

## **ELECTRICAL SPECIFICATIONS**

**ELECTRICAL  
INSTALLATION SPECIFICATION  
FOR  
NHLS**

**MAY 2024**

**INDEX**

**PAGE NO.**

NOTICE TO TENDERERS .....1

SPECIFICATION FOR ELECTRICAL WORK .....2

PART 1 - GENERAL.....4

PART 2: INSTALLATION DETAILS.....12

**NOTICE TO TENDERERS**

1. The tenderer for the principal contract shall submit additional information regarding the installer of the Electrical Installation together with the returnables enclosed with the tender enquiry documents

## SPECIFICATION FOR ELECTRICAL WORKS

### PART 1 - GENERAL

#### CONTENTS

1	TESTS .....	4
2	MAINTENANCE OF INSTALLATIONS .....	4
3	REGULATIONS .....	4
4	NOTICES AND FEES .....	4
5	SCHEDULE OF FITTINGS .....	4
6	QUALITY OF MATERIALS .....	4
7	CONDUIT AND ACCESSORIES .....	4
8	CONDUIT IN ROOF SPACES .....	5
9	SURFACE MOUNTED CONDUIT .....	6
10	CONDUIT IN CONCRETE SLABS .....	6
11	FLEXIBLE CONNECTIONS FOR CONNECTING UP OF STOVES, MACHINES, ETC. ....	7
12	WIRING: .....	7
13	SWITCHES AND SOCKET OUTLETS .....	7
14	SWITCHGEAR .....	7
15	SWITCHBOARDS .....	8
16	WORKMANSHIP AND STAFF .....	8
17	CERTIFICATE OF COMPLIANCE .....	8
18	EARTHING OF INSTALLATION .....	8
19	MOUNTING AND POSITIONING OF LUMINAIRES .....	10

## **PART 1 - GENERAL**

### **1 TESTS**

After completion of the works and before first delivery is taken, a full test will be carried out on the installation for a period of sufficient duration to determine the satisfactory working thereof. During this period the installations will be inspected, and the Contractor shall make good, to the satisfaction of the Representative/Agent, any defects which may arise.

The Contractor shall provide all instruments and equipment required for testing and any water, power and fuel required for the commissioning and testing of the installations at completion.

### **2 MAINTENANCE OF INSTALLATIONS**

With effect from the date of the First Delivery Certificate the Contractor shall at his own expense undertake the regular servicing of the installation during the maintenance period and shall make all adjustments necessary for the correct operation thereof.

If during the said period the installations is not in working order for any reason for which the Contractor is responsible, or if the installations develops defects, he shall immediately upon being notified thereof take steps to remedy the defects and make any necessary adjustments.

Should such stoppages however be so frequent as to become troublesome, or should the installations otherwise prove unsatisfactory during the said period the Contractor shall, if called upon by the Representative/Agent or the Director-General, at his own expense replace the whole of the installations or such parts thereof as the Representative/Agent or the Director-General may deem necessary with apparatus specified by the Representative/Agent or the Director-General.

### **3 REGULATIONS**

The installation shall be erected and tested in accordance with the SANS Regulations.

### **4 NOTICES AND FEES**

The Contractor shall give all notices required by and pay all necessary fees, including any inspection fees, which may be due to the local Supply Authority.

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

### **5 SCHEDULE OF FITTINGS**

In all instances where schedule of light, socket outlet and power points are attached to or included on the drawings, these schedules are to be regarded as forming part of the specification.

### **6 QUALITY OF MATERIALS**

Only materials of first-class quality shall be used, and all materials shall be subject to the approval of the Principal Agent/Client.

Wherever applicable the material is to comply with the relevant SANS standards, specifications, or to British Standard Specifications, where no SABS Specifications exist.

Materials wherever possible, must be of South African manufacture.

### **7 CONDUIT AND ACCESSORIES**

The type of conduit and accessories required for the service, i.e., whether the conduit and accessories shall be of the screwed type, plain-end type or of the non-metallic type and whether metallic conduit shall be galvanised, is specified in Part 2 of this specification.

Unless other methods of installation are specified for certain circuits, the installation shall be in conduit throughout. No open wiring in roof spaces or elsewhere will be permitted.

The conduit and conduit accessories shall comply fully with the applicable SABS specifications as set out below and the conduit shall bear the mark of approval of the South African Bureau of Standards.

- a) Screwed metallic conduit and accessories: SANS 1065, parts 1 and 2.
- b) Plain-end metallic conduit and accessories: SANS 1065, parts 1 and 2.
- c) Non-metallic conduit and accessories: SANS 950

All conduit fittings except couplings, shall be of the inspection type. Where cast metal conduit accessories are used, these shall be of malleable iron. Zinc base fittings will not be allowed.

Bushes used for metallic conduit shall be brass and shall be provided in addition to locknuts at all points where the conduit terminates at switchboards, switchboxes, draw-boxes, etc.

Draw-boxes are to be provided in accordance with the "Wiring Code" and wherever necessary to facilitate easy wiring.

For light and socket outlet circuits, the conduit used shall have an external diameter of 20mm. In all other instances the sizes of conduit shall be in accordance with the "Wiring Code" for the specified number and size of conductors, unless otherwise directed in part 2 of this specification or indicated on the drawings.

Only one manufactured type of conduit and conduit accessories will be permitted throughout the installation.

Running joints in screwed conduit are to be avoided as far as possible and all conduit systems shall be set or bent to the required angles. The use of normal bends must be kept to a minimum with exception of larger diameter conduits where the use of such bends is essential.

All metallic conduits shall be manufactured of mild steel with a minimum thickness of 1,2mm for plain-end conduit and 1,6mm in respect of screwed conduit.

Under no circumstances will conduit having a wall thickness of less than 1,6mm be allowed in screeding laid on top of concrete slabs.

Bending and setting of conduit must be done with special bending apparatus manufactured for the purpose and which are obtainable from the manufacturers of the conduit systems. Damage to conduit resulting from the use of incorrect bending apparatus or methods applied must on indication by the Client's inspectorate staff, be completely removed and rectified and any wiring already drawn into such damaged conduits must be completely renewed at the Contractor's expense.

Conduit and conduit accessories used for flame-proof or explosion proof installations and for the suspension of luminaires as well as all load bearing conduit shall in all instances be of the metallic screwed type.

Tenderers must ensure that general approval of the proposed conduit system to be used is obtained from the local electricity supply authority prior to the submission of their tender. Under no circumstances will consideration be given by the Client to any claim submitted by the Contractor, which may result from a lack of knowledge in regard to the supply authority's requirements.

## **8 CONDUIT IN ROOF SPACES**

Conduit in roof spaces shall be installed parallel or at right angles to the roof members and shall be secured at intervals not exceeding 1,5m by means of saddles screwed to the roof timbers.

Nail or crampets will not be allowed.

Where non-metallic conduit has been specified for a particular service, the conduit shall be supported and fixed with saddles with a maximum spacing of 450 mm. The Contractor shall supply and install all

additional supporting timbers in the roof space as required.

Under flat roofs, in false ceilings or where there is less than 0,9m of clearance, or should the ceilings be insulated with glass wool or other insulating material, the conduit shall be installed in such a manner as to allow for all wiring to be executed from below the ceilings.

Conduit runs from distribution boards shall, where possible terminate in fabricated sheet steel draw-boxes installed directly above or in close proximity to the boards.

## **9 SURFACE MOUNTED CONDUIT**

Wherever possible, the conduit installation is to be concealed in the building work; however, where unavoidable or otherwise specified under Part 2 of the specification, conduit installed on the surface must be plumbed or levelled and only straight lengths shall be used.

The use of inspection bends is to be avoided and instead the conduit shall be set uniformly, and inspection coupling used where necessary.

No threads will be permitted to show when the conduit installation is complete, except where running couplings have been employed.

Running couplings are only to be used where unavoidable and shall be fitted with a sliced couplings as a lock nut.

Conduit is to be run on approved spaced saddles rigidly secured to the walls.

Alternatively, fittings, tees, boxes, couplings etc., are to be cut into the surface to allow the conduit to fit flush against the surface. Conduit is to be bedded into any wall irregularities to avoid gaps between the surface and the conduit.

Crossing of conduits is to be avoided, however, should it be necessary purpose-made metal boxes are to be provided at the junction. The finish of the boxes and positioning shall be in keeping with the general layout.

Where several conduits are installed side by side, they shall be evenly spaced and grouped under one purpose-made saddle.

Distribution boards, draw-boxes, industrial switches, and socket outlets etc., shall be neatly recessed into the surface to avoid double sets.

In situations where there are no ceilings the conduits are to be run along the wall plates and the beams.

Painting of surface conduit shall match the colour of the adjacent wall finishes.

Only approved plugging materials such as aluminium inserts, fibre plugs, plastic plugs, etc., and round-head screws shall be used for fixing saddles, switches, socket outlets, etc., to walls, wood plugs and the plugging in joints in brick walls are not acceptable.

## **10 CONDUIT IN CONCRETE SLABS**

In order not to delay building operations the Contractor must ensure that all conduits and other electrical equipment which are to be cast in the concrete columns and slabs are installed in good time.

The Contractor shall have a representative in attendance at all times when the casting of concrete takes place.

Draw-boxes, expansion joint boxes and round conduit boxes are to be provided where necessary. Sharp bends of any nature will not be allowed in concrete slabs.

Draw and/or inspection boxes shall be grouped under one common cover plate and must preferable be



installed in passages or male toilets.

All boxes, etc., are to be securely fixed to the shuttering to prevent displacement when concrete is cast. The conduit shall be supported and secured at regular intervals and installed as close as possible to the neutral axis of concrete slabs and/or beams.

Before any concrete slabs are cast, all conduit droppers to switchboards shall be neatly spaced and rigidly fixed.

## **11 FLEXIBLE CONNECTIONS FOR CONNECTING UP OF STOVES, MACHINES, ETC.**

Flexible tubing connections shall be of galvanised steel construction, and in damp situations of the plastic sheathed galvanised steel type. Other types may only be used subject to the prior approval of the Client's site electrical representative.

Connectors for coupling onto the flexible tubing shall be of the gland or screw-in types, manufactured of either brass or cadmium or zinc plated mild steel, and the connectors after having been fixed onto the tubing, shall be durable and mechanically sound.

Aluminium and zinc alloy connectors will not be acceptable.

## **12 WIRING:**

Except where otherwise specified in Part 2 of this specification, wiring shall be carried out in conduit throughout. Only one circuit per conduit will be permitted.

No wiring shall be drawn into conduit until the conduit installation has been completed and all conduit ends provided with bushes. All conduits to be clear of moisture and debris before wiring is commenced.

Unless otherwise specified in Part 2 of this specification or indicated on the service drawings, the wiring of the installation shall be carried out in accordance with the "Wiring Code". Further to the requirements concerning the installation of earth conductors to certain light points as set out in the "Wiring Code", it is a specific requirement of this document that where plain-end metallic conduit or non-metallic conduit has been used, earth conductors must be provided and drawn into the conduit with the main conductors to all points, including all luminaires and switches throughout the installation.

Wiring for lighting circuits is to be carried out with 2,5mm<sup>2</sup> conductors and a 2,5mm<sup>2</sup>-earth conductor. For socket outlet circuits the wiring shall comprise 4mm<sup>2</sup> conductors and a 2,5mm<sup>2</sup>-earth conductor. In certain instances, as will be directed in Part 2 of this specification, the sizes of the aforementioned conductors may be increased for specified circuits. Sizes of conductors to be drawn into conduit in all other instances, such as feeders to distribution boards, power points etc., shall be as specified elsewhere in this specification or indicated on the drawings. Sizes of conductors not specified must be determined in accordance with the "Wiring Code".

The loop-in system shall be followed throughout, and no joints of any description will be permitted.

The wiring shall be done in PVC insulated 600/1000 V grade cable to SANS 1507.

Where cable ends connect onto switches, luminaires etc., the end strands must be neatly and tightly twisted together and firmly secured. Cutting away of wire strands of any cable will not be allowed.

## **13 SWITCHES AND SOCKET OUTLETS**

All light switches shall be installed at 1,2m above finished floor level and all socket outlets as directed in the Schedule of Fittings which forms part of this specification or alternatively the height of socket outlets may be indicated on the drawings.

## **14 SWITCHGEAR**

Switchgear, which includes circuit breakers, iron-clad switches, interlocked switch-socket outlet units, contactors, time switches, etc., shall be equal and similar in quality to such brands as may be specified.

For uniform appearance of switchboards, only one approved make of each of the different classes of switchgear mentioned in the Quality Specifications shall be used throughout the installations.

## **15 SWITCHBOARDS/DISTRIBUTION BOARDS**

All boards shall be in accordance with the types as specified, be constructed according to the detail or type drawings and must be approved by the Engineer/Client before installation.

In all instances where provision is to be made on boards for the supply authority's main switch and/or metering equipment the contractor must ensure that all requirements of the authorities concerned in this respect are met.

All outdoor distribution boards shall be weather and vermin proof and shall be mounted on a plinth and have brick work around it except in front of the doors. All outdoor distribution boards shall be made from CR12 metal.

Any construction or standard type aboard proposed, as an alternative to that specified must have the prior approval of the Client.

All busbars, wiring, terminals, etc., are to be adequately insulated and all wiring is to enter the switchgear from the back of the board. The switchgear shall be mounted within the boards to give a flush front panel. Cable and boxes and other ancillary equipment must be provided where required.

Clearly engraved labels are to be mounted on or below every switch. The working of the labels in English and Afrikaans, is to be according to the lay-out drawings or as directed by the Client's representative and must be confirmed on site. Flush mounted boards to be installed with the top of the board not more than 2,0m above the finished floor level.

## **16 WORKMANSHIP AND STAFF**

Except in the case of electrical installations supplied by a single-phase or three-phase electricity supply at the point of supply, an accredited person shall exercise general control over all electrical installation work being carried out.

The workmanship shall be of the highest grade and to the satisfaction of the Client.

All inferior work shall, on indication by the Client's inspecting officers, immediately be removed and rectified by and at the expense of the Contractor.

## **17 CERTIFICATE OF COMPLIANCE**

On completion of the service, a **certificate of compliance** must be issued to the Client's Representative/Agent in terms of the Occupational Health and Safety Act, 1993 (Act 85 of 1993).

## **18 EARTHING OF INSTALLATION**

### **Main earthing**

The type of main earthing must be as required by the supply authority if other than the Clients, and in any event as directed by the Client's representative, who may require additional earthing to meet test standards.

Where required an earth mat shall be provided, the minimum size, unless otherwise specified, being 1,0m x 1,0m and consisting of 4mm diameter hard-drawn bare copper wires at 250mm centres, brazed at all intersections.

Alternatively, or additionally earth rods or trench earths may be required as specified or directed by the Client's authorised representative.

Installations shall be effectively earthed in accordance with the "Wiring Code" and to the requirements of the supply authority. All earth conductors shall be stranded copper with or without green PVC installation.

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 1,60 mm solid copper strapping or 16 mm<sup>2</sup> stranded (not solid) bare copper wire or such conductor as the Client's representative may direct. Main earth copper strapping, where installed below 3m from ground level, must be run in 20 mm 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 pipework with brass nuts and bolts and against walls with brass screws at 150-mm centres. In all cases where metal water pipes, down pipes, flues, etc., are positioned within 1,6m of switchboards an earth connection consisting of copper strapping shall be installed between the pipework 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.

### **Roofs, gutters and down pipes**

Where service connections consist of overhead conductors, all metal parts of roofs, gutters and down pipes shall be earthed. One bare 10mm<sup>2</sup> 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 15m intervals to this conductor by means of 12mm X 0,8mm copper strapping (not conductors) and galvanised bolts and nuts. Self-tapping screws are not acceptable. Where service connections consist of underground supplies, the above requirements are not applicable.

### **Sub-distribution boards**

A separate earth connection shall be supplied between the earth busbar in each sub-distribution board and the earth busbar 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, armoured cables with earth continuity conductors included in the armouring may be utilised where specified or approved.

### **Sub-circuits**

The earth conductors of all sub-circuits shall be connected to the earth busbar in the supply board in accordance with SANS 10142.

### **Ring Mains**

Common earth conductors may be used where various circuits are installed in the same wire way in accordance with SANS 10142. In such instances the sizes of earth conductors shall be equivalent to that of the largest current carrying conductor installed in the wire way, alternatively the size of the conductor shall be as directed by the Engineer. Earth conductors for individual circuits branching from the ring main shall be connected to the common earth conductor with T-ferrules or soldered. The common earth shall not be broken.

### **Non-metallic Conduit**

Where non-metallic conduit is specified or allowed, the installation shall comply with the Client'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, luminaires, etc. The securing of earth conductors by means of self-threading screws will not be permitted.

### **Flexible Conduit**

An earth conductor shall be installed in all non-metallic flexible conduits. 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.

### **Connection**

Under no circumstances shall any connection points, bolts, screws, etc., used for earthing be utilised for any other purpose. It will be the responsibility of the Contractor to supply and fit earth terminals or clamps on equipment and materials that must be earthed where these are not provided.

Unless earth conductors are connected to proper terminals, the end shall be tinned and lugged.

## **19 MOUNTING AND POSITIONING OF LUMINAIRES**

The Contractor is to note that in the case of board and acoustic tile ceilings, i.e., as opposed to concrete slabs, close co-operation with the building contractor is necessary to ensure that as far as possible the luminaires are symmetrically positioned with regard to the ceiling pattern.

The layout of the luminaires as indicated on the drawings must be adhered to as far as possible and must be confirmed with the Client's representative.

Fluorescent luminaires installed against concrete ceilings shall be screwed to the outlet boxes and in addition 2 x 6mm expansion or other approved type fixing bolts are to be provided. The bolts are to be  $\frac{3}{4}$  of the length of the luminaires apart.

Fluorescent luminaires to be mounted on board ceilings shall be secured by means of two 40mm x No. 10 round head screws and washers. The luminaires shall also be bonded to the circuit conduit by means of locknuts and brass bushes. The fixing screws are to be placed  $\frac{3}{4}$  of the length of the fitting apart.

Earth conductors must be drawn in with the circuit wiring and connected to the earthing terminal of all fluorescent luminaires as well as other luminaires exposed to the weather in accordance with the "Wiring Code".

Incandescent luminaires are to be screwed directly to outlet boxes in concrete slabs. Against board ceilings the luminaires shall be secured to the bracing or joists by means of two 40mm x No. 8 round head screws.

## **PART 2: INSTALLATION DETAILS**

### **CONTENTS**

1	CABLE SLEEVE PIPES.....	12
2	NOTICES .....	12
3	ELECTRICAL EQUIPMENT .....	12
4	DRAWINGS .....	12
5	BALANCING OF LOAD.....	12
6	SERVICE CONDITIONS.....	12
7	SWITCHES AND SOCKET OUTLETS .....	12
8	LIGHT FITTINGS AND LAMPS.....	12
9	EARTHING AND BONDING .....	12
10	MAINTENANCE OF ELECTRICAL SUPPLY.....	14
11	EXTENT OF WORK .....	14
12	SUPPLY AND CONNECTION .....	14
13	CONDUIT AND WIRING.....	14
14	CABLES.....	14
15.	DISTRIBUTION BOARDS .....	17
16.	SCHEDULE OF LIGHT FITINGS.....	17
17.	SCHEDULE OF DISTRIBUTION BOARDS .....	18

## **PART 2: INSTALLATION DETAILS**

### **1 CABLE SLEEVE PIPES**

Where cables cross under roadways, other services and where cables enter buildings, the cables shall be installed in high-density polyethylene (HDPE) sleeves.

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.

### **2 NOTICES**

The Contractor shall issue all notices and make the necessary arrangements with Supply Authorities, the Postmaster-General, and S.A. Transport Services, Provincial or National Road Authorities and other authorities as may be required with respect to the installation.

### **3 ELECTRICAL EQUIPMENT**

All equipment and fittings supplied must be suitable for the relevant supply voltage and frequency and must be approved by the Client's representative.

### **4 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 built in.

### **5 BALANCING OF LOAD**

The Contractor is required to balance the load as equally as possible over the multiphase supply.

### **6 SERVICE CONDITIONS**

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

### **7 SWITCHES AND SOCKET OUTLETS**

The installation of switches and socket outlets must conform to clause 13 of Part 1 of this specification.

### **8 LIGHT FITTINGS AND LAMPS**

The installation and mounting of luminaires must conform with clause 19 of Part 1 of this specification.

All fittings to be supplied by the Contractor shall have the approval of the Client. All light fittings shall bear the approved mark of the S.A.B.S.

The light fittings must be of the type specified in the Schedule of Light Fittings.

### **9 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 as described in clause 18 of Part 1 of this specification and to the satisfaction of the Client's representative.

## **10 MAINTENANCE 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 and the user Client and the Client's representative.

## **11 EXTENT OF WORK**

The work covered by this contract comprises the complete electrical installation, in working order, as shown on the drawings and as per this specification, including the supply and installation of all fittings and also the installation of such equipment supplied by the Client.

## **12 SUPPLY AND CONNECTION**

The supply will be at 400/230 Volt 50Hz.

The Contractor will be responsible for the supply and installation of the supply cable from the meter box to the main low-tension distribution board (MDB). The size and length of the cable is listed and measured in the Bills of Quantities.

## **13 CONDUIT AND WIRING**

Conduit and conduit accessories shall be galvanised screwed conduit or galvanised plain end conduit.

All conduits, regardless of the system employed, shall be installed strictly as described in the applicable paragraphs of clauses 4 to 8 of Part 1 of the specification. Wiring of the installation shall be carried out as directed in clause 9 part 1 of this specification.

Where plain end conduit is offered all switches and light fittings must be supplied with a permanent earth terminal for the connection of the earth wire.

Lugs held by switch fixing screws or self tapping screws will not be acceptable.

## **14 CABLES**

The Contractor shall supply and completely install all distribution cables as indicated on the drawings and listed in the Schedule of Cables.

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 0,9m 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 clean and the bottom and sites 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 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.

All joints in underground cables and terminations shall be made either by means of compound filled boxes according to the best established practice by competent cable jointers using first class materials or by means of approved epoxy-resin pressure type jointing kits such as "Scotchcast". Epoxy-resin joints must be made entirely in accordance with the manufacturer's instructions and with materials stipulated in such instructions. Low tension PVCA cables are to be made off with sealing glands and materials designed for this purpose which must be of an approved make. Where cables are cut and not immediately made off,

the ends are to be sealed without delay.

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 of the live conductors of the cable but shall not be less than 2.5mm<sup>2</sup>. 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.

#### 14.1 LAYING, JOINTING AND MAKING OFF OF ELECTRICAL CABLES

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

1. The use of the term "Inspector" includes the engineer or inspector of the Client or an empowered person of the concerned supervising consulting engineer's firm.
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.
3. After the cable has been laid and before the cable trench is back-filled the inspector must ensure that the cable is properly bedded and that there is no undesirable material included in the bedding layer.
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.
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:
  - 5.1 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,
  - 5.2 that the joint pit is dry and that all loose stones and material are removed,
  - 5.3 that the walls and banks of the joint pit are reasonable firm and free from loose material which can fall into the pit,
  - 5.4 that the necessary cofferdams or retaining walls are made to stop the flow of water into the joint pit,
  - 5.5 that the joint pit is provided with suitable groundsheets so that the jointing work is carried out in clean conditions,



- 5.6 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,
- 5.7 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,
- 5.8 that the cables and other materials are dry, undamaged and in all respects are suitable for the joint work or making off,
- 5.9 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)

Flow temperatures of cable oil and compound must be determined with suitable thermometers. Cable oil and compound must not be heated to exceed the temperatures given on the containers and precaution must be taken to ensure that the tin is not overheated in one position. The whole mass must be evenly and proportionally heated.

(Temperatures of solder and plumbers' metal may be tested with brown paper (testing time: 3 seconds). The paper must colour slightly - not black or burnt.

- 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.

- 7. If the cable contains moisture or is found to be otherwise unsuitable for jointing or making of the inspector is to be notified immediately and he will issue the necessary instruction to cope with the situation.
- 8. The joint or making off of paper insulated cables must not be commenced during rainy weather.
- 9. Once a joint is in progress the jointer must proceed with the joint until it is complete and before he leaves the site.
- 10. The jointer must ensure that the material and his tools are dry at all times, reasonably clean and absolutely free from soil.
- 11. Relating to the jointing of the cable the following requirements apply:
  - 11.1 All jointing must be carried out in accordance with recognized and tried techniques and comply strictly with the instructions given by the supplier of the jointing kit.
  - 11.2 The cables must be twisted by hand so that the cores can be joined according to the core numbers. If necessary, the cable is to be exposed for a short distance to accomplish this. Under no circumstances may the cores in a joint be crossed so as to enable cores to be joined according to the core numbers. If it is not possible to twist the cables so that the preceding requirements can be met, then cores are to be joined in the normal way without any consideration of the core numbers.
  - 11.3 Normally the cables will have profile conductors. The conductors shall be pinched with gas pliers to form a circular section, bound with binding wire so that they do not spread, and then tinned before jointing.
  - 11.4 Jointing ferrules, the length of which are at least 6 times the diameter of the conductors, must be slid over the conductor ends to be joined and pinched tightly. Then they are soldered by means of the ladle process whilst being pinched further closed.

Use resin only as a flux. The slot opening in the ferrule must be filled, including all depressions.

Remove all superfluous metal with a cloth dipped in tallow. Work during the soldering process must be from top to bottom. Rub the ferrule smooth and clean with aluminium oxide tape after it has cooled down to ensure that there are not any sharp points or edges.

**NB:** The spaces between the conductor strands must be completely filled by soldering process and must be carried out quick enough to prevent the paper insulation from burning or drying out unnecessarily.

11.5 After the ferrules have been rubbed smooth and clean, they and the exposed cores must be treated with hot cable oil (110°C) to remove all dust and moisture. These parts are to be thoroughly basted with the oil.

11.6 The jointer must take care that his hands are dry and clean before the joint is insulated. Also the insulating tape which is to be used must first be immersed in warm cable oil (110°C) for a sufficient period to ensure that no moisture is present.

11.7 After the individual cores have been installed, 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.

11.8 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.

11.9 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.

11.10 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.

12. As far as cable end boxes are concerned the requirements as set out above are valid where applicable.


## 15. DISTRIBUTION BOARDS

In addition to clause 14 and clause 15 of Part 1 of this specification the following shall also be applicable to switchboards required for this service.

The Contractor shall supply and install the distribution boards as indicated on the drawings and listed in the distribution Board Schedule. All distribution be approved by the Client's representative.

## 16. SCHEDULE OF LIGHT FITINGS

The light fittings and accessories shall be approved by the Client/Clients representative.

Type	Description	Picture	Location
TYPE D	22W, Bulkhead LED, with sabs stamp of approval		Wall lighting.

TYPE B	22W Led downlight – Beka Rondo or similar approved		Toilets
TYPE V	55W Led surface mounted light fitting – Lascon or similar approved		Basement
Type I	65W Led Panel recessed light fitting (1200x600mm) Lascon LED Panel – or similar approved		Board Rooms & Offices
Type L	20W LED linear light fitting – Lascon P Pro70 or similar approved		Passages
Type S	9W LED decorative in ground light fitting		Outside lighting

## 17. SCHEDULE OF DISTRIBUTION BOARDS

The front panels of normal supply sections shall be painted in distinctive colors as follows:

Normal supply	:	White
Emergency supply	:	Red
UPS supply	:	Violet Blue

Please see single line drawings attached to this tender.