

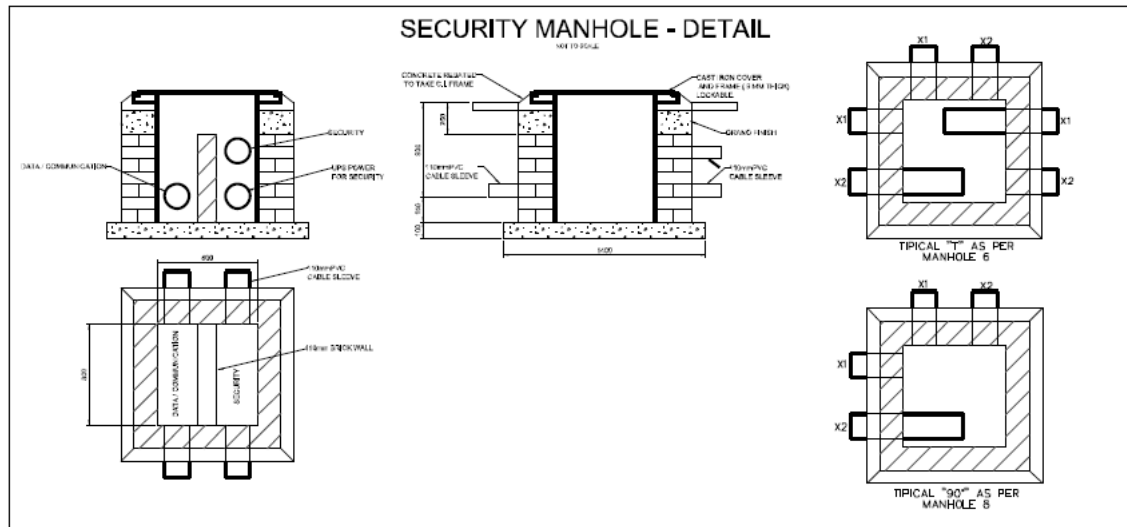
PART B Continue..

ELECTRICAL PROJECT SPECIFICATIONS

1. SCOPE OF WORKS

This specification covers the contract engineering, manufacture, supply, delivery, erection, wiring, commissioning, testing and handing over in complete working order for immediate use. **Guarantee for twelve months will be applicable** on all equipment and workmanship, calculated from the final completion date, for the following:

- The installation of the distribution boards with circuit breakers as specified;
- install all luminaries and socket outlets as specified and indicated on the drawings;
- complete all 1.5, 2.5- and 4mm² wiring in 20- and 25mm conduit.;
- install cable racks and cables as specified;
- conduct tests and supply all paperwork as required and
- remove all redundant material from site.



4. EARTH MAT

A new separate earth mat will be installed at the building edge below natural ground level (1.0m). The earth mat will consist of 16mm² round solid copper bars and will cover an area of at least 1.0m x 1.0m. The copper earth bars will form a grid of 500mm x 500mm. All connections will be cad-welded. Two round solid copper bars of 16mm² (the tails) from the mat will be connected to the Main DB earth bars. The tails will be connected at separate positions on the mat with a distance more than 1m apart. The tails will be connected into a separate York box at the mat and connected to a 70mm² single core cable to the Main Distribution kiosk.

5. TRANSFORMERS

NA

6. STANDBY GENERATOR AND CONTROL PANEL

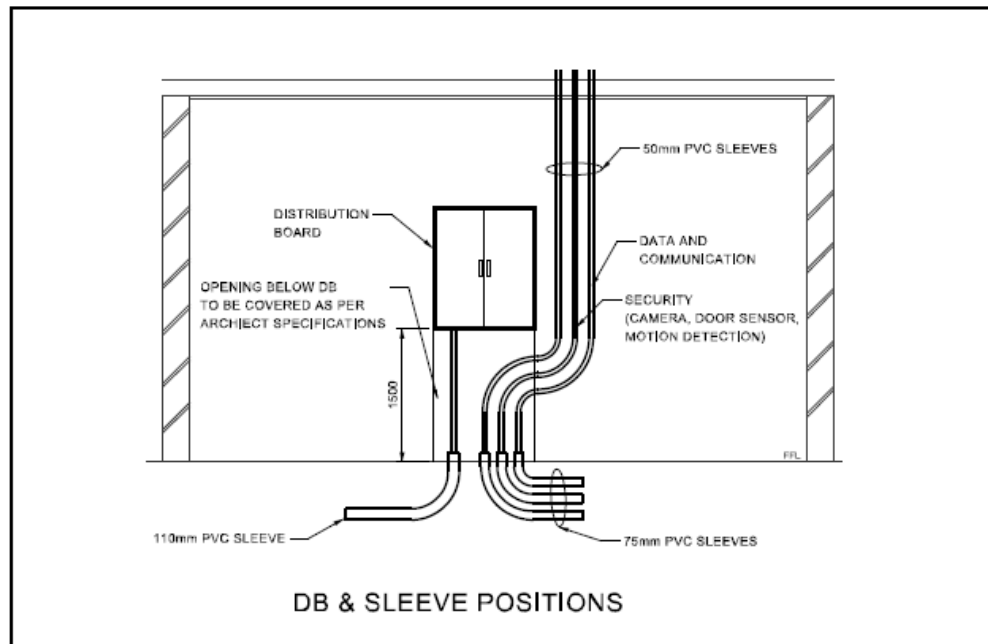
NA

7. CABLE SLEEVE PIPES

Where cables cross under roadways, other services and where cables enter buildings, the cables shall be installed in Fibre-cement pipes or earthenware pipes. When otherwise specified or agreed upon, PVC sleeves may be approved.

The electrical contractor will be responsible for all excavations, installation of sleeves, backfill and making neat of all.

The ends of all sleeves shall be sealed with a non-hardening watertight compound after the installation of cables. All sleeves intended for future use shall likewise be sealed.



8. NOTICES

The Contractor shall issue all notices and make the necessary arrangements with Supply Authorities, the Postmaster-General, S.A. Transport Services, Provincial of National Road authorities and other Authorities as may be required with respect to the installation. The Contractor will be held responsible for damage to any existing services brought to his attention by the relevant authorities and will be responsible for the cost of repairs.

9. ELECTRICAL EQUIPMENT

All equipment and fittings supplied must be in accordance with the approved quality specification, suitable for the relevant supply voltage and frequency and must be approved by the Consultant's representative.

10. DRAWINGS

The drawings generally show the scope and extent of the proposed work and shall not be held as showing every minute detail of the work to be executed.

The position of power points, switches and light points that may be influenced by built-in furniture must be established on site, prior to these items being installed.

The contractor will supply a complete set of "As Built" drawings at completion of the contract. This will be handed in with the Operational and Maintenance manuals.

11. BALANCING OF LOAD

The Electrical Contractor is required to balance the load as equally as possible over the multiphase supply. When Balancing of loads are not required, the specific phase to which a load must be connected will be indicated on the drawings.

12. WORK SEQUENCE

The sequence, in which the work must be carried out, must be established in consultation with the Department's representative.

13. SUPERVISION

The work shall at all times, for the duration of the contract be carried out under the supervision of a skilled and competent representative of the contractor, who will be able and authorised to receive and carry out instructions on behalf of the contractor. A sufficient number of workmen shall be employed at all times to ensure satisfactory progress of the work.

14. SUPPLY OF MATERIAL

The contractor shall be responsible to supply all the required material for the complete installation.













15. SERVICE CONDITIONS


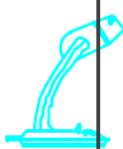
All plant shall be designed for the climatic conditions appertaining to the service.

16. SWITCHES AND SOCKET OUTLETS

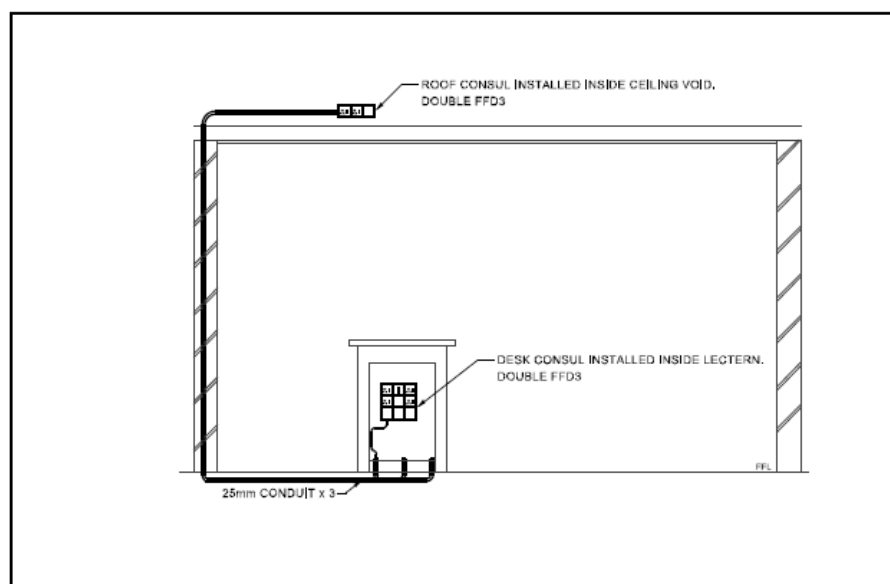
All switches will be supplied with a metal cover plate with brush aluminium or stainless steel finishing unless other wise specified in the Bill of Materials.

The following descriptions are as supplied in the table below:

| | |
|---|--|
|  | 100 x 50mm Galvanized steel box, flush for biometric reader, to be installed as per drawing. |
|  | 65mm diameter galvanized round box for magnetic lock, to be installed as per drawing. |
|  | 100 x 100mm Galvanized steel box, flush for air conditioner control unit, to be installed as per drawing. |
|  | Roof consul consisting of dedicated 2 X 15A power socket outlet, 1 X dedicated 15A power outlet, and 2 x data outlets. Typical housing Oline Double FFD3 installed in ceiling area. All switches and outlets to b ULTI as supplied by Schneider. |
|  | Desk consul consisting of dedicated 2 X 15A power socket outlet, 1 X dedicated 15A power outlet, and 2 x data outlets. Typical housing Oline Double FFD3 installed below the work level on the lectern. All switches and outlets |
|  | Inspection box to be installed underneath desks at lecture halls to connect the desk and roof consuls. To be galvanized steel 210 x 285 x 80mm, with lid. Typical: O-Line Power box. |
|  | Floor box to be installed in floor slab. To be galvanized steel 210 x 285 x 80mm, with lid. Typical: O-Line Power box. The Floor box shall be equipped with 4 x Normal 15A power socket outlets. |
|  | Double channel power skirting, 165 x 55mm. Metal with 2 covers, light hammer tone grey. Typical: O-Line MS2. |
|  | Fire detection sensor |
|  | Break glass |
|  | Motion Detector |
|  | Alarm panel |

| | |
|---|--------------------------------|
|  | Camera |
|  | Public announcement microphone |

Wiring will be done pvc/steel conduit. The detail for the installation of the roof and desk consuls is given in the picture below.



17. LIGHT FITTINGS AND LAMPS






Light circuits will be wired in 20mm pvc conduit

The minimum 80 lux for all levels of the car park, 300 lux for the store areas and an average of 500 lux for the office and classroom areas will be adhered to.

All fittings to be supplied by the electrical contractor shall have the approval of the Department. Incandescent lamps shall bear the approved mark of the S.A.B.S. and shall have the British light centre length.

The following fittings will be supplied and installed as per the Bills of Materials:

| | | |
|---|--|---|
|  | | 20 Watt LED, 274mm x 274mm x 104mm square bulkhead with prismatic diffuser. IP65. Typical: Series 21 |
|  | | 1200 x 300 x 100mm, 2 x 20W LED, open channel surface mounted. |
|  | | 1265 x 330 x 90mm cold rolled mild steel with white epoxy finish, 2 x 20W LED, double parabolic surface mounted |
|  | | 1200 x 300 x 100mm, 2 x 20W LED, Wire Gaurd surface mounted. |
|  | | 1200 x 300 x 100mm, 2 x 20W LED, Acrylic diffusor, surface mounted. |

| | | |
|---|---|---|
|  | | 1180 x 70 x 64mm, 2 x 54W T5 Open channel fluorescent, surface mounted. |
|  | | 220V Red indication light, Wall mounted. 80mm Diameter |
|  | | 20W 220V LED Downlighter, 140mm Diameter x 102mm. |
|  |  | Emergency Lighting, Exit, single sided, wall mounted, with battery back-up. 330 x 145 x 46mm. |

17.1 TUBULAR FLUORESCENT LAMP LUMINARIES

17.1.1 SCOPE

This specification covers the requirements for fluorescent luminaries using tubular fluorescent lamps for general indoor use. The type of luminaries covered is open-channel, industrial, decorative and recessed types and includes luminaries with one or more lamps with standard wattage ratings as specified in the Bills of Materials.

17.1.2 GENERAL

Luminaries, associated equipment and control gear shall be new and unused and shall be supplied complete with lamps, control gear, diffusers, mounting brackets, etc. and shall be delivered to site in a protective cover. Lamps shall be delivered separately.

17.1.3 STANDARDS

The following standard specifications of SABS shall apply to the luminaries' specifications:

| | |
|--------------|--|
| SANS 1119 | Interior Luminaries for fluorescent lamps. |
| SANS 1250 | Capacitors for use with fluorescent and other discharge lamp ballast's |
| SANS 890 | Ballast's for fluorescent lamps |
| SANS 1464 | Safety of Luminaries |
| SANS 1479 | Glow starters for fluorescent lamps |
| SANS IEC 400 | Lamp holders for tubular fluorescent lamps |
| SANS 1041 | Tubular fluorescent lamps for general service |
| SANS 1247 | Coatings applied by the powder-coating process |
| SANS 783 | Baked enamels |
| SANS 0142 | Wiring of premises |
| SANS 1464 | Safety |
| SANS 890 | Noise levels |
| SANS 1222 | Protection |

17.1.4 FIXING

The luminaries shall be suitable for mounting in or against ceilings as described below:

All holdings will be galvanized, cadmium plated or stainless steel and completely corrosion proof.

The holding screws will not be longer than 30mm and not shorter than 20mm.

At least four fixing screws per luminaries will be supplied and installed.

The position of any other equipment or material that could be damaged when fixing luminaries must be established prior to fixing any luminaries.

Luminaries will be installed completely parallel, straight or/and horizontal at all times.

17.1.5 ENVIRONMENTAL

The luminaries will be suitable to operate in ambient temperatures between - 10°C and +40°C.

17.1.6 SAFETY

The luminaries will bear the SANS 1464 safety mark.

17.1.7 NOISE

Noisy ballasts will not be accepted and shall be replaced at no cost. All ballasts shall comply with the requirements of the latest edition of SANS 890, Part 1.

17.1.8 GENERAL TECHNICAL REQUIREMENTS

GENERAL

Tubular fluorescent lamp luminaries shall comply fully with SANS 1119 and all amendments as well as the additional requirements of the specification. Luminaries shall bear the SABS mark.

The client reserves the right to have samples of luminaries offered tested by the SABS for compliance with SANS 1119. If sample luminaries are found not to comply with SANS 1119 the cost of such tests shall be borne by the tenderer.

CONSTRUCTION

Luminaries shall consist of a ventilated body manufactured of either cold rolled sheet steel not less than 0.8mm thick or injection moulded flame retardant GRP, suitably braced or stiffened to prevent distortion. The body shall be of sufficient strength for the mounting of the entire luminaries.

The luminaries shall be designed to accommodate the control gear, wiring, lamp holders and where applicable, the diffuser and reflectors. It shall be possible to reach the control gear without disconnecting wiring or removing the luminaries.

Except for mounting holes and/or slots and the required openings in air-return luminaries, the back of the body channel shall be closed over the full length of the luminaries.

Suitable knockouts shall be provided in the rear or both ends of the luminaries body for wire entry.

All components, including screws, bolts and nuts utilised in the construction of the luminaries or fixing of its components, shall be corrosion proof. Cadmium plated or stainless steel materials are preferred.

The lamp compartment and body will have a degree of IP 65 protection as per SANS 1222.

INTERNAL WIRING

Luminaries shall be completely wired internally. Conductors shall be protected with grommets where they pass through holes in the body.

The wiring shall be totally enclosed to prevent any possible contact with live components while changing lamps.

The conductor insulation shall be rated to withstand the temperature inside the luminaries body without deterioration.

The wiring shall terminate on a suitable terminal block having screw down plates bearing on the wires.

Terminal where screws bear down directly on wires will not be acceptable.

An earth terminal, welded to the luminaries body, shall be provided where applicable. To ensure good earth continuity the earth terminal shall not be spray painted. The earth conductor shall be connected to this terminal by means of a crimped lug.

LAMP HOLDERS

Lamp holders shall preferably be of twist-lock type. The mounting of the holders shall be able to accommodate the tolerances experienced in the length of lamps and in the manufacture of luminaries.

CONTROL GEAR

The control gear, ballasts, capacitors and starters shall be designed and manufactured to suit the control circuitry adopted. All luminaries shall operate on a switch-start basis.

Ballasts shall comply with SANS 890 and SANS 891, suitable for operation on 220V to 250V 50Hz supplies.

Ballasts shall further be suitable for the particular luminaries to ensure that the thermal limits specified in paragraph 3.5 of SANS 1119 are not exceeded.

Starters shall comply with SANS 1479 or with BS 3772 if it is not covered by SANS 1479. Starters with metal cans shall contain integral earthing facilities to earth the can upon insertion.

Starters shall be accessible from the outside of the luminaries, and the replacement of the starter shall not necessitate the removal of lamps.

Capacitors shall comply with SANS 1250. The power factor of each complete fitting shall be corrected to at least 0,85.

LAMPS

Fluorescent lamps shall be suitable for the control circuitry used. Lamps shall comply with SANS 1041.

Only Osram & Philips branded lamps will be accepted on this project.

If no colour is specified, the light colour shall correspond to colour 2 (4 300K) of SANS 1041.

Lamps of the same colour shall be provided for an entire installation unless specified to the contrary.

There shall be no visible flicker in the lamps and lamps shall readily strike when switched on. Faulty lamps or ballasts shall be replaced at no cost.

PHOTOMETRIC DATA

Photometric data sheets of the luminaries as prepared by a laboratory, that complies with SABS requirements, shall be submitted with the luminaries.

TECHNICAL INFORMATION

The tenderer shall include full technical particulars regarding the luminaries offered with the tender.

RECESSED LUMINARIES

Recessed luminaries shall be suitable for mounting in the ceiling structure specified in the project specification.

The diffuser or reflector shall fit flush with the ceiling and the only visible portion shall be the reflector or diffuser.

Should the luminaries be so designed that a surrounding frame is visible, then this frame shall be manufactured of anodized aluminium. The frame shall form a neat trim with the ceiling. The corners of the surrounding frame shall be mitered and reinforced.

LOW- BRIGHTNESS LUMINARIES

The luminaries shall be provided with an aluminium louvre with V-shaped longitudinal vanes and extruded stepped cross-shielding plates.

Louvres shall be constructed from high purity aluminium (99,98%), chemically brightened and anodized.

The total Light Output Ratio (LOR) shall be 62% or better. In the plane between 60 and 90 from the vertical, the LOR shall be below 3%.

LOW GLARE LUMINARIES

The luminaries shall be provided with a die-formed, bright-anodized high-purity aluminium (99.98%) louver with parabolic reflecting surfaces in both directions.

The total LOR shall be 62% or better. In the plane between 60 and 90 from the vertical, the LOR shall be less than 1.3%.

LUMINARIES FOR USE IN AREAS WITH VISUAL DISPLAY TERMINALS

The luminaries shall have anodized specular louvers to provide the brightness control required for this type of application.

At angles between 60 and 90 from the vertical the luminance shall not exceed 200cd/m².

At above angles the LOR shall be less than 0.6%. At angle between the vertical and 60 the LOR shall be 61% or better.

17.2 BULKHEAD LIGHT FITTINGS

17.2.1 SCOPE

The specification is for all bulkhead fittings to be used on this project.

17.2.2 GENERAL

Luminaries, associated equipment and control gear shall be new and unused and shall be supplied complete with lamps, control gear, diffusers, mounting brackets, etc. and shall be delivered to site in a protective cover. Lamps shall be delivered separately.

17.2.3 STANDARDS

The following standard specifications of the South-Africa Bureau of Standards shall apply to this luminary's specification:

| | |
|--------------|--|
| SANS 1119 | Interior Luminaries for fluorescent lamps. |
| SANS 1250 | Capacitors for use with fluorescent and other discharge lamp ballast's |
| SANS 890 | Ballast's for fluorescent lamps |
| SANS 1464 | Safety of Luminaries |
| SANS 1479 | Glow starters for fluorescent lamps |
| SANS IEC 400 | Lamp holders for tubular fluorescent lamps |
| SANS 1041 | Tubular fluorescent lamps for general service |
| SANS 1247 | Coatings applied by the powder-coating process |
| SANS 783 | Baked enamels |
| SANS 0142 | Wiring of premises |
| SANS 1464 | Safety |
| SANS 890 | Noise levels |
| SANS 1222 | Protection |

17.2.4 PHYSICAL AND ENVIRONMENTAL REQUIREMENTS

N/A

17.2.5 AREAS OF APPLICATION

The luminaries are attended for outdoor as well as indoor use.

17.2.6 FIXING

The luminaries shall be suitable for mounting in or against ceilings as described below:

All holding screws will be galvanised, cadmium plated or stainless steel and completely corrosion proof.

The holding screws will not be longer than 30mm and not shorter than 20mm.

At least four fixing points per luminaries must be established.

The position of any other equipment or material that could be damaged when fixing luminaries must be established prior to fixing any luminary.

17.2.7 ENVIROMENTAL

The luminaries shall be suitable for operation in ambient temperatures between -10 C and +45 C.

17.2.8 SAFETY

The luminary shall bear the SANS 1464 safety mark.

17.2.9 NOISE

Noisy ballasts will not be accepted and shall be replaced at no cost. All ballasts shall comply with the requirements of the latest edition of SANS 890, Part 1.

17.2.10 GENERAL TECHNICAL REQUIREMENTS

GENERAL

The bulkhead luminaries shall be suitable for surface mounting on a ceiling or wall and shall allow for surface conduits to enter on all sides.

CONSTRUCTION

The luminaries shall consist of a high-pressure die cast aluminium base and a structured opaque high impact acrylic diffuser.

It shall be the shape specified in the Bill of materials and shall be designed to operate compact fluorescent lamps up to 2 x 26W (staircases) or shaped as per the attached pamphlets for outside and bathroom lighting.

The diffuser shall be fixed to the body by four stainless steel Allen head screws. A silicon sponge gasket shall be fitted into a groove on the diffuser.

Four mounting holes shall be provided in the base for securing the diffuser onto the base.

All internal wiring shall be Teflon coated with protective sleeving to prevent damage by possible abrasion.

Main connections shall be by means of a suitable screw terminal block with a wire clamping contact.

All screws, bolts and metals shall be stainless steel or of non-corrosive material.

A luminary shall consist of a ventilated body manufactured of either cold rolled sheet steel not less than 0.8mm thick or injection moulded flame retardant GRP, suitably braced or stiffened to prevent distortion. The body shall be of sufficient strength for the mounting of the entire luminary

LAMP HOLDERS

Lamp holders shall preferably be of twist-lock type. The mounting of the holders shall be able to accommodate the tolerances experienced in the length of lamps and in the manufacture of luminaries.

CONTROL GEAR

The control gear shall be incorporated inside the separate control gear compartment and be mounted on a removable gear tray.

It shall be suitable for operation with the specified rating of the lamp on a 230V + 3%-10% 50Hz single-phase system.

All control gear components shall be removable and bear the relevant SABS mark.

The luminaries shall be power factor corrected to a minimum of 0.85.

Ignitors, where applicable, shall be of the superposed pulse type.

The luminaries shall be able to withstand ambient temperatures of at least 45 C. without resulting in any electrical or mechanical component exceeding its maximum allowed operating temperature.

The lamp compartment and body will have a degree of IP 65 protection as per SANS 1222.

LAMPS

Only Osram & Philips branded lamps will be accepted on this project.

If no colour is specified, the light colour shall correspond to colour 2 (4 300K) of SANS 1041.

Lamps of the same colour shall be provided for an entire installation unless specified to the contrary.

There shall be no visible flicker in the lamps and lamps shall readily strike when switched on. Faulty lamps or ballasts shall be replaced at no cost.

TECHNICAL INFORMATION

The Tenderer shall include full technical particulars regarding the luminaries offered with the tender.

EMERGENCY EXIT INDICATORS

Except for the following changes, all emergency exits will be indicated with the same Bulkhead fitting as specified above:

The high impact acrylic diffuser will be white.

The word "EXIT" will be indicated on the front of the diffuser and will be at least 60mm in height.

The colour of the script will be signal red.

The quality of the script will be such that it is engraved and will not be of the sticker type.

BATTERY BACK-UP UNITS

Where indicated on the attached drawings, bulkhead fittings will be fitted with battery back-up units with the following specifications:

The units must have self-testing facilities on a weekly basis and full functional test on a monthly basis.

It must have a one-hour standby facility with at least 18% of the normal light output.

It will have an external lamp, indicating the following:

- Mains on and system in working order.
- Battery voltage low.
- Battery voltage too high.
- Low capacity battery.
- Bad lamps.
- No mains.

18. EARTHING AND BONDING

The Contractor will be responsible for all earthing and bonding of the building and installation; the earthing and bonding is to be carried out strictly to the specification and to the satisfaction of the Department's representative.

Connection from the main earth bar on the main board must be made to the cold water main, the incoming service earth conductor, if any and the earth mat or other local electrode by means of 12mm x 1,6mm solid copper strapping of 16mm² stranded (not solid) bare copper wire or such conductor as the Department's representative may direct. Main earth copper strapping where installed below 3m from ground level, must be run in 20mm diameter conduit securely fixed to the walls.

All other hot and cold water pipes shall be connected with 12mm x 0,8mm perforated for solid copper strapping (not conductors) to the nearest switchboard. The strapping shall be fixed to the pipe work with brass nuts and bolts and against walls with brass screws at 150mm centers. In all cases where metal water pipe, down pipes, flues, etc., is positioned within 1,6m of switchboards an earth connection consisting of copper strapping shall be installed between the pipe work and the board. In vertical building ducts accommodating both metal water pipes and electrical cables, all the pipes shall be earthed at each distribution board.

Where service connections consist of overhead conductors, all metal parts of roofs, gutters and down pipes shall be earthed. One bare 10 mm² copper conductor shall be installed over the full length of the ceiling void, fixed to the top purlin and connected to the main earth conductor and each switchboard. The roof and gutters shall be connected at 15 m intervals to this conductor by means of 12 mm x 0,8 mm copper strapping (not conductors) and galvanized bolts and nuts. Self-tapping screws are not acceptable. Where service connections consist of underground supplies, the above requirements are not applicable.

A separate earth connection shall be supplied between the earth bush-bar in each sub-distribution board and the earth bush-bar in the Main Switchboard. These connections shall consist of bare or insulated stranded copper conductors installed along the same routes as the supply cables or in the same conduit as the supply conductors. Alternatively armored cables with earth continuity conductors included in the armoring may be utilized where specified or approved.

An earth conductor shall be installed in all non-metal flexible conduit. This earth conductor shall not be installed externally to the flexible conduit but within the conduit with the other conductors. The earth conductor shall be connected to the earth terminals at both ends of the circuit.

Where non-metallic conduit is specified or allowed, the installation shall comply with the Department's standard quality specification for "conduit and conduit accessories."

Standard copper earth conductors shall be installed in the conduits and fixed securely to all metal appliances and equipment, including metal switch boxes, socket-outlet boxes, draw-boxes, switchboards, luminaries, etc. The securing of earth conductors by means of self-threading screws will not be permitted.

19. INTERRUPTIONS OF ELECTRICAL SUPPLY

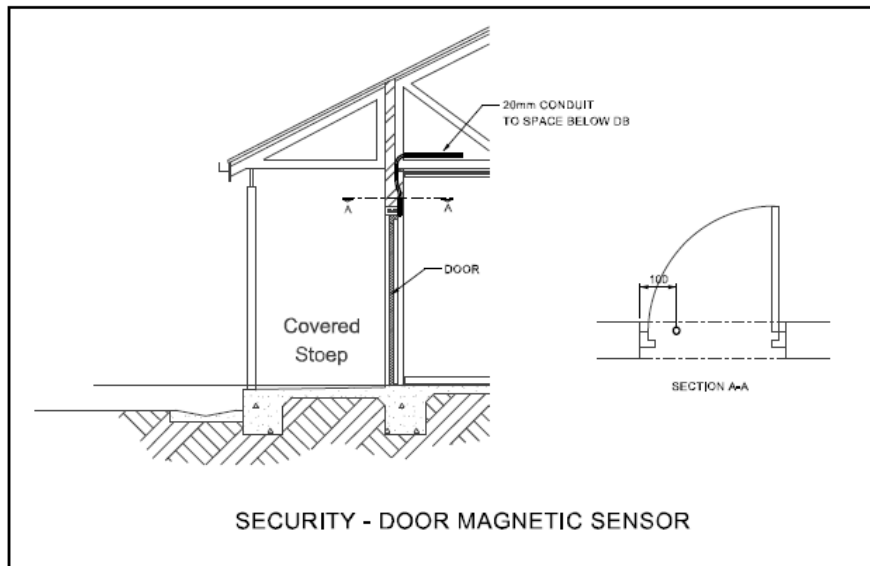
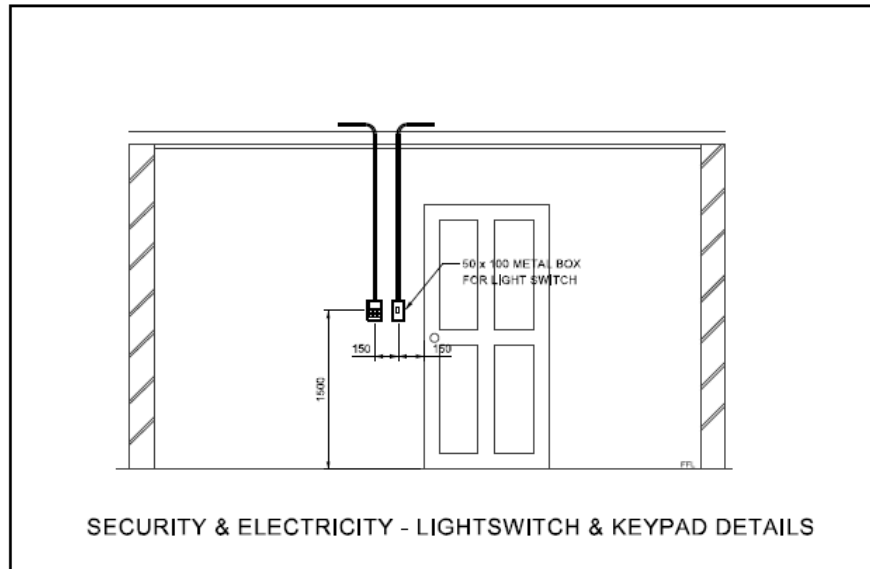
All interruptions of the electrical supply that may be necessary for the execution of the work will be subject to prior arrangement between the Contractor the schools and the Municipality.

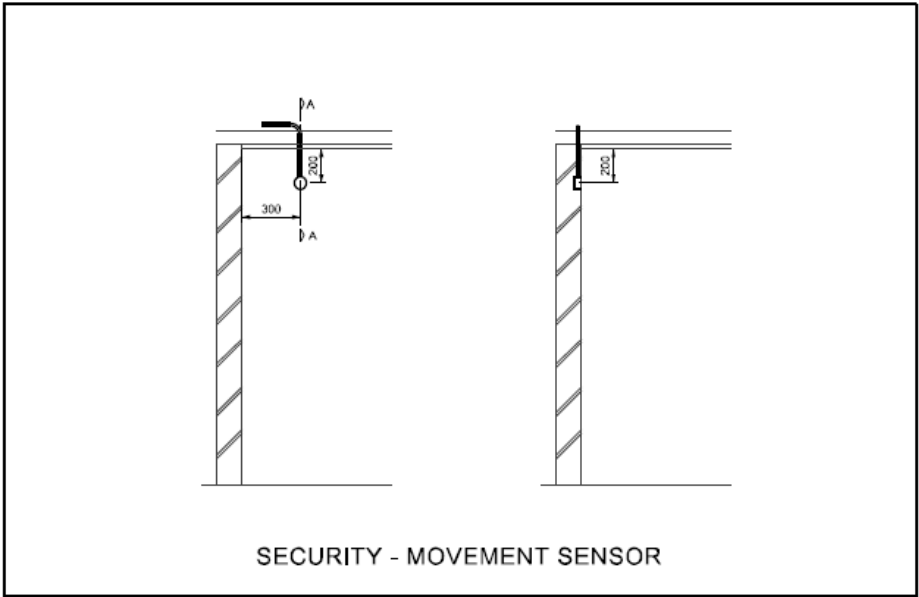
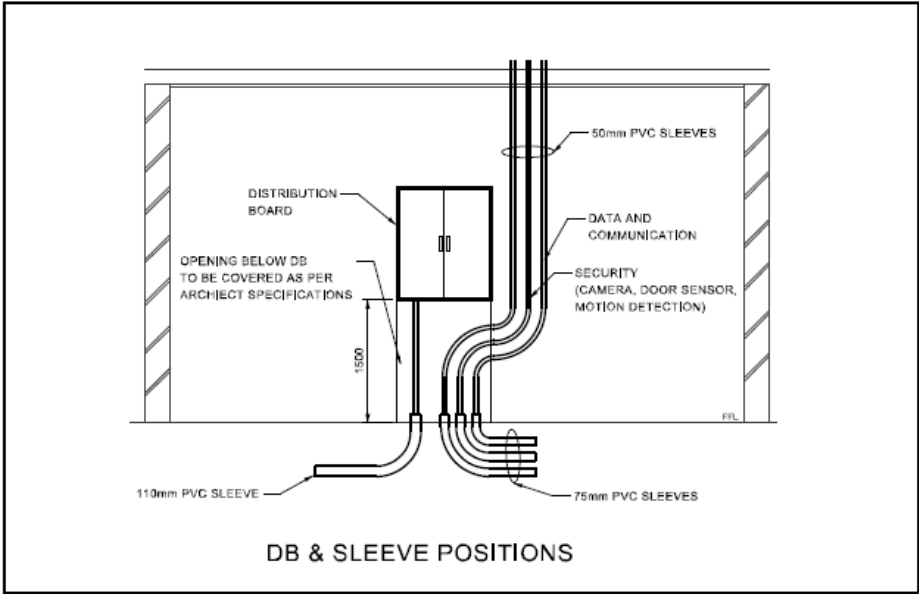
20. REGULATIONS AND CODES

The complete electrical installation shall be carried out in full compliance with the Wiring Code and with any Regulations or Codes of Practice in force or adopted in the area in which the contract is to be carried out. Tenderers shall familiarize themselves with all such Regulations or Codes before finalizing their prices; no price variations to the contract based on lack of knowledge or such Regulations or Codes will be allowed.

21. CONDUIT AND WIRING

Conduit will be PVC or steel 20mm or 25mm with SABS markings. Conduit will be fixed with raised saddles to ensure that the conduit is horizontal at the roof at all times and does not lift at entry level. Saddles will be installed at not more than 1000mm apart





22. CABLE TRAYS

Cable ladder” cable trays shall be used for all new cables in the ceiling void and service ducting. Typical OL55 and OL76 as per request

- Refer to Bill of quantities for detail on widths.

23. CABLES

Note: All LV regularly used cables will be XLPE Insulated PVC bedded SWA PVC sheathed 600/1000V manufactured to SANS 1507-4.

This contract will require the use of temporally cables from the main DB to the three level DB's that will be 4 Core Rubber insulated trailing cables.

The electrical contractor shall allow for the supply and complete installation of all distribution cables as indicated on the drawings, and listed in the Schedule of Cables.

Tenderers must base their tender on the amounts of cable, including earth conductors, as indicated in the Bill of Quantities. During the course of the work the actual lengths will be measured on site and adjustments will be made according to the price per meter length as inserted by the tenderer for the particular cable size concerned.

Tenderers must base their cost for trenching in earth; hard rock on the total quantities as indicated in the Bill of Quantities. The actual quantities, based on the dimensions as specified below for trenches for the applicable number of cables to be laid, will be measured on site during the course of the service and adjustments made according to the price per cubic meter as inserted by the tenderer. Payment for cable trenching having a greater volume than that specified for the purpose will not be considered except where extra excavations are necessary to by-pass obstacles such as water pipes, drains, large boulders etc. In all such instances the amount of the extra excavations must be agreed upon on site between the Engineer and the contractor.

Cables in soil will be buried 1,5m underground. Cables that are attached to roofs or walls will be tied with aluminum strapping (25mm) every 400mm to 100mm cable racks.

The storage, transportation, handling and laying of the cables shall be according to first class practice, and the contractor shall have adequate and suitable equipment and labour to ensure that no damage is done to cables during such operations.

The cable-trenches shall be excavated to a depth of 0,6m deep below ground level and shall be 450mm wide for one to three cables, and the width shall be increased where more than three cables are laid together so that the cables may be placed at least two cable diameters apart throughout the run. The bottom of the trench shall be level and clear and the bottom and sides free from rocks or stones liable to cause damage to the cable.

The contractor must take all necessary precautions to prevent the trenching work being in any way a hazard to the personnel and public and to safeguard all structures, roads, sewage works or other property on the site from any risk of subsidence and damage.

In the trenches made in soft and hard rock the cables shall be laid on a 75mm thick bed of earth and be covered with a 150mm layer of earth before the trench is filled in.

No joints will be allowed in cables.

The laying of cables shall not be commenced until the trenches have been inspected and approved. The cable shall be removed from the drum in such a way that no twisting, tension or mechanical damage is caused and must be adequately supported at intervals during the whole operation. Particular care must be exercised where it is necessary to draw cables through pipes and ducts to avoid abrasion, elongation or distortion of any kind. The ends of such pipes and ducts shall be sealed to approval after drawing in of the cables.

Backfilling (after bedding) of the trenches is to be carried out with a proper grading of the material to ensure settling without voids, and the material is to be tamped down after the addition of every 150mm. The surface is to be made good as required.

On each completed section of the laid and jointed cable, the insulation resistance shall be tested to approval with an approved "Megger" type instrument of not less than 500V for low tension cables.

Earth continuity conductors are to be run with all underground cables constituting part of a low tension distribution system. Such continuity conductors are to be stranded bare copper of a cross-sectional area equal to at least half that of one live conductor of the cable, but shall not be less than 4mm² or more than 70mm². A single earth wire may be used as earth continuity conductor for two or more cables run together, branch earth wires being brazed on where required.

24. LAYING, JOINTING AND MAKING OFF OF ELECTRICAL CABLES

NB : The requirements specified hereafter, are aimed essentially at high tension cable but are also valid for low tension cable, where applicable.

- 24.1 The use of the term “Inspector”, includes the engineer or inspector of the Department or an empowered person of the concerned supervising consulting engineer’s firm.
- 24.2 No cable is to be laid before the cable trench is approved and the soil qualification of the excavation is agreed upon by the contractor and inspector.
- 24.3 After the cable has been laid and before the cable trench is backfilled the inspector must ensure that the cable is properly bedded and that there is no undesirable material included in the bedding layer.
- 24.4 All cable jointing and the making off of the cables must only be carried out by qualified experienced cable jointers. Helpers of the jointers may not saw, strip, cut, solder, etc. The cable and other work undertaken by them must be carried out under the strict and constant supervision of the jointer.
- 24.5 Before the contractor allows the jointer to commence with the jointing work or making off of the cable (making off is recognized as half a joint) he must take care and ensure:
- that he has adequate and suitable material available to complete the joint properly and efficiently. Special attention must be given to ensure the cable ferrules and cable lugs are of tinned copper and of sufficient size. The length of the jointing lugs must be at least six times the diameter of the conductor,
- that the joint pit is dry and that all loose stones and material are removed,
- that the walls and banks of the joint pit are reasonably firm and free from loose material which can fall into the pit,

that the necessary coffer-dams or retaining walls are made to stop the flow of water into the joint pit,

that the joint pit is provided with suitable groundsheets so that the jointing work is carried out in clean conditions,

that the necessary tents or sails are installed over the joint pit to effectively avert unexpected rainfall and that sufficient light or lighting is provided,

that the necessary means are available to efficiently seal the jointing or cable end when an unexpected storm or cloudburst occurs, regardless of how far the work has progressed,

that the cables and other materials are dry, undamaged and in all respects are suitable for the joint work or making off,

that the heating of cable oil, cable compound, plumbers metal and solder is arranged that they are at the correct temperature when required so that the cable is not unnecessarily exposed to the atmosphere and consequently the ingress of moisture (care must be taken of overheating)

- 24.6 Before the paper insulated cables are joined, they must be tested for the presence of moisture by the cable jointers test. This consists of the insertion of a piece of unhandled insulated impregnated paper tape in warm cable oil heated to a temperature of $130 \pm 5^{\circ}\text{C}$. Froth on the surface of the oil is an indication that moisture is present in the impregnated insulation and the amount of the froth gives an indication of the moisture present.
- 24.7 If the cable contains moisture or is found to be otherwise unsuitable for jointing or making off the inspector is to be notified immediately and he will issue the necessary instruction to cope with the situation.
- 24.8 The joint or making off of paper insulated cables must not be commenced during rainy weather.
- 24.9 Once a joint is in progress the jointer must proceed with the joint until it is complete and before he leaves the site.

- 24.10 After the individual cores have been insulated they must be well basted with hot cable oil and again after the applicable separator and/or belt insulation tape is applied before the lead joint sleeve is placed in position.
- 24.11 The lead joint sleeve must be thoroughly cleaned and prepared before it is placed on the cable and must be kept clean during the whole jointing process. Seal the filling apertures of the sleeve with tape until the sleeve is ready for compound filling.
- 24.12 The plumbing joints employed to solder the joint sleeve to the cable sheath, must be cooled off with tallow and the joint sleeve is to be filled with compound while it is still warm. Top up continuously until the joint is completely filled to compensate for the compound shrinkage.
- 24.13 The outer joint box must be clean and free from corrosion. After it has been placed in position it must be slightly heated before being filled with compound. Top up until completely full.
- 24.14 As far as cable end boxes are concerned the requirements as set out above are valid where applicable.

25. DISTRIBUTION BOARDS AND CIRCUIT BREAKERS

The electrical contractor shall supply and install the distribution boards as indicated on the drawings. All distribution boards shall comply with the quality specification, and be approved by the Engineer or by the Department's representative.

All DB's as well as both ends of cables will be marked with engraving on aluminum plate.

All distribution boards shall be manufactured according to the detail specifications and drawings, and shall be inspected and **approved** by the Engineer before installation.

The Engineer shall first approve any other type of distribution board, which may be submitted as an alternative.

All bus bars and lugs shall be insulated, and wiring shall enter the switch gear from the back of the distribution board.

All circuit breakers will be the quality of **CBI** or better.

Quality Specification and Manufacturers:

All switchgear and equipment shall comply with the specification in the document.

Wiring:

The manufacturers shall internally wire all distribution boards. Wiring between switchgear and busbars shall be done by means of PVC insulated stranded copper conductors, fixed to the busbars with copper lugs, and brass bolts.

Only color coded wiring shall be accepted, e.g.: Red, yellow and blue for phases, and black for neutral.

Wiring colored by means of PVC insulated tape shall not be accepted.

Wiring shall be neatly strapped in a vertical and horizontal manner. All instrument and control wiring shall be 2,5mm² PVC insulated copper conductors, and shall be numbered for ease of tracing circuits.

Color:

The color of all distribution boards shall be light stone and all painting shall be done in accordance with the standard paint specifications in part 3 of this specification.

Doors:

Where specified, doors shall be of the removable type.

Separate Compartments:

Where distribution boards have separate compartments, they shall be separated by means of a metal dividing section, and be equipped with individual removable circuit breaker covers.

26. BILLS OF MATERIALS

- 26.1 This Bill of Quantities forms part of, and must be read in conjunction with the specification.
- 26.2 No alteration, erasure or addition is to be made in the text of the Bill of Quantities. Should any alteration, erasure or addition be made it will not be recognized but the original wording of the Bill of Quantities will be adhered to.
- 26.3 The Client will check the completed Bill of Quantities and reserves the right to adjust any individual price and to rectify any discrepancy whilst the total tender price as quoted remains unaltered.
- 26.4 The quantities given in the Bill for cable, cable markers, earth wire laid with cable, overhead conductors, overhead earth wire and excavations cannot be regarded as exact and are subject to measurement on site after completion of the service and adjustments will be made according to the unit rates given in the Bill.

All other quantities will not be measured on site.

In the event of discrepancies between the drawings, specifications and Bill of Quantities the Client shall decide whether the work as executed shall be re-measured on site or whether re-measurement shall be effected from the working drawings only.

NOTE:

Checking of Cable and Overhead Conductor Lengths

Notwithstanding the fact that the lengths of cables and overhead conductors as given in the Bills of Quantities have been measured from scaled drawings, the contractor shall check such lengths on site before ordering the cable as he will not be paid for excess cable after the completion of the service. Any allowance for off-cuts shall be made in the unit rates. The final measurements shall be based on the nett route length of the cables and overhead lines concerned.

- 26.5 Where alternative prices for gear of different manufacture are quoted the lowest alternative price for gear to specification must be quoted against the relevant item in the Bill of quantities. The remaining alternative prices must be furnished separately.
- 26.6 The unit prices quoted in the Bill of Quantities must include for such small Installation materials as are required for the complete installation in accordance with the specification.

27. X-RAY EQUIPMENT

N/A

28. LIFT INSTALLATION

N/A

31. DATA CABLING SPECIFICATION

1 GENERAL

This specification covers the supply, delivery, installation, testing, commissioning and maintenance during the guarantee period of the Data Cabling Installation covered under the scope of works for the Proposed New Development for the above mentioned building

2 SCOPE OF WORKS

DATA

This specification covers the supply, delivery, installation, testing, commissioning and maintenance during the guarantee period of the Data Installation, described below, for the Proposed New Development for the above mentioned building.

1. Backbone telecommunication infrastructure in the form of 15 pair telephone from each server building to Admin
2. 6U racks as specified;
3. 6 U Swing frame cabinet (6U X 600 X 500)
4. Cat 5e cabling between workstations and patch panels including terminations and plugs in power skirting.
5. Patch panels as specified;
6. Patch leads to switches
7. Labeling as specified.

3 MEASUREMENT

The attached Bill of quantities will be a guideline based on this specification and the accompanying drawings. The tenderer is to measure off the drawings for tender purposes, however, on award of contract the contractor shall measure on site quantities needed for installation. The tenderer is to provide a breakdown of his tender on the tender schedule page. The quantities provided can be adjusted and are for information only.

4 FORM OF CONTRACT

The successful tenderer shall enter into a selected subcontract agreement with the electrical contractor under the JBCC contract.

5 RELATED WORK BY OTHERS

1. N/A

6 STRUCTURED CABLING REQUIREMENTS GUIDELINE

6.1 COMPLIANCE

This Structured Cabling Systems (SCS) guideline, as outlined in the pages to follow, is mandatory in terms of the acceptance of work done in or on School premises and facilities.

The acceptance requirements as outlined in this document are mandatory. No variation will be tolerated nor accepted.

The design of the Structured Cabling System shall comply with the requirements of ISO 11801: 2002, and TIA 568-B.

Copper transmission performance shall exceed the specification for a Category 5e link as defined by the above standards.

The Quality Assurance provisions applied to the installation shall be compliant with BS EN 50174-1 and the Molex Premise Networks Global Warranty requirements.

Installation practices shall be compliant with ANSI/NECA/BICSI-568-2006, Standard for Installing Commercial Building Telecommunications

Cabling and shall be wholly compliant with the installation practices laid down by Molex Premise Networks.

Installation practices shall also meet all applicable local and national codes, standards and ordinances. Where a conflict exists between these standards, it is the responsibility of the contractor to detail these conflicts to the client prior to installation commencing.

6.2 DOCUMENT SCOPE

This document is intended as a guideline and therefore does not supersede the International Standards on which it is based. The purpose of the document is to provide the contractor with information specific to the implementation of Standards based generic structured cabling as per the requirements of the University Network environment and the support/maintenance thereof.

6.3 CONTRACTOR MINIMUM QUALIFICATIONS REQUIREMENTS

1. The contractor shall be Molex certified and possess a valid, authenticated Molex Certified Installer or Molex Business Partner certificate in order that the final installation be certified in accordance with the Molex Global Warranty program requirements.
2. The contractor shall provide only skilled labour to complete work within the agreed upon time frame.
3. The contractor is responsible for the provision of all tools required to full fill his installation obligations in accordance with task at hand at his cost. This includes specialist tools such as core drills etc.
4. By means of the submittal of a quotation and the acceptance of the relevant order number, the contractor is solely responsible for the successful delivery of all documentation pertaining to installed components. E.g. Floor plans , excel sheets and test results to Ingcali Consulting engineers
5. The contractor is solely responsible for the thorough pre-quotation inspection and installation evaluation of any given project for which a quotation is submitted. Any over-sites on the part of the contractor are for his account.

6.4 100 OHM UTP STRUCTURED CABLING SYSTEMS (SCS) GENERAL PRODUCT CONFORMANCE REQUIREMENTS

1. The minimum acceptable cable performance category to be installed on University premises shall be ANSI/TIA/EIA-568-B Category 5e / ISO 11801 Class E (2002) compliant.
2. Only cable and connecting hardware specified for the Molex Premise Networks Structured Cabling Solution shall be used.
3. All installed components shall be new, complete, in good condition and unused albeit for demonstration purposes.
4. All cable reels are to be visually inspected for damage incurred during shipping and transit prior to installation.
5. Cable and connecting components found to be damaged or defective prior and during the installation process are to be removed immediately and returned to the supplier at no additional cost to the University.

6.5 GENERAL PRODUCT PERFORMANCE REQUIREMENTS

The supplied product shall, once installed, conform to ISO 11801 Class E -2002 electrical characteristics for the purposes of Vendor warranty.

It is expected that installed products be capable of supporting voice and data communications applications and protocols from baseline 56Kbps to ISDN PRI for Analogue and Digital Voice and 10Base T to 1000 Base T for data as per the supported applications of ISO 11801 Class E (2002).

The project will be completed and signed off in 7 different phases by the Contractor and Ingcali Project Manager:

Phase 1: Category 5e Data cable Installation:

This comprises the horizontal cabling, extending from the patch panel in the rack or cabinet to the consolidation point if applicable and extending to the telecommunications outlet in the work area. This is the part of the horizontal cabling referred to by the standards as the Permanent Link. Both ends of the cable must be terminated to specification and labelled at both ends by means of a legible, permanent label. Where applicable, the portion of the horizontal cable extending from the patch panel in the cabinet to a consolidation point, intended for future extension to the telecommunications outlet, will be accepted.

| Installation | Color of Cat5e |
|--------------|----------------|
| Data | Grey |
| Telephone | Grey |

Phase 2: Category 5e Patch leads:

Provide patch leads from the patch panels to the switches and panels

| Installation | Color of Cat5e |
|--------------|----------------|
| Data | Green |

Phase 3:

Phase 4: The Main Telephone cable Installation :

The installation of a 15 pair telephone cable extending from the voice panel in the rack or cabinet to the KRONE panel in the cabinet in the main administration building.

Phase 5: Testing and Labelling:

All outlets will be tested using the appropriate Level 3 test equipment, set to the ISO 11801 Class E Permanent Link setting. All links shall be permanently labelled at both ends of the cable, on the

telecommunications outlet fascia and directly above or under the patch panel port as per the labelling requirements set out as specifications in this tender document.

Phase 6: Warranties:

All test results and floor plans will be submitted to Molex Premise Networks' INSIGHT on-line warranty registration program in electronic format for Warranty purposes. The contractor must furnish the INSIGHT reference number to the Ingcali Project Manager.

Phase 7: Final Handover:

The contractor will hand over all documentation, including, updated floor plans (as installed), test results and authenticated 25 year Molex System Performance Warranty Certificate to the INGCALI Project Manager, who will then sign off the installation.

6.6 GENERAL INSTALLATION PRACTICE REQUIREMENTS

1. During the cable installation process, the manufacturer's maximum tensile load recommendations may not be exceeded. This is typically specified as 110N, but should be verified with the manufacturer.
2. Cable being pulled in should be handled by no less than two individuals at all times in order to avoid damage to the cable by means of kinks, twisting along its own axis, getting snagged etc. It is recommended that three installers co-operate in the pulling in of any given cable run, one on each end and another in the middle or positioned near any obstructions to feed slack and thus avoid undue stress on the cable.

3. Whenever possible cable should be placed into pathways rather than be pulled in under tension.
4. Care should be taken not to score conductors during the removal of the outer insulating sleeve of the cable when preparing to terminate pairs.
5. Cables should not be subjected to a bend radius of less than 50mm when under tension (during installation) and the bend radius should not be less than 25mm when once installed.
6. During the installation process, installers are required to visually inspect cable and connecting hardware components for damage. If such damage is found, e.g. tears in the outer jacket of the cable, severe kinks as identified by white/grey bands of discoloration on cable jacket, these components are to be replaced immediately.
7. The installer is to make use of best practices when handling unjacketed conductors. Care is to be taken as not to create pair spread, pair wrapping, pair separation and the re-twisting of pairs.
8. Pair twists must be maintained up to the point of termination. Under no circumstances may pair untwist of more than 6 mm be allowed. The sheath should be trimmed such that no more than 25mm of wire may be exposed after termination.
9. All cabling shall be clearly labelled at both ends to the rear of the point of termination no more than 100mm from such a termination point.
10. All patch panel ports and workstation outlets shall be clearly labelled by means of appropriately secured printed labels (hand written labels are not acceptable).
11. All patch and workstation outlet cables shall be clearly labelled by means of an appropriately secured printed label.
12. All labeling schemes shall be confirmed with the appropriate representative of Ingcali/Project Manager before being applied.
13. The maximum number of screws or bolts as provided for by the design of connecting hardware or SCS components and accessories are to be used without exception.

6.7 DUCTING AND SUPPORTING STRUCTURES

1. Where support structures are used, such structures are to provide support at a maximum of 1.5 meters along the length of the run as to avoid cable tension as a result of the cumulative weight of such cable acting upon itself at the next point of support.
2. The surface of such support structures e.g. Cable hangers will not pose a risk of damaging cable due to sharp edges or angular surfaces which would act against the symmetry of wire pairs within the cable or a risk to installers e.g. Cuts.
3. Where cable ties are used, they are to be securely fastened but still permit for cable movement if tugged upon making use of reasonable force.
4. Cable ties are to be used at set intervals of 300mm for all cable bundles where exposed to present a uniform appearance. In concealed spaces, the bundles may be tied at nominal 1m intervals.
5. Under no circumstances shall any cable/s hang unsupported, vertical runs are to be supported are no greater than 300mm intervals.
6. When cable ties are cut; once appropriately fastened around cable bundles, in order to remove protrusions beyond the buckle, the installer will ensure that such a cut is clean and that no sharp edges are created which would damage other cable being pulled past it or injure installers and support staff.
7. Cable shall under no circumstances be strapped to PVC electrical conduit or any structures belonging to an unrelated functional unit such as an air conditioning drain pipe as future maintenance by associated maintenance staff may result in damage or removal in order to facilitate work.
8. Where purpose-installed conduits are to be used for structured cabling, such conduits may never be filled beyond 40% of capacity and should bend at a radius of no less than 6 times the outside diameter of such conduit, nor shall more than two 90 degree bends along the total span of such a conduit. No continuous conduit run may exceed 15 meters without an appropriate draw box.

9. Cable is at no point to be placed directly on top of suspended ceiling tiles.
10. Contractors are to ensure that cable is not installed in areas such as roof spaces or in direct sunlight where temperature ranges might exceed the manufactures operating temperate specifications (typically not in spaces where temperatures exceed 60 degrees Celsius.)
11. All metallic support structures, be it conduit, ducting or trays, shall be grounded in accordance with national electric regulations.
12. Ducting systems shall be securely fastened to walls by means of the appropriate fixing hardware so as to ensure a sound and durable installation.
13. Ducting system covers are to be fitted securely and any portion of the ducting system found to be cracked or damaged is to be immediately replaced.

6.8 POWER AND EMI SOURCE SEPARATION

1. Cable may be laid adjacent to sources of interference such as 240V electrical branch circuits with a minimum separation 75mm where:
 - a. A continuous grounded metallic barrier exists between electric cable and structured cabling.
 - b. A durable non-metallic insulation exists, other than the insulation material of the cable.
2. At no point may data cabling cross the path of any power or broadband cable, fluorescent lighting unit (where suspension is used as a means of separation) at an angle less or greater than 90 degrees.
3. The installer is to ensure that electrostatic devices such as photocopiers and sources of radiation such as x-ray devices, radio transmitters, their antennae and associated broadband cables are to be avoided when routing cable.

6.9 POST-INSTALLATION TEST AND CERTIFICATION

General Requirements

1. Every cabling link is to be tested and must meet with the requirements of ISO 11801 Class E (2002) Permanent Link model across the full length of the link.
2. Test requirements are as per Permanent Link certification requirement for which the appropriate test adapters are to be used.
3. The contractor will ensure that the full plot data is stored for each and every test.
4. The test results shall also be in in the test equipment native software format (eg. Fluke Networks Linkware format (.flw)).
5. Test results are to be stored and provided to Ingcali/Project Manager staff in electronic format in .csv and .flw . When submitting to Molex Premise Networks, the test results must be in the test equipment's native software format.
6. Only Fluke DTX series testers will be used to certify University SCS's or their subcomponents running the current firmware.
7. The test equipment is to be well maintained and in good working order. Ingcali/Project Manager staff reserves the right to insist on an annual factory calibration certificate for the instrument to be used for testing.
8. Ingcali/Project Manager staff further reserves the right to insist on being present during the self-calibration of the test unit and the instruments initial configuration prior to test and during the test process itself.
9. The contractor is to advise Ingcali/Project Manager staff within 3 working days of intent to commence testing in order that such a staff member may make himself available to attend testing procedures.
10. The contractor is required to make available the test equipment and necessary personnel at no extra cost should a member of Ingcali/Project Manager wish to perform random acceptance testing on approximately 10% of the installed cabling infrastructure.
11. Ingcali/Project Manager staff reserves the right to decline acceptance of marginal performing cables irrespective of their having passed testing

based on risk of future degradation over the life span of the installed product.

12. Where it is found that the random tests do not match those presented, Ingcali/Project Manager staff reserves the right to insist on a supervised re-test of any or all installed cables prior to acceptance.
13. It is the sole responsibility of the contractor to ensure that the appropriate Vendor test and documentation requirements are met in order that Ingcali/Project Manager be provided with a warranty certificate issued by the SCS Vendor.
14. Any contention regarding Vendor warranty requirements is to be resolved between the Vendor and the contractor and has thus no bearing on Ingcali's requirements as outlined here.
15. Documentation is to conform to the guidelines of EIA/TIA 606-A and provided in 4 parts:
 - a. An excel sheet indicating cable label, location of work area and Telecommunications closet termination points etc in electronic format.
 - b. Detailed test results in .fly (Fluke Networks Linkware) or similar native software format inclusive of all plot data.
 - c. A floor plan or site diagram reflecting the routes taken to and location of all installed cables in electronic format.
 - d. Laminated A3 sheets showing the floor plans for the area covered per rack and labeled voice & data points, to be placed inside each rack.

7 GENERAL

2 X 6 U rack will be provided.

Each rack will have the power connections from the top of the rack and the data connections will come from behind and the bottom. Cabinets will be fitted with a plinth of not less than 150mm in height to enable cable entry in the event that raised flooring is not available.

There will be walkway of 800 mm width in front and behind the cabinet(s) as depicted in figure 1 below.

8 RACK SPECIFICATIONS

- 6u x 1000mm deep
- 1 x 4-Way extractor fan tray mounted to the top of the rack

- 2 x 5-way dedicated Power Distribution Units (PDUs) mounted inside the racks
- Solid lockable doors on the back and sides, and lockable glass door on the front
- Standard colour rack – goose grey

9 CABLE COLOURS

- The horizontal Data cables must be Standard RAL grey colour PVC
- The horizontal camera cables must be Standard RAL yellow colour PVC
- The horizontal Biometric cables must be Standard RAL Black colour PVC
-
- Patch leads
 - Must be in standard length of 0.5 metres
 - Blue for voice points
 - Green for data points
- Fly leads
 - 3m standard length
 - Grey for all data points

10 PATCH PANELS

- Only Molex 1U 24-port Harmonica patch panels to be used.
- All the cables will be patched in separate panel. Switches will be installed in separate panel and connected with patch leads

11 LABELLING OF DATA, VOICE & FIBRE POINTS

- First patch panel begins with letter A, Points 1-24
- Second patch panel begins with letter B, Points 1-24
- Continues to Z, Points 1-24
- Then starts with AA, Points 1-24
- Next panel is AB, Points 1-24

12 SCHEDULE OF DATA/TELEPHONE OUTLETS **CAT 5e CABLING**

See Bill of Quantities

