MECHANICAL AND FIRE TECHNICAL SPECIFICATIONS AND DESCRIPTION OF WORK

MARITE POLICE STATION

Project Title:	Marite Police Station
Discipline:	Mechanical and Fire
Revision No:	0
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1 PREAMBLE

This document forms part of the contract data and describes the works to be executed by the Contractor in terms of the Contract.
The installations to be executed by direct contractors and others responsible to the employer are excluded.

2 GENERAL NON-TECHNICAL REQUIREMENTS

2.1 DEFINITIONS

The following words and expressions shall have the meanings assigned to them hereunder, except where the context otherwise requires:

Contractor	:	The party contracting with the Employer for the execution of the works as stated in the contract data.
Contract Number	:	TBC
Contract Works	:	The extent of work to be executed by the contractor described in the contract documents and contract instructions, which includes free issue, and materials and goods. Work or installations to be executed by direct contractors and others responsible to the employer are excluded.
Drawings	:	The drawings on which the requirements for the Contract Works are specified and which form part of the Contract Documents.
Employer	:	SAPS Marite Police Station.
Engineer	:	Mechanical, Electrical or Structural Engineer directly appointed by the Employer to provide professional engineering services relating to the project.
Independent Inspector	:	Independent Third Party Employed directly by the Employer to provide statutory inspection services.
Project	:	Marite Police Station
Site	:	Marite Police Station, Bushbuckridge, Mpumalanga
Specification	:	This document in which the requirements for the Contract Works are specified and which forms part of the Contract Documents.

2.2 INTRODUCTION AND GENERAL

2.2.1 Order of Precedence

Should any of the technical requirements in terms of the Specification and the Drawings for the Contract Works be found to be contradictory, the following list of documents, in descending order of precedence, shall apply:

a) Specification
b) Drawings

2.2.2 Contradictory Requirements

Should any requirements of the Specification and/or the Drawings be found to be contradictory, the Contractor shall bring such contradictions to the attention of the Engineer prior to the ordering of Materials and Goods and prior to the execution by the Contractor of any work which may be affected by such contradictions.

2.3 SCOPE OF THE WORKS

2.3.1 Introduction

The scope of work entails installation of the following:

- Heating Ventilation and Air-Conditioning (HVAC)
- Wet services (Water supply and drainage)
- Fire Protection

The works shall be completed in accordance with the terms specified in this technical specification document.

2.3.2 Site Location

The new Marite Police Station will be situated in Marite township within the Bushbuckridge Local Municipality in the Mpumalanga Province. The identified site is situated at the following coordinates:

31°7'25.22'' E, 24°55'56.06'' S

2.3.3 Extent of the Contract Works

The Contract Works included in this Contract document involves:

The supply, delivery, installation (including labour, hoisting, loading, provision of safe access – scaffolding, connection of required services –that is, water as well as electrical and instrumentation controls, plant management system connections provision, etc), testing and commissioning.

2.3.4 Contract Construction Period

The duration of the works shall be as per the project's construction programme.

2.3.5 Type of Contract

Refer to commercial terms.

2.4 SITE CONDITIONS

2.4.1 Access to the Site

To be confirmed after contract award.

2.4.2 Co-operation during construction

The Contractor shall co-operate with all other contractors on site and co-ordinate activities to avoid delays.

2.5 SITE FACILITIES

2.5.1 Site Office

The Employer shall make available a suitable area for the Contractor's site offices, workshops and stores. The Contractor shall advise in his proposal the area required for site establishment.

The Contractor shall make his own arrangements to secure the facilities provided. No employees, apart from a security guard, may be housed on the Site of the Works. Upon completion of the work in terms of this contract, the site must be cleared of all structures, concrete slabs and waste and excavations must be backfilled.

The Contractor must make the necessary arrangements with the Employer to obtain access for the vehicles and personnel he intends to employ on site.

2.5.2 Toilet and Ablution Facilities

Employer's provision of basic toilet and ablution facilities to be confirmed prior to execution of works. Should it however be required of the Contractor to provide its own temporary ablution facilities, the Contractor shall make the necessary arrangement to provide such facilities.

Chemical serviced toilets shall be the minimum acceptable standard. These must be placed in a position to be approved by the Employer. The facilities must be to the Employer's approval and must be maintained in a clean and sanitary condition.

2.5.3 Storage of Materials and Goods

The Contractor shall be provided on Site a suitable store for the temporary storage of Materials and Goods.

Provided that the Conditions of the Contract do not exclude payment for Materials and Goods on Site, but not yet installed, the Contractor will be paid for such Materials and Goods, but only if such Materials and Goods are stored in a proper store.

The location and nature of the store shall be determined on Site in collaboration with the Employer and payment for materials on Site will only be considered if the Employer and Engineer are satisfied that the store will ensure adequate security for such materials. The store shall be removed, and the area cleared to the satisfaction of the Employer on completion of the Works.

2.5.4 Living Quarters

Not required.

2.5.5 Water, Electricity and Sewerage

Water connection point will be provided by the Employer, cost associated with reticulation from connection point to point of use shall be to the Contractors costs.

Electrical connection point will be provided by the Employer, cost associated with reticulation to the site establish area shall be to the Contractors costs.

The Contractor will be required to provide its own construction power by means of generator should the employer be unable to provide.

2.5.6 Communication

The Contractor shall provide his own communication facilities on Site if required.

2.5.7 Weather Conditions

The Contractor shall consider the local weather conditions when planning the Contract Works. The Programme shall allow for the normal weather conditions prevailing at the Site during the construction period.

2.6 CONTRACT ADMINISTRATION

2.6.1 Supervisory Personnel

The Contractor will be required to nominate a responsible person to supervise the Contractor's activities on Site and to act as the liaison officer on the Contractor's behalf. The Engineer will nominate a responsible person who will carry out inspections on Site and act as the Engineer's liaison officer.

2.6.2 Site Meetings

It will be required from the Contractor to attend all Site meetings and inspections. It is a requirement that both the senior foreman on Site and the liaison officer of the Contractor shall attend such Site meetings and inspections.

2.6.3 Contractor's Instructions

All Contractor's Instructions regarding the Contract Works will be noted in the Contractor's site instruction book. However, instructions contained in minutes of meetings or in letters by the Engineer, need not of necessity appear in the site instruction book.

Only instructions issued by the Engineer or approved by him, shall be executed by the Contractor. All instructions resulting in variations to the Contract Works as described in the Specification and on the accompanying drawings, shall be confirmed by means of written variation orders, whether such variations result in cost implications or not. The Contract Sum will only be adjusted once approved official variation orders by the Engineer have been issued.

2.6.4 Employer's and/or Independent Inspector's Representative

The Employer and Consultant are authorised to send an inspector or any other representative to the Site for observation and inspection purposes. Such inspector or other representative will however not be authorised to issue any instructions to the Contractor. The Contractor shall under no circumstances perform work as a result of any instructions from such inspector or other representative, unless the necessary approval therefore is obtained from the Engineer first. No claim for additional compensation as a result of work performed by the Contractor on the instruction of an inspector or other representative of the Employer and/or the Local Supply authority will be considered by the Engineer, unless such instructions were obtained in writing and approved by the Engineer.

The Contractor is strongly advised to request an inspector or other representative for the Employer and/or the Local Supply Authority to get in touch with the Engineer should such inspector or representative require any variation to the Contract Works.

2.6.5 Construction Program

The successful contractor shall be prepared to commence with the execution of the Contract Works immediately after receipt of the Letter of Acceptance. The Contractor will be advised in writing of the actual starting date for the execution of the Contract.

The Contractor will be required to compile a construction program which will include all work related to the Contract Works.

The Programme shall be prepared in consultation with the Principal Contractor and the execution of the Works shall be programmed so as to keep pace with the Building Programme. The Contractor shall submit TWO copies of his Programme to The Engineer for approval and after approval by The Engineer in writing the Contractor shall supply copies to the Principal Contractor. After submission to and approval by The Engineer of such Programme, the Contractor shall adhere to the order of procedure and method stated therein unless he obtains the written permission of The Engineer to vary such order or method. The submission to and approval by The Engineer of such Programme shall not relieve the Contractor of any of his duties or responsibilities under the Contract.

2.7 LAWS, BYE-LAWS, REGULATIONS, STANDARDS AND CODES

2.7.1 Compliance

The Contractor shall be responsible to ensure that the Contract Works comply in full with the requirements laid down by the following laws, regulations, standards and codes of which the latest issues and revisions shall apply:

a) The Occupational Health and Safety Act, Act 85 of 1993
b) Code of Practice for the Wiring of Premises, SABS 0142: 1993
c) The Regulations of the Local Supply Authority
d) The Standard Regulations of any Government Department or Public Service Company where applicable.
e) Specifications and codes by the South African Bureau for Standards where applicable
f) The technical guidelines and/or technical specifications as issued by the relevant Local Supply Authority and applicable to electrical installations within the Local Supply Authority's area of jurisdiction.

2.7.2 Exemption

The Contractor shall exempt the Employer from all liabilities, losses, costs or expenditure which may arise as a result of the Contractor's negligence to comply with the requirements of the laws, bye-laws, regulations, standards and codes specified above.

2.7.3 Contradictions

It is assumed that the Contractor is conversant with the above-mentioned laws, regulations, standards and codes. Should any law or regulation contradicting the requirements of this Specification apply or become applicable during construction of the Contract Works, such law or regulation shall overrule the requirements of this Specification. The Contractor shall immediately inform the Engineer of such a contradiction, if possible, prior to the ordering of any materials affected and prior to the execution of any work affected.

Under no circumstances shall the Contractor carry out any variations to the Contract Works in terms of such contradictions without first obtaining the written permission to do so from the Engineer.

2.8 OPERATION AND MAINTENANCE DOCUMENTATION

2.8.1 Operation and Maintenance Manuals

The Contractor shall submit to the Engineer three (3) complete sets of operation and maintenance manuals, drawings, pamphlets, test certificates and other technical documents which may be required for the maintenance and/or operation of the Contract Works. The copies would be three (3) complete sets in hard copies and three (3) complete sets in electronic format.

2.8.2 Record Drawings

During the construction of the Contract Works, the Contractor shall record the as built conditions on a set of record drawings to be supplied by the Engineer for that purpose. On completion of the Contract Works, the Contractor shall submit a complete set of record drawings to the Engineer.

2.8.3 Handing Over Certificate

The submission of operation and maintenance documentation will form part of the Contract Works and the Handing over Certificate will not be issued unless acceptable and complete documentation had been submitted to the Engineer.

2.9 PROJECT BOARD

Not required.

3 GENERAL TECHNICAL REQUIREMENTS

3.1 QUALITY OF MATERIALS AND EQUIPMENT

All materials and equipment to be supplied in terms of this Contract shall be new and unused. Where specific manufacturers' materials or equipment were not prescribed in the Specification, Materials and Goods supplied shall be of the best quality available. Preference shall be given to materials of South African manufacturer and in particular to materials bearing the SABS mark of quality.

The Engineer reserves the right to call for the replacement of any materials found on Site which do not conform with the above requirements, provided that alternative materials which do conform with the above requirements are available. Any such replacements shall be affected by the Contractor at his own cost and the cost shall not be recoverable from the Employer or the Engineer.

3.2 DELIVERY OF MATERIALS AND EQUIPMENT

The Contractor shall ensure that all materials and equipment required for the completion of the Works, shall be timeously ordered and delivered. Delivery dates and possible delays shall be established at an early stage. No claims for extension of the Contract period as a result of delays in delivery of materials shall be considered by the Engineer, unless such delivery periods are in excess of the Contract Construction Period.

3.3 FINISHES ON MATERIALS AND GOODS

3.3.1 General

All Materials and Goods to be supplied for the Works, shall have durable finishes to withstand the weather conditions on Site for acceptable periods of time. The Contractor shall exercise care regarding Materials and Goods to be utilised in corrosive areas.

The types of finishes required on various Materials and Goods are specified in the relevant sections of the Technical Specification.

In the event of painting, baked enamel and electrostatically applied powder coating, the metal surface shall be prepared as follows prior to painting. All sharp edges shall be smoothed and rounded to ensure that the finishing layer(s) will adhere properly to the entire metal surfaces. Surface preparation shall comply with the requirements of SABS 064. All metal parts shall be thoroughly cleaned of corrosion, mill scale, grease and foreign matter to a continuous metal finish. Sand or shot blasting or acid pickling and washing shall be employed for these purposes.

3.3.2 Finishes

The following terms will be used to specify the required finishes and are defined as follows:

a) Painting:

In the event of ungalvanized metal work, one layer of approved zinc chromate

undercoat conforming to the requirements of the SABS 679, Type 1, shall be applied immediately after cleaning is competed and the metal properly dried.

The undercoat dry film thickness shall measure at least 125 microns. Once the undercoat layer has dried for a period of minimum 24 hours, the first of two final coats of high gloss paint shall be applied. The paint shall conform to the requirements of SABS 630, Grade 1. The dry film thickness for each coat shall be minimum 25 microns, resulting in an overall paint dry film thickness of at least 75 microns. In highly corrosive areas or in areas with 50 km from the cost, the paint thickness shall be increased so that the total dry film thickness shall be at least 120 microns.

In the event that painting of galvanised metal work is required, the galvanised metal shall be treated with a passivate coating and then washed with water and dried. Thereafter one coat of calcium plumage undercoating complying with the requirements of SABS 912 shall be applied, followed by one coat of approved undercoat conforming to the requirements of SABS 681, Type 2. Once the undercoat has dried for a period of minim 24 hours, the first of two final coats shall be applied. The paint shall conform to the requirements of SABS 630, Grade 1. The dry film thickness for each coat shall be minimum 25 microns, resulting in an overall paint dry film thickness of at least 75 microns.

In the event that painting of aluminium is required, one coat of self-etching primer, conforming not the requirements of SABS 723 (Plascon Hi-Sheen or similar and equal) shall be applied immediately after the cleaning is completed and the metal properly dried. Once the primer has dried for a period of minimum 24 hours, the first of two final coats shall be applied. The paint shall conform to the requirements of SABS 630, Grade 1. The dry film thickness for each coat shall be minimum 25 microns, resulting in an overall paint dry film thickness of at least 75 microns.

Paint thickness shall be determined in accordance with the SABS 140 or 141 methods.

b) Baked enamel:

Immediately after cleaning, all surfaces shall be covered by a tough, corrosion inhibiting, unbroken, metal phosphate film and then properly dried. Within forty-eight (48) hours after phosphatising, a passivating layer, consisting of a high-quality zinc chromate primer shall be applied, followed by two coats of high-quality alkyd based baked enamel paint. The enamel finish shall comply with the requirements of SABS 783, Type IV. The minimum dry film thickness shall be 75 micron and in coastal areas the dry film thickness shall be increased to at least 120 microns. The paint finish shall further have an impact resistance of 5.65 J on cold rolled steel plate and a scratch resistance of 2.0 kg.

c) Galvanising

All galvanising shall be of the hot dip process and shall conform to the requirements of SABS 763. All completed galvanised structures shall either bear the SABS mark of approval or shall be accompanied by a certificate by the galvanising company to confirm that the galvanising conforms to the requirements of the SABS 763. It will be the Contractor's responsibility to obtain and submit such certificates to the Engineer and pay all costs in such regard. Should the Engineer at his own discretion prefer to have the galvanising evaluated by the SABS and the SABS should find that such galvanising does not conform to the requirements of the SABs 763 specification, the Contractor will be instructed to have all suspect structures re-galvanised at his own costs. In addition, the Contractor will be liable for all costs incurred by the Employer and the Engineer during the process of evaluation by the SABS and the re-galvanising

process.

Prior to galvanising, the metal work shall be designed and prepared to ensure thorough liquid zinc coverage of all metal surfaces, both inside and outside, and to prevent undue distortion of the metal structure due to the heat of the hot dip process. The metal structure shall be prepared with all drilling, welding, punching, cutting, bending and other forming processes completed prior to galvanising. Furthermore, all welded seams shall be inspected for suitability and properly prepared prior to galvanising.

In the event that the galvanising finish should get damaged after galvanising and prior to the first handover of the Contract, the Contractor will be liable to repair such damage at his own cost and to the satisfaction of the Engineer. Repairs shall be the form of either re-galvanising or on site repairing. On site repairing shall be by means of soldering or preferably hot zinc spaying in accordance with SABS 763, as called for by the Engineer at his own discretion.

3.4 OPERATING CONDITIONS

All materials and equipment supplied by the Contractor and all installation methods applied by the Contractor shall be suitable for the following operating conditions.

3.4.1 Environmental Conditions

Altitude above sea level	:	1700 m
Summer	:	31.7°C DB and 17.8°C DB
Winter	:	3.9°C DB

3.4.2 Electrical Conditions

Supply voltage	:	low voltage
	:	420V ±6% line voltage 242V ±6% phase voltage frequency:50 Hz

3.5 EXISTING SERVICES

The Contractor shall exercise care to avoid any damage to existing services. The Contractor will be liable for the costs involved to repair any damage inflicted upon existing services by the Contractor or his personnel. Such repairs may not be undertaken by the Contractor unless approved by the Employer, since such existing services may still be under guarantee and any interference by the Contractor with such services may nullify such guarantees. All damage shall therefore be reported to the Engineer who will arrange for the repairs of such damage.

The Contractor is however strongly advised to insist on written quotations in respect of repairs to damage prior to the undertaking of such repairs.

The Engineer reserves the right to issue variation orders on this Contract to omit any costs due to repairs made by others.

3.6 ELECTRICAL SUPPLY

3.6.1 Connection Point

The connection point shall be determined on site and confirmed with the Employer.

3.6.2 Application for electricity Connection

Not required.

3.7 REPAIRS AND CLEARING

3.7.1 Repair of Incidental Damage

The Contractor shall be liable for the repair of any incidental damage caused by the Contractor or his personnel on Site. Such repairs shall be affected to the satisfaction of the Engineer and the Engineer reserves the right to call for the replacement of any items which are badly damaged. All such repairs and replacements shall be affected at the cost of the Contractor.

3.7.2 Clearing

On completion of the Contract Works, the Contractor shall clear away and remove from Site all excess materials resulting from the execution of the Contract. The Contractor shall further tidy and clean the Site to the satisfaction of the Engineer.

4 TECHNICAL SPECIFICATION

4.1 Definitions and Abbreviations

Definitions of terms used herein:

"Provide"	To supply, install, connect and hand over complete and ready for safe and regular operation of particular work referred to unless specifically indicated otherwise.
"Install"	To erect, mount and connect, complete with all related accessories.
"Supply"	To purchase, procure, acquire and deliver, complete with all related accessories.
"Work"	All labour, materials, equipment, apparatus, controls, accessories and other items required for correct and complete installation.
"Piping"	Pipe, tube, fittings, flanges, valves, controls, strainers, hangers, supports, accessories, drains, insulation and all related items.
"Wiring"	Conduit, fittings, wire, junction and outlet boxes, switches, cut-outs, socket outlets and all related items.
"Concealed"	Embedded in masonry or other construction, installed in furred spaces, within double partitions or hung ceilings, in trenches, in crawl spaces or in enclosed spaces.
"Exposed"	Not installed underground or concealed as defined above.
"Indicated", "Shown" or "Noted"	As indicated, shown or noted on drawings and/or specifications.
"Similar" or "Equal"	Of approved manufacture, equal in weight, size, design and efficiency of performance of the product specified or mentioned by name.
"Approved", "Satisfactory", "Accepted"	As approved, satisfactory or accepted by the Engineer and Employer.
"SABS"	South African Bureau of Standards.
"BSI"	British Standards Institution.

"ASHRAE"	American Society of Heating, Refrigeration and Air Conditioning Engineers.
"ASME"	American Society for Testing Materials.
"ASA"	American Standards Association.
"NBS"	National Bureau of Standards (U.S.A.).
"NEMA"	National Electrical Manufacturers Association.
"NFPA"	National Fire Protection Association.
"SANS"	South African National Standards.

4.2 WET SERVICES INSTALLATIONS

4.2.1 Professional Requirements

To ensure acceptable standards of delivery all tenderers must comply with the following criteria:

- Proof of registration with professional body / bodies e.g.: Plumbing Industry Registration Board.
- Trained Plumber: Licensed Plumber responsible for supervision of the installations.

If a prospective bidder is compliant to specific ISO standards, proof of such certification needs to be provided, e.g. Management System Standards (ISO 9001, ISO 14001), Occupational Health And Safety Management Standard (ISO 18001 / OHSAS 18001), etc. (this is however a non-mandatory requirement). Further membership of any other technical governing bodies or applicable institutes may be provided.

4.2.2 Scope of Works

The proposed Wet Services installation shall only be for the internal domestic and sewer reticulation.

Excluded from this scope are:

- Bulk sewer disposal
- Irrigation
- Storm water including roof drains

The following building areas of the new Marite Police Station will receive new plumbing and drainage installations:

- Admin Block
- Cell Block
- Living Quarters
- Refuse Block

The contractor shall ensure that he is conversant with the layouts of the building and of other services before he commences with any work on these buildings.

Any challenges that the contractor may experience during the contract period must be timeously discussed with The Engineer.

All the work shall be carried out in full conformance with these project specifications.

4.2.3 Codes and Standards for Wet Services Installations

Installations shall be designed and constructed to meet the following standards:

Unless otherwise specified further in this specification, the following standard specifications (Including amendments) of the organizations indicated shall form part of this specification.

- SANS 10252-1:2016 Water Supply and Drainage of Buildings - Part 1: Water supply installations for buildings.
- SANS 10252-2: 1993 Water Supply and Drainage of Buildings - Part 2: Drainage installations for buildings.
- SANS 21003-1/ISO 21003-1, Multilayer piping systems for hot and cold-water installations inside buildings – Part 1: General.
- SANS 21003-2/ISO 21003-2, Multilayer piping systems for hot and cold-water installations inside buildings – Part 2: Pipes.
- SANS 204 - Energy efficiency in buildings.
- SANS 10254:2012 Edition 4 - The installation, maintenance, replacement and repair of fixed electric storage water heating systems.
- SANS 1733, WC flushing systems (low-flushing capacity) that operate with flushing cisterns.
- SANS 1808-5, Water supply and distribution system components – Part 5: Flexible connectors.
- SANS 1808-9, Water supply and distribution system components – Part 9: Metering taps and valves (metallic bodies).
- SANS 1808-10, Water supply and distribution system components – Part 10: Copper alloy check valves (spring-loaded).
- SANS 1808-15, Water supply and distribution system components – Part 15: Mechanical backflow-prevention devices.
- SANS 1808-44, Water supply and distribution system components – Part 44: Pipe saddles.
- SANS 1808-58, Water supply and distribution system components – Part 58: In-line strainers.
- SANS 1808-66, Water supply and distribution system components – Part 66: Demand type water taps.
- Recommendations of the Plumbing Industry Registration Board (PIRB).
- SAPS Project Five Star 2012.

4.2.4 Hot and Cold Water Supplies

- Water piping systems shall as far as reasonably practical follow the routes indicated on the relevant Drawings. It should be noted the installation if note green field, but already has existing cold and hot water pipe lines installed. The Sub-Contractor is required, prior to installation of new pipework, assess the existing installation configuration, condition of the pipework and advise the Engineer of any identified opportunity for design and construction optimization.
- Piping shall be arranged to maintain sufficient headroom, keep access ways unobstructed and not interfere with maintenance and adjustment of valves and equipment. The system shall be complete in all details and provide for all central valves and accessories necessary for satisfactory operation.
- All piping passing through wall or under floor should be sleeved with a sleeve of internal diameter of at least 15mm plus the outside nominal diameter of such portion. The sub-Contractor should provide for the expansion in pipework above ground.
- The sub-Contractor is referred to clause 9, SANS 10252-1 for the procedure to clean, inspection, testing and disinfection
- Where pipe sizes are not indicated on the drawings, pipes shall be sized for a maximum water velocity of 2.5 m/s within the Plant Areas/ Pump Station and a maximum of 2 m/s for piping extending between the Plant Areas/ Pump Station and the fire hydrants and fire hose reels.
- All copper alloy components in contact with potable water shall comply with the minimum standard when tested in accordance with SANS 6509. The maximum penetration shall not exceed 250µm.
- The copper requirements deemed to be acceptable:
    - Copper tubes recommended in SANS 460 for the design conditions,
    - Solders, fluxes and the method of soldering described in SANS 460 and the manufacturer's instructions,
    - Copper-based fittings for copper tubes that comply with the requirements of SANS 10671, or SANS 1067-2, as relevant
    - Class O and class 1 copper tubing shall not be bent or formed in any manner during installation or installed underground.
    - Copper tubing should be free from carbon residues in the bore where the supply water can support localized pitting corrosion.

- All SANS standards for plastic polymer piping system for hot and cold-water supplies are approved for use inside buildings only. All plastics pipes used in hot and cold-water installations near external doorways and windows shall be protected from sunlight. Unlike metal pipes (steel and copper) that have generic pipe and fitting standards, thermoplastic pipe systems are required to be installed using the fittings and tools that are tested and approved as a complete system, The use of pipes, fittings and tools from other manufacturers or suppliers, that are not the same as the approved system, shall not be acceptable.

- Long radius bends shall be used wherever possible, elbows only being permissible where limited space dictates their use. Reductions in pipe sizes shall be effected with reducing sockets, bushing reducers not being permissible. Threaded fittings shall be malleable iron to B.S.S. 143 or wrought steel to B.S.S. 1740:1971 as relevant. Welded fittings shall be genuine butt-weld fittings, to ASTM A234 GR.WPB-Dimensions to BS1640 or ASA B16.9 it not being permissible to weld threaded fittings.

Plastics pipes or fittings should not be laid beneath areas where spillage of oils, fuels, creosote or other hydrocarbons is likely to take place, unless such pipes or fittings are laid inside an impermeable sleeve or duct.

4.2.5 Drainage

a) Material And Gradients

The following material should be used for the different pipes:

i. Underground drain pipes –uPVC SABS 791,
ii. Surface pipes:
- Soil stacks and vent pipes - uPVC SABS 791,
- Waste pipes - uPVC SABS 791,
- Anti-siphon pipes - uPVC. The use of uPVC surface pipes is subject to certain conditions and the engineer must be consulted on this matter.

b) Installation of Drains

Where any drain is constructed adjacent to or under or through a structural part of any building, adequate measures must be taken to ensure that the trench in which such drain is laid in no way impairs the stability of such building or the stability of any other building or interferes with or affects any existing services.

Any drain shall be of such strength, having regard to the manner in which it is bedded or supported, so that the maximum loads and forces to which it may normally be subjected will be sustained by it and it shall where necessary be protected against damage.

The requirements contained above shall be deemed to be satisfied if either of the following is complied with:

i. The minimum cover over the outside of the drain is not less than 300 mm or
ii. Precast or cast-in-situ concrete slabs are placed over the drain, isolated from the crown of the pipe by a soil cushion not less than 100 mm thick and such slabs are wide enough and strong enough to prevent excessive superimposed loads being transferred directly to the pipes.

Any drain shall;

- Be laid in a straight line between any points where changes of direction or gradients occur.
- Be laid with approved flexible joints which will permit joint movement to take place throughout the life of the drainage installation.
- Withstand root penetration and not deteriorate when in contact with sewage or water, and will not cause any obstruction in the interior of such drain.
- Be laid at a minimum gradient of 1:60 for 100 Ø and 1:100 for 150 Ø pipes. However the Project Manager may in his discretion permit gradients less than those specified above.
- Where the gradient exceeds 1:5 it must be provided with anchor blocks which must securely fix such drain in place.

Where any portion of a drain passes under any building such portion shall:

- Be of uPVC SABS 791,
- Be laid without change of direction or gradient.

- Not be provided inside such building with any means of access for cleaning.

Where any portion of a drain passes through a building such portion shall be:

- Be of uPVC SABS 791,
- Supported throughout its length without restricting thermal movement and such support must be securely attached to the building.
- So placed that any junction, bend or any point of access into it is readily accessible.

Where any drain has a branch drain connected to it, such connection shall:-

- be by means of a junction fitting which shall not be a saddle junction. Enable the flow from such branch drain to enter the drain obliquely in the direction of flow so that the included angle between the axes of the two drains does not exceed 45°.

c) Inspection eyes should be provided

- at all junctions (except those of vent pipes) and bends in the drainage system;
- within 0,5m downstream of each cleaning eye;
- above and below each vertical or sloping ramp and
- Above each ramp to an inspection chamber.

d) Cleaning Eye (CE)

Cleaning eyes should be provided:

- above ground at each junction and bend of all soil and waste pipes;
- underground at not more than 25m for a 100mm drain;
- at the head of each branch drain longer than 3m;
- at each ramp.

4.3 HEATING VENTILATION AND AIR-CONDITIONING (HVAC)

4.3.1 Professional Requirements

To ensure acceptable standards of delivery all tenderers must comply with the following criteria:

- SARACCA (South African Refrigeration and Air-conditioning Contractors).
- Trained Technicians and Artisans

If a prospective bidder is compliant to specific ISO standards, proof of such certification needs to be provided, e.g. Management System Standards (ISO 9001, ISO 14001), Occupational Health And Safety Management Standard (ISO 18001 / OHSAS 18001), etc. (this is however a non-mandatory requirement). Further membership of any other technical governing bodies or applicable institutes may be provided.

4.3.2 Scope of Works

The following building areas of the new Marite Police Station will receive new HVAC installations:

- Admin Block
- Cell Block

- Living Quarters

4.3.3 Codes and Standards for HVAC Installations

Installations shall be designed and constructed to meet the following standards:

The design and installation shall be done in line with the applicable local and international standards, codes, and regulations for HVAC systems.

i. Client Specifications (SAPS Project Five Star 2012)

ii. South African National Standards (SANS), e.g.
   - SANS 10400-O: 2011 - Lighting and ventilation.
   - SANS 1238:2005 - Air-conditioning ductwork.
   - SANS 1424:1987 (2001-11-07) - Filters for use in air-conditioning and general ventilation.
   - SANS 10147:2002 - Refrigerating systems including plants associated with air-conditioning systems.
   - SANS 10173:2003 - The installation, testing and balancing of air-conditioning ductwork.
   - SANS 10400:1990 - The application of the National Building Regulations.
   - SANS 60730-1:2007 / IEC 60730-1:2007 - Automatic electrical controls for household and similar use Part 1: General requirements.
   - SANS 10400 - The application of the National Building Regulations Local Authority's codes and by-laws.

iii. American Society of Heating, Refrigerating and Air-Conditioning Engineers (ASHRAE) Standards.

iv. IUSS Building engineering services, 17-February-2014

4.3.4 Ambient Design Conditions

Altitude above sea level	:	1700 m
Summer	:	31.7°C DB and 17.8°C DB
Winter	:	3.9°C DB

The above conditions are the mean average maximum and least temperatures recorded in the area which are normally not exceeded on more than ten days in a year.

4.3.5 Inside Controlled Conditions

For the air-conditioned office**:**

Summer	22.5 °C DB
Humidity	50% RH (approximately)
Winter	20 °C DB

For the air-conditioned wards:

Summer	22 - 25 °C DB
Humidity	40% - 70% RH (approximately)
Winter	22 °C DB

The air-conditioning system servicing sections of the building shall ensure 12 ACH (Air Changes per Hour) air-conditioned fresh air supply and the pressure relative to adjacent areas shall be negative for Wards Area.

The above temperatures are those at which many people are comfortable, as indicated on a Comfort Chart. The relative humidity would not be positively controlled but would be indirectly controlled within the comfort range as a function of the design and choice of the cooling plant. The temperatures would be controlled within a tolerance of ± 1.5°C, i.e. greatest temperature=26.5 °C DB.

4.3.6 Ventilated Area

Ablutions:
Extraction at 10 air changes per hour. No heating or cooling has been allowed for.

Storeroom and stockroom:
Extraction at 10 air changes per hour. No heating or cooling has been allowed for. The areas will be at ambient temperature.

4.3.7 Filtration

- Fresh air will be filtered with a Primary filter to EN779 Classification G4 and a Secondary filter to EN779 Classification F9.
- All ductwork between the filter housing and the air terminal shall be of rigid medium pressure ducting (SANS 10173 - The Installation, Testing and Balancing of Air-Conditioning Ductwork) construction.
- All extraction ductwork shall be rigid high-pressure ducting.

4.3.8 Equipment Specification

The AC (Air Conditioning) units to be installed shall be of inverter type split units of a known make such us LG, Daikin, Samsung, Jet Air, York etc…The manufacturer brand is subject to the Engineers' approval after submission of data sheet and prior to procurement.

The table below presents the technical specifications of midwall split ac units to be installed.

Item	Description	Quantity	Location	Cooling Capacity
MSU-01	Midwall Split Unit	1	Admin Block	12000 BTU/hr / 3.5 kW
MSU-02	Midwall Split Unit	9	Admin Block, Cell Block & Living Quaters	18000 BTU/hr / 5.28 kW
RFCU-01	Round Flow Cassette Unit	4	Admin Block	24000 BTU/hr / 7.03 kW
CU-01	Console inverter	29	Admin Block	12000 BTU/hr / 3.5 kW

	Unit			
CU-02	Console inverter Unit	2	Admin Block	18000 BTU/hr / 5.28 kW
DU-01	Dehumidifier Unit	3	Admin Block	-
ACU-01	Air Curtain Unit	2	Admin Block	-

4.3.9 System Requirements

Indoor Unit (Evaporator)

The indoor unit shall be complete with cooling coils, drip trays, collector trays, drain connectors, defrosting arrangement if required, supporting arrangement, etc.
The unit shall be complete with air purifying filter, power plug, inlet grille, mould proof air filter, remote signal receiver and adjustable louvers for air flow.
The unit shall have a filtration with an ionizer which it will assist to reduce dust levels in the air and the filter should have a narrow opening, that it will limit the amount of dust that can pass through the filter whilst the ionizer produces negatively charged ions which help attract positively charged dust particles they come in contact with.
The expansion valve/ capillary and other accessories and fittings shall also be provided with drip trays to avoid the chances of sweat water dropping down to the floor shall be fitted.
The evaporator unit shall be so designed that, it affords easy access for cleaning the drip tray, cooling coil, etc. The cooling coils shall be of copper tubes and aluminum fins. The fan guards shall be of plastic-coated steel construction.
The condensate water within the housing, shall be routed to the nearest drainage system. The drainage system will normally consist of a drain line or condensate line, a drainage pan with float switch.
The layout or the routing of condensate drain lines shall be such as not to leak within wall cavities and ceilings. It is also important to note that condensate drain lines can create condensate if not properly insulated. This can also result in minor staining to ceilings and walls where the drain line passes through, thus, precautions shall be taken when installing.

Outdoor Unit (Condenser)

The outdoor unit shall be fitted with compressor that operate from power supply and the outdoor unit shall be fitted with suitable mountings for medium vibration and noise free operation.
The unit shall be complete with suction and discharge shut off valves, relief valve, safety devices and internal and external overload protection, piping, electrical wiring, signal receivers, the air inlet and outlet, drain hose connection etc.
Outdoor unit shall be of a factory-built item, comprising condenser coil, fan motor, drive, casing and supporting stand or concrete base if required. Condensers shall incorporate fans of adequate size to obtain the required air flow rate under site operating conditions.
Suitable interlocking wiring shall be included to ensure that, the compressor cannot be switched on before the condenser fan.
The fans shall be balanced both statically and dynamically. Bearings specifically suited for outdoor operation of the condenser shall be used for the fan motors.

Refrigerant Piping

The sizing of refrigerant piping shall be done according to the air conditioning manufacturer's requirements, considering equivalent pipe length and height difference

between indoor unit (evaporator) and outdoor unit (condenser).
Refrigerant Piping interconnecting the outdoor unit (condenser) and indoor unit (evaporator), during welding of refrigerant copper piping, the Contractor shall take necessary measures 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.
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.
All refrigerant piping must be pressure tested in accordance with the relevant standards and the system pressure must be monitored. An approved leak testing method must be used to find leaks. In case where a leak repair has been performed, pressure test must be repeated.

All pipework to be carried out in refrigerant quality soft/medium drawn copper tubing to BS EN14276:2007 or latest and complete with the appropriate headers, joints, and fittings.
All pipework shall be insulated with slip on closed cell elastomeric pipe insulation with a fire performance, according to building regulations. An insulation branch pipe connection is to be by the pre-formed foam insulator supplied with the unit. Continual vapour seal between this insulator and the pipe insulation is to be completed after pressure testing.
Brazing shall be carried out to the requirements of HVAC Code of Practice Brazing and Bronze Welding of Copper Pipe. Refrigerant R32 charge weight must be calculated to the actual installed length of pipework in accordance with the manufactures recommendations and all refrigerant piping shall be well saddled and secured to minimize vibration of piping. Pipework to be properly fixed and supported where required shall be run on galvanized trays. All pipe work to be labeled. All pipes shall be de-burred and cleaned after being cut. Pipework shall be pressure tested according to BS EN378 or equivalent specification.

4.4 FIRE PROTECTION

4.4.1 Professional Requirements

To ensure acceptable standards of delivery all tenderers must comply with the following criteria:

- Proof of registration with professional fire protection body / bodies e.g.: SAGCC Fire
- Trained Technicians and Artisans.

If a prospective bidder is compliant to specific ISO standards, proof of such certification needs to be provided, e.g. Management System Standards (ISO 9001, ISO 14001), Occupational Health And Safety Management Standard (ISO 18001 / OHSAS 18001), etc. (this is however a non-mandatory requirement). Further membership of any other technical governing bodies or applicable institutes may be provided.

4.4.2 Scope of Work

The fire protection scope of work includes the installation of firefighting equipment (Fire hydrants, hose reels, extinguisher), firefighting equipment signages, emergency evacuation signages and fire detection system. The following building areas of the new Marite Police Station will receive new plumbing and drainage installations:

- Admin Block

- Cell Block
- Living Quarters
- Refuse Block
- Site

4.4.3 Codes and Standards for Fire Installations

Installations shall be designed and constructed to meet the following standards:

The design and installation shall be done in line with the applicable local and international standards, codes, and regulations.

i. South African National Standards (SANS), e.g.

SANS 10139 - Fire Detection & Alarm Systems for Buildings, System Design, Installation and Servicing, 2007 Edition.

SANS 10400-O: 2011 - Lighting and Ventilation.

SANS 10400-T: 2011 - Fire Protection

SANS 10400 – The Application of the National Building Regulations Local Authority's codes and by-laws

SANS 10400 – W: Fire Installation

ii. Life Safety Code based on NFPA 101

iii. Local Authority – Emergency Services requirements for rational fire design

iv. SFPE - Handbook of Fire Protection Engineering, 2nd edition.

v. EN 12101 - Smoke and heat control systems.

vi. NFPA 170 - Standard for Fire Safety Symbols, 2002 edition.

vii. NFPA 220 - Standard on Types of Building Construction, 1999 edition.

viii. SAPS Project Five Star 2012

4.4.4 Fire Protection Specifications

The specification of fire protection system to be procured, supplied and installed by the Contractor is as follows:

- The fire hydrants, hose reels and extinguishers installations shall be installed in line with the following codes:
    - SANS 10400 - The Application of the N.B.R, 1990, latest edition.
    - SANS 543 - Fire Hose reels (with semi-rigid hoses), latest edition.
    - SANS 1128 - Fire Fighting Equipment, parts 1 and 2, latest edition.
    - SANS 1151 - Portable Rechargeable Extinguishers, latest edition.
- Large open spaces must be fitted with fire hose reels with a 30-metre length of hose to be connected to the 100mm diameter hydrant main and installed at a rationalized approach of using reach as opposed to the prescriptive approach of 1 hose reel per 500 m2 of floor area.

- The nozzle of each hose reel must reach to all parts of the open plan. The hose reels shall be mounted at an approximate height of 1.5 metres, measured from the finished floor level to the centre line of the drum.
- All pipework to hose reels to be medium quality black pipe with the following diameters:
    - 25mm where the pipe serves 1 or 2 hose reels.
    - 32mm where the pipe serves 3 hose reels.
    - 40mm where the pipe serves 4 or 5 hose reels.
    - 50mm where the pipe serves more than 5 hose reels.
- Fire hydrants in the building shall be provided at a rate of not fewer than one per 1000m2 and shall comply with the requirement of SANS 1128-1.
- 2 x 4.5 kg Dry chemical powder fire extinguisher shall be securely mounted inside each hose reel and hydrant cabinet. 2 kg, 5 kg, and 10 kg carbon dioxide fire extinguishers shall be installed in plant / electrical rooms and special risk areas.
- The fire extinguishers shall be mounted on wooden backing boards at an approximate height of 1.3 metres, measured from finished floor level to the top of the fire extinguisher.
- In all cases, adequate unobstructed access shall be provided to all fire equipment. This includes 4.5kg Dry Chemical Powder (DCP) and 5kg CO2 fire extinguishers.
- Fire extinguisher installations shall be installed in line with the code SANS 1128 – Fire Fighting Equipment and SANS 1151 – Portable Rechargeable Extinguishers.
- Individual fire extinguishers shall be provided at a rate of one per 200m2.
- The fire water storage capacity shall be capable of running one fire hydrant and one fire hose reel for up to 120 minutes.
- All firefighting equipment, fire escape routes and exit doors must be clearly indicated by means of photoluminescence symbolic signs securely mounted, without the use of adhesives.
- Photoluminescent statutory emergency signs to comply with SANS 1186: Part 1 and 5.
- Escape doors may only be fitted with approved locking devices.
- All fire doors to comply with SANS 1253 and be provided with self-closing devices.
- All escape doors discharging to the outside are clearly identified from the exterior of the buildings/ tenancies by signs stating, "FIRE EXIT KEEP CLEAR".
- The fire signage shall be sized as per below guideline:
    - 150 x 150mm for less than 8-meter viewing distance,
    - 190 x 190mm for 10 to 20 meters viewing distance,
    - 290 x 290mm for 20 to 30 meters viewing distance,
    - 440mm and Larger for viewing distance more than 30meters.

4.5 DRAWINGS

These clauses are relevant to all of the mechanical and fire installations.

4.5.1 Engineering drawings

The consulting engineer's drawings are not to be used for manufacturing or installation purposes. Copies of Engineers drawings may not be used by the contractor for purposes of producing working drawings without the permission of the Engineer.

The Contractor will be required to keep a separate set of all approved drawings on site and to continually "mark-up" any alteration, additional information in order that he can produce "as installed" drawings.

4.5.2 Contractor's Responsibility

The contractor shall produce all required drawings for the execution of the contract, including any additional details that may be requested by the engineer. The contractor shall be responsible for the design, location and dimensioning of the installation.

Verification that the positioning or location of equipment, opening sleeves, penetrations, ducting, piping, etc. do not clash with other services is the responsibility of the contractor.

4.5.3 Standards

General arrangement, installation and layout drawings will be prepared to a standard engineering scale.
Enlarged details prepared for clarification shall be drawn to a scale of 1:20 or 1:10.
The smallest drawing sheet size consistent with clarity and un-ambiguity selected from the following shall be used: A0 / A1 / A3.

4.5.4 Approval

The contractor shall not issue any original or revised drawings, to any parties, for information, manufacture, installation or for any other reason, unless such drawing has been checked by and stamped with the Engineer's mark of approval.

The Engineer will check drawings for correctness and compliance with design only. Physical sizes and correct location of equipment and components shall remain the responsibility of the contractor.

Corrections or comments made on drawings by the Engineer do not imply a change in the "Scope of Work". The contractor shall inform the Engineer immediately, in writing, prior to modifications to the original drawings, whether in his opinion such corrections and comments will result in a change to the "Scope of Work".

Three (3) prints of each drawing submitted for approval are required. The corrected print will be returned to the contractor and shall be dealt with in accordance with the Engineer's stamped requirements.

4.6 CONTRACT MANAGEMENT OF MECHANICAL & FIRE CONTRACTS

4.6.1 Co-Operation with the Employer and Other Contractors

Render full co-operation to the Employer and to other Contractors. Provide any information necessary to permit work of all trades to be installed satisfactorily and without interference or delay.

Where work is to be installed in close proximity to work of other trades, or where there is evidence that work may interfere with work of other trades, assist in resolving co-ordination issues to make satisfactory adjustment prior to preparation of shop drawings.

4.6.2 Supervision

In addition to the requirements of the Conditions of Tender and Conditions of Contract, the Contractor shall supply the services of an experienced and competent Contract Supervisor to be in constant charge of work at site.

4.6.3 Handling of Equipment

The Contractor shall investigate each space through which equipment must be moved or handled. Where necessary, equipment shall be transported from manufacturer in crated sections of size suitable for moving through restricted spaces available.

4.6.4 Temporary Use of Equipment

No equipment intended for permanent installation shall be operated for temporary purposes, without the written permission of, and in complete agreement with stipulations, as set for by the Engineer.

4.6.5 Storage of Materials

In addition to the requirements of the Conditions of Tender and Conditions of Contract, the following shall apply:

Materials permitted to be stored within building shall be safely stacked and shall not overload floor construction beyond the legal permissible floor loading.

Combustible materials shall not be stored on premises longer than minimum period necessary for execution of work. Provide fire protective measures as directed by Engineer.

4.6.6 Handover Inspections

The Contractor must allow for reasonable assistance to the Engineer during the following inspections:

The installation will be inspected by the Engineer on a regular basis during the course of the Contract to ensure compliance with this specification. A written record will be kept of all defects noted.

The Contractor shall provide a competent person to accompany the Engineer or his representative during inspections. This person shall know the installation, shall be in a position to accept and carry out instructions and shall take notes during the inspections so that the remedial work can commence immediately and is not held up while waiting for the inspection certificate.

On completion of the contract works, final physical inspections will be carried out as commissioning proceeds. Any deviation from specification or below standard workmanship is to be rectified to the satisfaction of the Engineer by the Contractor, prior to requesting a Certificate of Practical Completion.

The Contractor must replace any portion of the installation that does not meet with the requirements of this Specification as may be imposed thereon by test or inspection. Such replacements shall be done at his own cost.

A certificate of Practical Completion will be issued when the contract works are to all intents

and purposes complete, commissioned and available for beneficial use by the Employer. (The date of this Certificate will determine the commencement of the guarantee period.)

A Certificate of Final Completion will only be issued when all defects listed at the time of partial completion have been complied with. The issue of this Certificate will coincide with certification of payment of the full contract sum (excluding retention).

The Contractor must ensure that the installation is correct, complete and to specification before calling for acceptance inspections.

Recording charts of all tests by the Contractor must be submitted to the Engineer before applying for acceptance inspections.

The cost of any abortive inspections, where the Engineer is called to site, but finds the Contractor ill-prepared for it, may be deducted from the Contract Price by Variation Order.

The Engineer can request that any part of the system of the complete system be retested, recorded and measured as part of the acceptance inspections if there exists reasonable doubt about the accuracy of the test.

4.6.7 Guarantee

The Contractor shall guarantee the material, apparatus and workmanship delivered by him for a period of twelve months. The guarantee must be valid for a period starting on the date when the Contract is accepted by the Engineer as complete and in working condition.

The complete installation must be guaranteed against defects as a result of patent and latent defects of the design and apparatus, (save design defects made or specified by the Engineer), as well as against faulty materials and workmanship. The guarantee must provide that all parts, spares and appurtenances that become defective during the guarantee period be replaced free of charge.

The costs of labor and transportation required to replace such part of a defective installation shall be borne by the Contractor and shall be included in his guarantee. The Contractor shall cede to the Employer the remainder of any equipment guarantee, which he has received from his suppliers, which extend beyond the period of twelve months mentioned herein.

In the event of the project being phased, guarantee on installation and equipment shall commence on the date on which it is put into operation for beneficial use to the satisfaction of the Engineer.

4.7 TESTING AND COMMISSIONING OF MECHANICAL AND FIRE INSTALLATIONS

4.7.1 General

The Contractor shall carry out all tests and commissioning of the systems installed by him, in a coordinated and properly organized manner.

The Contractor shall test, balance and commission the installation as required to achieve specified performance and efficient operation of the system and record all details of measurements taken. A responsible Commissioning Engineer employed by the Contractor

shall be present to supervise the operation and adjustment of the equipment during the entire commissioning stage.

The Contractor shall carry out all of the above before requesting acceptance and witnessing of performance by the Engineer. Commissioning data shall be fully tabulated in conjunction with the design data and submitted to the Engineer prior to the inspection being carried out by the Engineer.

Commissioning of equipment and systems shall not be undertaken if damage to the equipment, systems or the building could result due to incomplete and incorrect installation work.

Commissioning procedures as stipulated by the suppliers of equipment shall be strictly adhered to.

The commissioning of the climate wizard units shall be undertaken by the suppliers under the supervision of the Contractor.

Calibrated instrumentation required to measure flows, pressures, temperatures, etc. shall be provided by the Contractor. The entire control system shall be adjusted and commissioned by the control system specialist contractors, where applicable.

All safety protection systems shall be fully commissioned and set points properly checked out and adjusted, before equipment shall be allowed to run for commissioning purposes.

4.7.2 Pressure Tests

Water Piping

Water piping shall be tested for leaks. Operating care shall be taken to avoid putting excessive pressures on the equipment, safety devices, etc.

Leaks in screwed fittings shall be corrected by remaking the joints. Leaks in welded joints shall be cut out and re-welded. Caulking of leaks will not be permitted. The test must be witnessed by the Engineer.

Air Ducts

All medium and high-pressure air ducts shall be tested in accordance with SMACNA ("High Velocity Duct Construction Standards").

The Contractor shall include for blank-off plates to isolate the main supply duct system from the branch ducts for test purposes. The complete main supply duct systems shall be tested.

The Contractor shall provide the required test fan and approved instrumentation and the tests shall be witnessed by the Engineer.

The first completed branch duct from the main supply duct to the supply air diffusers shall be pressure tested while witnessed by the Engineer. The Contractor shall allow for the closing off of spigots.

Ducts classified as "low pressure ducts" shall be smoke tested and only be visually inspected by the Engineer.

4.7.3 Performance and Capacity Tests

Where the Engineer is to witness tests, the Contractor shall ensure that the Engineer receives reasonable notice that such tests will take place. Tests required to demonstrate specified capacity and general operating characteristics of all systems and equipment, shall be undertaken by the Contractor under the direction of the Engineer at time of final inspection.

4.7.4 Noise Testing

Should the installation, in the opinion of the Engineer, be excessively noisy, (i.e. exceed the specified noise levels), acoustic tests shall be carried out by a nominated Acoustic Consultant.

Should the results of the initial acoustic test prove to be unsatisfactory, the Contractor shall carry out modifications to the equipment so that further tests can be made until the plant complies with the Specification. The cost of all such further tests and the necessary modifications to the plant shall be met by the Contractor.

4.8 OPERATING AND MAINTENANCE INSTRUCTIONS

4.8.1 Manuals

A condition of the final acceptance of the works will be the provision of three copies of an approved comprehensive Maintenance and Operating Instruction Manual.

Each copy of the manual is to include the following:

- A general description of the system and its operation.
- Details of the method of operation of the plant and controls.
- An equipment and controls list giving the following:
    - Description
    - Quantity
    - Make
    - Model Number
    - Location
- A schedule of the servicing to be done on each item of equipment and controls and the frequency.
- A log sheet giving the design parameters and provisions for the logging of these parameters by the plant operator.
- Description of automatic control system, accompanied by control schematics (where necessary).
- Step-by-step instructions for starting/stopping each item of equipment.
- A record of relevant readings taken during final commissioning and hand-over tests.
- "As-built" drawings, wiring diagrams, piping schematics.

4.8.2 Owner Instruction

The Contractor, in addition to the operating and maintenance manuals, shall give detailed explanation of and instructions to the Owner on the operation of the complete installation as finally commissioned and handed over.

The Contractor shall operate the whole plant for a period of three consecutive full working days, unless otherwise specified, after the plant is handed over. During this period, the Contractor shall instruct the Owner in the operation of the plant.

4.9 GENERAL REQUIREMENTS, WORKMANSHIP, MATERIALS AND CONT. ADMIN

4.9.1 General

The Contractor will be required to provide all labor, materials, equipment and services and perform all operations required for the complete installation of HVAC systems as shown on the relevant drawings and in accordance with all applicable requirements of the Contract documents.

The detailed Installation Specification takes precedence over this part of the specification should there be any conflict in description or requirements referred to in both parts.

4.10 NOISE AND VIBRATION CONTROL

4.10.1 General

The noise and vibration generated by equipment shall be isolated from the structure by means of anti-vibration mountings, spring hangers or flexible pipe connections.

All equipment, piping, etc. shall be mounted on or suspended from approved foundations and supports, all as specified herein.

Unless otherwise specified, all floor mounted equipment shall be erected on a reinforced concrete pad, cast into a channel frame. Where vibration isolation between machine and base is used, the base shall be extended to support the isolating system.

All vibration isolators shall be selected and supplied by the same manufacturer and shall be approved by the Engineer before installation.

Vibration isolators shall have a guaranteed static deflection as specified and the isolators shall be installed in accordance with the manufacturer's recommendations.

4.10.2 Vibration Isolation Mountings

Neoprene Mountings

Neoprene mountings shall have a minimum rated static deflection of 10mm. All metal parts shall be molded into the neoprene to prevent corrosion and to provide friction, so that the mounting need not be bolted to the floor.

Unrestrained Spring Mountings

This Specification covers three alternatives:

i) Open Spring Mountings

Spring mounting shall be open and free standing, and laterally stable without any housing. The springs must be isolated from the floor by neoprene friction pads or cups. Mountings shall have leveling bolts that can be rigidly bolted to the equipment. Spring diameters shall not be less than 80% of the compressed height of the springs at rated load. Springs shall have a minimum additional travel to solid equal to 50% of the rated deflection. When the load per mounting exceeds single spring capacity, springs may be clustered in units of two or more.

ii) Housed Spring Mountings

The housing shall consist of cast iron top and bottom elements, separated by neoprene sponge inserts, to provide lateral support. The mounting shall incorporate a height adjusting bolt and a friction pad bonded to the bottom element, which must have provision for bolting down to the floor. Spring diameters shall not be less than 80% of the compressed height of the spring at rated load. Springs shall have a minimum additional travel to solid equal of 50% of the rated deflection. When the load per mounting exceeds single spring capacity, springs may be clustered in units of two or more.

iii) Open Spring Mountings with Concrete Bases

When equipment is installed on a concrete base (without steel framework) the height of the base shall be at least 250mm and the base shall be cast on a plastic sheet to facilitate separation from the floor. Cast iron or fabricated steel housings shall be cast into the base, so that spring mountings as described in Specification i) can be neatly recessed into the base. The housing shall have an internal height equal to the height of the mounting and shall have a means of locating the adjusting bolt of the mounting in the center of the housing, so that the mounting can be used to elevate the concrete base.

Restrained Spring Mountings

Equipment which has an operating mass different from the installed mass, such as cooling towers, chillers and boilers and equipment exposed to the wind, shall be mounted on spring mountings as described for unrestrained spring mountings, but installed in a housing that includes restraining bolts to prevent extension when the mass is reduced. The housing shall also serve as blocking during erection so that the installed and operating heights shall be the same. A minimum clearance of 5mm shall be maintained around the restraining bolts and of 12mm between the housing and the spring, so as not to interfere with the spring performance. The housing shall be hot dipped galvanized.

4.10.3 Vibration Isolation Hangers

Spring Hangers

This Specification covers three alternatives:

i) This is a basic spring hanger incorporating a low-profile spring that ensures that the hanger rod does not touch the hanger cage. Vibration isolation hangers shall consist

of a steel spring housed in a steel cage. The spring shall fit into a neoprene cup, which locates in the cage. To prevent contact between the cage and lower hanger rod, the cup shall contain a steel washer to evenly distribute the load on the neoprene. Spring diameters shall not be less than 80% of the compressed height of the spring at rated load. Springs shall have a minimum additional travel to solid equal to 50%of the rated deflection. The spring height and diameter, and the neoprene cup containing the spring, shall be so dimensioned as to allow the lower hanger rod to swing through a 30° arc before coming into contact with the cup. When the load exceeds single spring capacity, springs may be clustered in units of two or more.

ii) This adds a neoprene element to i) for better efficiency, particularly in eliminating high frequency noise, and is to be used when superior performance is required. Hangers shall be as specified in i) above but shall incorporate a neoprene element with a minimum rated static deflection of 8mm. The element shall locate in the top of the cage in order to prevent contact between the cage and the upper hanger rod.

iii) This adds a fixed elevation device to i) and ii), to facilitate installation. It also ensures that excessive load is not put onto equipment flanges and is to be used for the three hangers nearest the inlet and outlet of each item of equipment. Hangers shall be as specified in i) or ii) above but shall have provision for the spring to be pre-compressed to the rated deflection so as to keep the piping or equipment at a fixed elevation during installation. The hangers shall be provided with a method of releasing any residual pre-compression after the installation is complete and the hanger is subjected to its full load. Deflection shall be indicated by means of a scale. Pre-compressed hangers shall be used at the three support points nearest the inlet and outlet of each item of equipment.

4.10.4 Vibration Isolation Joints

Flexible Rubber Connections

Flexible rubber connectors shall be used in the positions indicated in the drawings, or where otherwise required, to reduce transmission of vibration or noise from equipment to pipework, accommodate pipe expansion and contraction, take up minor misalignment and facilitate connecting up. Where equipment is provided with a shut-off valve, the flexible connector shall be installed between the equipment and the valve.

Connectors shall be molded in neoprene rubber with nylon reinforcing. Steel rings or wire reinforcement shall not be permitted. Only connectors of the spherical or arch type, allowing movement and misalignment in all planes, shall be used. Rubber hoses are not permitted.

The neoprene body shall be fitted with loose flanges, free to rotate, so as to facilitate lining up. Flange bolts must be fitted with the heads towards the rubber body. Where desirable for space saving or economy, elbow connectors can be used. For nominal diameters of up to 65mm flexible connectors with threaded ends, instead of flange, may be used.

Neoprene connectors may be used with single arch construction but where large movement or misalignment must be accommodated, or where maximum vibration and noise control is required, double arch connectors are preferred.

In cases where the piping is unanchored and the operating pressure (or test pressure or possible pressure surges) could over-extend the connector, rods or cables must be used to restrain thrust. Suitable neoprene washers must be used to isolate the rods or cables from the

flanges, to prevent vibration short circuiting the connector.

Neoprene connectors offered must have a guaranteed burst pressure of at least three times the required working pressure. When allowance is made for temperature/pressure de-rating. Connectors must be rated for continuous operation at the required working pressure and temperature. If the pressure and/or temperature are excessive for neoprene connectors, flexible stainless-steel connectors must be used.

4.10.5 Mounting Surfaces

The shipping weight of climate wizard is 340 kg with net operating of weight of 330 kg, including water. The climate wizard can be mounted direct to floor slab provided the slab has been confirm to be sufficient strength to carry the additional weight.

Should a frame be required, it shall meet the manufactures requirements. The frame shall be made from structural steel with the details as indicated on the drawing.

Should a bigger stand be required, it shall be manufactured from minimum 100x50x5 channel structural steel, blasted and galvinised or painted with minimum two coat application. The design of the structural steel supports/frames shall meet site conditions and take maintenance access into consideration.

Should concrete foundations be required this shall have approved vibration isolators for rotating equipment. Refer to section "Noise and Vibration Control".

The foundations shall be not less than 100mm high and extend not less than 150mm beyond the equipment on all sides. The Contractor shall provide galvanized steel channel forms the size and shape of each foundation. These forms shall be of suitable strength such that they will not distort when concrete is cast therein. Where necessary, the foundations are to be case on an isolating layer, which shall be provided by the Contractor. The forms and the isolating layers shall be provided to the contractor together with any holding down bolts required and drawings giving all necessary dimensions.

All mounting structural and civil designs shall be submitted by the Contractor to the responsible Employer's appointed Structural/Civil Engineer for review and approval prior to commencement with material ordering and manufacturing.

These foundations shall be painted by the Contractor once cast in position. A suitable etching primer shall be used on the exposed surfaces of the galvanized steel. Color of paint to be used to be selected by the Engineer.