CLUSTER

Trading Services

UNIT

Water and Sanitation

DEPARTMENT

Sanitation Operations

PROCUREMENT DOCUMENT

INFRASTRUCTURE

Documents are to be obtained, free of charge, in electronic format, from the National Treasury's eTenders website or the eThekwini Municipality's website.

Contract No: 30661-5W

Contract Title: Construction of the Southern Wastewater Treatment Works Multidisciplinary Upgrades

Est. CIDB Grade/ Class: 9 9EP and 9ME

CLARIFICATION MEETING AND QUERIES

Clarification Meeting: Compulsory Clarification Meeting

Meeting Location, Date, Time: Southern Wastewater Treatment Works (@ co-ordinates - 29.955135360820552, 30.97299685576011) on 13 June 2025 at 11h00

Queries can be addressed to The Employer's Agent's Representative:

Name: Shanir Ramjathan
Tel: +27 (0)31 254 5700
eMail: Shanir.r@ixengineers.co.za.co.za

TENDER SUBMISSION

Delivery Location: The Tender Box in the foyer of the Municipal Building 166 KE Masinga Road, Durban

Closing Date/ Time: Friday, 04 July 2025 at 11h00

FACSIMILE, eMAIL, or POSTED TENDERS WILL NOT BE ACCEPTED

Issued by:

ETHEKWINI MUNICIPALITY

Deputy Head: Water and Sanitation

Date of Issue: 30/05/2025

Document Version 01/03/2024

VOLUME 7 OF 9

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Tenderer Name:			VAT Registered: Yes No
	Price (excl)	VAT	Price (incl)
Submitted:	R	R	R
Corrected:	R	R	R

INDEX to TENDER DOCUMENT - VOLUMES

This Tender Document consists of 9 (Nine) Volumes as indicated in the table below.

Volume	Description	Contents
1 of 9	Tender Document	Tendering Procedures Returnable Documents Agreement and Contract Data Scope of Work Site Information
2 of 9	Pricing Data	Pricing Assumptions / Instructions Bill of Quantities
3 of 9	Standard Specifications	Standard Specifications Amendments to standard Specifications
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5 of 9	Mechanical	Standard Specifications Project Specifications - Mechanical Particular Specifications – Lifting Equipment Mechanical Data Sheets
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8 of 9	Annexures	Quality Assurance, Transport, Installation, Testing and Commissioning Environmental Management Plan Employer's Health and Safety Specification Employers Standard Electrical Standard Specifications Employers Standard Mechanical Specifications Employer Control Instrumentation Project Specification
9 of 9	Drawings	General Drawings Electrical Drawings Mechanical Drawings Building Work Drawings Structural Drawings HVAC Drawings Civil Drawings

Declaration by Tenderer

I, the undersigned, hereby declare and confirm that I have obtained all 9 (Nine) of the Tender Document Volumes as indicated in the table above.

NAME (Block Capitals): _____ **Date**

SIGNATURE: ---------- ----------

This Tender Document (Volume 7 of 9: HVAC) consists of the following Documents.

PROJECT SPECIFICATIONS - HVAC
PARTICULAR SPECIFICATION - HVAC
PRICING INSTRUCTIONS – HVAC (SECTION P IN BILL OF QUANTITIES)
RETURNABLE SCHEDULE - HVAC
ANNEXURES – INSPECTION SHEETS - HVAC

C3.2 PROJECT SPECIFICATIONS : HVAC

Contents

C3.2 PROJECT SPECIFICATIONS : HVAC

1. GENERAL SPECIFICATIONS

This contract is for the supply, delivery, installation, testing, commissioning, maintenance, and guarantee of the HVAC installations for the additions and alterations as described in section 000.

2. DESIGN DATA

Table 1 : Design Data

Location	eThekwini, Durban, KZN, South Africa
Outdoor Summer Temperatures	30.6°C Db / 26.1°C Wb
Outdoor Winter Temperatures	5.5 °C Db / 3.7°C Wb
Indoor Conditions	See Section 4.1.2 System Requirements
Altitude Above Sea Level	8 m
Condenser Coil Selection Temperature	38.6°C

3. COMPULSORY STANDARDS

The equipment, installation, commissioning, and maintenance shall in all respects comply with the following authorities and regulations:

- The Occupational Health and Safety Act, Act No. 85 of 1993.
- Local municipal regulations, by-laws, and ordinances.
- Local fire department regulations.
- SANS 10400: The application of the National Building Regulations.
- Local electrical supply authority regulations.
- The wiring of premises Part 1: Low-voltage installations, SANS 10142-1 as amended.

All losses, costs, or expenditures which may arise as a result of negligence to comply with any regulation applicable to this service as specified above, shall be for the account of the Contractor.

The Contractor shall work strictly according to this specification and shall ensure that only the best quality material is used and that the installation is handed over as a complete working system.

The scope of work, in general, shall be in accordance with:

- SANS 1125: Room air conditioners and heat pumps
- SABS 0147: Refrigerating systems including plants associated with air-conditioning systems.
- SANS 10142-1-2003: The wiring of premises Part 1: Low-voltage installations
- SABS 1424-1987: Filters for use in air-conditioning and general ventilation
- SANS 1238:2005: Air-conditioning ductwork

- SANS 10173:2003: The installation, testing, and balancing of air-conditioning ductwork.

4. SCOPE OF WORK

The scope of work will cover the following components:

4.1. Low-Level Pump Station Upgrade - General HVAC:

4.1.1. Background

The pump station is a sewage low-level pump station located at eThekwini's Southern Waste-Water Treatment Works in the south of Durban. It is a concrete structure with brick infill, comprising three existing main areas: the Pump Station, Pump Pit, Pumping Sumps. Additionally, a new substation will be added to the building. Odour control and proper ventilation are critical for the HVAC system of the pump station. To ensure optimal performance of the mechanical equipment, the low-level pump station is to be upgraded with enhanced ventilation and air conditioning.

4.1.2. System Requirements

The low-level pump station will require the following modifications:

- Odour Ventilation: Existing PVC pipes used for odour ventilation in the pumping sumps will be fitted with ducting. Axial extraction fans and discharge cowls.
- Air Extraction: Air will be extracted from the pumping pit through two new ducts, each equipped with extraction fans and sound attenuators. The extracted air will be discharged through weather louvres on the northeastern side of the building.
- Fresh Air Supply: Existing ducting, which penetrates through two existing holes in the roof slab, will be reused and outfitted with fresh air fans and filter banks fixed on the roof slab. These fans will supply filtered fresh air to the pump station, specifically to the areas where the pump motors are located. The inside of the ducting will be modified to accommodate double deflection punkah louvres aimed at the pump motors to ensure they operate at a maximum temperature of 35 degrees Celsius. This setup will also provide sufficient make-up air to be ventilated in conjunction with the extraction ducting of the pumping pit.
- VSD Cooling in New Sub-Station Room: Three condensing units will be required to maintain an indoor temperature of 25 degrees Celsius inside the new substation where the pump motors' VSDs will be situated. The three condensing units will be placed on the roof slab above the new substation and connected to three indoor units inside the substation. The refrigerant will be placed inside trunking from the indoor units to the outdoor units, ensuring a safe and efficient connection, while condensate piping will be directed to drains points as per drawing.
- Note that the site is situated in a high erosion environment, and that all ducting should be 1mm thick Galvanized Steele, and mounting frames should be made of galvanized steel. All HVAC Equipment components to be factory treated from corrosion.
- All Slab penetrations to be waterproofed.
- All extraction fans are to be spark-proof and certified.

C3.4 PARTICULAR SPECIFICATION: HVAC

Contents

C3.4 PARTICULAR SPECIFICATION: HVAC

1. GENERAL

The air-conditioning units and installation in general shall be in accordance with the unit supplier's recommendations. Any discrepancies between this specification and the supplier's recommendations that may influence the unit's performance or guarantee shall be clarified with the Engineer during tender stage.

The indoor unit and condensing unit shall be interconnected with refrigerant piping, electrical wiring and interlocking control cabling. The pipe and cable connections shall be made in accordance with the unit supplier's recommendations. The refrigerant shall be of the R410a or R32 type.

The evaporator unit shall be controlled to keep the temperature in the space at the desired set-point level. All controls, control panel and complete wiring, including interlocking with the condensing unit shall form part of this installation.

Each condensing unit with connected evaporator unit(s) shall be clearly labelled to identify different split units and refrigerant controller boxes.

The "auto restart after power failure" option shall be available on all units' settings. The units shall also be able to operate in a "fan only" mode.

The electrical power requirements to the condensing units shall be:

- Single-phase when the cooling capacity of the unit is less than 10 kW.
- Three-phase when the cooling capacity of the unit is more or equal to 10 kW.

Ceiling cassette units shall have factory fitted, electrically operated condensate pumps with a drainpipe connection. Integral safety switches shall be provided to prevent the pump from running dry, and to prevent the unit from operating when the condensate pump has failed. The indoor unit shall be fitted with a fresh air-connection knockout panel.

The evaporator units shall be controlled to keep the temperature in the space at the desired set-point level. All controls, control panel and complete wiring, including interlocking with the condensing unit shall form part of this installation.

The indoor units shall be of mid-wall, ceiling concealed and ceiling cassette type.

Units shall consist of a direct expansion, indoor fan coil evaporator unit and a separate (remote) externally located, air-cooled, condensing unit.

Heating shall be by means of heat pump action by the reversal of the cooling cycle. All the necessary control equipment, valves and piping required to perform this function shall be supplied as part of this work. The control system shall be such that the unit will automatically change from heating to cooling and vice versa. A time delay relay shall prevent the compressor from restarting immediately when changing from heating to cooling and vice versa.

A defrosting system shall be provided that will defrost the condensing coil during the winter months when heating is required. The defrosting system shall be a proven system that functions automatically without affecting the room temperature.

The evaporator unit shall be equipped with an easily accessible washable, long life filter, a 3-speed adjustable centrifugal fan driven by a squirrel-cage induction motor and evaporator coils manufactured from seamless copper tubing mechanically bonded to aluminium fins. The condenser cooling fan shall be of the direct driven multi-wing, dynamically balanced propeller type axial flow fans.

When an indoor unit is equipped with vanes, the unit shall have an auto swing vane function that allows the vanes of the unit to swing up and down automatically. An auto-flap shutter shall close automatically when the unit is turned off.

Indoor units shall have integral condensate drain pans with drain hose connections.

The compressor unit shall be of the hermetic scroll type, powered by an induction motor, and installed with anti-vibration mounts such as rubber or spring isolators. The compressor shall be equipped with crankcase heater.

The outdoor unit casing shall be manufactured from mild steel plate and shall be corrosion protected as follows or to a method as approved by the Engineer:

- Galvanised
- Electro-plated.

The outdoor unit shall be colour coated as follows or to a method as approved by the Engineer:

- Acrylic resin powder-coated.
- Polyester powder-coated.

The outdoor unit coil shall be pre-treated for corrosion in the factory. The inside of the units and all parts shall be sprayed with an approved anti-corrosion plastic film treatment eg Tectyl or equivalent.

For reverse cycle units, a proper galvanised steel drip pan with drainage piping or drain piping connected to the integral drain pan shall be provided for the condensing units.

The installation shall comply with the following:

- Trunking shall be cut at 45 degrees on bends or custom-made bends shall be used, lids shall be butted at 90 degrees.
- All external trunking to be galvanised.
- All orifices where pipes and wiring protrude through galvanised trunking, shall be covered with protective strips to avoid damage to pipes and wiring.
- Endcaps shall be installed at the end of all trunking.
- Exposed pipe-runs and trunking shall be at right angles.
- Drainpipe diameter shall be a minimum of 20 mm, terminated no higher than 300 mm from ground level and secured with brackets at intervals of no less than 1 m.
- No condensate shall be allowed to flow onto a walkway but may flow into gardens.
- Drip trays shall be installed where there is a risk of condensate flowing onto walkways.
- No joints shall be allowed in the refrigeration pipes or wiring.
- All installations to be accompanied with a commissioning sheet, signed off by the engineer.
- Power cables shall be of Norse type; signal cables shall be of Cabtyre or better.
- All cables and pipes to be neatly bundled and fixed to wire way with Velcro straps (ceiling voids and external locations)

Electrical interlocking shall be provided to ensure that:

- The compressor cannot run without both evaporator and condenser fans running.
- It shall not be possible to switch cooling and heating on simultaneously

1.1. SETTING OUT OF THE WORKS

The contractor shall fully cooperate with other trades and take all reasonable precautions to ensure that he

does not impede the progress of or damage their work.

The engineer's drawings show broad principles of design, general layouts, schematic arrangements and when read together with the specifications and the drawings of other disciplines and other contractors, they carry sufficient information to enable the contractor to determine how the installation is to be installed, operated, services and maintained.

The contractor must check all relevant details, levels and dimensions on site prior to commencement of any work.

1.2. AIR DIFFUSION

Where selected by the Contractor, air diffusion equipment shall be selected in accordance with the manufacturer's recommendations, capable of passing the specified air quantity at the appropriate throw without creating excessive resistance, noise or local draughts. All air diffusing equipment shall be capable of meeting the NC level requirements for the space environment where the equipment is installed.

In all instances where spigot boxes (plenums) are used for the connection of air diffusion equipment, the inside surfaces shall be painted black to prevent visibility of the internal surface from ground level.

During commissioning of the system, each grille, diffuser, valve etc. shall be set to deliver the specified air quantity. It is the Contractor's responsibility to check regenerated noise levels of grilles offered against the overall acoustic performance of the system required. Noisy grilles that exceed the NC level requirements of the given space shall be replaced at the Contractor's expense with more suitable types.

1.3. CLAIMS

Any claim for equipment on site must be accompanied by a signed delivery note, and photos on site if Engineer was not present. No claims shall be processed without all documents submitted before the date provided.

2. INSTALLATION REQUIREMENTS

2.1. INDOOR AND OUTDOOR UNITS

During installation, care shall be taken to ensure that no vibrations are carried over to structures to which the indoor and outdoor units are fixed.

Outdoor condensing units shall be installed on wall-mounted brackets and/or a concrete slab as indicated on the project drawings.

Where installed on wall-mounted brackets, the condensing unit shall be properly bolted to the mounting bracket with adequately sized fasteners.

Where installed on a concrete slab, the condensing unit shall be fitted on top of neoprene vibration isolating pads and 450mm square concrete paving slabs.

2.2. CONDENSATE PIPES

If an outdoor unit (heat pump type) is mounted against a wall more than 1 m above ground / floor level, the unit shall be fitted with an uPVC drainpipe neatly saddled to the wall. Drainpipe sizes for outdoor units shall be to the supplier's recommendation.

Condensate drainpipes shall always run together with refrigerant pipes and shall always be installed in the same trunking and on the same cable trays for as far as the installation permits. Surface-mounted drain piping shall only be allowed where condensate drainpipes run in a different direction to either a service duct, wastewater pipe or any other location as indicated on the project drawings. Surface-mounted drain piping shall be secured to the wall by means of galvanised steel saddles at no more than 1 m intervals.

Drainpipes shall run and connect to wastewater pipes as indicated on the project drawings. The connection

between the drain pipe and wastewater pipe shall be an airtight sealed connection that allows positive drainage of condensate. The plumber will leave a condensate pick up point within one meter from each indoor unit. All condensate pipes running from indoor units to wastewater pipes, outlet gullies, or open wastewater points shall be fitted with a HEPVO self-sealing (dry seal) waste valve supplied and installed by the plumber at a location as indicated on the project drawings.

uPVC pipes shall be used for drain piping from indoor units. Drainpipe sizes for indoor units shall be Ø 25 mm for all unit sizes and will connect to a main line of Ø 50 mm as indicated on the drawings.

The first 1.5 m, (by the Mechanical sub-contractor) with "Armaflex" type, lightweight, elastomeric nitrile rubber tube insulation. Insulation thickness shall be 13 mm.

Horizontal mounted drainpipes shall be installed at a slope of 20 mm per 1 000 mm, ensuring positive drainage. Where drainage piping or control cabling is required to be installed flush-mounted, positioning and chasing shall be done in good time to meet construction programs.

2.3. REFRIGERANT PIPING

Refrigerant piping in ceiling voids and mounted internally against walls shall be installed in 101 mm wide galvanised steel Cabstrut light duty cable trays (per unit). Pipes shall be strapped over insulation to cable trays at

500 mm intervals with suitably sized cable ties. Cable trays shall be 152 mm wide where drainpipes run together with refrigerant piping (per unit).

Externally mounted refrigeration pipes and drainpipes shall be mounted in Cabstrut P9000 cable trunking (127 mm x 76.2 mm). Cable trunking shall be complete with clip-on covers. Pipes and cables shall be strapped together every 500 mm with suitably sized cable ties and loosely fitted in the trunking. The trunking shall be manufactured from galvanised steel and epoxy powder coated to a colour as specified by the Engineer.

Any insulation material not covered by the trunking and exposed to the elements shall be neatly strapped with Velcro straps to minimise the possibility of dirt and water entering between the insulation and refrigeration pipes.

Refrigeration piping shall be of seamless copper tubing. Where soft drawn material is used, bends shall be with a long radius formed with the proper tools. Where hard drawn material is used only long radius brazed bends shall be used. All refrigerant piping shall be properly sealed against moisture and dirt at all times.

Refrigeration pipes shall be individually insulated in "Armour flex". Refrigerant piping shall be arranged so that normal inspection and servicing of the compressor and other equipment is not hindered. Locations where copper tubing will be exposed to mechanical damage shall be avoided. Hangers and supports where piping go through walls shall be installed to prevent transmission of vibration to the building.

All refrigeration pipes shall be sized to the supplier's method. The refrigerant charge shall be accurately calculated by the same method. The Contractor shall adhere to the recommended maximum pipe lengths as set out by the manufacturer.

All joints installed horizontally shall be mounted with branch piping in a horizontal plane.

Only synthetic oil compatible with the refrigerant shall be used to lubricate any cutting, reaming, and flaring tools.

Only phosphor copper brazing rods shall be used without any flux on the piping joints. The pipework shall be continuously purged with low-pressure nitrogen during all brazing operations.

Simple purging of the refrigerant pipes between the indoor and outdoor units shall not be acceptable. Refrigerant pipes shall be correctly pressure tested with nitrogen and a small amount of refrigerant to 3.8 MPa for R410A and left for 24 hours to ensure that the pressure does not drop. A vacuum pump shall then be used to purge the piping for longer than 2 hours to -100 kPa. The system shall be capable of holding this

vacuum for 1 hour or to the satisfaction of the Engineer.

The system shall then be charged in the liquid state with the calculated amount of additional refrigerant by using an accurate charging scale (charging cylinder shall not be used). Only once the system is correctly charged shall the refrigerant valves on the outdoor units be opened.

The Contractor shall make use of colour coding (insulation type straps) to differentiate between refrigerant pipes running from refrigerant risers to different thermal zones.

Refrigerant pipes for multiple outdoor units shall be correctly arranged to meet manufactures requirements. Where multiple outdoor units are used, insulated oil equalisation line shall be installed between the units.

The Contractor shall apply the “Armaflex” insulation in such a manner as not to cause leaking. The wall thickness of the insulation shall be to the following table:

Table 2 : Insulation Wall Thickness

Refringent Pipe Diameter (mm)	Wall Thickness (mm)
6.34	9
9.53	9
13.7	13
15.88	13
19.05	19

The insulation for the refrigerant piping shall be of the “ultra-violet resistant” type. Isolation exposed to the outside weather shall be finished off with ultra-violet resistant plastic tape.

2.4. PRELIMINARY TESTING

The Mechanical sub-contractor shall perform preliminary commissioning on the VRF system.

The Contractor shall switch the electrical power on to all indoor and outdoor units after the system has been charged with refrigerant. Power shall be supplied to all units for duration of 9 hours before initial testing shall commence.

The equipment test sequence shall be run, and the errors displayed on the controller shall be rectified.

The system as well as individual equipment shall be adjusted to give the specified performance. Control systems shall be adjusted and placed in operation.

2.5. REFRIGERANT CIRCUITS

Refrigerant piping shall be in accordance with the following standards:

- SABS 0147: Refrigerating systems including plants associated with air-conditioning systems.

Fittings shall be copper-based capillary solder fittings in accordance with SABS 1067. All soldered joints on proprietary manufactured units shall be carefully checked and remade if found damaged in transit.

Pipe size selections shall be such as to produce moderately low velocities whilst:

- Ensuring proper oil return to the compressor and minimizing lubricating oil being trapped in the system.
- Ensuring practical lines without excessive pressure drops and with proper feed to evaporators.

- Preventing liquid refrigerant from entering the compressor during operation and at shutdown.

Refrigerant piping shall be sized and fitted with the necessary oil traps strictly in accordance with the unit manufacturer's requirements. Suction and liquid pipelines shall be insulated separately and joints on insulation shall be glued with the insulation manufacturer's recommended adhesive to create a vapour barrier.

2.6. HAIL GUARDS

All condensing unit coils require protection from hail damage if they are externally mounted and exposed any weather conditions. **The hail guards are not listed in the Bill of Quantities and thus the mechanical sub-contractor must allow for it as part of the condensing unit.**

The proposed protection solution/Hail Guards must be approved by the manufacturer of the air conditioning equipment before the hail guards are manufactured or ordered. The Mechanical sub-contractor will be liable for any additional costs.

3. DX SPLIT AIR CONDITIONING

The DX Split section of the specification to be read in conjunction with section 300- of the specification.

The air-conditioning systems shall be standard factory assembled, DX inverter split with standard indoor and outdoor units. The units shall be thoroughly tested for all operating conditions. Spares shall be freely available in South Africa. On request, the Contractor shall provide the Engineer with performance test certificates.

Units to be supplied by **Mitsubish**i. Indoor Unit PEA-RP400GAQ Hide Away Type Unit, Outdoor Unit PUHZ-P200YKA2 x2. Units shall be factory treated against corrosion.

DX non-inverter units shall only be supplied in areas indicated on the project drawings. Non-inverter units shall be of R410A or R32 type. The units shall be thoroughly tested for all operating conditions. Spares shall be freely available in South Africa. On request, the Contractor shall provide the Engineer with performance test certificates.

Note: Ceiling concealed units will be of suitable manufacture that provides units fitted with integrated condensate drain pumps. If condensate pump is an optional extra, it must be priced for and will be seen as part of the ceiling concealed unit.

All indoor units to be fitted with a hard wire controller as standard. If not possible, consultant to be made aware in returnable schedule and pricing for the hard wire option to be attached.

3.1. PERFORMANCE SPECIFICATIONS

Cooling and heating capacities are room conditions, and all equipment shall be de-rated to meet these requirements.

De-rating shall be done to compensate for the following:

- Altitude above sea level
- Refrigerant pipe lengths
- Design conditions specified.

All units shall be capable of meeting total and sensible cooling requirements. Tenderers shall provide proof of de-rated capacities with their tender. All capacities specified are to be achievable at medium evaporator fan speed.

3.2. SAFETY

The following minimum safety protection caused by abnormal conditions shall be provided (manual & automatic reset options to be available):

- High discharge pressure
- Low suction pressure
- Crankcase heater
- Thermal overload protection
- Current overload protection
- Re-starting time delay for compressors
- Auto restart on power supply interruption

4. ELECTRICAL

4.1. GENERAL

Generally, the power to the mechanical equipment shall be provided by the Electrical Contractor in the form of an isolator/plug mounted within 1.5m from the equipment. The Mechanical Sub-contractor shall do the entire electrical installation from the isolator/plug to the mechanical equipment.

All electrical and control cables shall be neatly strapped with the refrigeration piping in a galvanised cable tray.

The entire electrical installation shall comply with:

- SANS 10142-1-2003: The wiring of premises Part 1: Low-voltage installations

The Mechanical Contractor shall issue a compliance certificate (COC) for their portion of the electrical installation on completion.

Electrical and control cables mounted between indoor and outdoor units shall be installed without joints in the cable and shall be of the UV protected type.

5. CONTROL

5.1. ROOM CONTROLLER

Controls shall be of the hard-wired, wall mounted electronic type. Controls shall be of the same manufacturer as the air-conditioner. Controls shall be mounted over a flush mounted electrical box. Control wiring shall be installed in a 20 mm electrical conduit from the controller to the air conditioning unit.

Controls shall have the following minimum functionality:

- Manual ON/OFF
- ON/OFF by seven-day timer
- Room temperature display
- Room temperature adjustment
- Cooling / heating / ventilation selection
- Automatic change-over between cooling and heating.
- Lock out by administration

6. FILTERS

6.1. GENERAL

Frames and filters shall be constructed in such a manner that the passage of unfiltered air is prevented. Gaskets shall be provided between filters and filter holding frames to prevent unfiltered air bypass.

Each filter bank shall be supplied with an identification label stating type of filters, quantity of filter elements, model numbers and all other information necessary for re-ordering filter material.

Filters shall be adequately protected against dirt during construction and shall not be operated until the system is thoroughly cleaned.

Differential pressure manometer gauges or liquid column pressure manometers shall be provided for primary, secondary and tertiary filters to indicate the filter condition. The manometer shall be connected to static pressure taps of approved design so that it will indicate correctly the resistance to airflow of the filter. The full scale reading of the manometer shall be between 30% and 60% higher than the change out pressure of the filters. **The meters shall be clearly marked to indicate filter change.**

Filter dimensions shall be selected to suit the configuration of the air handling unit. Sufficient space shall be provided in front or behind filters to enable inspection and servicing.

All filter accessories including the channel filter holding frames and clips shall be standard products of the filter manufacturer. Filter holding frames shall be manufactured from galvanised or stainless steel. Filter holding frames shall be bolted or riveted together, where necessary, and shall be suitably reinforced in larger arrangements to withstand all possible operating conditions. An airtight seal shall be provided where filter holding frames are joined. All metal parts shall be sufficiently protected against corrosion.

Filter efficiencies of secondary and tertiary filters shall be tested and certified.

Air filters of the make, type and size as specified on the drawings shall be installed.

Filters installed close to exposed air inlets, shall be protected by means of weather louvers and wire mesh screens.

Filter holding frames shall be of approved manufacturer with standardized dimensions to enable replacement with equivalent filters of all recognized manufacturers.

Construction and manufacture of all components shall be such that under no circumstances any unfiltered air can by-pass filters or filter banks.

Sufficient space shall be allowed in front or behind filters, to enable inspection and servicing.

All AHUs fitted with HEPA filters shall pass a Dispersed Oil Particle (DOP) test before a particle count takes place.

Filters to be of Vokes or equivalent type.

6.2. PRIMARY FILTERS (MERV 8)

Primary filters shall be of the 50 mm pleated washable panel type. The media shall be synthetic and shall be of the self-supporting type. The media shall fit into and extend to seal all round in the panel frame to ensure that no air bypasses the media. The filter outer panel frame shall be of galvanized steel.

Primary filter panels shall fit into channel holding frames with sealing gaskets located between filter panel and channel holding frame. Where the channel holding frames are located on the downstream side of the filter, at least two spring loaded clips shall be used to ensure a positive seal against the edge gaskets and to keep the filter panel in place. Where the channel holding frames are located at the upstream side of the filter, at least four spring loaded clips shall be used. All clips shall be from stainless steel.

The primary filter shall be of filtration class G3 with an average ASHRAE arrestance of 90% (SABS tested). The dust holding capacity shall not be less than 150g per square meter. The initial (clean) and final (dirty)

resistance of the filter shall be 65 Pa and 250 Pa respectively. The above-mentioned features shall be based on a rated face velocity of 2.5 m/s.

6.3. SECONDARY FILTERS

Secondary filters shall be of the bag filter type with galvanised header frames. Gaskets shall be installed between the channel holding frame and the filter header frame to seal all round and prevent the pass of unfiltered air. Each filter bag shall have shape retaining spacers for blow-up prevention. Bags shall always be fitted vertically and not horizontally. Bag filters shall be of a suitable depth to meet the performance requirements as stated below.

Bag filters shall be of class F8 (EN 779) with an average atmospheric dust spot efficiency of 95% for 0.4 µm particle size. The initial and final resistances of the filter shall be 100 Pa and 250 Pa respectively, based on a rated face velocity of 2.5 m/s.

6.4. TERTIARY HEPA FILTERS

Tertiary HEPA Filters shall be of the extended surface, disposable, leak-free media type at least 300 mm deep. The media shall be of the non-woven, water resistant micro fibreglass paper type, folded with constantly calibrated spacing using thermoplastic threads.

The filter frame shall be of hot-dipped galvanised steel or stainless steel, gasket sealed either upstream or downstream as required to ensure that the filter is leak-free. The filter shall slide into the channel holding frame and shall be fastened with the corresponding holding bracket, threaded rods and handheld plastic handle nut.

The filter to frame seal shall be a routed fluid seal. The sealing fluid shall be a silicon or polyurethane type, be highly viscous, non-solidifying and shall not support bacteria or bacteria growth. The seal between filter and frame shall be airtight allowing no bypass of unfiltered air.

The HEPA filter shall be of filter class H13 (EN 1822) with an initial pressure drop of 250 Pa and a final resistance of 600–800 Pa. HEPA filters shall be tested in accordance with EN 1822 test standard.

6.5. BAG IN BAG OUT SAFE CHANGE HOUSING

A bag in – bag out system will be utilised for the Tissue Culture Lab extraction system. The system shall provide contamination free filter replacement using a safety bag (‘Bag In - Bag Out’). The filter element shall be fixed in place with two eccentric rods (Cam Shaft arrangement) in stainless steel. The removable maintenance cover shall be fixed in position using manual clamping wheels and sealed against leaks with an all-round rubber seal and additionally strap as dual seal arrangement. Since the Tissue Culture Lab extraction system has multi-stage filtration, three housings shall be combined with each other (one for each filter: primary, secondary and tertiary). See below figure illustrating the concept of the safe change housing:

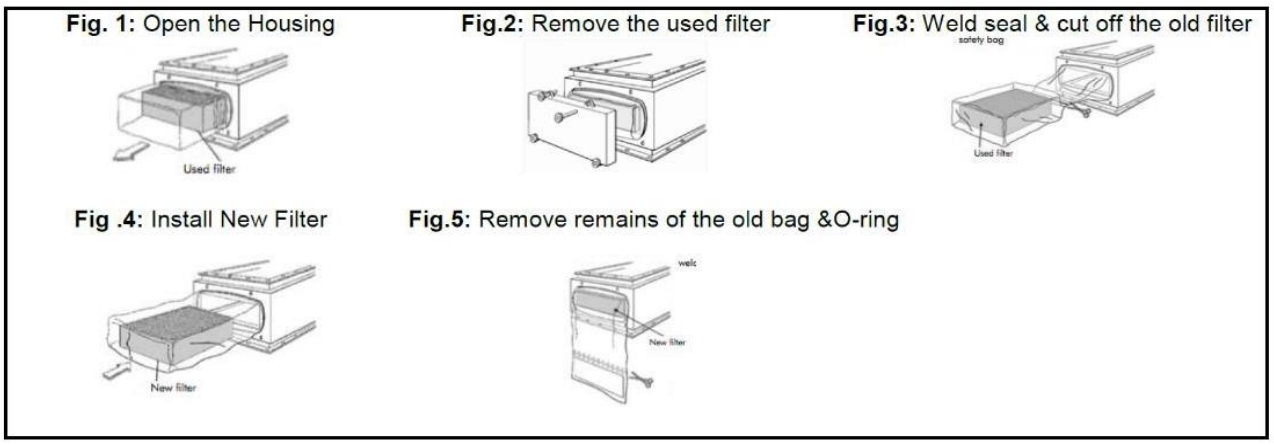

Figure 1: Bag in Bag out safe change housing

6.6. MAGNEHELIC GUAGE

A single Magnehelic gauge shall be installed at all fresh air filters. The gauge will be mounted right up against the ceiling boards below the fan, along the wall for routine visual inspection.

7. GRILLES

7.1. RETURN AIR

Return air grilles shall be manufactured from extruded aluminium, epoxy powder coated to colour as specified by the Engineer. Return air grilles shall in all instances have fixed blades with a curved blade profile.

Return air grilles shall be capable of meeting the airflow requirements, as set out on the project drawings, with a face velocity not exceeding 2 m/s.

Return air grilles shall be installed directly on the ducting or pressurised ceiling were indicated on the project drawings unless specified otherwise. The connection between return air grilles and ducting shall be airtight and sufficiently strong to handle the duct pressure.

Return air grilles shall be of the hinged type with filter media.

Transfer air grilles shall be complete with fixed curved blades and outer frame on both sides of the wall or partition. Transfer air grilles shall be of the aluminium extruded type, powder coated to colour as specified by the Engineer. Openings in walls where transfer grilles are to be installed shall be provided by the Building Contractor.

Transfer ducting shall comprise galvanized sheet metal ducting and aluminium curved blade intake and outlet transfer grilles.

Return, transfer, and door grilles shall be provided where indicated on the project drawings and shall be installed to the supplier’s recommendations.

7.2. WEATHER LOUVERS

Weather louvers shall be of the Trox or Europair, WL type with standard blade spacing of 50mm.

Weather louvers shall be manufactured of extruded aluminium, powder coated to colour as specified by the engineer. Weather louvers shall be constructed with drip edges to blades and rigid frames to enable building in. The top and bottom blade of each weather louver shall be fitted flush with the frame and shall be smooth without grooves, channels, or recesses where dirt or water can accumulate. Weather louvers shall be watertight and shall prevent the entrainment of raindrops at a face velocity of up to 3 m/s. Galvanised expanded metal or wire mesh screens with 12mm opening sizes shall also be fitted behind the blades.

Weather louvres smaller than 450mm x 300mm, shall be of the Europair RA type with RB blades and 19mm spacing between blades. Europair RARB grilles shall be installed horizontally at the location were indicated on the project drawings.

7.3. FIXING OF WALL-MOUNTED GRILLES AND LOUVRES

All wall-mounted grilles and louvers shall be fixed to a hardwood frame. **The timber frames shall be supplied with the grilles as part of this installation.**

The timber frames shall be manufactured in such a way that the grilles fit into them and such that the flanges of the grilles extend past the outer edge of the frames by approximately 5 mm. The timber frames shall be provided with the necessary cleats with which to mount them in brick or concrete walls. The depth of the timber frames shall be similar to the walls in which they are fitted.

The frames shall be supplied to the builder in good time so that they can be built into the walls. Should the mechanical contractor fail to do this, the frames shall be let into the walls afterwards and all builder's work,

making good and painting shall be for the account of the mechanical contractor.

8. BALANCING DAMPERS

Balancing Dampers (Volume control dampers) shall be installed in branch ducting to ensure a balanced airflow to all duct sections where shown.

Damper blades, links, and damper frames shall be of rigid construction and manufactured from galvanised steel. Dampers shall comply with SANS 1238.

Dampers for positive volume control purposes shall be manual or electric actuator driven as specified. Dampers shall be of the link or gear type.

A manually adjustable damper shall be fitted with an external adjusting lever in an accessible position. The lever shall be mounted on a square shaft and fitted with a locking mechanism that clearly indicates the current position of the blade. "OPEN", "CLOSED" and "OPERATING POSITION" shall also be clearly marked on each damper.

The inside cross-sectional area of the damper shall be equal to that of the connecting ductwork and shall conform to the same standards of airtightness as the rest of the ductwork system. The damper shall be fitted to the ducting in which it is installed by means of a flanged connection.

Dampers creating unacceptable vibrations and noise levels will be rejected and will need to be replaced at the Contractor's expense.

Multi-vane control dampers shall be of the opposed blade type.

9. SOUND ATTENUATORS

Supply and install the sound attenuator as shown on the drawings.

Unit shall be a standard catalogue product and the manufacturer shall provide certified performance curves and detail selections of the expected operating conditions.

Sufficient care shall be taken during transport, delivery, storage and installation on site, to ensure that the complete unit and all its components are in "as new" condition at the date of take-over.

Unit shall be installed in accordance with the manufacturer’s instructions to give the maximum sound reduction and minimum pressure loss.

Sound attenuators shall be of the square splitter, cylindrical with or without pod types. Unless otherwise shown on the drawings the 90-degree mitred bend type shall not be permitted.

Units shall be selected in conjunction with the sound source to give the noise level in the occupied space.

Casings shall be of pre-galvanised steel with galvanised external flanges. Splitters and side wall linings shall be of resin-bonded mineral wool faced with woven glass fibre material to prevent the mineral wool being eroded in the air stream. Unit and all materials used shall be vermin proof, fire retardant and rot resistant.

Mineral wool shall be retained by galvanised expanded steel for cylindrical types.

Pods in cylindrical units shall be aerodynamically designed, tapered towards the downstream side to give static regain.

Units shall where possible be installed directly on to the sound source to minimise break-out noise through flexible connections.

The sub-contractor shall produce his own calculations and select attenuators to maintain specified noise levels, based on the actual selected equipment.

The maximum NC value in the occupied spaces may not exceed 40.

Occupied Spaces NC <= 40

Un-occupied Spaces NC <= 45

10. DUCTING

10.1. GENERAL

Sheet metal ductwork shall be manufactured in accordance with SANS 1238, and installed, balanced and tested as set out in SANS 10173. The installation and manufacture of ductwork shall strictly be in accordance with SANS standard specifications with specific attention given to the following:

- Changes in size and shape of ducting: refer to SANS 1238, Section 6.3
- Access openings, doors and covers: refer to SANS 1238, Section 5.3
- Sealant requirements: refer to SANS 1238, Section 5.6.
- External ducting insulation: refer to SANS 10173, Section 5.4
- Material thickness and duct stiffening for low-pressure ductwork: refer to SANS 1238, Section 6 for rectangular ductwork and SANS 1238, Section 7 for circular ductwork
- Radius and square bends as well as turning vanes: refer to SANS 1238, Section 6.4
- Unless the sheet-metal ductwork is inherently corrosion protected, all sheet-metal shall be protected against corrosion as outlined in SANS 1238, Section 8.

It shall be the responsibility of the installing contractor to ensure proper assembly and sealing of sheet-metal ductwork and insulation strictly in accordance with SANS specifications.

The air duct system shall be of the low-pressure type and the ductwork shall be manufactured of galvanised mild steel with general material requirements as set in Section 5.1 and 5.2 of SANS 1238. The ductwork shall either be circular or rectangular in cross-section as indicated on the project drawings.

The first dimension given on the drawings for rectangular ductwork shall be read as the width on plan and the depth on the section, and the second dimension shall be read as the depth on plan and the width on the section.

The duct dimensions shown on the drawings are sheet metal dimensions. All final dimensions shall be checked on site or verified by means of architect’s working drawings and structural drawings, before the fabrication of the ducting.

Sealing membranes and adhesives for affixing insulation shall meet the indexes for surface spread of flame, heat contribution and smoke production as set out in Section 4 of SANS 1238.

The inner surfaces of ducting shall be smooth, and no internal insulation shall be used. Dampers, sound attenuators, duct splitters and turning vanes shall be installed where indicated on the drawings.

Flexible connections shall be provided between all fans, sound attenuators and ducting. Flexible connections exposed to weather shall be provided with protecting galvanised sheet steel cover strips. The material used for flexible joints shall comply with the requirements as set out in SANS 1238, Section 5.5.

Ducting shall always be installed in such a way that, especially in plant rooms, maximum height between the floor and the underside of ducting is achieved.

The installation and testing of hangers shall comply with the requirements as set out in SANS 10173. All hangers shall be treated against corrosion and shall be painted.

The ducting sections to be painted are indicated on the project drawings. The galvanised surface of the

ducting shall not be damaged or marked in any way. The internal surface of plenums and ducting shall be painted black where necessary, to prevent the visibility of the inside surface of the duct or plenum.

Reinforcement, duct stiffening and fastening accessories shall be galvanised and installed where required. Only duct accessories manufactured from compatible materials, which comply with SANS 10173, shall be installed with the ductwork. Tie rods shall be manufactured from galvanised steel. Rivets, screws, bolts and other fastening equipment shall be corrosion proof.

Inspection doors shall be fitted to inspect dampers and/or equipment for which external indication is impossible

10.2. FLEXIBLE DUCTING

Flexible ducting shall comply with the requirements as set out in SANS 10173, Section 5.7. Flexible ducting shall be proprietary manufactured with a fire rating to SABS 0177 Part 3 Class 1. The flexible ducting shall have adequate working pressure and temperature range to suit the application of the installation.

Flexible ducting shall at all times be kept to a length not exceeding 1.5m. Flexible ducting shall not have more than the equivalent of one 90o bend and bends shall be of the maximum possible radius. Flexible ducting shall be supported with sufficient and correct brackets that will ensure maintenance of shape.

Flexible ducting shall be provided between air terminals, diffusers and all locations as indicated on the project drawings.

The inner core shall be of aluminium laminate with a heavy-duty steel helix core. The flexible ducting shall be insulated with 40mm fibreglass insulation and provide with reinforced multiple layer aluminium laminated outer vapour barrier. The flexible ducting shall be of the Europair Euroflex thermally insulated Isodec Type 40 A.

Flexible ducting on extraction systems shall not be thermally insulated. Flexibles on the return air systems side shall be of the acoustic insulated type.

10.3. DUCTING INSULATION

All air ducts carrying heated or cooled air, except where ducting run in conditioned spaces or specifically stated to the contrary, shall be externally thermally insulated. All external supply & return air ducting to be double skinned insulated, with an 50mm FRK layer in between the two sheet metal ducting layers. Internal insulation shall not be acceptable. All joints and valves, dampers etc. shall also be adequately insulated. All ducting insulation material and installation shall comply with the requirements as set out in SANS 10173, Section 5.4.2.1

External duct insulation shall be highly resistant, organic glass fibre blanket bonded with resin, faced and vapour protected with an aluminium foil cover laminate. The external insulation shall be 50mm thick of the Europair FRK Duct Wrap type or other approved with similar properties as given in the table below. “Other approved” means approved by the engineer during the tender stage.

Table 3 : Ducting Installation

Type	**Thickness (mm)**		**Volumetric Mass (Kg/m^3)**	**Thermal Conductivity (W/m°C)**	**Temperature Limits**	**Fire Rating**
Duct Wrap 50	Indoor 25	Outdoor 50	16	0.040 @ 35°C	120°C	Class 1

Insulating material shall be fixed to the duct with adhesive and strapped or clamped at intervals not exceeding 300mm. Mechanical fastener pins may also be used on the bottom and sides of the duct. The

Contractor shall reinstate the integrity of the vapour barrier after the pins have been fixed. Joints in the insulation shall be taped by means of an aluminium type of the same quality as the foil facing with a minimum overlap of 50mm. No vapour seal shall be left punctured.

All insulated ductwork shall be provided with a vapour barrier to the requirements as set out in SANS 10173, Section 5.4.2.3. If an alternative insulation material to Europair FRK Duct Wrap type is used that is not faced with an aluminium foil, a continuous vapour barrier shall be secured to the insulation and adequately sealed with adhesive aluminium tape or equal method. The vapour barrier material shall comply with the requirements for flammability of sealing membranes of SANS 1238.

Ducting running in areas exposed to the weather elements shall be provided with an additional protective galvanised sheet metal layer over the existing vapour barrier to shed water and provide protection against physical damage. The galvanised sheet metal cladding shall at least be 0.6mm in thickness and secured tightly to the **50mm FRK insulation**. In the case of a vapour barrier, care shall be taken to ensure that the vapour barrier is not damaged in any way. If the vapour barrier is damaged in the process of installing the cladding then the contractor shall repair, seal and reinstate the integrity of the vapour barrier as needed.

10.4. UPVC DUCTING

All new ducting and duct fittings associated with fume hoods shall be of standard uPVC class 6.

10.5. TESTING OF DUCTWORK

All ducting shall be leak tested in accordance with SANS 10173, Section 4.3 and the results supplied to the Engineer. No ducting shall have leakage rates in excess of 5% of the required air flow rate in any section of ductwork or in excess of the SANS permissible leakage rates, whichever is the smallest. Maximum allowance between design airflow and actual air flow of duct work or the diffuser may not exceed 5%.

11. GENERAL – VENTILATION FANS

The combination of fan and attenuators shall be such that the specified noise levels are achieved.

Where no pressure requirements are indicated, the Contractor shall estimate the fan static pressure requirements for the system lay-out and tender accordingly.

Ventilation and extraction fan duties as specified on the tender drawings shall be checked against the respective system's design resistance once all information on the selected system is available. Where fan duties are found inadequate, the contractor shall notify the Engineer before ordering the equipment.

Fans shall be selected to operate at or as close to maximum efficiency as possible.

In the event of power failure, Fans should be able to Auto-Restart.

Attenuators shall be mounted directly onto the fan casing with flexible connections between the ducts and attenuators.

Fans shall be fitted with the manufacturer's nameplates permanently fixed to the casing in a prominent position, clearly indicating manufacturer, model number, size, speed, maximum operating speed, maximum power absorbed and serial number.

Fan air in/outlets not connected to ducting or equipment shall be protected with easily removable safety wire mesh screens.

Indicating arrows for both direction of rotation and direction of airflow shall be provided on fan casings.

All fans shall be installed in accordance with the manufacturer's requirements and recommendations.

All fans shall be mounted on anti-vibration mountings or supported from anti-vibration hangers.

Bearings shall be of the ball or roller type and shall be quiet in operation. They shall be sized to give a long

life (not less than 100 000 hours) at the loads imposed by the application.

12. IN-LINE AXIAL FLOW FANS

Axial flow fans shall be of the non-overloading, aerofoil type with peak power requirements occurring at normal operating pressure range. The fan motor shall have a rating exceeding this requirement. Axial flow fans shall operate at the highest possible efficiency at the lowest possible blade tip speed. Phase failure protection shall be included for a three phase installation.

Impeller blades shall be manufactured from a die-cast aluminium alloy clamped in a split steel or aluminium cast hub. Hubs on larger fans shall be manufactured from hot dip galvanised steel. The blade pitch shall be adjustable at the hub. Cast steel hubs shall be electro-coated.

Axial flow fan casings shall be manufactured from hot dipped galvanised mild steel with predrilled flanges on both ends of the fan. An access panel of ample size shall be provided in the casing. All fasteners shall be zinc plated.

Fan motors shall be totally enclosed and shall be of the squirrel-cage induction type with protection to IP 55 standard. An external weather proof terminal box forming part of the casing shall be included in the design for motor connections.

Axial flow fans shall be statically and dynamically balanced in accordance with ISO 1940 – 1973 within grade G6.3.

Axial flow fans shall always be resiliently mounted on anti-vibration mountings to prevent carry-over of vibration to the structure to which the unit is fixed.

All extraction axial flow fans are to be spark-proof and certified.

Fans shall be installed with sound attenuators as specified in Section 300 of this specification.

In-line axial flow fans shall be of the **Donkin manufacture or AMS**, type Majax 2 or equally approved.

Fan motors not to exceed 2880 rpm.

Rotation arrow & air flow arrow shall be clearly visible on the fan casing.

The van pitch shall be manually adjustable.

The Mechanical contractor shall supply all necessary field testing instruments to prove the fan performance. A 5% variance in performance is acceptable. All fan performances shall be documented and included in the commissioning data in the O&M Manual

13. INSPECTING AND TESTING

The installation shall be inspected prior to testing. Visual inspections to detect faults in construction, materials and compliance with drawings, specifications and requirements.

The contractor shall provide labour, materials, power, fuel, accessories and properly calibrated and certified instruments necessary to carry out such tests. The contractor shall make arrangements for such tests and he shall give at least 72 hours' notice to the engineer, in writing, of the test prior to commencement.

In the event of the plant or installation not passing the test, the employer shall be at liberty to deduct from the contract price all reasonable expenses incurred by himself or his agents attending the repeated test.

Whenever any installation or equipment is operated for testing or adjusting as provided for above, the contractor shall operate the entire system for as long a period as required to prove satisfactory performance at all times in the occupied space served by that system for up to twenty-four hours a day continuously until

the system is handed over.

The contractor shall provide all labour and supervision required for such operation and the employer may assign operating personnel as observers, but such observation time shall not be counted as instruction time.

After complete installation of the system all equipment shall be tested, adjusted and readjusted until it operates to the satisfaction and approval of the engineer and the client.

The contractor shall submit certificates of tests carried out to prove all equipment and certificates to be obtained from all relevant authorities and statutory bodies.

The client has the right to request destructive testing on any installation. If test yields no critical failures or danger points, test will be paid by the client. If test results are not within specification or standards entire system can be rejected and must be reinstalled by subcontractor at his own account (all related costs for the installation and rectification).

PRICING INSTRUCTIONS: HVAC

1. GENERAL

The Bills of Quantities form part of, and must be read in conjunction with, this specification document and drawing(s), which document contains the full descriptions of the work to be done and material and equipment to be used and, unless otherwise described in the Bills of Quantities, reference should be made to the Specification for the full meaning of descriptions of work to be done and materials and equipment to be used in this service.

No alteration, erasure or addition is to be made in the typed text of the Bills of Quantities. Should any alteration, erasure or addition be made other than in the areas allowed for this, it will not be recognised but the original wording of the Bill of Quantities will be adhered to.

The Priced Bills of Quantities of the successful Tenderer will be checked and the Engineer reserves the right to call for adjustments to any individual price and to rectify any discrepancy whilst the total Tender Price, as submitted, remains unaltered.

The responsibility for the accuracy of the quantities written into the Bills by the tenderer remains with the Tenderer. The Tenderer shall not be relieved of responsibility for measuring quantities at the Tender stage, and the Tender Sum submitted shall be in respect of the quantities set out in the Bills of Quantities. The Tenderer shall be required to make his assessment of components such as brackets, fixing, etc., from details stated in the Bills and shall include in the item prices for such small installation materials as are required for complete installation in accordance with the Specification.

The successful Tenderer and the Employer or his Agent may agree that the total of the Bill or Bills, including any variations by way of additions thereto or deductions therefrom, represents a fair and accurate quantification of the items set out in the Bills and the parties may agree to final payment on that basis. In the event of any dispute as to the quantities, then the disputed item or items shall be adjusted where necessary by the Engineer.

The quantities in these Bills of Quantities are not to be used for ordering materials.

Variations in the scope and extent of the work included in the Bills shall be allowed to meet the Employer's requirements and shall be measured and costed at rates entered in the Bills, where appropriate, and shall form an addition to or deduction from the total of the Bills. Any items or variation for which rates have not been included in the Bills shall be agreed and priced as non-scheduled items, in accordance with the provisions of the Contract.

The rules governing the extent and costing of the variation shall be those provided for in the Conditions of Contract form.

Variations to the planning before the work has been executed shall be priced as above. Alterations to work already executed cannot necessarily be priced as above and must be reviewed on their merits.

Unless a separate rate for the supply and for the installation of any item is specifically called for, the supply and installation costs of any item shall be fully included in the unit price.

The description of each item shall, unless otherwise stated herein, be held to include making, conveying and delivering, unloading, storing, unpacking, hoisting, setting, fitting and fixing in position, cutting and waste, patterns, models and templates, plant, temporary works, return of packings, establishment charges, profit and all other obligations arising out of the Conditions of Contract.

All measurements are net, unless otherwise stated, and Tenderers must allow in the rate for wastage.

All provisional sums shall be expended as directed by the Engineer and any balance remaining shall be deducted from the amount of the Contract Sum.

All items described as "Provisional" shall be measured as executed and paid for according to prices in the

Bills of Quantities and any unexpended amounts shall be deducted from the amount of the Contract Sum. No work for which "Provisional" items are provided shall be commenced without written instructions from the Engineer.

It is a requirement of the Contract that the work shall be carried out in the manner, which is most economical on materials. Unless detailed by the Engineer, the electrician is required to use the shortest practical route for conduits and cables, subject to the restrictions of the specification and good electrical practice.

Any work for which a budgetary allowance has been made, shall be priced in terms of the n/s agreement. Any balance remaining shall be deducted from the budgetary allowance in the n/s contract sum.

Where escalation is calculated in terms of the JBCC formula all non-scheduled item prices must be de-escalated to the base date.

2. ITEM CLASSIFICATION

2.1. DUCTING

Item		Unit
600.0.01.00	Ducting	
.01.01	(Rectangular Ducting)	
.01.01	(Ducting Category)	square meters (m²)
.01.02	(Round Ducting)	
.01.02	(Ducting Category)	length (m)
	etc. for other duct	
.01.03	categories	square meters (m²) / length (m)
.01.03	etc. for other duct types	

The unit of measurement for rectangular ducting shall be the square meters of each type and category constructed and completed as shown on the Drawings and as specified. The unit of measurement for round ducting shall be the length in meters of each type and category constructed and completed as shown on the Drawings and as specified.

The assignment of categories is per the SMACNA standard. The quantity represents the total duct area/length for a particular type of ducting and category, measured over bends, transformations and other fittings. The tendered rate should not allow for fitting extra-over's, these are itemised separately.

The tendered rates shall include full compensation for the installation of the ducting, including the supply of all materials, cutting, installing, jointing, and brackets.

2.2. DUCT FITTINGS

Item		Unit
600.0.02.00	Duct Fittings	
.02.01	(Ducting Category)	
.02.01	(Type of Duct Fitting)	number (No)
.02.02	etc. for other duct fittings	number (No)
.02.02	etc. for other duct categories	

The unit of measurement shall be the number of each fitting (type and category) constructed and completed as shown on the Drawings and as specified.

The assignment of categories is per the SMACNA standard. The quantity represents the total number of fittings extra-over's for a particular type of ducting and category. The fitting-duct area is allowed for in the ducting section.

The tendered rate is an extra-over and should include full compensation for additional labour, vanes, etc. relating to the particular fitting.

Item		Unit
600.0.03.00	Duct Insulation	
.03.01	(External Insulation)	
.03.01	(Insulation Thickness)	square meters (m²)
.03.02	(Internal Insulation)	
.03.02	(Insulation Thickness)	square meters (m²)
.03.03	etc. for other thicknesses	square meters (m²)
.03.03	etc. for other insulation types	

The unit of measurement for duct insulation shall be the square meters of each type and thickness constructed and completed as shown on the Drawings and as specified.

The tendered rates shall include full compensation for the installation of the insulation, including the supply of all materials, cutting, installing, jointing, and fastening.

2.3. DUCT ACCESSORIES

Item		Unit
600.0.04.00	Duct Accessories	
.04.01	(Type of Duct Accessory)	
.04.01	(Size of the Duct Accessory)	number (No)
.04.02	etc. for other duct accessory sizes	number (No)
.04.02	etc. for other duct accessory types	

The unit of measurement shall be the number of each duct accessory constructed and completed as shown on the Drawings and as specified.

The quantity represents the total number of duct accessories for a particular type and size.

The tendered rates for each item shall include full compensation for any costs, work or materials required to provide and install each accessory, as specified and approved by the Engineer.

2.4. CONDENSATE PIPING

Item		Unit
600.0.05.00	Condensate Piping	
.05.01	(Type of Piping Material)	
.05.01	(Nominal Diameter of the Piping)	length (m)
.05.02	etc. for other pipe nominal diameters	length (m)
.05.02	etc. for other pipe materials	

The unit of measurement shall be the metre of each size of condensate pipe installed as shown on the Drawings and as specified.

The tendered rates shall include full compensation for the installation of the condensate pipes, including the supply of all materials, cutting, installing, jointing, and brackets. The tendered rate shall also include full compensation for stop ends, elbow, tees, reducers, etc., and any other work necessary for installing the condensate piping as specified.

2.5. AIR TERMINALS

Item		Unit
600.0.06.00	Air Terminals	
.06.01	(Type of Air Terminal)	
.06.01.01	(Sub Type of Air Terminal)	
.06.01	(Size of the Air Terminal)	number (No)
.06.02	etc. for other air terminal sizes	number (No)
.06.02.01	etc. for other air terminal sub types	
.06.02	etc. for other air terminal types	

The unit of measurement shall be the number of each air terminal constructed and completed as shown on the Drawings and as specified.

The quantity represents the total number of air terminals for a particular type, sub type and size.

The tendered rates for each item shall include full compensation for any costs, work or materials required to provide and install each terminal, as specified and approved by the Engineer.

2.6. MECHANICAL EQUIPMENT

Item		Unit
600.0.07.00	Mechanical Equipment	
.07.01	(Type of Mechanical Equipment)	
.07.01.01	(Sub Type of Mechanical Equipment)	
.07.01	(Size of the Mechanical Equipment)	number (No)
.07.02	etc. for other mechanical equipment sizes	number (No)
.07.02.01	etc. for other mechanical equipment sub types	
.07.02	etc. for other mechanical equipment types	

The unit of measurement shall be the number of each piece of mechanical equipment constructed and completed as shown on the Drawings and as specified.

The quantity represents the total number of mechanical equipment items for a particular type, sub type and size.

The tendered rates for each item shall include full compensation for any costs, work or materials required to provide and install each piece of mechanical equipment, as specified and approved by the Engineer.

RETURNABLE SCHEDULE - HVAC

1. RETURNABLE SCHEDULE

PLEASE INCLUDE A LIST OF THE FOLLOWING EQUIPMENT SUPPLIERS:

Table 4 : Equipment Suppliers

Equipment	Supplier	Lead time
Axial Flow Fans		
Ducting		
Air Terminals		
Filters		
DX-Split Units		

ANNEXURES - INSPECTION SHEETS – HVAC

HVAC Inspection Form - Mechanical Equipment		
Site:	**Date:**	**Completed by:**
Drawing Name:		
Drawing Reference Number:		**Checked/Comment**
1.All equipment neat and clean		
2.Have the air flows on equipment been balanced		
3.Are all bird screens in place		
4.All bolts, fixings etc. secured		
5.Air paths to fresh air and extraction openings unobstructed		
6.Guards installed where required		
7.Anti-vibration mountings and fixings fitted and fastened		
8.Inspection covers fitted		
9.Drain pan clean and correctly installed (canted towards gravity drain pan nipple)		
10.All sensing elements (humidifier, thermostat, etc.) installed in the correct position		
11.Any damage to coils, fins, sensing equipment etc..		
12.Air tight seating of filters - no bypass		
13.Water seals fitted		
14.Pulleys secured, correct belt tension		
15.All equipment clean and free of any rubble		
16.All fan impeller clean, secured, free to rotate and static balanced		
17. Correct drive fitted		
18.Fans installed in the correct direction 19.All equipment labelled		
Contractor:		
Consultant:		

HVAC Inspection Form - Ducting		
Site:	**Date:**	**Completed by:**
Drawing Name:		
Drawing Reference Number:		**Checked/Comment**
1.Is the installation correct, neat and free of rubble		
2.Are the fittings/joints sealed with the correct duct sealer		
3.Are the hangers at 2.4m intervals		
4.Are the hangers straight, level and the threaded rod cut neatly		
5.Are the flexible ducts complete, correct length and no tears		
6.Have the correct straps/clamps been used on the flexible ducts		
7.Are the vibration collars straight and level		
8.Are all stop end fitted and sealed		
9.Water seals fitted		
10.Has the system been pressure tested - No Leaks		
11.Builders'work ducts and shafts sealed		
12.Intake screen/louvre clean		
13.Dampers in correct position		
14.Damper blades with respect to quadrant indication		
15.Air terminals in the anticipated position		
16.Suficient access to fire dampers		
17.All dampers in open position		
18.Dampers motors connected and operational		
Contractor:		
Consultant:		

HVAC Inspection Form - Piping (Refrigerant, Chilled Water, Domestic Water, Condensate etc.)		
Site:	**Date:**	**Completed by:**
Drawing Name:		
Drawing Reference Number:		**Checked/Comment**
1.Is the installation correct and neat		
2.Have wire baskets/cable trays or brackets been used to support the pipework		
3.Are the hangers straight and threaded rod cut		
3.Have the pipe been covered with the correct lagging/cladding/trucking		.
4.Is the trunking painted to suite the building		
5.Has the piping been pressure tested to applicable standards		
6. Have the correct traps been used for drain pipe installation		
7.Are the drain pipes terminated in a suitable drain point		
8.Is there sufficient fall on the drain piping		
9.Was the correct welding/ joining procedure used		
10.Was the correct material used		
11.Are the isolating valves in the correct position		
12.Identification/labelling of pipes/valves (Hot&Cold; Supply&Return)		
13. First meter of condensate pipe insulated		
14.Refrigerant isolating valves are full port design with integral Schrader port rated for R 410A		
15.Isolating valves have same internal diameter as the connected pipe		
16.Two isolating valves installed (1x high pressure liquid; 1x low pressure vapour)		
17.Isolating valves installed with Schrader port between the indoor unit and the isolating valve.		
Contractor:		
Consultant:		

HVAC Inspection Form - Electrical		
Site:	**Date:**	**Completed by:**
Drawing Name:		
Drawing Reference Number:		**Checked/Comment**
1.Control wiring complete and correct		
2.Local Isolation		
3.Starters and overload fuses as per motor specifications		
4.Correct motor fitted		.
5.Breaker sizes and kA ratings to equipment specification		
6.All equipment earthed where necessary		
7.Clearly labelled		
8.Cables /wires not mechanical damaged		
9.Certificate of competence [COC]		
Contractor:		
Consultant:		

HVAC Inspection Form - AHU		
Site:	**Date:**	**Completed by:**
Drawing Name:		
Drawing Reference Number:		**Checked/Comment**
1. Supply air [l/s]		
2. Return air [l/s]		
3. Fresh air [l/s]		
4. On coil Db/Wb [deg C]		
5.Off coil Db/Wb [deg C]		
6.VSD [Hz] with clean filters		
7. Setpoint [deg C]		
8. Room temp [deg C]		
9. Ambient [deg C]		
10. Compressor Amperage [A]		
11. Primary Filter ΔP [Pa]		
12. Secondary Filter ΔP [Pa]		
13. Tertiary Filter ΔP [Pa]		
14. Labelling		
15.Humidifier false signal demonstration		
16.Unoccupied mode - false signal demonstration		
16.Economy Cycle (all dampers operational)		
Contractor:		
Consultant:		