Mekan engineering services (pty) ltd

K5010M TSWELELOPELE PRISON REPAIR AND MAINTENANCE 3 YEARS DURATION

MECHANICAL SERVICES SPECIFICATION

2022/11/18

the dr&pw

Department:
Roads And Public Works
NORTHERN CAPE PROVINCE
REPUBLIC OF SOUTH AFRICA

CLIENT

DEPARTMENT
OF ROADS AND
PUBLIC WORKS

OLD MAGISTRATE
COURT

21-23 MARKET

STREET SQUARE

KIMBERLEY

8301

CESA safma GREEN BUILDING COUNCIL MEMBER ORGANISATION 2017 SABS ISO 9001

HVAC SPECIFICATION

Table of Contents

PART 1 – NOTICE TO TENDERERS

1. Any technical enquiries shall be made Onkabetse Ntehelang or Richard Hahlani on 063 130 6522/082 575 3260 or 053 832 4837.

2. Site inspection is compulsory
3. The number of pages in each of the sections of this document is given and tenderers shall scrutinize their documents to ascertain that all pages are legible and have been included in the binding. If there are any discrepancies, prospective tenderers shall take immediate steps to obtain missing information in time for them to complete the document prior to tender closing time.

4. Tenderers are advised that the main offer ***shall be according to specification.*** Alternative offers can however be made by separate form.

5. Tenders will close in accordance with the main contractors' tender dates.

Note:

1. **The Lowest or any Tender will not necessarily be accepted.**
2. **Respondents must have a CIDB grading designation of: e.g 7ME or higher**
3. **Only those tenderers who are registered with CIDB are eligible to have their tenders evaluated.**

PART 2 – FORM OF TENDER

THE SUPPLY, INSTALLATION, COMMISSIONING, MAINTENANCE AND GUARANTEES OF THE HVAC INSTALLATION

2.1 *Tender Price*

Having examined the Conditions of Contract, Specifications, and Drawings listed in this document for the above-named works, I / We the undersigned are willing to contract for, perform and complete the whole of the works required to be done in the supply, installation, commissioning, maintenance and 12-month guarantee of the general Air Conditioning and Ventilation Installation and to complete to the Engineers satisfaction.

The contract price will be subject to escalation with the tender date as base date and according to the main contractor's contract period.

In words:

.....

.....

made up as follows:

1. Nett amount for Air-Conditioning and Ventilation Installation from pricing schedule (Sub Total pg. 68, Bill4)

   R.....

2. Builders Profit and Attendance (___ %) R.....

3. **TOTAL TENDER PRICE. R.....**

TOTAL Carried over to the Final Summary page A – of Part I Bills of Quantities

Name of Tenderer .....

Name of Signatory .....

PART 3 - CONDITIONS OF CONTRACT

CONDITIONS OF CONTRACT SHALL BE AS PER THE JBCC 2005 JULY EDITION FOR NOMINATED / SELECTED SUB CONTRACTORS.

THE TENDERERS ARE INSTRUCTED TO REVIEW THE PRELIMINARIES AND GENERAL CONDITIONS PERTAINING TO THE MAIN CONTRACTORS DOCUMENTATION.

THE TENDERERS SHALL IN ADDITION FAMILIARIZE THEMSELVES WITH THE JBCC CONDITIONS PERTAINING TO THIS PROJECT BY REQUEST TO THE MAIN CONTRACTOR.

NO EXTRA'S OR ALTERNATE CONDITIONS WILL BE CONSIDERED FOR TENDERERS LACK OF KNOWLEDGE OF THE CONDITIONS OF CONTRACT.

PART 4 - GENERAL REQUIREMENTS

4.1 Introduction

The project, more fully described in these documents and drawings, comprises of the supply, installation, commissioning, handing over and maintenance/guarantee for one year of the air conditioning/ventilation systems to serve.

4.2 Definition of Terms

In these Conditions, Agreement, Specification, Bills of Quantities (if any), Schedules and Drawings, the following terms and expressions shall, unless the context otherwise requires, have the meanings hereby assigned to them:

- "EMPLOYER" shall mean that party with whom the Principal contractor for this contract work has entered into a building contract for the carrying out of the specified works by him in terms of this contract. The term Employer shall also include his or their duly appointed representatives or any other official, duly authorised to act on his/their behalf for the purpose of the said Contract. The appointment of such official for such purpose shall be notified to the Sub-contractor in writing.
- "ARCHITECT" shall mean that registered Architect who has been appointed as the principal agent of the Employer and whose name shall appear as the appointed Architect in the contract document between the Employer and the Principal contractor for these contract works.
- "QUANTITY SURVEYOR" shall mean that party responsible for the quantity surveying and whose name shall appear as such in the "Agreement" and "Schedule of Conditions of Building Contract" signed between the Employer and the Sub-Contractor.
- "ENGINEER" shall mean Mekan Engineering Services. The Engineer has been appointed to act as Engineer for the project described in these documents and who is the delegated representative of the architect for the purposes of this sub-contract.
- "RESIDENT ENGINEER" shall mean that person duly appointed by the Engineer to control and administer the sub-contract works on site.
- "PRINCIPAL CONTRACTOR" shall mean that person, firm or company who shall be appointed as the contractor by the Employer to carry out the contract works and the Principal Contractor shall include his or their legal personal representatives, administrators, successors and/or assigns.
- "SUB-CONTRACTOR" shall mean that person, firm or company who shall be selected as Sub-Contractor to carry out the sub-contract works described in this specification and accompanying documents and shall include his or their legal personal representatives, administrators, successors and/or assigns.
- "PRINCIPAL CONTRACT" shall be the contract entered into between the Employer and the Principal Contractor to which this selected sub-contract forms a supplement.
- "SUB-CONTRACT" shall mean the sub-contract agreement entered into between the Principal Contractor and the selected Sub-Contractor, together with the documents referred to herein, including these Conditions of Sub-Contract, Specifications, Bill of Quantities, (if any) Schedule of Price (if any) and Drawings. All these documents taken

together shall form one sub-contract and be considered complementary to one another and shall be ready jointly.

- "WORKS" shall be the construction project for which the Principal Contractor has entered into agreement with the Employer to construct, erect or otherwise proceed with to the requirements of the Employer.
- "SUB-CONTRACT WORKS" shall mean the engineering works described in the specification and/or bills of quantities and/or as shown on the drawings and shall include all modified extra or additional work and obligations to be performed and shall include all plant and materials to be provided and work to be done by the Sub-Contractor in terms of this sub-contract.
- "INSPECTOR OF WORKS" shall mean any person appointed as such whose duties shall be to act as inspector or supervisor of the sub-contract works on behalf of the Employer and under the direction of the architect or, if so delegated, the Engineer. The Sub-Contractor shall afford him every facility for the performance of that duty. The inspector of works shall have no authority to relieve the Sub-Contractor in any way of his duties or obligations under the sub-contract, nor shall he have authority to order any work involving delays or extras.
- "SITE" shall mean the land and/or building placed at the disposal of the Principal Contractor from time to time for the purpose of executing the contract work.
- "MONTH" shall mean one calendar month.
- "WRITING" shall include any manuscript, typewritten or printed statement undersigned by a person properly authorised to sign such statement on behalf of the issuing party.
- "APPROVED" shall mean prior approval to the work given in writing by the Architect or, if so delegated, by the Engineer.
- Words supporting the singular shall be deemed to include plural and vice versa where the text requires and works purporting persons shall include bodies, firms and corporations.
- "ACCORDING TO THE MANUFACTURER'S INSTRUCTIONS" shall mean the manufacturer's instructions at the time of tender.
- "APPROVAL" shall mean the approval by the architect or, if so delegated by the Engineer in writing and is limited to visual appearance of the work, material or components. Approval does not relieve the Contractor from compliance with the specification.
- "B.S" shall mean British Standard.
- "DRAWINGS" shall mean drawings forming part of the contract documents and any modification thereof or additions thereto delivered by the Engineer to the contractor during the execution of the works.
- "NBR" shall mean National Building Regulations.
- "PARTICULAR SPECIFICATION" shall mean a specification that is drawn up as a supplement to the Project Specification to specify items for a particular contract not covered by the Project Specification.
- "STANDARD SPECIFICATION" shall mean the latest edition (as revised) of the standard quality specification of the Engineer.
- "SANS" shall mean South African National Standards.
- "SABS" shall mean South African Bureau of Standards.
- "SABS-CKS" shall mean specifications prepared by the SABS mainly for the procurement of products for the use of government departments.

- "Specified" shall mean as specified in the Project Specification, Particular Specification, drawings, Bill of Quantities or in any other contract document.
- "Hepa" shall mean high efficiency particulate filters.
- "NPSH" shall mean Nett Positive Suction Height.
- "TEFC" shall mean Totally Enclosed Fan Cooled.
- "UL" shall mean Underwriters laboratory
- "SMACNA" shall mean Sheet Metal and Air Conditioning Contractors National Association.

4.3 *Sub-Contractor's Drawings*

The preparation and submission of working drawings, and co-ordination drawings in respect of certain services will form part of this sub-contract as follows:

Working drawings, drawn to a scale of not less than 1: 50 shall be produced by the Sub-Contractor and submitted for approval to the Engineer or Employer's representative for approval (nine hard copies & soft copies 'dwg' and pdfs). Such drawing must be based on and co-ordinated with the latest available architectural, structural, roof truss and services drawings and dimensions shall be verified on site prior to installation. The tender price schedule in the bill2 shall include for all necessary variations of duct and pipe layouts for co-ordination and to clear other services and obstacles.

The attention of the Engineer shall be drawn to any deviation from the Specification by the Sub-Contractor at the time of submission.

Builder's work drawings showing masonry work, openings for ducts, pipes, cables and other services through concrete sub-structures, slabs, walls, partitions etc. are to be supplied to the Engineer (three hard copies & soft copies 'dwg' and pdfs). This provision applies similarly to builders' work requirements related to equipment foundations, and the provision of fresh water, drainage, and electrical mains provisions.

Three sets of "as installed" drawings of the system, including wiring diagrams and control diagrams are to be supplied to the Engineer for the eventual retention by the Employer.

The Engineers drawings for the contract shall be those issued at the time of tender together with any others issued to cover the variations to the contract.

As part of this contract the HVAC Contractor shall provide the following drawings:

- Manufacturing and Installation Drawings:
- Builder's work drawings showing all penetrations required.

The manufacturing and installation drawings ("shop drawings") shall provide all details of the plant area, plinths etc. necessary for the manufacture and installation of the complete system in accordance with this specification and drawings.

4.3.1 Wiring Diagrams:

The wiring diagrams shall provide details of all the electrical wiring associated with the Air Conditioning and Ventilation Installation. The same drawing symbols and system shall be used as used in the Engineers drawings.

4.3.2 Builder's Work Drawings:

All necessary builders work drawings as described elsewhere in this specification shall be provided as part of this Contract.

4.3.3 Record Drawings:

On completion of the installation but before the plant is handed over, the Contractor shall provide a complete set of drawings showing the completed installation including wiring.

In addition to the drawings listed above the Contractor shall provide all drawings necessary for the execution of the Contract and shall submit such general and detailed drawings of the plant and apparatus as the Engineer may require approving construction of the plant.

Details and drawings of all major items of equipment made by the Contractor or his suppliers shall be submitted for approval without specific request from the Engineer.

All required drawings shall be submitted to an agreed programme to suit the construction of the plant.

All drawings shall be clearly numbered or marked with the equipment item numbers, area references, etc.

4.3.4 Approval of Drawings:

The Contractor shall submit for approval, in principle, copies of all above mentioned drawings prior to starting work or issue to other parties. Any work started (off site or on site) prior to receiving the Engineers approval of drawings shall be at the Contractors own risk and cost.

The Engineer may require from the Contractor further detailed drawings and/or calculations which clarify features not adequately shown on the layout drawings. The request for additional details shall not be construed as extending the scope of this contract or altering the programme.

The Contractor shall submit two copies of each drawing to the Engineer for approval.

The Engineer will return to the Contractor within ten working days of their receipt by him, once copy of each drawing marked "APPROVED IN PRINCIPLE' or marked with any changes which are necessary.

The Contractor shall modify the details and drawings as required by the Engineer. The nature and date of each modification and a distinguishing symbol shall be added and the drawings submitted again for approval.

Alterations to drawings by the Engineer are not intended to change the scope of work unless explicitly stated as doing so. Should any alterations, in the opinion of the Contractor, change the scope of work, the Contractor shall notify the Engineer immediately on receipt of the altered drawings before any further drawing work or fabrication is carried out. Claims for a change of scope, made after performance of the work, constituting the claimed change of scope, will not be considered.

The approval in principle of drawings by the Engineer shall not relieve the Contractor of any responsibility in terms of the contract. The Engineer will check the drawings for design only and approval of the drawings, schedules and catalogues shall not be construed as a complete check.

The contractor shall be responsible for any discrepancies, errors or omissions in the drawings other particulars supplied by him whether such drawings or particulars have been approved by the Engineer or not, provided that such discrepancies, errors or omissions are not due to inaccurate information or particulars furnished in writing to the Contractor.

Five copies of the Final Manufacturing and Installation Drawings shall be issued to the Engineer by the Contractor within ten days of receipt of approval in principle. Further copies shall be provided as may be required by the Engineer either before or after final approval.

The Contractor shall provide at his own expense, all copies of drawings by him in the execution of the work and shall also, at his own expense, supply to the Engineer, such drawings and copies thereof as are provided for in the specification.

4.3.5 Record Drawings:

On completion of the installation, but before final handover, the Contractor shall provide an electronic copy plus the necessary prints of each of the following drawings showing the services as fixed:

1. Complete 1:50 scale layout of pipework inside plantrooms.
2. Large scale (at least 1:50) details of plantrooms.
3. Complete 1: 50 scale drawings of the whole installation.
4. Detailed drawings of all items of plant.
5. Electrical layouts and wiring diagrams.
6. Details of any other items requested by the Engineer.
7. The drawings shall be sufficient in detail to enable the Employers staff to maintain, dismantle, reassemble and adjust all parts of the works.
8. The layouts shall show the location of all manual and automatic valves, controls, control panels, outlets, etc.
9. A copy of the wiring diagram shall be mounted in the Plantroom in a glass fronted frame. The diagrams shall be printed by a non-fading process.

4.4 Materials and Equipment Submittals

The Sub-Contractor shall submit to the Engineer for his approval comprehensive Manufacturer's technical data (submittals) of major equipment and materials which he proposes to use. Applicable model numbers, operation points, capacities and applicable options shall be highlighted or marked up in order to demonstrate compliance with the specification. Optional items not applicable should be crossed out to avoid any doubts with regard to what is proposed.

The Sub-Contractor shall ensure that the technical data is submitted in good time to avoid the risk of delays. Within 7 days after being awarded the sub-contract or letter of intent, (whichever occurs first) the Sub-Contractor shall submit to the Engineer for his approval a Schedule of items of equipment and materials which he intends to submit complete with scheduled submittal and latest approval dates in co-ordination with the "agreed installation programme" as detailed in paragraph INSTALLATION PROGRAMME AND PROGRESS.

All material shall be new of high quality and suitable for the conditions on site. Should the materials not be suitable for use under temporary site conditions then the Contractor shall at his own cost provide suitable protection until these unfavourable site conditions cease to exist. All materials and workmanship shall comply with the relevant SABS or BS standards.

The Contractor shall where requested to do so, submit samples of equipment and material to the Engineer for his approval prior to installation. Samples may be retained in the Engineer's possession until the contract is completed after which they will be returned and no charge will be made for such samples.

Locally manufactured equipment shall be used where possible and practical in preference to imported equipment. The owner in no way binds himself to assist the Contractor in obtaining import permit for imported equipment.

The works shall be designed to provide ease of inspections, cleaning and maintenance.

All artisans employed on site shall be competent in terms of the Regulations and Acts.

The contract shall be executed to a high standard and to the satisfaction of the Engineer. Should any workmanship, equipment or material not be to the satisfaction of the Engineer, it shall be rectified at the cost of the Contractor and all rejected materials shall be removed from site.

If, in the opinion of the Engineer, any member of the Contractor's staff is not competent to carry out the work to the required standard, then that person shall be removed from the project if so, instructed by the Engineer.

4.5 *Commissioning and Testing Prior to Completion*

As part of the commissioning procedures the Sub-Contractor shall carry out all necessary tests and submit the test results recorded on approved forms for approval by the Engineer of each item of equipment as demonstration that the relevant items of equipment operate in accordance with or exceeds the minimum requirements of the Specification and approved manufacturer's technical data.

The Sub-Contractor shall give the Engineer notice in writing when any portion of the plant is ready for test and if the Engineer does not himself or through his representative attend to witness the test within seven (7) days from the receipt by him of such notice, then the Sub-Contractor may proceed with the test, duly forwarding to the Engineer, certified copies of the results thereof. In such case, the test shall be deemed to have been made in the Engineer's presence.

If, in the discretion of the Engineer test results are insufficient or not acceptable, the Contractor shall carry out necessary remedial work and repeat the necessary tests at his own expense.

4.6 *Design Conditions*

Where, in terms of this specification, air conditioning systems are installed, these systems have been designed on and shall be commissioned (subject only to the limitations of their design), on the basis of the following climatic, temperature, humidity, and sound level data unless specified differently in the technical schedules in Section 3 of the Specification.

4.6.1 *Ambient Design Conditions*

Summer 34°C db 18°C wb

Winter 2°C db

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

4.6.2 *Inside Controlled Conditions*

Summer 22°C db at ± 50% Relative Humidity. Humidity will not be actively controlled.

Winter 22° C db

The above temperatures are those at which the majority of people are considered to be comfortable, as indicated on a Comfort Chart.

The temperature would be controlled within a tolerance of ± 1.5°C.

The relative humidity would not be positively controlled but would be indirectly controlled within the comfort range as a result of the design and selection of the cooling plant.

The winter temperature would be maintained via heat pump cycle from the reverse cycle split type AC units.

4.6.3 Noise Levels

The air conditioning and ventilation installations must be designed not to exceed the rating levels of ambient noise for the relevant indoor dwelling spaces based on the South African National Standard (SANS) 10103.

Refer to table below for design and maximum rating levels of ambient noise for indoor dwelling spaces as per SANS 10103:

SPACE	DESIGN $L_{Req,T}$,DBA	MAXIMUM $L_{Req,T}$, DBA
ALL AREAS	35	40

Project Altitude: 1196 m

Whilst considering required duties and capacity data of plant items, with regard to the selection of such items the project altitude of 1196 meters must be taken into account.

In this respect it should be noted that the capacity data in the Specification and specification drawings is based on the project altitude.

MEASURES TO REDUCE NOISE AND VIBRATION

- Where attenuators are fixed into walls, canvas collars are to be placed on noise sensitive side.
- Where piping and ducting pass through walls, they are to be wrapped with high density (64 – 103 kg/m^3) preformed, resin-bonded glass wool of 25mm thickness and then with thick Builder's plastic. Grouting is then to be done hard-up to the plastic.

4.6.4 Outside Air Ventilation

Offices, boardrooms, kitchen, hospital, bakery, laundry, textile where applicable would be supplied with mechanical ventilation systems as per SANS 10400 Part O.

4.7 Tools and Equipment: Acceptable Manufacturers, Types and Model Numbers

Where, in these documents, requirements are stated in terms of the acceptability of manufacturers, installation firms, of types/model numbers of systems or equipment, these requirements are to be strictly adhered to unless the Engineer has, in writing, authorised, at his sole discretion, further and alternative names before the tender date.

Unless otherwise specified, the Contractor shall provide all tools, materials, scaffolding, power, water, etc. necessary for the proper and efficient execution of the work covered by this specification.

No extra payment will be made for plant equipment, materials required by the contractor to complete the work.

The Contractor shall provide all rigging, cranes, lifting equipment, etc., necessary to execute the works.

4.8 Definition of System

The word "system" where used in these documents shall mean not only the major terms of plant and equipment covered by the Specification, but all work and the incidental sundry components (including hoisting, rigging, scaffolding, etc.) necessary for complete execution of the works in an efficient and workmanlike manner and for the proper operation of the installation, with their labour charges, whether or not these sundry components and/or charges are mentioned in detail in the documents.

4.9 Maintenance and Maintenance Tools

During the [12] months guarantee period specified in Part 3 of these documents, the Sub-Contractor, will at no extra charge, service and maintenance to be done as per manufacturer maintenance guideline. Such maintenance/service operations shall include inspection and lubrication where required on all moving parts; checking and adjusting where necessary of v-belt drives, cleaning of filters, checking and cleaning and adjusting where necessary of refrigeration systems and their associated controls, checking and adjusting where necessary of temperature control systems, and any other maintenance required in terms of manufacturers' instructions.

The Sub-Contractor is to arrange for service record sheets to be signed by a representative of the Employer, and these signed record sheets are to be furnished to the Engineer as documentary proof that the requirements of this maintenance clause have been met.

The Contractor shall provide one set of all special tools, gland keys, valve keys, etc. required for testing, maintaining and operating of all items of equipment.

Duplicate keys shall be provided for all control panels, instrument locks, safety valve locks, etc.

All special tools etc. referred to above shall be handed to the client when the system handover is done.

4.10 Guarantee

Without limiting the requirements and obligations of the sub-contractor in respect to the Latent Defects Liability Period contained in Clauses 27, 36 and 39 of the sub-contract agreement, the sub-contractor shall provide a guarantee to the Employer for the material, apparatus and workmanship delivered by him. The guarantee must be valid for a period ending twelve months from the date when the sub-contract is accepted by the Engineer as completed 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. Fair wear and tear is excluded from the guarantee.

The guarantee must provide that all parts, spares and appurtenances that become defective during the guarantee period be replaced free of charge of any nature to the Principal Contractor, the Employer or the Engineer.

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

4.11 Operating and Maintenance Instructions

The Sub-Contractor, as a pre-condition to acceptance by the Engineer of the system as practically completed and ready for beneficial occupation by the Employer, will prepare and submit three sets of operating/maintenance/fault finding instructions pertaining to the operation and maintenance of all major items of equipment.

These operating instructions are to include:

1 Detailed plant description

2 Detailed daily plant operation description

3 Description of overall plant operation

4 Details of main items of equipment, each containing:

4.1 Design capacity details

4.2 Tested performance details

4.3 Manufacturers; data sheets with operating points highlighted

4.4 Manufacturers' commissioning and maintenance instructions

4.5 List of recommend spare parts (for two-year period)

4.6 Details of local suppliers

5 Schedule of set points (for controls and safety devices)

6 "Troubleshooting List"

6.1 Step-by-step procedures for unspecialised fault finding

6.2 What remedial action to take

6.3 When to call for specialised assistance

7 Maintenance Schedule

8 One complete set of "as built" drawings as described in Para OPERATING AND MAINTENANCE INSTRUCTIONS.

4.12 Training of Personnel

The Sub-Contractor must explain and demonstrate the following to person (s) nominated by the Employer or Engineer:

1. Stopping and starting of equipment.
2. Repair of minor defects
3. Adjustment of controls
4. Routine maintenance inspection
5. Routine maintenance

Two man-days, to be arranged in conjunction with the Engineer, must be allocated for this exercise, and a pre-requisite being that the operating and maintenance manuals and "on site" wiring diagrams have been compiled and supplied before that day.

4.13 Completeness of Contract Documentation and Drawings

Part 6 and the Engineer's drawings forming part of these documents are described as follows, and the Sub-Contractor is deemed to have satisfied himself of the completeness of these documents.

4.14 Legal Requirements

The installation shall be erected and carried out in compliance with:

1. SABS 0142, 1982, as amended: Code of Wiring of premises.
2. Machinery and Occupational Safety Act No. 6-1983 as amended.
3. The Mines and Works Regulations, Government Notice No. R10609 of the 28 September 1952.
4. The local Municipal by-laws and Regulations as well as the regulations of the local Supply Authority.
5. SABS 0103, 1983, Code of Practice for environmental noise.
6. SABS 0400, 1990.
7. The Factories, Machinery and Building Work Act of 191 as amended.
8. The regulations of the local Gas Board.
9. The SABS Code for the Wiring of premises. – SABS 0142-1987 as amended as well as SABS 0180-1974 as amended.
10. The local Fire Regulations.
11. The Building regulations as described in SANS 10400 (current edition).
12. The Occupation Health and Safety Act (current edition).
13. The Specifications of the applicable Public Works Department.

In addition, the Contractor shall issue all notices and pay all the required fees in respect of the installation to the Local Authorities; and shall exempt the Principal Agents and Employer from all losses, cost or expenditures which may arise as a result of the Contractor's negligence to comply with the requirements of the regulations enumerated in this paragraph.

Should any requirement, by-law or regulation, which contradicts this Specification, apply or become applicable during erection of the Installation, such requirement, by-law or regulation shall overrule the Specification; and the Contractor shall immediately inform the Engineer of such a contradiction.

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

It shall be assumed that the Contractor is conversant with the above-mentioned requirements. Should any requirements, by-laws or regulations, which contradict the requirements of this document, apply or become applicable during erection of the installation, such requirement, by-law or regulation shall overrule this Document and the Contractor shall immediately inform the Engineer of such contradiction. Under no circumstances shall the Contractor carry out any variation to the installation in terms of such contradictions without obtaining written permission to do so from the Engineer.

4.15 Sub-Contracted Work

Under no circumstances shall the Sub-Contractor subcontract work or part of works out to other parties other than as shown in the completed questionnaires of Section 6 without the prior approval of the Engineer.

4.16 Installation Programme and Progress

An "agreed" installation programme produced by the Sub-Contractor in close consultation with and approved by the Principal Contractor shall be submitted to the Engineer for approval within 7 days of awarding of the Sub-Contractor issuance of Letter of Intent whichever occurs first.

The programme for the carrying out of the works shall be submitted in detailed form covering all significant operations and shall be in the form of a bar chart.

The Contractor shall liaise with all necessary parties (other contractors, sub-contractors, consultants, equipment suppliers, etc.) to ensure that the programme is as accurate and as realistic as possible.

The Contractor shall submit the programme in a format agreed with the Principal Contractor and the Engineer.

The programme shall list each scheduled item of equipment in the contract and shall indicated periods for:

1. Preparation, approval and finalisation of manufacturing drawings.
2. Ordering
3. Manufacturing
4. Inspection and testing during manufacture.
5. Delivery
6. Installation
7. Testing
8. Commissioning

The Contractor shall build into the programme a period of two weeks for approval of drawings by the Engineer.

The Contractor shall allocate to a senior member of his staff the duties of studying and evaluating the works in relation to the approved programme, of devising methods to overcome or prevent delays and of co-operating with the Engineer and other contractors working on site. He shall report to the Engineer and draw his attention timeously to anything, which may cause a delay in the execution of the works.

The programme shall be updated as and when necessary to take account of changed circumstances.

4.17 Work by Others

The following work is excluded from this subcontract:

1. Openings in walls, partitions, and other structures to accommodate ducting, piping, electrical cables and other services. These openings to be made good and air tight sealed by the Sub-Contractor. See also sleeve wall detail.
2. Timber linings for duct penetrations through masonry walls.

3. Roof penetrations, providing suitable roof curbs for roof fans, flashing off and waterproofing where necessary. Sub-Contractor to provide counter flashing.
4. Holes in ceilings and bulkheads where shown on drawings and to accommodate air terminals, diffusers and grilles.
5. Provision of suitable access panels in ceilings, bulkheads and walls for servicing/commissioning of air conditioning equipment.
6. Concrete bases and up stands (150mm high) to support air conditioning equipment and air handling units where shown on the drawings, as well as masonry supports under cooling towers where shown on the drawings.
7. Concrete for the inertia blocks for major items of equipment. However, the steel trays for inertia blocks to be supplied by the Sub-Contractor.
8. The Sub-Contractor will be responsible for providing angle framework around corners of base plinths for casting in by the Principal Contractor.
9. The provision of full-bore condensate drain points with P-traps to sewer pipes near air handling plants and cooling towers where shown on the drawings.
10. The provision of suitable mains water supply points with valves where shown on the drawings. Mains water supply points are required to cooling towers and feed and expansion tanks.
11. Unless specifically stated differently in this Specification, the supply, installation of the main electrical supply cables to the air conditioning/ventilation switchboards. The Sub-Contractor shall be responsible for the termination and connection of all such cables to the switchboards supplied under these contracts.
12. The electrical supply, switching arrangements and connecting up to local isolators of all small fans where indicated "By Others" in the technical schedules of Section 3 of this Specification, or where shown on the drawings. The Sub-Contractor to wire from these local isolators to the referred fans.
13. Waterproofing of plantroom floors with 150mm high up stands or steel sleeves around holes in floor under doors and waterproof floor sealing.
14. Undercutting of doors and supply and installation of louvred doors where shown on the drawings.
15. The installation of door grilles and cutting of holes in door, as shown on the drawings. The door grilles to be supplied by the Sub-Contractor.
16. Roof insulation, solar shielding and solar shading louvres or windows where required.
17. Holes in window glass for the window mounted fans where shown on the drawings.
18. Exterior painting of exposed ducting by the Principal Contractor or his painting subcontractors.
19. Where applicable, smoke detection system including low voltage wiring and connecting up to terminals in the air conditioning switchboards to be carried out by the electrical subcontractor.
20. Electrical conduits with draw boxes from sub control panels to main air conditioning panels, as details in Sections 2 and 4 and the drawings, to be provided by the electrical subcontractor.
21. Supply and installation of console and window/wall a/c units and associated outside wall sleeves and louvres, unless specified in detail in Sections 2 and 3 of the Specification.
22. Electrical conduits (dia. 25mm) to above ceiling level with 100mm x 100mm draw boxes at 1800 AFFL for wall mounted thermostats and control consoles marked

23. "T" on the drawings to be supplied and installed by the electrical sub-contractor.

4.18 Compliance with Standards

When so requested by the Engineer, provide evidence in the form of delivery slips, certificates, test reports or other written proof that material or components comply with the standards laid down in this specification.

Products that are specified as mark-bearing must bear the mark of the relevant standards body.

4.19 Summary of SANS Specifications Application to the Standard Quality Specification for Air Conditioning Installation

1. SANS 10064: The preparation of steel surfaces for coating.
2. SANS 1200 HC: Corrosion protection of structural steelwork.
3. SANS 1091: National colour standards for paint.
4. SANS 12944-4: Paints and Varnishes – Corrosion protection of steel structures by protective paint system Part 4Types of surface and surface preparation.
5. SANS 460: Copper and copper alloy tubing.
6. SANS 455: Covered electrodes for the manual Arc welding of carbon and carbon manganese steels.
7. SANS 10044: Welding: Parts I to VII
8. SANS 10238: Welding and thermal cutting processes – Health and safety
9. SANS 121: Hot-dip (galvanised) zinc coatings (other than on continuously zinc-coated sheet and wire).
10. SANS 3575: Continuous hot-dip zinc-coated carbon steel sheet of commercial, lock forming and drawing qualities.
11. SABS 0214: The design, fabrication and inspection of articles for hot-dip galvanising.
12. SANS 1186-1: Symbolic Safety Signs Part 1:
13. Standard signs and general requirements.
14. SANS 62-1: Steel Pipes Part 1: Steel pipes of NB Not exceeding 150mm.
15. SANS 62-2: Steel Pipes Part 2: Pipes and pipe fittings of nominal bore not exceeding 150mm, made from steel pipe.
16. SANS 10147: Refrigeration System including plants associated with air-conditioning systems.
17. SANS 1125: Room air conditioners and heat pumps.
18. SANS 719: electric welded low carbon steel pipes for aqueous fluids (ordinary duties)
19. SABS 23: Brazing alloys containing silver
20. SANS 193: Fire Dampers
21. SANS 10173: The installation, testing and balancing of air conditioning duct work.
22. BS 10: Specification for flanges and bolting For piping, valves and fittings.
23. BS 3601-22: Specification for carbon steel pipes and tubes with specified room temperature properties for pressure purposes.

24. BS 4504: Circular flanges for pipes, valves and Fittings (PN designated), Specification for steel flanges, Specification for copper alloy and Composite flanges.
25. BS 5000-99: Machines for miscellaneous applications.
26. BS EN 1561: Founding, Grey cast irons.
27. BS EN 1563: Founding, Spheroidal graphite cast iron.
28. BS EN 1982: Copper and copper alloys, ingots and castings.
29. BS EN 10213-1: Technical delivery conditions for steel castings for pressure purposes.
30. BS EN 10213-2: Technical delivery conditions for steel castings for pressure purposes. Steel grades for use at room temperature and at elevated temperatures.
31. BS 1486
32. BS 848 Part 1 & 3
33. BS 970
34. BS 21
35. BS 1387
36. BS 1740
37. ASTM B61: Standard Specification for Steam or Valve Bronze castings.
38. ASTM B 62: Standard Specification for Composition Bronze or Ounce Metal Castings.
39. ASTM A 126: Standard Specification, for Gray Iron For Valves, Flanges, and Pipe Fittings.
40. ASTM A 216/A 216M: Standard Specification for Steel Castings, Carbon, Suitable for Fusion Welding, for High Temperature Service.
41. ASTM A 389/A 389M: Standard Specification for Steel Castings, Alloy, Specially Heat-Treated for Pressure-Containing Parts, Suitable for High - Temperature Service.
42. ASTM A 395/A 395M: Standard Specification for Ferritic Ductile Iron Pressure – Retaining Castings for use at Elevated Temperatures.
43. ASTM F 1369: Standard Specification for Heaters, Convection, Steam and Hot Water.
44. ASTM F 1508: Standard specification for Angle Style, Pressure Relief Valves for Steam, Gas and Liquid Services.
45. API 5L: Specification for line pipe.
46. IP 44
47. IP 55:
48. SO 1940: Mechanical vibration
49. ISO 2372
50. OHS Act: The Occupational Health and Safety Act, Act 85 of 1993.

4.20 Site Conditions

No claims from the contractor which may arise from insufficient knowledge of site access, type of site, labour conditions, establishment space, transport and loading/unloading facilities power, water, supply, etc. will be considered after submission of tenders. For services where prior permission is required before contractor can visit the site, a visit will be arranged for all interested parties at their request.

4.21 Arrangements with the Supply Authority

The Contractor shall give all notices required by and pay all necessary fees, including any inspection fees, which may be required by the local supply Authority unless otherwise specified.

On production of the official account, only the net amount of the fee charged by the Supply Authority for connection of the installation to the supply mains will be refunded to the Contractor by the Owner.

It shall be the responsibility of the Contractor to make the necessary arrangements at his own cost with the local supply authority and to supply the labour, equipment and means to inspect, test and commission the installation to the requirement of the local and supply authorities.

The Contractor shall supply and install all notices and warning signs that are required by the appropriate laws and regulations and/or the Documents.

4.22 Storage of Equipment and Materials

The Contractor shall ensure that all stored material and equipment are safely stacked and that they are not damaged by stacking.

The Contractor shall ensure that stored materials and equipment do not overload the structure of floor construction.

The storage of combustible materials on site shall be kept to a minimum.

The Contractor shall be responsible for ensuring that such combustible materials are safely stored. Suitable firefighting equipment shall be provided by the Contractor who shall further ensure that staff capable of using the equipment is at hand.

4.23 Location of Equipment

The Contractor shall check on doorways, passages, openings, lifts, etc, provided and shall ensure that all equipment offered can be moved through them to its final position. If necessary, equipment shall be ordered in a partially dismantled condition so that is suitable for moving through the restricted openings or areas of restricted height or areas of restricted load.

4.24 Co-operation with Other Trades

The Contractor shall ascertain the extent of the work of other trades on site.

The Contractor shall give all necessary assistance to other trades to ensure that the work of all trades can be installed satisfactorily and without delay.

The Contractor shall liaise with other trades working in close proximity to the work covered by this specification and shall assist in working out equipment and material positions to ensure that all trades can complete their work satisfactorily.

4.25 Builder's Work

The successful tenderer shall, within 30 days, or any shorter period which may be necessitated by the construction programme, submit two sets of all drawings showing all builders works required for the project.

The drawings shall provide the builder with all the dimensions, details, etc., for the work to be carried out correctly.

The Engineer will scrutinise the drawings and request changes and adjustments as required. After such changes are satisfactorily made the Engineer will fix his stamp; of approval to the drawings.

The successful tenderer shall provide all the necessary copies of the drawings to the Engineer to issue to all parties.

It is the responsibility of the Contractor to check the builder's work as it is completed to ensure that the work has been correctly carried out in accordance with the drawings. The Contractor shall point out any problem areas as soon as possible to the builder so that they can be rectified. No claims shall be considered for delays or other additional costs which arise of the contractor's failure to check the builders work in good time.

The builder's work drawings shall be fully dimensioned and shall include the following:

1. Details of all plant bases required.
2. Positions of all drain points.
3. Details of all openings in walls and concrete work.
4. Details and positions of all equipment to be built into walls.
5. Any other work required.

The contractor and builder to the approval of the Engineer and Architect shall carefully detail all areas where the Air Conditioning and Ventilation Installation pierces waterproofing. All necessary sleeves, caulking and flashing as required to make the installation waterproof shall be provided as part of this contract.

4.26 Supervision and Site Organisation

For the full duration of this Contract the Sub-Contractor shall employ at least one good and competent Supervisor careful and skilled in all aspects of the trades and skills required by this Contract. This supervisor shall be on site whenever work associated with this contract is being carried out and shall at all times be available to attend to queries by the Principal Contractor or Engineer.

The Supervisor shall be the contractor's authorised represented for the project on site and shall be available to attend progress meetings when called upon to do so by the

Principal Contractor, Engineer or Architect, whether or not these take place prior to work actually starting on site.

The supervisor shall be empowered to make all decisions necessary for the execution of the contract.

The supervisor shall not be transferred from his position unless on the express instructions of the Engineer.

The sub-contractor shall at all times have on site copies of all relevant drawings as well as a copy of the specification and a unpriced BOQ. The sub-contractor shall institute the necessary procedures to ensure the drawings on site are the latest drawings and that all superseded drawings are removed from site.

PART 5 – GENERAL TECHNICAL SPECIFICATION

5.1 General Information Regarding Equipment

This section of the tender documents represents the combined functions of statements and schedules of technical requirements relating to equipment, and of schedules to be filled out, in part by the tenderer at tender stage, and in full by the successful sub-contractor.

It is to be carefully noted that only the items of information in the Schedules marked with an asterisk (*) are required to be completed by the tenderer at tender stage. All other information will require to be completed by the successful tenderer before the subcontract is entered into with the principal contractor.

To facilitate the process of tendering for this project in view of the fact that exact pumping heads and fan resistance characteristics cannot be determined at this stage, as such characteristics could vary depending on the finally accepted major items of equipment, estimated figures have been entered in the schedules, and tenderers are to base the selection of their fans and pumps on this data.

Should the actual pumping head and fan resistance figures, at the time of selection of equipment, be different from the corresponding figures appearing in these Schedules, corresponding subcontract price adjustments, approved to the satisfaction of the Engineer, will be made.

Attention is drawn to paragraph 4.8. Tenders who do not comply with this paragraph shall be disqualified.

5.2 General Equipment Protection

5.2.1 Protection against Damage

All equipment delivered to site shall be adequately protected against damage that can be expected on a building site.

Protection against weather is the responsibility of the sub-contractor carrying out the work detailed in this specification.

5.2.2 General Machinery Protection

All high speed couplings, projecting shaft ends and every dangerous moving parts of machinery which is within normal reach of a person shall be protected by a guard manufactured from not less than 1, 6 mm mild steel plate.

The coupling guards shall be neatly formed and securely fixed in position.

All belt or rope drives within normal reach shall be adequately protected by a belt guard.

The belt or rope guard shall be manufactured from wire mesh or open type expanded metal, securely braced and stiffened with light rolled steel section and bolted in position.

All chain drives shall be fitted with sheet steel chain cases and lubrication facilities to chain manufacturers' recommendations. All joints shall be dust tight and arranged for convenient installation and dismantling.

Each chain case shall be fitted with a hinged inspection door, drain hole and plug.

All guards shall be finished in a light orange colour too B.5 381. C.

5.3 Quality Assurance

5.3.1 General

The following general points shall be noted:

The Air Conditioning and Ventilation Contractor shall be responsible for implementing a full quality assurance plan covering all activities included in this contract.

Contractors and suppliers with ISO 9000 certification will be considered favourably in the adjudication process.

Contractors who do not have ISO 9000 certification shall provide a comprehensive quality assurance plan in accordance with ISO 9000 provisions at the time their tender is accepted.

The quality plan shall cover design activities, procurement, storage, construction, handover, maintenance and guarantee.

5.3.2 Quality Management Plan

A Quality Management Plan shall be prepared by the successful Air Conditioning and Ventilation contractor and this plan shall be submitted to the Engineer for approval within 14 days of receiving an advice of the appointment. The QMP shall include at least the following:

A responsibility matrix identifying all parties in the contractors organisation who will be involved in the project or who are responsible for aspects of the project. The specific activities shall be identified with the responsible individual.

A list of all applicable specifications and third party inspections required.

A list of all inspection holds points with actions and responsibilities to ensure that these are timeously inspected.

A list of all inputs required from the Engineer or the client with actions and responsibilities to ensure that the proper persons are advised in good time.

5.4 Testing and Commissioning

5.4.1 General

The Engineer or his representative shall be advised of all testing and commissioning and shall be given the opportunity to witness all tests. However, the Engineer will only be on site to witness the tests and takes no responsibility for the acceptance of test results.

The testing and commissioning procedure shall form part of the Quality Verification Plan submitted by the Contractor and shall be the subject to the same prior approval by the Engineer. The testing and commissioning procedure shall embody the following principles:

All plant shall be tested off site prior to delivery. No plant or equipment will be accepted and paid for if it is not accompanied by the manufacturer/supplier certificate verifying that it has been tested.

All plant and systems on site shall be tested as early as possible after installation to verify that the plant/system/sub-system is operating correctly.

No testing or commissioning shall take place without an approved written procedure.

The responsibility for the proper testing and commissioning of the system rests fully with the Contractor. This includes the provision of all necessary test equipment, measuring and test points, valves and dampers, etc. to test and commission the system.

At the time of submitting equipment for approval, full details of the commissioning requirements shall be provided.

5.4.2 Testing and Commissioning Program

At least four weeks before commencing any testing and commissioning the contractor shall submit a complete program for such work so that the Engineer can arrange to be on site at the appropriate time. The programme shall embody the agreed testing and commissioning procedure.

The programme shall include –

A bar chart covering all activities.

Names and addresses of companies involved in each activity.

The way in which each test will be carried out complete with pro forma forms for tabulating results.

5.4.3 Equipment and Procedure

The equipment supplied under the Contract shall be subject to inspection by the Engineer or his Selected Agent at all stages of manufacture.

The tests and commissioning procedure as laid down and such additional tests as the Engineer may reasonably require to prove compliance with the Specification shall be carried out at the Contractor's Works and at Site.

The Contractor shall give reasonable notice of time and place in writing to enable the Engineer to inspect and witness tests of materials and equipment. He shall provide the Engineer with facilities for witnessing the tests and for any additional tests or inspection of any portion of the works required by the Engineer.

The Contractor shall at his own cost render all assistance and supply all labour, appliances and any other materials, as the Engineer may require to check the setting out, measure up and inspect any portions of the works at any stage during fabrication, construction, erection or painting. During such operations, the Contractor shall if required, suspend any or all of the Works, without having claim for loss or damage as a result thereof.

The testing of the plant (or any part thereof) supplied under this contract shall be carried out through its full operating range (or part thereof) as required by the Engineer.

All such tests and inspections and the necessary inspection facilities shall be provided as part of the Tendered price for the Contract.

At the commencement of and during the whole of the Commissioning and Testing Periods, the Contractor shall have available on site all essential spares and tools considered necessary to enable repair work of defective parts to be carried out immediately in the event of a breakdown or adjustments being necessary.

The Contractor shall be responsible for the proper operation and maintenance of the plant throughout the period of the tests and until the operator training period is complete.

Acceptance by the Engineer of any plant item, following such inspection or tests, shall not relieve the Contractor of any obligations under this Contract.

All pumps shall be lined up and tested as a complete set. Test Certificates shall be supplied before dispatch.

All rotors and motor/impeller combinations shall be statically and dynamically balanced. Test Certificates shall be supplied before dispatch.

All such other tests as required by the Engineer to prove compliance with the specification shall be carried out.

5.4.4 Test Certificates

The Contractor shall provide three copies of test certificates in respect of all materials and equipment, further copies are to be bound into the operating and maintenance manuals.

5.4.5 Insulation Tests

All electrical wiring and equipment shall be subjected to insulation tests. All instruments and other equipment for the tests shall be provided by the Contractor.

5.4.6 Draining and Cleaning

On completion of the pressure test on a section of pipework the water used for testing shall be drained away as quickly as possible to remove as much dirt and dross as possible. After completion of a pipework circuit the circuit shall be flushed through to remove all pipe scale, dross and similar materials.

The Contractor shall provide all necessary connections, by-pass pipes, temporary strainers, and temporary make-up pieces, to enable the systems to be drained and cleaned.

Additionally, on boiler commissioning, steam lines are to be charged with steam to full operating pressure and allowed to cool. this procedure is to be carried out three times over a period of two days. Following the third cycle the pipes are to be open ended and blown through.

These procedures are to be supervised by the Engineer.

5.4.7 Plant Commissioning

The Contractor shall arrange at his cost for the manufacturer's representatives to check over and fully commission all major items of equipment. This work is to be carried out by skilled engineers preferably employed by the manufacturers, who are completely familiar with the equipment involved and shall be capable of training the operating and maintenance staff in the duties they are to perform.

On completion of the plant commissioning the Contractor shall obtain written confirmation from the various manufacturers that they have completed all commissioning work and are satisfied that the items of plant for which they are responsible are functioning satisfactorily.

Copies of the manufacturer's written confirmation shall be sent to the Engineer.

5.4.8 Tests on Completion

On completion of the balancing and commissioning of equipment the plant shall be put into normal operation and the final adjustments of the equipment shall be made.

Thereafter the Test on Completion shall be carried out to ensure that the plant meets the specification.

Such tests shall include the following:

Simulated tests for all alarm and safety cut out equipment to prove the operation of the equipment.

Simulated tests on automatic controls to prove the ability of the controls to correct conditions which are outside the required design conditions.

The tests shall be carried out by manually changing the desired values to produce an incorrect condition and then re-setting the controls to the design conditions and checking the operation of valves, etc. to restore the design conditions.

Operational tests on the Plant to demonstrate that it is giving the rated output and efficiency.

The Contractor shall provide all necessary temporary measuring and recording equipment. The equipment shall be of a type generally used for this type of testing and shall be to the approval of the Engineer. All instruments shall be accurately calibrated before the tests begin.

On completion of the whole of the tests and when the Contractor is satisfied that the entire plant is operating satisfactorily and will fulfil the function for which is has been supplied, he shall submit to the engineer triplicate copies of all test records and charts together with reports on all the tests required in terms of the approved Quality Verification Plan. The Engineer shall reserve the right to ask for any reasonable additional tests or for the repetition of previous tests in order to prove that the operation of the plant is satisfactory and in accordance with the Performance Specification.

5.5 Electric Wiring

Electrical mains supply cables will be brought to the air conditioning switchboards by others unless otherwise stated but will require to be terminated by the air conditioning sub-contractor.

Electrical connections and associated conduit work and cable ducting between the switchboards and all air conditioning, ventilation and associated plant shall be provided by the air conditioning sub-contractor.

All electric wiring and earthing shall be executed in accordance with the relevant local authority regulations.

Horizontal distribution of cables to equipment shall be by means of suitable trays using UNISTRUT type cable trays and accessory fittings. Cables installed on the cable trays must be neatly arranged in parallel and adjacent to each other and clamped at disturbances not exceeding 600 mm.

Isolator switches shall be fitted to equipment remote from the Electrical switchboards where required to meet local wiring regulations and where safety of operation demands such isolators.

Please refer to the schedules where all electrical power points to be provided by the main electrical sub-contractor.

The wiring to and the connections to the power points are to be undertaken by the main air conditioning contractor. Details and final power selections are to be confirmed timeously by the air conditioning contractor.

All miscellaneous fans to have suitable connection box on side of fan or duct for easy connection. Before fans are switched on the air conditioning sub-contractor is to test wiring installation for connection.

All wiring to electrical heater banks shall be heat resistant in accordance with the acceptable standards and local regulations.

Low voltage wiring and low voltage control wiring shall be of grey colour and have terminals physically separated from the usual 220V terminals for easy identification and to avoid confusion.

Low voltage wiring shall be properly "screened" where necessary to prevent the risk of "ghost" signals resulting from induction.

Whereas the supply and installation of the mains electrical supply to the air conditioning equipment is part of the electrical sub-contract, the air conditioning contractor shall ensure that suitable connections are made available to cable sizes as advised.

The mechanical distribution board(s) shall be rendered moisture, dust and vermin proof. During erection of the installation, the distribution board(s) shall be protected against damage and penetration of moisture, dust and vermin.

Care shall be taken to ensure that all equipment is fully labelled and that accurate descriptions appear. Engraved plastic or ivory sandwiched strips shall be used throughout. The strips shall bear either white lettering on black background or black lettering on white background.

Letters shall at least 5mm high.

5.6 Variable Refrigerant Flow and Direct Expansion Split Type Systems

5.6.1 After Sales Support

To ensure long term support and given the specific nature of variable refrigerant flow and direct expansion split type systems spares, the system offered shall be from a worldwide recognised brand only, with branch offices on all continents. The South African branch office shall offer full technical and local spares support. The mother

company shall guarantee full spares availability for at least 10 years after the model that is installed, has been discontinued for replacement with a later model.

5.6.2 Outdoor Units

The Direct expansion split outdoor units shall run on R-410A refrigerant. They shall be air-cooled and positioned at well ventilated spaces.

The variable refrigerant system shall be of the heat pump type, using either a 2-pipe or 3-pipe configuration and run on R-410A refrigerant. Outdoor units shall be air-cooled.

The compressors shall be of the inverter driven scroll type. Digital scroll type compressors shall not be accepted.

In order to make up the required total cooling capacity for the building, outdoor units may be grouped in parallel, but interlocked to work as a single system.

The mechanical design shall be such, that should a compressor fail on any of the outdoor units, acid contaminated oil will be effectively contained in the unit of failure so that it does not cause failure of the remaining units.

The DX split outdoor units shall run from a 220V 1-phase, 50 Hz power supply, with a tolerance of at least 10% in supply voltage. DX SPLIT units shall come standard fitted with voltage protection in the case of any electrical surges or power dips to protect PC boards and compressors.

The VRF/VRV outdoor units shall run from a 400V 3-phase, 50 Hz power supply, with a tolerance of at least 10% in supply voltage. VRF/VRV units shall come standard fitted with voltage protection in the case of any electrical surges or power dips to protect PC boards and compressors.

Should it be needed to install the outdoor units in an enclosed space where the discharge air needs to be ducted to the outside, the standard outdoor fan shall have suitable capacity to provide maximum required flow at an additional 50 Pa static pressure.

The outdoor units shall be fitted with hail guards over and above the original protection provided by the suppliers.

5.6.3 System Design

The complete system design to shall be done by the supplier of the product, with supplier specific software, based on the capacities and layout in this specification and the drawings. To effectively make use of the heat recovery function, the units shall be grouped per level as indicated on the drawings.

The design report shall include the following on a schematic diagram:

1. Pipe sizing and junction types
2. Remote controller connection of single units, or Master / Slave configuration
3. Component addressing if addressing is done manually

5.6.4 Communication Bus and Master Controller

Indoor and outdoor unit controllers shall be interconnected via a communication bus. A master control panel shall be supplied for central control with the following functions:

1. Programmable to suit the specific building setup.
2. Reading of all measured parameters of indoor and outdoor units.
3. Adjusting of temperature set points of all units on the system.
4. Support addressable logic for all controllers connected to the system.
1. Support Lonworks and BACnet BMS protocols for integration with other BMS systems.

Regardless of the fact that the system shall be provided with a master control panel, all parameters and fault codes of all the units connected to the system, shall be readable from the controller of the outdoor unit.

5.6.5 Refrigerant Piping

All refrigerant piping shall be rated for use with R-410A refrigerant.

Hard drawn pipes shall be ordered with specific mention to have end caps on both ends, to prevent dirt and moisture from accumulating inside the pipes. Pipes that arrive on site without end caps, or pipes that lays open ended on site during assembly, shall be confiscated during routine and surprise inspections and the contractor shall be ordered to cut any pipes of the engineer's choice for inspection, at his cost.

During sweat on assembly of hard drawn pipes, the contractor shall pressurise the pipeline with Nitrogen from the end of which assembly has started. The flow of nitrogen shall be sufficient to prevent any carbon build-up on the inside of the pipes, during assembly. Whenever assembly needs to be discontinued, both ends of the pipes shall be sealed off with insulation tape.

Should it be revealed on any inspection, or during commissioning that due care was not taken to prevent dirt from entering the pipe system, or that nitrogen pressurisation was not used during assembly causing a carbon build up, the engineer has the right to reject

the entire pipe installation and all damaged or blocked components will be replaced on the cost of the contractor.

5.6.6 Training Certificates

It is a specific condition of this specification, that the contractor is certified by the supplier of the product as an approved installer. Proof of successful completion of the specific supplier's installation training course, shall be submitted for each technician that does the physical installation.

5.6.7 Commissioning

It is a specific condition, that commissioning of the variable refrigerant system, shall be done by technical representatives of the local supplier. During commissioning, the contractor shall make any changes or reparations required by the commissioning technician, at his cost.

5.7 Ductwork

5.7.1 Sheet metal Ductwork

Construct air ducts according to "Low Velocity Duct Construction Standards" and "High Velocity Duct Construction Standards" (SMACNA) or SABS 1238 – 1979 as amended.

Install ductwork as indicated on the project drawings.

All duct dimensions, (including internally insulated ducts), refer to the clear internal cross-sectional area.

Where changes in duct sizes indicated are necessitated on site, duct sizes must be determined using equivalent diameters (hydraulic diameter) and not cross-sectional area.

Ducts must be airtight, not drum or vibrate when the internal static pressure varies and must be so constructed that airflow is even without excessive static pressure drop. Construction must be sturdy.

Ducts must be thermally insulated in accordance to Section 4.3.19. Apply internal or external insulation according to requirements shown on the Engineer's drawings.

Avoid aspect rations in excess of 4:1 in rectangular ductwork. Internal duct dimensions of less than 200mm in rectangular ducting are not acceptable in low and medium velocity ductwork.

Provide adjustable opposed blade dampers, sound attenuators, duct splitters and turning vanes where shown on the drawings.

Unless otherwise specified ductwork must be manufactured of galvanised sheet steel using thickness as recommended by SMACNA.

Paint ductwork as specified.

Isolate all ducts passing through concrete or brick walls from the walls by means of a high density glass fibre collar at least 20mm thick to prevent transmission of vibration to the building structure. Seal all openings where ducts pass through plant room walls by means of polysulphide mastic.

Flexible joints exposed to weather must be provided with protecting galvanised sheet steel cover strips.

Flexible connections must be made of fireproof fabric reinforced air-tight material attached both sides with approved galvanised steel collars or frames.

Overhead hangers for horizontal ducts must be of the "Trapeze"type (SMACNA page 45). Support vertical ducts in accordance with SMACNA page 43, Fig B.

Ductwork connected to equipment such as cooling towers, evaporative condensers, plenum chambers etc., must be provided with flanged removable sections to allow for removal and access to eliminators, etc.

5.7.2 Low Velocity Ducts

This refers to ducts with velocity up to and including 10 m/s and static pressure up to and including 500 Pa.

Refer to "Low Velocity Duct Construction Standards". (SMACNA) for all constructional requirements. Alternative methods applicable are specified hereafter.

Galvanised sheet steel must be used with thickness as recommended in SMACNA ("Table 1, page 11). Either cross-breaking or beading is acceptable. Longitudinal seams must be of the "Pittsburg Lock" or Acme Lock" type. Transverse joints must be as follows: (SMACNA – Table 1, page 11):

Dimensions of Longest side if duct	**Transverse joints**		**Reinforcing Angle**
	Long Side	**Short Side**	
Up to 450mm	B	A	SMACNA – P11
475 to 750mm	E	A	SMACNA – P11
775 to 1500mm	L	L	SMACNA – P11
1525 and larger	M	M	SMACNA – P11

Reinforcing the angle irons must be galvanised. Rivets, screws, bolts and other fastening equipment must be completely corrosion proof.

Elbows must be in accordance with SMACNA page 61. Use standard radius elbows generally. Install short radius elbow pieces as shown on the project drawings.

Provide square elbows with galvanised turning vanes, SMACNA Fig. A, Page 53.

5.7.3 High Velocity, Medium Pressure Ducts

Refer to "High Velocity Duct Construction Standards" (SMACNA) for all constructional requirements. Ducts with velocities higher than 10 m/s and a static pressure between 500 Pa and 1 500 Pa apply.

Galvanised sheet metal must be used with thickness as recommended in SMACNA fig 3 – 1, pages 14 and 15. Construction must be in accordance with (1), (2), (4) and (12) of Fig 3-1.

Use standard radius generally. Install short radius square elbows as shown on the project drawings. Provide short radius elbows with splitters and square elbows with double thickness type turning vanes.

(SMACNA pages 42,43 and 44).

Flexible ducts must be of the spiral wire reinforced glass fabric type (SMACNA) page 63).

Overhead hangers for horizontal ducts must be of the "Trapeze" type (SMACNA page 56). Support vertical ducts as indicated in SMACNA page 57.

5.7.4 High Velocity, High Pressure Ducts

This refers to ducts with velocities above 10 m/s and static pressure above 1 500 Pa. Refer to "High Velocity Duct Construction Standards" (SMACNA) for all constructional requirements. Alternative methods applicable are specified hereafter.

Use galvanised sheet steel with construction in accordance with SMACNA Fig 3-2 Pages 16 and 17, Tables (1), (2), (4) and (11).

Use standard radius elbows generally. Install short radius square elbows as shown on the project drawings. Provide short radius elbows with splitters and square elbows with double thickness type turning vanes. (SMACNA) Pages 42,43 and 44.

Flexible ducts must be of the spiral wire reinforced glass fabric type (SMACNA Page 63).

Overhead hangers for horizontal ducts must be of the "Trapeze" type (SMACNA Page 56). Support vertical ducts as indicated in SMACNA Page 57.

5.7.5 Flexible Ductwork

Where indicated on the project drawings, ductwork must be connected to mixing boxes and integrally mounted ceiling diffusers by means of flexible ducting.

Flexible ducts must be either of the flexible aluminium foil metal type or of the spiral reinforced fabric type, in accordance with SMACNA Page 106, all flexible ducts must be insulated externally.

Flexible ducting must comply with local fire codes, NFPA Bulletin 90A and SABS 0400 fire resistance requirements.

Flexible ducts connected to diffusers or mixing boxes must, unless otherwise shown or approved, not exceed 1,2m in length nor have more than the equivalent of one 90 ° bends. Bends must be of the maximum possible radius without flattening or distorting the flexible ducting.

Support flexible ducting with sufficient and correct brackets that will maintain its shape.

5.7.6 Duct Access Doors

Access doors must be of the insulated hinged type as shown in SMACNA Fig. B, page 17 ("Low Velocity Duct Construction Standards").

Access doors must be of sizes as shown on the project drawing.

5.7.7 PVC Ductwork

PVC Ductwork where specified on the layout drawings must be of unplasticized polyvinyl chloride (uPVC) manufactured and installed in accordance with SMACNA – "The Thermoplastic Duct Construction Manual".

The class of ducting mused must be as specified.

Provide for expansion and contraction of the ductwork.

Flexible connections must be made of plasticized polyvinyl chloride (PVC).

Duct joints must be welded flanges or male/female socket type welded around. Test all welded joints and seams by high frequency spark test at 40 kV.

5.7.8 Manual Air Dampers for Volume Control

Provide each branch duct leading to a single air outlet with a damper unless the outlet diffuser is of the variable volume type. Provide each branch duct leading to a group of air outlets with a damper at the point where the branch leaves the main air duct. Splitters may be used in lieu of dampers where the estimated pressure drop does not exceed 30 Pa. Install dampers and splitters so that they can be adjusted at any time after the completion of the work. Provide access panels where the adjusting mechanism

is concealed by suspended ceilings, furring, etc. Front and back bars or vanes of directional grilles are not to be used for adjustment of air quantities.

Butterfly dampers must be of the balanced type with opposed blades and must be constructed in accordance with SMACNA Pages 64,65,66 and 67.

("Low Velocity Duct Construction Standards").

Dampers shall not be used to create artificial resistance in the system in order to reduce fan air flow capacity.

Reduction of air flow shall be accomplished by reduced fan speed or by changing the fan blade angle.

5.7.9 Testing

Unless otherwise specified, test the total ductwork installation for leakage as per SANS 10173.

Leakage rates must not exceed 5% of the required air flow quantity in any section of ductwork or exceed the SABS permissible leakage, whichever is the smaller.

5.7.10 Duct Installations

Install ductwork in accordance with the layout drawings issued with the Project Specification.

The tender drawings are diagrammatic and do not purport to show exact positions of ducts or specific details of construction of the latter. Check all final dimensions on site before preparation of manufacturing drawings and the fabrication of ducting.

Where beams, stanchions or other obstructions interfere with the straight running of ducts, provide suitable offsets or alternatively make changes in the section of the particular duct.

Study all the drawings of the particular building in order to determine the number of such offsets or changes in section and the positions in which they will be required. Allow for such offsets. A complete set of drawings of the building may be inspected at the office of the Architect.

5.7.11 General

Unless specified, type 316 stainless steel shall be used for stainless steel ducting.

All exhaust air ducting for moisture producing equipment such as cooling towers or where air is drawing through or over water shall have sealed longitudinal and cross joints and shall be painted on the inside with corrosion protection paint to the satisfaction of the Engineer. Corrosion protection shall be selected to give a minimum protection life of five years.

Black mild steel of a minimum thickness 1,6mm thickness, shall be used for grease contaminated exhaust systems. All joints shall be welded.

5.7.12 Duct Hangers

Duct Hangers shall be as follows:

Longest duct dimensions (mm)	Round hangers (mm)	Galvanized Strap Hangers (mm)	Shelf Angles	Maximum Spacing (mm)
Up to 760	6	25 x 1.6	25 x 25 x 3	3.0
761 to 1000	10	25 x 1.6	38 x 38 x 3	3.0
1001 to 1200	10	25 x 1.6	50 x 50 x 3	2.4
2101 to 2400	10	25 x 1.6	50 x 50 x 6	2.4
2401 and over	12	25 x 1.6	50 x 50 x 6	2.4

Hangers shall not protrude below the lowest part of the shelf angles.

5.8 Fans

5.8.1 General

The combination fan and silencer selection must be such as to satisfy the specified noise levels.

Requirements under the above heading apply to fans which are not integral parts of cooling towers, air handling units or similar equipment designed as standard units by the manufacturer.

Fan duties are specified in the Equipment Schedules.

Where no pressure requirements are indicated, estimate the fan static pressure requirements from the system lay-out drawings and equipment.

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

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

Flexible connections must be fitted between fan inlet/discharge and ducting or equipment as appropriate.

Matching flanges to be supplied with all fans.

Fit fans with manufacturer's nameplates permanently fixed to the casing in a prominent position clearly indicting manufacturer, model number, maximum operating speed, maximum power absorbed, size and serial number.

Protect fan in/outlets which are not connected to ducting or equipment with removable screens.

Provide indicating arrows for direction of rotation and direction of air flow on fan casings.

Fans for special applications such as corrosive gases, explosive atmospheres, etc., must be selected for the particular medium mentioned.

Fans for proprietary and package units although not specifically covered in this specification must however comply with the general requirements of this specification.

Mount all fans on anti-vibration mountings or support from anti-vibration hangers. All anti-vibration mountings must be to the approval of the Engineer.

Bearings must be ball or roller type, and quiet in operation. They must be sized to give a long life (not less than 100 000 hours) at the loads imposed by the application.

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

Fans must be painted in the factory with one primer coat and two coats of high gloss corrosion resistant paint.

Where stated in the technical schedules under Electrical power from: "By Principal Contractor" or "By Others", the electrical contractor shall provide and connect the electrical supply wiring with local isolator near each fan wired to the fan via an interlocking ON/OFF switch where necessary as indicated in the technical schedules. For 380 volt 3 phase fans the electrical contractor shall provide a 3 phase local isolator wired up to a 380 volt 3 phase supply with interlocking starter contactor with suitable overload protection.

The air conditioning sub-contractor shall wire and connect from the isolator to the fan.

5.8.2 Centrifugal Fans

Centrifugal fans must be of the forward or backward curved, multi-vane type with single or double inlet and arrangement as specified in the Equipment Schedules.

Fan performance must be based on tests carried out in accordance with BS 848: Part 1 or Part 3 (as applicable) and as amended.

The fan casing must be of the volute type manufactured from sheet steel with lock forming or continuously welded seams, suitable reinforced and adequately supported by means of a steel superstructure. Fans with a wheel diameter above 1000mm must be provided with access doors fitted to the fan casing.

Fan wheel and shaft assembly must be statically and dynamically balanced to ISO 1940 within grade G6,3.

Fan drives shall be by means of standard V-belt and grooved pulley configuration or direct drive.

Fans and motors must be rigidly bolted to a common prefabricated steel frame with the motor mounted on slide rails for normal belt drive adjustment or replacement. The complete frame must be mounted on anti-vibration mountings.

Larger fans must be manufactured with split casings in sections to permit installation through available openings in new and existing buildings.

Shaft bearings must be grease lubricated, self-aligning ball or roller bearings in accordance with the fan manufacturer's standard practice. For bearings located in the air stream, precaution must be taken to prevent loss of lubricant.

Shafts must be fully machined steel shafting conforming to BS 970.

Provide a drain socket with plug at the lowest point in the fan casing (except if discharge is at lowest point).

Fans used in variable volume applications must have stable characteristics throughout the operating range to suit the particular application.

All fans must be tested in the factory and checked for vibration to ISO 2372.

Bearings must be checked using a shock impulse meter. All measurements and observations made during this test run must be recorded and made available to the Engineer on request.

Fan motors in the air stream in draw-through applications with spray coolers or sprayed coils must be TEFC and protected to IP44 or better.

Shafts for variable inlet vane control must be supported by pre-lubricated sealed bearings. Both sets of variable inlet vanes on double inlet fans must be controlled simultaneously and equally.

5.8.3 Axial Flow Fans

Axial flow fans must be of the aerofoil type with non-overloading characteristic with peak power requirements occurring in normal operating pressure range and motor rating exceeding this requirement.

Axial fans must be selected for the highest possible efficiency with the lowest possible blade tip speed. All fans must be of the adjustable pitch impeller type.

The complete fan unit must be statically and dynamically balanced in accordance with ISO 1940 within Grade G6,3.

Fan performance must be based on tests carried out in accordance with BS 848: Part 1.

Fan casings must be manufactured from reinforced mild steel with pre-drilled flanges at both ends. Casing access panels must be provided where specified in the Equipment Schedules.

Fan motors must be totally enclosed squirrel cage induction type with protection to IP55 unless for a special application as set out in the Equipment Schedules.

Motor connections must be in an external weatherproof terminal box forming part of the casing except for flameproof and special applications which are specified in the Equipment Schedules.

Lubrication points must be extended to the outside of the casing and inspection doors of ample size must be provided in the casing.

In the case of aerofoil bladed fans, fan impellers shall be manufactured from aluminium or rigid PVC and shall be fitted in machined hubs featuring individual blade angle adjustment.

Fans mounted in ducts shall be provided with access panels for inspection and shall be easily removable for maintenance purposes.

Vibration isolation equipment to axial fans shall be provided in accordance with the Specification.

Axial flow fans, where not mounted in ducting, shall be protected with suitable wire-guards.

5.8.4 Roof Extract Fan

Roof extract units must be of the vertical jet or mushroom type unless prior approval for an alternative type is given by the Engineer in writing.

Install fans in accordance with the manufacturer's recommendations.

Outlet cowls and shutters must be the standard product of the fan unit manufacturer.

Outlet grilles must protect the fan from birds.

Provide single phase fan motors only where specified in the Equipment Schedules.

Flow and rotation direction arrows on fan casings must be easily visible from the plant room or from the access to the fan.

Where specified, units must be suitable for upstand and curb mounting, complete with weather skirting and flashing as required.

5.8.5 Propeller Fans

Propeller fans must be suitable for mounting with or without mounting plate (diaphragm) as specified in the Equipment Schedules.

Wall cowls, wire guards, diaphragm plates and louvre shutters must be standard products supplied with the fans.

Mounting plates (diaphragm) where required must be of pressed steel or fibreglass reinforced polyester with integral bell mount orifice.

Impellers must be of heavy gauge contoured pressed steel blades or reinforced polypropylene or fibreglass reinforced polyester ultra-violet stabilised, mounted on cast aluminium or steel hubs.

Fan motors must be three phase totally enclosed squirrel cage induction type with protection to IP 44 unless otherwise specified in the Equipment Schedules.

Mount fans resiliently.

Balancing and testing must be as set out as for axial flow fans.

Fit motor and impeller protection screens as applicable.

Where applicable, fit fans on exterior walls with weather proof galvanised louvre shutters and where specified with wall cowls.

Fans are essentially to be manufactured from corrosion resistant material, chemically treated and painted in a high gloss enamel.

5.8.6 Window / Wall Extract Fans

Fit window / wall type fans with automatic shutters and with finger protection guards.

Where specified provide speed control. Fit motors with thermal overload protection.

Where remote control is specified wiring between fan, control point and power supply point must be flush mounted with conduit and draw boxes.

Fans shall be supplied complete with mounting accessories.

5.9 Sound Attenuators

5.9.1 General

Sound attenuators shall be generally manufactured, selected and supplied by the fan manufacturer.

Sound attenuators shall be factory made units of a make approved by the Engineer, and consist of a casing, internal baffles and sound absorbing lining material.

Sound attenuators shall be suitable for the system working pressure, velocity and for an air temperature up to 80 ° C.

Casings shall be constructed of galvanised sheet metal, of which the minimum thickness is in accordance with requirements laid down elsewhere in the specification.

The sound absorbing lining material shall be odourless, non-flammable, rot proof and shall not tear loose as a result of the air stream flowing over it.

Sound attenuators shall be provided complete with mating flanges.

(Duct mounted) sound attenuators shall be of the rectangular or circular type to achieve the noise criteria ratings stated in the Specification.

Sound attenuators of the rectangular type shall be flanged heavy metal duct sections containing built-in silencer baffles. Baffles shall be installed in order to achieve the required attenuation rate.

Sound attenuators of the circular type shall be complete with flanges, and shall comprise of a heavy gauge circular duct section with internal sound absorption lining, complete with centre pod, (if the centre pod is required to achieve the sound attenuation rate stated in the schedule).

Sound absorbent material shall be manufactured from non-flammable, odourless, rat proof, fire resistant, non-combustible, damp-resistant material edged with galvanised sheet steel and covered with fireproof erosion resistant material. The finished product shall not tear loose as a result of the air stream flowing over it.

Sound absorbent material for sound attenuators serving kitchen canopy exhaust system, shall be "MALINEX" covered and sealed to prevent the impregnation of kitchen greases.

Sound attenuators shall be factory manufactured by recognised specialist manufacturers in this field, accepted manufacturers being TROX, HOWDEN AIR, WOODS, AIR MOVEMENT SUPPLIES or equally approved.

The attenuators shall be selected with a maximum air pressure drop of 50 Pa.

The tenderer to note the sound attenuator properties on the "Sound Attenuator Technical Schedule".

5.9.2 Air conditioning applications

In the case of normal air conditioning applications, sound attenuator panels shall be covered with perforated metal sheet.

Sound attenuators shall be provided complete with mating flanges. The size of the flanges shall be at least as that specified for ducting of the same duty and dimension.

5.9.3 Special applications

Sound attenuators in the air flow of kitchen extraction systems shall have a sound absorbing lining which shall not absorb any grease or fat.

In the case of corrosive airflow applications, the sound attenuator materials shall be suitable for the application.

Note: Should fibre glass be used as a sound absorbent material, the exposed internal lining shall be protected with MALINEX and perforated metal sheet.

5.10 Grilles, Diffusers, louvers and Dampers

5.10.1 Grilles

Supply and return air grilles must be provided as indicated on the drawings.

Each grille must be selected in accordance with the manufacturer's recommendation to be capable of passing the specified air quantity without creating excessive resistance, noise or local draughts.

Grilles must be manufactured of stamped, extruded or rolled aluminium or steel sections, finished as specified and mounted in a neat frame.

Provide supply air grilles with double deflection aerofoil vanes adjustable from the front of the grille.

Vanes must be spaced at not more than 20mm centres.

Exhaust and return air grilles in the same installation must be similar in general appearance and construction to the supply air grilles but with a single set of fixed vanes.

Provide supply air grilles with opposed blade volume control dampers adjustable from the front of the grille.

Provide return air grilles with opposed blade dampers for volume control. Grilles shall be furnished in a natural anodised finish to the Architect's requirements. Dampers must be adjustable from the front of the grille.

Grilles must in all cases be selected with free air passage areas not less than that indicated on the drawings.

Grilles shall be finished in natural anodized. Finished to Architect's requirements.

5.10.2 Weather Louvres

Weather louvers must be manufactured of extruded aluminium sections or ferrous metal hot dip galvanised after manufacture, as specified.

Weather Louvers must be constructed with drip edges to blades and rigid frame to enable building in.

Weather louvers must be finished in natural anodised aluminium, powder coated or painted as specified.

Weather louvers must be watertight even with nominal air velocity up to 3,0m/s.

Weather louvers must be fitted with 12mm opening size galvanised expanded metal or wire mesh screen.

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

5.10.3 Ceiling Diffusers

Ceiling diffusers shall be manufactured of steel or aluminium and shall be finished in high quality white baked enamel or epoxy coated in a colour matching the ceiling to the Architect's requirements.

Ceiling diffusers throughout the building project shall be of similar appearance.

The Sub-Contractor shall, prior to placing orders for ceiling diffusers, submit a sample unit to the Architect in the colour format required by the Architect.

Diffusers must be square, round or rectangular with face plates matching the ceiling grid as specified.

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

Each diffuser must be provided with an opposed blade volume control damper or alternatively, an adjustable disk type throttling mechanism.

Dampers must be selected and installed so as not to disturb the supply air distribution pattern or induction ratio of the diffuser.

Diffuser cores must be removable for cleaning and access purposes.

5.10.4 Variable Volume Outlets

Variable volume outlets with controls and re-heaters must be provided where indicated on the drawings.

Only well catalogued and proven products will be considered.

Minimum air volume must be factory set and site checked for each outlet.

Outlets must be selected and installed to ensure that no dumping or coning of supply air streams occurs, particularly at low air flow rates.

Variable volume control must be achieved with pneumatic or electric drives as specified. Low noise levels during operation are essential.

Re-heaters must be protected against overheat and must be switched with an adequately rated and reliable micro-switch.

Easy access to all parts possibly requiring servicing, removal or setting must be provided.

5.10.5 Dampers

Dampers for positive volume control purposes must be manual or electric actuator driven as specified and provided where indicated on the drawings.

Damper blades, links and damper frames must be of rigid construction galvanised steel generally as per SANS 1238, and of the opposed blade type.

Manually adjusted dampers must be provided with adjusting levers in accessible positions with provision for positive locking in any position from fully open to fully closed.

Dampers must be of the link or gear type as specified.

Damper blade shaft bearings shall be brass.

5.10.6 Non Return Outlet Louvers

Non return outlet louvers must be installed where indicated on the project drawings.

5.10.7 Door Grilles

Door grilles shall be supplied where shown on the drawings. Such door grilles shall be delivered to the Principal Contractor in good time for fitting by him in the relevant doors/frames.

Door grilles shall of the "no vision" type incorporating flanges on both sides of the door and horizontal blades of the v - type spaced in order to limit air friction loss.

Door grilles shall be finished in natural anodised finish to the Architect's requirements.

5.11 Painting

5.11.1 General

The clauses which appear under this heading shall be considered as forming part of each of the following paint specifications.

Paint shall not be applied over any surface containing traces of grit, grease, oil etc. loose mill scale or corrosion products of any kind.

All metal surfaces to which paint is applied shall be moisture dry. Paint surfaces which are to be over coated shall be hard dry before over coating, unless the specification states otherwise.

All traces of soluble salts and corrosive air-borne contaminants shall be thoroughly washed from the surface prior to painting, dried and painted immediately thereafter.

Unless otherwise stated, no paint shall be applied within 50mm of areas which are to be welded.

Welds and adjacent parent metal shall be deslagged, inspected and approved and all spatters shall be removed prior to painting.

The weld area shall be wire brushed and all contaminants shall be removed prior to painting. The weld area shall then be flushed with fresh water and allowed to dry. In the case of rust formation, the weld area should again be wire brushed.

Surfaces which are to rest on concrete or other floors shall receive the full paint system prior to erection.

Areas where the paint coating has been damaged during transportation, erection or by any means whatever shall be repaired.

Rust spots shall be removed by means of a wire brush or emery paper and the surrounding paint which is still intact shall be feathered for a distance of 20mm beyond the damaged area.

Spot priming shall consist of all the coats previously applied and shall overlap the undamaged area by 20 mm.

Where the shop coat has been allowed to age for a few months before painting, it shall be light sanded or rubbed with steel wool or scrubbed with Polycell Sugar Soap Solution, using a bristle brush. The surface shall then be rinsed with drinking water.

Mating or contact surfaces shall be brought together by ensuring that the two surfaces brought into contact with each other are prepared and primed in accordance with the specification.

Areas which will be inaccessible after erection shall receive the full specified coating system, before erection or assembly.

Unless otherwise specified, steel embedded within concrete shall not be painted except to within 50 mm below the concrete / air interface.

All sharp edges and cut ends shall be filed smooth and shall then receive the specified dry film thickness of paint.

When blast-cleaning, a satisfactory blast profile (i.e. anchor pattern) shall be achieved. If the abrasive used for blast cleaning is sand, then it shall be free of clay. Alternatively, an approved grit shall be used.

The Contractor shall ensure that the final finishing coat obscures the previous coat.

The Contractor shall ensure that the manufacturer's recommended thinners are used for any particular paint.

The Contractor shall ensure that primed steelwork, piping etc. which is to be delivered to site is stacked on bearers and is clear of the ground. Wherever possible channels, angles, etc. shall be stacked so that water cannot collect on the steel.

Surfaces which are to be friction bolted shall be prepared in accordance with the specification (i.e. wire brushed) but shall receive no paint coating.

The painted dry film thickness shall be measured using a non-destructive thickness gauge such as the Mikrotest or equivalent.

All the mixing of paints shall be done using either a flat-sided paddle or by means of a mechanical mixer.

Where a specified volume ratio of components must be mixed together, provision shall be made on-site for a practical yet accurate method of volume measurement.

All air used for abrasive blast-cleaning or for spraying shall be free from all traces of oil, water and other contaminants.

The paint manufacturer's instructions shall be strictly adhered to.

5.11.2 Painting of Chequer Plate or Egg-crat Flooring and Supporting Frames

This paint specification will be referred to as Class "C" painting. Chequer plate and egg-crate flooring shall not be delivered to site with a bituminous coating.

Finishing

Three coats of HYSHEEN EPOXY TAR (SAR 681-BROWN, SAR 682-BLACK) to SABS 801-1973, Type II, shall be applied, at a dry film thickness of 70-80- micrometres per coat. Overcoats shall be applied within a minimum of 16 hrs, and a maximum of 48 hrs.

5.11.3 Steelworks

All steelwork which is not galvanised, chrome plated or otherwise protected against corrosion shall be given a coat of protective paint at the Manufacturers' works and the Contractor shall maintain this protective coat until the work is finally painted.

Surface preparation

All surfaces shall be thoroughly degreased with AQUASOLV DEGREASER (Code AR), then rinsed with fresh water and allowed to dry. The surfaces shall then be wire brushed to remove loose rust and loose mill scale to a St 3 finish to Swedish Standard 515 05/59/00-1967.

Priming:

One coat NAMELCOAT PRIMER (U 53) shall be applied to a dry film thickness of 30-40 micrometres.

Undercoat

One coat of MERIT UNIVERSAL UNDERCOAT (UC1) shall be applied to a dry film thickness of 30-40 micrometres.

Finishing

One coat of UNIVERSAL HIGH GLOSS colour shall be applied, to a dry film thickness of 30-40 micrometres.

The total dry film thickness to be less than 90 micrometres.

5.11.4 Motors, Gear-Boxes Pumps and Other Equipment

Surface Preparation

The surfaces to be painted shall be abrasive blast cleaned to Grade C 5a 2 ½ of the Swedish Standard SIS 055900-1967.

Priming

One coat of EPIMIDE EPOXY PRIMER ZINC/CHROMATE IRON OXIDE (EPD 41) shall be applied to form a uniform coat and to fill all porosities in the castings.

Undercoat

One coat of EPIDUCT CHEMICAL RESISTANT EPOXY ENAMEL (EPD 700/699 series), tinted to a shade just lighter than the finishing colour with UNIVERSAL STAINERS (X 14-20), shall be applied.

Finishing

One coat of EPIDUCT CHEMICAL RESISTANT EPOXY ENAMEL (EPD 700/699 series) in the specified colour shall be applied.

The blast profile for this system shall be between 25 and 40 micrometres.

If over coating the primer after two weeks, abrades to a matt surface with 220-350 grit waterproof paper and rinse with fresh water.

5.11.5 Piping (Other than Steam Piping)

Piping which is not galvanized is to be protected as follows after installation.

Above Ground

Surface Preparation

The surfaces shall be wire brushed to remove loose rust and loose mill scale to an St 3 finish to Swedish Standard SIS 05/59/00-1967.

Priming

One coat of NAMELCOAT PRIMER (UC 53) film thickness of 30-40 micrometres.

Undercoat

One coat of MERIT UNIVERSAL UNDERCOAT (UCI) shall be applied to a dry film thickness of 30-40 micrometres.

Finishing

One coat of UNIVERSAL HIGH GLOSS ENAMEL (G) in the specified colour shall be applied to a dry film thickness of 30-40 micrometres.

The total dry film thickness for the coating system shall not be less than 90 micrometres.

Underground or in trenches.

Piping installed underground or in trenches shall be painted with bitumastic paint whether the pipe is insulated or not.

5.11.6 Galvanised Iron

Surface Preparation (General)

All grease and other deposits shall be removed from all surfaces with galvanised iron cleaner (Code G.I.C.). The surface shall then be rinsed with clean water to give a water break-free surface.

All surfaces must be thoroughly clean and dry prior to the application of any materials. Should this state not be achieved, the cleaning process must be repeated.

5.11.7 Galvanised Cladding Inside Buildings

Priming

One coat CALCIUM PLUMBATE PRIMER to a dry film thickness of 25 – 35 micrometres.

Intermediate coat

One coat UNIVERSAL UNDERCOAT (UC 1) to a dry film thickness of 25 – 35 micrometres.

The total dry film thickness shall not be less than 75 micrometres.

5.11.8 Galvanised Cladding Exposed to Atmosphere

Priming

One coat CALCIUM PLUMBATE PRIMER to a dry film thickness of 25 – 35 micrometres.

Intermediate coat and finishing

Two coats of IRONGUARD MIO MICACEOUS IRON ORE ROOF PAINT to a dry film thickness of 50 – 70 micrometers.

The total dry film thickness shall not be less than 75 micrometres.

5.11.9 Galvanised Cladding Moist Conditions

Priming

One coat CHEMICOTE HIGH BUILD CHEMICAL RESISTANT PRIMER (CHC 1) to a dry film thickness of 60 – 80 micrometres.

Intermediate coat

One coat CHEMCOTE HIGH BUILD CHEMICAL RESISTANT INTERMEDIATE COAT (CHC 101) to a dry film thickness of 60 – 80 micrometres.

5.11.10 All Galvanised Pipes

Finishing

One coat CHEMCOAT ENAMEL (CHC 3000) to 25 – 35 micrometres.

The total dry film thickness shall not be less than 145 micrometres.

PART 6 – DETAILED TECHNICAL SPECIFICATION

6.1 General Description of the Project

This specification covers the supply, delivery, installation and commissioning of all equipment related to the HVAC services for the Tswelelopele Prison, located atCnr Nobengula Street &, Schmidtsdrift Rd in Kimberley, Northern Cape province.

6.2 Scope of Work

The works shall include the following:

1. Supply, delivery and installation of Dx split units for the offices.
2. Supply, deliver and installation of centralised in-line extraction air fans.
3. Supply, deliver and installations of roof/wall or window mounted fans

6.3 Detail specification

6.3.1 Applicable Drawings

N/A

6.3.2 Indoor Condition

Room indoor conditions shall be maintained at maximum 23°C DB in summer and at 22°C DB in winter.

6.3.3 Ambient Conditions

Outdoor DB temperature: 29°C
Outdoor WB temperature: 15°C
Winter DB temperature: -3°C

6.3.4 High/Mid Wall and Underceiling cassette Split Type Units

The units shall be of the heat pump inverter (R410a) type.

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

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

The indoor unit and condensing unit shall be interconnected with refrigerant piping, electrical wiring and interlocking control cabling. The pipe and cable connections shall be made in accordance with the unit supplier's recommendations. The refrigerant shall be of the R410 type.

Each condensing unit with connected evaporator unit shall be clearly labelled to identify different split units.

All units shall be of Samsung / LG / Midea or other approved make. "Other approved" means approved by the Engineer during the tender stage.

6.3.5 *Four Way Cassette Split Type Units*

The units shall be of the heat pump inverter (R410) type.

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

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

The indoor unit and condensing unit shall be interconnected with refrigerant piping, electrical wiring and interlocking control cabling. The pipe and cable connections shall be made in accordance with the unit supplier's recommendations. The refrigerant shall be of the R410 type.

Each condensing unit with connected evaporator unit shall be clearly labelled to identify different split units.

All units shall be of Samsung / LG / Midea or other approved make. "Other approved" means approved by the Engineer during the tender stage.

6.3.6 *Concealed Ducted Hide Away Split Type Units*

The units shall be of the heat pump inverter (R410) type.

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

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

The indoor unit and condensing unit shall be interconnected with refrigerant piping, electrical wiring and interlocking control cabling. The pipe and cable connections shall

be made in accordance with the unit supplier's recommendations. The refrigerant shall be of the R410 type.

Each condensing unit with connected evaporator unit shall be clearly labelled to identify different split units.

All units shall be of Samsung / LG / Midea or other approved make. "Other approved" means approved by the Engineer during the tender stage.

6.3.7 Refrigerant Circuit

Refrigerant piping shall be in accordance with the following standards:

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

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

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

- Ensuring proper oil return to the compressor and minimizing lubricating oil being trapped in the system.
- Ensuring practical lines without excessive pressure drops and with proper feed to evaporators.
- Preventing liquid refrigerant from entering the compressor during operation and at shutdown.

Refrigerant piping shall be sized and fitted with the necessary oil traps strictly in accordance with the unit manufacturer's requirements.

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

Suction and liquid pipelines shall be insulated separately and joints on insulation shall be glued with the insulation manufacturer's recommended adhesive to create a vapour barrier.

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

6.3.8 Installation of Refrigerant Piping

Refrigerant piping shall be arranged so that normal inspection and servicing of the compressor and other equipment is not hindered. Locations where copper tubing will be exposed to mechanical damage shall be avoided. Hangers and supports where piping goes through walls shall be installed to prevent transmission of vibration to the building.

Refrigerant piping in ceiling voids and mounted internally against walls shall be installed in 101 mm wide galvanised steel Cabstrut light duty cable trays (per unit). Pipes shall be strapped over insulation to cable trays at 500 mm intervals with suitably sized cable ties. Cable trays shall be 152 mm wide where drain pipes run together with refrigerant piping (per unit).

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

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

6.3.9 *Installation of Indoor and Outdoor Units*

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

Outdoor condensing units shall be installed on wall mounted brackets and / or a concrete slab as indicated on the project drawings. All condensing units to be supplied with hail guards.

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

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

All condenser units shall be supplied with hail guards.

6.3.10 *Installation of Condensate Drain Pipes*

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

Condensate drain pipes shall always run together with refrigerant pipes and shall always be installed in the same trunking and on the same cable trays for as far as the installation permits. Surface mounted drain piping shall only be allowed where condensate drain pipes run in a different direction to either a service duct, waste water

pipe or any other location as indicated on the project drawings. Surface mounted drain piping shall be secured to the wall by means of galvanised steel saddles at no more than 1 m intervals.

Where units are mounted on the inside of exterior walls on wall-mounted brackets, the mechanical contractor shall drill sufficiently sized holes through which refrigerant pipes, drain pipes and cable wires shall penetrate the walls/windows of the indoor unit. Drain pipes running from the indoor unit through the wall/windows shall be adequately sloped to ensure positive drainage.

All condensate pipes running from indoor units to waste water pipes, outlet gullies or open waste water points shall be fitted with a U-trap at a location as indicated on the project drawings.

uPVC pipes shall be used for drain piping from indoor units. Drain pipe sizes for indoor units shall be ∅ 32 mm for all unit sizes.

The first 5m of drain piping shall be insulated with "Armaflex" type, lightweight, elastomeric nitrile rubber tube insulation. Insulation thickness shall be 13 mm.

Where drainage piping or control cabling is required to be installed flush mounted, positioning and chasing shall be done in good time to meet construction programs.

6.3.11 Fresh Air Supply System

The fresh air supply system will consist of primary filters with a forward curved blade in-line axial fan supplied by a reliable supplier in RSA. The fresh air system will need to be approved at tender stage to avoid any variations at construction stage.

The system is to be mounted within the ceiling void on the trusses. Flexible connections between ducts and the FAF system is to be installed to avoid any vibrations carried over to the building.

The control of the fan will be via a timer relay that can be programmed to suit the occupancy of the buildings.

PART 7- SCHEDULE OF CAPACITIES

7.1 General

The following points shall be noted with respect to the Schedule of Capacities below:

1. All capacities are minimum, and the Bidders offer must meet or exceed the specified capacities.
2. Where equipment performance is dependent on the selection of other equipment, The Bidder shall offer compatible equipment. No claims for additional cost will be considered for equipment not correctly selected.

3. Capacities should be corrected for altitude.
4. Failure to complete these schedules will invalidate the Bid.

AC		
	SPECIFIED	OFFERED
Type	Floor standing	
Make	Samsung or similar approved	
Model		
Total Heating Capacity		
Total Cooling Capacity	12000Btu(3,6kW)	
Air Flow		

AC		
	SPECIFIED	OFFERED
Type	4way Cassette	
Make	Samsung or similar approved	
Model		
Total Heating Capacity		
Total Cooling Capacity	18000Btu(5,4kW)	
Air Flow		

AC		
	SPECIFIED	OFFERED
Type	Mid-Wall	
Make	Samsung or similar approved	
Model		
Total Heating Capacity		
Total Cooling Capacity	9000Btu(2,6kW)	
Air Flow		

AC		
	SPECIFIED	OFFERED
Type	Mid-Wall	
Make	Samsung or similar approved	
Model		
Total Heating Capacity		
Total Cooling Capacity	12000Btu(3,6kW)	
Air Flow		

WEF		
	SPECIFIED	OFFERED
Type	Wall mounted	
Size	100mm diameter	
Air Volume	50 l/s	
Static Pressure	50 Pa	
Sound Attenuation		
Filter Box		
Make	Actom/AMS/Donkin or equally approved	

RF		
	SPECIFIED	OFFERED
Type	Roof mounted	
Size	550mm diameter	
Air Volume	800 l/s	
Static Pressure	100Pa	
Sound Attenuation		
Filter Box		
Make	Actom/AMS/Donkin or equally approved	
Sound Attenuation	1.5D Complete With Pods	
Make	Actom/AMS/Donkin or equally approved	

PART 8: INFORMATION ON PREVIOUS CONTRACTS

Tenderers are requested to give information on at least three contracts recently successfully completed, or presently being executed by them. The contracts must at least be similar to this installation with respect to type and size of location. This information will be used when tenders are considered.

Name of client and description of works	Name of consultants	Amount of contract	Date of completion

PART 9- BILLS OF QUANTITIES

The quantities set out in the Schedule of Quantities are to be read in conjunction with the project specifications and drawings. Unless otherwise stated, items are measured net in accordance with the drawings, and no allowance is made for waste.

The quantities set out in the Schedule of Quantities are the estimated quantities of the Contract Works, but the Contractor will be required to undertake whatever quantities may be directed by the Engineer from time to time. The Contract Price for the completed contract shall be computed from the actual quantities of work done, valued at the relevant unit rates and prices.

The prices and rates to be inserted in the Schedule of Quantities are to be the full inclusive prices for the work described under the several items. Such prices and rates shall cover all costs and expenses that may be required in and for the execution of the work described, and shall cover the cost of all general risks, liabilities, and obligations set forth or implied in the documents on which the bid is based, as well as overhead charges and profit. Reasonable prices shall be inserted as these will be used as a basis for assessment of payment for additional work that may have to be carried out. Prices and rates shall include all profit and the Main Contractor's attendance/profit.

A price or rate is to be entered against each item in the Schedule of Quantities, whether the quantities are stated or not. An item against which no price is entered will be considered to be covered by the other prices or rates in the Schedule.

Except where rates only are required, the Bidder shall insert all amounts to be included in his total bid price in the "Amount" column and show the corresponding total bid price.

KITCHEN, BAKERY & LAUNDRY SPECIFICATION

CONTENTS

1. GENERAL PRESCRIPTIONS AND STANDARDS

1.1 Where commercial names and or references to catalogues are mentioned in this specification/document, it only determines the standard of the material/apparatus.

1.2 Exact positions of all apparatus will be ascertained on site.

1.3 All the necessary safety features shall be incorporated. All machines/apparatus/including installations must comply with the relevant SABS specifications and **THE OCCUPATIONAL HEALTH AND SAFETY ACT (Act 85 of 1993)** and/or any amendment.

1.4 Tenderer must provide for all material and apparatus that may be necessary to complete the installation. The work must only be done by expects who can provide proof of previous installation successfully installed by them.

1.5 **SABS STANDARDS AND REQUIREMENTS:** The different materials, spare parts and/or installation must comply with the appropriate standards in the following list.

SABS 62/1971	Steel pipes and fittings
SABS 199/1972	Cylinder shut-off valve for L.P gas
SABS 219/1978	Welded steel cylinders
SABS 460/1975	Copper and copper alloy tubes
SABS 460/1975	Mixture of liquid petroleum
SABS 1737/1978	Low pressure regulators for liquid petroleum gas.
SABS 087	Handling, string and distribution of liquid petroleum gas for house and industrial installations (all parts)
SABS 0140	Identification colour coding (all parts)
SABS 1109 - ISO	Pipe thread for piping and fitting where compression fittings are made.

All installations and South African made apparatus offered, must comply with the latest relevant SABS specifications.

2. INFORMATION OF THE APPARATUS OFFERED

2.1 Technical data of all apparatus offered in the different parts mentioned, must be submitted writing to the Mechanical Consultants for the approval before ordering from Suppliers.

2.2 Machines or equipment used as demonstration models or models that are already withdrawn from the market will not be accepted.

2.3 A complete set of manual/operating instruction booklets and a spare part list must be supplied for each type of installation/apparatus (where applicable) specified in the mechanical document. These booklets must be neatly field in sturdy hard cover plastic files and handed over to the Mechanical Consultants in charge of the project in writing on a date that will be determined by a site meeting/site instruction.

2.4 The operation of all apparatus where applicable must be demonstrated to the staff and Supervisor. The contractor must be convinced himself that the staff member of a particular section who will use the apparatus, are familiar of how to operate the apparatus with ease and in an economical way.

3. PAINT WORK:

3.1 All equipment installed by the contractor shall be painted for protection against corrosion with colour being approved by the Supervisor. Colour coding will be in accordance with the latest SABS specifications.

3.2 All unpainted metal surfaces, excluding galvanized surface, shall be cleaned thoroughly by removing all welding scale, mill scale mist, oil, grease, etc. The appropriate amount of an undercoating, as prescribe by the suppliers for the various surfaces, must be applied. The final coat of all surfaces must match the colours as specified by the consultant's architect on site.

3.3 All apparatus and fittings that are to be installed by the contractor shall be painted for protection against corrosion with colour with the consultants architect. Colour cording will be in accordance with the latest **SABS Specification 0140, PART IV.**

3.4 The following SABS code must be followed.

SABS - 064	Preparation of steel surface for panting
SABS - 0140	Identification colour coding (all parts)
SABS - 630	High gloss enamel art paint
SABS - 631	Oil gloss paint for in and outside surface.
SABS - 678	Based paint for wood (inside and outside)
SABS - 679	Zinkchromate-based base paint for steel.
SABS - 681	Under coats paint work.
SABS - 682	Aluminium body colour paint.

SABS - 723	Etching paint
SABS - 912	Calcium plumbed based paint.
SABS - 1091	National standards for paint
SABS - 1186	Safety symbol sign.

4. BUILDING WORK:

All holes through building work, such as walls or concrete structures shall preferably be drilled or otherwise neatly cut and chipped with clearance diameter not to exceed 20mm.
The Contractor must ensure that copper pipe sleeves are installed where piping passes through walls, ceilings and floors. Filling media such as cement plaster shall be used to cork sleeves to building structures.

5. PAINT WORK:

5.1 The Contractor will be required to guarantee the complete installations unconditionally for a period of 12 months starting after Practical Completion of the whole project.

5.2 The guarantee for new equipment which is normally offered by the manufacture of the equipment **will have no legal binding, influence or effect** what so ever on the 12 months guarantee which are compulsory on this project and described hereunder.

5.3 Where a guarantee for the inner cylinder of the new house hold geysers normally extended to five years, the successful tender shall provide a legal guarantee in writing to the Consultants to ensure that the guarantee favours the Department as the first buyer, in case of dispute or claims which may extended guarantee period.

5.4 If during any one of these twelve months period any of these new installations/apparatus are not in a working order, or not working satisfactorily owing to the faulty material, or workmanship, the contractor will be notified and immediate steps shall be taken by him to rectify the defects and/or replace the effected parts on site, at his or her expenses. The Contractor will not be held responsible for damages or faulty operating of existing equipment, except where he **cause** the damages.

6. CERTIFICATE OF FULLFILMENT:

6.1 Certificate of fulfilment must be must be filled in properly and handover to the Consultant Electrical Engineer for all applicable electrical operated apparatus for which a certificate is required according to the law before first delivery can take place.

7. COMMISSIONING AND TESTING OF APPARATUS:

7.1 The Contractor must carry out a complete efficiency test under working conditions/loads for at least 1 hour on the fan motors in the presence of Consultants (Prison Authorities) and / or a person monitor by the Mechanical Consultant any malfunction of the apparatus

during the. testing periods will be for the account of the Contractor. The air flow, amps and current test instruments must be able to register accurate reading of high quality. The Department will stand in for any malfunction of existing parts not damaged by the contractor.

8. DRAWING AVAILABLE FOR THIS MECHANICAL INSTALLATION:

N/A

9. KITCHEN, BAKERY AND LAUNDRY EQUIPMENT SCHEDULES

9.1. NEW EQUIPMENT TO BE SUPPLIED, INSTALLED AND COMMISSIONED

9.1.1 KITCHEN, BAKERY AND LAUNDRY EQUIMENT

Ref:	Qty	Description
	.	**Kitchen Equipment**
	16	135Lt steam jacketed cooking pot, 890mm X 890mm X 1100mm, 12kW, 3ph, 400V
	3	80Lt electric tilting pan, 14,4kW, 380V, 1440x 867x 940
	1	1000x850 mm Heavy duty electrical range with oven, 14kW, 230V, 3ph
	1	Electric band "meat" cutting saw, 1,5kW, 220V,50Hz, 490x 495x 850
	2	Industrial 3 solid plate hotel stoves, 380V; 16kw; Dimensions: 1000 x 700 x 900mm
	2	1100kg/h floor standing mincer, 3kW,220V,50Hz, 1020x 520x 975mm
	2	780mm Diamond potato peeler, 1,1kW, 220V, 1ph
	2	60Lt food mixing machine,2,3kW, 380V, 910x740x1600
	4	8Lt Empero food processor 295x490x365mm high, 0,37kW,220V,1ph
	4	10Kg electric scale, 235 x 211 x 46mm, 3W
	2	1260Lt/hr WAP electra 18/48 380V, 200bar
	1	200 Rack advancing dish washer with inlet and outlet table, size 3000 x 780mm
	1	13mm bread slicer, 440 x 300 x 165 mm, 380V 3Ph 50Hz / *220V 1Ph 50Hz, 0,55 kW
		Bakery equipment
	1	Stainless steel two-rack two door prover side by side, 2,5kW,220V, 1000x 750x 1890mm
	2	D20 Hydraulic divider 3,5amp, 3ph
	1	250L geyser,133x 86x 86mm, 1,5kW, 220V
	1	In-line fan Alstom, 3ph induction 3ph
	1	Cold room 6.1x 3,7x 3,4 m high compressor cubicoil
		Laundry equipment
	2	Gibrau, washing machine 12kg,1,1kW, 900x 900x 1420mm
	1	Forenta, iron steam press industrial, 101cm x 30cm. 2,600watt of power. Heavy Duty Press

SCHEDULES OF MATERIAL OF TECHNICAL INFORMATION

The following material will be used should I/we be awarded the Contract:

Equipment name	Manufacturer name	Technical specification	Country of origin

MEDICAL GAS SPECIFICATIONS

Volume 1 Part A Piped Gases Specification Section 1

Materials & Workmanship

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1. Materials & Workmanship

1.1. Piped Gases General

This specification contains standard technical requirements for medical gas and vacuum installations and anaesthetic gas scavenging systems.

1.1.1. Project Specification

This standard specification and drawings will at times have to be read in conjunction with project specification and drawings in which the specific requirements, scope and layout of the installation are set out.

Where contradictions arise between such project specifications and drawings and this standard specification and standard drawings, the project drawings and project specification will take precedence.

1.1.2. Competence of Installation Technicians

It is a requirement that all pipe fitters employed in medical gas and vacuum installations are able to show proof of knowledge of, and experience in such installations before commencing work on a medical gas and vacuum system.

1.1.3. Standards and Relevant Publications

The piped gases services installation shall comply with SANS 7396-1:2009 (Ed. 1.00) Medical gas pipeline systems Part 1: Pipeline systems for compressed medical gases and vacuum, Infrastructure Unit Support Systems (IUSS), SANS, Health Technical Memorandum (HTM) 02-01 Medical Gases requirements, all relevant BS EN standards or equivalent. All materials used shall be SANS or BS EN approved and shall be readily available in the region, supplied through reputable suppliers and manufactures.
The installation of the piped gases services shall be carried out by a specialist company with a proven record of such or similar complexity and magnitude installations.

1.1.4. Other Standards and Publications

1.1.4.1 Occupation Health and Safety Act (Act No. 85 of 1994) As amended.

1.1.4.2 Standard Specification for Electrical Installations Pertaining to Mechanical Equipment.

1.1.4.3 SANS 50286-1:1998 Simple unfired pressure vessels designed to contain air or nitrogen Part 1: Pressure vessels for general purposes

1.1.4.4 SANS 7396-2:2008 (Ed. 1.00) Medical gas pipeline systems Part 2: Anaesthetic gas scavenging disposal systems

1.1.4.5 SANS 460 – 1975 Copper and copper alloy tubing.

1.1.4.6 SANS 1091 – 1975 National colour standard for paint.

1.1.4.7 SANS 1062:2010 Pressure and Vacuum gauges.

1.1.4.8 SANS 1409:2014 Outlet sockets and probes for medical (gas and vacuum) services used in hospitals

1.1.4.9 SANS 7396-1:2009 Medical gas pipeline systems Part 1: Pipeline systems for compressed medical gases and vacuum.

1.1.4.10 SANS 532:2009 Standard and specifications for industrial, medical, propellant, food and beverage gases, refrigerants and breathing gases

1.1.4.11 CKS 605:1987 Pressure regulators for medical gases.

1.1.4.12 SANS 10140-3 2017 Identification colour markings

1.1.4.13 R158 Regulation Hospital norms.

1.2. Medical Compressed air systems and components

1.2.1. General

Medical air compressor units shall be factory assembled, wired, piped, and tested and capable of producing air at not less than 800 kPa. Medical air compressor units shall be supplied complete with control panels

1.2.3. After-coolers

Not Applicable.

1.2.4. Refrigerated Compressed air dryers

Compressed air dryer units shall be:

If not integrated in compressor, be sized for maximum system demand, include pressure gauges, and automatic ejection of condensate from air stream; and

Direct expansion type, non-cycling, air-cooled with steel enclosure and capability to deliver air at 3 deg C dew point, working pressure for the system 1000 kPa.

1.2.5. Receivers

Air receivers shall comply with SANS 347, of all welded construction with dished ends and shall be supplied with test certificates. The vessels water capacity of the receivers shall be 50% of the total compressed output for one unit in one minute, stated in terms of free air delivered at normal working pressure. Receivers shall also be fitted with pressure gauge and an automatic drain. Mark the maximum working pressure in red of the faceplate of the gauge.

1.2.6. Compressed air purification system

Compressed-air purification systems shall:

1. Remove excessive moisture, solid particulates, oil and oil mist, carbon monoxide, and hydrocarbon vapours.
2. Capacity and dew point indicated, but not higher than 3 deg C at 1000 kPa.

Filters - Parallel duplex filters, each sized for maximum system demand, and with valved bypass for filter servicing.

Accessories - Factory- or field-installed inlet and outlet pressure gauges, safety valves, and shutoff valves; and capability to automatically eject condensate from airstream.

Filter assemblies

Compressed-air filter assemblies shall be:

Suitable for medical air, in parallel duplex arrangement. Size each assembly for maximum system demand of capacities indicated, but not less than capacity and operating pressure of medical air system. Include automatic ejection of condensate from airstream, factory or field-installed inlet and outlet pressure gauges, and shutoff valves.

Factory fabricated filter system consisting of 3 air filters equivalent to those specified, pipe, fittings, valves, differential pressure switch, and enclosure: with additional field-installed automatic drain traps and gauges.

Size filter assemblies not to exceed 50 kPa maximum air pressure drop when filters are new and clean, at system rated capacity, and at 1000-kPa working pressure.

Differential Pressure Switch: Adjustable, diaphragm type, with electrical connections for alarm system, to indicate when air pressure drop through filters rises to more than 20 kPa greater than when new and clean.

Particulate Filters - Collection efficiency of 99.5 percent retention of particles 1 microns and larger

Coalescing Filters: Collection efficiency of 99.996 percent retention of particles 0.01 micron and smaller.

Odour and Taste Filters: Vapour-absorbing, activated charcoal.

Include factory- or field-installed automatic drain trap for each filter.

Air dryer

Compressed-air dryer as part of the filter assemblies shall be:

Desiccant or refrigeration type capable of reducing the water content to permissible in the medical pipe line systems as [shall not exceed 115 VPM or 0.95mg/l with dew point of –40 C at atmospheric pressure]

1.2.7. Special-purpose valves

Safety Valves - Bronze body, with settings to match system requirements, to relevant SANS.

Pressure Regulators - Brass or bronze body and trim; spring-loaded, diaphragm-operated, relieving type; manual pressure setting adjustment; rated for 1725 kPa minimum inlet pressure; and capable of controlling delivered air pressure within 5.0 kPa for each 100 kPa inlet pressure.

Automatic Drain Valves - Corrosion-resistant metal body and internal parts, 1500 kPa minimum working-pressure rating, capable of automatic discharge of collected condensate.

1.2.8. Execution

1.2.8.1. Equipment installation

Compressed air equipment (air compressors, intercoolers, aftercoolers, air-receiver tanks, dryers etc.) shall be installed on concrete bases and shall be set and connected including all accessories according to manufacturers' instructions. Units shall be installed plumb, level, and firmly anchored in locations indicated, maintaining manufacturers' recommended clearances. Plant shall be oriented in such a way that the equipment, controls, and devices needing service are accessible.

The Subcontractor shall:

Anchor Compressed air equipment and major accessories to substrate.

Support Compressed air equipment with concrete inertia base and spring isolators unless otherwise indicated.

1.2.8.2. Connections

The Subcontractor shall:

1. Install piping next to Compressed air equipment and accessories to allow service and maintenance.
2. Connect Compressed air piping to equipment and accessories with unions and shutoff valves.
3. Install thermometers on receiver tanks and separators.
4. Install Compressed air gages on receiver tanks and separators.
5. Install automatic drain valves on intercoolers, after-coolers, separators, receivers, dryers and filters.
6. Discharge condensate over nearest floor drain / gully trap.

1.2.9. Delivery, storage, and handling

Deliver and store medical Compressed air equipment on factory-installed shipping skids, with sealing plugs in pipe connections.

Store pre-cleaned and sealed equipment and accessories with sealing plugs and sealing packaging intact.

Label equipment and accessories that have not been pre-cleaned, or that have been pre-cleaned but have seal or packaging that is not intact, with temporary labels indicating that cleaning is required before installation.

1.3. Medical vacuum system and components

1.3.1. General

Medical vacuum pump system shall be factory-assembled, wired, piped, and tested and capable of producing vacuum at not less than 78 kPa. Medical vacuum pump system shall be supplied complete with control panels incorporating automatic control station with load control and protection functions and shall include the following features and devices:

1. Mounting and Wiring - Factory installed and connected as an integral part of equipment package.
2. Motor Controllers - Full-voltage, combination-magnetic type with undervoltage release feature and motor-circuit-protector-type disconnect and short-circuit protective device.
   a) Control Voltage: 230 V, ac or less, using integral control power transformer.
   b) Motor Overload Protection - Overload relay in each phase.
   c) Starting Devices - Hand-off-automatic selector switch in cover of control panel, plus pilot device for automatic control as indicated.

d) Automatic Alternating Starting - Switches lead vacuum producer for duplex vacuum units.

3. Instrumentation - Include vacuum-receiver vacuum gage, inlet-line vacuum gage, hour meter, discharge-air and coolant temperature gages, and control transformer.
4. Alarm Signal Device - Connect to master alarm panels. Indicate when back-up vacuum pump is operating.

Receiver Tanks and Safety Valves shall comply with SANS 347 and bear appropriate code symbols, with vacuum relief valve, vacuum gage, and automatic drain.

1.3.2. Rotary vane, medical vacuum pumps

Medical vacuum pump system shall be in triplex arrangement (each with 100% design capacity); single-stage, continuous-duty, vane pumps complete with:

1. Inlet filters.
2. Coupling - Nonlubricated, flexible type.
3. Cooling/Lubrication System - Unit-mounted, air-cooled exchanger package, prepiped to unit with air pressure circulation system, with coolant stop valve, full-flow coolant filter, and thermal bypass valve.
4. Capacity Control - Capacity modulation between 0 and 100 percent vacuum delivery, using manufacturer's standard control. Include necessary control to hold constant vacuum. When vacuum demand is zero, unload unit by using vacuum switch and blow-down valve.
5. Outlet silencers on discharge connections.

Medical vacuum pump system shall have the following built-in features/accessories:

1. Heavy duty structural base
2. Complete instrumentation to aid in maintenance.
3. Dual set-point vacuum switch.
4. Reverse rotation protection consisting of a pressure switch, set at between 3 and 5 kPa above atmosphere. This switch shall be wired into the main motor control circuit.
5. Plant shall automatically re-start on power restoration after power outage.
6. The machines shall be equipped with line vacuum, sump pressure, discharge temperature gauges

1.3.3. Special-purpose valves

Safety Valves shall be bronze-body pressure relief valves with settings to match system requirements.

Automatic Drain Valves shall be Corrosion-resistant metal body and internal parts, 1380 kPa minimum working pressure rating, capable of automatic discharge of collected condensate.

1.3.4. Exhaust attenuation

Exhaust pipe shall be taken to outside of the plantroom above the highest point of the roof, pipe end shall be formed in "goose neck" and fit with an insect mesh and exhaust muffers to ensure silent operation.

1.3.5. Vacuum reservoir

A vacuum reservoir shall be provided to prevent pump running continuously on low loads, manufactured in accordance with SANS 347, with test certificates provided to the user. The minimum test pressure shall be 4 bar. The unit shall be of all welded construction with dished ends.

The water capacity of the reservoir shall be equal to the plant design flow at 60 kPa in terms of free air aspirated in 1 minute with the pump operating at 60 kPa.

Provision shall be made for draining the reservoir under vacuum conditions. Bypass facilities shall be provided, so that the reservoir can be drained and inspected without interruption to the vacuum supply. The reservoir shall be fitted with vacuum gauge, suitable lifting lugs/feet and internally coated with an approved corrosion protection. The receiver shall also be fitted with non-return valve towards the pump.

1.3.6. Filters and traps

The bacterial filters and drainage trap shall comprise two identical sub-assemblies with manually operated isolating valves arranged to allow sub-assembly to be on-steam. Each sub-assembly shall contain a bacterial filter rated at the plant capacity.

The bacterial filter shall be marked with the legend "bio-hazard" together with a description of a safe procedure for changing and disposing of the filters and emptying the drainage trap.

The bacterial filters shall have a filter efficiency when tested by the sodium flame test in accordance with SANS of less than 0.005% at the system design flow.

The pressure drop across a clean filter at the system design flow shall not exceed 3.3 kPa at a vacuum of 63.3 kPa.

The drainage trap may be integral with the bacterial filter and shall be fitted with a transparent sterilisable bowl to collect liquid.

Moisture traps shall be provided with multi-port valve at following positions:

- Shut-off
- By-pass
- Bottle

1.3.7. Pressure Control

The cut-in setting for the vacuum pumps shall be adjusted to allow for the pressure drop across the pipeline distribution system and the bacterial filters. The cut in may be expected at about 66 kPa.

The cut-out setting shall be at an appropriate point on the performance curve of the pump, which minimises stop/start operation but is at a vacuum which is economically attained by the pump. This cut-out setting may be expected at about 86 kPa.

1.3.8. Pressure regulation of vacuum system

A vacuum of 40 kPa is required at the connection point of each terminal unit with a flow of 40 l/min whilst the system is operating at system design flow.

A maximum pressure drop of 13 kPa is allowed across the terminal unit at a flow of 40 l/min (BS 5682:1984). A further maximum pressure drop of 7 kPa is allowed in the distribution pipework, giving a total pressure drop of 20 kPa between the terminal unit connection point and the plant test point. Thus the target vacuum at the test shall be 60 kPa.

1.3.9. Vacuum Indicators

Vacuum indicators shall comply with SANS 1062 or have an equivalent performance if electronic indicators are used. Calibration shall be 0-100 kPa. All gauges shall be a minimum scale length of 90 mm.

Vacuum indicators shall be located on.

a. The plant control unit indicating the vacuum in the pipeline (that is, on the pipeline side of the bacterial filter).

b. Each reservoir.

A different vacuum indicator shall be located across the bacterial filter.

1.3.10. Execution

1.3.10.1. Equipment installation

Vacuum equipment shall be installed on concrete bases and shall be set and connected including all accessories according to manufacturers' instructions. Units shall be installed plumb, level, and firmly anchored in locations indicated, maintaining manufacturers' recommended clearances. Plant shall be oriented in such a way that the equipment, controls, and devices needing service are accessible.

The Subcontractor shall:

Anchor vacuum equipment and major accessories to substrate.

Support vacuum equipment with concrete inertia base and spring isolators unless otherwise indicated.

1.3.10.2. Connections

The Subcontractor shall:

1 Install piping next to vacuum equipment and accessories to allow service and maintenance.

2 Connect vacuum piping to equipment and accessories with unions and shutoff valves.

3 Connect drainage piping to equipment and accessories with unions and shutoff valves.

4 Install thermometers on receiver tanks and separators.

5 Install vacuum gages on receiver tanks and separators.

6 Install automatic drain valves on vacuum receiver tanks and separators.

7 Discharge condensate over nearest floor drain / gully trap.

1.3.11. Delivery, storage, and handling

Deliver and store medical vacuum equipment on factory-installed shipping skids, with sealing plugs in pipe connections.

Store precleaned and sealed equipment and accessories with sealing plugs and sealing packaging intact.

Label equipment and accessories that have not been precleaned, or that have been precleaned but have seal or packaging that is not intact, with temporary labels indicating that cleaning is required before installation.

1.4. Cylinder manifold installation for 400 kPa installations

1.4.1. General

Manifolds should be connected to the pipeline via a control panel which provides two equal banks of gas cylinders. The changeover from the "duty" to the "standby" bank of cylinders should be automatic. All manifolds should be capable of passing the full pipeline flow. The temperature of the gas may fall as low as –30°C as the gas passes through the regulator at maximum capacity, and the equipment should be designed accordingly.
The gas manifolds shall provide a continuous supply of medical grade gas to the various locations throughout the building. All the supply systems consist of gas cylinders (100% run/ 100% standby), gas manifold, automatic changeover valves, safety valves, high pressure filters, pressure regulators, non-return valves, pressure contact gauges, warning and alarm systems, interface, pipeline, etc. the materials and fittings for the manufacturer of the manifolds must be of stainless steel and the piping must be of heavy gauge bronze or copper.

1.4.2. Manifolds

Manifolds and control panels shall be designed and certificated for use with 20000 kPa cylinders. The materials and fittings used for the manufacture of the manifolds shall be of forged bronze, while piping shall be of heavy gauge bronze or copper. Pigtails shall be of heavy gauge copper tubing. The tail-pipe manifold connector shall be gas-specific.

The manifold shall:

- Incorporate duty and standby cylinder banks. The manifold shall come complete with certification that the manifold has been tested to the prescribed test pressure and that all components are free from oil.
- Be of a duplex type with automatic changeover between duty and standby cylinder banks while simultaneously actuating the warning system.
- Be wall mounted.
- Incorporate a renewable non-return valve to allow removal and replacement of any cylinders without disruption to others.
- Be clearly identified as to the contained gas and shall be provided with warning, colour coding and instruction notices.
- Have contact gauges on each bank, and on the delivery line.

An automatic manifold changeover from "duty" to standby should occur at a cylinder pressure which will ensure the greatest possible utilization of the contents of the cylinders in the "duty" bank. A nominal changeover at a gauge pressure of 800 kPa is usually satisfactory for a distribution pressure of 400 kPa. If the normal operation of the changeover control depends on an electricity supply, the design should be such that failure of the electricity supply does not disrupt the flow of gas to the distribution system.
Some manifolds default to a specific bank following a power failure, regardless of which bank was the running bank prior to interruption of the supply. In the event of power failure, on restoration of the power supply, the original running bank should be on-line, that is, the same bank as was the running bank prior to interruption of the supply.

The oxygen manifold shall include provision for connection with the Vacuum Insulated Evaporator (VIE).

Construction of manifolds shall allow for future extension without disruption to the existing gas supply to the building.

1.4.3. Pigtail pipes

Cylinders shall be connected to the manifold by pigtail pipes, which shall be of sufficient length and flexibility to permit easy connection to the cylinders without having to strain the pigtail pipes. Each outlet connection from the manifold to the pigtail pipe shall have a non-return valve fitted. Pigtails shall be fitted with high pressure gas connections (not soldered) and standard cylinder connections for cylinder coupling. These connections shall be with permanent handles of minimum 200mm long to secure whilst the connecting nuts to the cylinder are being tightened. Each pigtail shall be with serial number stamped on and delivered with manufacturers test certificate.

1.4.4. Pressure control

Pressure indications shall be provided to indicate pressure in each cylinder bank and in the pipeline distribution system.

There shall be separate pressure regulating valves for each cylinder bank, and the control system shall be designed so that the cylinders of one bank can be changed or the pressure regulator for one bank can be overhauled without loss of continuity of the gas supply.

Pressure safety valves shall be of the self-closing type, and be installed on each distribution pipeline downstream of the manifold line pressure regulator and upstream of the main isolation valve. A pressure safety valve shall also be installed between the emergency/reserve manifold and the pipeline distribution system. It shall have a flow capacity at least equal to that of the pressure regulator immediately upstream of it. The discharge pipe shall be at least one size larger than the main pipeline.

This discharge pipeline shall be vented to atmosphere, outside the building, in, an area where the discharge of oxygen will not contribute to a fire risk, where no hazard will arise from the discharge of nitrous oxide and where it is not liable to injure personnel when discharging.

It shall be well clear of any openable window or air intake. The ends of the discharge pipelines shall be turned downwards to prevent the ingress of dirt and moisture and be placed and protected so that frost cannot form or be collected upon them.

1.4.5. Control panel

Medical gases cylinders shall be manifolded together with the attendant control panel, alarm and stand-by supply systems. The control panel shall maintain an outlet pressure, as specified elsewhere, at the required flow.

The stand-by supply shall feed into the control panel and, in the event of the primary cylinder supply pressure dropping below a pre-set value, a flow from standby source shall commence automatically. A constant supply of required gas at the correct pressure shall be maintained.

1.4.6. Stand-by manifold

The stand-by supply shall consist of a compressed manual changeover manifold. The stand-by gas manifold size, and quantity of hospital stock shall be as specified for the hospital's particular requirements.

1.4.7. Siting requirements for manifolds

Cylinders shall be installed within the designated building. If required to be installed in the open air, they shall be in an enclosure designed for the purpose.

Cylinders shall be in well-ventilated areas, well away from any heat sources. The location shall be free from constrictions, with sufficient access to the cylinders, manifold, and control panel.

The floor shall be level but designed to avoid any accumulation of water in the vicinity of cylinders.

The cylinders shall be located at least 3 metres from:

1. open sewers/drains
2. pits
3. trenches
4. any openings to underground rooms/enclosures
5. any combustible materials

1.4.8. Gas cylinders

The cylinders supplied shall be full and sealed at handover. They shall not be used for testing and commissioning. All deposits on gas cylinders shall be paid and the slip handed over to the end user at practical completion.

Generally, gas cylinders and valve components shall be in accordance with SANS ISO 407.

Total storage shall be provided based on one week's supply. Each bank of the manifold shall hold not less than two days' supply and a supply for three days shall be held in cylinders in the store.

The nominal and usable capacities of the cylinders commonly used on manifold are given in Table 1 (the figure are the equivalents at standard temperature and pressure).

Table 1 Capacities of size J medical gas cylinders used in manifolds

Gas	Nominal capacity (l)	Usable capacity (l)
Oxygen	6820	6540
N_2O	9070	8900
Medical air 400kPa	6400	5540
Surgical air 700kPa	6400	5540

The usable capacity figures are for discharges down to a gauge pressure of 700 kPa. Two sets of figures are provided for air – for 400 kPa systems and 700 kPa systems. The latter is for discharge down to 1500 kPa.

All medical gases shall meet quality standards as specified in BS 4275.

All cylinders in a bank shall be fixed against a rack with individual safety chain at approximately 2/3 of the cylinder height. Secure the chains with eye bolts and deep hooks to the racks.

1.5. Emergency reserve supply

1.5.1. General

The reserve supply shall provide the same flow rate as the primary system and have sufficient connected capacity to supply the pipeline for at least four hours. When such provision would result in six cylinders or more on each bank, the additional cylinders shall be held in the manifold rooms. A non-return valve shall be installed immediately up-stream of the reserve manifold connection to the pipeline distribution system.

1.5.2. Emergency reserve supplies for manifold installations

The supply shall be brought into operation automatically via a non-return valve.

A two-cylinder emergency reserve supply would normally be considered adequate for a cylinder manifold supply system. The cylinder valve of one shall be permanently open, so that gas is immediately available.

The cylinder valve of the second cylinder shall be closed, so that by alternative use a continuous supply can be maintained.

1.6. Anaesthetic gas scavenging system and components

1.6.1. General

Anaesthetic gas scavenging system shall comply with SANS 7396 and shall be an active system.

The materials shall be resistant to corrosion, and shall withstand cleaning, disinfection or sterilization as appropriate. The transfer system and other detachable components shall withstand steam sterilization at 136 ± 4°C. The manufacturer shall recommend methods for cleaning, disinfecting and sterilizing the system.

The fixed pipework shall be of copper using degreased tubes.

1.6.2. AGS Pumps

All safety devices shall fail safe and all AGS systems shall comply with SANS 7396.

Safety criteria for AGS systems

Maximum pressure increase at inlet	at 30 l/min for 5s (Pa)	at 90 l/min for 5s (Pa)
Positive pressure relief at inlet to transfer system inoperative	50	500
With any hose or tubing totally obstructed	1000	2000

Maximum induced flow into the receiving system from the transfer system: 0.05 l/min.

1.6.3. Performance criteria

The performance criteria for the disposal system shall be as specified in the BS. In terms of the extract flows at specified resistances shall be as shown in table below.

Flow with a resistance to flow producing a pressure drop of 1 kPa	Flow with a resistance to flow producing a pressure drop of 4 kPa
Maximum flow 75 l/min	Minimum flow 50 l/min

The performance criteria shown in the table above shall be achieved regardless of the number of terminal units on each system; where more than one terminal unit is provided on the system, the performance criteria shall be achieved with all, or one, of the terminal units operative.

1.7. Pressure regulation

1.7.1. Pressure regulation for 400 kPa systems (medical gases and medical air)

Minimum pressure required by medical equipment at terminal units in 400 kPa systems is 355 kPa. The pressure settings on the line regulators shall be based on achieving this minimum pressure considering operating tolerances of the components.

The various pressure settings in 400 kPa system to achieve this minimum pressure at outlet are:

Pressures rounded off (kPa)	Safety valve pressure settings and operating tolerances		Over pressure alarm switches tolerances ±5%		Line pressure regulator tolerances ± 4%		Pipeline operating pressure range	Local under pressure alarm switches operating tolerance ±5%
580	Max dis. Set pressure	580						
560								
	Set pressure	530	Max over pressure	530				
520								
	Set pressure	510	Set pressure	505				
500			Min. over pressure	483				
480	Resetting pressure 90% of set pressure	480						
					Max. line pressure set pressure	478		
460					Set pressure	460		
440	Plant output min. 440 kPA				Min. line pressure	440		
420								
400	Nominal pipeline pressure							
380							Max under pressure	390
360							Set pressure	370
340							Min under pressure	354

1.7.2. Pressure settings for 400 kPa compressor plant systems

The HTM 02 requirements for various pressures for pipeline installations and plant are:

Nominal pressure	400 kPa
Vessel safety valve set pressure (valv to BS 6759 Part 2)	1100 kPa
Compressor minimum output pressure (if separate compressor provided)	800 min.
Safety valve (BS 6759 Part 2)	
1. Full discharge	580 kPa
2. Maximum lift	557 kPa
3. Set pressure	530 kPa
4. Minimum lift	510 kPa
5. Reseating pressure	480 kPa
Over pressure alarm nominal setting	505 kPa
Maximum operating pressure	478 kPa
Plant output minimum pressure	440 kPa
Pipeline distribution pressure	400 kPa
Operating tolerances – over pressure alarm	529 – 478 kPa
Operating tolerances – under pressure alarm	392 – 354 kPa

1.7.3. Pressure regulation for surgical air 700 kPa system

Compressed air for surgical tools shall be available at terminal units at a pressure of 700 kPa at the required maximum flow of 350 l/min. To avoid overpressure at lower flows, a pressure control unit shall be located upstream of the terminal unit.

1.7.4. Pressure settings for 700 kPa compressor plant systems

The HTM 02 recommendations for pipeline and plant pressure settings are:

Nominal terminal unit pressure	700 kPa
Plant safety valve set pressure	1400 kPa
Plant minimum output pressure	1270 kPa
Pipeline pressure regulator set pressures	1210 kPa
Maximum pipeline distribution pressure	1265 kPa
Minimum pipeline distribution pressure	1000 kPa

The various pressure settings in 700 kPa system to achieve this minimum pressure at outlet are:

Pressure rounded of (kPa)f	Safety valve pressure settings and operating tolerances		Alarm pressure switch/tolerance ± 5%		Max pipeline static pressure line pressure regulator tolerance ± 5%		Control range of terminal units pressure regulator device		Safety valve pressure settings & operation tolerance
1600									
	Max. discharge 110% set pressure	1550							
1500									
	Set pressure	1405							
1400									
	Set pressure min. lift 99%	1365	Upper tolerance	1395					
1300			Set pressure	1335					
	Reseating pressure 90% set pressure	1270	Lower tolerance	1270	Upper tolerance	1265			
1200					Set pressure	1210			
					Lower tolerance	1150			
1150									
1050	Pipeline Distribution Pressure								
1000									
900									
							Max discharge	845	
800							Set pressure	770	
							Min. lift	745	
700	Nominal Terminal Unit Pressure								
							Reseating pressure 90% of set pressure	705	

1.7.5. Area alarm nominal setting

The following applies to both 400 kPa and 700 kPa systems.

The alarm pressure switch setting, and the safety valve settings shall overlap. It is not intended that the alarm system shall provide a warning of safety valve relief. The over-pressure alarm is intended to provide users with advance warning of a potentially hazardous increase in line pressure, which could adversely affect the operation of equipment such as blenders. Safety valves shall hence provide system protection in the event of regulator failure.

The over-pressure alarm setting shall allow the alarm to switch off at a pressure just above the maximum static pressure in the system. This is set at 505 kPa for 400 kPa systems and 1335 kPa for 700 kPa systems. In both cases the pressure switch tolerance shall be ±5%.

Safety valves shall be to BS 6759 with a specified performance in which the minimum lift pressure is 97% of the set pressure, whilst the full discharge pressure is 110% of the safety valve set pressure.

Vessel safety valve set pressure shall be 110% of 1000 kPa, which shall be the nominal working pressure of the vessel.

1.8. Control, warning and alarming systems

1.8.1. Compressed air system

1.8.1.1. Operating and indicating system

The operating and indicating system shall perform the following functions:

1. Overall plant control and indication
2. Individual compressor starting
3. Control of dryers
4. Plant status monitoring and indication
5. Indication of the plant alarm status

The individual compressor shall be housed in a separate compartment. The above functions shall be carried out by separate units installed in a common panel and located on the plant on the plantroom wall. Control panels containing components shall have vents to permit release of pressure in the event of components failure. All functions and indicators shall be appropriately identified and shall have a design life of at least one year.

The operating system shall be capable of automatically restarting after reinstatement of the power supply.

All components of the medical air supply shall be connected to the stand-by electrical supply. The control system shall ensure that compressors restart in sequence, to avoid overloading the stand-by power supply.

1.8.1.2. Plant control unit

The control unit shall have a separate power supply for each compressor, controlled by a separate sub-circuit derived from the yellow phase.

The unit shall allow either manual selection of duty/stand/by for each of the compressors or have an automatic sequence selection with a means for manual override. The unit shall ensure that two or more compressors do not start simultaneously when power is applied.

Load and un-load cycle shall be incorporated for lead compressor only. The load compressor shall run continuously and may only switch off if no pressure drop is detected for a period of 60 minutes. A maximum pressure difference of 10% of the normal working pressure is allowed between load and un-loads.

Lead/lag automatic selection shall be controlled by the fitted controller and shall be set to achieve 60/40 run hour ratios. The lead/lag operations shall ensure that the lead machine carry the base load demand and the lag machine remains as automatic standby.

If the system pressure drops, the lag machine shall start-up to assist the lead machine to attain system pressure.

Pressure switches shall be set as follows: