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TENDER TECHNICAL SPECIFICATION

MECHANICAL

REVISION 01

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TABLE OF CONTENTS

EXECUTIVE SUMMARY	4
1 INTRODUCTION.....	5
2 MECHANICAL SCOPE OF WORK	6
3 MECHANICAL REQUIREMENTS	7
3.1 ROOM MG08	7
3.2 ROOM MG06A	7
3.3 ROOM MG06B	7
3.4 ROOM EG04.....	7
4 INSTALLATION REQUIREMENTS	8
4.1 INSTALLATION REQUIREMENTS.....	8
4.1.1 INSTALLATION OF INDOOR AND OUTDOOR UNITS	8
4.1.2 INSTALLATION OF CONTROLS	8
4.1.3 INSTALLATION OF CONDENSATE DRAINPIPES	8
4.1.4 INSTALLATION OF REFRIGERANT PIPING	9
4.1.5 PRELIMINARY TESTING.....	11
4.2 AIR TERMINALS AND DAMPERS.....	11
4.2.1 GENERAL	11
4.2.2 SUPPLY AIR DIFFUSERS AND SUPPLY AIR GRILLES	12
4.2.3 RETURN, TRANSFER, AND DOOR GRILLES.....	14
4.2.4 WEATHER LOUVERS	14
4.2.5 FILTERS.....	15
4.2.6 SOUND ATTENUATORS	15

LIST OF FIGURES

Figure 1. Aerial Site View	5
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EXECUTIVE SUMMARY

ADQ Engineering Projects were requested to do a site investigation on the mechanical requirements and upgrades to be done on the air-conditioning and ventilation installation for the lighting labs at Groenkloof.

At SABS (South African Bureau of Standards) in Pretoria there is a lab with huge testing machines and equipment that need to be removed for new machines to be placed. The lab requires new flooring, ceilings, painting, and installation of new doors. The project will be carried out in sections as the lab will still be fully operational. SABS is looking for a reputable contractor who can carry out the renovations of the Lab.

The Contractor is Required to:

- a. To consider that the Lab will be fully functional, and machines need to be always protected when carrying out work.
- b. To consider that other machines will require to be dismantled and moved somewhere specified by the client.
- c. To consider that work will be carried out in conjunction with the client's schedule of work.

The air-conditioning and ventilation will be installed as the requirements and specifications from the client and as indicated and specified on the drawings and the BOQ.

A compulsory tender briefing meeting will be held on site at a date to be confirmed.

The main offer shall be strictly in accordance with the subcontract documents. The tenderer may offer as an alternative, equipment and/or methods or standards other than those laid down in the tender documents, but acceptance or rejection thereof will be at the sole discretion of the Engineer.

Such deviations shall be individually declared at the time of tendering and shall be accompanied by all documentation necessary for adjudication of such deviations, which will not be binding on the Employer unless approved by him and incorporated in the subcontract.

Any queries are to be addressed in writing to the consulting engineers
derekdw@adqengineering.co.za

1 INTRODUCTION

ADQ Engineering Projects was appointed to design and specify new air-conditioning and ventilation requirements for specific areas within the Lighting Lab at the SABS Head Offices in Groenkloof, Pretoria. This document describes the technical specifications and requirements for the installation of the air-conditioning and ventilation. The following drawings form part of the tender and must be read in conjunction with this document:

- P23072-PD-MEC-101-REV 0B - ROOM MG08 HVAC LAYOUT
- P23072-PD-MEC-102-REV 0B - ROOM MG06A HVAC LAYOUT
- P23072-PD-MEC-103-REV 0B - ROOM MG06B HVAC LAYOUT
- P23072-PD-MEC-104-REV 0B - ROOM EG04 HVAC LAYOUT

The appointed contractor would be responsible for all required civil and building works required such as trenching and backfilling and the construction of the pumphouse and tank foundations.



Figure 1. Aerial Site View

2 MECHANICAL SCOPE OF WORK

The specification covers the following:

The supply, delivery, installation and commissioning of:

- DX Split AC Installations
- Fresh air ventilation
- Extract air ventilation

DESIGN DATA	
Outdoor summer temperatures	37.0 °C Db/22.0 °C Wb
Outdoor winter temperatures	-4.0 °C Db/-0.1 °C Wb
Indoor conditions	22.5 °C Db/ 50 % RH
Indoor Noise Levels (NC)	35
Altitude above sea level	1500 m
Condenser Coil Selection Temperature	35 °C Db

3 MECHANICAL REQUIREMENTS

3.1 ROOM MG08

Air-conditioning and ventilation.

Temperature to be $24\pm 2^{\circ}\text{C}$, however, during testing the temperature should not shift by more than 1°C .

Humidity to be 30-60% with the introduction of fresh air.

Unit to be 4-way ceiling cassette DX split type.

New heat extraction canopy.

3.2 ROOM MG06A

Air-conditioning and ventilation.

Temperature to be $24\pm 2^{\circ}\text{C}$, however, during testing the temperature should not shift by more than 1°C .

Humidity to be 30-60% with the introduction of fresh air.

Unit to be in-ceiling ducted DX split type.

Maximum airspeed to be 0.2m/s.

3.3 ROOM MG06B

Air-conditioning and ventilation.

Temperature to be $24\pm 2^{\circ}\text{C}$, however, during testing the temperature should not shift by more than 1°C .

Humidity to be 30-60% with the introduction of fresh air.

Unit to be in-ceiling ducted DX split type.

Maximum airspeed to be 0.2m/s.

3.4 ROOM EG04

Air-conditioning and ventilation.

Temperature to be $24\pm 2^{\circ}\text{C}$, however, during testing the temperature should not shift by more than 1°C .

Humidity to be 30-60% with the introduction of fresh air.

Unit to be 4-way ceiling cassette DX split type.

4 INSTALLATION REQUIREMENTS

4.1 INSTALLATION REQUIREMENTS

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

4.1.2 INSTALLATION OF CONTROLS

Where it is required that a wired controller or signal-receiver unit is to be installed against a wall, the controller or signal-receiver unit shall be mounted over a flush-mounted 100 mm x 50 mm electrical box. Control wiring shall be installed in a 20 mm electrical conduit from the controller/signal-receiver-unit to the air conditioning unit. The conduit and outlet box shall be chased into the wall by the Electrical Contractor. The Electrical Contractor shall install the conduit from the outlet box to 100 mm above ceiling level, directly above the controller.

Wireless remote controllers shall fit in a wall-mounted holder neatly mounted next to the room light switch.

Control wiring (F1) to individual unit controllers shall be different in colour to the colour of the control wiring (P) that interconnects air conditioning units and the central system controller.

4.1.3 INSTALLATION OF CONDENSATE DRAINPIPES

A galvanised drain tray with suitable drainpipe connection shall be mounted beneath the outdoor units. Drainpipes that run from the drain tray to the nearest wastewater gulley shall be installed to ensure positive drainage of condensate.

Condensate drainpipes from indoor units 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. Deviation from this 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.

Drainpipes shall run and connect to wastewater pipes as indicated on the project drawings. The connection between the drainpipe and wastewater pipe shall be an airtight sealed connection that allows positive drainage of condensate.

The condensate drainpipes shall be medium pressure uPVC tubing complete with matching (standard) fittings. Main and secondary condensate lines (as indicated on drawings) shall be 50 mm and 25 mm in diameter respectively. All condensate pipes running from indoor units shall be fitted with a U-trap or HEPVO self-sealing waste valve before its connection to the wastewater pipe as indicated on the project drawings. Drainpipes shall be sized to the supplier's recommendation and shall be adequate in size to allow positive drainage. The first 5 m of drain piping shall be insulated with Armaflex-type, lightweight, elastomeric nitrile rubber tube insulation. Insulation thickness shall be 13 mm.

In ceiling voids, drainpipes shall be installed in galvanized cable trays. Where drain piping does not run with refrigeration piping in the same cable trays, a 76 mm galvanised 'Cab strut' light duty cable tray shall be used. Drain piping shall be fixed to the cable tray with suitably sized cable ties installed at 500 mm intervals.

Horizontal-mounted drainpipes shall be installed at a slope of 20 mm per 1000 mm, ensuring positive drainage.

Surface-mounted drain piping shall be secured to the wall by means of galvanised steel saddles at no more than 1 m intervals.

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 programmes.

4.1.4 INSTALLATION OF REFRIGERANT PIPING

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.

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 the manufacturer's requirements. Where multiple outdoor units are used, an 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 1 Insulation Wall Thicknesses

REFRIGERANT PIPE DIAMETER (MM)	WALL THICKNESS (MM)
6.34	9
9.53	9
13.7	13
15.88	13
19.05	19

Refrigerant piping in ceiling voids and mounted internally against walls shall be installed in galvanised steel Cab strut light duty cable trays of adequate size to cope with the pipe load. Pipes shall be strapped over insulation to cable trays at

500 mm intervals with suitably sized cable ties. Where drainpipes run together with refrigerant pipes, cable trays shall be to a size of 30% excess capacity of the condensate and refrigerant piping the tray carries.

Externally mounted refrigeration pipes and drainpipes shall be mounted in Cab strut P-series cable trunking to a size as to be confirmed. 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 cable ties to minimise the possibility of dirt and water entering between the insulation and refrigeration pipes.

4.1.5 PRELIMINARY TESTING

The equipment manufacturer's authorised representative shall perform preliminary commissioning on the DX 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.

4.2 AIR TERMINALS AND DAMPERS

4.2.1 GENERAL

Where selected by the Contractor, air diffusion equipment shall be selected in accordance with the manufacturer's recommendations and should be 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 industry standard 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.

4.2.2 SUPPLY AIR DIFFUSERS AND SUPPLY AIR GRILLES

Where Europair type SD or DD grilles are specified on the project drawings, the supply air grilles shall be manufactured of extruded type 505 anodising grade aluminium and shall be provided with opposed blade volume control dampers, unless specified otherwise on the project drawings. Volume control dampers fitted with supply air grilles shall conform to SANS 1238, section 6.5 requirements. The blades shall be adjustable from the front of the grille.

Where Europair type CD ceiling diffusers are specified on the project drawings, diffusers shall be manufactured from extruded type 505 aluminium, naturally anodised or epoxy powder coated to a colour as specified by the Engineer. Europair type CD ceiling diffusers shall be complete with an opposed blade damper, plenum box with spigot and ceiling plate. CD type diffusers shall have a standard flat frame with blade spacing and distribution pattern as indicated on the standard drawings.

Where Europair type FGR diffusers are specified on the project drawings, diffusers shall be manufactured from fibre glass matt and approved SABS fire retardant resin painted to a colour as approved by the Engineer. The face plate shall be adjustable for air balancing

Where Europair type CVD and CCVD diffusers are specified on the project drawings, diffusers shall be manufactured from steel and be powder coated to a colour as specified by the Engineer. Diffusers shall be equipped with a locking bracket to lock the adjustable radial disc once the system has been balanced.

Where Rickard type CCD, CSD, CRD and CSW diffusers are specified on the project drawings, diffusers shall be manufactured from steel and finished in a chip resistant baked epoxy powder coating to a colour as specified by the Engineer. The control disc shall be adjustable to vary airflow for balancing purposes. The diffuser shall be equipped with a locknut on the control shaft to lock the volume control disc in position after the system has been balanced.

Where Rickard diffusers with electrical reheaters are specified on the project drawings, the electrical elements shall be of the incoloy black heat type, installed in the neck of the diffuser. The reheater elements shall have overheated protection. The Rickard type ESU-3 temperature controller shall be used to control the temperature of the reheaters. The temperature controller shall provide a proportional-integral signal that will vary the reheater output capacity with a pulse width modulation action, i.e., switching the heaters on and off via a triac switching set. The zone temperature setpoint shall be adjustable with a Rickard type DXC digital remote controller, neatly mounted next to the light

switch. The capacity of the reheaters shall be as indicated on the project drawings. The Electrical Contractor shall provide either a lockable isolator or 16 A switch socket outlet next to the diffuser (not further than 1 m from the diffuser), whichever is specified on the project drawings.

Where Krantz type DD-N-DN twist outlet diffusers are specified on the project drawings, diffusers shall be manufactured from aluminium. Krantz type RA-N-DN radial outlet diffusers shall comprise sheet steel radial outlet elements, circular outlet jacket, moulded visible outlet surface and central fastening screw. Krantz type DD-M-DN radial diffusers shall comprise a twisted outlet with sheet steel fixed twist vanes, shaped round visible surface and manually adjustable control disc. The installation method and diffuser sizes shall be as specified on the project drawings. Installation shall either be with an aluminium reducer and galvanised steel L-suspension, or galvanised steel connection box complete with volume control butterfly damper. The connection box shall be of the flat design with connecting spigots and shall include flange boreholes for suspension and fasten diffusers centrally. Diffusers shall be to a colour as specified by the Engineer.

Where Krantz type RA-V-DN adjustable radial outlet diffusers are specified on the project drawings, diffusers shall comprise low outer air outlet casing, shaped visible surface, built-in sheet steel radial vanes, built-in diaphragm and fastening screw. The discharge direction shall be adjusted by the rotation of a vertically movable guide ring. The guide ring shall be adjusted with two opposite cams on the inner ring. The shaped visible surface shall either be square or circular as specified on the project drawings. Krantz type DD-VZ-DN type variable twist outlet diffusers shall comprise an outer cylinder with round exit, fixed diaphragm, swirl cylinder with core chamber and static twist vanes. The latter diffuser types shall be manually adjustable. The diffuser shall connect to round ducting with a round tube and sleeve and to rectangular ducting with a suitably sized spigot. A connection box shall be used for installation if so, specified on the project drawings. All diffusers shall be to a colour as specified by the Engineer.

Where Linear Slot Diffusers are specified on the project drawings, the diffuser shall be Swegon FlowBar High-Capacity Slot Diffusers or similar approved. Designed to combine a high air handling capacity with maximum flexibility and shall be suitable for either ceiling or sidewall applications. The diffusers shall be manufactured from aluminium.

Diffusers shall be installed at the locations were indicated on the project drawings. The Contractor shall install insulated flexible ducting of length not exceeding 1.5 m and of the same diameter as the diffuser, extending from the supply duct to the diffuser. Spigots shall be attached to the ducting and sealed with silicon sealer around the outer perimeter of the joint. Flexible ducting shall be strapped to the diffuser and spigots with steel straps to form an airtight connection.

Alternatively, where indicated on the project drawings, diffusers shall be 'hard' connected to ducting with rivets or taper screws and sealed with silicone sealer to form an airtight connection. All diffusers shall be capable of meeting the discharge pattern and throw requirement as set out on the project drawings.

4.2.3 RETURN, TRANSFER, AND DOOR GRILLES

Return air grilles shall be manufactured from extruded type 50S anodised aluminium, naturally anodised or epoxy powder coated to a colour as specified by the Engineer and shall be of the hinged type. Return air grilles shall in all instances have fixed blades with a curved blade profile. Return air grilles shall have a fixed outer frame and a hinged inner frame with grille section, handle and securing clips. A wire mesh with clips shall be located behind the hinged inner frame to allow the insertion of filter media. The design of the return air grille shall be such as not to allow the bypass of any unfiltered air.

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.

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

Door air grilles shall be installed in wooden doors only. In cases where steel and glass doors are used, transfer grilles or transfer ducting as an alternative shall be installed. Door air grilles shall be of the chevron-blade type. Door air grilles shall be manufactured from extruded type 50S anodised aluminium, naturally anodised or epoxy powder coated to a colour as specified by the Engineer.

Transfer ducting shall comprise galvanised sheet metal ducting and aluminium curved blade intake and outlet transfer grilles. Flexible ducting shall not be used as transfer ducting.

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

Return air grilles shall be installed directly on the ducting where 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.

4.2.4 WEATHER LOUVERS

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

Weather louvers shall be manufactured of extruded aluminium, naturally anodised or epoxy powder-coated to a 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. Plastic bird mesh screens shall be fitted behind the blades. Galvanized expanded metal or wire mesh screens with 12 mm opening sizes shall also be accepted.

All weather louvres are to include fresh air filtration.

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

4.2.5 FILTERS

Washable filter media shall be fitted behind hinged return air grilles were indicated on the project drawings. The filter media shall be of the Peter McLeod PM 100 type, 100 grams/m² density and 5 mm thick. The filter media shall be of the synthetic type and shall be capable of arresting lint of the return air. The filter media shall fit and extend past the outer perimeter of the wire mesh in the return air grille such that the bypass of unfiltered air is avoided. The filter media shall be fireproof. Glass fibre filter media type shall not be acceptable

4.2.6 SOUND ATTENUATORS

If sizes are not specified, sound attenuators shall be selected to comply with the industry standard noise levels for specific areas.
