for approval. Full details of proposed anti-vibration mountings shall be shown on the Mechanical Sub-Contractor's shop drawings.

### 11.6 SPRING MOUNTINGS

Spring mountings shall apply to and comply with the following:

- a) Fans less than 300mm dia.
- b) Fans shall be supported by spring hinges with ribbed neoprene pads to give a minimum vibration isolation efficiency of 95%.
- c) Fans greater than 300mm diameter.
- d) Fans shall be mounted by the combined use of free-standing, spring mounted and ribbed neoprene pads to give a minimum vibration isolation efficiency of 95%.
- e) The minimum static deflection of mountings shall be 20mm.

## SECTION 12 COMMISSIONING & PERFORMANCE TESTS

### 12.1 EXTENT OF WORK

Commission the plant to provide the specified performance.

This section of the Specification covers the requirements for commissioning and acceptance tests for all the equipment and systems installed under this Contract.

Provide all power, fuel, labour and materials used during the commissioning and testing of the system. Carry out all tests required by statutory Authorities.

Authority approvals shall be obtained in writing and included in the Maintenance Manuals.

Modify, or replace defective equipment that fails to meet the guaranteed performance. Conduct further tests as necessary to prove performance.

### 12.2 PRE-COMMISSIONING

Prior to commencement of the Commissioning of the systems the following procedures shall be carried out:

- a) Before testing and operating any item of plant, ensure that such item is correctly installed; fan shafts rotate freely and are correctly lubricated, electrical and control wiring is firmly connected and the installation is safe to operate.
- b) Pressure and leak test ductwork systems as outlined in Testing section of this Specification.

### 12.3 COMMISSIONING

- a) Carry out all commissioning tests necessary to put the systems into use and to approval before Practical Completion is granted. Record all test results and include in Maintenance Manual. Commissioning shall be carried out by specialist in the respective fields. Controls shall only be commissioned by the Controls supplier or authorised representative.
- b) Commissioning personnel shall be provided with preliminary copies of Maintenance Manuals and As Installed drawings to facilitate correct commissioning and for checking Manuals and drawings for correctness.
- c) All the system shall be run and the operating and safety control set to give the required conditions.
- d) All air flow rates shall be adjusted to give design figures within - 0+ 5%.
- e) The total air flow quantity for each system shall be achieved by adjusting the fan speed and not by throttling dampers. Air capacities shall be taken with filters in the 'dirty condition'.
- f) Air outlets shall be checked and adjusted to give correct air distribution in each area without draught.
- g) Operating, safety and event controls shall be tested. Failures and event modes shall be simulated to demonstrate the correct operation of all safety and event controls systems.
- h) After the commissioning of the Installation is complete, advise the Project Manager and submit for perusal the complete commissioning data sheets and drawings showing all air temperature chart recordings from selected zone.
- i) Demonstrate to the Engineer the correct operation of safety and operation controls, correct air and water flows.

### 12.4 PERFORMANCE TESTS

Carry out Performance Tests on all systems installed under this Contract.

Performance tests shall be run over a nominated period of up to five consecutive days in summer, and during the Warranty Maintenance period. The extent and nature of the test data to be recorded shall be as necessary to determine the operating capacity and efficiency of the various systems. Submit for approval proposed test sheets. Provide all test instruments. (Refer Testing Section).

Two copies of all calculations shall be submitted to the Engineer together with photocopies taken of all charts etc.

## **SECTION 13 MAINTENANCE MANUALS & AS INSTALLED DRAWINGS**

### **13.1 GENERAL**

The Mechanical Sub-Contractor shall supply at Practical Completion As Installed drawings and Installation Manuals for the project.

### **13.2 MAINTENANCE MANUAL**

Provide three weeks before Practical Completion three copies of approved Maintenance Manuals. The Manuals shall include a full description of the Installation and functioning of the various systems involved and instruction to cover every action necessary for the efficient operation and maintenance of the Installations. The Manuals shall be neatly prepared and bound in a vinyl hard-back folder with stamped lettering on the front and along the spine of the folder. The folder shall be A4 sized and have a minimum of 3 binding rings. Provide dividers between sections with plastic covered labelled tags. The cover and spine shall have the words 'Installation Manual', Mechanical Services and the job name only. Letters shall be a minimum of 15mm high. The contents of the Manual shall be in the following general format:

#### **13.2.1 INDEX**

All sub-divisions of each section including lists of drawings, equipment and similar shall be indexed for quick reference.

#### **13.2.2 GENERAL DESCRIPTION AND CAPACITIES OF INSTALLATIONS**

Each individual system shall be included as a sub-section as appropriate. Full details of any system which requires regular maintenance shall be included. The function of each system or sub-system shall be described. Divide into sub-sections for each individual air conditioning, mechanical ventilation or mechanical system as appropriate and include full details of supply, return and fresh air flow rates, dry and wet bulb temperatures, cooling and, heating duties, etc.

#### **13.2.3 AS INSTALLED DRAWINGS**

A complete set of As Installed drawings shall be included in the Installation Manual. If drawings are to be bound as a separate set, include full index of all drawings here.

#### **13.2.4 EQUIPMENT**

All major items of equipment installed shall be listed complete with manufacturers name, agent's name, model, and/or type No., Serial No., size, and design ratings in sub-divided sections as for Section 2 above (i.e. all relevant data necessary for re-ordering or replacing). As far as practicable, all equipment should be broken down to individually identifiable items such as, motors, drive belts, fans, filters, etc.

#### **13.2.5 INSTALLATION, MAINTENANCE & OPERATING INSTRUCTIONS**

Manufacturer's installation, maintenance and operating instruction for each system shall be included and sub-divided as for Section 2. A comprehensive maintenance schedule to be followed throughout the warranty period shall be included along with copies of all data relating to commissioning testing.

#### **13.2.6 PLANT OPERATING INSTRUCTIONS**

A complete description and correct sequence of all actions necessary to start up and operate each system shall be provided and sub-divided as for Section 2. Full operation on such items as normal and abnormal dial readings and protection equipment settings shall be included. Information on the immediate action to be taken in the event of hazardous conditions arising shall be provided concluding with the following sentence in large lettering.

FOR SERVICE - CALL TELEPHONE NO.: \_\_\_\_\_

With appropriate telephone number provided.

### **13.2.7 PERFORMANCE TEST RESULTS**

Space for inclusion of all performance test results shall be provided and sub-divided as for Section 2. All results of progressive tests during the installation works shall be included.

### **13.3 AS INSTALLED DRAWINGS**

Provide with the Maintenance Manuals, three copies of all installation drawings. Drawings shall be true and accurate representation of the installation as finally installed. These drawings shall include the following:

- a) Complete plant and equipment layout drawings with full identification of each and every item of equipment.
- b) Complete electrical and control wiring diagrams showing all electrical controls, relays, cut-outs, timing devices, inter-locks, fuses, over-loads, contactors, solenoids, starters, etc, with all items clearly identified as to type, function, fault ratings, sizes, settings etc.
- c) Drawings shall be supplied either bound in the Maintenance Manuals, or as separate sets, plus one plastic laminated set for mounting in the Plantroom.
- d) All As Installed drawings shall be drawn on AutoCAD prior to practical completion. Submit to the Engineer for approval 3 sets of prints of all As Installed drawings. Upon approval, provide one (1) set of compact disc and one (1) set of As Installed drawings to the Engineer. All drawings shall be produced on A2 sized sheets and to the Principal's drawing format.

#### **13.3.1 IN THE MANUAL**

If included within the Manual covers, drawings shall be folded to size and contained in clear plastic A4 size envelopes. The envelopes shall be edge-bound in. A maximum of two drawings per envelope shall be allowed.

#### **13.3.2 SEPARATE SETS**

All drawings shall be printed on the same size paper sheets irrespective of actual drawing size.

All printed drawing sheets are to be trimmed to the same size.

All drawings in the set are to be aligned carefully to present a neat appearance. The title block of all drawings shall appear in the right-hand bottom corner of the set, (if necessary, small drawings print on a larger sheet to achieve this).

The first drawing in each set shall be an index of all drawings contained including both drawing title and number.

Drawings shall be supplied bound into sets with a front and rear cover sheet (front cover labelled to identify the Set) and clear plastic protective front and rear sheets.

### **13.4 INSTALLATION MANUALS**

Three copies of an Installation Manual shall be provided to the Architect at Practical Completion. A full description of the various systems involved and instructions covering every action necessary for the efficient operation and maintenance of the installation shall be included. The manual shall be bound neatly in a blue vinyl hardback folder with stamped gold lettering on the front cover, in a format to be confirmed by the Engineer. In addition, the words, Installation Manual, the services, and the job name, shall be stamped in gold lettering along the spine of the folder. All aspects of the style and quality of the manual, including folders and contents shall be to approval. The general format to be followed shall be:-

### **13.5 DRAFT MANUAL AND DRAWINGS**

Provide Commissioning personnel with draft copies of the Maintenance Manual and As Installed Drawings. Refer Commissioning Section.

## **SECTION 14 MAINTENANCE AND SERVICING**

### **14.1 MAINTENANCE**

Routine maintenance and servicing shall be carried out for a period of 52 weeks from date of Practical Completion to the end of the Maintenance and Defects Liability Period. Routine maintenance shall be carried out during normal working hours. Emergency service shall be available on a 24 hours call out basis.

Routine maintenance shall be:

- a) Twelve site visits at 1 month intervals.
- b) The last visit shall be 2 weeks prior to the end of the Defects Liability Period. Unless advised otherwise by this Sub-Contractor, the Proprietor's staff shall carry out daily and weekly maintenance with this Sub-Contractor's on site instruction and in accordance with the Maintenance Manual.

This does not relieve this Sub-Contractor of his responsibilities regarding the rectification of defects and warranty of equipment, unless such loss is caused by willful damage to the plant by others.

Maintenance procedures shall be as appropriate to ensure the safe and proper operation of all systems and shall be in accordance with current standards requirements of the Building Act and Regulations having jurisdiction, relevant Australian Standards, Local Authority Regulations and the schedule provided in the Installation Manual as outlined in Section 12 Commissioning and Performance Tests of this Specification.

Routine maintenance shall be deemed to be the regular maintenance of equipment and shall include not less than:

- a) Checking and cleaning of all cleanable filters, monthly.
- b) Checking and reports on necessity for replacement of removable filter media and installation of such media, as required.
- c) Checking the operation of all electrical switchgear, including setting and operation of motor overloads, bi-annually.
- d) Checking the operation, setting and calibration of all controls, bi-annually.
- e) Checking of all motors for temperatures rise, operating current and leakage, quarterly.

NOTE: Provide clean filters at Practical Completion. Supply of consumable media shall be by the Principal after initial supply of media.

The last maintenance visit prior to the end of the Defects Liability Period shall be a major visit for complete service. The Engineer shall be advised of the proposed service program for the last major visit not less than one week prior to the date of the proposed last visit so that a representative may be present during the service.

### **14.2 RECTIFICATION OF DEFECTS**

All defects shall be promptly rectified. Retention moneys or Bank Guarantee will not be released until all outstanding defects notified during the Maintenance and Defects Liability Period has been rectified and completion of such work subsequently advised in writing to the approving Authority.

### **14.3 SERVICE LOG BOOK**

Provide a log book bound in an approved hard cover folder and containing sufficient pages to record all operational maintenance during the defects liability period. Provide a fixed holder in an approved location for the log book.

Record in the log book all maintenance work performed. Each log sheet shall be signed by the Serviceman responsible and shall include the date and description of work carried out.

All log sheets must be countersigned by the Principal's representative.

The front cover of the log book shall be labelled with the name of the project and shall clearly note that

each sheet must be countersigned. Inform the Maintenance staff and supplier's Serviceman on the correct use of the log book.

#### **14.4 SERVICE CALLS**

Emergency service calls shall be attended within 24 hours. If service is not provided within the specified time, the Principal reserves the right to arrange for alternative emergency attendance and deduct from the Contract all costs associated with the attendance. A copy of each service call (routine maintenance or defects maintenance) shall be forwarded to the Engineer for his records.

#### **14.5 SPECIALISED MAINTENANCE**

Specialised maintenance for items such as controls, air balancing, etc, shall be carried out by approved specialists in those fields. In all cases maintenance shall be carried out by personnel approved by the Specialist Equipment Supplier.

#### **14.6 DEFECTS LIABILITY**

The Defects Liability Period shall be 52 weeks from the date of Practical Completion.

During the Defects Liability Period the Mechanical Sub-Contractor should be responsible for the provision of all labour, materials and other costs associated with the removal of defective components, bad workmanship and the installation, adjusting and testing of replacements and to carry out such work within a reasonable time.

Equipment replaced or repaired during the warranty period shall be provided with a warranty of 52 weeks commencing from the date of replacement or repair.

Warranty maintenance for the replaced or repaired equipment shall be limited to the 52 weeks from date of Practical Completion.

#### **14.7 CERTIFICATION**

At the end of the Defects Liability period, make a final service visit and upon satisfactory completion of the above procedures certify in writing that the installation is operating correctly.

# APPENDICES

**APPENDIX I TENDER FORM – OPTION 1 – SUPPLY AND INSTALLATION**

MECHANICAL SERVICES TENDER  
LAND TRANSPORT AUTHORITY KARAVI WEIGHBRIDGE STATION  
KARAVI, BA, FIJI

We, the undersigned having examined the Drawings and Specification hereby offer to execute and complete the whole of the Works required to be done, as shown on the said Drawings and described by or referred to in the Specification and for the Fixed Lump Sum of:

.....  
..... (FJ \$.....)

Which includes all Contingency, Provisional and P C Sums and is a Fixed Lump Sum without provision for fluctuations in the cost of labour and materials.

AS WITNESS OUR HANDS THIS ..... day of ..... 2019

SIGNATURE OF TENDERER .....

OFFICE STAMP .....

ADDRESS .....

WITNESS [SIGNATURE AND BLOCK CAPITALS] .....

ADDRESS1 .....

OCCUPATION .....

DATE .....

We confirm that our time for completion is .....calendar weeks.  
The Tender shall be open for acceptance for a period of sixty (60) days.  
The Principal does not bind himself to accept the lowest or any tender.  
The documents must not be altered in any way. Any special observation should be made in a separate letter attached to this Tender. Please return documents with Tender.  
The Tender is to be enclosed in a sealed envelope and must arrive at the nominated office as per the details in the "Tender Invitation Letter".

Name of Tenderer \_\_\_\_\_

Signature \_\_\_\_\_ Date \_\_\_\_\_

**APPENDIX II SUMMARY OF TENDER – SUPPLY AND INSTALLATION****PRINCIPAL** : LAND TRANSPORT AUTHORITY**SHEET 1 of 1 SHEET****PROJECT** : LAND TRANSPORT AUTHORITY  
KARAVI WEIGHBRIDGE STATION**PROJECT NO:** 7835**SPECIFICATION:** MECHANICAL SERVICES**DATE:** MAY 2019

ITEM	DESCRIPTION	PRICE
a)	Preliminary and General	\$
b)	Supply and installation of Split air conditioning systems.	\$
c)	Supply and installation of insulated liquid and gas refrigeration lines between the outdoor condensing unit and indoor units.	\$
d)	Supply and installation of insulated condensate drain lines between indoor units and discharge points as indicated on the drawings.	\$
e)	Extension of power supply from outdoor condenser units to the weather-proof isolators mounted next to outdoor condenser units	\$
f)	Supply and installation of toilet exhaust fans and accessories with door grilles	\$
g)	All other items not included above ( Please specify _____ )	\$
h)	Supply of Shop Drawings	\$
i)	Supply of As Installed drawings	\$
j)	Supply of Installation Manuals	\$
k)	Twelve (12) months Maintenance	\$
l)	Contingency Sum (VEP)	<b>\$ 5,000.00</b>
	<b>TOTAL TENDER PRICE (VAT Exclusive)</b>	<b>\$</b>
	<b>VAT @ 9%</b>	<b>\$</b>
	<b>TOTAL TENDER PRICE (VAT Inclusive)</b>	<b>\$</b>

Name of Tenderer \_\_\_\_\_

Signature \_\_\_\_\_ Date \_\_\_\_\_

**APPENDIX III SCHEDULE OF TECHNICAL DATA**

**PRINCIPAL** : LAND TRANSPORT AUTHORITY

**SHEET 1 of 2 SHEETS**

**PROJECT** : LAND TRANSPORT AUTHORITY  
KARAVI WEIGHBRIDGE STATION

**PROJECT NO:** 7835

**SPECIFICATION:** MECHANICAL SERVICES

**DATE:** MAY 2019

**NAME OF TENDERER:** .....

Two loose copies of this Schedule are supplied with this Specification.

One copy shall be completed, signed by the Tenderer and returned with his tender.  
The other copy is for the Tenderer's retention.

A Tender shall be regarded as not complying with this Specification if the information required by this Schedule of Technical Data is not supplied with the Tender.

Tenders are to be based on equipment etc., as specified.

Alternatives may be submitted, but must be clearly described to receive consideration.  
For each alternative, an alternative tender price must be submitted.

	<b>NAME OF PROPOSED SUB-CONTRACTOR / SUPPLIER</b>	<b>SUB-CONTRACT EQUIPMENT</b>
1	.....	.....
2	.....	.....
3	.....	.....
4	.....	.....
5	.....	.....
6	.....	.....

	<b>COMPARABLE WORK CARRIED OUT BY THE TENDERER AND APPROXIMATE VALUE</b>	
1	.....	\$.....
2	.....	\$.....
3	.....	\$.....
4	.....	\$.....
5	.....	\$.....
6	.....	\$.....

Name of Tenderer \_\_\_\_\_

Signature \_\_\_\_\_ Date \_\_\_\_\_

**APPENDIX III SCHEDULE OF TECHNICAL DATA**

**PRINCIPAL** : LAND TRANSPORT AUTHORITY

**SHEET 2 of 2 SHEETS**

**PROJECT** : LAND TRANSPORT AUTHORITY  
KARAVI WEIGHBRIDGE STATION

**PROJECT NO:** 7835

**SPECIFICATION:** MECHANICAL SERVICES

**DATE:** MAY 2019

**A. EXHAUST AIR FAN TYPE EAF- 1**

Manufacturer .....

Model No .....

**B. EXHAUST AIR FAN TYPE EAF- 2**

Manufacturer .....

Model No .....

**C. WALL MOUNTED UNIT – 2.6 kW**

Manufacturer .....

Model No .....

**D. WALL MOUNTED UNIT – 3.7 kW**

Manufacturer .....

Model No .....

**E. CEILING CASSETTE UNIT – 2.7 kW**

Manufacturer .....

Model No .....

**F. CEILING CASSETTE UNIT – 3.6 Kw**

Manufacturer .....

Model No .....

**G. DOOR GRILLE TYPE DG1**

Manufacturer .....

Model No .....

Name of Tenderer \_\_\_\_\_

Signature \_\_\_\_\_ Date \_\_\_\_\_

**APPENDIX IV SCHEDULE OF RATES (To be completed and submitted with Tender)****PRINCIPAL** : LAND TRANSPORT AUTHORITY**SHEET 1 of 1 SHEET****PROJECT** : LAND TRANSPORT AUTHORITY  
KARAVI WEIGHBRIDGE STATION**PROJECT NO:** 7835**SPECIFICATION:** MECHANICAL SERVICES**DATE:** MAY 2019

The following Schedule of Rates shall be used as a basis to value variations (either additions or deletions) and progress claims for this Contract.

Rates shall include all overheads (including on and off site supervisory staff, allowance etc.) profit and VAT.

Rates for equipment and materials are that delivered to site, without installation. (Unless otherwise stated)

ITEM	DESCRIPTION	UNIT	PRICE (VIP)
1	Licensed Technician (Refrigeration)	Per hour	\$.....
2	Licensed Technician (Electrician)	Per hour	\$.....
3	Technician	Per hour	\$.....
4	Unskilled Labour	Per hour	\$.....
5	Exhaust Air Fan Type EAF-1		\$.....
6	Exhaust Air Fan Type EAF-2		\$.....
7	Wall Mounted Unit 2.6 kW		\$.....
8	Wall Mounted Unit 3.7 kW		\$.....
9	Ceiling Cassette Unit 2.7 kW		\$.....
10	Ceiling Cassette Unit 3.6 kW		\$.....
11	Door Grille Type DG1		\$.....
	<u>On Cost Percentage Mark-Ups</u>		
12	Labour		.....%
13	Material		.....%
14	Plant		.....%

Name of Tenderer \_\_\_\_\_

Signature \_\_\_\_\_ Date \_\_\_\_\_