PROJECT TECHNICAL SPECIFICATION

1. SCOPE OF ELECTRICAL INSTALLATION WORK

References to the Contractor, Subcontractor, Electrical Contractor and / or Electrical Subcontractor in the specifications and drawings shall mean the Contractor / Subcontractor for this Electrical Installation.

The Electrical Installation includes the supply, delivery, off-loading, storage, installation, testing, commissioning and handing over in proper working order of the complete electrical installation as specified in this Specification, Schedules and on the Drawings.

The project comprises of the installation of new data cabling infrastructure, including 2 new LAN rooms, for the Schumann Building, Stellenbosch.

The Schumann building is an existing 9 storey building which includes a basement level.
- The building consists of lecture halls, computer laboratories and lecture / admin offices.
- The Schumann building has a temporary fibre connection to the De Beers fibre node.
- There are existing network services in the Schumann building, which must remain undisturbed during the installations in this contract.

The Subcontractor shall liaise closely with the Main Contractor / Employer / User to ensure that the Works do not affect any operations of the existing university network during the installation of the new structured data cabling infrastructure.

The following broadly defined sections of work are included in this electrical installation:

- Making safe and removal as specified of existing electrical installations.
- Disposal certificates for lamps.
- Removal offsite to dump and / or to Employer's store of removed but unused materials and plant (The Client has the option of retaining possession of all / any equipment removed).
- Acceptance, storage, installation and commissioning of free issue materials and plant.
- Provisional Dayworks and Provisional Sums (To be expended as directed by the Employer / Architect / Engineer).
- Arrangements / Liaison with and attendance on Data contractors / specialists for installation of data cabling and equipment installations.
- Supply and installation of the wire mesh tray / powerskirting infrastructure, including trays and supports, required for the data cabling infrastructure.
- Supply and installation of wire ways, conduits, drawboxes, outlets, wiring, switches, switch sockets, luminaires, cover plates, isolators, etc.
- Supply, installation and termination of the telecommunications main ground busbar (TMGB) in both LAN rooms connected to the main building earth using 25 mm² insulated copper conductor
- Supply, installation and termination of 16mm² green and yellow isolated copper conductor between the TMGB in each of the LAN rooms and the wire mesh tray infrastructure.
- Cables and earth conductors.
- Distribution boards DB.LAN206 and DB.LAN622 in the new LAN rooms
- Feeder circuit breakers with labels, cables and earth conductors from Sub-distribution boards to LAN

room distribution boards.

- Supply and installation of powerskirting, powerskirting covers, outlets boxes, outlet box covers, cradles, yokes and blanked LAN points (Adaptors and keystones by Electronic Subcontractor)
- Telephone, Security, Access Control, Fire Alarm, TV and Data communication electronic boards / wonderboxes
- Drawwires in all telephone, IT / Computers, security, access control, TV, communication (electronic installations) and unused electrical conduits and sleeves.
- Earthing and bonding.
- Power supplies, earth conductors, connections to and rotation / operation tests of electrical equipment, plant, machines, etc. supplied and installed by others e.g. airconditioning, fans, etc. where local isolators and/or outlets are provided as part of the electrical installation.
- Pointing out and checking requirements for, positioning and correctness of Builder's work required for and related to this services installation, e.g. sleeves, manholes, making and closings openings, making good, etc, as well as checking thereof during construction so that it is correctly and timeously provided by the Builder.
- Submission of samples.
- Compiling, submission and resubmission of workshop and as-built /record drawings and information, operating and maintenance manuals. (NB : required in final approved format and content before final handover will be taken).
- Training of Employer / User staff.
- Carrying out of tests and submission of test records and certificates.
- One year comprehensive guarantee and repair period (excluding lamps in luminaires = 3 months).
- All other materials and labour to complete, tests, commission and hand over the services installation in accordance with this specification and the accompanying documents, drawings and schedules.

Care shall be taken not to damage / disrupt any existing services / installations.

Any switching / switchover involving disruption of the power supply shall only be done outside normal hours as agreed with the Employer / User.

2. BUILDER'S WORK & WORK BY OTHERS

The following sections of work are not included in this Subcontract / Electrical installations :

- Work by Builder and/or Others :
  - As indicated on the drawings
  - As requested during / with tender
  - Trenching and manholes
  - Sleeves with nylon draw wires
  - Core drilling
  - Replacement of ceiling
  - Removal of existing furniture / shelving / fixtures in rooms being converted into LAN rooms
  - Painting, floor covering
  - New kitchen fit-out

- Work by Data/Electronic Subcontractor:
  - Free issue IT/Data equipment
  - Data cables for computers, access control, CCTV, CATV and other IT equipment.
  - Adaptors and keystones for IT outlets
  - LAN room cabinets (and cabinet ground bar)

Should already plastered walls be chased without permission, the repair cost will be for the account of the Electrical Subcontractor.

Builder’s work as specified shall be checked and verified by the Electrical Contractor:
- To be complete and sufficient, and point out any further requirements to the Engineer.
- During construction so that it is provided correctly and timeously by the Builder.

3. SITE AND EXISTING SERVICES

The Schumann Building situated on the campus of Stellenbosch University between Bosman Rd and De Beer Rd.

The Subcontractor shall liaise with authorities (e.g. Electricity Supply Authority Telkom, etc.) and the User / Tenant regarding the existence, positions, pointing out, protection and / or relocation of existing services and, after informing the Client / Architect / Engineer and having been instructed to proceed, arrange for and/or undertake the protection and / or relocation of affected existing services.

4. DRAWINGS

The Electrical and Mechanical Installation is specified on the drawings as listed in the attached SCHEDULE OF DRAWINGS.

The Subcontractor shall also consult the architectural, civil, structural, mechanical and other services drawings.

Workshop drawings shall be provided of the following :

- Builder's works required for the services installation, e.g. plinths, holes, openings, etc.
- Distribution boards : electrical, telephone, IT / computers, security, access control, fire alarm, CATV, CCTV and communication
- Power skirting and fittings / accessories layouts and details
- Floor trunking / ducting and fittings / accessories layouts and details
- Cable ladders / trays and fittings / accessories layouts and details
- Wiring trunking / ducting layouts and details
- Ducted systems e.g. Airconditioning and Fans

These must be submitted timeously to permit enough time for scrutiny, adjustment and resubmission and such that no delivery problems are caused.

The Engineer's scrutiny of shop drawings or samples shall not relieve the Subcontractor of responsibility for any deviation from the requirements of this Subcontract, unless the Subcontractor has informed the Engineer in writing of such deviations at the time of submission of shop drawings or samples and the Engineer has given written approval for the specific deviation, nor shall this relieve the Subcontractor of responsibility for errors or omissions in the shop drawings or samples.

As-built drawings of all drawings for which workshop drawings were submitted shall be provided.

5. SAMPLES AND ALTERNATIVES

Samples or catalogues are required of all the electrical and mechanical materials / equipment, e.g. luminaires, light switches, dimmers, photocell, socket outlets, isolators, coverplates, power skirting, standard power skirting colours, floor duct and pedestals, fixings, AC units, fans, grilles, louvres etc.

These must be submitted timeously to permit enough time for scrutiny, adjustment and resubmission and such that no delivery problems are caused.

The Engineer's scrutiny of shop drawings or samples shall not relieve the Subcontractor of responsibility for any deviation from the requirements of this Subcontract, unless the Subcontractor has informed the Engineer in writing of such deviations at the time of submission of shop drawings or samples and the Engineer has given written approval for the specific deviation, nor shall this relieve the Subcontractor of responsibility for errors or omissions in the shop drawings or samples.

6. ELECTRICITY SUPPLY

The two new distributions boards shall be supplied as followed:

- New DB.LAN206 from existing floor sub-distribution board DB OVB.2
- New DB.LAN622 from existing floor sub-distribution board DB OVB.6

Work on and changes to existing infrastructure which will require the existing power supply, or any other service, to be switched off, shall be scheduled / carried out outside normal working hours or as agreed with the Employer / User.

7. COMPLIANCE WITH THE REGULATIONS, STANDARDS AND CODES

The entire installation shall be carried out in accordance with the latest revisions and amendments of the following :

- The latest Stellenbosch University's Standard Cabling Infrastructure Specification
- National Building Regulations and SANS 10400.
- The Code of Practise for the Wiring of a Premises SANS 10142.
- The Occupational Safety and Health Act.
- The Municipal Bye-Laws and any special requirements of the local and supply authorities of the area.
- Telkom regulations and requirements.
- Fire Office / Officer.
- The applicable SANS Specifications and Codes of Practice or, where no SANS Specification or Code exists, the relevant BS or IEC Specifications or Codes of Practice shall apply.

The Subcontractor shall work safely and in accordance with the provisions of the OSH Act. Should any hazardous situation arise during construction and / or from the work being performed / undertaken, the Subcontractor shall immediately inform the Main Contractor / Employer / Architect / Engineer of such situation, as well as what action he is taking to rectify this situation, alternatively what assistance / action he may require from the Main Contractor / Employer in this regard. The Main Contractor / Employer reserves the right to take whatever action as may be required to enforce safety standards should the Main Contractor / Employer / Architect / Engineer discover that the Subcontractor is working unsafely.

The Subcontractor is required to appoint a full time safety co-ordinator on site who shall take responsibility for safety on site and liaise with the Main Contractor / Employer on matters relating to safety.

No claims for extras in respect of failure by the Subcontractor to comply with any of the above regulations will be considered.

8. COMPLIANCE CERTIFICATE

The work shall not be considered complete until the applicable test and / or compliance certificates have been issued by the Subcontractor to the responsible Authority and copies of these have been submitted to the Employer / Architect / Engineer by the Subcontractor.

Where it is required that the Engineer should also sign a certificate, the Contractor shall firstly complete and sign such certificate before submission to the Engineer for his signature.

9. ACCEPTANCE TESTS AND COMMISSIONING

After completion, either in a part or as a whole, the complete installations shall be subject to acceptance tests by the Employer / Architect / Engineer. The Subcontractor shall assist the Employer / Architect / Engineer during any test carried out and must supply and operate/handle equipment, tools, instruments and consumables for testing purposes.

All labour, power, fuel, dummy and test loads and all instruments and appliances that may be required for the tests and commissioning, shall be provided by the Subcontractor.

10. MATERIALS

All equipment and materials shall be in accordance with the latest Structured Cabling Infrastructure Specification of Stellenbosch University.

All equipment and materials shall comply with a SANS code and have the SANS mark. Where no such code exists, the applicable BS or IEC code shall apply. It may at any time be required of the Contractor to provide proof hereof, without any additional cost or compensation to provide such proof and / or to comply herewith.

All materials, equipment and fixings must be corrosion resistant/proof.

Compatibility of equipment, materials and fixings with each other and the environment is vital. Where doubt exists regarding this aspect, it is the Subcontractor's responsibility to request, in writing, additional information from the Employer / Architect / Engineer.

Interchangeability of equipment : similar and equivalent equipment shall be identical in all respects and to the smallest detail such as contacts, fuses, coils, methods of wiring, wiring numbers, instruments, indicating lights and other accessories. It shall be possible to replace any piece of equipment with any similar and equivalent item of equipment under the same contract / subcontract.

Where a certain manufacturer's material or apparatus is mentioned / specified in the drawings or specifications, such materials or apparatus shall be provided as specified, except where an alternative to this condition is allowed in the specifications. Where a specification for material or apparatus is not provided, it shall be understood that all normal requirements for the use of such material or equipment shall apply.

The Contractor shall in all cases and at all times ensure that such equipment/materials comply with an SABS code and bear the SANS mark.

11. TRENCHING, EXCAVATION & BACKFILLING

All cable trench excavation and backfilling shall be by hand and be compacted to 93% of modified AASHTO maximum density in the case of cohesive soil (clay materials) or 100% of modified AASHTO maximum density in the case of non-cohesive soil (sandy materials).

Backfill to trenches under roadways will have to be done with imported sand and compacted to 100% MOD AASHTO density. Excess material is to be spoiled off site.

Cable covered depths are to be implemented as specified in the A4 set of illustrations.

Marking Tape
Orange PVC warning tape shall be placed over all cable routes as per the illustrations.

12. MAKE SAFE AND REMOVAL

Make safe and removal shall include the following :
- Testing, isolating, making safe and disconnecting of electrical services.
- Removal of all electrical and electronic services in existing rooms 206, 621 and 622
- Dumping / disposal / delivery to store of materials after giving the Client the opportunity to keep some or all of the removed materials.
- Providing disposal certificates to the Engineer for materials like lamps, oils, etc.

13. DISTRIBUTION BOARDS

Standard, approved manufacture, SANS approved and type tested as per SANS code distribution boards, complete with doors where specified, shall be used.
The distribution boards shall be manufactured and assembled in accordance with the latest revisions and amendments of the following:

- SANS 1973-1, Low-voltage switchgear and controlgear ASSEMBLIES –Part 1: Type-tested ASSEMBLIES with stated deviations and a rated shortcircuit withstand strength above 10 kA.
- SANS 1973-3, Low-voltage switchgear and controlgear ASSEMBLIES – Part 3: Safety of ASSEMBLIES with a rated prospective short-circuit current of up to and including 10 kA.
- SANS 1473-1, Low-voltage switchgear and controlgear assemblies – Part 1: Type-tested, partially type-tested and specially tested assemblies with a rated short-circuit withstand strength above 10 kA.
- SANS 1973-8, Low-voltage switchgear and controlgear ASSEMBLIES – Part 8: Safety of minimally tested SSEMBLIES (MTA) with a rated short- circuit current above 10 kA and a rated busbar current of up to and including 1 600 A a.c. and d.c.
- SANS 60439-4/IEC 60439-4, Low-voltage switchgear and controlgear assemblies – Part 4: Particular requirements for assemblies for construction sites (ACS).
- SANS 60439-5/IEC 60439-5, Low-voltage switchgear and controlgear assemblies – Part 5: Particular requirements for assemblies for power distribution in networks.

Standard, approved manufacture, SABS approved and type tested as per SANS code distribution boards, complete with doors where specified, shall be used.

Distribution boards of 160A and larger shall be certified. Certificates are required with the workshop drawings and again on delivery of the boards and for the record / as-built documents / manual. Type tests are not required, unless specifically specified.

All distribution boards shall comply with the requirements of the Electricity Supply Authority and shall have the necessary space and / or equipment per their normal requirements, e.g. for metering, pre-payment meters, current demand circuit breakers, as well as space for the necessary equipment for the switching of water heating equipment by means of ripple relay, etc.

All wire ends of stranded conductors shall be boot laced ferruled unless the conductor is crimped with a lug.

All inner panels / doors / faceplates to be hinged type with key locking mechanism. Where applicable, access to inside of board to be door / hinged. No removable panels shall be accepted.

All locking mechanisms on distribution boards shall be made of metal. Each distribution board shall be equipped / issued with its' own square / locking key at the electrical installations inspection before practical completion.

Workshop drawings of distribution boards must be submitted timeously for comment.

The Engineer will require inspecting all distribution boards at the manufacture's work, before shipment to site. The Engineers inspection of any distribution board shall not relieve the Subcontractor of his responsibility of complying with the specification.

All distribution boards shall be equipped with minimum 6kA circuit breakers / equipment or higher as specified

All telephone, data, security, access control, fire alarm, communication, etc. boards and drawboxes larger than 100 x 100 shall be labelled as such. Exact wording shall be requested from and provided at a later stage by the Engineer / IT Depaartment.

Telephone, IT / computers, security, access control, fire alarm, CCTV, communication, etc boards shall be manufactured to the same standard as for electrical distribution boards, to Telkom requirements, with hinged doors with handles and Telkom approved locking, soft wood backing, interconnection openings between compartments and name labels. Location, sizes, surface / recessed and compartments specified on the drawings.

Colours of boards :
- Main distribution board : Electric orange
- Subdistribution boards : As specified on the A4 schematic layouts
- Telephone boards : Off-white
- Data, security, access control, fire alarm, TV and communication boards : Off-white

14. CABLES AND ACCESSORIES

All cables shall be PVC armoured with copper conductors and separate earth conductors.

Where exposed cables may be subject to mechanical damage, they must be protected in galvanised kickpipe.

All cable routes shall be confirmed on site prior to excavation and cutting of cables.

All cables shall be labelled at both ends with tags and cable ties type labels to indicate the size of the cable, what it is feeding and from where it is fed.

All wire ends of stranded conductors connected to plug points, isolators, light switches and other equipment shall be boot laced ferruled unless the conductor is crimped with a lug.

15. EARTHING AND BONDING

Main earth, earthing and bonding of electrical systems, cable tray infrastructure and equipment by Electrical Subcontractor.

Earthing and bonding shall be carried out in accordance with the Wiring Code and as specified.

All cables and circuits wiring shall have a separate earth conductor : Refer DB-SCHEMATIC and DB-SYMBOLS A4 size drawings.

A common earth may be installed in cable ducts, cable trays, wiring channels, power skirtings and floor ducts T-ing off from this to DB's, outlets, etc. when more than one cable/circuit are drawn in together.

D-Pin socket outlets circuits are "dedicated clean power" circuits for computers: no earth leakage protection and separate PVC insulated earth conductor(s).

The entire installation shall be properly and effectively earthed and bonded as prescribed in the SABS/SANS Code of Practice for wiring of Premises, Code SANS 10142.

Self-tapping screws are not acceptable as means of securing earth conductors. All equipment shall be earthed at the earthbars which in turn shall be connected to the main earth system.

Cable armouring's shall be earthed via cable glands.

All luminaires shall be earthed.

Jointing and T-off's of lengths of earth conductor shall be performed by means of suitable line taps Cadwelding or Silbralloy welding. An overlap of minimum three times the width of the conductor shall be used.

Where lugs are used for terminating stranded earth conductors, the lugs shall be crimped with an approved type of crimping tool. The lug stud size shall correspond to the fixing bolt and the lug shall be so positioned that the full contact area of the lug is utilised.

All bolts and screws used for the earthing shall be high tensile steel, brass or cadmium plated mild steel bolts.

The cable armour shall be bonded to earth at all terminations of cables.

The Subcontractor shall install a telecommunications ground bar (TMGB) in both new LAN rooms. These ground bars shall be connected directly to the main building earth using 25mm² black isolated copper wire. The wire mesh tray infrastructure must also be connected to either one of the above TMGBs using 16mm² green and yellow insulated copper wires.

Earthing shall be inspected and tested after installation and the readings recorded and forwarded to the Engineer.

16. CONDUITS AND ACCESSORIES

All conduits and accessories shall be heavy duty galvanised / threadless (Bosal), with PVC permissible in the false ceilings and in the brick walls, and shall be recessed unless otherwise specified or approved.

No mixed runs of PVC / steel conduit are permitted unless fitted with separate full length earth conductors and all equipment earthed with it.

Where conduits are chased in, the Electrical Contractor shall apply a scratchcoat (plaster) to hold the conduits in position and minimise the making good plaster/skin required.

Conduits shall be installed in a neat and workmanlike fashion and at right angles to the building elements.

IT / Data, Telephone and Electronic Services conduits/wire ways and cables shall NOT be run parallel and directly adjacent to electrical conduits or cables. A clear gap of 400mm minimum shall be left between these and electrical conduits and cables/conductors where these are installed near or parallel to each other.

Drawwires shall be installed in all electronic: telephone, IT / Data, Communication, CATV, CCTV, access control, fire alarm, security (electronic services) and unused electrical conduits and sleeves.

17. OUTLET BOXES, DRAW BOXES AND COVER PLATES

All outlet boxes, draw boxes and inspection boxes shall match the conduits installed and comply with the requirements of SABS 162 and shall be provided with metal cover plates and rust free screws.

All coverplates shall be white unless specifically specified. All coverplates shall be labelled on the inside indicating from which circuit breaker in which distribution board it is fed from. Each switch socket outlet, lights switch, isolator etc. shall be marked in the same way as its' corresponding coverplate. The marking small be done with white self adhesive tap and black marking on the tape.

Telephone and IT outlets shall be provided with coverplates, cradles and yokes which can accommodate a RJ11 and RJ45 outlet.

Install blank cover plates on the unused electrical drawboxes and outlets and on telephone, IT / Computers, security, access control, fire alarm, CATV, CCTV, communication and other electronic services outlets and drawboxes.

Use oversize coverplates on all round outlet boxes.

- **In wet / damp areas : Screws on faceplates of switch sockets, outlets, switches, etc shall be plastic with plastic covers (or stainless steel but not chromed steel).**

18. CONDUCTORS

All conductors shall be stranded copper PVC insulated for 660/1000 volts. Conductors shall comply with SABS 150 and shall bear the SABS mark.

The conductors must be installed as per the A4 size DB-SCHEMATIC and DB-SYMBOLS drawings.

All wire ends of stranded conductors connected to plug points, isolators, light switches and other equipment shall be boot laced ferruled unless the conductor is crimped with a lug.

19. LUMINAIRES

The Subcontractor must supply, install, connect and commission all luminaires complete with lamps, poles and accessories as specified in the SCHEDULE OF LUMINAIRES.
- Only Osram or Phillips lamps may be used / installed.

Unused light outlet points shall be blanked off with the wiring terminated in a connector block.

Circuit wiring shall not be run in or through luminaires, but shall enter and leave at the entry point nearest the luminaire connection terminals.

20. POWER SKIRTING

The power skirting shall be 2 tier, 3 compartment Cabstrut Execuduct (EXE2 duct), complete with covers.

The colour shall be from the standard range to the Employer / Architect / Engineer's choice: submit samples for selection.

21. WIRE MESH TRAY / TRUNKING

Cable trays shall be medium duty galvanised wire mesh trays with apertures no greater than 50mm x 50mm.

Cable trays / ladders shall have a minimum 50mm turn up (side rail)

Size as specified on the drawings, or as required where not specified

All clamps joining cable trays shall be fitted with the rounded head of the bolt facing the data cable while the

nut points outward.

Only factory manufactured bends and T's shall be used to prevent sharp corners and/or pressure points for data cables.

The Subcontractor shall earth, using 16mm² green and yellow insulated copper conductor, the wire mesh trays to either one of the telecommunications ground bars located in the 2 new LAN rooms.

A common 16mm² insulated green and yellow earth conductor shall be installed in each of the data risers from level 1 to level 7. The common earth, in both risers, shall T-off on each floor and be bonded to the cable tray ring installed in the corridor ceiling.

The Subcontractor shall, where the cable tray is not continuously bolted, screw / bolt / install a 4mm² conductor to bond / bridge the cable tray to ensure continuity of the earth.

Electrical wiring shall be held in place in trunkings by means of Z-clips at maximum 1,2m spacing.

22. INSTALLATION AND CONNECTION OF ELECTRICAL APPLIANCES AND EQUIPMENT

Airconditioning Units : supplied and installed by others, unless otherwise specified. The Subcontractor shall be responsible for the final connections to the appliances.

Fans : supplied and installed by others, unless otherwise specified. The Subcontractor shall be responsible for the final connections to the appliances.

Hydroboil : supplied and installed by others, unless otherwise specified. The Subcontractor shall be responsible for the final connections to the appliances.

IT/Data : supplied and installed by others. The Subcontractor shall be responsible for pointing out conduit routes.

23. MECHANICAL INSTALLATION BY SPECIALIST SUBCONTRACTOR OF ELECTRICAL CONTRACTOR

References to the Contractor, Subcontractor, Mechanical Contractor and / or Mechanical Subcontractor in the specifications and drawings shall mean the Contractor / Subcontractor for this Mechanical Installation.

This section of the specification specifically deals with the mechanical installations for this project, however, the entire specification should be read together and as a whole.

The Mechanical Installation includes the supply, delivery, off-loading, storage, installation, testing, commissioning and handing over in proper working order of the complete mechanical installation as specified in this Specification, Schedules and on the Drawings.

The project comprises of the installation of new data cabling infrastructure, including 2 new LAN rooms, for the Schumann Building, Stellenbosch.

Airconditioning and ventilation will be installed in the 2 new LAN rooms located on the 2nd and 6th floor.

The Subcontractor shall liaise closely with the Electrical Subcontractor to ensure that the Works do not affect any operations of the existing university network during the installation of required mechanical installations.

23.1 Scope of Mechanical Installations

The following broadly defined sections of work are included in this mechanical installation:

- 4 x New Daikin inverter midwall spilt units of capacity 3 kW (FTXN-L or approved similar)
- 4 x Stainless steel drip trays installed below indoor units
- Gravity drain connected to drip tray, to run to nearest drain point, in the case of no drain point available for gravity fed drain, allowance will be made to install an aspen mini line pump.
- Control board must be included to switch off the indoor unit if the condensate drain pump malfunctions
- Positive pressure to be maintained in LAN room, air flow quantities to be maintained as per drawings

23.2 Vibration

All equipment generating vibration shall be mounted on anti-vibration mountings and springs to prevent any vibration carry-over to the building structure.

23.3 Fans

Fans shall be of the type as specified on the drawings.

The fans shall be capable of delivering the specified air flow rate at the specified pressure. Fan characteristics curves, with the duty point marked on them, as well as noise ratings over the full frequency range, must be included with tenders.

Fan motors must be rated for continuous operation. The power supply to the fans shall be supplied within 1 metre of the fan and shall terminate in an isolator: supplied by the Electrical Subcontractor.

23.4 Weather louvers

Weather louvers shall be powder coated white extruded aluminium with 19mm blade spacing. All fixings shall be concealed.

23.5 Ducting

All ducting shall be galvanized mild steel low-pressure ducting, unless otherwise indicated.
Ducting shall be manufactured to SABS 1238 and shall be installed to SABS 0173.

23.6 Flexible ducting

All flexible ducting shall be of the sound attenuating type EUROPAIR SONODEC or equal. Fire rated as per SANS 10400. Flexible ducting length shall not exceed 1.5m.

23.7 Air valve

Air valves shall be powder coated mild steel of size as per the drawings.

23.8 Schedule of ventilation fans

According to drawings

23.9 Schedule of airconditioning units

4 x Dainkin FTXN-L midwall split units 3kW

23.10 Refrigerant piping

Sizes to manufacturer’s specifications and recommendations

23.11 Air-conditioning Controls

Wired remote controls, must be allowed for each of the AC units. Position as indicated on the drawings.

23.12 Testing and Handover

After commissioning of the systems, the Subcontractor shall test the system to prove correct functioning of all elements in the system and these test results shall be documented. Further tests may be called for if the Engineer is not satisfied that the systems comply with the specifications.

23.13 Operation and Maintenance Manuals

Three (3) sets of operation and maintenance manuals shall be prepared and submitted to the Engineer as a prerequisite for the Handover Inspection.

The structure and contents of the O&M shall be as follows:

- System description and instructions for use and operation
- Routine operator maintenance schedules
- Equipment specification sheets and extracts from the manufacturers' and suppliers' catalogues
- Test certificates and commissioning data
- 1 year free maintenance and guarantee contract
- Schematic wiring and control logic diagrams
- Subcontractor's as-built drawings
- Engineer's subcontract / construction drawings

23.14 Training of Operating Staff

The Subcontractor shall train the Client/User to be fully competent in the operation and basic operational trouble shooting of the systems.

23.15 One Year Guarantee Period

1 Year Guarantee period will be provided by the Subcontractor starting from the day that the final handover is completed. This guarantee with the dates of the 1 Year Guarantee period must be enclosed in the as-built / record information documentation.

24. SPECIFICATIONS and DRAWINGS

The specifications, schedules and drawings shall be read together and as a whole.

25. SCHEDULES OF INFORMATION AND RATES

The Schedules of Information and Rates shall be completed in full and submitted at tender stage.

All rates and prices shall exclude VAT.

The Subcontractor shall submit a complete and detailed Bill of Quantities of the project electrical installations as used to arrive at his tender price. This Bill of Quantities shall be used by the Engineer in tender adjudication and for construction stage administration, variations and valuations. The lump sum tender shall be awarded as a lump sum contract/subcontract and the existence of the bill of quantities shall not permit the Contractor to motivate/claim for price adjustment on the basis of over or under measurement at tender stage.