

# **ANNEXURE A**

## **GENERAL SPECIFICATION**

### **FOR**

#### **NTP – PELINDABA**

# **HEATING, VENTILATION & AIRCONDITIONING INSTALLATION**

## Contents

PART A-GENERAL SPECIFICATION .....	3
1. GENERAL.....	3
2. COMPLIANCE WITH REGULATIONS AND STANDARDS.....	3
3. STORAGE OF MATERIALS.....	3
4. ACCESSIBILITY .....	3
5. SUPPORTS FROM OVERHEAD CONSTRUCTION.....	3
6. IDENTIFICATION .....	4
7. SOUND AND VIBRATION CONTROL.....	4
8. INSULATION .....	5
9. OPERATING AND MAINTENANCE MANUALS .....	7
10. ENVIRONMENTAL .....	7
11. SPECIFICATION AND DRAWINGS.....	7
12. ORGANISATION AND STAFF OF SUB-CONTRACTORS .....	8
13. ONE YEAR'S MAINTENANCE .....	9
14. GUARANTEE.....	9
15. TESTING, BALANCING, COMMISSIONING, OPERATING OF PLANT AND BALANCING .....	9
16. DIVISION OF WORK SCHEDULES .....	10
16.1. BUILDER'S WORK .....	10
16.2. 1PLUMBING CONTRACTOR .....	10
16.3. ELECTRICAL CONTRACTOR .....	10
17. DESCRIPTION OF THE HVAC SYSTEM.....	11
18. DESIGN CRITERIA.....	12
PART B - EQUIPMENT SPECIFICATION .....	13
1. AXIALFLOW FAN.....	13
2. AIR DISTRIBUTION SYSTEM.....	14
3. LOW VELOCITY LOW PRESSURE DUCTWORK.....	15
4. SOUND ATTENUATORS.....	17
5. REFRIGERANT PIPING .....	17
6. SPLIT TYPE AC UNIT COMPLETE WITH REMOTE AIR-COOLED CONDENSER.....	18
7. EXTRACT / RETURN / TRANSFER AIR GRILLE .....	20
8. DOOR GRILLE .....	21
9. INTAKE/EXHAUST AIR WEATHER LOUVRE .....	21
10. EXHAUST AIR FAN .....	21
11. WASHABLE AIR FILTERS.....	22
12. MANUALLY ADJUSTABLE AIR DAMPER.....	23
13. CONSTANT VOLUME CEILING AIR TERMINAL .....	24
14. REFRIGERANT PIPING .....	24
PART C - BILL OF QUANTITIES.....	26
1. DETAIL BREAKDOWN & TENDER SUMMARY .....	26
PART D -SCHEDULE OF INFORMATION .....	27
1. SCHEDULE OF INFORMATION .....	27

## PART A- GENERAL SPECIFICATION

### 1. GENERAL

The contract works to be carried-out consists of the engineering, supply, erection, testing, commissioning into service, guarantee and maintenance of an air conditioning and ventilation installation as described herein.

The engineering and equipment selection, shop drawings, testing, balancing, commissioning and preparation of operating, and maintenance manuals, and inspections are to be executed in a systematic manner

The HVAC Contractor shall familiarize himself with the project management procedures and submit the detailed cost breakdown on his engineering and management.

### 2. COMPLIANCE WITH REGULATIONS AND STANDARDS

It shall be the responsibility of the HVAC Contractor to ensure that all equipment and methods used in the installation, comply with all relevant statutory regulations, and amendments thereto in particular the following:

The Occupational Health & Safety Act of 1993, as amended.

Government, Provincial and Local Authorities Ordinances, Regulations, By-laws, Rules and other statutory requirements.

### 3. STORAGE OF MATERIALS

Materials shall be stored in areas allocated by the Main Contractor/Client. Stored material shall be safely stacked and shall not overload floor construction beyond design limits.

### 4. ACCESSIBILITY

Equipment shall be installed so as to be readily accessible for testing, operation, maintenance and repair. Minor deviations from drawings may be made to accomplish this, but changes of magnitude or which involve extra costs shall not be made without approval of the Architect or Engineer.

### 5. SUPPORTS FROM OVERHEAD CONSTRUCTION

Where overhead construction does not permit fastening of supports, additional approved framing shall be provided.

Duct and pipe support brackets shall be firmly fixed to overhead construction by an approved system. "Shot firing" of supports into concrete will not be accepted.

## 6. IDENTIFICATION

All identification shall be legible, and shall be painted or fixed after completion of final finishes

### 6.1. Labels

A label shall be provided on to each outdoor & indoor AC unit, in-ceiling fans, outdoor fans & remote

The labels shall consist of non-corroding material with non-glossy appearance.

### 6.2. Ductwork

All ductwork shall be identified by writing in words the service of the duct and by pointer showing the direction of flow. Markings shall appear at least at the point of origin and whenever ducting enters or leaves walls, floors or ceilings and for every 10 m centers of straight lines.

The identification letters shall be at least 50 mm high and the flow arrow 150 mm long.

## 7. SOUND AND VIBRATION CONTROL

The HVAC Contractor shall be responsible for the rectification of any excessive noise and/or vibration caused by the operation of the air conditioning and ventilation system installed under this contract.

### 7.1. Isolation of Mechanical Equipment

All mechanical equipment shall, wherever possible, be orientated in such a way that maximum sound radiation patterns are directed so as to cause least disturbance. (Maximum sound radiation occurs in the direction in which fluid enters and leaves the equipment)

All rotating machinery shall be balanced.

Vibration isolation mountings shall be provided for all rotating equipment such as fans & AC condensing units. Mountings shall be installed in accordance with the manufacturer's instructions.

Floor mounted equipment shall be erected on (A) concrete plinth, which shall protrude at least 25 mm above finished screened floor level, or (B) suitable steel sub-frame protruding at least 100 mm above finished floor level.

The amplitude of motion due to operation of the supported equipment shall not exceed 3 mm.

Spring isolators shall be designed and installed in such a way that the ends of the springs are constricted to remain parallel during deflection. For stability, the outside diameter of springs shall be at least equal to their compressed height at rated load. Springs shall have a minimum additional travel to solid, equal to 20% of the rated deflection. Each spring mounting shall be set on 7 mm thick neoprene acoustical pads.

## 7.2. Isolation of Piping and Ducts

All connections to equipment shall be sufficiently flexible to prevent excessive strain to allow the equipment freedom to move and to prevent plant vibration being conducted. Flexible connections shall be inserted, and other necessary adjustments shall be made, at the HVAC Contractor's expense, should the need arise.

All ductwork and piping within 10 m from connected vibration-inducing equipment shall be hung on resilient hangers. The first four hanger supports shall be capable of supporting piping at a fixed elevation during installation and, in addition, shall have a secondary adjustment to transfer the load to the spring element within the mounting.

Where piping and ductwork passes through walls, floors or ceilings or plantrooms, acoustical seals shall be employed to confine airborne noises to the inside of such rooms.

## 7.3. Sound Attenuation

Sound attenuating units or treatment shall be provided as indicated and/or required to control the noise from air conditioning and ventilation systems to within the limits specified. Noise levels caused by the equipment shall not exceed the ambient noise levels by more than 7dB in each frequency on the site boundary.

It should be noted that the provisions for sound attenuation shown the Engineer's drawings are based on average published data for equipment noise and inherent attenuation.

To minimize the need for sound attenuation, fans shall be selected to operate near their maximum efficiency point when producing the required air quantity and static pressure.

Sound attenuators and acoustic treatment in ducts shall be proof against fire, fungus and erosion and not produce dust or come loose.

"Packaged" attenuators shall normally be flanged for bolted connections, and flexible duct connectors shall be used as shown or required.

Attenuators shall have an air resistance not exceeding 50 Pa measured at maximum air quantity.

## 7.4. Noise Measurement

Noise level in the conditioned space through the operation of the unit at any operation point shall not exceed the specified internal NC level. Due allowance shall be made for all attenuators required to meet the specified noise levels whether shown on the drawings or not. Operating of the unit shall not cause noise levels in the surrounding areas to be more than 7 dB, in each frequency, above ambient noise levels at any boundary of the site.

## 8. INSULATION

All piping and ducting shall be insulated as specified below.

All insulation of piping, ductwork and equipment shall comply with BS 5970, provisions of 885422. Test reports may be requested from an approved testing laboratory, at the HVAC

Contractor's expense, certify the declared thermal conductivity under operating temperature of the chosen insulating materials.

Insulation shall be applied in accordance with manufacturer's general instructions in a neat and workmanlike manner so as to present a smooth and even surface. The insulation shall be compatible with the surface to be insulated and shall not demonstrate or cause any corrosion or stress corrosion under operating conditions. Vapor proofing and adhesives shall be compatible with the insulation; under no circumstances shall an adhesive or solvent be used which could attack or dissolve the surface or material of the insulation.

Covering which is subject to abrasion during normal maintenance shall be protected by perforated sheet metal with corners and edges of insulation being returned by formed angles fixed to panel edges inside the casing.

Piping, ductwork or equipment shall be clean, dry, free from grease, rust and scale and may be tested and approved for tightness and workmanship prior to application of insulation. Insulation shall be continuous through sleeves, wall and ceiling openings.

#### 8.1. Materials and Finishes

Any insulation material and their finishes used shall resist rotting, fire, decay, fungus growth, attack by vermin or erosion, thermal or acoustic, whichever may occur under operating conditions.

The thickness of insulation for refrigerant piping shall be in accordance with good engineering practice and to equipment manufacturer's requirements.

#### 8.2. Ductwork

Unless otherwise specified or noted, the following ductwork need not be insulated:

Fresh air ductwork; exhaust air ductwork; supply ventilating systems except when incorporating heating.

Unless otherwise specified or noted, insulation shall be applied to the outside of the duct.

Ductwork insulation exposed to atmospheric conditions shall be covered by galvanised Sheetmetal panels soldered and lapped (Double Skin) so as to be weatherproof.

Where insulation is fixed to the inside of the ductwork, the surface treatment of such insulation exposed to the air flow shall resist shredding and erosion, and where such insulation is adjacent to humidifiers, air washers or cooling coils; the surface shall have water protection.

**DUCTING (INSIDE OF BUILDINGS):** External insulation: 25mm fiberglass

**DUCTING (OUTSIDE OF BUILDINGS):** 50mm fiberglass, Double Skin ducting.

Density: 16kg/m

Fixing: Mechanically fixed and pinned

To ensure that the correct thickness of insulation and covering has been applied, the HVAC Contractor shall, if required to do so, cut one or more section from the finished insulation. If deficiencies are revealed, the Sub-Contractor shall, at his own expense, remove the whole and provide and fix the correct insulation.

### 8.3. Piping and Fittings

Unless otherwise specified or noted, the following piping need not be insulated:

Vent, overflow, drain and relief piping; pneumatic control air piping; cold water make-up piping; water treatment piping; condenser water piping.

All cold piping (chilled water, refrigerant suction) and all steam, condensate and hot water circulating piping shall be insulated, using rigid performed sections having a bore to suit the pipe.

The insulation shall be externally covered. The covering to insulation on cold piping shall form a complete vapor barrier as specified below.

Covering of insulation which is visible but not readily accessible shall be finished neatly. Where the covering used, as specified above, is not suitable for the purposes, hard setting compound shall be applied, troweled true and smooth, and painted.

Insulation of piping exposed to the weather shall be metal cased as specified above, and this casing shall be lapped so as to be rainproof.

Self-tapping screws, or blind rivets, the application of which could damage the vapor sealing, shall NOT be used for fixing metal casings to vapor sealing.

Where insulation is specified for piping, the same shall apply to all fittings and pipe connections within the system.

The insulation shall cover flanges by means of boxes or by increasing the thickness of insulation to give at least a 6 mm cover at these points.

## 9. OPERATING AND MAINTENANCE MANUALS

The HVAC contractor shall supply four (4) comprehensively indexed Operating and Maintenance Manuals, bound in loose leaf plastic covers, including As-built drawings, maintenance schedule and commissioning data.

## 10. ENVIRONMENTAL

The sub-contractor shall take the necessary care to avoid the release of Refrigerant gas into the atmosphere. In the instance of the gas having to be drained, the sub-contractor shall obtain the services of a gas-recovery company who specializes in the removal, storage and re-use of refrigerants.

## 11. SPECIFICATION AND DRAWINGS

### 11.1. Engineer's Drawings and Specification

The drawings prepared by the Engineer show general layout of all equipment and distribution systems, complete with schematic arrangements. These, together with the specification, give sufficient information to enable the HVAC Contractor to estimate the cost and to determine how the system must be installed, tested, balanced, inspected, operated, serviced

and maintained.

These drawings are not dimensioned installation drawings and cannot be used as construction/shop drawings. Location dimensions shown are only indicative of the routes and zones in which the service must be installed.

#### 11.2. Structural Drawings

The HVAC Contractor shall supply to the Engineer marked-up structural drawings or other drawings showing any changes or additional requirements to be made in the structure in order to fit apparatus and materials to be installed by him (if required). However, it will be the HVAC Contractor's responsibility to ensure that sufficient installation clearance is provided for positioning the selected equipment into the building space provided.

#### 11.3. Shop Drawings

These drawings shall indicate all equipment, distribution systems, testing/inspection/instrumentation positions, access requirements and builder's work requirements.

Drawings shall be produced in AutoCAD or later format and the HVAC contractor shall be able to receive and transmit drawings electronically.

Builder's work requirements shall include all work by others (holes in concrete, frames, masonry holes, bases, etc.) as well as the sizes, capacities and positions of service connections.

The HVAC Contractor may, if he so desires, obtain AutoCAD electronic drawings of the Engineer's drawings for modification and updating if required. These drawings shall be re-titled in accordance with the HVAC Contractor's system and shall thereafter be submitted as the HVAC Contractor's shop drawings.

"As Built" drawings in electronic format shall be furnished on completion to the Engineer. These shall comprise the shop drawings as specified above, embodying all modifications made during construction, and further system diagrams indicating the intended functioning, capacity data and control functioning of all systems.

#### 11.4. Samples

Samples are any samples required by the Architect or the Engineer. Samples shall be physical examples to illustrate materials, equipment or workmanship, and to establish standards by which the works may be judged. Such samples, after approval, will be retained by the Architect or Engineer for a period sufficient to ascertain that the relevant component is actually provided as per such sample, but will then be returned to the HVAC Contractor.

## 12. ORGANISATION AND STAFF OF SUB-CONTRACTORS

In addition to the site Supervisor/Foreman, the HVAC Contractor shall employ as many responsible and experienced engineers, programmers and administrators as may be necessary for the purpose for the contract to ensure:

- Selection and/or engineering or equipment and components into working assemblies all in conformance with the design concept contained herein.



- Attendance of meetings.
- Conducting of all tests required.
- Expediting of the work.

### 13. ONE YEAR'S MAINTENANCE

The HVAC Contractor shall furnish free of charge all maintenance on the entire contract works for a period of twelve months after handover. Maintenance shall include systematic examination and adjustment of equipment at least once a month or in accordance with the manufacturer's recommendations.

The HVAC Contractor shall in the course of such maintenance or on call during the maintenance period, repair or replace defective parts if required, and shall use only genuine standard parts produced by the manufacturer of the original part.

The HVAC Contractor shall respond within 24 hours after receipt of a call-out.

The HVAC Contractor shall supply all spare parts, lubricants, refrigerant, chemicals, filters, fuses, etc. during the free maintenance period. Renewals or repairs resulting from misuse by somebody other than the HVAC Contractor, however, shall not be made at the expense of the HVAC Contractor.

This guarantee shall be in addition to the employer's common law rights.

### 14. GUARANTEE

The HVAC Contractor shall guarantee that the air conditioning and associated systems will be installed and adjusted in such a manner that it will maintain the dry bulb temperature and humidity levels as specified.

### 15. TESTING, BALANCING, COMMISSIONING, OPERATING OF PLANT AND BALANCING

Conduct full testing, balancing and commissioning procedures for individual equipment and for the entire air conditioning and ventilation systems.

Include the following:

- a) Setting of protective devices to stop operation of equipment at overload or abnormal conditions.
- b) Checking of performance of equipment and systems by simulation through the range of maximum to minimum operating conditions.

After physical completion, has been reported and all defects made good, "start-up" shall take place and the above check-out procedures shall be carried-out.

The HVAC Contractor shall provide all labor, supervision and equipment required for testing and operating the plant. "The Employer" may assign operating personnel as observers, but such observation time shall not be counted as instruction time.

The HVAC Contractor's operator(s) shall be fully conversant with the operation and experienced in running similar installations. The HVAC Contractor shall train the Employer's operator(s) to enable them to be responsible for and capable of operating the plant.

All tests shall be recorded in a field test report for insertion in the operating and maintenance manual

## 16. DIVISION OF WORK SCHEDULES

The following related work to the air conditioning and ventilation (HVAC) contract will be provided by others. The HVAC contractor shall be responsible for the detailing, checking and ensuring that the work as listed in the schedules and shown in principle on the drawings is provided as per his detailed builder's work and related services drawings.

Instructions for the HVAC contractor's exact requirements shall be transmitted to the Main contractor and other sub-contractors timeously in the form of builder's and associated services drawings in accordance with an agreed program. Should these instructions be issued after the completion of relevant areas, then this work will be carried-out at the expense of the HVAC contractor.

### 16.1. BUILDER'S WORK

The following will inter alia be required as detailed in drawings:

- a. Core drilled opening through roof slab for refrigerant piping.
- b. Timber framed openings through walls and slabs for ducting and grilles as required.
- c. Openings in doors for door grilles.
- d. Openings in suspended ceilings for supply air terminals, grilles and return air grilles.
- e. Sealing and making good of the openings in the building structure after mechanical services have been installed.
- f. Openings in walls and windows for wall/window mounted fans.
- g. Undercutting of doors for rooms with an outdoor air supply, or exhaust rate less than 75L/s.

### 16.2. PLUMBING CONTRACTOR

Drain points will be required for the condensate pipe system of the split type air conditioning indoor units as indicated on the drawings.

### 16.3. ELECTRICAL CONTRACTOR

Power supply, single phase and neutral to the live side of an isolator, including the isolator, adjacent to:

- a. Condenser unit of split type air conditioning unit.

Power supply, single phase, earth and neutral to an isolator, including the isolator, adjacent to each:

- a. In-line tube fan
- b. Wall/window mounted fan
- c. VAV Diffuser / Diffuser with/without neck heater.

Power supply, three phases, earth and neutral to an isolator, including the isolator, adjacent to:

- a. Condensing unit of split type air conditioning unit.

Control Conduits 25 mm Diameter conduit and draw wire shall be provided by the electrical contractor between all air conditioning units and their controllers (if required).

## 17. DESCRIPTION OF THE HVAC SYSTEM

All areas, except toilets, tea kitchens, strong rooms, small passages and store rooms will be air-conditioned.

All info regarding the system is shown on the HVAC drawings.

### 17.1. Types of Systems

DX SPLIT TYPE UNITS (Most common type system for branches)  
VRV TYPE SYSTEM  
ROOFTOP PACKAGE SYSTEMS EXISTING  
CENTRAL SYSTEMS WATERCOOLED  
PACKAGE SYSTEMS

NOTE:

New or existing swirl type diffusers (if required) shall be installed for the air-conditioned areas.

Outdoor units shall be positioned in a well-ventilated area, in accordance with the manufacturer's recommendations and Engineers approval.

All units shall be of Heat pump type units.

All **new AC units** shall be of the **inverter type** units, utilizing **R407 / R410** refrigerant gas (Unless Stock not available).

### 17.2. Toilet and Store ventilation

The public toilets and store areas will be ventilated by means of extract fans and ducting systems as per drawings. In case of existing systems, equipment shall be cleaned & serviced (If not central system).

### 17.3. Fresh air supply

Fresh air ducted systems shall be installed as per the drawings. The air will be continuously introduced into each room through the AC units. No heating is provided for the outside air introduced.

In case of existing systems, equipment shall be cleaned & serviced (If not central system).

## 18. DESIGN CRITERIA

### 18.1. Functional Performance

- Outside summer design conditions: As per CSIR climate/info for particular area
- Outside winter design conditions: As per CSIR climate/info for particular area
- Altitude: As per town / area average elevation
- Internal design conditions: 22.SOC  $\pm$  1oc / 50% RH

(Relative humidity will not be controlled but equipment shall be sized to achieve the RH under peak cooling conditions).

- Maximum Noise levels

Occupied air-conditioned areas:	NC35
Toilets:	NC40

## PART B - EQUIPMENT SPECIFICATION

### 1. AXIALFLOW FAN

Supply and install as shown on the drawings, fans delivery the specified air quantity as listed on the drawings.

The fan shall be fully catalogued product and the documentation shall include sound power level spectrum, performance curves and/or tables for the operational condition.

Performance curves and selection tables shall be based on a reproducible and certified test in an approved laboratory.

The selection shall be in the stable part of the curve.

Fan shall be so constructed and installed that any sub-component replacement shall not take longer than 1 day when executed by qualified building maintenance staff.

The fan shall be selected for a minimum service life of 15 years' operating for 3 000 hours per annum under normal building operating conditions.

Fan installation shall comply with local authority by-laws and with Occupational Health and Safety Act of 1993, as amended.

Fan shall be installed in accordance with Manufacturer's recommendations and shall be maintained in 'as new' condition at start-up of installation.

Fan shall be statically and dynamically balanced at the manufacturer's works within the design operating speed range.

Fan and motor assembly shall be installed on vibration isolating mounting to limit amplitude of vibration to 3 mm.

Fan shall not be operated until connected ducts have been cleaned and specified filters have been put into regular operating conditions.

Rotation arrow shall be installed.

Lubrication shall be possible while fans are in operation without removing any part and without danger of over lubrication.

All parts of the fan shall be readily accessible for ease of inspection, maintenance and service.

Fan casing shall not drum, distort or leak at any operating point and shall, if necessary, be externally sound insulated to maintain specified noise level in plantroom or adjacent room.

Motor rating shall not be less than the maximum power required by the fan at any operating point between zero and break-off capacity for the impeller furnished.

Power supply to motors shall be flexible.

The motor shall be of the totally enclosed fan type. The motor starter, motor and drive shall be selected to ensure slip free starting without the causing of unacceptable voltage drop.

## 2. AIR DISTRIBUTION SYSTEM

### 2.1. GENERAL

The HVAC Contractor shall supply and install the air distribution, return and exhaust systems as shown on the drawings.

The entire ducting system, including spigots but excluding flexible connections to air terminals, shall not leak more than 4% of the maximum design air flow at design duct static pressures, as determined in the manner specified.

Ducts shall be even, and internally smooth with neatly finished joints, shall be free from vibration and drumming under all operating conditions and shall ensure an even flow of air without undue pressure loss.

The entire ducting system, including flexible ducts, finishes, hangers and supports, dampers and valves, connections, access doors, acoustical treatment and thermal insulation, sealants and sealing gaskets, shall be selected, constructed and installed to give a minimum working life of 20 years under expected building service conditions.

Unless otherwise indicated, all **ductwork sizes shown on the drawings** are clear **internal air passage sizes**.

Ducting shall be identified for services and direction of flow in accordance with the "Identification" section.

The HVAC Contractor shall select, construct and install the ducting and other sheet metal work in accordance with the following classification of conditions in the several sections of the air distribution system: -

	<b>VELOCITY (m/s)</b>	<b>PRESSURE (Pa)</b>
Low Velocity Low Pressure	Up to 10	Up to 500
High Velocity Medium Pressure	Over 10	501 to 1500
High Velocity High Pressure	Over10	1501 to 2500

### 3. LOW VELOCITY LOW PRESSURE DUCTWORK

#### 3.1. General

Except as noted, ducts and other Sheetmetal work for air distribution shall be constructed and installed in accordance with:

- a) Contract drawings.
- b) Latest edition: "Low Velocity and Duct Construction Standards" by SMACNA or SANS 1238-2005 and 10173-2003.

Ducting and appurtenances shall be constructed of Galvanised Steel.

Bracing angles shall be compatible with the duct material.

Changes in dimensions, shape and direction of ducting shall be gradual, complying with SANS 1238- 2005, Sections 5.4.

Elbows shall be of the standard radius ( $R=W$ ) type. Short radius ( $R=1/3W$ ) and vaned square elbows shall be used only where required to fit restricted space.

Air turns shall be installed in all non-standard radius elbows and shall consist of 'double-thickness' type vanes, arranged to permit the air to make the turns without appreciable turbulence.

#### 3.2. Branches and Take-Offs

Throat velocities in branch connections shall not exceed main duct velocity.

#### 3.3. Sealants

All joints shall be sealed using an approved sealant.

#### 3.4. Installation

Ducts shall be securely attached to building construction in an approved manner.

#### 3.5. Flexible Connections

Ductwork shall be connected to fans, air handling units or other vibration inducing equipment by flexible connections suitable for the pressure at the point of installation. Such flexible connections shall consist of fireproof fabric reinforced airtight material. Flexible connections will also be required at expansion joints in the building structure, unless sufficient flexibility is provided in the adjacent ducting.

Connections shall be attached at both ends by approved metal collars or frames.

The openings being connected shall be of equal size, aligned and parallel.

The flexible material shall be in folds to permit sufficient movement.

#### **Flexible Ducting**

Where indicated ductwork shall be connected to mixing boxes and integrally mounted ceiling diffusers by means of flexible ducting.

Flexible ducting shall consist of aluminium foil faced glass fiber fabric mechanically interlocked by a corrosion resistant metal spiral helix on the outside of the fabric.

Flexible ducting shall comply with local codes, NFPA Bulletin 90A and SANS fire resistance requirements.

**Flexible ducts** connected to diffusers of mixing boxes shall, unless otherwise shown or approved, **not exceed 1,5m** in length nor have more than (the equivalent of) two 90-degree bends. Bends shall be of the maximum possible radius without flattening or distorting the flexible.

### 3.6. Access Doors and Panels

Access doors and panels shall be installed in casings, plenum chambers and ducts where shown and required for inspection, maintenance and replacement of equipment, instruments and controls in accordance with SANS 1238-2005.

### 3.7. Testing

All duct work shall be leak tested and made airtight before ducts are insulated or concealed. Calibrated equipment for leak testing shall include rotary blower, orifice section and U-type gauge board complete with cocks, rubber tubing and other appurtenances required for conducting tests, generally as described in the SMACNA "High Velocity Duct Construction Standards".

As installation progresses, suitable and approved sections of ducting including spigots for flexible ducts shall be temporarily sealed for testing.

Test pressure shall be 75 Pa. During the test period, the entire section of ducting tested shall be examined for leaks and noise. Leaks and noisy conditions shall be marked, repaired and re-tested. Noisy leaks shall be repaired under all conditions, even when leakage is within acceptable limits.

Test holes for instruments shall be 25 mm diameter and provided with an effective seal. Reports on leak testing shall be submitted in a bound folder with all accompanying sketches, and shall indicate that the total of "operating" leakages inferred from tests on all sections of the system does not exceed the specified maximum of 4% of the (maximum) design air quantity for said system. (Note: Actual leakage quantities found in each test may be reduced in the ratio  $P_t/P_o$  where  $P_o$  equals design operation pressure and  $P_t$  the test pressure employed, to calculate the "operating" leakage).

The HVAC Contractor shall provide all facilities for measuring and testing.



#### 4. SOUND ATTENUATORS

Sound attenuators shall be manufactured by a reputable manufacturer regularly engaged in the manufacturing and testing of sound attenuators.

The sound attenuators shall be tested to BS 4718 as amended and test data shall be available for both static and dynamic insertion losses in octave frequency bands from 63 to 8000Hz.

The sound attenuator shall be tested for pressure drops and tables of airflow vs pressure drop shall be available.

The attenuators shall be leak proof.

The attenuators shall have a Class 1 rating for surface spread of flame as measured to BS 476 Part 7.

The casing shall be manufactured from galvanised mild steel.

#### 5. REFRIGERANT PIPING

During the welding of refrigerant copper piping, a small amount of nitrogen must be passed through the pipes to avoid flaking of the inside of the piping.

Brazed joints shall be used instead of screwed or flared joints. The number of joints shall be minimized.

All refrigerant piping shall be well saddled and secured to minimize vibration of piping. All pipes shall be de-burred and cleaned after being cut. Only circular pipe cutters shall be used, no sawing of pipes shall be allowed.

Pipe benders, flaring and swaging tools shall be used.

Sizing of refrigerant piping shall be done according to air-conditioning unit manufacturer's requirements, taking into account equivalent pipe length and height difference between evaporator and condenser.

**All refrigerant piping must be pressure tested** at 20% above operating pressure, using nitrogen and the refrigerant that will be used in the system. The system pressure must be observed, and any reduction in pressure means that there is a leak in the system. An approved leak testing method must be used to find leaks. After leak repair, the pressure test must be repeated.

**All refrigerant piping system are to be evacuated with a vacuum pump**, to a pressure of 40 to 45 microns (electronic vacuum gauge). A two-stage vacuum pump must be used specially designed for this purpose.

The manifold valves shall be closed off and vacuum observed for at least 2 hours. If there are no movement on the gauge, then there are no leaks or moisture in the system. Gauges will indicate between -80 and -100 kPa.

If the vacuum reading moved above 45 microns in 2 hours, the system must be checked for leaks or further vacuum pumped to remove moisture.

## 6. SPLIT TYPE AC UNIT COMPLETE WITH REMOTE AIR-COOLED CONDENSER

Supply install and commission the air-conditioning units as shown on the drawings.

Controls and protective devices shall be factory wired and located in a readily accessible location. Control box shall be removable from front of unit.

The performance of the unit shall be fully documented and certified by a certifying authority in control of manufacture and/or ARI standard instrumentation  $\pm 5\%$  and/or SABS and CSIR for South African manufactured products. The documentation shall include:

- a) Sound power data for the octave band mid frequencies of 63 to 8000Hz, measured in enclosure and outside the enclosure as indicated on the arrangement drawing.
- b) The performance curves or tables stating Total and Sensible Cooling capacities with power absorbed, all at the altitude shown in the design conditions, for the following range of operating conditions:

Entering Air Dry Bulb to evaporator 20 to 25 °C.

Entering Air Wet Bulb to evaporator 14 to 19 °C.

- c) The possible percentage variations of data measured on site (with calibrated and certified instrumentation) compared to the catalogued performance data.

The unit shall be fully protected and shall be fail-safe. Minimum safety protection, caused by possible external abnormal conditions, shall be provided for the following and require manual reset after fault occurrence:

- a) High discharge pressure.
- b) Low suction pressure.
- c) Thermal overload for single phase motors.
- d) Combined thermal overload and phase-failure for three phase motors.
- e) Over/under voltage protection.

The unit capacity shall be controlled by a control switch and adjustable thermostat.

Thermostat shall switch on the heater or compressor automatically in accordance with the load. The switch shall have 3 positions: OFF-AIR CONDITIONING -FAN ONLY.

Appearance, finish and colour of exposed thermostats shall be to Architects approval. All controller set points shall be adjustable over a small range to enable fine-tuning to take place in the field.

Controllers shall be hard-wired, and wall mounted if requested. The HVAC contractor shall co-ordinate his requirements and the positions of controllers with the main contractor and electrical sub-contractor.

In addition to 3 above the HVAC contractor shall submit the following: -

- a) Installation and operating manual with check-out and start-up procedures;

- b) Normal and emergency operating instructions;
- c) Trouble analysis guide;
- d) Number and details of periodic services for recommended preventative maintenance program;
- e) Warranty policy- Minimum requirement shall be one year for entire unit and 5 years for refrigeration equipment and accessories.

NOTE: Warranty shall commence with the beneficial use of the equipment when set in operation.

The minimum selected service life for which the unit has been engineered and components selected when operated under normal building conditions with optimum servicing and maintenance, shall be 15 years with 5000 operating hours and 1000 stop and starts per annum.

The Engineer reserves the right to call for:

- a) Test certificates and reports from the Supplier's quality control laboratory and independent test laboratory such as SABS, and/or.
- b) Site inspections, customer reports, references and user's interviews, and/or. c) Full engineering, design and components selection details.

The units shall comply with regard to electrical safety and supply interference suppression requirements of SABS and/or local authorities by-laws. The units shall also comply with safety codes for mechanical refrigeration ASA-89.1.

Special care shall be taken in crating, transport, delivery and instruction for storage on site to ensure that the units can be installed in "as new" condition.

The overall unit dimensions including mounting details shall not exceed those shown on the drawing. The HVAC contractor shall check the proposed enclosure and ducting details and ensure that all necessary provisions are made for the servicing and maintaining of the units in accordance with the supplier's service and maintenance instructions.

The unit shall be of the air-cooled, split type complete with compressor(s), fan(s), filters, coils (remote condenser) electrics and safety controls.

The unit shall not drum, vibrate or leak under any operating conditions. Parts used in the construction of the units shall have adequate strength and the overall construction and installation shall ensure satisfactory operation under normal service conditions.

The air discharge of the air-conditioning units shall be as shown on the drawing.

Evaporator fan shall be of the direct-drive centrifugal type.

Units shall be furnished with washable filters, filtering the evaporator air. Mounting arrangements for filter shall obviate bypass of untreated air. Filters shall be easily removable from units.

Units shall be equipped with a hot dipped galvanized drain pan of sufficient size to trap condensate.

All electrical components of the unit shall be suitable for power supply of 380/220V with a variation of +/- 10% without any modification to the basic unit.

All condenser coils shall be protected from possible damage by hail by hail-guards.

The unit shall be capable of operating safely (at reduced capacity) without tripping at an ambient temperature of 40°C.

Units shall be reverse cycle to provide heating (heat pump). A defrost cycle shall automatically be activated.

High-wall units serving the DATA room shall each have low ambient protection/control device. Units shall also be fitted each with a condensate pump if shown on the drawings.

Under ceiling or High-wall units serving the ATM service room shall each have low ambient protection/control device. Units shall also be fitted each with a condensate pump if shown on the drawings

All new AC outdoor units located in **coastal areas** shall be treated with **Bluechem** for the fins and coils.

All new split type AC units shall run on **R-407 or R-410 refrigerant**.

All outdoor refrigerant piping shall be covered by weatherproof trunking.

The following makes are acceptable:

- Mitsubishi

If another make is offered it will be the privilege of the ENGINEER to decide whether the particular unit offered by the tenderer is acceptable.

## 7. EXTRACT / RETURN / TRANSFER AIR GRILLE

Supply and install air grilles extracting/transferring the air quantities as shown on the drawings.

Unless otherwise indicated, the grille shall be complete with an air quantity adjustment device.

The grille shall be a fully catalogued product and the documentation shall include selection tables.

Special care shall be taken in transport, delivery, storage on site and installation to ensure that the grilles are installed and maintained in "as new" condition at start-up of the installation.

The grille shall be epoxy powder coated to an approved colour (If required).

## 8. DOOR GRILLE

Supply and install as indicated, door grilles transferring the air quantities stated as shown on the drawings.

The door grille shall be a fully catalogued.

Special care shall be taken in transport, delivery and storage on site to ensure that the door grilles are installed and maintained in "as new" condition at start-up of the installation.

The door grille shall be aluminium and of the "no sight core" type and shall be finished in an epoxy powder coating to an approved colour (colour- if required by Architect).

## 9. INTAKE/EXHAUST AIR WEATHER LOUVRE

Supply and install as shown on drawings, outside air/exhaust air louvres for the air quantity at the static pressures.

The outside air/exhaust air louvres shall be fully catalogued product.

Special care shall be taken in transport, delivery, storage on site and installation to ensure that the outside air/exhaust air louvres are in "as new" condition at start-up of the installation.

The outside air/exhaust air louvres shall be installed as shown in principle on the drawings.

The louvres shall be finished in baked enamel to an approved colour or epoxy powder coated (colour- if required by Architect).

All outside air/exhaust air louvres shall be complete with mounting frames suitable to be built into the brick walls by the builder. All outside air/exhaust air louvres shall be vermin proofed.

## 10. EXHAUST AIR FAN

Supply and install as shown on drawings the exhaust air fans handling the specified air quantities as listed in the schedule.

The fan shall be a fully catalogued product and the documentation shall include sound power level spectrums, performance curves and/or tables for the expected range of operational conditions.

Performance curves and selection tables shall be based on a reproducible and certified test in an approved laboratory.

The Sub-contractor shall submit at time of equipment submission-

- a) The service and maintenance instructions.
- b) The estimated total expenditure on replacement of parts during the service life.

- c) Installation, testing, balancing and commissioning instructions and trouble analysis guide.

Fan selection shall be in the stable part of the curve.

The fan shall be engineered, and components selected when operated under normal building conditions with optimum servicing and maintenance for a minimum service life of 10 years with 6 000 operating hours per annum.

The Engineer reserves the right to call for

- a) Test certificates and reports from the manufacturer's quality control laboratory or independent test laboratory such as SANS, and/or
- b) Site inspections, customer reports/references and user's interviews, and/or
- c) Full engineering, design and component selection details to check the correctness of the claimed service life.

Fan installation shall comply with local authority by-laws and with Occupational Health and Safety Act of 1993, as amended.

Fan shall be complete with wire guard(s) if accessible from either side.

Fan shall be installed in accordance with manufacturer's recommendations and shall be maintained in "as new" condition at start-up of installation.

Fan and motor shall be weatherproof and shall be protected from wind, rain and insects (if installed outside).

Fan shall be quiet in operation and shall be statically and dynamically balanced at the factory.

Bearings shall be of the permanently lubricated type.

Mounting plates shall not distort under any operating conditions.

Power source to motors shall be through flexible conduit.

## 11. WASHABLE AIR FILTERS

Supply and install as shown on the drawings, filters passing the air quantity at the specified maximum face velocity, pressure drops, efficiency and dust holding capacity.

Air filters shall be a current catalogued product with complete documentation, including tables and graphs listing efficiency, dust hold capacity and pressure drop, for the expected range of operating conditions.

The filter bank shall be so constructed and installed and necessary access provided to make it possible to change one filter element in five minutes.

Filter materials shall be fire resistant.

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

Special care shall be taken in transport, delivery, storage on site and installation to ensure that the filters are installed in 'as new' condition.

After all the adjustments etc., are completed and before the filters are accepted for regular operation, these shall be cleaned.

Filters must be put in regular operating conditions before the fans are operated for any purpose such as temporary ventilation or adjusting.

The filter frame shall be suitable for standard commercial range of filter media available.

Plate shall show serial number, model number and all other data necessary for ordering the new media.

Filter elements shall be either removable from sides of unit or front of filter bank.

Adequate personnel access shall be provided in front of filter bank if filter elements are removed from front.

The filter elements and filter frame shall be fully corrosion protected. Construction of filter frame, and method of holding down filter elements shall ensure no passage of unfiltered air through filter bank.

**Two** spare set of filters shall be provided for each filter bank.

## 12. MANUALLY ADJUSTABLE AIR DAMPER

Supply and install the dampers of the opposed blade, 100% shut-off type suitable for the capacity listed on the drawings.

The damper, complete with frame and linkage, shall be a fully catalogued product of a manufacturer regularly engaged in the production of the high-quality dampers.

Special care shall be taken in transport, delivery, storage on site etc., to ensure that the dampers are installed and maintained in "as new" condition at start-up of the installation.

The damper and damper frame shall be installed level in both directions. There shall be no torsion or twist in the frame to prevent smooth operation of the damper. The blades shall not touch any adjacent material throughout the full travel of the blades and shall be capable of opening to a full 90 degrees.

The drive shaft for the linkages shall be suitable for manual operation and shall be lockable.

The dampers and linkage shall be cleaned of any debris or dirt that may cause binding.

Pressure drop through the damper shall not exceed 50 Pa at 5 m/s velocity over the face area.

Damper frame and blades shall be manufactured of galvanised sheet steel.

### 13. CONSTANT VOLUME CEILING AIR TERMINAL

Supply and install constant air volume diffusers delivering the air quantities as shown on the drawings.

Unless otherwise indicated, the air terminal shall be complete with air quantity adjustment device.

The air terminals shall be a fully catalogued product and the documentation shall include performance curves or selection tables.

Special care shall be taken in transport, delivery, storage on site and installation to ensure that the air terminals are installed and maintained in "as new" condition at start-up of the installation.

The terminal shall be epoxy powder coated to an approved color (color- if required by Architect).

The HVAC contractor shall supply the portable air measuring device, specified and calibrated by the air terminal manufacturer to check the air delivery of the air terminals. The air measuring device shall work in conjunction with a commercially available meter.

### 14. REFRIGERANT PIPING

During the welding of refrigerant copper piping, a small amount of nitrogen must be passed through the pipes to avoid flaking of the inside of the piping.

Brazed joints shall be used instead of screwed or flared joints. The number of joints shall be minimized.

All refrigerant piping shall be well saddled and secured to minimize vibration of piping.

All pipes shall be de-burred and cleaned after being cut. Only circular pipe cutters shall be used; no sawing of pipes shall be allowed.

Pipe benders, flaring and swaging tools shall be used.

Sizing of refrigerant piping shall be done according to air-conditioning unit manufacturer's requirements, taking into account equivalent pipe length and height difference between evaporator and condenser.

All refrigerant piping must be pressure tested at 20% above operating pressure, using nitrogen and the refrigerant that will be used in the system. The system pressure must be observed, and any reduction in pressure means that there is a leak in the system. An approved leak testing method must be used to find leaks. After leak repair, the pressure test must be repeated.

All refrigerant piping systems are to be evacuated with a vacuum pump, to a pressure of 40



to 45 microns (electronic vacuum gauge). A two-stage vacuum pump must be used specially designed for this purpose.

The manifold valves shall be closed off and vacuum observed for at least 2 hours. If there are no movement on the gauge, then there are no leaks or moisture in the system. Gauges will indicate between -80 and -100 kPa.

If the vacuum reading moved above 45 microns in 2 hours, the system must be checked for leaks or further vacuum pumped to remove moisture.

Records of pressure testing and evacuation of each refrigerant piping systems must be kept and submitted to the mechanical engineer.

## PART C - BILL OF QUANTITIES

### 1. DETAIL BREAKDOWN & TENDER SUMMARY

The sub-contractor shall complete this section in order to assess project progress valuations and variations. The prices shall be:

- Net cost of equipment materials supplied and installed on site.
- Excluding Value Added Tax
- Prices firm in RSA currency.
- Prices inclusive of electrical wiring & connection between HVAC equipment and electrical isolators.

**TOTAL** R \_\_\_\_\_

Add 15% Vat R \_\_\_\_\_

**TOTAL TENDER AMOUNT** R \_\_\_\_\_

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

Address: \_\_\_\_\_

\_\_\_\_\_

Telephone: \_\_\_\_\_

Fax: \_\_\_\_\_

Date: \_\_\_\_\_

Signature: \_\_\_\_\_

## PART D -SCHEDULE OF INFORMATION

### 1. SCHEDULE OF INFORMATION

The information below shall be supplied by the tenderer and shall be deemed to comply with the specification unless deviations from the specification are specifically pointed out in writing in the tender by the tenderer.

#### **SPLIT TYPE AIR CONDITIONING UNIT**

1. Make
2. Name of supplier
3. Model and type
4. Country of origin

#### **AXIALFLOW FAN**

1. Make
2. Name of supplier
3. Model and type
4. Country of origin
5. Applicable standard, test bureau or code of practice

#### **CONSTANT VOLUME SQUARE CEILING AIR DIFFUSERS**

1. Make
2. Name of supplier
3. Model and type
4. Country of origin
5. Applicable standard, test bureau or code of practice

**SPECIFICATION FOR PELINDABA BUILDING C4**  
**GROUND FLOOR NORTH WING AND GROUND FLOOR SOUTH WING AIR CONDITIONING AND**  
**FRESH AIR SYSTEMS**

**AIR CONDITIONING UNITS**

Air Conditioning units shall be R410A Inverter Cassette units for the various areas as follows:

Preferred  
Supplier:  
Mitsubishi

**GROUND FLOOR NORTH WING**

AREA	CAPACITY B T U ' s	QUANTITY
Executive 1	18 000	1
Executive 2	24 000	1
Executive 3	18 000	1
Executive P A	18 000	1
GMD PA	18 000	1
Strategic 1	9 000	1
Strategic 2	9 000	1
Visitors Lounge	24 000	1
GMD Office	24 000	1
Reception	24 000	1

**GROUND FLOOR SOUTH WING**

AREA	CAPACITY B T U ' s	QUANTITY
Executive Boardroom	36 000	1
New Pause Area	36 000	2
Training Room A	36 000	1
Training Room B	36 000	1
Document Storage	24 000	1

**REFRIGERATION PIPING**

All refrigeration piping shall be suitable for R410 A refrigerant with the following distance between the indoor and outdoor units.

AREA	LENGTH
Executive 1	15
Executive 2	12
Executive 3	10
Executive P A	25
GM PA	25
Strategic 1	22
Strategic 2	26

Visitors Lounge	25
GMD Office	20
Executive Boardroom	25
New Pause Area – Units 1 & 2	50
Training Room A	30
Training Room B	30
Reception	30
Document Storage	5
Fittings, Armaflex, Refrigerant	Included in Above

The condensers should be mounted on suitable center lever brackets fixed to the brackets with spring nuts and bolts

#### **PVC CONDENSATE DRAIN PIPING**

50dia Piping	60m
25dia Piping	100m
50dia T Pieces	20
50 to 25 Reducer	20
50dia 90° Elbow	15
25dia 90° Elbow	70
PVC Adhesive as required	
50dia Brackets	30
25dia Brackets	50
Fixings as required	

#### **CABLE TRAY FOR COPPER PIPING AND CABLES**

Cable tray should be galvanised medium grade

100mm wide	110m
200mm wide	65m
400mm wide	50m
Supports & Fixings	Lot
Joiners	Lot

#### **CONTROL AND ELECTRICAL CABLE FROM INDOOR UNITS TO CONDENSORS**

All units	300m
Cable Ties	Lot
Clamps	50

#### **CORE DRILL FOR REFRIGERANT PIPING**

150mm Core	20
100mm Core	10
75mm Core	10
50mm Core	5

## FRESH AIR SYSTEM

There are two Fresh Air supply systems which serve the following respective areas

AREA BEING SERVE	FLOOR AREA m <sup>2</sup>	AIR QUANTITY L/S
Executive 1	26	40
Executive 2	29	44
Executive 3	22	34
Executive P A	30	45
GMD PA	35	52
Strategic 1	12	18
Strategic 2	12	18
GMD Office	30	45
Executive Board Room	75	150
Pause Area	160	650

## FILTERS

Supply filters as indicate on accompanying drawing

## SUPPLY AIR DIFFUSERS

Supply diffusers as indicate on accompanying drawing, including "False Diffusers" to serve as access hatches adjoining ceiling cassette units installed in flush plastered ceilings

## RETURN AIR GRILLES

Supply grilles as indicate on accompanying drawing. All return air grilles shall be fitted with a plenum to connect on the ceiling concealed units. Grilles shall be white powder coated, with a hinged access door.

## UN-INSULATED DUCTING

Supply and install fresh air supply and toilet extraction ducting as indicated on the accompanying drawing.

## TOILETS AND KITCHEN EXTRACT SYSTEM

### GENTS TOILET- NORTH WING

#### FAN DUTY

466 L/s at 100 Pa	
Type of Fan-	
Size	308
Altitude	1700
RPM	45
Kw	0.26
Silencer	2
Power	240volt

### LADIES TOILET- NORTH WING

#### FAN DUTY

655 L/S at 100 PA	
Type- Axial Flow Adjustable Pitch	
Size	315
Altitude	1700m
RPM	2880
Kw	0.4
POD Silencer	2
Power	380volt

### SWIVEL JET DISC VALVES FOR TOILET EXTRACT SYSTEM- NORTH WING

Size	200 dia
Quantity	11
400 x 400 Door Grilles	6

### UN -INSULATED FLEXIBLE DUCTING FOR TOILET EXTRACT SYSTEMS- NORTH WING

200dia	310
200dia Clamps	25

**TOILET EXTRACT SYSTEM GROUND FLOOR**

**NEW LADIES TOILET- SOUTH WING**

**EXTRACT FAN**

Type	In Line Tube Fan
Model (AMS)	TD 2000/315
Dia.	315
Power Supply	220volt
Motor Power	0.3Kw
Supports	
POD Silencer 315dia	2
200dia to 178dia Red 300	1

**SWIVEL JET DISC VALVES**

Size	200dia
Quantity	9

**TEA KITCHEN EXTRACT- NORTH WING**

**EXTRACT FAN**

Model	
Dia.	250dia
RMP	1500
Power	220volt
Kw	0.3
Electrical Connection to light circuit	



**SITE VISIT**

It is required that a site visit must be undertaken so that you familiarise yourself with the site conditions.

Contact Person: Aileen Heydenreich

Contact Number: 012 305 5336

**QUANTITIES**

The lengths given are provisional subjected to firming up on your site visit

**Proof of Site Visit to be handed in with tender documents. Failure to hand in shall disqualify the tenderer.**

Date: \_\_\_\_\_

Company: \_\_\_\_\_

\_\_\_\_\_

**NTP Representative Signature**

Name (Print): \_\_\_\_\_

\_\_\_\_\_

**Contractor's Representative Signature**

Name (Print): \_\_\_\_\_

**PELINDABA BUILDING C4**  
**GROUND FLOOR NORTH WING AND SOUTH WING AIR CONDITIONING FRESH AIR**  
**SYSTEMS, TOILET EXTRACT AND TEA KITCHEN EXTRACT**

**COST SUMMARY**

1. Ground Floor North Wing Air Conditioning
2. Ground Floor South Wing Air Conditioning
3. Ground Floor North Wing Fresh Air System
4. Ground Floor South Wing Fresh Air System
5. Ground Floor North Wing Toilet Extract System
6. Ground Floor South Wing Toilet Extract System
7. Ground Floor North Wing Tea Kitchen Extract System
8. Ground Floor South Wing Tea Kitchen Extract System

**Sub Total (Excl.)**

--

1. Health & Safety Manual
2. Compliance with OHS act
3. AsBuilt Drawings
4. Operating and Maintenance Manual
5. Supervision
6. Induction
7. 12Months Maintenance and Servicing
8. Electrical COC
9. Contingency Provision
10. Core Drilling

R120 000-00

**Sub Total (Excl.)**

--

**Total (Excl.)**

--

**15% Vat**

--

**Total (Incl.)**

--