MHSC

MINE HEALTH AND SAFETY COUNCIL

AIR-CONDITIONING AND VENTILATION INSTALLATION

BID No.: MHSC 011/2025-26

FULL PROJECT SPECIFICATION

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AIR-CONDITIONING AND VENTILATION INSTALLATION

PROJECT SPECIFICATION

1 SECTION 1: GENERAL

1.1 GENERAL SPECIFICATIONS

This specification shall specify in principle and all design conditions, selection criteria and operational considerations including all required features, minimal applicable standards and minimal technical requirements for all systems and equipment to be installed as part of this project. No applicable manufacturer equipment shall be applicable but a minimal compliance to this specification shall be used a selection criterion for manufacturer or make considerations.

Where a particular manufacturer is mentioned, described or named directly, all equipment specified in this regard shall act as a baseline for similar approved equipment selection in all technical respects of the product application, operation and selection criteria.

"**Other approved" means approved by the engineer during the tender stage.**

The project and typical drawings form part of the project specification and shall be read in conjunction with the project specification.

Conflicts, errors or discrepancies found in this specification or drawings shall be brought to the Engineer's attention for resolution.

Any deviations from the specifications, drawings and/or equipment specified shall be listed together with the alternatives offered and shall be submitted as part of the tender. If no deviations are listed, it will be assumed that the Tenderer comply with all the relevant technical parts of this specification.

All installations shall be complete in all respects, and the Contractor shall allow for the completion and successful operation of the complete installation, irrespective of whether every separate item is specified or not.

1.2 SITE AND SITE INSPECTION

The site is situated at:

- Section 8, Tuscany Office Park
- 2 Coombe Place, Rivonia, Sandton, 2128, Gauteng

One formal site inspection will be held.

Tenderers are advised to visit the site and acquaint themselves with the nature and extent of the work involved before submitting their tenders. This is a critical aspect and is highly recommended.

1.3 COMPLETION DATE

Completion dates are stipulated by the Client's program and is not included in this document. The Contractor will be required to keep up with the contract in accordance with the main Client's program and to complete the mechanical installation concurrently with the main contract. The responsibility will be wholly with the contractor to ensure compliance with the Client's program.

1.4 PROGRAM

Directly after acceptance of this tender, the Contractor shall submit time schedules for each activity for which he is responsible to the main contractor, for the inclusion thereof in the main contractor's program. This must be done by keeping in mind site conditions as per site visit

A copy of the program (and revisions thereto) shall be submitted to the Engineer well within time and at regular intervals.

The following items shall be programmed in consultation with the Client/Engineers:

- Working drawings
- Approval of working drawing
- Equipment detail submission for approval
- Ordering of material
- Ducting installation
- Piping installation
- Approval of first fix
- Plant equipment installation
- Second fix
- Electrical installation
- Commissioning and testing
- Final inspection

1.5 FINISHING AND TIDYING

In view of the intense concentration of construction activities likely to be experienced during the contract period, progressive and systematic finishing and tidying will form an essential part of this contract. On no account, must spoil, rubble, materials, equipment or unfinished operations be allowed to accumulate in such a manner as to unnecessarily impede the activities of other works.

Finishing and tidying must be done on a daily basis and not simply be left to the end of the contract. All finishing and tidying shall be carried out to the best advantage of the project as a whole.

1.6 SCAFFOLDING AND PLANT

All plant required for the execution of the contract shall be supplied by the Contractor under this contract.

The Contractor shall provide his own scaffolding and plant equipment. For installation purposes the Contractor shall allow for his own lifting equipment, cranes etc. which may be necessary to complete the installation.

1.7 SUPERVISORY STAFF AND IDENTIFICATION

At all times while on the premises, all artisans and labour members of the mechanical contractor’s staff will wear clothing adequately marked with the relevant contractor's name.

The work shall be done by, or at all times be under the personal supervision of a qualified artisan (or qualified technician) in the respective trade. Details of this operation and prospective work shall be given at the time of tendering in a covering letter.

1.8 QUALITY OF MATERIALS AND WORKMANSHIP

All materials shall be new, undamaged and free from rust or other defects. Only material of the best quality, which has been approved by the Engineer, shall be used.

The Contractor shall, upon the request of the Engineer, furnish him with documentary proof to his satisfaction that the material is of the quality specified. Samples of materials for testing, if required, shall be supplied by the Contractor, free of charge.

Where applicable, all material shall be in accordance with the relevant standard specifications of the South African Bureau of Standards and the British Standard Specifications.

The installation shall be carried out according to the latest modern engineering practices.

The Engineer reserves the right to reject any work or part thereof that, according to his judgement, does not meet the highest standards of material and workmanship and to enforce replacement of the work at the expense of the Contractor.

1.9 RATING OF EQUIPMENT

The Contractor shall supply the sizes and rating of all the equipment offered to the Engineer for approval prior to purchasing or ordering such equipment.

All equipment offered shall operate well within the manufacturer’s ratings, and equipment to be operated beyond these limits will not be considered.

1.10 SPACE REQUIREMENTS AND ACCESS

Tenderers shall ensure that the equipment offered by them can be installed in the available space as shown on the drawings. Should it be found at a later stage that the equipment offered does not fit, all costs arising from the rectification of this problem shall be for the Contractor’s account.

The equipment shall be installed in such a manner that complete access is provided for operating and maintenance purposes.

Tenderers shall also ensure that the equipment offered by them will pass through available building openings. Large equipment shall be made up in sections and each section shall be small enough for access through doors and other building openings. All additional costs involved for the modification of equipment or to change the maker of equipment in order to allow access shall be for the account of the Contractor.

1.11 REGULATIONS AND STANDARDS

The equipment, installation, commissioning and maintenance shall, but not limited to, comply in all respects with the following laws and regulations:

a) The Occupational Health and Safety Act, Act No. 85 of 1993.

b) Local Municipal Regulations, by-laws and Ordinances.

c) Local Fire Department Regulations.

d) SANS 10400: Latest edition: The application of the National Building Regulations.

e) Local Electrical Supply Authority Regulations.

f) The wiring of premises Part1: 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.

Where trade names and references to catalogues are found in the specification, the intention is to set a particular standard of equipment. Where “other approved” equipment is specified, the Tenderer shall obtain written approval from the Engineer before he may deviate from the specified equipment. This approval must be obtained at tender stage.

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.

1.12 DRAWINGS

The dimensions and positions of equipment shown on the Engineer’s drawings are schematics for tender purposes only. The drawings are not suitable for manufacturing purposes or procurement purposes. The responsibility for dimensional and layout accuracy remains with the Contractor. The exact positions will be pointed out on site where necessary. In certain instances where drawings have not been provided, the bills of quantities must be used for measurement of costing.

The following drawings shall be submitted by the Contractor to the Engineer for approval, within four (4) weeks of acceptance of the tender:

1.12.1 Builder’s work drawings

All building requirements are to be indicated on these drawings to meet the dimensional requirements of the equipment and materials to be installed by the Contractor.

1.12.2 Mechanical drawings

These are workshop and equipment layout drawings required for the manufacture and installation of equipment, showing detailed dimensions.

1.12.3 Electrical drawings

These include switchboard layouts, circuit diagrams, interconnection diagrams, and cable and equipment schedules.

Any work done by the Contractor without an approved drawing shall be at the Contractor's own risk, and any changes required to conform with the contract documents or co-ordinate his work with other trades, shall be for the account of the Contractor.

The approval of drawings by the Engineer shall not relieve the Contractor of his responsibilities to carry out the work in terms of the contract documents.

The mechanical and electrical drawings shall be updated during the contract period and shall be included in the operation manual at the end of the contract period as "as built" drawings.

1.13 OPERATION MANUALS AND MAINTENANCE INSTRUCTIONS

The Contractor shall submit three (3) copies of operation and maintenance manuals to the Engineer.

Manuals shall consist of:

a) Comprehensive literature of the different components of the installation.
b) Paper prints of all approved drawings and diagrams where applicable.
c) Start-up and shutdown procedures.
d) Commissioning data of all equipment in tabulated form.
e) Prescriptions for routine tests, which shall be performed by the user together with the time when such tests shall be, performed (e.g. pressure tests).
f) Schedule of apparatus and equipment complete with model numbers, optional extras, modifications, electrical requirements, etc.
g) Detailed daily, weekly, monthly, quarterly, bi-annual or annual preventative maintenance procedures where applicable.
h) Manufacturer's catalogues.
i) List of spares for all equipment.
j) Suppliers telephone numbers and addresses.
k) Wiring diagrams.
l) Test certificates.
m) Building Management System (BMS) integration

The operation manuals shall be sturdily bound in a strong hard cover. Material in the manual shall be clear, legible and well-arranged and provided with an index.

In addition to the manuals the contractors shall also provide a very simple operational instruction with areas/zones affected, on A4 or A5 paper sheet size, framed and mounted in sprinkler cabinets and adjacent to control console to which it pertains. This is to enable a non-technical person to operate the system. It shall give clear instructions of how to stop and start the plant/system, the use of the auxiliary/standby equipment, etc.

The above manuals shall be available three weeks before first handover / practical completion of the installation and no handover shall be considered without these manuals.

1.14 MAINTENANCE AND GUARANTEE

All equipment supplied and work done as part of this contract shall be maintained for a period of one year from date of practical completion.

All equipment supplied and work done as part of this contract shall be guaranteed for a period as per the original equipment manufacturer's terms and conditions from date of practical completion.

The Contractor is responsible for all material and labour during this period.

The Contractor shall visit the installation uninterrupted and do the scheduled maintenance as prescribed in the operating instructions. On completion of the monthly visit a full report shall be prepared and submitted to the Engineer within seven (7) days from the visit.

In case of a breakdown, the Contractor shall react within reasonable time and repair the installation to the satisfaction of the Engineer. Should the Contractor, in the discretion of the Engineer, not react within reasonable time, the Engineer shall commission another Contractor and the cost thereof shall be recovered from the defaulting Contractor.

1.15 PAYMENT CLAIMS

In addition to the conditions of contract, the Contractor shall attach to his application for payment an explanation of material cost and labour cost. The following information is required with respect to material and labour:

- Estimated percentage delivered/completed at date of the previous claim.
- Estimated percentage delivered/completed at date of current claim.
- Total cost claimed at date of previous claim.

1.16 PAINTING

Where applicable the following painting specifications shall apply:

Iron and steel surfaces shall be properly cleaned by removing all dirt, oil, scale and rust by brushing and sanding until a clean shiny surface is obtained. Hereafter a metal primer shall be applied.

Galvanized surfaces shall be cleaned with a galvanizing cleaning agent and then washed with clean water to remove the factory applied protection against white rust. Hereafter a calcium plumbate primer shall be applied, followed by an undercoat between 24 and 72 hours after application of the primer.

Other surfaces shall be cleaned by removing all dirt and a primer as specified by the paint supplier for the particular surface.

The primer coat shall be followed by a matt undercoat and a final topcoat of high gloss enamel of an approved colour. Each layer of paint shall be clearly distinguishable from each other by means of different colours and each layer shall be properly sanded before the following coat is applied.

All paint shall at least be of SABS quality for industrial use and shall be approved by the Engineer. Equipment shall be painted according to the National Colour Standards, SANS 1091.

1.17 DAMAGE AND PROTECTION OF WORKS

The Contractor shall take all precautions necessary for the protection of life, equipment and property in connection with the works during installation.

The Contractor shall be held completely responsible for any damage of equipment during transport and installation, as well as any damage to the building and shall repair any such damage at his own expense. Where equipment cannot be repaired to an “as new” condition, it will be completely replaced at the expense of the Contractor.

Equipment delivered to site shall be stored in a well-protected area where it cannot be damaged by either the weather or other trades.

1.18 WELDING

Welding shall be carried out in accordance with the current edition of SANS 10044 Parts 1 to 2 where applicable. All welding shall be performed according to the latest technology and where exposed, it shall be smoothly finished off.

1.19 BUILDING WORK AND REMOVAL OF EQUIPMENT

The following work shall be carried out by the builder/main Contractor.

a) Drilling and cutting of necessary holes in the concrete, brickwork, ceilings and wooden doors, including making good to match finish.

b) Concrete plinths for installation of equipment.

c) Waterproofing of roof penetrations and plinths.

d) Provide drain points where required.

1.20 TESTING

The plant shall be tested and operated to meet the performance figures and duties specified. All safety features and interlocks shall be tested.

Pressure tests for water and piping shall be done at a test pressure of 1.5 times the maximum working pressure at the lowest point in the system, but not less than 700 kPa. All instrumentation, which could be damaged during the test, shall be removed from the pipe system.

The relevant system shall be filled with water and all high points shall be vented at least 24 hours before the test. The duration of the pressure test shall be 2 hours, after which no water leaks shall be visible and no pressure drop shall occur after corrections have been made for changes in ambient temperature during the test period.

Pressure tests shall be completed prior to insulating or covering piping. If leaks are found, welded connections shall be cut out and re-welded. Rectified piping shall be retested.

1.21 COMMISSIONING

The installation shall be commissioned in accordance with the relevant codes and recognised commissioning procedure or code approved by the consulting engineer:

The Contractor shall submit a commissioning program to the engineer at least two weeks prior to the commencement of commissioning and at the same time shall notify the consulting engineer of the code or procedure to which the plant/equipment will be commissioned.

The results of all checks and measurements shall be recorded in writing during the commissioning period. Commissioning records shall be handed over to the engineer prior to the first acceptance of the plant. The commissioning records shall also be included in the operation manuals.

1.22 STAFF TRAINING

The Contractor shall be responsible for the training of the Client's site staff after the commissioning has been completed. The site staff shall receive enough instructions to ensure that they are fully conversant with the equipment concerned. The operating manuals shall be used during training. Upon completion of the training exercise the contractor is to obtain the client's representative's written acceptance of this handover tuition, thus acknowledging complete understanding of the operational procedures for this installation. Site staff shall be instructed on:

a) the general operating method of the plant;

b) starting and stopping instructions;

c) stopping the plant in an emergency and warning against restarting after an emergency;

d) positions and normal settings of control equipment;

e) safety measures;

f) operational checks on gauges, flow switches, indicator lights, etc.;

g) name, address and telephone number of competent person responsible for the maintenance of the plant.

1.23 SCOPE OF WORK

The specification covers the following:

The supply, delivery, installation and commissioning of all HVAC equipment including but not limited to:

- High/mid wall split type units
- Cassette split type units
- Hide Away split type units
- Supply and extract ventilation

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2 SECTION No. 2: DIRECT EXPANSION UNITS

2.1 SCOPE

The following installations shall be specified under this section of the project specification:

- Direct Expansion DX Units

2.2 DESIGN CRITERIA

DESIGN DATA	
Outdoor summer temperatures	31 C° Db/24 C° Wb
Outdoor winter temperatures	-3 C° Db/-1,6 C° Wb
Indoor conditions	22 C° Db/50 % RH
Altitude above sea level	1750 m

2.3 APPLICABLE STANDARDS

The air-conditioning units and installation 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 60335-2-40: Household and similar electrical appliances – Safety. Part 2 – 40: Particular requirements for electrical heat pumps, air conditioners and dehumidifiers
- SANS 10142-1-2003: The wiring of premises Part 1: Low-voltage installations
- SABS 1453: Copper tubes for gas and vacuum services

2.4 DIRECT EXPANSION INSTALLATION (DX)

The DIRECT EXPANSION system shall be of the Inverter Heat Pump type.

All air-conditioning indoor and outdoor units shall be standard factory assembled, piped and wired. 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. The air conditioning units and the installation of the DX system shall generally be in accordance with the DX system 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 electrical power requirements to all indoor and outdoor 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

DX unit sizing shall be as per bills of quantities

2.5 PROTECTION AND SAFETY DEVICES

Protection fuses shall be provided for all control circuits.

The compressor shall have high and low refrigerant pressure protection.

The indoor and outdoor units shall comply with the safety requirements as set out in:

- SANS 60335-2-40: Household and similar electrical appliances – Safety. Part 2-40: Particular requirements for electrical heat pumps, air-conditioners and dehumidifiers

2.6 INDOOR UNITS

All indoor units shall be of the heat pump invertor type to allow the DX system to operate in required mode.

Remote controls for each indoor unit shall be of the type as indicated in the relevant specification for the indoor units below.

If the controller is of the wired type or if the signal-receiver-unit is separate from the indoor unit itself then the controller / 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.

If the indoor unit operates on a wireless remote controller then the controller shall be fitted in a wall mounted holder neatly mounted next to the room light switch.

2.7 CEILING MOUNTED CASSETTE

The ceiling mounted cassette type shall be of the Samsung, LG, Mitsubishi or equivalent approved.

The ceiling mounted cassette type unit shall be of the 4-way blow type discharging air in the directions as indicated on the project drawings. The contractor shall fix the sealing material to the air outlets in accordance with the discharge requirements.

Cassette units shall have factory fitted, electrically operated condensate pumps with a drain pipe connection. Integral safety switches shall be provided to prevent the pump from running dry, and to prevent the cassette unit from operating when the condensate pump has failed. The cassette unit shall be complete with a decoration panel.

The cassette unit shall have a high efficiency replacement ultra-long-life filter.

The cassette unit shall be installed with a fresh air intake kit and accompanying branch duct for fresh air intake as depicted on the project drawings.

All ceiling mounted cassette type unit shall be provided with an individual zone controller. The zone controller shall be the Wired Remote Controller.

2.8 HIGH WALL MOUNTED TYPE – WHERE APPLICABLE

The wall mounted unit type shall be of Samsung, LG, Mitsubishi or equivalent approved.

The wall mounted unit shall be provided with a drain pump kit fitted at a location as indicated on the project drawings.

All high wall mounted type units shall be provided with an individual zone controller. The zone controller shall be of the Wireless Remote Controller type.

2.9 OUTDOOR UNITS

Outdoor units shall be of Samsung, LG, Mitsubishi or equivalent approved.

Outdoor units shall be of the heat pump invertor type.

The outdoor unit shall have sufficient capacity to meet the cooling requirements of the indoor units. The outdoor unit shall be equipped with inverter control capable of changing the speed of the compressors in accordance with the cooling or heating load requirements. The outdoor unit shall be equipped with a drain pan kit for operation in the reverse (heat pump) cycle.

2.10 PERFORMANCE SPECIFICATION

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.

2.11 ELECTRICAL

Generally, the power to the indoor & outdoor units shall be provided by the electrical contractor in isolator mounted within 1 m from the air conditioning unit. The isolator provided at the outdoor units shall be of the weather proof type. The mechanical contractor shall do the entire electrical installation from the isolator to the outdoor and the indoor units.

Where the electrical contractor provides a cable only to a distribution board that serves a group of air-conditioning units, the mechanical contractor shall provide the distribution board, connect the incoming power cable and shall do all the electrical wiring from the distribution board to the outdoor and the indoor units.

In all instances the mechanical contractor shall provide isolators as required. All electrical and control cables shall be neatly strapped with the refrigeration piping in a galvanized cable tray.

Where applicable, section 9 (electrical) of this project specification shall also apply to this section of the specification.

The entire electrical installation shall comply with:

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

On completion, the contractor shall issue a compliance certificate for the entire electrical installation.

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.

2.12 REFRIGERANT CIRCUITS

Refrigerant piping shall be in accordance with the following standards:

- SABS 1453: Copper tubes for gas and vacuum services
- SABS 0147: Refrigerating systems including plants associated with air-conditioning systems

The refrigeration piping system shall be REFNET piping system. The main refrigerant supply from the outdoor units shall be branched to indoor units with the appropriate REFNET Joints and Headers located where indicated on the project drawings.

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 to the supplier’s recommendation and 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.

All refrigerant pipelines shall be insulated with the "Armaflex" type (or equivalent), lightweight, elastomeric nitrile rubber tube insulation. Insulation thickness shall be 13 mm.

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.

The installation of trunking and trays shall form part of this mechanical contract.

2.13 INSTALLATION OF INDOOR & 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 a concrete slab or brick wall 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 concrete paving slabs.

2.14 INSTALLATION OF CONDENSATE DRAIN PIPES

A galvanised drain tray with suitable drain pipe connection shall be mounted beneath the outdoor units. Drain pipes that run from the drain tray to the nearest waste water gulley shall be installed to ensure positive drainage of condensate.

Condensate drain pipes 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 drain pipes run in a different direction to either a service duct, waste water pipe or any other location as indicated on the project drawings.

Where drainpipes are connected to waste water pipes as indicated on the project drawings. The connection between the drain pipe and waste water pipe shall be an airtight sealed connection that allows positive drainage of condensate.

Where drain pipes run to the outside, it shall run together with the refrigerant pipes to the outside unit where the condensate shall be drained.

uPVC pipes shall be used for drain piping from indoor units. All condensate pipes running from indoor units shall be fitted with a u-trap at a location as indicated on the project drawings. Drain pipes 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, drain pipes shall be installed in galvanized cable trays. Where drain piping does not run with refrigeration piping in the same cable trays, galvanised “Cabstrut” (or equivalent approved) light duty cable tray shall be used. Drain piping shall be fixed to the cable tray with suitably sized cable ties installed at 500mm intervals.

Horizontal mounted drain pipes 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 programs.

2.15 INSTALLATION OF REFRIGERANT PIPING

Refrigeration piping shall be carried out in seamless copper tubing. All piping shall be kept properly sealed against moisture and dirt at all times. Bends in soft drawn material shall be made with long radius using proper tools. If hard drawn piping material is used then only long radius brazed bends may be used.

The piping shall be correctly sized using the equipment manufacturer’s method or software. The additional refrigerant charge shall be accurately calculated by the same method. The maximum pipe lengths shall be adhered to.

All branch connections shall be by means of “REFNET” type joints with moulded insulation as supplied by the air conditioning equipment manufacturer. The joints shall be installed with the connections on a horizontal plane or with the direction of flow in a vertical plane.

Only synthetic oil compatible with the refrigerant shall be used 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 lines between the indoor and outdoor sections is not acceptable. The lines shall be correctly pressure tested with nitrogen plus a small amount of refrigerant to 3.8 MPa for R410A and left for 24 hours to ensure pressure does not drop. The piping shall then be purged using a vacuum pump to –100 kPa (for more than 2 hours) and ensure that it holds this vacuum for 1 hour 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 cannot be used). Only once the system is correctly charged shall the refrigerant valves on the outdoor units be opened.

The pipework arrangement for multiple outdoor units shall be correctly arranged to meet the equipment manufacturers requirement. On multiple outdoor units, an insulated oil equalisation line shall be installed between the units.

All piping shall be supported at regular intervals from the structure by means of galvanised cable tray supported on galvanised Unistrut brackets.

The contractor shall allow for neat coring of holes through the structure where necessary for the passage of refrigeration and drainpipes **covered with appropriately approved fire-retardant material**

The liquid and suction gas pipes shall be separately insulated with Armaflex or equivalent closed cell insulation and the fittings wrapped in non-drip tape to provide a neat appearance. The wall thickness of the insulation shall be as follows for various pipe diameters:

PIPE DIA mm	WALL THICKNESS mm
6.34 (1/4)	9
9.53 (3/8)	9
13.7 (1/2)	13
15.88 (5/8)	13
19.05 (3/4)	19

2.16 PRELIMINARY TESTING

The Contractor shall allow for preliminary commissioning of the DX system by the equipment manufacturer's authorised representative.

After charging the system with additional refrigerant as detailed above electrical power to all indoor and outdoor units shall be switched on. Power shall be supplied to the outdoor units for at least 9 hours prior to running the initial test.

The equipment test sequence shall be run and action taken to correct any errors, which are shown on the remote controller.

Each piece of equipment individually and each completed system as a whole shall be correctly adjusted as required to give satisfactory performance. Control systems shall be adjusted and placed in operation.

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3 SECTION 3: DUCTING

3.1 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. Particular requirements are given on the following standard drawing: TYPICAL CHANGE IN SIZE AND SHAPE OF DUCT CROSS-SECTIONAL AREAS, STD-D23.
- 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. Typical bend layouts as set out in SANS 1238 are given on the following standard drawings: BENDS AND TURNING VANES FOR VARIOUS SIZE RECTANGULAR DUCTS, STD-D15 and BENDS AND TURNING VANES FOR VARIOUS SIZE CIRCULAR DUCTS, STD-D24.
- 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 & 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 section, and the second dimension shall be read as the depth on plan and the width on 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, air-handling units, 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. Flexible connections shall be provided on both sides of the equipment.

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 rust and painted.

Unexposed ducting shall be left unpainted. The galvanised mild / aluminium / stainless steel 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 for plenum.

All galvanised ducting shall be prepared, coated and painted to the following method. All galvanized surfaces requiring painting shall be thoroughly cleaned with galvanised iron cleaner, rinsed and dried. It shall then be painted with one coat galvanised iron primer or self-etch primer. Finally, the surface shall be given two coats of high gloss enamel paint to a colour as specified by the architect. All coats shall either be of the Plascon (*Super Enamel, Wall 'n All* or *Roofpaint)* or Dulux (*Roofguard* or *Gloss)* type or equivalent approved.

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.

3.2 LONGITUDINAL SEAMS AND TRANSVERSE JOINTS

Pieces of ductwork shall be joined with the necessary sealants, as applicable, as set out in SANS 10173, Section 5.

3.3 RECTANGULAR DUCTWORK

Longitudinal seams and Transverse joints for rectangular ductwork shall be in accordance with SANS 1238, Section 6.

As an alternative to transverse joints specified in SANS 1238, other flanged joints such as MEZ-flanges will also be considered provided that they meet the SANS requirements.

MEZ-flanges or equivalent products shall be manufactured from cold rolled steel and hot-dip galvanized after manufacture.

3.4 CIRCULAR DUCTWORK

Longitudinal Seams and Transverse Joints for circular ductwork shall be according to SANS 1238, Section 7.

3.5 THE HANGING AND SUPPORTING OF DUCTWORK

3.5.1 Ducting With Insulation And Vapour Barrier

Hangers and supports for rectangular and circular ductwork shall comply with SANS 10173, section 5.3 *"Ductwork with a vapour barrier"*. The hanger and support types are depicted in the following drawing: HANGERS AND SUPPORTS FOR DUCTING WITH INSULATION, STD-D19.

3.5.2 Ducting With No Insulation

Hangers and supports for rectangular and circular ductwork with no insulation shall comply with SANS 10173, section 5.3 *"Ductwork with no vapour barrier"*. The hanger and support types used for ducting with insulation may be used. In addition to these types, the types depicted in the following standard drawing may also be used: HANGERS AND SUPPORTS FOR DUCTING WITH NO INSULATION, STD-D18.

3.6 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. 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 of the Europair FRK Duct Wrap (or equivalent) type or other approved with similar properties as given in the table below. "Other approved" means approved by the engineer during the tender stage.

Type	Thickness (mm)	Volumetric Mass (kg/m^3)	Thermal Conductivity (W/m^oC)	Temperature Limits	Fire Rating
Duct Wrap 25	25	18	0.040 @ 35 ºC	120 ºC	Class 1

Insulating material shall be fixed to the duct with adhesive and strapped or clamped at intervals not exceeding 300 mm. 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 50 mm. 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 (or equivalent) type is used that is not faced with an aluminium foil then a continuous vapour barrier shall be secured to the insulation and adequately sealed with an adhesive aluminium tape or equal method. The vapour barrier material shall comply with the requirements for flammability of sealing membranes of SANS 1238.

3.7 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 an 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 90^{o} bend and bends shall be of 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 25/40/50 mm 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 25/40/50 A or equivalent.

3.8 TESTING OF DUCTWORK

All ducting shall be leak tested in accordance with SANS 10173, section 4.3. 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.

3.9 AIR TERMINALS AND DAMPERS

3.9.1 GENERAL

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, as specified in sound control section of this document, 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.

3.9.2 RETURN, TRANSFER AND DOOR GRILLES

Return air grilles shall be manufactured from extruded type 5OS 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 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 5OS anodised aluminium, naturally anodised or epoxy powder coated to a colour as specified by the engineer.

Transfer ducting shall comprise of 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.

3.9.3 WEATHER LOUVERS

Weather louvers shall be of the Europair, WL type or equivalent, 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.

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

3.9.4 FIXING OF WALL-MOUNTED GRILLES AND LOUVRES

All wall-mounted grilles and louvers shall be fixed to a hard wood 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 flanges of the grilles is mounted flush with the wall and extend past the outer edge of the timber 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.

3.9.5 SUPPLY AIR DIFFUSERS AND SUPPLY AIR GRILLES

Where Europair type SD or DD grilles (or equivalent) are specified on the project drawings, the supply air grilles shall be manufactured of extruded type 5OS 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 (or equivalent) CD Ceiling diffusers are specified on the project drawings, diffusers shall be manufactured from extruded type 5OS aluminium, naturally anodised or epoxy powder coated to a colour as specified by the engineer. Europair type (or equivalent) 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 (or equivalent) 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 (or equivalent) CVD and CCVD diffusers are specified on the project drawings, diffusers shall be manufactured from steel and 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 (or equivalent) 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 (or equivalent) with electrical reheaters are specified on the project drawings, the electrical elements shall be of the incaloy black heat type, installed in the neck of the diffuser. The reheater elements shall have overheat protection. The Rickard type ESU-3 temperature controller (or equivalent) 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 set-point shall be adjustable with a Rickard type DXC digital remote controller (or equivalent), 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 1m from the diffuser), whichever is specified on the project drawings.

Where Krantz type DD-N-DN twist outlet diffusers (or equivalent) are specified on the project drawings, diffusers shall be manufactured from aluminium. Krantz type RA-N-DN radial outlet diffusers (or equivalent) shall comprise of sheet steel radial outlet elements, circular outlet jacket, moulded visible outlet surface and central fastening screw. 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, include flange bore holes 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 (or equivalent) are specified on the project drawings, diffusers shall be comprise of 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 (or equivalent) shall comprise of 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.

Diffusers shall be installed at the locations where 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.

3.10 VOLUME CONTROL DAMPERS

Volume control dampers shall be of the opposed multi-blade damper (OBD) type or alternatively be of the butterfly-valve type suitable for use in circular ducting.

Volume control dampers shall be installed in ducting where indicated on the project drawings. The Contractor shall balance the ducting system after installation and set the required flow rates to the various air terminals as specified on the project drawings. The Contractor shall test, balance and adjust the duct system to the requirements of SANS 10173: 2003, Section 8.

All dampers, whether it is an OBD or a butterfly valve, shall in all cases comply with requirements of SANS 1238, Section 6.5. The damper frames and blades shall be constructed of galvanised mild steel, assembled with galvanised bolts, nuts and washers. Extruded aluminium blades shall also be acceptable. Blades shall have a mill, anodized or epoxy powder finish. All volume control dampers shall have manually quadrant operation. Dampers shall be gear operated.

Dampers creating unacceptable vibrations and noise levels will be rejected and will need to be replaced at the Contractor’s expense. Volume control dampers shall be of the Europair type or other approved. “Other Approved” means approved by the Engineer.

3.11 FIRE DAMPERS

Fire dampers shall be installed according to the manufacturer's and SABS requirements and recommendations. Fire dampers shall be located where indicated on the project drawings.

Fire/smoke control dampers shall in all instances comply with the requirements of SABS 193 as amended, and shall bear the SABS mark with proven low leakage in the closed position. Each fire damper shall be clearly marked as per clause 5 of SABS 193. Fire dampers shall have at least a 2-hour resistance rating when tested in accordance with SABS 193.

Fire dampers shall be flanged both sides, and an access panel shall be provided in the ducting at each fire damper, preferably on the upstream side of the damper. The open or closed status of the damper shall be clearly indicated outside the casing for inspection purposes.

Fire dampers shall be actuated by means of a fusible link.

Labels shall be installed on the ceiling grid below all fire dampers indicating their positions, and reading: "Fire damper above".

Dampers shall be sized so that the nominal free air area when in the open position is not less that the connected duct free air area.

Fire dampers shall be installed as to form part of a continuous barrier to passage of fire when in a closed position. Where a fire damper cannot be fitted immediately adjacent to the fire wall, the section of ducting between the damper and the wall shall be of at least the same metal thickness and fire rating as the damper casing.

Dampers shall be self-supporting in case of duct destruction due to heat. Care shall be exercised that the supporting frame be installed so that the closing device is accessible.

Sheet metal sleeves shall be provided for housing the fire dampers where fire dampers are mounted in walls. These sleeves shall be built into the walls by the Principal Contractor. Retaining angles shall be installed on the four sides of the fire damper sleeve on both sides of the wall. The angles shall be fastened to the sleeves only, and not to the wall. The retaining angles shall lap the masonry by a minimum of 25 mm around the entire opening. Recommended minimum angle sizes are:

Largest dimension of fire	Angles
Up to 1 200 mm	38 x 38 x 3,2 mm
1 200 mm to 1800 mm	44 x 44x3, 2 mm
Over 1 800 mm	51 x 51 x 4,8 mm

Clearance shall be provided between the sleeve and the masonry opening on the top and at the sides of the fire damper to allow for expansion. Allow a gap of 1 mm for each 100 mm of sleeve width or depth, but the gap shall not exceed 15 mm.

All fixing and installation materials, i.e. bolts and nuts, rawl-bolts and mortar works shall be as per fire damper manufacturer's specification and shall not affect the fire rating of the fire damper installation. Combustible materials such as plastic or similar rawl-bolts and plugs are not permitted.

3.12 FILTERS

3.12.1 Filter Media

Washable filter media shall be fitted behind hinged return air grilles where indicated on the project drawings. The filter media shall be of the Peter McLeod PM 100 type or equivalent, 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 fire proof. Glass fibre filter media type shall not be acceptable

3.13 SOUND ATTENUATORS

This part of the specification shall be read in conjunction with the Sound Control section.

All sound attenuators shall be of Donkin type (or equivalent) or as needed for required attenuation. If sizes are not specified, sound attenuators shall be selected to comply with the noise levels as specified in Sound Control section of this specification

MHSC OFFICE RENOVATIONS - TUSCANY

AIR-CONDITIONING AND VENTILATION INSTALLATION

PROJECT SPECIFICATION

4 SECTION 4: VENTILATION SYSTEMS

4.1 SCOPE

The following installations shall be specified under this section of the project specification:

- Extract fan systems;
- Supply fan systems

4.2 DESIGN CRITERIA

DESIGN DATA	
Outdoor summer temperatures	31 C° Db/24 C° Wb
Outdoor winter temperature	-3 Db/-1,6° Wb
Indoor conditions	22 C° Db /50 %RH
Altitude above sea level	1750 m

4.3 GENERAL

The combination of fan and attenuators shall be such as to satisfy the specified noise levels.

Where no pressure requirements are indicated, the Contractor shall estimate the fan static pressure requirements for the system lay-out and tender accordingly. Where filters are included in the system, the static pressure losses through filters shall be estimated at 180 Pa through each stage of filtration.

The total fan system's design resistance shall be finally checked when all information on selected system elements are available.

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

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 easy 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.

Belt guards shall be arranged to permit lubrication and use of speed counters with the guards in position. Belt guards shall have adequate ventilation for belt cooling.

The construction and design of electrical apparatus for ventilation equipment in hazardous environments shall comply with the relevant SABS specification, (such as SABS 0108).

Fan duties shall be as per drawings and bills of quantities.

Where the applicable fans are selected, the following is applicable as part of the selection and installation criteria

4.4 IN-LINE MIXED FLOW FANS

In line mixed flow fans shall be suitable for duct installation as indicated on the project drawings for the relevant ventilation and/or extraction system(s). Mixed flow fans shall be manufactured from a self-extinguishing material, be IP54 protected and be equipped with fan motor overload protection. Fans shall have compact overall dimensions with the overall diameter only slightly larger than the ventilation duct.

In-line mixed flow fans shall have two speed settings and shall be sized and selected so as to meet the required fan duty at the lower speed setting. In line mixed flow fans with their adjoining attenuators shall not exceed the NC level as set out in Sound Control section.

To minimise the transmission of vibration of fan noise, fans shall be resiliently mounted on rubber cushions or anti-vibration hanger rods.

Fans shall be installed with sound attenuators as specified in sound section of this specification. In line mixed flow fans shall be of the ***Vortice*** manufacture, ***Lineo*** Range or equivalent approved.

4.5 IN-LINE CENTRIFUGAL FANS

In-line centrifugal fans shall be suitable for duct installation as indicated on the project drawings for the relevant ventilation and/or extraction system(s). The in-line centrifugal fan shall be complete with rectangular box, fan motor and ancillary equipment (i.e. controller, terminal box, belt & pulley drive etc.)

The centrifugal fan and rectangular box shall be manufactured from galvanised sheet steel material with MEZ-flanges at both suction and discharge sides. The fan shall be factory wired and assembled, ready for installation on-site.

Fans shall be of the double inlet, multi-vane type with forward curved vanes. The fan housing shall be fabricated from galvanised sheet steel, reinforced and rigidly supported by means of a galvanised steel support-structure. All metal joints shall be gasket sealed to form an airtight fan box enclosure. Fan shafts shall be manufactured from C40 carbon steel. Fans shall not be installed with their shafts in a vertical position.

Bearings shall be of the deep groove self-aligning ball or roller type in accordance with the fan manufacturer's standard practice. The fan wheels and shafts shall be statistically and dynamically balanced and be designed to prevent vibration at the required operating speed.

Where constant volume fans are specified, fans shall be belt driven by means of V-belts and grooved pulleys. Belts shall be oil resistant, non-sparking and non-static. Belt drives shall comply with OHSA requirements. Where variable air volume fans are used, fans shall be direct driven suitable for variable speed control. Fan motors mounted on the fan housings shall not be accepted. A plugged drain point shall be provided at the lowest point in the fan casing except where the fan discharge is located at the lowest point.

Fan motors shall be drip-proof motors to IP55. Fan housings shall be protected to IP 44. Fan motors shall be provided with thermal protection.

Fans shall be installed with sound attenuators as specified in this specification. In line centrifugal fans with their adjoining attenuators shall not exceed the NC level as set out in Sound Control section of this specification.

In-line centrifugal fans shall be of the ***Donkin (type VFC) / Nicotra (type ADN)*** manufacture, or equivalent approved. Where Nicotra type fans are specified on the drawings, the contractor shall be responsible for the supply and manufacture of the rectangular box in which the fan and motor is installed.

4.6 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.

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. Where belt driven fans are used, belts shall be of the V-belt type with grooved pulleys. Belts shall be oil resistant, non-sparking and non-static. Belt drives shall comply with OHSA requirements.

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.

Fans shall be installed with sound attenuators as specified in this specification. In line centrifugal fans with their adjoining attenuators shall not exceed the NC level as set out in Sound Control section of this specification.

In-line axial flow fans shall be of the AMS or DONKIN ***manufacture***, type or equivalent approved.

4.7 PLATE-MOUNTED PROPELLER FAN

Plate mounted propeller fans shall be suitable for the movement of large air volumes against medium pressures for installation on walls, plenum or ducts. The fans shall be of the high efficiency type capable of meeting the noise criteria as set out in Sound Control section of this specification.

Impeller blades shall be of the aerofoil design, manufactured from polypropylene reinforced with glass fibre or cast aluminium. Impellers shall be dynamically balanced in compliance with ISO 1940 standard. The frame shall be fabricated from aluminium, steel or glass reinforced plastic materials with external surfaces permanently colour impregnated to SANS 1091. All steel surfaces shall have epoxy resin powder anti-corrosive finish, zinc phosphate treated and oven baked.

Fasteners shall be zinc plated and passivated. Fan motors shall be of the squirrel cage induction type, SANS approved and complete with Class F insulation. Fans shall be totally enclosed with IP54 protection.

All exhaust fans shall be equipped with protection guards. Protection guards shall have a spirally wound steel construction sturdily fixed with screws to the mounting plate. Guards shall provide protection for both the suction and discharge sides of the fan. Wall/window built-in fans shall be of the **Donkin / AMS** manufacture or equivalent approved.

4.8 WALL/ WINDOW BUILT-IN FANS

Wall/window built-in fans shall be of the reversible type capable of moving the specified air volume at the specified air pressure. Wall/window built-in fans shall be complete with sleeves to allow the installation in varying wall thicknesses, time delay automatic shutters to prevent backdraughts and splash proof external grilles. The fan shall be protected against the ingress of water from both indoor and outdoor.

Fans shall be installed with anti-vibration gaskets around the perimeter of the casing to prevent vibration carry-over and to minimise noise levels.

The fan outer casing shall be manufactured from shock-resistant UV stabilised ABS, the structural components from UV resistant ABS and the internal components from shock resistant PS

Wall/window fans shall have noise levels that do not exceed the specified noise levels in sound section of this project specification. Fan motors shall be single phase complete with thermal overload protection. The fan blade design shall allow for high performance level achieving maximum efficiency.

Wall/window built-in fans shall be controlled with either a multi-speed setting switch, electronic thermo-humidistat, air quality sensor or timer switch. Where wall/window built-in fans are required to be interlocked with the light switch, wall/window fans shall continue to run from between 3 to 20 minutes (depending on the timer setting) after the light has been switch off.

Where a controller is used, the controller shall be remotely mounted neatly next to the light switch or where so indicated on the project drawings. Where the electronic thermo-humidistat is specified, the

control shall be such that the humidity can be set from 30% to 90%. Hard wired controllers shall have control wiring installed in conduits chased into the wall or 15 mm trunking neatly mounted from the fan to the controller. Cordless remote controllers shall have holding brackets mounted next to the room light switch.

Wall/window built-in fans shall have double insulated shaded pole type motors with self-aligning, permanently lubricated and sealed long life ball bearings. Wall/window built-in fans shall be of the **Donkin / AMS** manufacture or equivalent.

4.9 CEILING MOUNTED FANS

Ceiling mounted fans shall be capable of moving the specified air volume at the specified air pressure. Ceiling mounted fans shall have an easy removable interior grille that will provide access to the internal parts such as the impeller and fan motor. Fan motors shall be of the double insulated shaded pole type with self-aligning, permanently lubricated and sealed long life ball bearings.

The fan shall be IP24 splash proof with the fan motor rated at IP44. The fan outer casing shall be manufactured from shock-resistant UV stabilised ABS, the structural components from UV resistant ABS and the internal components from shock resistant PS

Ceiling mounted fans shall have an integral backdraught shutter. Fans shall be installed with anti-vibration gaskets around the perimeter of the casing to prevent vibration carry-over and noise.

Ceiling mounted fans shall have noise levels that do not exceed the specified noise levels in sound section of this project specification. Fan motors shall be single phase complete with thermal overload protection. The fan blade design shall allow for high performance levels achieving maximum efficiency.

Ceiling mounted fans shall either be controlled by interlocking with the light switch or via an electronic thermo-humidistat. Where humidity control is required, a separate humidity controller shall be installed next to the light switch that will allow humidity adjustment from 30% to 95%. Ceiling mounted fans shall be complete with a run-on timer that will allow the ceiling fan to run for a preset time after the light switch has been switched off.

Hard wired controllers shall have control wiring installed in conduits chased into the wall or 15 mm trunking neatly mounted from the fan to the controller. Ceiling mounted fans shall be of the **Donkin / AMS** manufacture or equivalent.

4.10 CENTRIFUGAL FANS

Centrifugal fans shall be of the compact design type capable of delivering the specified air volume at the given pressure drop. Centrifugal fans shall be of the ***double*** inlet multi vane type with ***backward*** curved vanes.

Fan casings shall be of the volute type, fabricated from galvanised sheet steel, reinforced and rigidly supported by means of a galvanised steel angle support structure. Casing construction shall incorporate continuously welded seams or lock forming joints in accordance with the fan manufacturer's standard practice. Non-galvanised steel surfaces shall be degreased, painted with one coat enamel primer and two coats enamel. Epoxy-polyester paint coatings for the non-galvanised surfaces shall also be accepted.

Fan shafts shall be manufactured from EN.6 or BS 970 070M20 bright carbon steel or similar approved and shall be properly protected against corrosion by means of suitable wrappings and protective grease coatings.

It shall be the contractor's responsibility to check that all centrifugal fans fit through the available openings in the building and to notify the engineer in due time should they not fit. Where centrifugal fans are too large for the available openings, the fan housing shall be supplied in sections so as to permit assembly and installation on site.

Centrifugal fan impellers and shafts shall be statically and dynamically balanced to ISO 1940 Grade G6.3 so as to prevent vibration at the required operating speed.

Bearings shall be of the self-aligning, grease lubricated ball or roller type in accordance with the fan manufacturer's standard practice. Bearings shall be selected and fitted for quiet operation to the recommendation by the bearing manufacturer. Bearings that prove to be noisy during the maintenance and guarantee period shall be replaced with more suitable types at the contractor's expense. Where bearings are located in the air stream precautions shall be taken to prevent the loss of lubricant.

Fan drives shall be by means of V-belts and grooved pulleys. Fan motors mounted on fan housings shall not be acceptable. Direct driven fans shall only be accepted where specifically specified on the project drawings or where variable speed fans are employed.

Centrifugal fans operating at pressures exceeding 1500 Pa shall have aerofoil designed impeller blades.

A plugged drain point shall be provided at the lowest point in the fan casing except where the fans discharges to the bottom.

Fan motors shall be of the squirrel cage induction type manufactured in accordance to IEC 34-1 standards. Single phase fan motors shall be protected to IP 44 standard and shall be complete with auto-reset safety thermal overload protection and class B motor insulation. Fan motors shall have Class I electrical insulation. Centrifugal fans shall be of the **Donkin / AMS** manufacture or equivalent approved.

4.11 DUCTWORK

All duct work shall adhere to the ducting section as part of this specification

4.12 AIR TERMINALS AND DAMPERS

4.12.1 GRILLES

Each grille shall be complete with opposed blade damper, plenum box and flexible connection. The inside surfaces of the plenum boxes shall be painted black to prevent visibility of the internal surface from ground level.

Grilles shall be selected in accordance with the manufacturer's recommendations to be capable of passing the specified air quantity without creating excessive resistance, noise or local draughts.

During commissioning of the system, each grille 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 shall be replaced at the Contractor's account with more suitable types.

Supply air grilles shall be of the aluminium, horizontal adjustable blades type, in an epoxy finish with a colour to be approved by the Engineer. The blades and dampers shall be adjustable from the front of the grilles.

Door grilles shall be of the inverted V-blade type, manufactured from natural anodized aluminium and flanged on both sides of the door.

4.12.2 WEATHER LOUVRES

Weather louvres shall be manufactured of extruded aluminium sections and finished in a colour as approved by the Engineer. Louvres shall be of the Europair type WL or equivalent approved.

Weather louvres shall be constructed with drip edges to blades and rigid frames to enable building in.

Weather louvres shall be watertight and shall prevent the entrainment of raindrops at a face velocity of up to 3 m/s.

Galvanized expanded metal or wire mesh screens with 12 mm opening sizes shall be fitted behind the blades of each weather louvre.

Top and bottom blades shall be fitted flush with the frame and smooth without grooves, channels or recess where dirt or water can collect.

The free area through the louvre available for airflow shall be a minimum of 65 % of the nominal area of the louvre.

4.12.3 FIXING OF WALL-MOUNTED GRILLES AND LOUVRES

All wall-mounted grilles and louvers shall be fixed to a hard wood 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.

4.12.4 DIFFUSERS

Diffusers shall be manufactured of extruded aluminium sections and finished in a colour as approved by the Engineer. Diffusers shall be of the Europair OR Rickard type or equivalent approved.

Each diffuser shall be selected in accordance with the manufacturer's recommendations to be capable of passing the specified air quantity without creating excessive resistance, noise or local draughts. Before ordering the diffusers, the actual diffuser selection shall be forwarded to the Engineer for approval.

It is the Contractor's responsibility to check regenerated noise levels of diffusers offered against the overall acoustic performance of the system required. Noisy diffusers shall be replaced at the Contractor's account with more suitable types.

Diffusers shall have a collar size as shown on the drawing and shall be connected to the spigot on the supply ducting via a section of insulated flexible ducting of the same diameter as the diffuser or directly to the circular duct. The length of flexible ducting per diffuser shall not exceed 1 m in length.

4.12.5 EXHAUST DISC VALVES

Disc valves shall be supplied and installed in the ceilings of the ablution areas and connected to the extract ducts by means of sheet metal spigots and flexible ducting.

The disc valves shall consist of a ring and central disc, which when rotated shall adjust the volume through the outlet. During commissioning of the system, each disc valve shall be set to exhaust the specified air quantity.

Disc valves in ceilings shall be of the polypropylene type, in a finish to match the ceiling colour. The valves shall be of the Europair DVK type or equivalent approved.

4.12.6 VOLUME CONTROL DAMPERS

Volume control dampers shall be installed in branch ducting to ensure a balanced air flow to all duct sections.

Damper blades, links and damper frames shall be of rigid construction and manufactured from galvanised steel. Dampers shall comply with SABS 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 air-tightness 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.

4.12.7 FIRE DAMPERS

Fire dampers shall be installed where indicated on the drawings and where any duct enters a separate floor from any main ducting or enters through a fire wall or fire barrier. Where not included in drawings the contractor will be responsible to indicate this at tender stage as part of his submission.

Fire/smoke control dampers shall comply with SABS 193 as amended, and shall be SABS marked with proven low leakage in the closed position.

Fire dampers shall be flanged both sides, and an access panel shall be provided in ducting at each fire damper, preferably on the upstream side of the damper.

Fire damper markings shall be as follows:

a) Manufacturer's name or trade name or trade mark.

b) Fire resistance rating, in hours.

c) Vital instructions regarding installation, direction of airflow, mounting position.

The open or closed status of the damper shall be clearly indicated outside the casing for inspection purposes.

Fire dampers shall have at least a 2-hour resistance rating when tested in accordance with SABS 193.

Fire dampers shall be fusible link operated.

Labels shall be installed on the ceiling grid below all fire dampers indicated their positions, and reading: "Fire damper above".

Dampers shall be sized so that the nominal free air area when in the open position is not less that the connected duct free air area.

Fire dampers shall be installed according to the manufacturer's and SABS requirements and recommendations.

Fire dampers shall be installed as to form part of a continuous barrier to passage of fire when in a closed position. Where a fire damper cannot be fitted immediately adjacent to the fire wall, the section of ducting between the damper and the wall shall be of at least the same metal thickness and fire rating as the damper casing.

Dampers shall be self-supporting in case of duct destruction due to heat. Care shall be exercised that the supporting frame be installed so that the closing device is accessible.

Sheet metal sleeves shall be provided for housing the fire dampers where fire dampers are mounted in walls. These sleeves shall be built into the walls by the building contractor. Retaining angles shall be installed on the four sides of the fire damper sleeve on both sides of the wall. The angles shall be fastened to the sleeves only, and not to the wall. The retaining angles shall lap the masonry by a minimum of 25 mm around the entire opening. Recommended minimum angle sizes are:

Largest dimension of fire	Angles
Up to 1 200 mm	38 x 38 x 3,2 mm
1 200 mm to 1 800 mm	44 x 44 x 2 mm
Over 1 800 mm	51 x 51 x 4,8 mm

Clearance shall be provided between the sleeve and the masonry opening on the top and at the sides of the fire damper to allow for expansion. Allow a gap of 1 mm for each 100 mm of sleeve width or depth, but the gap shall no exceed 15 mm.

All fixing and installation materials, i.e. bolts and nuts, rawl-bolts and mortar works shall be as per fire damper manufacturer's specification and shall not affect the fire rating of the fire damper installation. Combustible materials such as plastic or similar approved rawl-bolts and plugs are not permitted.

4.13 AIR FILTERS

4.13.1 GENERAL

Each fan will be fitted with a primary filter specified as follows:

Bag filters shall be of class ***F8 (EU8)*** with an average atmospheric dust spot efficiency of **95%** for 0.4 µm particle size, SABS/ DIN 24185 tested to ASHRAE 52.2 test standard. The initial and final resistances of the filter shall be ***65*** Pa and ***250*** Pa respectively, based on a rated face velocity of ***2.5*** m/s

Filters installed close to exposed air inlets, shall be protected by means of weather louvres 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 un-filtered air can by-pass filters or filter banks.

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

Filter holding frames shall be the manufacturer's standard product installed and used in accordance with his recommendations. Frames shall be manufactured from at least 16 gauge galvanised or epoxy powder coated steel.

Holding frames may be bolted or riveted together and shall be suitably reinforced in larger arrangements to withstand all possible operating conditions.

Fasteners shall be of the positive sealing type that clips in, with a minimum of four fasteners per filter. Fasteners shall match the particular filter, filter arrangement and frame.

Filter boxes shall be constructed and installed such that under no circumstances may any un-filtered air by-pass the filter.

4.14 SOUND ATTENUATORS

This part of the specification shall be read together with Sound Control section.

All sound attenuators shall be off the DONKIN/AMS type or equivalent approved. If sizes are not specified, sound attenuators shall be selected to comply with the noise levels as specified in Sound Control section of this document.

4.15 ELECTRICAL

Power for fans shall be provided by the electrical contractor to the control DB (by mechanical contractor) for interlocking of the Air conditioning and outdoor air systems.

An electrical isolator for fans shall be provided by the electrical contractor within 1 m from the fans. The mechanical contractor shall do the entire electrical installation from the isolator to the fans.

Power for fans shall be provided to FAN DB (dedicated) shall be supplied and installed by the mechanical contractor and shall contain all switching and safety equipment as specified in Section 9. The mechanical contractor shall do the entire electrical installation including the isolators to the fans.

An electrical isolator for all fans shall be provided by the electrical contractor within 1 m from the fans. The mechanical contractor shall do the entire electrical installation from the isolator to the fan.

4.16 CONTROL

All fans shall be supplied with a control DB at the fan or hide-away unit for interlocking of the fan with the air conditioning unit. The extract air fans shall switch on and off with the main air conditioning units. The panels, switches and DB labels shall be labelled as indicated on the drawing.

These controls shall be installed by the mechanical contractor.

4.17 OPERATION IN THE EVENT OF A FIRE

All the extract air fans to the separate floors shall, upon receiving a signal from the fire detection system, switch-off. The mechanical contractor shall allow for this function in the interlocking control panels.

A fire signal shall be provided by others to the relevant points indicated by the mechanical contractor upon receiving the signal all the supply and extract systems including ALL AHU’s fed from the panel shall switch OFF.

MHSC OFFICE RENOVATIONS - TUSCANY

AIR-CONDITIONING AND VENTILATION INSTALLATION

PROJECT SPECIFICATION

5 SECTION 5: ELECTRICAL INSTALLATIONS

5.1 SCOPE

The general electrical installations and mechanical control panels and distribution boards shall be specified under this section of the project specification.

5.2 DESIGN CRITERIA

DESIGN DATA	
Outdoor summer temperatures	31 C° Db/24 C° Wb
Outdoor winter temperature	-3 C° Db/-1,6 C° Wb
Indoor conditions	22 C° Db / 50 % RH
Altitude above sea level	1750 m

5.3 GENERAL

The services of a qualified electrical contractor shall be employed by the mechanical contractor, who shall be responsible for the design engineering, documentation, supply, installation and commissioning of the electrical system for the air-conditioning installation. The electrical system shall be designed, installed and tested in accordance with the criteria laid down in the Standard Regulations for the wiring of premises, SABS 0142-1 latest Edition. An electrical certificate of compliance shall be issued by the mechanical contractor after completion of the installation.

All mechanical equipment shall be controlled from a DB supplied by the mechanical contractor.

The distribution boards shall be totally enclosed, vermin and insect proof, drip proof, dustproof to class IP 55 of I.E.C 144. The mechanical contractor shall ascertain the positions of the distribution boards timeously and ensure that provision is made in the structure for sleeves, pipes, access holes, etc. as required.

Before commencing manufacture of the distribution boards/control panels, shop drawings shall be submitted to the Engineer for approval. The distribution board shall be thoroughly tested before leaving the factory and copies of the manufacturers test certificate shall be submitted to the Engineer for approval before installation.

The electrical contractor shall supply main supply cables to the position of the HVAC distribution boards. The supply cables shall be connected to the distribution boards by the mechanical contractor.

The mechanical contractor shall supply and install all cables and galvanised conduit from the distribution boards to all the fans. The connecting of cables in the distribution boards shall be executed by the mechanical contractor.

An electrical point in the form of a surface mounted weatherproof isolator shall be supplied at each of the pieces of equipment by the mechanical contractor. The feed from the isolators to the units shall run in galvanised conduits, installed by the mechanical contractor, and shall be neatly connected to the units.

Labelling of the electrical system shall be of engraved laminated plastic with 4 mm high white lettering on black background or equal. Labels shall be securely fitted, and labels glued into position shall not be acceptable.

5.4 DISTRIBUTION BOARDS AND CONTROL PANELS

The distribution boards and control panel/panels shall be of the wall-mounted type, robustly fabricated of 16 S.W.G. galvanised mild steel sheet, with fascia plates behind lockable doors.

All metalwork shall be suitably treated against corrosion and shall be coated with a self-etching primer, two coats of metal primer, and finished, internally one coat, externally two coats, with a good quality hard gloss enamel of an approved colour. The final coat colour shall be a standard B.S. colour readily matchable. No hammer tone or similar.

All control equipment is to be chassis mounted behind a hinged fascia plate through which only circuit breaker toggles, reset buttons, etc., protrude. Equipment shall not be fixed to the fascia plate. Alarm pilot lights, timing units and ammeters shall be mounted on the doors, all other equipment being behind the doors. The control panels shall be complete with main isolator/s that can be operated without opening the doors. Access to equipment and wiring shall not be possible without switching off the main isolator.

The cable boxes to terminate the incoming cable will be mounted by others, but supports for this box are to be provided. Where PVC insulated cable is indicated, a gland plate only is required.

Busbars are to be located in a separate chamber. The busbars shall be of solid copper, rated at 155 amps per square centimetre, and shall be spaced and mounted to withstand the short circuit current, equal to the rating of the main isolator. All busbars and conductors shall be fully insulated in the respective phase colours. Each board is to be provided with neutral and bare earth busbar, with one way for each circuit and for each conductor.

Internal busbars, wiring, and terminals, shall be of suitable size and rating. Terminals shall be of brass and comply with sections 5.14.2 and 5.14.4 of SABS 152-1951. Wiring shall be neatly bunched and run in PVC wiring channels.

The electrical equipment to be provided on the switchboard shall comply with the detailed requirements.

Each control panel shall have red alarm pilot lights to indicate any malfunction or operation of any safety device. Normal running conditions of fans, pumps, etc., shall be indicated with green pilot lights. All pilot lights shall have a "lamp test" facility. This can be done either collectively or singly by means of a push button switch.

All exposed equipment and pilot lights are to be clearly labelled by means of plastic engraved labels, mounted on the fascia panels by means of screws or channelling. Each item of equipment in the board is to be labelled to correspond to its reference number on the wiring diagram. All wiring connections to equipment are to carry numbered ferrules corresponding to the connection number on the wiring diagram. All wiring to external equipment is to terminate in a numbered terminal block, to which the external wiring is to be connected. The terminals are to be of suitable rating for each circuit. No deviation from these requirements will be permitted.

The grouping of equipment on panels will be logical and neat and shall be done on the following basis:

i) Main incoming breaker, main metering, and incoming cable access;

ii) Each motor circuit with sub-main breakers, starters, and Contactors;

iii) Plant room auxiliaries and general control circuits.

A detailed drawing of the control panels, as well as an electrical component and connection diagram shall be submitted for approval before manufacture commences. A wiring diagram of each control panel is to be laminated and installed inside the panel with clips or hooks.

The following shall be provided as part of the distribution boards/control panels:

One ampere meter with phase selector switch	YES	YES
One voltmeter with phase selector switch	YES	YES
ON/OFF/AUTOMATIC selector switch	YES	YES
Fault indication lights	YES	YES
Run indication lights	YES	YES
Lamp test pushbutton	YES	YES

5.5 MOTORS

Motors shall comply with B.S. 2613: 1957 and dimensioned to B.S.S. 2960 as amended and be suitable for 220 volt, 1 phase, 50 cycle A.C. supply, unless otherwise specified and shall be continuously rated for operation at the required attitude, and ambient conditions.

The motors shall be suitably insulated to a minimum of class E, the speed not to exceed 1 500 r.p.m. and should suit the speed of the plant offered.

The motors shall be of the approved squirrel cage type with a low starting current.

Frames shall generally be of the standard protected type, but in dirty and damp installations they shall be totally enclosed, fan cooled. Where operating in moist air conditions, motor windings shall be specially treated.

The motors shall be protected against overheating by three temperature sensing devices incorporated in the stator windings. The devices shall be connected and wired in such a manner that the power supply to the motor will be interrupted when the temperature in the windings exceeds the manufacturers rating.

Motors shall be able to start satisfactorily at a voltage of 10 % below nominal voltage, as measured immediately after the starter is switched on. Motors shall be run up to full speed in the time given in Appendix E of B.S.S. 587:1957 with the voltage reduced by 10 % as above. Acceleration shall be smooth throughout the starting period with no signs of hesitation or "crawling".

Motors shall have a rated brake horse power at least 15 % in excess of the maximum horse power required to drive the unit when working under normal maximum load.

The motors shall be provided with approved watertight cable glands to accommodate the cables to be supplied with the equipment.

On completion at the manufacturer's works all motors shall be subjected to routine and type tests in accordance with B.S. 2613:1957, and test certificates shall be submitted for approval before delivery to site is undertaken.

Contractors shall supply wiring diagrams and efficiency, power factor and starting current curves of the motors at the time of tendering.

Where any motor is remote from/or obscured from view, from the panel, a separate isolator shall be provided for it. In the case of equipment, which is located out of doors, weatherproof lockable isolators are to be supplied. Alternatively, lockable type isolators shall be provided at the control panel.

5.6 STARTERS

The starters or switches for starting the electric motors shall be so designed, to limit the amount of current when starting and accelerating, to the current values set out below: -

- 1,5 kW to 3,7 kW four times full load current.
- 4,5 kW to 11,0 kW twice full load current.
- 11,5 kW to 18,5 kW one and three quarters full load current.
- over 18,6 kW one and a half times full load current.
- Starters are to be of the same manufacture.

Starters are to be of the magnetically operated type, preferably with thermal overload protection in each phase. For motors above 37 kW thermal overloads are to be of the bi-metal indirectly heated type. Either type of starter is to be such that with correct overload settings, the starter will trip within 45 seconds when the motor is single phasing. Where this latter requirement cannot be met, separate single phasing preventers are to be fitted on all 3 phase motors.

On starters for motors above 75 kW, protective relays shall be installed for overload, under and over-voltage, negative phase current, phase imbalance etc.

After commissioning, the full load current of each circuit is to be measured and the overloads set to suit this loading.

All starters are to be suitable for a minimum of 15 operations per hour.

All starters are to incorporate at least two auxiliary contacts that can be arranged as either normally open or closed and shall be suitable for adding further contacts if required.

They shall be suitable for both local and automatic operation.

In the case of star delta or reversing starters, only units comprising both electrical and mechanical interlocks will be accepted.

Where starting resistors are used these shall be mounted above or remote from the control panel, or starter enclosure in the case of large drives, to allow for adequate heat dissipation. The resistance banks shall be protected against overheating by thermal sensors.

The starters shall be automatic and shall have "START" and "STOP" push buttons and shall be provided with reset buttons for the overload and over temperature trips.

The starters shall be fitted with approved terminal boxes and glands of ample dimensions to suit the cables to be supplied with this equipment. Provisions shall be made for easy access by means of doors to the starters for maintenance purposes.

An approved earth terminal shall be provided on the frame of each starter housing gear and provision shall be made for earthing each starter in accordance with the requirements of local regulations.

On completion at the manufacturer's works, the starters shall be subjected to the routine and type tests in accordance with clause 83-93 of B.S. 587: 1957 and test certificates should be submitted for approval before delivery to site is undertaken.

5.7 CONTACTORS

All contactors shall be of highest quality and shall have easily removable contact and coils, such as Sprecher Shuh, Cutler Hammer or equivalent approved.

All contactors shall have adequately rated contacts and continuously rated coils with a drop-off value of not more than 80 % of rated voltage.

5.8 SWITCHGEAR

All switchgear shall be rated for the anticipated load and the maximum rupturing capacity of the particular system.

i) Main isolators

All control panels shall be provided with a suitably rated Main Isolator, which is to be of the "on-load" type, and can be operated without opening the door. This isolator shall be mechanically interlocked so that no live components are exposed without the isolator being in the off position.

ii) Miniature and moulded case circuit breakers

Heinemann circuit breakers to SABS 155 shall be used with magnetic inverse time overcurrent tripping and in addition with magnetic instantaneous tripping on excessive overcurrent or short circuit, of 250 volt rating for single and double pole and 380 volt rating for three pole, and shall be of the ampere rating and class of breaking capacity specified or shown on drawings. Where not otherwise specified or shown on drawings the breaking capacity shall be class C.

iii) Miniature isolators

Miniature isolators shall be micro-gap type manually operated air break switches suitable for flush mounting and shall be to SABS 152. Where individually mounted they shall be in galvanised steel boxes with brass dished cover plates finished to match switch cover plates.

iv) Fused switches

The fuse-switch units shall be of the three phase and neutral arrangement having double break moving contacts supporting H.R.C. fuses, all housed in a robust metal toggle mechanism. Interlocks shall be provided to ensure that the cover cannot be opened when the switch is in the closed position.

The fuses shall be of the H.R.C. type and shall comply fully with B.S. 88/1947 category of duty A.C. 4.

One set of spare fuses of each rating used in the switchboards shall be supplied and handed to the representative at the site.

5.9 METERING AND INDICATION EQUIPMENT

i) kWh Meters

The meters shall be individually tested and shall comply with SABS 01/1955.

The scale shall be of the cyclometer type and definition down on 1/10 th of a unit shall be provided for.

ii) Maximum demand ammeters

Moving iron ammeters suitable for 5 Amp secondary current transformers shall be used.

Ammeters shall indicate the instantaneous current and have a separate indication for a 15-minute average value, preferably of bi-metal element type.

The scale shall be clearly calibrated in black on a white background and both instantaneous and maximum demand readings shall be on concentric scales by means of different coloured pointers.

Meters shall be over-scaled with a suppressed over range corresponding to the starting current and where current transformers are used, the ratio of such transformers shall preferably be indicated on the ammeter fascia.

iii) Voltmeters

The instrument shall be a moving iron type, suitable for horizontal as well as vertical flush mounting.

The scale shall be clearly calibrated in black on a white background.

Calibration shall be up to 120 % of rated voltage and a suppressed scale at the zero reading shall be preferable.

The instrument shall comply with B.S.S. 89 of 1964 and shall have an Industrial Grade accuracy.

iv) Voltmeter switches

Voltmeter switches shall have one "OFF" and six measuring positions and shall be suitable for panel mounting in such a way that only the handle and labelling plate extends to the front of the panel.

The fascia inscriptions on the labelling plate shall be clearly marked.

The switch terminals shall be suitable for lug connections and shall be clearly marked.

The contact movement shall have a rolling or wiping action.

The voltage rating shall be suited to the installation.

v) Voltmeter fuses

The fuse base shall have a voltage rating suited to the particular installation and shall be suitable for either flush or projection mounting.

Cartridge type fuses shall be used with a nominal rating of 2 amp at 220 Volts 50 Hz

vi) Current transformers

Current transformers shall be of the cooled type and shall have mounting facilities.

Split core current transformers shall not be acceptable.

Current transformers shall comply with BS 3938 and IEC 185 with an accuracy of 50 for indicating instruments, and for measuring instrument up to 200 amp 1.0, 250 - 600 amp 0,5 and 800 amp and above 0,2.

Transformation ratios, primary and secondary terminals and polarity of windings shall be clearly marked.

5.10 CABLE

Cables shall be 600-volt grade polyvinyl chloride (PVC) insulated steel wire armoured to SABS 150 - 1957 general purpose grade.

Tenderers are required to state in the schedule of prices the size of the cable between the various units to be supplied under this contract. The current ratings of PVC cables shall be in accordance with the standard wiring regulations.

The Contractor will be responsible for measuring on his final layout plan for the plant room, the lengths of the different cables required. The tender price must include for the supply and installations of all the necessary cables.

No cable joints will be permissible within any plant room.

5.11 EARTHING

All motors, starters, switchboards and cable armouring are to be connected to earth by means of separate PVC covered stranded copper conductor the same size as the cable conductors, run alongside cables and strapped thereto. Earthing conductors shall be fitted with sweated lugs at ends and are to be solidly bonded to each other, to the electrical plant and equipment and to earth.

The Contractor shall provide and install a suitable earth mat which must be connected to the switchboard and shall be responsible for the supply of all material for earthing the electrical gear to be supplied and installed under this contract.

5.12 RADIO AND TV INTERFERENCE

An electrical installation shall comply with Government and Local Government Laws and Regulations in respect of radio and television interference suppression. Interference suppression components shall not be used in any part of the circuit in such a way that their failure might cause an unsafe condition.

5.13 EARTH LEAKAGE PROTECTION

All general-purpose power outlets and switched socket outlets shall be protected by an earth leakage unit.

Earth leakage protection shall be of the current-balance type. A static tripping arrangement, either a magnetic or a solid-state amplifier of simple design, shall be used.

The relay shall have sensitivity, such that immediate tripping will result from a total leakage of between 15 m A and 20 m A.

The relay shall have an integral tripping facility and shall also be temperature-compensated.

The relay shall stand up to high values of earth-fault current without damage to the tripping arrangement.

The relay shall be of an approved type to SABS 767/1964 and shall bear the mark.

5.14 TESTING

The following tests will be carried out on the installation in the presence of the Engineer or his representative.

i) Insulation resistance test using 500-volt insulation tester (Megohmmeter);

ii) Earth continuity test;

iii) Test for correct direction applied to every motor;

iv) Earth resistance test;

v) Prove the correct connection and rotation of any energy meters;

vi) Settings of all overload and other adjustable protective devices shall be set to the requirements of the equipment.

5.15 DRAWINGS AND INSTRUCTION BOOKS

The Contractor shall supply the following information:

i) Equipment layout drawings showing the main items of equipment as well as all cable and wiring runs;

ii) Switchboard and control board outline and equipment layout drawings and details of manufacturing;

iii) Single line and wiring diagrams detailing all control, metering and indication circuits;

iv) Instruction and maintenance books for all major items or equipment.

5.16 ELECTRICAL SUPPLY

The electricity supply shall be 230 50 Hertz 1 phase, and all equipment shall be selected to operate at the appropriate single-phase voltages.

The electricity supply shall be installed by others up to a point indicated on the project drawings and shall terminate in an open flush mounted draw box over which the Contractor shall mount the distribution board for the plant room.

MHSC OFFICE RENOVATIONS – TUSCANY

AIR-CONDITIONING AND VENTILATION INSTALLATION

PART 1

PROJECT SPECIFICATION

6 SECTION 6: SOUND CONTROL

6.1 SCOPE

The general sound control for the air conditioning and ventilation installations shall be specified under this section of the project specification.

6.2 DESIGN CRITERIA

DESIGN DATA	
Outdoor summer temperatures	31 C° Db/24C Wb
Outdoor winter temperature	-3 C° Db/-1,6 Wb
Indoor conditions	22 C° Db / 50 %RH
Altitude above sea level	1750 m

6.3 GENERAL

The installation shall operate without causing undue noise and vibration. The Contractor shall take the necessary precautions to ensure that noise levels in occupied areas do not exceed the levels as specified below.

Environment	NC level
General offices	35
Private offices, libraries and lecture rooms	30
Cafeterias	40
Equipment rooms	45

Noise generating equipment such as fans, compressors, pumps, motors, etc. shall be selected to operate as close to the point of maximum efficiency as possible. It is the responsibility of the Mechanical Contractor to check operating noise levels of equipment before tendering. Contractors offering equipment with low noise ratings may receive preference.

Background noise levels shall be measured separately with the plant switched off and shall be deducted from the total measured sound pressure levels.

Contractors are advised to calculate sound levels on the system offered before tendering. Where it is not possible to meet the specified sound levels due to the noise generated by the equipment, or due to inadequacies in the building structure, or the design of the plant, such deficiencies shall be stated in the tender together with the Contractor's recommendations and cost implications.

Where piping and ducting pass through plant room walls or slabs, the opening around the pipe, duct or sound attenuator shall be sealed with high density fibreglass and galvanised flashing on both sides of the wall or slab. Shafts directly connected to plant rooms shall be considered as part of the plant room.

Noise levels on the outside of buildings due to air-conditioning and ventilation equipment shall not exceed the following values when measured at a distance of 10 m directly in front of the noise source (cooling tower outside air grille, etc.) unless more stringent levels are called for in any bye-laws by local authorities such as municipalities, etc.

Environment	NC Value
Buildings in residential areas with 24-hour plant operation	25
Buildings in residential areas with 12-hour plant operation	30
Buildings in city centres adjacent to or across roads to flats, hostels, hotels, etc. with 24-hour plant operation	25
Building in city centres adjacent to or across roads to flats, hostels, hotels, etc. with 12-hour plant operation	30
Building in industrial areas with 24 or 12-hour plant operation	35

Cooling towers, condensers, etc. on the outside of buildings shall be positioned so that the side having the lowest sound power level is facing the nearest residential building.

Equipment shall be provided with sound attenuators, enclosures, or sound attenuating cowls in order to meet the minimum sound levels specified above, if required.

If required, outside air louvers shall be provided with sound attenuating cowls, design for a minimum air static pressure loss. Alternatively, acoustic louvers may be offered.

If the noise levels exceed the NC values specified above, the Contractor shall be responsible to carry out all the necessary rectifications at his own expense. Noise readings outside the building shall preferably be taken at night when the background noise levels are low.

6.4 SOUND ATTENUATORS

Sound attenuators shall be provided and installed in positions as indicated on the relevant drawings and in such places where the system attenuation alone is inadequate. Special attention shall be given to noise regeneration due to heater banks, dampers, etc. inside ductwork.

The Contractor shall submit noise-estimating sheets for all systems as well as the insertion loss ratings of sound attenuators for approval before ordering. Failure to do so may result in additional costs to the Contractor if noise levels in any area should exceed the specified limits.

Rectangular sound attenuators shall be of the splitter type, like HOWDEN DONKIN Series RAS or equivalent approved.

Cylindrical sound attenuators shall be of the acoustic pod type, with length of 1.5 x diameter, like HOWDEN DONKIN Series SILAX or equivalent approved.

Sound attenuation shall be of the proprietary manufactured type. The sound attenuators shall be manufactured of pre-galvanised mild steel sheet. The acoustic infill material shall be moisture repellent, shall not support combustion and shall be guaranteed against surface erosion up to air velocities of 20 m/s.

Sound attenuators in ductwork after supply air fans shall be designed for insertion loss large enough to limit the total sound pressure levels of the noise at a distance of 1,5 m directly in from of the first air outlet in the duct system to the NC level specified.

The static pressure loss through sound attenuators shall not exceed the maximum permissible pressure loss at the design NC level as recommended by the manufacturer. Where sound attenuators are larger than the ducts, the joint duct sections shall be enlarged to the size of the attenuator. All sound attenuators shall be provided with flanged connections.

Sound attenuators in plant rooms shall be installed in or as close to the plant room wall as possible to prevent break-in of plant room noise into the duct after the sound attenuator. Where this is not feasible due to space limitations, the duct section between the sound attenuator and plant room wall shall be externally insulated and plastered with a suitable hard setting plaster at least 10 mm thick on all four sides. Where ducting passes through an external noisy area it shall be treated to prevent any noise transmission into the duct.