SPECIFICATION AND TENDER DOCUMENTATION FOR THE

MECHANICAL AIR-CONDITIONING INSTALLATION

AT THE

SABS HEAD OFFICE

GENERAL TECHNICAL SPECIFICATION

GENERAL REQUIREMENTS

AIR CONDITIONING INSTALLATION

1 GENERAL INFORMATION

- The General Technical requirements cover the delivery, installation, testing, commissioning and maintenance of the Air Conditioning Installation.

    - The complete Air Conditioning Installation shall comply with the requirements of this specification. Should any discrepancies or contradictions arise between this part of the Specification and the Detailed Technical specification (Section 1) then the latter shall take preference. Should any discrepancies appear between the written specifications and the drawings, tenderers shall ascertain the position before the tender closing date, otherwise, the worst or any case may be assumed by the Engineer entirely at his discretion.
    - This specification is of simplified form and includes abbreviated sentences. The omission of words or phrases shall be implied by inference.
    - The Contractor is required to provide all material, equipment, labour and services and to perform all operations required for the installation to be complete and operative.
    - “Document" shall mean the complete set of contract and specification documents including all drawings variation orders and Engineer’s instructions issued in terms of the contract.
    - The Engineer will inspect the installation from time to time during the progress of the work. Discrepancies will be pointed out to the Contractor, which shall be remedied at the Contractor's expense.
    - Under no circumstances shall the above-mentioned inspections relieve the Contractor of his obligations in terms of this document.
    - The Contractor shall notify the Engineer timeously when the installation reaches important stages of completion (e.g. equipment installation, pressure testing, proving connections etc.) so that the Engineer's representative may schedule his site inspections in the best interests of all concerned. It will be the Contractors’ responsibility to schedule all inspections to give the Engineer at least 2 days advance notice. No claims for delay will be considered where the Engineer is unable to attend having been given less than 2 days’ notice.
    - Unless it is explicitly stated to the contrary and the words "Contractor" shall refer to the successful tenderer for the Air Conditioning Installation.

2 REGULATIONS

- The installation shall be erected and tested in accordance with the following regulations:
    - The Factories, Machinery and Building Work Act of 191 as amended.
    - The regulations of the local Gas Board.
    - Regulations Governing Patient Care Facilities, Manual R158
    - The SABS Code for the Wiring of premises -SABS 0142-1987 as amended as well as SABS 0180-1974 as amended.
    - The local Municipal By-Laws and Regulations as well as the regulations of the local Supply Authority.
    - The local Fire Regulations.
    - The Building Regulations as described in SABS 0400 (current edition)
    - The Occupational Health and Safety Act (current edition)
    - The Gauteng Provincial Government Standard Quality Specification for Airconditioning Installations.
- The Contractor shall issue all notices and pay all the required fees in respect of the installation to the authorities and shall exempt the Owner from all losses, claims, costs or expenditures which may arise as a result of the Contractor's negligence in not complying with the requirements of the regulations.
- It shall be assumed that the Contractor is conversant with the above-mentioned requirements. Should any requirements, bye-laws or regulations, which contradict the requirements of this Document, apply or become applicable during the 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.

3 SITE CONDITIONS

- Tenderers are instructed to visit the site and acquaint themselves with all local conditions pertaining to the execution of the installation before the tender closing date. 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 the contractor can visit the site, a visit will be arranged for all interested parties at their request.

4 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 the 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.

5 MATERIAL, EQUIPMENT AND WORKMANSHIP

- 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 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.

6 OPERATOR TRAINING

- On completion of all tests to the satisfaction of the Engineer the Contractor shall continue to be responsible for the complete operation and maintenance of the plant for a period of one week during which time instruction shall be given to the Employer's staff on the proper operation and maintenance of the plant.
- The operation and maintenance of the plant for the duration of the instruction period shall not in any way relieve the Contractor of his responsibility under the terms of the contract.

7 TOOLS AND EQUIPMENT

- 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.

8 MAINTENANCE TOOLS

- 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.

9 STORAGE OF EQUIPMENT AND MATERIALS

- The Contractor shall ensure that all stored materials 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 fire fighting equipment shall be provided by the Contractor, who shall further ensure that staff capable of using the equipment are at hand.

10 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 it is suitable for moving through the restricted openings or areas of restricted height or areas of restricted load.

11 PROGRAMME AND PROGRESS

- The Contractor shall provide a detailed programme for the complete works within 14 days of appointment. 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 engineer.
- The programme shall list each scheduled item of equipment in the contract and shall indicate periods for:

    - Preparation, approval and finalisation of manufacturing drawings.
    - Ordering
    - Manufacturing
    - Inspection and testing during manufacture.
    - Delivery
    - Installation
    - Testing
    - 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.

12 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.

13 BUILDERS WORK

- The successful tenderer shall, within 14 days, or any shorter period which may be necessitated by the construction programme, submit two copies 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 for issue to all parties.
- It is the responsibility of the Contractor to check the builders 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 out of the contractors failure to check the builders work in good time.
- The builders work drawings shall be fully dimensioned and shall include the following:

    - details of all plant bases required.
    - positions of all drain points.

- details of all openings in walls and concrete work
- details and positions of all equipment to be built into walls.
- any other work required.

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

14 SUPERVISION AND SITE ORGANISATION

- For the full duration of this Contract, the 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 Engineer.
- The supervisor shall be the contractor's authorised representative for the project and on site and shall be available to attend progress meetings when called upon to do so by the Engineer 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 contractor.
- The supervisor shall not be transferred from his position unless on the express instructions of the Engineer.
- The contractor shall at all times have on site copies of all relevant drawings as well as a copy of the specification. The 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.

15 DRAWINGS

- The Engineers drawings for the contract shall be those issued at the time of Construction together with any others issued to cover the variations to the contract.
- As part of this contract the Contractor shall provide the following drawings:

Manufacturing and Installation Drawings:

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

Wiring Diagrams:

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

Builders Work Drawings:

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

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 to approve 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 suite the construction of the plant.
- All drawings shall be clearly numbered or marked with the equipment item numbers, area references, etc.

- **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.
  - 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, one 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 and 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.

- **Record Drawings:**

  - On completion of the installation, but before final handover, the Contractor shall provide two hard copies and one soft copy (USB) of each of the following drawings showing the services as fixed:

    - Complete 1 : 50 scale layout of pipework inside plantrooms.
    - Large scale (at least 1:50) details of plantrooms.
    - Complete 1 : 50 scale drawings of the whole installation.
    - Detailed drawings of all items of plant.
    - Electrical layouts and wiring diagrams.
    - Details of any other items requested by the Engineer.

  - The drawings shall be sufficient in detail to enable the Employers staff to maintain, dismantle, reassemble and adjust all parts of the works.
  - The layouts shall show the location of all manual and automatic valves, controls, control panels, outlets, etc.
  - A copy of the wiring diagram shall be mounted in the Plant room in a glass fronted frame. The diagrams shall be printed by a non-fading process.

16 MAINTENANCE AND GUARANTEE

Maintenance

- The Contractor shall maintain the entire installation as described in this specification for a period of one year from the date of final handover.
- The maintenance visits shall be carried out at regular monthly intervals.
- The maintenance shall cover all items of plant and equipment and shall include replacement of all expendable items, e.g. drive belts, fuses, filters, etc.
- In addition to the monthly maintenance visits, the Contractor shall carry out all necessary visits due to failure of any item of the plant or equipment. The contractor shall attend to all complaints by the Employer.
- The Contractor shall report to the Owners nominated representative, both on arriving and leaving the site. The Contractor shall provide the Owner and the Engineer with a Service Report for each visit whether scheduled or breakdown.
- At each maintenance visit, the Contractor shall check the function of each item of plant and equipment and shall ensure that the plant is performing to specification. All automatic controls and bulbs, etc. shall be checked and adjusted or replaced as necessary.
- The equipment and plantrooms shall be cleaned at each scheduled visit.
- The Contractor shall notify the Engineer prior to the final monthly service so that the Engineer may accompany the Contractor.
- The Engineer may at his discretion allow he maintenance period on any item of equipment or section of the installation start at a date prior to final handover if it is put into operation for beneficial use of the owner prior to final handover. This will not be permitted in cases where final handover is delayed due to the Contractor not carrying out remedial work in good time.

Guarantee

- The Contractor shall guarantee the entire installation as described in this specification for a period of one year from the date of final handover. The guarantee shall provide that all pats, spares, equipment that becomes defective during the guarantee period shall be replaced free of charge. The guarantee shall cover all costs including material, labour, overheads, travelling etc.
- The complete installation shall be guaranteed against defects whether patent or latent as well as against faulty materials and workmanship.
- The guarantee shall cover all materials, plant and equipment whether or not it is covered by a manufacturers guarantee. The one year guarantee in terms of this contract on the entire installation shall not be affected by the prior expiry of any guarantee provided by the manufacturer of any item of equipment or plant.
- The Contractor shall cede to the Owner the remainder of any equipment guarantee which he has received from his suppliers and which extends beyond the one year period. It shall be the responsibility of the Contractor to ensure that the guarantee is transferable.
- The Engineer may at his discretion allow the guarantee period on any item of equipment or section of the installation start at a date prior to final handover if it is put into operation for beneficial use of the Owner prior to final handover. This will not be permitted in cases where final handover is delayed due to the contractor not carrying out remedial work in good time.

17 OPERATING AND MAINTENANCE MANUALS

- The Contractor shall provide three copies of the Operating and Maintenance Manuals.
- The Contractor shall submit for approval to the Engineer, four weeks before completion of the installation, two copies of the maintenance and operating manuals for the plant and equipment supplied. The contract will not be accepted for handed over until the Operating and Maintenance Manuals are approved.
- The Engineer will return to the Contractor within ten working days of their receipt by him one copy marked with all changes which are necessary.
- The Contractor shall modify the manuals as required by the Engineer and submit to the Engineer, within ten working days, two revised copies of the manual. On completion of the installation, but before the plant is handed over to the Employer, the Contractor shall provide three copies of the final Operating and Maintenance Manuals for the plant and equipment supplied. The manuals shall be bound in book form with hard plastic covers to withstand constant use.
- The manuals shall be properly indexed to facilitate easy reference.
- The manuals shall include:

- A list of recommended servicing tools and specialist equipment.
- A list of spares to be supplied by the Contractor to cover the period of warranty.
- A priced list of recommended spares necessary for a period of 2 years in operation.
- Exploded drawings or detailed spares list from which every item of every piece of equipment can be positively identified for ordering replacements.
- A list giving the name and address of the local agent of each item of equipment.
- A list giving the name and address of the manufacturer of each item of equipment.
- A copy of all test certificates obtained with the plant.
- A list of recommended lubricants.
- A preventative maintenance programme for all equipment.
- Operating instruction for each item of equipment.
- Performance date and/or characteristic curves.
- Commissioning data.
- Record drawings.

SECTION 1 PART 1.1

CABLE INSTALLATION AND ACCESSORIES

1 GENERAL

- The installation of cables for distribution of power in buildings, structures and in the ground for system voltages up to 11000 volt, 50 Hz, comprise the following:-

2 Cable Types

- The following cable types shall be used, unless specified to the contrary in the detail technical specification:

    - Low voltage supplies in ground: PVC insulated armoured.
    - Low voltage supplies in Substation: PVC insulated armoured
    - Low voltage supplies to main distribution boards and sub-distribution boards: PVC insulated armoured, Unarmoured PVC insulated cables may only be used for supplies to sub-distribution boards if such cables are installed in conduit, sleeves or metal trunking.
    - Connections to equipment: PVC insulated armoured or unarmoured when installed in conduit or metal trunking.
    - Cables with copper conductors shall be used throughout. All cable installations shall conform to the SABS Code of Practice 0142 : 1978.

3 Routes

- Cables shall be installed in the positions indicated on the drawings. Deviations are to be pointed out to the Engineer before installation commences.
- Cable routes, or portions thereof, may be altered in advance of laying cables. Price adjustment, in respect of additional work shall be at the documented rates.
- Obstructions along the cable routes shall be brought to the attention of the Engineer.

4 INSTALLATION OF CABLES IN CONCRETE TRENCHES

Installation

- Cables shall be installed in concrete trenches in one of the following ways:

    - On horizontal cable trays.
    - On horizontal metal supports with suitable clamps, or
    - On vertical cable trays or metal supports fixed to the side of the trench. Cables shall be clamped in position.

- Cables shall not be bunched and laid on the floor of the building trenches.

Covers

- The covering of concrete trenches shall as a rule fall outside the scope of the electrical installation. The Contractor shall however be responsible for the cutting or drilling and smoothing of holes for cables through chequer plates, concrete or other covering as required.

Filled trenches

- Floor trenches shall be filled with sand only when it is a specific requirement of the Local Authorities.
- If a sand filling is required the cables shall be fixed to non-corroding supports.
- Sand-filled trenches if required shall be covered as follows:-

- Reinforced concrete covers
- Sand and cement screed or
- Removable chequer plates.

- Method 1 above shall be used where vehicular traffic may be encountered over trenches, in which case the covers must be designed to withstand the predetermined mass.

5 FIXING OF CABLES TO TRAYS OR STRUCTURES

Installation

- Cables may be installed in one of the following ways:
-
  - on horizontal cable trays,
  - against vertical cable trays with suitable clamps,
  - against horizontal or vertical metal supports or brackets with suitable clamps, or
  - on clamps which are fixed to the structure.

- Cable trays installed between steel columns must be supported by means of vertical suspension rods to prevent the tray from sagging or warping.

Clamps

- Suitable clamps (cleats) which will secure cables without damage shall be used. Clamps shall consist of adjustable metal wings which clamp to a metal support, or consist of two halves bolted together. The correct clamp size to fit the cable shall be used. Cables of different sizes may only be fixed by a common clamp when the clamp is specially made to accommodate the various cables.

Spacing of Supports

- The maximum spacing between cleats (clamps) to which cables are fixed in horizontally and vertical routes shall be determined from Table 1 below. Additional cleats shall be installed at each bend or offset in the cable run. Spacing of supports for cables for high voltage lighting shall be in accordance with Table 8 of SABS 0142.

TABLE 1

Cross Sectional Area of Cable Conductors (sq.mm)	Maximum spacing of supports (cleats) (mm)			
	Armoured Cables		Unarmoured Cables	
	Horizontal Cable Routes	Vertical Cable Routes	Horizontal Cable Routes	Vertical Cable Routes
1.5 4 core	450	750	300	400
2.5 4 core	450	750	300	400
4.0 4 core	600	750	300	400
6.0 4 core	600	750	300	400
10.0 4 core	750	900	400	450
16.0 4 core	750	1000	400	550
25.0 4 core	900	1000	450	550
35.0 4 core	900	1000	450	550
50.0 and above	900	1000	450	550
Multi core	30 X outside dia with max of 900 mm		20 X outside dia with max of 550mm	

Spacing correction factors

- Cables shall be spaced apart. Should this not be possible, the grouping correction factor, according to SABS 0142 shall apply.

Cables on Different Levels

- Where parallel cable runs are installed at different levels (e.g. on parallel cable trays) a minimum spacing of 300 mm shall be maintained between each level.

High Voltage Cables

- High voltage cables shall be separated from other cables and services throughout the installation and shall as far as possible be installed in separate floor trenches, pipes or metal channels. Where this is not feasible a minimum spacing of 300 mm shall be maintained.

Cables for other Services

- Cables for telephones, communication systems and other low voltage systems (less than 5O V) shall be separated from power cables. In vertical building ducts a physical barrier shall be provided between power cables and cables for other services. Where armoured cables are used for such other services, they shall be installed on separate cable trays or shall otherwise be at least 300 mm away from power cables. Where unarmoured cables are used for these other services, they shall be installed in separate conduits or metal channels.

6 TERMINATION OF CABLES

General

- Cable ends shall be terminated with glands and the associated accessories such as clamps, shrouds, etc. conforming to the requirements of SABS 0142.
- Connection of cables to switchgear shall always be effected in such a way that the various phases, seen from the front of the switchgear will be in the following positions:

No. 1 conductor : left (red) (A)
No. 2 conductor : centre (white) (B)
No. 3 conductor : right (blue) (C)

- Cable cores shall be marked with coloured tape where necessary to identify the phases, but standard phase colours are preferable.
- The current-carrying capacity and breakdown voltage of the cable end shall be the same as for the complete cable.

PILCSTA and PILCSWA Cables

- Paper insulated cables shall be manufactured in accordance with SABS 597.
- Cable end boxes shall comply with BS 542 and the filling compound to BS 1858.
- The ends shall be terminated in cable end boxes filled with bituminous cold filling or resin oil semifluid compound or heat shrinkable terminations in accordance with the specification, and to the manufacturer's recommendation.
- Before terminating or jointing PILCSTA and PILCSWA cables a test to establish the presence of moisture must be carried out. The test procedure must be forwarded to the Engineer for approval.
- The armouring shall be bonded to the main earth bar of the switchgear or transformer, but the bond shall be easily removable for testing purposes.
- All cut cable ends which will be exposed to the atmosphere for more than two hours shall be sealed and wiped to prevent penetration of moisture.

PVC Insulated Cables

- PVC insulated cables shall be manufactured in accordance with SABS 150.
- PVC cable glands shall be made of nickel plated bronze or brass and must consist of a barrel carrying a cone bush screwed into one end and a nickle-plated brass nipple and galvanised steel lock nut on the other end.
- Flameproof glands shall comply with SABS 808 groups 1, 2a and 2b.
- All cable ends shall be terminated with approved glands ensuring a watertight connection between the sheath, gland and equipment. In cases where copper ECC earth conductors are jointed to the armouring special glands adhering to SABS 150-1970 paragraph 5.8.3(c) shall be used for ECC cables.
- The glands to be used shall be constructed so that the armouring of the cable is clamped between two beveled cores with a screw-clamp, with the cable gland screwed to the gland plate or equipment and fixed with a lock nut.

- A Neoprene or PVC shroud of the correct size shall be used to seal the gland and sheath watertight.
- Cable ends shall be supplied with the necessary earth connection.
- A supporting channel or other approved means of support shall be provided to remove mechanical stress from the cable glands.

XLPE Cables

- Cable ends shall be terminated strictly in accordance with manufacturer's specifications. The termination shall withstand the same test voltage as the rest of the cable.
- Termination for high voltage XLPE cables must have a satisfactory stress relief in order to keep the partial discharges extinguished.
- Outdoor termination must be able to withstand air pollution and bad weather without any signs of surface current tracking.
- Taped or prefabrication terminations may be used, in accordance with the manufacturers recommendation.

JOINTS

- No joints in cable runs will be allowed unless a cable run exceeds the maximum length available on a cable drum.
- Jointing shall be carried out strictly in accordance with the manufacturer's instruction and by personnel competent in jointing the types of cables used.
- The joint shall not impair the anti-electrolysis characteristics of the cable.
- The Contractor shall notify the Engineer timeously of the day on which jointing is to be carried out in order that an inspection may be arranged if so required. Any cable joint not inspected by the Engineer because of insufficient notice being given, shall be opened for inspection and redone at the discretion of the Engineer and at the cost of the Contractor.
- Joints shall be fully water and air tight and shall be free of voids and air pockets.
- The crossing of cores in joints will not be permitted under any circumstances.

7 CONNECTION OF CABLE CORES

- Suitable lugs shall be used, preferably crimped to cable core ends using mechanical or pneumatic tools designed for this purpose
- Cables that are connected to clamp type terminals where the clamping screws are not in direct contact with the conductor, need not be lugged but the correct terminal size shall be used.
- Contact surfaces shall be thoroughly cleaned and smoothed and fixing bolts shall match the hole size of the lug.
- Ferrules shall be used as far as possible where cable cores are connected directly to equipment with screws against the conductor strands.
- When cutting away insulation from cable cores to fit into lugs, care shall be taken that no strands are left exposed. Under no circumstances may any of the conductor strands be cut away to fit into lugs.

8 TESTING

- Each cable shall be tested after installation SABS 150 (Up to 1000V) and SABS 97 (Up to 11 requirements of the Local and Supply Author
- LV Cables shall be tested by means of a suitable megger 1000V and the insulation resistance shall be tabulated and certified.
- HV. Cables shall be pressure tested in accordance with the following table and the exact leakage current shall be tabulated and certified.

Cable rating (volts)	**Test Voltage (Applied for 15 minutes)**			
	Between conductors		**Conductors to sheath**	
	AC (r.m.s.)	**DC**	**AC (r.m.s.)**	**DC**
3300	6000	9000	3500	5000
6600	12000	18000	7000	10500
11000	20000	30000	11500	17000

- The Contractor shall make all arrangements, pay all fees and provide all equipment for these tests. The costs of testing must be included in the tender price. The tests are to be witnessed by the Engineer after timeous notification by the Contractor.
- On completion of the tests on any cable, the Contractor shall with-out delay, submit three copies of the certified Test Reports to the Engineer.

9 CABLE TRAYS AND LADDERS

- Cable trays and ladders shall comply with SABS 763 with respect to finishes. PVC trays shall be rigid unplasticised.
- The Contractor shall supply and install all cable trays and/or ladders as specified or as required including the necessary supports, clamps, hangers, fixing materials, bends, angles, junctions, reducers, T-pieces etc. He shall further liaise with the Main Contractor for the provision of holes and access through the structure and finishes.

Supports

- Trays shall be supported at the following maximum intervals:
- 1,6 mm thick metal trays with 12 mm return 1m spacing
- Metal trays with folded over return and 50 mm upstand 1.22 spacing
- 2,4 mm thick metal trays, and 75 mm return 1.5m spacing
- Metal cable ladders other than SCALLADDER 1.5m spacing
- SCALLADDER or similar 1.0 spacing
- 3,0 thick PVC trays with 40 mm return 1.0m spacing
- 4.0 mm thick PVC trays with 60 mm return 1.5m spacing
- In addition trays and ladders shall be supported at each bend, offset and T-junction. The above spacing of supports are applicable to both vertical and horizontal installation of trays and ladders.

Joints

- Joints shall be smooth without projections or rough edges that may damage the cables. The Contractor will be required to cover joints with rubber cement or other non-hardening rubberized or plastic compound if in the opinion of the Engineer joints may damage cables. Joints shall as far as possible be arranged to occur at supports. Where joints do not coincide with supports, joints shall in the case of trays with single returns be made by means of wrap-around pieces of the same thickness of the tray and at least 450 mm long. The two cable tray ends shall butt tightly at the centre of the splice and the splice shall be bolted to each cable tray by means of at least 8 round head bolts, nuts and washers.

  Splices shall have the same finish as the rest of the tray. Where joints which do not coincide with supports occur in trays with folded over returns, tight fitting metal guide pieces, at least 450 mm long, shall be inserted in the folded return to provide the necessary support to the two cable tray ends. Splices as described above shall be provided at joints which do coincide with supports if the loaded tray sags adjacent to the joint due to the interruption of the bending moment in the tray.

Fixing

- Trays and cable ladders shall be bolted to supports by at least two round head bolts per support. Bolts shall be securely tightened against the tray surface to avoid projections which might damage cables during installation.

Fixing to the Structure

- The supports for cable trays and ladders shall in all cases be securely fixed to the structure by means of heavy duty, expansion type anchor bolts. Cantilevered trays shall be supported at two points with a minimum of 2 expansion bolts per support. It is the responsibility of the Contractor to ensure that adequate fixing is provided since cable trays and ladders that work loose shall be rectified at his expense. The fixing shall take into account site conditions that prevail during installation.

Earthing

- Metal trays and ladders shall be bonded to the earth bar of the switchboard to which the cables are connected. Additional bare copper stranded conductors or copper tape shall be bolted to the tray or ladder where the electrical continuity cannot be guaranteed. These additional conductors or tapes shall always be installed in all outdoor applications and in coastal regions.

Expansion Joints

- Where cable trays/ladders have to cross expansion joints, the trays/ ladders must form a gap of at least 25 mm between the two sections. Cables installed across expansion joints, must have enough slack to accommodate the expansion of the building.

SECTION 1 PART 1.2

FIXING MATERIALS FOR ELECTRICAL SERVICES

1 GENERAL

- This section covers the general requirements for fixing materials forming part of the electrical installation.

2 Responsibility

- It is the responsibility of the Contractor to position and securely fix conduits, ducts, cables and cable channels, switchboards, fittings and all other equipment or accessories as required for the instillation. The Contractor shall provide and fix all supports, clamps, brackets, hangers and other fixing materials.

3 Finishing

- All supporting steelwork installed by the Contractor shall be wire brushed and given one coat of rust-resisting primer, followed by one coat of high quality enamel paint before any other equipment is fixed.

4 Welding

- Supports, brackets, hangers, etc. may only be welded to steel structural members where prior permission of the Engineer has been obtained.

5 Screws and Bolts

- Equipment with securing holes shall be fixed with bolts and fixing screws as specified. Where sizes are not specified, the largest bolt or screw that will fit into the hole shall be used.

6 Wall Plugs

- Where the fixing holes in brick or concrete walls are smaller than 10 mm dia. any where the mass of the equipment is less than 15 kg, wall plugs may be used to fix conduits, cables and other equipment. Aluminium fibre or plastic plugs only may be used. Wooden plugs are not acceptable. Plugs installed in seams between bricks are not acceptable. A masonry drill of the correct size shall be used to drill holes for plugs. Round-headed screws of the correct diameter to match the specific plug shall be used throughout.

7 Anchor Bolts

- Where the fixing holes are 10 mm and larger or where the mass of the equipment is 15 kg or more, equipment shall be fixed by means of expanding anchor bolts or by means of bolts cast into the concrete or built into walls.

8 Galvanised Equipment

- Brass screws, bolts and nuts shall be used to fix galvanised equipment.

9 Shot-Fired Fixing

- Materials such as metal cable ducts or channels may be fixed against wall and concrete slabs by means of the shot-fired method designed for this purpose.
- The Contractor shall ascertain whether this method of fixing will carry the weight of the material including conductors, cables and other items of equipment to be installed later. Should it be found that the method of fixing is inadequate and joints tend to loosen the Contractor will be required to fix the material by an alternative method to the satisfaction of the Engineer.

- Where the shot-fired method is used warning signs shall be placed at all entrances leading to the area where this work is in progress. The Contractor shall take all reasonable precautions to prevent accidents. Nails recommended by the manufacturer of the shot-fired equipment shall be used. Refer to clause C49 of Factories, Machinery and Building Work Act.

10 Clamps and Brackets

- Clamps and brackets used to fix or support equipment such as cable trays, ducts, etc. shall be of a purpose made type suitable for the specific application. Specially made brackets or clamps may only be used after approval of the Engineer has been obtained.

SECTION 1 PART 1.3

STANDARD SPECIFICATION FOR AIR FILTERS

1 GENERAL

- Only filter units shall be acceptable which can be shown to the satisfaction of the Engineer to be the standard products of a reputable manufacturer, regularly engaged in the fabrication of the particular type of air filter. If an imported product, the sub-contractor shall be able to prove that such products are well represented in the Republic of South Africa.
- Only filters tested by the South African Bureau of Standards to the ASHRAE Standard 52-68 will be acceptable. Arrestance (gravi-metric), efficiency (photometric), dust holding capacity and resistance against air velocity shall be documented according to the above test.
- Frames and filters shall be constructed in such a manner that the passage of unfiltered air is prevented. Gaskets shall be provided between filters and frames and filter frames unit casing.
- Each filter bank shall be supplied with an identification label stating the type of filters, quantity of filter elements, model numbers and all other information necessary for reordering filter material.
- Filters shall be adequately protected against dirt during construction and shall not be operated until the system is thoroughly cleaned. Filters must be put in regular operating condition before the fans which they connect are operated for any purpose.
- An inclined manometer shall be made with copper tubing. The full gauge shall be connected to static pressure taps of approved design so that it will indicate correctly the resistance of airflow to the filter. Connections shall be installed on each filter bank. The scale reading of the inclined manometer shall be between 30 and 60 percent higher than the change-out pressure of the filters.
- All filters other than automatic types shall be provided with pressure differential switches which shall operate when the pressure drop across the filter reaches a value recommended by the manufacturer. The switch shall energize a pilot light on the main control board.
- Filter dimensions shall be selected to suit the configuration of the air handling unit.
- All filter accessories including the filter holding frames and clips shall be standard products of the filter manufacturer.
- All metal parts shall be sufficiently protected against corrosion.
- All metal parts shall be coated with baked enamel or equivalent paint.

2 PANEL FILTERS

- Each filter bank shall consist of a factory made robust sectional steel supporting frame, which shall accommodate the filter cells.
- All filter cells on the same project shall have the same dimensions.
- Filter cells shall be easily removable from the upstream or down-stream side of the filter.
- The filter medium shall be pleated and bonded to the media holding frames.

3 AUTOMATIC ROLL FILTERS

- Filters shall be of the automatic renewable medium type, in which a roll of medium is unwound across the airstream by a mechanism controlled by the air pressure drop through the medium.
- All factory wiring shall be run in rigid conduit terminating in fittings suitable for the location.
- The differential pressure control shall be adjustable to any cut in and cut out pressures from 50 Pa to 150 Pa with a pressure differential from 10 to 20 Pa. Initial adjustment shall be as prescribed by the media manufacturer.
- Filters shall be provided with suitable means to stop the travel of the medium when the end of the roll is reached and operate a visual signal on the main switchboard to indicate the need for renewal.
- The replaceable filter medium shall be freely available from stocks in South Africa in minimum lengths of 15 meters.

4 FILTERS

- Filter frames and retaining mechanisms shall be supplied and in-stalled by the filter manufacturer.
- The filter to frame seal shall be a routed fluid seal. The sealing fluid shall be a silicon type, be highly viscous, non-solidifying and shall not support bacteria or bacteria growth. The sealing fluid shall be selected for the particular application.
- The filter material shall be water repellent.
- The filter media enclosing frame shall be corrosion protected steel.
- The complete filter installation shall be leak tested by the filter manufacturer. The leak test shall be either a DOP or sodium flame test.
- The filter efficiency of each filter cell shall be tested and certified.

5 GREASE ELIMINATORS

- Grease eliminators shall be 316 stainless steel Uys Engineering panels or equal. a V-formation.
- The unit shall be made up of interlocking frames for the individual filter units, or bolted in a common assembly. The ends of the assembly shall be suitably blanked off.
- Each pair of filter units shall be provided with a readily re-movable drip tray.
- Filters shall be fitted with suitable handles.
- The filter depth shall not be less than 50 mm.

6 SPARE MEDIA

- One complete set of spare filter media shall be supplied for all the filters on the entire project.
- Spare filter media shall be suitably packed and protected for storage. The packing shall withstand the normal handling procedures without damage to the filters.

SECTION 1 PART 1.4

GENERAL TECHNICAL SPECIFICATION

DX SELF CONTAINED & DX SPLIT AIR CONDITIONING UNITS

1 GENERAL

- Room type air conditioners must be completely self-contained units of the direct expansion unitary or split type design, air cooled. The air conditioners must generally be in accordance with SABS 1125 with sound levels not exceeding 45 dBA or as specified in the Project Specification. Unless otherwise specified all units must be of the inverter reverse cycle type.

- Evaporation units must be equipped with a suitable and easily accessible filter, three speed fan, adjustable directional air discharge grille, control thermostat which, must be installed in the return air path of the unit, drain-pan, drain piping and cooling coil. In addition to this all controls, control panel and complete wiring, including interlocking with outdoor unit must be part of the unit.

- The outdoor unit must contain the matching compressor unit, air-cooled condenser, condenser fan within a waterproof painted and corrosion protected casing.

- The indoor/outdoor units must be interconnected with refrigerant piping (separately insulated suction and delivery piping for reverse cycle units), electric wiring and interlocking control cabling. Refrigerant piping and cabling must be installed inside a galvanised sheet steel trunking for external runs and PVC trunking for internal runs. These must be neatly installed and painted if specified.

- Make provision for the drainage of excessive condensate to the nearest building drain by means of copper or uPVC tubing of no less than 25mm diameter. Provide units with factory mounted condensate pumps where required.

- For inverter reverse cycle heating units, including split type units, provide a proper stainless steel drip pan with drainage piping for the indoor units.

- Use copper for external drainage and uPVC for internal drainage and where drain piping is installed inside galvanised trunking.

- Surface mounted copper drain piping must be secured to the wall by means of copper or brass saddles at no more than 2 meter intervals.

- Where drainage piping is required to be installed flush mounted, positioning and chasing must be done in good time to meet construction programmes

- All external panels must be neat fitting with hard wearing exposed surfaces of baked enamel or equal finish of approved colour.

- Provide electrical interlocking to ensure that:
    - Compressor cannot run without both indoor and outdoor fans running.
    - Electric heating elements can only be switched on if the indoor fan is running.
    - It shall not be possible to switch cooling and heating on simultaneously.

- Room type air conditioners must be derated to accommodate altitude, refrigerant pipe lengths and design conditions specified in the Project Specification. Contractors must provide proof of derated capacities with their submission. All capacities specified are to be achievable at medium evaporator fan speed.

- The units must be of a well-known manufacturer and spares must be freely available in South Africa. In selecting units, it must be ensured that the selections fit into the areas allocated.

2 WINDOW TYPE UNITS

- Window type room air conditioners must be suitable for mounting in window frames or wall openings and must be completely self-contained.
- The units must be made up in two parts namely the chassis or cabinet and the main body. Mount the cabinet in the window frame or wall. The main body must slide in/out on self-locating guides and guide strips to facilitate maintenance.
- Where a unit is installed beyond normal reach the controls must be installed remotely at eye level. Unless otherwise specified in the Project Specification all wiring between the unit and the remote control must be installed in flush conduit and draw-boxes.

3 CONSOLE TYPE UNITS

- Unless otherwise specified on the drawings or in the Project Specification, install units through a wall with a steel sub-frame built in to the wall and neat finishing architraves inside and outside. The external architrave must be of aluminium angle and must be mitred at corners and must cover the sub-frame and opening completely. Seal the architrave and sub-frame surround with clear silicone sealant. Units are to consist of a two part construction allowing the sub-frame to be built in to the wall with the main body sliding in and out.
- Console units must be completely self-contained. Mount above skirting height in the position as detailed on the project drawings.
- Provide matching weather tight air intake and exhaust louvered panels of anodised aluminium with horizontal blades and install with each unit. Submit louvers to the engineer for approval prior to ordering. Louvers must be to the supplier's approval. Depending on size, detail and wall thickness the louver must form part of the cabinet or must be fixed to the sub-frame.
- Slinger ring type drainage water disposal may be considered in lieu of conventional pipe drainage system if specified in the Project Specification. There must be no condensate carry over, even in high humidity conditions.

4 SPLIT TYPE UNITS

- Split type units must consist of a direct expansion indoor fan coil unit and a separate (remote) externally located air-cooled condensing unit.
- The indoor fan coil unit may be floor-mounted, wall mounted, under-ceiling mounted as specified in the Project Specification.
- Above ceiling units must be properly insulated, particularly where exposed to roof or lighting heat loads.
- Remote controls must be wired in conduit and mounted at eye level in the positions indicated on the drawings. Controllers must be of the digital type and must be hard wired or of the remote wireless type. Any additional controller functions are specified in the Project Specification.
- Install all conduit and draw boxes flush in the walls or partitions in new buildings. Use surface mounted PVC trunking in existing buildings. The PVC trunking and control units of hard wired units must be screwed to the wall. Gluing is not acceptable.
- No joints are allowed in the control wiring.
- Insulate suction and delivery lines separate and tape joints on insulation to create a vapour barrier.
- Install outdoor units on raised plinths or where wall mounted, on robust galvanised steel brackets, properly braced and fixed with suitable wall anchors to the satisfaction of the Engineer. Install units as per the manufacturer's recommendations.
- Surge refrigerant piping and fit with the necessary oil traps strictly in accordance with the manufacturer's requirements.

SECTION 1 PART 1.5

STANDARD SPECIFICATION

FOR

TESTING AND COMMISSIONING

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/subsystem 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.

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.

3 EQUIPMENT AND PROCEDURE

- The equipment supplied under this Contract shall be subject to inspection by the Engineer or his Nominated 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 as 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, with-out 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.

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 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.

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.

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 manufacturers written confirmation shall be sent to the Engineer.

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 Tests 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 fulfill the function for which it 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.

SECTION 1 PART 1.6

STANDARD SPECIFICATION

FOR

GENERAL EQUIPMENT PROTECTION

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.

2. GENERAL MACHINERY PROTECTION

- All high speed couplings, projecting shaft ends and every dangerous moving part 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 with 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 to B.5. 381. C.

SECTION 1 PART 1.7

STANDARD SPECIFICATION

FOR

STEEL FABRICATION AND WELDING

1 STEEL FABRICATION AND BASEPLATES

- The manufacture of all fabricated items of plant shall be generally in accordance with BS 449 as amended, Part S.
- The fabrication and manufacture of the plant and equipment shall be completed in the Contractor's workshops before delivery to site.
- No fabrication of completed units shall take place on site, sitework shall be confined to only such minor alterations and adjustments as are found to be necessary during erection. If major alterations are found necessary, the items of plant concerned shall be returned to the Contractor's workshops for modifications or replacement and shall be tested and checked before re-delivery to site
- Drive baseplates shall be robustly constructed and adequately stiffened to prevent twisting and distortion. The ratio of the base length to its height shall not be more than 10:1.
- Fabricated baseplates shall be of all-welded construction and formed of rolled mild steel plates and sections.
- Surfaces shall be free from recesses and cavities wherever possible to prevent the accumulation of dirt and/or waste material,
- Where driving units are directly coupled to the driven component all mounting surfaces shall be accurately machined to ensure correct alignment. After final shop assembly and testing, the individual items of plant shall be accurately dowelled in position on the baseplate to prevent any misalignment during installation or ducting operation.

2 STRUCTURAL STEELWORK

- The structural steelwork used in this Contract shall be in accordance with BS 15.
- Black bolts and nuts shall be in accordance with BS 916. Black metal washers shall be in accordance with BS 3410, Part 2. High strength friction grips, bolts, nuts and washers shall be in accordance with BS 3139, Part 1, and their application shall con-form to BS 3294, Part 1, torque wrenches or impact tools where used shall be recalibrated before each shift- All fabrication and erection procedures shall be in accordance with BS 449 as amended, Part 5.
- Before commencing the fixing of the steelwork an erector shall check the seating for line. level and bolt setting and any errors which cannot be accommodated by the steelwork shall be reported to the Engineer

3 WELDING

- All oxy-acetylene welding and testing shall be in accordance with B.5. 1821 or BS 2640, as applicable, for oxy-acetylene welds in mild steel pipe lines up to 1670 kPa and/or temperatures up to 218°C.
- Metal arc welding shall be in accordance with B.5. 1856 or BS 2633, as applicable.
- Before any welding is undertaken, each welder to be used on the Contract Work shall make a sample weld in the Works or on Site of an average size pipe or section of the same physical and chemical analysis as that to be used for the Contract. These test welds shall be executed in the presence of a representative of the Engineers and when completed the welds shall, after stress relieving or normalizing, be cut up and specimens prepared for micro and macro examination and physical tests- After the welding samples have been approved only the welders who have been responsible for these samples shall be employed on the Contract Works.
- The Engineer shall reserve the right to ask for welded joints to be removed for detailed testing at the Contractor's expense.
- On completion each weld shall be coated with one coat of red lead paint.

SECTION 1: PART 2

DETAILED TECHNICAL SPECIFICATION FOR THE AIR-CONDITIONING INSTALLATION

DETAILED TECHNICAL SPECIFICATION

FOR THE

AIR CONDITIONING INSTALLATION

AT THE

SABS IT SERVER ROOM

2.1 GENERAL

The purpose of this project is to provide a complete HVAC installation for an IT server room according to the requirements. The project will focus on the installation of air conditioning split units to ensure optimal temperature and humidity control for the IT equipment in the server room.

HVAC (Heating, Ventilation, and Air Conditioning) is an essential component of any building that houses IT server rooms. The following requirements must be met for the HVAC system in the IT server room.

- Tenderers are advised to visit the site and to satisfy themselves, in conjunction with the drawings of the nature and extent of the works to be done.
- The Contractor is advised to check all dimensions and heights on site affecting the existing buildings against those indicated on the plans as he will be held responsible for all new work being of the correct sizes.
- In taking down and removing existing work, the utmost care is to be observed to avoid any structural or other damage to the remaining portion of the building.
- The Contractor must protect all work not removed, such as **SERVERS**, walls, floors, tiles, windows or other joinery or fittings etc., from damage during the progress of the work and provide all necessary material for so doing.
- The contractor shall be responsible for establishing the exact position of all services within the site of works. Where existing services may be exposed, the contractor must sufficiently protect these services. Should any of these services be damaged, the contractor will be held responsible for the repair thereof.
- Should there be any doubt regarding the below specification, the tenderer should consult the Engineer and have the matter clarified before submitting the tender.

2.2 DESCRIPTION OF INSTALLATION

- This specification covers the Air Conditioning Installation for Phase 2 of the SABS IT Server Room.
- The Sub-Contract includes the design (insofar as design is required for the correct selection of equipment), supply, delivery, installation, testing, commissioning, maintenance and guarantee of the installation as described herein.
- Tenderers are instructed to visit the site. No claim arising out of lack of knowledge of the site or environs will be considered.
- The work will be carried out in accordance with the programme set out by the Contractor. The Air Conditioning contractor shall, by submitting a tender, accept that any penalties arising from the inability of the Air Conditioning Contractor to meet the project programme will be payable by the Air Conditioning contractor.

2.3 SCOPE OF WORK

Firstly, the cooling capacity of the HVAC system must be sufficient to maintain the server room temperature between 19°C and 20°C during normal operation. This is important as high temperatures can cause IT equipment to overheat and malfunction, leading to data loss and damage to hardware. Therefore, the HVAC system has been designed to provide a steady and consistent temperature within this range.

The HVAC system must maintain humidity levels between 40% and 60% in the server room. Humidity control is crucial as high levels of humidity can cause condensation to form on IT equipment, leading to corrosion and damage. Low humidity levels can cause static electricity build-up, which can damage IT equipment.

It is essential for the HVAC system to provide uniform air distribution throughout the server room to ensure that all equipment is cooled efficiently. Uneven air distribution can cause hot spots, which can lead to equipment failure. The HVAC system will be carefully designed to provide a balanced and uniform distribution of cooled air throughout the server room.

Energy-efficient components and controls are a necessity to minimize energy consumption and reduce operating costs. Energy efficiency is critical as IT server rooms consume a significant amount of energy, and energy-efficient HVAC systems can significantly reduce energy consumption.

The split units for the HVAC system will be selected based on the cooling capacity required to maintain the server room temperature at a maximum of 20.8°C during normal operation. Split units are ideal for IT server rooms as they provide efficient cooling without taking up valuable floor space.

The split units will be installed in a redundant configuration to provide backup cooling in case of unit failure. Redundancy is essential as IT equipment is critical to business operations, and downtime can result in significant financial losses.

The split units will be installed in a way that maximizes their efficiency and minimizes their impact on the server room layout. Proper installation of the split units is essential as it ensures that they operate efficiently and do not obstruct the movement of people or equipment within the server room.

Lastly, the split units will be equipped with filters that are easily accessible and replaceable to ensure their continued efficiency and performance. Proper maintenance of the HVAC system is essential as it ensures that it operates efficiently and effectively.

This contract shall include but shall not be limited to:-

- The design (insofar as design is required for the correct selection of equipment), supply, delivery, installation, commissioning, maintenance and guarantee of the Air Conditioning System.
- The delivery of material and equipment must include packing, forwarding, payment of all freight, insurance, import, customs, excise and other duties, levies, railage and all other transportation and delivery charges.
- Management of manufacturing and delivery of all HVAC equipment.
- The preparation of all necessary workshop drawings, detail drawings, submission of samples and performance specifications as detailed herein. This will include taking whatever on site measurements is necessary for the preparations of the drawings and for the design work required.
- The provision of all wiring and control systems necessary to complete and make operational the Air Conditioning System described herein.
- The painting and finishing of all equipment, piping, ducting, etc. as described herein.
- The Tenderer shall ensure that the equipment offered fits into the spaces provided with adequate access and maintenance space. If, in the opinion of the Engineer, the equipment does not fit into the space provided with adequate access and maintenance space other equipment selected by the Engineer shall be provided at no additional cost.
- The tender price shall include an allowance for all tools, equipment, scaffolding, hoisting, transport, etc. necessary for the completion of the works.
- The supply and delivery of commissioning spares must be included.
- The supervision of and responsibility for the commissioning including preliminary trials, final testing, starting, setting to work, proving and handing over to Client of all plant, equipment and

materials in full working order under the stated operating conditions and complying with the performance and other guarantees specified.
- The supply of all specified operating, training and maintenance information including complete parts data, parts manuals (if applicable) and drawings as specified.
- The remedy of the plant and equipment during the "Defects Liability Period".
- The supply of all services, information and data.
- Any other items not covered by the foregoing, but forming part of the contractor's obligations and responsibilities.

Generally the contractor shall, as part of the contract, also allow for:

- All the foregoing shall be carried out by the Contractor in accordance with the Specification and the other contractual documentation to complete the Contract Works within the Contract Program and at the Contract Price stated in the Contract.
- The whole of the Contract Works shall be complete in every respect, ready for operation and continuous production at full load. Should any part or parts of the plant/ work/ services/ information which may be necessary for the satisfactory operation and maintenance of the plant/ equipment be omitted by the Contractor, such items shall be provided expeditiously by the contractor free of all extra cost to the Client.
- The contractor shall supply and install all equipment and materials necessary for the complete and correct electrical operation of the mechanical services under normal operation, fire mode and emergency power mode.
- The smoke detection contractor shall allow a fire signal, specifically a 2-pair cable for final connection by the mechanical contractor to the control terminals. Note that the fire signal shall be a fail-safe type consisting of a potential free normally closed circuit. Further note that the fire signals relay is only able to switch up to a maximum of 5 amps / 220 volt AC.
- All items of equipment shall be of good quality with regard to design and manufacture and shall be completely satisfactory for operation, control, safety and maintenance under all conditions of service.
- Uniformity of type and manufacture of switchgear, control gear, fittings and accessories shall be preserved throughout the whole of the installation.

2.4 STANDARDS AND REGULATIONS

The Installation shall be designed and installed in accordance with the following standards, Design Codes and regulations:

- National Building Regulations and Standards Act No 103 of 1977 as amended
- Occupational Health and Safety Act No 85 of 1993 as amended
- SANS 10400 – The Application of the National Building Regulations (All relevant parts applicable)
    - SANS 10400 Part A – Determine the occupancy density
    - SANS 10400 Part O – to Determine Fresh Air and Extract requirements
    - SANS 10400 Part XA – to determine energy requirements
- SANS 204 – Energy Efficiency in Buildings, 2011 as amended
- SANS 10147 – Refrigeration systems including plants associated with A/C systems
- SANS 1125 – Room Air conditioners and Heat Pumps
- Wiring of Premises SABS 0142-1987 as amended.
- Identification Colour Markings SABS 0140
- BS EN 121010 – Smoke and Heat Control Systems
- South African Green Building Guidelines.

2.5 HEATING, VENTILATION AND AIR CONDITIONING SYSTEMS

The buildings will be air conditioned as per following:-

- The server rooms and data rooms will be air-conditioned by independent DX type split unit system with each system made-up of a condensing unit, indoor unit, insulated refrigerant piping, and a wall mounted simple controller per unit. A secondary stainless steel drip tray will be installed under the indoor units to guard against condensate dripping on to the server/data equipment.

2.6 DX INVERTER TYPE SPLIT AIRCONDITIONING UNITS

(This section is to be read in conjunction with the General Technical Specification for DX self-contained type units – Section 1 Part 1.4)

2.6.1 Indoor Units – Under Ceiling Units:

Indoor units shall be under ceiling units installed in the positions shown on the drawings.

Each unit shall have an electronic expansion device, which controls refrigerant flow rate in response to load variations of the room.

The address of the indoor unit shall be set automatically in case of individual and group control.

The under ceiling units shall consist of an evaporator coil, mildew-proof polystyrene condensate drip compartments, supply air fan, fan scroll, fan motor, controls, condensate pump and efficient filter all mounted in an attractive compact casing.

The unit shall be fitted with a single, silent running, diffuser type turbo fan. The fan blades shall be of dynamically balanced aluminium or other non-ferrous metal manufacture, mounted on a central shaft and driven by a continuously rated three-speed electric motor, resiliently mounted on a suitable cradle. The fan motor is to be fitted with self-aligning sealed bearings.

The fan motor shall be of the single phase, permanent split capacitor type with built-in re-settable overload protection. The motor shall have multi speed windings and shall be factory connected to a terminal box. All wiring is to be marked to correspond with labelled terminals matching the motor wiring diagram.

The supply air louvres shall be of the auto-swing type with remote pre-set and automated vertical airflow direction control.

The evaporator coil shall consist of a multi-pass coil of heavy gauge, solid drawn copper tubing mechanically expanded into aluminium cooling fins. The coil shall be provided with an automatic defrost thermostat to prevent excessive frosting.

The evaporator coil shall be completely sealed off to ensure that maximum supply air flows over the coil.

The air filter shall be of the easily accessible and removable mould resistant resin net type, washable with mild detergent. The filter media shall be arranged so that no air bypasses the filter at the edges.

The unit shall be efficient and extremely quiet in operation and the noise level shall not exceed 33 dB's on the "A" scale at a distance of three meters from the unit.

The units shall be self contained and set to deliver air that is filtered and cooled, or filtered and heated as may be required. The units shall be suitable for a single phase, 220V, 50 Hz, AC power supply.

Heating shall be by reverse (heat recovery/pump) cycle only.

2.6.2 Piping Installation

All refrigerant piping shall be supported from cable tray as indicated on drawings.

The cable tray installation will consist of 300mm wide cable tray down in riser duct from roof level to respective floors. This will accommodate the refrigerant piping and air conditioning electrical power supply & control cables.

Main 300mm wide cable trays shall be installed in the main passages of respective floors to accommodate refrigerant piping, supply and control cabling as indicated on drawings.

Refrigerant piping to individual indoor units shall be supported on 150mm wide cable tray as indicated on drawings.

All cable trays shall be supported from soffit above with threaded rods. Support intervals shall not be greater than 1.5 m. All threaded shall be trimmed to not extend 20mm past installation nut.

All cable trays and metal pipe supports shall be thermally insulated by means of thermal breaks from the refrigerant piping to prevent heat loss or gain and to prevent condensation of moisture on the pipe supports.

The pipe routes shown on the drawings are generally diagrammatic. The runs and arrangements of piping shall be as indicated, subject to modifications as required to suit conditions at the building, to avoid interference with work of other services and for proper convenient and accessible location of all parts of the piping system. All required offsets, fittings, valves, traps, drains, etc. may not be indicated but allowance must be made in tenders for all such necessary items to be furnished.

Piping shall be installed as straight and direct as possible, neatly spaced and in general forming right angles with, or parallel to walls or other piping.

The pipe sizes shall be installed by the contractor for the sizes of units offered in accordance with the manufacturer's specifications and the schematic pipe layout indicated on the drawing. The pipe sizing must be verified by the manufacturer. Any discrepancy between this specification and the manufacturer's specification is to be brought under the attention of the Engineer.

The piping network shall be connected using refrigerant branch joints, complete with the necessary reducers with the matching insulation as supplied by the system manufacturer.

Suction, discharge and liquid pipes are to be insulated separately and not grouped together as for a single line. Approved pipe insulation shall be used.

All piping shall be run to avoid passing through ductwork, recessed light fixtures or interference with electric light outlets.

Where piping protrudes through building structures, pipe sleeves are to be installed, as part of the contract, to ensure easy removal thereof. No pipes may be built or plastered directly into the structure.

The contractor shall be responsible for the drilling of the holes and making good on the outside of the building to the plaster and paint.

Pipe sleeves must be of similar material as the pipe and must be large enough to allow enough free space for movement.

Where specified and where the opening between the sleeve and pipe is large and unsightly, blank cover plates must be installed.

Sleeves through outside walls, slabs and piping through roofs and windows must be sealed off watertight.

All sleeves must be installed neatly and made watertight. The opening between the pipe and sleeve must be sealed off by means of silicon rubber or any other approved product.

2.6.3 Drain Piping

Provision shall be made for the drainage of condensate to the outside or to dedicated drain points by means of PVC piping of the sizes as indicated on the drawing.

Piping shall run above ceilings and vertical down in the positions indicated on the drawings. All piping shall terminate at ground level where it shall be routed to the nearest drain point.

Drain piping shall be installed without any loops in the piping where condensate can accumulate. The

pipes shall have a uniform slope of 1 in a 100 from the unit to the outside and shall be tested in the presence of the Engineer.

The drain lines from individual indoor air-conditioning units shall have a minimum internal diameter of 25 mm.

Condensate pumps shall only be provided where it is specifically shown on the drawings, or where it is factory installed as an integral component of the air-conditioner. The condensate pumps shall be insulated as per the refrigerant lines.

External condensate drain lines shall be in Class 0 or better copper piping. Elbows and fittings shall be of the compression or capillary type. Bending of Class 0 copper piping will not be allowed. Internal condensate drain lines shall be in u-PVC.

2.6.4 Refrigerant Piping

All piping and fittings shall be of the best quality seamless, dehydrated, de-oxidised refrigeration class copper tubing, suitably sized for the unit installed and in accordance with SANS 460 as amended.

All refrigerant piping shall be hard drawn refrigeration copper tubing in accordance with ASTM B280-88.

Only jointing by means of capillary fittings will be allowed except in cases where equipment needs to be removed from the piping system for regular maintenance or replacement. In such cases joints between the equipment and piping shall be with DZR brass compression fittings.

Capillary type fittings shall comply with SANS 1067 - Part 2 or any of the related ISO 2016, DIN 2856 and BSS 864 - Part 2 specifications.

Soldering flux shall be used to remove residual traces of oxides, to promote wetting and to protect the surface to be soldered from oxidation during heating.

The flux shall be applied to clean surfaces and only enough should be used to lightly coat the areas to be joined and should be applied as soon as possible after cleaning.

Only the following solders shall be allowed to be used on capillary joints:

Composition	Specification
97/3 (97% tin and 3% copper)	SANS 24 – DIN 1707
96/4 (96% tin and 4% silver)	SANS 24 – DIN 1707
75/25 (75% tin and 25% zinc)	

Resin core and acid core solder shall not be used at all.
No welding of refrigeration systems will be allowed unless the pipe system is continuously filled and under pressure using nitrous gas.

All soldered joints, on factory supplied equipment, shall be carefully checked before commissioning and remade if found damaged in transit.

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.

A refrigerant charging connection shall be provided in the liquid line. Before charging the system with refrigerant the circuit shall be leak tested and dehydrated.

All pipes, vessels, etc. operating below ambient dew point shall be insulated and a vapour barrier provided.

An isolating valve shall be installed in both the liquid and gas lines where connected to the evaporator unit. Valves shall be of the bronze body, ball type.

When completed, the installation shall maintain a complete vapour barrier and any signs of sweating or dripping shall cause the installation to be rejected.

All piping shall be rigidly supported, both vertically and horizontally.

Inside the building piping shall be installed on approved medium-duty galvanised cable tray wide enough to accommodate both refrigerant pipes and the drain piping.

Outside the building piping shall be installed on approved medium-duty galvanised cable tray wide enough to accommodate both refrigerant pipes and the drain piping, including galvanised sheet metal covers painted to colour match the walls. Rung spacing shall be at 300mm intervals.

All cable trays shall be supported on approved 41x41x1.5mm galvanised channels including galvanised hold down saddles, bolts, nuts, washers and screws. The channel shall be supported from 8mm diameter hanger rods including washers and nuts. Channels to be spaced at intervals not exceeding 1500mm. Cable trays are to be installed to a fall of 1 in 100.

All cable ladders shall be supported on approved 41x41x2.5mm galvanised channels including galvanised hold down cup, bolts, nuts, washers and screws. The channel shall be rawl bolted directly to external walls or slabs. Channels to be spaced at intervals not exceeding 1500mm. Cable ladders to be installed to a fall of 1 in 100.

All piping shall be secured to cable trays and ladders with approved adjustable type galvanised cross rung clamps only. Care shall be taken not to pinch, compress or damage the pipe insulation when securing piping to cable trays and ladders. Any damaged insulation shall be completely removed and replaced to the satisfaction of the Engineer.

Strappings and cable ties will not be permitted. Hangers and supports where piping penetrates through walls shall be designed to prevent transmission of vibration to the building. Supports must be installed near to joints and fittings. Pipe clamps shall be installed at the following centre to centre distances.

Nominal Pipe Size	**Centre to Centre Spacing**	
Copper	**Horizontal Pipe**	**Vertical Pipe**
12 mm	1.0 m	1.2 m
15 mm	1.2 m	1.5 m
22 mm	1.5 m	1.8 m
28 mm	1.9 m	2.1 m
35 mm	2.1 m	2.4 m
42 mm	2.4 m	2.7 m
54 mm	2.4 m	3.0 m
66 mm	2.4 m	3.0 m
76 mm	2.5 m	3.0 m

Extra support must be supplied at T-offs, valves and other heavy fittings.

2.6.5 Pipe Insulation (Sans 1445 & Sans 1508 As Applicable)

The copper piping installed inside the building shall all be insulated with approved insulation. Vapour barrier integrity will be critical to prevent dripping. No zip type insulation will be allowed. Liquid and gas lines shall be insulated separately.
The insulation material shall meet the following minimum requirements:

Temperature range : -80°C + 120°C
Thermal conductivity : 0,038 W/m K at 0°C

Thickness	:	15 mm
Density	:	35kg/m3
Odour Properties	:	Neutral
Cellular Structure	:	Totally closed
Fire Properties	:	Self-extinguishing

The insulation shall be applied to form a continuous and homogenous vapour barrier over bends, supports, etc. All joints and seams shall be glued. Non-drip tape shall not be used for assembling seams and joints.

All fittings and valves shall be wrapped with black non-drip tape.

When completed, the installation shall ensure a complete vapour barrier and any signs of sweating or dripping shall cause the installation to be rejected.

Insulated pipe work penetrating through masonry or concrete elements shall have its insulation extended right through the penetration to ensure the vapour proof integrity of the insulation. All penetrations shall be sealed and caulked to approval by the Contractor.

2.6.6 Pressure Testing On Piping

All new copper refrigerant piping shall be hydraulically pressure tested to 1.5 times the working pressure or 1000 kPa, whichever is the largest. The test shall be carried out in the presence of the Engineer.

All piping shall be subjected to the test pressure for a period of one (1) hour during which time the system shall retain the pressure with no leaks or losses.

2.6.7 Controls Individual control unit

All controls for the automatic control of the Air-Conditioning Services shall be of the electronic type. The control system shall be an integrated component of the air-conditioning equipment and shall be installed and maintained as part of this contract.

All sensors and controllers etc. shall be types suitable for maintaining conditions within the limits as elsewhere specified. The whole of the installation shall automatically restart on restoration of power after a power failure.

All controller positions shall be confirmed with the engineer prior to installation.

All space thermostats shall be suitable for wall mounting.

Remote control panels shall be fully labelled.

The contractor shall supply and install approved hard- wired remote controllers in the positions indicated on the drawings.

The controller shall perform the following functions:

(a) Start/Stop.
(b) Temperature setting.
(c) Airflow setting.

All DX type split air conditioning units are to be equipped with inverter type compressors.

The AC system is provided by way of split units in the server and data rooms in all office blocks. The split unit’s indoor fittings are under ceiling units.

Under ceiling units are to be mounted on the ceiling, at the centre of the mounted wall from a horizontal perspective and at a high enough level such that it does not clash with windows. .

Piping between the indoor unit and outdoor condenser shall be with SABS 460, class 2 copper pipe.

The pipe shall fit together by capillary fittings and shall be further insulated.

The under ceiling split units piping must be placed on cable trays and these trays should be mounted to the soffit or roof truss, with treaded bar and nut/bolt combination. The piping running should be placed in PVC trunking. Refrigerant piping running outside the building (external wall or on roof slab) should be in sheet metal trunking. All trunking shall have removable covers and be accessible.

All piping shall be visually inspected for quality before a hydrostatic pressure test is conducted on the piping. This must be witnessed by the engineer or site representative.

Condensate drains from the under ceiling units must be piped to the nearest drain and allowing for a fall of 1:100. The HVAC contractor shall be responsible for the u-trap before the drain connection. Drain piping shall be uPVC conduit type and surface mounted. Exposed piping shall be placed within trunking as stated above. The trunking must be painted to suit wall colour and must be approved by the engineer.

The control for under ceiling s shall be done by wired remote control. Care must be taken when running the control wire and conduits should be shared if possible. Chasing of conduits must be confirmed with engineer before breaking.

Outdoor units must be mounted on anti-vibration mounts.

Units must be stored safely before installation and covered if building work is continuing in an area.

Openings through the wall for piping must be closed and made good after installation by the HVAC contractor.

2.7 FIXING OF EQUIPMENT

The Contractor shall identify the location of hangers and/or other support points of all equipment with a mass in excess of 25 kg to the Engineer. Approval of the proposed hanging and fixing shall be obtained from the Engineer, prior to carrying out the work.

All lightweight fixing to brick or concrete shall be made with steel screws and "Fischer" or other approved plugs. Holes of the required size for the plugs, which shall suit the screws used, are to be neatly drilled in the concrete or brickwork (not in the joints between bricks) to a depth excluding plaster or soft wall finish equal to at least the length of the plugs. The plug lengths shall be such that all the threaded length of the screws are in the plugs.

Fixings to timber shall be made with greased brass wooden screws. For fixing to hollow tiles, etc., screw anchor type fixings shall be used, fitted as above as far as possible. Fixing to soft or hard fibre boards, etc., which are inaccessible to the back, shall be made with sherardized self-tapping screws of appropriate sizes.

All heavy weight fixings to brick or concrete shall be by means of appropriately sized grouted galvanised bolts or by one of the various types of suitable expanding bolt fixings. After erection of equipment all exposed metalwork of fixings shall be treated with two coats of paint to match the finish of the equipment. Bolts shall in all instances be secured by means of a washer on the bolt head side and a lock washer on the nut side of the items being bolted.
Where the Contractor is in any way uncertain of the method of fixing of any plant or material, the proposed fixing and loading involved shall be cleared with the Engineer prior to carrying out the work on site.

2.8 VIBRATION ISOLATION

Unless otherwise noted on the equipment schedules hereafter, all mechanical equipment, i.e. machinery, piping, ducting, etc., shall be mounted on vibration isolators to prevent the transmission of vibration and mechanically transmitted sound to the building structure.

2.9 CORROSION PRECAUTIONS AND FINISHES

All materials such as brackets, hangers, etc., shall be shot blasted, pre painted, galvanised or treated

against corrosion prior to their delivery to site. Any work that will require site cutting, etc., i.e. exposure of the bare steel to the atmosphere, shall immediately be treated by cold galvanising, painting, etc.

The method of treatment for the above shall depend on the particular environment and type of surface to be coated. The surface preparation, primer coats, finishing coats, etc. shall therefore be in accordance with those specified by reputable paint manufacturers such as Plascon, Dulux, etc.

All black steel piping, support brackets, hangers, etc., installed inside the building shall be treated with two coats of corrosion inhibitor paint prior to installation. The first coat shall be allowed to dry completely before the next coat is applied.

A further coat of corrosion inhibitor shall be applied after installation and allowed to dry completely. Two coats of enamel paint, to the Engineers specification, shall finally be applied. The first coat shall be allowed to dry completely before the next coat is applied.

All black steel piping, support brackets, hangers, etc., exposed to the weather shall be hot dipped galvanised.

All duct, supports, equipment and materials exposed to view (i.e. not in shafts, false ceiling, bulkheads, etc.) shall be cleaned, primed and then finished with two coats of enamel paint to the Engineer's specification. Each application shall be allowed to dry completely before the next coat is applied.

Colour coding shall follow the coding currently used on site. If no colour coding is in use, or in the case of new installations, the latest SANS 10173 (clause 6) and SANS 10140 Standards shall be used.

Plant and equipment, pre painted or pre primed at the factory shall be examined to ensure that the paint finishes are in a good condition. If not satisfactory, priming paint or finishing coats shall be removed where necessary, the surface cleaned to remove rust, and all such surfaces re primed and finished in two coats of high quality paintwork to match the original.

The contractor shall fix black on white ivorine labels to all items of equipment (machinery, fans, pumps, electric heater batteries, humidifiers, air handling units, outdoor condensers, etc.), as well as to all active valves (motorised and solenoid) and major isolating valves.

The labels shall be screwed or pop-riveted to the equipment and attached to the valves with steel cables. The lettering shall not be less than 10 mm in height and the wording shall be approved by the Engineer. The wording and tag numbers shall be the same as those used in this specification and indicated on the drawings.

2.10 ELECTRICAL WORK

All electrical switchgear and wiring required for the proper operation of the works shall be provided by the Contractor.

Others will, however, provide waterproof maintenance isolators adjacent to the outdoor sections of the split units. The air-conditioning contractor will allow for the necessary wiring between the isolators and the individual units.

Maintenance Isolators shall furthermore be provided by others within 1 m of all ventilation fans. The air-conditioning contractor is to allow for the connection between these isolators and his equipment.

Others will furthermore provide the following conduits and draw boxes:

Ø20 mm Conduits with draw wires between the indoor unit and remote control station of each hide-away in ceiling split type air-conditioner.

The conduits shall terminate in 100x50 mm recessed draw boxes at the remote control sensor positions, at the height as light switch at 1 200 mm above finished floor level.

Tenderers shall indicate whether the above power supplies are sufficient or not and whether additional plug points, conduits and draw boxes are required. All costs arising from the failure to comply with this instruction will be for the Contractors account.

The Contractor shall ensure that the power supply to the equipment is installed correctly and that, once switched on, it will not damage the equipment.

All costs arising from the failure to comply with the above instructions will be for the Contractors account.

SECTION 2:

PROVISIONAL BILL OF QUANTITIES

SECTION 2:

BILLS OF QUANTITY

GENERAL NOTES: PROVISIONAL BILL OF QUANTITIES

1. GENERAL

1. These Bills of Quantities contain pages numbered consecutively in each Bill as indicated in the Master Index. Before the Tenderer submits his tender, he shall check the number of pages, and if any are found missing or duplicated, or the figures or writing indistinct, or the Bills of Quantities contain any obvious errors, he should notify to the Engineer at once and have same rectified, as no liability whatsoever will be admitted by the Engineer in respect of errors in tender due to the foregoing. The Bills of Quantities are provisional and no claim of loss of profit etc. will be accepted die to any change in the scope of the works. The rates shall remain fixed no matter what the change in scope, either up or down.

2. Bill of Quantities form part of and must be read in conjunction with the specification document and the drawings, which contains the full descriptions of the work to be done and material and equipment to be used. Unless otherwise described in the Bills of Quantities, reference shall be made to the Specification and drawings for the full meaning of descriptions and scope of the work to be done and materials and equipment to be used. No claims will be considered for extras where the tenderer has not read the requirements of the Standard Specification (Part 4), Drawings and the Detailed Technical Specification (Part 5) in conjunction with the Bill description and included the full requirements in the rate.

3. The responsibility for the accuracy of the Quantities written into the Provisional Bills remains with the Consulting Engineers who prepared the Bills. The Tenderer shall be relieved of responsibility of measuring quantities at the tender stage, and the tender sum submitted shall be in respect of the quantities set out in the Bills and Specification, although the tenderer will be required to make his assessment of items such as brackets, fixing etc., from details stated in the Specification and Drawings and shall include in the item prices for such small installation materials as are required for the complete installation in accordance with the Specification. It shall be noted by the tenderer that the Specification and Drawings form part of the Bills of Quantity and in interpreting the descriptions in the bills reference shall be made to the Drawings and Specification to gain a proper understanding of the full scope of each description (which description are of necessity of an abbreviated format).

4. The Priced Bills of Quantities of the successful tenderer will be checked and the Engineer reserves the right to call for adjustments to any individual price and to rectify any discrepancy whilst the total tender price, as submitted, remains unaltered.

5. The Drawings are attached in the document. Tenderers are to price in strict accordance with the Bill of Quantities Provided

6. The quantities in these Bills of Quantities are provisional and shall not be used for ordering materials. Ordering shall be done only on the basis of approved equipment submissions and approved drawings that shall be prepared by the successful contractor. The client will give direction for spending of funds.

7. The published national indices shall be used for this contract, if applicable.

8. At all times the Province reserves the right to determine annual expenditure on this contract within the contract period. The expenditure shall be spread over the contract period in conjunction with the progress schedule of the contractor, unless otherwise stated by the client.

9. The appropriate portion of the Preliminaries sum is payable on the percentage of work completed, unless otherwise stated by the client.

10. Unless a separate rate for the supply and for the installation of any item is specifically called for, the supply and installation costs of any item shall be fully included in the unit price. The

description of each item shall, unless otherwise stated herein, be held to include samples, making, conveying and delivering, unloading, storing, unpacking, hoisting, setting, fitting and fixing in position, cutting and waste, patterns, models and templates, plant temporary work, return of packing, establishment charges, profit and all other obligations arising our of the Conditions of Contract.

11. The rates shall include the cost of preparation of drawings, design, selection of equipment, testing, documentation, manuals, as built drawings, etc. all as necessary to meet the requirements of the specification.

12. The rates shall include all supervision, transport, overheads, etc. necessary for the execution of the works.

13. It shall be noted that the contract includes the installation of piping and wiring in confined spaces (i.e. Shafts plantrooms etc.) that will require close co-ordination with other services as well as particular sequencing of work.

14. All measurements are nett unless otherwise stated and tenderers must allow for wastage in the rates.

15. All provisional sums shall be spent as directed by the Engineer and any balance remaining shall be deducted from the amount of the contract sum.

16. All rates and prices given in the Bills of Quantities shall be nett and exclusive of VAT. Provision is made on the Form of Tender for the applicable VAT to be added.

17. Where specific product names and manufacturers names are used in the item descriptions in the Bills tenderers may offer equivalent products or other manufacturers equipment but the onus will be on the tenderer/successful contractor to prove to the Engineer that the alternative offer is indeed a product of equivalent quality and performance to the specified product / manufacturer. The Engineer reserves the right to insist on the named product or manufacturer should he not be satisfied with the alternative offer.

18. Payment of retention money, calculated in terms of clause 23 (2) (e) of the conditions of contract, shall be considered on receipt of an acceptable guarantee to the value of the full amount of the retention money stated in the said clause. If Tenderers would like to take advantage of this, they must indicate the saving which they are prepared to offer to the Province as a counter offer. Provision for this will be made in the final summary. Only guarantees issued by a recognized commercial bank or building society situated within the borders of South Africa and/or registered insurance company which id authorized by the register of insurance companies to issue unconditional guarantees, will be considered and must be submitted on the official guarantee form of the administration. This provision is only applicable to contracts when the tender amount is R 100 000.00 or more.

19. The lowest or any Tender will not necessarily be accepted.

2. METHOD OF MEASUREMENT

1. All piping support costs shall be included in the rate for piping and fittings and shall include fixing to concrete slabs, roof trusses etc. as described in the Bills of Quantity or indicated in the drawings.

2. The rate for piping shall include cutting, jointing and running joints. The lengths of piping shall be measured over/through all fittings but not over valves, pumps and in-line instruments such as strainers site glasses etc.

3. Pipe fittings are measured as extra - over piping.

4. The rate given for items of equipment AHU'S, Fan coils, pumps etc., shall include all necessary accessories and controls required to install, commission and operate the equipment in accordance with the specification.