PSA WHOLESALE LIMITED

VERNON HOUSE

SICILIAN AVENUE, LONDON WC1

ELECTRICAL ENGINEERING SERVICES

CONSULTING ENGINEER:

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GJC/GJC/4238
January 1998

PSA WHOLESALE LIMITED

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ELECTRICAL ENGINEERING SERVICES

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ELECTRICAL ENGINEERING SERVICES

SECTION 1A PRELIMINARIES

1.1 DESIGNATION

The designation 'Contract Administrator/Project Manager/Architect' or 'Consultant Engineer' stated within this Specification shall be deemed to read 'Engineer'.

1.2 DRAWINGS AND SPECIFICATION

The Specification and drawings shall form part of the Main Contract documentation and, therefore, shall be read in conjunction with the said document.

The Engineering Services (herein after called the "Services") shall be executed in accordance with the Specification, contract drawings and such further instructions as may be issued from time to time by the Contract Administrator/Project Manager/ Architect in the most substantial and workmanlike manner according to the true intent and meaning of the Specification and no advantage shall be taken of the outline drawings and Specification and shall be completed to the full satisfaction of the Contract Administrator/Project Manager/Architect.

The Contractor shall include for all relevant items shown upon the drawings whether or not such items are referred to in the Specification but not shown upon the drawings.

Positions of plant shown upon the drawings shall be used for the purposes of tendering but they may be reasonably varied by the Architect without extra cost unless such alterations are made after the plant is installed.

The Contractor shall be held to have carefully examined the site, Specification and the drawings and shall be held to concur as a practical manufacturer and tradesman in the methods and styles of construction to be adopted and the sufficiency of the material proposed to be used in the execution of the "Services".

Should anything be omitted from the said Specification or drawings which is fitting and usually considered necessary to be done for the due and proper completion of the "Services", the Contractor shall execute the same as if it has been particularly specified or shown upon the drawings and shall supply whatever may be necessary to complete the whole "Services" without any claim for payment for such omissions.

Should there be any item or items in the Specification or upon the drawings which the Contractor has any doubt as to the true intent and meaning thereof, he shall satisfy himself by enquiring of the Contract Administrator/Project Manager/Architect before submitting his tender. The Contract Administrator/Project Manager/Architect's decision shall be final. After formal acceptance of the tender, the Contract Administrator/Project Manager/Architect's interpretation thereof will be binding on the Contractor.

1.2 DRAWINGS AND SPECIFICATION (Contd.)

In the event of any discrepancies in the scale approved to any plan or drawing and the figured dimensions thereon, the figured dimensions shall be taken and held to be correct.

1.3 COSTS TO COMPLY WITH SPECIFICATION

Costs for the total of Services shall be based on the specified fittings, articles and materials.

No alternative scheme will be considered and Contractors shall conform strictly to the Specification and associated drawings.

1.4 SCHEDULE OF RATES

The Contractor shall, within 14 days of being so requested by the Contract Administrator/Project Manager/Architect, furnish a schedule of rates showing in detail, the quantities, prices and extensions used in the calculations of his price and he shall accept responsibility for the accuracy of any quantity and extensions contained therein which shall balance with the total cost of this.

This Schedule shall form part of the Contract Documents.

1.5 CONTRACTOR TO INFORM HIMSELF FULLY

The Contractor shall be responsible for all measurements and for the completion of quantities required and no allowance will be made for any alleged ignorance or insufficient knowledge, inaccurate measurements or error on his part.

The drawings prepared in connection with the "Services" indicate diagrammatically the position of the various runs, points and equipment etc., but the actual runs and positions of equipment etc., shall be fully determined on site and the Contractor is required to obtain all information in respect of dimensions, door hangings, architectural features, furniture etc., from the Contract Administrator/Project Manager/Architect's drawings and by enquiry of the Contract Administrator/Project Manager/Architect.

1.6 INSPECTION, TESTING AND REJECTION

The "Services" shall be carried out in accordance with the instructions which will be given from time to time by the Contract Administrator/Project Manager/Architect's Representative and to his satisfaction in all things.

The Contract Administrator/Project Manager/Architect shall have full power to inspect and test at the sole cost and charge of the Contractor, the work or materials during manufacture or construction or at any place where any materials are being made or obtained therewith. All other operations of the Contractor or any authorised Sub-Contractor, manufacturer or tradesman shall be open to the inspection of the Contract Administrator/Project Manager/Architect at all times The Contract Administrator/Project Manager/Architect shall have full power either before or after delivery or erection to reject any of the work which he may consider defective either in material manufacture or workmanship and to order removal of same and his directions on such subjects are to be final and shall be promptly attended to by the Contractor at his own expense Should compliance with such instructions be refused or neglected for three days, the Contract Administrator/Project Manager/Architect shall have power to have the rejected work taken down and removed without being answerable or accountable for any loss or damage which may arise or happen to the same and any consequential expense shall be paid to the Employer.

1.6 INSPECTION, TESTING AND REJECTION (Contd.)

Except where otherwise specified, the Contractor shall provide free of charge such assistance, labour, materials, electricity, fuel, stores, apparatus and instruments as may be requisite and as may be reasonably demanded to carry out the tests efficiently

1.7 TESTS UPON COMPLETION

The Contractor shall give the Contract Administrator/Project Manager/Architect twenty one days notice in writing of the date after which the Contractor will be ready to carry out the tests on completion hereinafter specified. Unless otherwise agreed, the tests shall take place within ten days after the said date on such day or days as the Contract Administrator/Project Manager/Architect shall in writing notify the Contractor.

If the Contractor fails to make such tests within the time aforesaid, the Contract Administrator/Project Manager/Architect may himself proceed to make tests and all tests so made by the Contract Administrator/Project Manager/Architect shall be at the risk and expense of the Contractor.

The Contractor will be required to provide all necessary testing equipment and instruments and to test the installation in the presence of and to the satisfaction of the Contract Administrator/Project Manager/Architect and to carry out such rectification to the plant and further tests as the Contract Administrator/Project Manager/Architect may direct and shall leave the installation in perfect working order as specified
All such tests shall be carried out free of charge to the Employer.

To facilitate progress of the "Services" it may be necessary to test sections of the "Services" separately and no extra charge to the Employer will be allowed.

If any portion of the "Services" fails to pass the tests of the said portion, tests shall, if required by the Contract Administrator/Project Manager/Architect, be repeated within a reasonable time upon the same terms and conditions and all costs arising from the repetition of the tests shall be met by the Contractor.

1.8 SETTING OUT OF WORKS

The Contractor shall take out all his own dimensions for all plant and materials to be supplied and fixed and shall be entirely responsible for their accuracy. All measurements are to be taken from actual buildings and plant and not from drawings and Specification

1.9 BUILDERS WORK

All excavation, back filling, cutting away, making good and all incidental builders work has been measured elsewhere and no cutting away will be allowed without the sanction of the Contract Administrator/Project Manager/Architect. The Contractor shall mark out in advance and shall be responsible for the accuracy and size of all cut holes and chases required

The Contractor shall drill and plug all holes for securing services which require screw or bolt fixing.

Building work requirements in sufficient detail to enable accurate setting out of holes built-in sleeves and bases shall be detailed by the Contractor well in advance so that exact positions can be agreed.

1.10 INSTALLATION LIAISON

Particular care shall be taken to ensure there is close liaison with other trades in installing services to prevent obstruction of Services positions etc.

Services through ducts shall be arranged to permit maximum access in the ducts and the services shall be readily accessible for maintenance.

Any work which has to be rectified due to negligence in this respect will be the responsibility of the Contractor.

The routes of services and the approximate positions of apparatus are shown upon the drawings, but their exact position shall be determined by dimensional detail drawings, or on site by the Contract Administrator/Project Manager/Architect in consultation with the Contractor.

Particular care shall be taken to obtain uniform and tidy arrangements of wall and ceiling mounted equipment The precise position of a piece of equipment shall be determined as follows :-

a) Single items of equipment which are visually remote from other electrical or mechanical equipment shall be erected at the mounting heights stated in the Specification or shown upon the drawings.

b) Two or more items of equipment whether mechanical or electrical or both, which are to be erected on the same wall, or ceiling, or which will be otherwise visually close to each other, shall be arranged in a neat and symmetrical group.

Symmetry of arrangement shall be obtained by horizontal and vertical alignment through the centre lines and not the edges of equipment and for this purpose the mounting heights stated in the General Specification or on the drawings may be varied slightly.

1.11 SAMPLES ETC

The Contractor shall include for submitting samples of materials, valves, cables, switches, fittings etc., together with sketches, illustrations, leaflets or drawings if required to the Contract Administrator/Project Manager/Architect. Such samples and illustrations etc., shall remain the property of the Contract Administrator/Project Manager/Architect until the termination of the Contract, when they will be returned to the Contractor

No material shall be ordered or used until it has been approved by the Contract Administrator/Project Manager/Architect.
The Contractor shall clearly mark samples etc., with his own name and address and the contract to which they refer.

1.12 ELECTRICAL WORK ASSOCIATED WITH MECHANICAL SERVICES

The Contractor shall ensure that the wiring connections to all plant conforms to the diagrams shown on the tender drawings If any discrepancy is found, then the Contract Administrator/Project Manager/Architect shall be informed before installation

1.13 WORKMANSHIP AND MATERIALS

The "Services" shall be executed, manufactured, erected and completed in the best and most workmanlike manner and with the best materials of their respective kinds and everything is to be done to the full spirit and intent of the Contract which is intended to comprise everything necessary for the perfection completion of the works

1.13 **WORKMANSHIP AND MATERIALS** (Contd)

Where particular materials are called for, the Contract Administrator/Project Manager/Architect shall have authority to reject materials which do not conform to the Specification.

Where the words "equal" and "approved" appear in the Specification, they shall mean an article or articles approved in writing by the Contract Administrator/Project Manager/Architect, being equal in every respect to that or those specified

In cases where permission is given for a lower priced article to be provided, the Contract price shall be adjusted to suit the difference in cost.

Unless otherwise specified and approved, all design materials and installations shall comply with the latest issue of the relevant current British Standards, British Codes of Practice, Statutory Regulations and Bye Laws etc. Unless otherwise stated, all materials shall be new and unused.

1.14 **INFORMING MANUFACTURERS**

Whilst preliminary discussions between the designers and the specified manufacturers have taken place at various stages it cannot be assumed that any of the firms specified are fully aware of the final design requirements.

It is, therefore, essential that the tenderer fully informs the manufacturers and equipment suppliers of the exact requirements as shown in the Specification and drawings as claims for extra costs due to lack of knowledge will not be entertained.

1.15 **PROGRAMME AND PHASING OF WORKS**

Commencement, completion and phasing of the works on site shall be agreed to suit the proposed programme of works as noted in the Main Contract Tender documentation and associated drawings.

The Contractor shall allow in his tender for all of the work and facilities required to meet the programming and phasing of the works including non-productive overtime.

Claims for lack of knowledge in respect of any of the above aspects of the works shall not be entertained

APPENDIX ONE

PROGRESS ANALYSIS FORM

CONTRACT ..... SUB CONTRACTOR .....

1. CONTRACT VALUATION

Interim Claim No. ..... Date .....

Sub-Contract Tender Sum ....

Delete Provisional Sums & Contingencies ....

Nett Contract Sum .....

Value of Variations Instructed ....

Total Contract Value to Date .....

	Subcontractor's Valuation	Consultant's Valuation
Value of Unfixed Materials on Site (refer to attached Sheet 2)	.....	.....
Value of Contract Work Executed (refer to attached Sheet 3)	.....	.....
Value of Variation Work to Date (refer to attached Sheet 4)	.....	...
TOTAL		...

Notwithstanding any previous payments, we certify payment is due up to a gross value of

£..... .....

Signed .... Date .

On Behalf Of

3. PROGRESS ANALYSIS OF CONTRACT WORK

SECTION	CONTRACT VALUE	% COMPLETE	CLAIM
TOTAL		£	

5. VALUE OF PRICE FLUCTUATIONS

BASE MONTH . . . . . .

WEIGHTINGS :-

LABOUR . . . . . % MATERIALS . . . . . %

NON ADJUSTABLE ELEMENT . . . . . .

INDICES AT BASE MONTH LABOUR . . . . . MATERIALS . . . .

INDICES AT CLAIM MONTH LABOUR . . . . . MATERIALS . . . .

DETAILS OF CALCULATIONS .

TOTAL £

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ELECTRICAL ENGINEERING SERVICES

SECTION 1B PRELIMINARIES

For Details of the Main Contract Preliminaries refer to the Main Contract.

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ELECTRICAL ENGINEERING SERVICES

SECTION 2

GENERAL TECHNICAL CLAUSES

SECTION 2 INDEX

SECTION 2 INDEX (Contd.)

MIDDLETON HALL

MIDDLETON ST. GEORGE

NEW NURSING UNIT & GATE HOUSE

ELECTRICAL ENGINEERING SERVICES

SECTION 2 GENERAL TECHNICAL CLAUSES

PART 1 INTRODUCTION

2.01 DEFINITION OF TERMS

The word "shall" is mandatory. The word "will" is informative. The word "should" is advisory. The word "provide" means supply and fix or install.

The words "Contract" and "Contractor" shall read as meaning Subcontract and Subcontractor when this specification relates to a Subcontract.

This section specifies the general quality of the electrical installation. Section 3 and the accompanying drawings specify in detail the installation to be provided. All clauses of this section may not apply to this project and only those relevant to the works are applicable.

All work shown on the drawings but not described in the specification, or vice versa, shall be provided.

The I.E.E. Wiring Regulations are identified by a three part number, e.g. 413-02-07. Where reference is made in this section to a two part number, it is to be taken to include all the individual regulation numbers which are covered by that side heading and include two part numbers.

2.02 COMPLIANCE WITH REGULATIONS

The complete installation shall comply with the following:

a) The 16th Edition 1991 of the Regulations for Electrical Installations with amendments, issued by the Institution of Electrical Engineers (to be referred to as the I.E.E. Wiring Regulations) - BS7671 : 1992.

b) The Electricity Supply Regulations 1988 incorporating the latest amendments.

c) The Electricity at Work Regulations 1989.

d) Health & Safety at Work Act 1974.

2.02 COMPLIANCE WITH REGULATIONS (Contd.)

e) Construction (Design and Management) Regulations 1994 (Including the implementation and development of the Health & Safety Plan, e.g. Production of Method Statement, etc.).

f) The Electromagnetic Compatibility Regulations - SI 1992/2372.

2.03 INSPECTION & TESTING

Inspection

During the installation period the Contractor shall continuously check the whole of the works to ensure complete safety and compliance with the specification and the I.E.E. Wiring Regulations.

The following list, although not exhaustive, is an indication of the items to be checked and inspected.

Switchgear shall be checked for correct labelling, warning notices, completed circuit schedules and satisfactory operation by hand.

Interlocking facilities shall also be checked for correct operation.

Clearance around switchgear for operation and maintenance shall be checked for adequacy. Distribution board labels shall be checked for correctness and completion. Fuse/MCB ratings and settings of other protective and monitoring devices shall be verified against circuit schedules and specification. MCB boards shall be checked for satisfactory operation by hand. The radius of all cable bends shall be checked as shall the routing of all cables in safe zones together with the provision of mechanical protection and cable shrouds.

Cable trenches shall be checked for dimensions and the spacing between services, the provision of earthenware ducts, cable tiles, identification tapes and route markers.

All switching and control arrangements shall be checked against drawings and for operation.

Labelling and engraving shall be checked for compliance with drawings and specification.

Luminaires shall be inspected for operation and correct colour and rating of lamps.

Sockets and fused spur units shall be checked to ensure:

- Compatibility with specification and drawings.
- Labelling and engraving is in accordance with the specification and drawings.

Three phase power outlets shall be checked to ensure that provision is in accordance with specification and drawings.

2.03 INSPECTION & TESTING (Contd.)

Inspection (Contd.)

All circuits shall be checked to ensure conductors are sized as specified, connected correctly, identified in accordance with the regulations and separately grouped as specified.

All earthing and bonding shall be checked to ensure conductors are correctly sized, connected and labelled.

The electrical installation as a whole shall be checked to ensure:

- Protection against indirect and direct contact.
- Presence of fire barriers and protection against thermal effect.
- Prevention of mutual detrimental influence.
- Presence of diagrams, instructions and similar information.

When the installation is complete but before testing is commenced, the Contractor shall carry out a final visual inspection and shall provide for the Consulting Engineer a schedule listing the items inspected and their compliance with the specification and regulations.

Testing

The Contractor shall provide all the necessary instruments for testing the installation, in accordance with the Regulations and any extra tests called for elsewhere in the specification. Details of the type of testing equipment required for routine tests are given below, together with the method of testing. In all tests, evidence of the accuracy of the test instruments must be provided. Failure to provide such evidence will invalidate the test.

Items shall be tested in the sequence shown within Part 7 of the Regulations and all results recorded in a format approved by the Consulting Engineer.

Each individual circuit shall be separately tested for continuity of live conductors and protective conductors, insulation resistance of all live conductors, polarity and earth fault loop impedance. Final testing shall be carried out in the presence of the Consulting Engineer and three copies of a Completion Certificate and Inspection Certificate, as described in the I.E.E. Wiring Regulations, Appendix 6, shall be supplied to the Consulting Engineer.

This certificate shall be as issued by the NICEIC and shall identify the Contractor's roll number, installation schedule and test results.

In addition, the Contractor shall supply the following as specified by the NICEIC:

i) Fire alarm system installation and commissioning certificate.

ii) Emergency lighting inspection and test certificates.

iii) Completion certificates.

The installation shall not be accepted until such certificates have been approved by the Consulting Engineer.

2.03 INSPECTION & TESTING (Contd.)

Testing (Contd.)

A notice, as described in the I.E.E. Wiring Regulations 514-12 shall be provided by the Contractor adjacent the main switchboard.

Tests shall be carried out as follows:

a) Continuity of Protective Conductor : Regulation 713.02

NOTE: Where earth loop impedance tests are carried out, there is no need for protective conductor impedance measurement as this will be included within the impedance of the earth loop. Continuity checking however is still necessary as the circuit must be energised to carry out this latter test and a dangerous situation can result in the protective conductor has a high impedance or is wrongly connected.

Continuity may be checked by connecting together the neutral and protective conductors at the mains position and checking between earth and neutral at every outlet.

Test equipment required:

Heavy 50 Hz current (1.5 times the circuit design current but maximum 25A), extra low voltage low reading ohmmeter with heavy duty leads of known impedance.

Test Method

Step 1:

Solidly connect the phase conductor to the protective conductor at the extremity of the circuit. At the DB measure the impedance between the phase and protective conductors.

See Appendix 1 - Sketch 1

Step 2:

Disconnect the phase conductor from the protective conductor and connect it to the neutral conductor. At the DB, measure the impedance between the phase and neutral conductors.

See Appendix 1 - Sketch 2

The impedance of the protective conductor is then equal to the first measurement minus half the second measurement.

b) Continuity of Ring Final Circuit Conductors : Regulation 713.03

Test equipment required: Heavy current low reading ohmmeter.

Test method (Ring Circuit with cable CPC)

2.03 INSPECTION & TESTING (Contd.)

Testing (Contd.)

a) Contd.

Step 1:

See Appendix 1 - Sketch 3

Measure the impedance between the open ends of each conductor as shown above.

Step 2:

See Appendix 1 - Sketch 4

Complete the ring at the DB and short circuit all the conductors at a point near the centre of the ring.

Measure the impedance between phase and neutral rings.

The result should be approximately half that of the phase and neutral rings previously measured.

Measure the impedance between phase and protective conductor. The result should be approximately one quarter of the phase ring plus one quarter of the protective conductor ring previously measured.

c) Insulation Resistance : Regulations 713-04 & 713-05

Test equipment required:

500 volt DC insulation resistance tester - for circuits working at 240 volts.

1000 volt DC insulation resistance tester - for circuits working at 415 volts.

Test Method

Step 1:

Ensure neons and capacitors are disconnected from the test circuit to avoid inaccurate test results.

Step 2:

Disconnect any electronic or other devices that may be damaged by the test voltage.

Step 3:

Install all fuse links, close all switches and circuit breakers, remove all lamps and other current using equipment from the test circuit.

Testing (Contd.)

c) Contd.

Where the removal of lamps and/or disconnection of current using equipment is impracticable, the local switches may be open but in this case this should be indicated on the test sheets.

Step 4:

To test resistance to earth:

Connect all live conductors together at the DB and measure the resistance between the live conductors and earth.

Where equipment is connected as required in step 2 and the equipment has exposed conductive parts, the insulation resistance between the exposed conductive parts and all live parts of the equipment shall be measured separately and noted on the test sheets.

Step 5:

To test resistance between poles.

For a single phase circuit, measure the resistance between phase and neutral poles.

For a three phase and neutral circuit, measure the resistance between:

- Red phase and yellow, blue and neutral all connected together.
- Yellow phase and red, blue and neutral all connected together.
- Blue phase and red, yellow and neutral all connected together.
- Neutral and red, yellow and blue all connected together.

d) Insulation of Site Built Assemblies : Regulation 713-05

Test equipment required:

A rod of rigid material 1 mm diameter and 300 mm long. High voltage test set with an output of 2.2 kV and suitably insulated test leads. Heavy current low reading ohmmeter.

Test Method:

Step 1:

Ensure site built assembly is completely erected, all cables connected and all doors and covers securely fixed in place.

Step 2:

All switches in the 'ON' position and isolate all conductors into or out of the equipment at their remote ends (taking appropriate safety precautions).

2.03 INSPECTION & TESTING (Contd.)

Testing (Contd.)

d) Contd.

Step 3:

Disconnect any electronic devices which would be damaged by the test voltage.

Step 4:

Apply a test voltage of 2.2 kV between phases for a minimum of one minute.

Step 5:

Apply a test voltage of 2.2 kV for a minimum of one minute all the phase conductors (connected together) and the enclosure.

Step 6:

Apply a test voltage of 2.2 KV for a minimum of one minute between the neutral conductor and the enclosure.

Step 7:

Measure the impedance between the casings of each section of the assembly.

Step 8:

Measure the impedance between the main bonding conductor and each outgoing cable gland and trunking connector/adaptor.

Step 9:

Check all holes, slots and the like in the enclosure to ensure that no parts of the casing assembly will allow the insertion of a 1 mm diameter rod.

e) Protection by Electrical Separation : Regulation 713-06

Test equipment required:

500 volt DC insulation resistance tester.

Test Method:

Step 1:

Connect one lead of the test set to the protective conductor and the other lead to the circuit protective conductor of the separated circuit and measure the resistance.

Testing (Contd.)

e) Contd.

Step 2:

Measure the insulation resistance between the live conductors of the ordinary installation and the live conductors of the separated circuit.

f) Protection by Barriers & Enclosures : Regulation 713-07

Tests to prove the insulation of site built assemblies (Test No. d) are deemed to cover the above tests.

g) Polarity : Regulation 713-09

Test equipment required:

Continuity tester and suitable test leads.

Test Method:

Step 1:

Ensure all fuses are installed and all circuit breakers in the 'ON' position.

Remove all lamps and disconnect any other current using devices.

Step 2:

Check that any residual current or fault voltage operated protective devices in the circuit will not operate during the test.

If there is a possibility of this, then the operating coils should be shorted out during the test.

Step 3:

At the origin of the installation, short out the phase and earth conductors. Isolate neutral conductor from earth.

Step 4:

At each DB, check the continuity between the phase and protective conductors.

Step 5:

At each single pole switch, check the continuity between the phase and protective conductor.

Ensure switch is left in 'ON' position

Testing (Contd.)

g) Contd.

See Appendix 1 - Sketch 5

Step 6:

At each ES lamp holder, check the continuity between the centre contact and the protective conductor.

At every lighting outlet point, check the continuity between the phase and protective conductor.

Step 7:

At each socket outlet, check the continuity between the phase pin (right hand side when viewed from front for 13A socket) and the earth pin.

h) Earth Fault Loop Impedance : Regulation 713-10

Test equipment required:

Phase earth loop impedance tester with suitable test leads.

Test Method:

Step 1:

Check that the supply is connected and that the earthing conductor and all equipotential bonds are correctly connected.

Step 2:

Temporarily short out any RCDs in the circuit under test. It is strongly recommended that temporary warning notices are attached to the device and to the consumer's main switch, advising that the device is inoperative.

Note:: It is essential to prevent the use of the circuit for the duration of the test and to ensure that persons or livestock are not at risk due to indirect contact.

Step 3:

With the circuit control switches closed, measure the loop impedance between the phase and protective conductor at the last lighting outlet on each circuit.

Step 4:

Measure the loop impedance between the phase and protective conductor at each socket.

Testing (Contd.)

h) Contd.

Step 5:

Temporarily disconnect the main equipotential bonds and measure the loop impedance between the phase and earth conductors at the origin of the installation.

Step 6:

Replace the main equipotential bonds and remove all shorting links from RCDs.

i) Earth Electrode Resistance : Regulation 713-11

Test equipment required:

Hand driven AC generator with output of 240 volts and maximum current of 25 amps test electrodes and leads.

Test Method

Step 1:

An alternating current of a steady value shall be passed between the earth electrode and an auxiliary earth electrode T1 placed at such a distance from T that the resistance areas of the two electrodes do not overlap. A secondary auxiliary earth electrode T2, which shall be a metal spike driven into the ground is then inserted half way between T and T1 and the voltage drop between T and T2 shall be measured.

The resistance of the earth electrodes is then the voltage between T and T2, divided by the current flowing between T and T1 provided there is no overlap of the resistance areas.

See Appendix 1 - Sketch 6

T	:	Earth electrode under test, disconnected from all other sources of supply
T1	:	Auxiliary earth electrode
T2	:	second auxiliary

Step 2:

The resistance of the earth electrodes shall be checked to ensure a true value, by taking two further readings with the second auxiliary electrode T2 moved 6 m further from and 6 m nearer to T respectively.

See Appendix 1 - Sketch 7

Testing (Contd.)

i) Contd.

T	:	Earth electrode under test, disconnected from all other sources of supply.
T1	:	Auxiliary earth electrode
T2	:	Second auxiliary earth electrode
X	:	Alternative position of T for check measurement
Y	:	Further alternative position of T for check measurement.

Step 3:

If the three readings/results are substantially in agreement, the mean of the three readings is taken as the resistance of the earth electrode T.

If there is no such agreement the tests, steps 1 & 2 shall be repeated with the distance between T and T1 increased.

Note: On an existing installation it is important that only half of the electrodes should be tested at a time to ensure that the installation is always safely earthed.

j) Effectiveness of Residual Current Devices : Regulation 713-12

Test equipment required:

Proprietary RCD test meter indicating operating current and tripping time. (Note: The type of meter with 'GO/No GO' indicators is not acceptable.)

Test Method:

i) Disconnect all loads supplied via the circuit breaker and ensure the circuit breaker is in the 'ON' position.

ii) Connect the test meter in accordance with the manufacturer's instructions. Inject the rated tripping current of the circuit breaker and note the tripping time. Reset the circuit breaker and repeat test. The tripping time recorded on the test sheets is the higher of the two readings.

iii) Re-set the circuit breaker and inject half the rated tripping current. Note the tripping time. Re-set the circuit breaker and repeat the test. The tripping time recorded on the test sheets is the higher of the two readings.

iv) If the circuit breaker has a rated tripping current of 30 mA or less, repeat the above test with a test current of 250 mA and record the tripping time.

v) Disconnect the test meter. Reconnect all loads supplied via the circuit breaker and reset the circuit breaker. Operate the test button on the circuit breaker/and check that the circuit breaker has tripped.

2.03 INSPECTION & TESTING (Contd.)

Testing (Contd.)

k) Determination of Prospective Short Circuit Current : Regulation 434:02

Test Equipment Required:

Proprietary short circuit current tester and suitable test leads.

Test Method:

Step 1:

Switch off the supply at the origin of the installation and solidly connect the test meter as close to the origin as possible.

The meter should be connected between the phase and neutral poles for a single phase installation and between two phases for a three phase installation.

Step 2:

Switch on the supply and calibrate the meter in accordance with the manufacturer's instructions.

Step 3:

Measure the short circuit current.

Step 4:

Switch off the supply and disconnect the meter.

Step 5:

Repeat the test at the location of each protective device.

Note: If the prospective short circuit at the origin of the installation is less than the breaking capacity of the smallest rated protective device to be used in the installation, no further determination of the prospective short circuit current is necessary.

2.04 ROUTINE/WITNESSED TESTS OF PLANT

Where routine tests are applied to plant before delivery to site, two copies of the relevant test certificates shall be forwarded to the Consulting Engineer.

On certain occasions the Consulting Engineer may wish to witness tests carried out on plant before delivery to site. These instances will be detailed when required and the Contractor shall give at least seven days notice in writing, of the date of these tests.

Two copies of all test certificates subsequently supplied to the Contractor by the manufacturer shall be supplied to the Consulting Engineer.

2.05 INSTRUCTION PERIOD

Details will be given when required regarding the instruction of personnel appointed to operate/or maintain items of plant or system. The Contractor shall include in his tender for the instruction specified.

2.06 SPARES

The following spares shall be supplied by the Contractor on or before the date of completion.

a) Fire Alarm : Break Glass Units

1 No. spare glass for each 4 No. installed

b) HRC Fuse-links and MCB's

5 No. of each rating used up to 100 amps
2 No. of each rating used over 100 amps

Adjacent the main switchboard the Contractor shall provide a suitable wall mounted box to accommodate the spare fuse links.

c) Lamps and Tubes

10% of each type installed

d) Plug Tops

The Contractor shall supply 13A plugs to BS1363 fitted with 13A and 3A fuse links on a 1 : 1 basis at a ratio of 1 No. plug per 4 No. socket outlets.

2.07 POSITION & NEATNESS OF INSTALLATION

The positions of all plant shown on the drawings will be used for the purposes of tendering, but the Contractor shall not scale the drawings for actual site installation.

The Contractor shall set out work involved and take all measurements and dimensions required for the erection of plant on site, making any modification in detail as found necessary during the progress of work.

The Contractor shall ascertain on site that the installation will not conflict with other services or furniture and any work requiring alteration due to negligence by the Contractor in this respect shall be at the Contractor's expense. Particular care shall be taken to obtain uniform and tidy arrangements of wall and ceiling mounted equipment.

The precise position of an item of equipment shall be determined as follows:

a) Single items of equipment which are visually remote from other electrical or mechanical equipment shall be erected at the following mounting heights except where stated otherwise in the specification or on the tender drawings.

2.07 POSITION & NEATNESS OF INSTALLATION (Contd.)

a) Contd.

ITEM	HEIGHT (from floor level to centre line of unit)
Light switch	1320 mm
Socket outlet (general) and telephone outlet	400 mm
Fire alarm break glass unit	1320 mm
Clocks	2200 mm
Thermostats/Detectors	1700 mm
Socket outlet (over worktop) and telephone outlet	150 mm above worktop to centre line of unit

b) Two or more items of equipment whether electrical or mechanical or both which are to be erected on the same wall or ceiling or which will be otherwise visually close to each other, shall be arranged in a neat and symmetrical group. Symmetry shall be obtained by horizontal and vertical alignment through the centre lines of the equipment and for this purpose the mounting heights may be varied slightly, from those specified or on the tender drawings.

In the planning of arrangements the Contractor shall co-operate with the Main Contractor and any other Contractor involved. Exact positions of plant and equipment shall be marked out on site and agreed with the Consulting Engineer prior to installation and before any holes or chases are cut.

Failure to comply with this requirement may result in disruptions to other disciplines and the Contractor shall be held responsible for any additional expenditure involved in resolving the issue.

2.08 MAINTENANCE MANUAL & 'AS INSTALLED' DOCUMENTATION

Maintenance Manual

The Contractor shall furnish to the Consulting Engineers upon practical completion of the complete installation, three copies of a maintenance manual.

The manual shall be of the loose leaf type, A4 size having stiff covers, with sub-division for each section, a ready means of reference and a detailed index. The manual shall contain full operating and maintenance instructions for each item of equipment and shall deal systematically with each system including the following:

a) Switchgear.

b) Contactors.

c) Emergency lighting.

2.08 MAINTENANCE MANUAL & 'AS INSTALLED' DOCUMENTATION (Contd.)

Maintenance Manual (Contd.)

d) Fire alarms.

e) Communication systems.

f) Security alarms.

g) Lighting installation.

h) Wiring diagrams.

i) List of spares.

j) Prints of the 'as installed' drawings.

k) Copy of test sheets, inspection, completion and commissioning certificates (as specified in clause 2.03, b).

Note: Manufacturer's standard 'hand-out' cards and leaflets will be accepted in the manual, but only as supporting information additional to the instructions detailed above.

'As Installed' Drawings & Charts

During the progress of the works the Contractor shall record on drawings in an approved manner, the information necessary for preparing the installation record drawings.

The marked-up drawings shall be made available to the Consulting Engineer for inspection and checking at any time during the Contract.

The marked-up drawings shall indicate:

a) The exact positions of all plant and apparatus.

b) The size, type and routes of all cables, conduits, trunking, etc.

c) The size, type and date of laying of all underground cables and ducts.

d) Schematic diagrams of distribution systems and control systems.

e) The exact location and size of all earthing and bonding connections.

f) The exact locations of all devices performing the functions of protection, isolation and functional switching.

g) The prospective fault current at the location of each protective device.

h) Diagrams and charts shall be provided indicating the type and composition of all circuit (points of utilisation served, number and size of conductors and type of wiring).

2.08 MAINTENANCE MANUAL & 'AS INSTALLED' DOCUMENTATION (Contd.)

'As Installed' Drawings & Charts (Contd.)

Should the Contractor fail to provide the above information within ten days of being requested to do so, the Consulting Engineer will visit the site to carry out any investigation necessary to obtain the information and All costs incurred will be charged to the Contractor.

The final 'as Installed' drawings shall be completed by the date of practical completion.

'As installed' drawings shall be on an approved transparent plastic material.

If the Contractor fails to produce to the Consulting Engineer's approval the 'as installed' drawings at the date of practical completion, the Client may instruct the Consulting Engineer to provide the drawings with whatever assistance the Consulting Engineer deems necessary and the cost of preparing the drawings will be deducted from the outstanding payments due to the Contractor.

Where specified in section 3, the Contractor shall provide 'as installed' drawings in CAD format - AutoCAD Release 12, .DWG format on a 3.5" high density disk(s). Drawings shall be produced at a scale of one drawing unit to 1 mm. Each engineering service shall constitute one layer and text shall be on a separate layer.

The Engineer's design drawings may be available to the Contractor either in hard copy (negatives) or AutoCAD Release 12, .DWG format (3.5" HD disk(s)) as appropriate. An appropriate charge shall be made for the provision of this service.

2.09 CONTRACTOR'S WORKING DRAWINGS

The Contractor shall prepare his own working drawings. If any further instructions, details or drawings are required to enable these working drawings to be prepared or any work to be done, the Contractor shall apply in writing to the Consulting Engineer for such information.

The Contractor shall submit to the Consulting Engineer, for approval, the following:

a) On or before the dates named in the specification such drawings as may be called for therein.

b) During the progress of the "Services" and within such reasonable times as the Consulting Engineer may require, such drawings of the general arrangement and details of the "Services" or any part thereof as the Consulting Engineer may reasonably require.

Within a reasonable period after receiving such drawings, the Consulting Engineer shall signify his approval or otherwise.

Four copies of all drawings which require to be approved by the Consulting Engineer shall be provided by the Contractor and shall be signed by the Consulting Engineer and the Contractor. Two of the copies so signed shall be retained by the Contractor.

2.09 CONTRACTOR'S WORKING DRAWINGS (Contd.)

The Consulting Engineer shall appraise the drawings on a technical nature only in terms of the drawings being compatible with the intent of the design and approval by the Consulting Engineer shall not relieve in any way the Contractor from his responsibilities under this Contract, in respect of the accuracy of drawings or the relationship of the drawing content in terms of co-ordination of other trades.

Drawings signed as above described shall not be departed from except as provided by an official Consulting Engineer's Instruction.

The Consulting Engineer shall have the right at all reasonable times to inspect at the Premises of the Contractor, all drawings of any portion of the "Services".

In the event of any discrepancies in the scale approved to any plan or drawing and the figured dimensions thereon, the figured dimensions shall be taken and held to be correct.

The Contractor shall be responsible for and shall pay the extra cost, if any, occasioned by any discrepancy, error or omissions in the drawings and other particulars supplied by him, whether they have been approved by the Consulting Engineer or not, provided that such discrepancies, errors or omissions are not due to inaccurate information or particulars furnished in writing to the Contractor by the Employer or Consulting Engineer.

2.10 BRITISH STANDARDS

All British Standards referred to in this specification shall include all the latest amendments.

SECTION 2 GENERAL TECHNICAL CLAUSES

PART 2 LOW VOLTAGE SWITCHBOARD PANELS & DISTRIBUTION FUSEBOARDS

2.11 GENERAL

All switchboards and distribution equipment shall be designed and manufactured to the appropriate British Standards and adequate for the voltage, current, fault levels and type of supply, all as indicated in section 3.

They shall be of the same manufacture throughout the works.

2.12 ENCLOSURES

Enclosures shall be of metal construction, with all electrical conductors, contacts, etc. totally enclosed and protected to not less than IP41 for indoor use and IP54 for exterior use unless otherwise specified.

Enclosures shall be provided with facilities for padlocking or locking to prevent unauthorised interference and provided with adequate means of isolation, earthing and insulation to ensure safety of operatives during maintenance works.

They shall be adequately ventilated or cooled.

Finish shall be to manufacturer's standard unless otherwise specified. Plain steel-work shall be painted to BS6150 with red lead primer and two coats of enamel to match the switchgear.

Operating handles, control knobs, push buttons, etc. shall preferably be located within the range of 450 mm and 1950 mm above floor level.

The enclosure shall be so designed and constructed as to provide effective segregation between incoming circuits/control circuits and equipment. Where equipment is fitted above bus-bar chambers it shall not be possible for objects to fall into the chamber.

The segregation provided shall prevent the passage of ionised gas, resulting from the making or breaking of any circuit under normal or fault conditions, to any bus-bar, adjacent switch, etc.

Conductors of AC circuits installed in ferrous enclosures shall be arranged such that all phase conductors and neutral conductors are contained in the same enclosure. Where such conductors enter ferrous enclosures they should be arranged such that the conductors are not separated by ferrous material or provision made to prevent circulating eddy currents, e.g., (i) single core M.I. cables shall be terminated into a ferrous enclosure using a non-ferrous gland plate, (ii) 4 No. single core cables of a TP&N circuit shall enter a ferrous enclosure through the same bushed entry aperture.

Multi-core sheathed cables (e.g. MI; PVC/PVC; LSF/XLPE; PVC/XLPE) entering any electrical enclosure (including H&V control panels) shall have the outer sheath (and armouring where applicable) removed back to the enclosure gland plate (or outer skin). The insulated conductors shall then be run neatly and formally and adequately supported to their termination point.

2.13 SWITCHGEAR

a) Fuse Switches & Switch Fuses

Fuse switches and switch fuses shall be to BS5419.

They shall be fitted with HRC fuses to all phase conductors for AC and to all poles of DC systems and fitted as required with a neutral terminal. For units exceeding 100A this terminal shall have a removable bolted link.

b) Air Circuit Breakers (ACBs) & Moulded Case Circuit Breakers (MCCBs)

ACBs and MCCBs shall be to BS4752 Category P2 and provided with positive means for preventing any one pole of a multi-pole MCCB being operated or tripped, independently of the other poles.

c) Miniature Circuit Breakers (MCBs)

MCBs shall comply with BS3871 and have the voltage and current rating and category of duty as specified with a minimum breaking capacity of 6000 amps.

They shall be provided with positive means of preventing any one pole of a multiple MCB being operated or tripped independently of the other poles.

The position of the contacts shall be either externally visible or clearly and reliably indicated. An indication of the isolated position shall only occur when the specified isolating distance has been attained in each pole.

d) Distribution Boards

Distribution Boards shall be to BS5486 (Parts 11 or 12) and fitted with neutral and earth bars having a separate terminal for each outgoing TP&N circuit when required for TP circuits.

For SP&N power and lighting circuits the bars shall have a separate terminal for each outgoing SP circuit.

Each neutral conductor and CPC shall be identified at its termination in the DB by a cable ferrule (relating it to its associated circuit conductor).

Earth bars shall have additional terminals designed for incoming earth and bonding conductors.

Distribution boards shall be fitted with HRC cartridge fuses, MCBs or RCDs and shall be surface or flush as specified.

Surface distribution boards shall be mounted over suitably sized adaptable boxes where they are used on concealed cable installations.

An access aperture cut in the back of the distribution board shall be adequately bushed and the box shall be provided with spare conduits, all effectively bonded to the board.

2.13 SWITCHGEAR (Contd.)

d) Contd.

Fuse ways designated as spare shall be provided with fuse links of the maximum rating of the carrier.

MCB ways designated as spare shall have proprietary blanking plates fitted.

e) Fuses

Fuses shall be to BS88 HRC cartridge type for general lighting and power applications or to BS1361 cartridge type where domestic consumer units are specified. They shall be fitted to all insulated carriers so designed that a failed fuse can be readily located.

f) Bus-bars & Connections

Bus-bars and connections shall be to BS5486 and of constant cross section copper throughout and air insulated except where solid insulation is a design feature.

They shall be connected to outgoing switches with solid copper connections.

The connections shall be as short and direct as possible. Insulated cable connections will only be used on unit type switchboards or where specifically stipulated.

Bus-bars and connections shall be rigidly clamped and secured to prevent undue movement under fault conditions or displacement as a result of the installation of cabling and provided, where necessary, with insulated phase or circuit barriers.

All clamping and supporting bolts, nuts and screws to be plated brass or steel.

Bus-bars shall be connected by clamps to risers, interconnections and bus-bar couplers.

Drilled connections to bus-bars will only be accepted where specifically specified.

Bus-bars shall be separate for individual supply systems.

Two systems shall not occupy the same bus-bar chamber unless they are segregated by earthed metal.

g) Unit Switchboards

Unit switchboards shall be to BS5486, Part 1 (BS EN 60439-1 : 1994) Form 4 and the National Annex.

Separate items of switchgear shall be assembled and connected to provide a switchboard secured by built in fixings or masonry bolts.

g) Contd.

A suitable bus-bar chamber shall house the appropriate bars for the system such chambers to be capable of ready extension.

Bus-bars shall be of such length within the chamber that outgoing connections are taken from the bars at right angles, undue deviation will not be accepted other than the necessary sets to provide electrical clearance.

In the case of wall mounting units, unit switchboards shall be assembled above and below a bus-bar chamber extending the full length of the board and wholly supported on floor stands below the chamber.

Additional support shall be provided where required as for wall mounting units.

Switchboards shall be supplied with removable gland plates, drilled for conduit entry, or suitable cable glands, clamps, spreader boxes and reverse entry chambers as required.

Operator's rubber floor mats shall be provided for all switchboards. (1 m x length of switchboard minimum).

h) Cubicle Switchboards

Cubicle switchboards shall be to BS5486, Part 1 (BS EN 60439-1 : 1994) Form 4 and the National Annex and shall be manufactured from sheet steel, suitably rust-proofed and stove enamelled or equal finish to an approved colour.

Switchboards shall be generally floor mounting, with access back and front, or front only, as specified in section 3.

They shall be of modular construction with interchangeable units where applicable and shall not exceed 2250 mm in height excluding cable boxes.

Cubicles shall be constructed in sections to facilitate delivery and installation and shall be arranged for the storage of spare fuses within the cubicle.

Switchboards shall be complete with removable gland plates, drilled for conduit entry, or suitable cable glands, clamps and spreader boxes.

Operator's rubber floor mats shall be provided for all switchboards (1 m x length of switchboard minimum)

i) Switchgear Earthing

Switchboards shall be provided with an earthing terminal consisting of a brass threaded stud or copper/brass bar, fixed adjacent the incoming cable.

All incoming and outgoing cables shall be connected to the earthing terminal by copper circuit protective conductors. Similar connections shall be provided to the conduit entry plates and to metal trunking.

2.13 SWITCHGEAR (Contd.)

i) Contd.

Clearance or tapped holes shall be provided in the conduit entry plates, such holes being cleaned and free from paint to ensure a positive connection for the bush/coupling or M.I. gland for earthing purposes.

Circuit protective conductors shall be of flat soft copper strip or PVC cables sheathed green and yellow.

All connecting faces and/or lugs shall be tinned and secured by brass bolts, nuts, washers and locking arrangements.

Any moveable panels or doors carrying items of equipment e.g., push buttons, meters, etc. shall be connected by a flexible circuit protective conductor.

j) Labels & Identification

Switchgear shall be fitted with engraved labels to indicate the duty of the unit, its voltage, phase and current rating and size of conductor involved and serial code for any coding system required, e.g. Main Incoming 95 mm² (Cu) 415 TP&N Main Essential Isolator 160 Amp RYB + N.

Each distribution board shall be fitted with an engraved (black on white) plastic label indicating the duty of the unit, its voltage phase and current rating and its designation.

A renewable typed circuit chart shall be provided in a transparent plastic envelope permanently fitted inside all distribution board covers indicating:

i) The source of supply

ii) Incoming cable size, type and designation

iii) Outgoing circuit designations

iv) Location of points controlled by each fuse (or MCB)

v) Cable size (live and protective conductors)

vi) Circuit load (KW or Amps)

vii) Fuse (or MCB) rating

In addition, a further copy of each typed circuit chart shall be mounted in a glass fronted, framed wall chart securely screwed to the wall adjacent each distribution board.

2.14 FUSE LINKS (DISTRIBUTION BOARDS)

Shall be cartridge fuses complying with BS88 of the category of duty and class of fusing factor specified.

2.14 FUSE LINKS (DISTRIBUTION BOARDS) (Contd.)

Dimensions of fuse links shall comply with the following BS88 definitions:

BS88 Reference Symbol	Current Rating
A.1	20 amp maximum
A.2	32 amp maximum
A.3	63 amp maximum
A.4	100 amp maximum
B.1	100 amp maximum
B.2	200 amp maximum
B.3	300 amp maximum
B.4	400 amp maximum
C.1	500 amp maximum
C.2	500 amp maximum
C.3	800 amp maximum

Unless stated otherwise final distribution fuseboard fuse links shall be rated at 10 amp for lighting circuits and 32 amp for ring main circuits.

For three phase motors they shall be as follows:

Motor Rated Output	Fuse Link for DOL Starting	Fuse Link for Star Delta Starting
0.75 kW (1.0 h.p.)	10 amp	4 amp
1.1 kW (1.5 h.p.)	10 amp	6 amp
1.5 kW (2.0 h.p.)	16 amp	6 amp
2.2 kW (3.0 h.p.)	16 amp	10 amp
3.0 kW (4.0 h.p.)	20 amp	15 amp
4.0 kW (5.5 h.p.)	25 amp	15 amp
5.5 kW (7.5 h.p.)	32 amp	20 amp
7.5 kW (10.0 h.p.)	40 amp in 32 amp cartridge	25 amp
11.0 kW (15.0 h.p.)	50 amp in 32 amp cartridge	30 amp
15.0 kW (20.0 h.p.)	63 amp	40 amp in 32 amp cartridge

2.14 FUSE LINKS (DISTRIBUTION BOARDS) (Contd.)

The above motor rated outputs are the preferred outputs of standardised motors to British Standard. Where there are motors with outputs greater than those listed the rating of the fuse link will be stated on the drawings and in subsequent sections of this specification.

2.15 FUSE LINKS (CONSUMER UNITS)

These shall be cartridge fuses complying with BS1361 and of the rating as specified.

Unless otherwise stated consumer unit fuse links shall be rated at 6 amp for lighting circuits and 32 amp for ring main circuits.

2.16 OUTDOOR DISTRIBUTION PILLARS

These shall comprise the open back distribution and isolating link units of the rating and ways specified, complete with bus bar system and phase dividing fillets, all mounted on mild steel support bars in a cast iron shell.

The distribution and link units shall be complete with porcelain bases fitted with bus bar and outgoing conductor fittings.

Fuse link carriers shall be the porcelain edge blade type fitted with wedge type cartridge fuse links to BS88 with slotted tags. Neutral links shall also be fitted with hinged bolted link for the phases with a withdrawable bolted link for the neutral.

The shell shall be of cast iron construction throughout with removable rear panels and doors with brass hinges at the front. The door shall be fitted with a recessed barrel lock with flush brass screwed plug.

The shell shall be so constructed to ensure ample ventilation, the ventilators having insect barriers and being complete with a separate cast iron root bolted to the shell.

Pillars shall be complete with insulated combined lifting handle and screwdriver, suitable for removing brass plug and operating lock, circuit identification labels, weatherproof circuit chart mounted on the inside of door, angular type sealing boxes suitable for the cables specified and ventilating heater unit with separate circuit wiring complete with 2 amp single pole fuse on the phase conductor.

Sealing boxes shall be supplied complete with sealing compound suitable for the type of cable specified. Cables entering pillars shall not be bent during installation to a radius smaller than the minimum bending radius as shown below:

2.16 OUTDOOR DISTRIBUTION PILLARS (Contd.)

Minimum Internal Radii of Bends in Cables for Fixed Wiring:

Insulation	Finish	Overall Diameter	Factor to be applied to overall diameter of cable to determine the minimum internal radius of the bend+
Rubber or PVC (circular, or circular stranded copper or aluminium conductors)	Non-armoured	Up to 10 mm	3(2)*
		Over 10 mm, but not exceeding 25 mm	4(3)*
		Over 25 mm	6
	Armoured	Any	6
PVC (solid aluminium or shaped copper conductors)	Armoured Non-armoured	Any	8
Impregnated paper	Lead sheath	Any	12
Mineral	Copper or aluminium sheath with or without PVC covering	Any	6

+ For flat cables the factor is to be applied to the major axis.

* The figure in brackets relates to single-core circular conductors of stranded construction installed in conduit, ducting or trunking.

Note: Where a manufacturer indicates a minimum bending radius greater than that shown above, the manufacturer's recommendations shall be implemented.

The Contractor shall ensure that the pillar is bolted firmly to the plinth and that the pillar shell is secure and vertical.

Roots shall be fitted with sheet steel aprons and both roots and aprons shall be protected with an approved bituminous compound and the pillar shell painted with a coat of flat and two coats of good quality gloss paint.

After cabling work at pillars is completed, the void in the root within the pillar shall be filled with sand, well rammed down and the sand covered with a coating of bituminous compound as a damp course.

2.17 LABELLING

Labels shall be of traffolyte with 5 mm high black letters on a white background fixed in a readily observable position by screws or nuts and bolts to the outer cover of the unit.

2.17 LABELLING (Contd.)

All electrical control panels, distribution boards, starters, switch fuses and isolators shall be labelled with the legend detailed. If details are not specified the Contractor shall allow in his tender price for labels to be engraved with a minimum of 30 characters per unit.

2.18 TREATMENT NOTICE

Adjacent the main switchboard (exact position to be decided on site) the Contractor shall provide a plastic coated 'Treatment for Electric Shock' notice 350 mm x 450 mm.

A suitable notice is obtainable from Business Press International Limited, Quadrant House, The Quadrant, Sutton, Surrey. SM2 5AS

SECTION 2 GENERAL TECHNICAL CLAUSES

PART 3 METAL CONDUIT INSTALLATION

2.19 CONDUITS

Conduits shall be no smaller than 20 mm diameter and to BS4568, Part 1 for sizes up to 32 mm or to BS31 for sizes above 32 m.

Conduit shall be seam welded, heavy gauge, finished Class 2 (black enamelled) in all locations except where surface fixed and in kitchens, boiler houses, plant rooms, service ducts and externally, where it shall be finished Class 4 (galvanised).

For flameproof installations conduit shall be solid drawn, heavy gauge, finish Class 4 (galvanised).

2.20 CONDUIT FITTINGS

All fittings shall comply with BS4568 and BS31 as applicable and shall have the same protective covering as the conduit with which they are being used.

Conduit boxes used shall be screwed, circular pattern for 20 mm and 25 mm and circular large pattern for 32 mm conduit. Boxes for sizes above 32 mm or for cables of 4 mm^2 and above shall be rectangular.

All conduit boxes shall have flat steel covers secured by brass screws. Gaskets shall be fitted for all Class 4 finishes (galvanised).

Boxes shall be fitted with oversized lids when used as flush inspection boxes and with break joint rings at all visible ceiling outlet points.

Adaptable boxes shall be of steel or cast iron and shall have overlapping lids where used as part of a flush installation.

Where necessary to segregate services, earthed steel barriers shall be provided.

Adaptable boxes used in Class 4 installations shall have external fixing lugs and gasketted lids.

All boxes shall be fixed in accessible positions and be of adequate size for the number and size of cables in the box and for the largest size of conduit connected to the box.

All outlet boxes for lighting fittings, switches, sockets, etc. shall be securely fixed by at least two round head screws and in a flush installation shall be recessed approximately 2 mm below the wall or ceiling finish. To ensure this dimension is met the Contractor shall verify on site the finished levels of walls and ceilings.

2.21 INSTALLATION

The installation shall be surface or concealed as specified.

Prior to erection all burrs and sharp edges, any dirt, oil or paint shall be removed.

2.21 INSTALLATION (Contd.)

Care shall be taken to prevent ingress of dirt or moisture during erection and all conduits shall be swabbed through before wiring commences. Where threads are exposed or the finish is damaged the conduit shall be cleaned and treated with a rust inhibiting paint immediately after erection.

Conduits shall not be run in floor screens unless specified, but if so shall be galvanised and provided with temporary protection until the floor screed is laid.

Conduits shall be bent on site to suit local conditions using a bending machine to ensure minimal deformation of bore. Inspection elbows shall not be used. Draw-in boxes shall be provided in all runs exceeding 10 m in length or containing more than two right angle bends.

Running couplings shall be kept to a minimum but where required they shall be fitted with milled circular lock-nuts at each end.

On vertical runs the running thread shall be above the coupling.

Where condensation is likely, the conduit shall be fitted with adequate drainage points and installed so that the relevant section is isolated by means of a compound filled conduit box located in the higher sections of the conduit run.

On vertical drops or risers, a running coupler socket shall be inserted within 300 mm of the ceiling or floor.

Conduits shall be fixed using crampets when concealed in plaster or concrete, etc. and distance saddles when surface spaced as follows:

Conduit Size	Vertical & Horizontal
22 and 25 mm	1.2 m
32 & 40 mm	1.5 m
50 mm	1.8 m

A clearance of 150 mm shall be maintained between electrical conduits and other services running parallel and 25 mm when crossing.

Surface conduits shall be installed as neatly and unobtrusively as possible, parallel to general building lines, using distance saddles.

Concealed conduits shall be installed in such a manner that inspection and draw-in boxes are accessible, using crampets where buried in plaster or concrete, or saddles in roof voids, etc.

Conduits shall be run in a straight line from point to point.

Where distribution boards are installed with recessed conduits, a spare 25 mm diameter conduit shall be provided from the distribution board to the nearest accessible duct or ceiling void. The conduit shall terminate in a through conduit box with the unused way blanked off.

2.21 INSTALLATION (Contd.)

Where practical all wall chases shall be vertical.

Saddles shall be rigidly fixed to the structure by means of proprietary wall plugs and screws to a depth to suit the structure, all fixing holes being made with a masonry drill.

When assessing conduit capacities, which shall be in accordance with the I.E.E. Wiring Regulations, circuit protective conductors shall be taken into account.

Conduit systems shall be complete before the commencement of wiring.

2.22 CONTINUITY

All conduits shall be screwed and butted solidly in boxes and conduit fittings, etc. and be satisfactorily mechanically continuous, before drawing-in of cables commences.

The system shall also be tested for electrical continuity before plastering or screeding is done and before cabling is installed.

Where boxes without screwed spout entries are used, the conduit shall be secured to the box by means of a smooth bore male brass bush and earthing coupling with compression washers used.

An insulated earth continuity conductor shall be connected from the coupling to the box from the box to the equipment fixed to the box.

(N.B. This also applies to conduit entries to steel trunking, control panels, adaptable boxes, etc.)

Conduits shall not be concealed before inspection and approval.

SECTION 2 GENERAL TECHNICAL CLAUSES

PART 4 INSULATED CONDUIT INSTALLATION

2.23 CONDUITS

Conduits shall be heavy gauge, high impact, PVC smooth inside and outside and free from imperfections. No conduit less than 20 mm diameter shall be installed.

Conduits shall comply with BS4607 or BS6099 as applicable and shall be metric sizes.

While in storage and during installation, conduits shall be protected from the weather and mechanical damage and shall be fitted with wooden or plastic plugs or plastic caps to prevent the ingress of foreign matter.

Conduits shall be suitable for jointing by compression joints, PVC solution or for screwing with standard electrical threads.

Prior to erection conduits shall be reamed, to remove all sharp edges and burrs after screwing or cutting. Threads shall be cut using a suitable lubricant and debris shall be removed prior to erection.

Previously cut threads shall be cleaned by re-running with dyes and wiping.

2.24 CONDUIT FITTINGS

Fittings shall be of the same manufacture as the conduit, complying with BS4607. All boxes shall be PVC except for those to which lighting fittings will be directly fixed, which shall be metal conduit boxes complying with BS31 or BS4568. PVC boxes used in any other way for supporting lighting fittings shall be fitted with metal inserts for locating screw fixings.

Self-tapping screws for suspension purposes shall not be allowed.

2.25 INSTALLATION

The installation of a rigid PVC conduit system shall be generally in accordance with that specified for a metal conduit system.

Bends and sets formed on site shall be carried out using a helical spring fitted internally.

The conduit shall be warmed sufficiently for it to move without deformation of the bore and without avoidable wall thinning on the outside of the bend.

Couplings to equipment not having shaped or smooth conduit entries shall be by means of plastic bushes fitted inside the equipment, with lock rings.

Expansion couplers shall be provided at intervals not exceeding 6.0 metres on straight runs, with clearance between the ends of the conduits and having the couplers secured to one conduit with adhesive and a sliding fit to the other sealed with mineral jelly to prevent ingress of moisture.

2.25 INSTALLATION (Contd.)

The conduit system shall be installed in accordance with the manufacturer's instructions and the circuit protective conductor shall be connected at all exposed metal items to provide electrical continuity.

Conduit systems shall be complete before the commencement of wiring.

When accessing conduit capacities, which shall be in accordance with the I.E.E. Wiring Regulations, circuit protective conductors shall be taken into account. PVC conduit shall not be installed where the ambient temperature is below 5°C. or working temperature is above 60°C.

SECTION 2 GENERAL TECHNICAL CLAUSES

PART 5 FLEXIBLE CONDUIT

2.26 INSTALLATION

Flexible conduits shall be PVC sheathed of type 'B' to BS731 or shall be double leaded steel foil interleaved type of heavy duty grade complete with solid type couplers.

An insulated protective conductor shall be run within the conduit and bonded at each end.

Terminations shall be made on the correct type bolted terminals.

Couplings and connections shall be to BS731 and shall be cadmium plated mild steel with shake-proof accessories.

Flexible conduit shall be used with items of equipment which are withdrawable or subject to vibration or adjustment and shall be of sufficient length to allow the necessary full range of movement.

Where used externally, weatherproof grade of conduit and fittings shall be used.

SECTION 2 GENERAL TECHNICAL CLAUSES

PART 6 METAL TRUNKING & TRAY PLATE

2.27 CABLE TRUNKING

Trunking shall be manufactured from rust proofed sheet steel in the following gauges:

a) Up to and including 50 mm x 50 mm or equivalent C.S.A. - 1.25 mm U.

b) Above 50 mm x 50 mm and up to and including 100 mm x 100 mm or equivalent C.S.A. - 1.6 mm U.

c) Above 100 mm x 100 mm or equivalent C.S.A. 2 mm U.

The trunking shall comply with BS4678, Part 1 and shall be fitted with an over-lapping, well-fitting, drip proof, removable cover fixed with captive screws in such a manner that damage to cables is avoided. Self-tapping screws or fixed bridge pieces shall not be allowed for fixing the cover.

The trunking shall be fitted with a fixed section of cover where trunking passes through the structure.

Such fixed section shall be restricted to the minimum length necessary. The system shall be free from all sharp edges and projections.

Finish shall be Class 2 for internal, dry non-corrosive situations and Class 4 for external and damp situations.

Internal fire barriers in accordance with I.E.E. Wiring Regulations 527-02 shall be provided by binding the cables and filling the spaces with non-asbestos fire resisting material.

Insulated cable support pins shall be fitted at intervals of 1.2 m in vertical runs of trunking exceeding 2 m in length. Where the removable cover is on the underside of the trunking, cable retaining straps or holders shall be provided at intervals not exceeding 600 mm.

The trunking system shall be electrically and mechanically continuous throughout, with every joint bridged by a tinned copper bonding strap to ensure electrical continuity.

All links shall be visible and all bonding connections cleaned and free of paint.

The entire system shall be adequately connected to the distribution system earthed network.

All trunking fittings such as elbows, tees and end plates shall be as supplied by the trunking manufacturer, unless specified otherwise. All transitional fittings (e.g., bends elbows, tees etc) shall be 'gusseted' to facilitate cable installation.

Fittings and cover plates shall be the same gauge as the trunking body wall.

2.27 CABLE TRUNKING (Contd.)

Trunking shall be fitted with factory made flanged adaptors for connections to equipment.

Partitions in trunking for multi-compartment systems shall be of the same material and finish as the trunking and may be up to 0.5 mm thinner than the trunking material with a minimum thickness of 1.0 mm (20 swg). The welded edge of the partition where it is attached to the trunking shall be arranged to present a clear flat face over the full width for any conduit or supporting nuts and bolts.

The exposed edge of the partition shall be turned up 12 mm to present a flat face.

Electrical continuity between trunking and steel conduit systems shall be provided by means of a smooth bore male brass bush, serrated washer and earthing coupling with the earth coupling bonded to a terminal on the trunking by an insulated cable sized in accordance with the Regulations.

The cable shall be terminated with a crimped lug onto an M5 brass bolt, four plain washers, two serrated washers and three M5 nuts which shall be fixed to the trunking to provide a permanent connection.

Alternatively, a circular conduit box fixed by a smooth bore male brass bush, lock nut and female bush can be used, with the male bush fitted through the back of the conduit box within the lock nut and female bush inside the trunking. Earth continuity shall be achieved via a short length of protective conductor run from an earth stud in the conduit box to a similar connection on the trunking.

Where the finish is removed by cutting or drilling, it shall be made good to match the original manufacturer's finish.

Unless direct fixing is particularly specified, trunking shall generally be fixed to the building fabric and spaced off the structure to a minimum distance of 6 mm by means of spacers at regular intervals not exceeding the following:

Cross Sectional Area of Trunking (mm^2)	Vertical & Horizontal
Exceeding 1500 and not exceeding 2500	1.0 m
Exceeding 2500 and not exceeding 5000	1.2 m
Exceeding 5000	1.5 m

Note: Supports shall be provided within 225 mm of bends and intersections.

Spans of trunking will only be permitted where its design is adequate for the particular requirements.

Supporting metalwork shall be wire-brushed, cleaned and painted with zinc rich (i.e. phosphate) primer.

The trunking system shall be complete before the commencement of wiring.

2.28 CABLE BASKET SYSTEMS

Cable basket shall be manufactured from rigid steel wire of at least 3.5 mm diameter for sizes up to 200 mm wide and at least 5 mm diameter for larger sizes.

Baskets shall be hot dip galvanised to BS 729 where used externally and zinc plated where used internally, except where specified otherwise.

Baskets and supports shall be adequately sized to avoid unnecessary bunching of cables and so that undue deflection, when fully loaded, is avoided.

Bare copper sheathed cable shall not be installed on cable basket.

Fixings shall be zinc plated nuts and bolts with proprietary fixings and suspension brackets. All baskets shall be supported using propriety suspension brackets and twin 6 mm screwed drop rods, one at each edge of the basket. Fixing points shall be at regular intervals not exceeding 1.2 metres. Screwed drop rod supports shall be cut back to within 25 mm and the cut ends protected by proprietary plastic end caps.

All baskets shall be mounted in the horizontal plane with return flanges facing up.

Baskets shall only be wall fixed where specifically indicated. In this instance, proprietary cantilever brackets shall be utilised.

When sections are cut, all sharp edges shall be removed and exposed metal edges painted with rust inhibitor. Sections of basket shall be joined using proprietary coupling plates fixed with zinc plated nuts and bolts. Bends and tees shall be site fabricated utilising proprietary coupling and gusset plates fixed using zinc plated nuts and bolts.

Where cabling exits the tray via rigid or flexible conduit systems (as specified) the conduits shall be terminated at the basket flange using proprietary mounting brackets. Where such conduit is steel, earth couplings shall be used, the earth cabling terminating at the bracket fixing via a crimped lug.

Cable fixings shall be by means of proprietary forms of plastic or PVC covered copper or brass cable clips, brass saddles or straps. Brass nuts and bolts or galvanised roofing bolts shall be used to fasten the fixings to the fixings to the basket.

Reference shall be made to the appropriate section of the specification on the type of cable to be installed for the fixing method to be adopted.

The cable basket installation shall be electrically and mechanically continuous and shall be adequately connected to the distribution system earthing network.

The basket system shall be complete before the commencement of wiring.

2.29 CABLE TRAY

Perforated cable tray shall be plain steel sheet complying with BS1449, Part 1B, Class CR4/GP of not less than 1 mmU from 150 mm to 300 mm width and 2 mmU from 300 mm to 600 mm width.

2.29 CABLE TRAY (Contd.)

Trays shall be galvanised in external locations and provided with an approved alternative rust resisting finish such as zinc phosphate for internal applications.

Galvanising shall be hot-dipped to BS729, Part 1.

Trays shall be of adequate size to avoid undue bunching of cables and shall be supported so that undue deflection, when fully loaded is avoided.

Bare copper sheathed cable shall not be installed on galvanised cable tray.

Fixings shall be by sheradised nuts and bolts with a gap of 25 mm between the structure and the tray.

Fixings for tray shall be disposed at regular intervals not exceeding 1.2 m and at 225 mm for bends and intersections.

At each fixing position, two fixings shall be provided and for trays wider than 300 mm three fixings shall be provided where the tray is to be supported from the underside of roofs or ceilings.

Supports shall be fabricated from mild steel flat bar complying with BS4360. When used with galvanised cable tray, supports shall be hot-dipped galvanised to BS729, Part 1 unless only bending and drilling is required in the manufacture when galvanised mild steel flat bar may be used.

Drop screwed rod supports shall be cut back to within 25 mm and the cut ends protected by proprietary plastic end caps.

Site fabricated accessories and supports for internal applications shall be wire brushed, cleaned and painted before erection to ensure that the fixing bolts or screws are protected. When sections are cut or drilled, all sharp edges shall be removed and exposed metal painted with a rust inhibitor. Areas of finish damaged by welding shall also be made good as described above (e.g. zinc phosphate paint).

Holes cut in the tray for the passage of cables shall be provided with grommets, bushed or lined.

Bends and tees shall be factory made using the same material, thickness and finish as the tray.

Site fabrication of accessories shall be kept to a minimum and manufacturer's standard items and method of installation shall be used.

Where special sections are required, the material, thickness and finish shall be as specified for standard items.

Where cut sections are used for sets they shall be free from sharp edges an joined by means of fish plates bolted to each section with mushroom head steel roofing bolts complying with BS1494, Part 1.

Cable tray shall only be cut along a line of plain metal and not through perforations.

2.29 CABLE TRAY (Contd.)

Cable fixings shall be by means of proprietary forms of plastic or PVC covered copper or brass cable clips, brass saddles or straps. Brass nuts and bolts or galvanised roofing bolts shall be used to fasten the fixings to the fixings to the tray.

Reference should be made to the appropriate section of the specification on the type of cable to be installed for the fixing method to be adopted.

The cable tray installation shall be electrically and mechanically continuous and shall be adequately connected to the distribution system earthed network.

The tray system shall be complete before the commencement of wiring.

SECTION 2 GENERAL TECHNICAL CLAUSES

PART 7 PVC TRUNKING

2.30 INSTALLATION

Trunking shall be extruded unplasticised PVC compound of the colours specified. It shall be smooth inside and outside and free from imperfections.

Gauge and type shall be as specified and it shall be fitted with a drip-proof well fitting lid of an approved type. Where the cover is on the underside, cable retaining straps at intervals not exceeding 1.2 m shall be fitted. In vertical runs exceeding 1.8 m, insulated cable support pins shall be fitted at intervals of 1.2 m, the first pin, in cases where junction occur, being not more than 0.3 m from the junction.

Internal fire barriers shall be fitted in the trunking in accordance with I.E.E. Regulation 527-02. All joints, tees, off-sets, and other fittings shall be the manufacturer's standard items, joints being made using standard internal connectors without the use of solvent and as instructed by the manufacturer.

Environmental conditions appertaining to the installation of PVC conduit shall also apply to PVC trunking.

The trunking system shall be mechanically continuous throughout containing a separate insulated circuit protective conductor to ensure electrical continuity between exposed metal items.

The whole system shall be adequately supported and substantially fixed to the building structure using purpose made supports 50 mm each side of all joints and elsewhere at regular intervals, not exceeding the following:

Cross Sectional Area of Trunking (mm^2)	Vertical & Horizontal
Exceeding 300 and not exceeding 1500	0.5 m
Exceeding 1500	1.0 m

General conditions relating to supporting metalwork shall be as specified for metal trunking.

PVC trunking shall not pass through fire compartment walls.

The trunking system shall be complete before the commencement of wiring.

SECTION 2 GENERAL TECHNICAL CLAUSES

PART 8 POWER DISTRIBUTION CABLES

2.31 GENERAL

All cables shall be of the type and voltage grade as specified and be B.A.S.E.C. approved.

The Contractor shall obtain the approval of the Consulting Engineer in writing to use cables by other manufacturers prior to ordering.

In any one contract, all cables shall be manufactured by the same maker. When delivered to site each drum or coil of cable shall have attached the manufacturer's labels giving details of the cable and manufacturer's test certificate. Replacement of faulty cable shall be at the Contractor's expense.

All cables shall have a B.A.S.E.C. or B.A.S.E.C. <HAR> marking on the outer sheath as appropriate.

All cables shall be run on routes indicated on the drawings and in the specification. Any deviation shall be approved by the Consulting Engineering before laying commences.

The routes shall be measured by the Contractor on site and he shall be responsible for ensuring that correct lengths are ordered. All cables laid direct in the ground shall have an overall sheath of PVC.

PVC/LSF sheathed cables shall not be installed in direct contact with any form of polystyrene.

Cables shall be installed only when both the cable and ambient temperatures are not less than 5° and have been so for the previous 24 hours, or when special precautions have been taken to maintain the cable at or above this temperature.

Single core cables armoured with steel wire or tape shall not be used for AC.

2.32 PAPER INSULATED (Up to & Including 11 kV)

These shall be mass impregnated non-draining belted type, complying with BS6480 and unless stated otherwise are for use on an earthed system.

They shall have copper conductors, lead sheath and be armoured. The type of overall sheath, if any, shall be as specified and cables shall have shaped cores of identical cross-sectional area, including neutral.

Each cable shall be kept sealed before installation by means of wiped joints and end caps.

2.33 XLPE INSULATED (Up to and including 3.3 kV)

These shall comply with BS6724/BS5467 having shaped cores of identical cross-sectional area (including neutral).

2.33 XLPE INSULATED (Up to and including 3.3 kV) (Contd.)

Cables shall have an overall protective sheath as follows:

a) Internally installed : LSF sheath

b) Externally installed : PVC sheath

External circuits installed internally exceeding 30 metres in length shall be deemed internal to first point of utilisation.

Where cables are connected to equipment or accessories designed to operate at a temperature of 70°C or installed in an enclosure containing cables (e.g. PVC insulated) rated at 70°C, the current ratings shall be as given in the equivalent table of the I.E.E. Regulations for 70°C PVC insulated cables (BS6004, BS6346).

Cables shall be armoured and have copper conductors as specified.

2.34 CABLE ROUTING

Cables shall be run between termination points in continuous length. Joints shall not be allowed unless specified or unless agreed by the Consulting Engineer.

Where cables are installed in the ground, they are to be laid at depths and spacings specified below:

Minimum Depth of Cable Trenches:

Type of Cable	General Conditions	Traffic Roads	Cultivated Areas	Areas Beneath Drainage
Road Lighting	500 mm	750 mm to top of ducts	600 mm	1.0 m
Communication	500 mm	750 mm to top of ducts	600 mm	1.0 m
Alarm	500 mm	750 mm to top of ducts	600 mm	1.0 m
Low Voltage	500 mm	750 mm to top of ducts	600 mm	1.0 m
High Voltage	800 mm	1.0 m to top of ducts	1.0 m	1.0 m

2.34 CABLE ROUTING (Contd.)

Minimum Spacing Between Services Laid Direct in the Ground (General Conditions):

Cable	HV/EHV	LV	Communi-cation & Alarm	Water Services	Gas &Hot Services
HV/EHV	150 mm	300 mm	600 mm	600 mm	800 mm
LV	300 mm	75 mm	300 mm	600 mm	800 mm
Communication & Alarm	600 mm	300 mm	50 mm	600 mm	800 mm

Minimum Width of Cable Trenches for Required Depths:

Nominal Depth	Nominal Width
Down to 500 mm	300 mm
Down to 800 mm	500 mm
Down to 1.0 m	500 mm
Down to 1.5 m	700 mm
Below 1.5 m	800 mm

Where scheduled minimum depths cannot be accommodated, cables shall be installed in earthenware ducts set in concrete.

Where cables laid in the ground follow the same route they shall be laid in horizontal formation with spacing between cables where possible of not less than 150 mm with the exception of single core cables which shall be run in trefoil formation and touching along their entire length.

Underground cables shall be laid on 75 mm of sand and covered by 75 mm of sand with interlocking cable tiles to BS2484 laid on the sand directly over the cable. Tiles shall be of such width as to provide a minimum overlap of 50 mm on each side of the cable.

Trenches shall be backfilled with the excavated material which shall be well compacted at intervals of 150 mm.

At approximately 300 mm below finished ground floor level a continuous strip of plastic marker tape marked "Danger Electric Cables" shall be laid in position directly above the cable. All excavation, backfilling, laying of sand and tiles and laying of tape will be done by others unless otherwise specified, but it shall be the Contractors responsibility to ensure that the complete installation is correctly carried out.

2.34 CABLE ROUTING (Contd.)

Concrete cable markers shall be used to indicate the route of buried cables at intervals of not more than 50 metres and at points where change of direction and joints occur and at each side of every road crossing. Markers shall be not less than 150 mm long x 800 mm wide x 75 mm thick, to be marked "Electric Cable" and 300 mm shall be exposed above ground.

Cables under roads, paths, floors through walls or skirting buildings shall be run in self-sealing glazed earthenware conduits of minimum diameter 100 mm.

At roadway crossings the ducts shall extend 1.0 m on either side of the roadway.

Where the cable ducts terminate in buildings they shall be sealed with a permanently plastic waterproof sealing compound to prevent ingress of water, foreign matter and vermin.

Where cables enter buildings plastic labels shall be fitted to the external wall engraved with the size and voltage of the cable.

When passing through floors or walls the earthenware conduit shall be fitted with a fire resisting material to comply with the I.E.E. Wiring Regulations.

Cables shall be protected from mechanical damage up to a height of 1.5 m above floor level where run on the surface of walls. Paper insulated cables shall be installed without removing the wiped joint end cap until it is necessary for making the actual termination.

Cables shall be installed only when both the cable and ambient temperatures are at or above a temperature to avoid risk of damage during handling.
Paper insulated and armoured XLPE cables run in air (including engineering service ducts) shall be fixed with aluminium alloy claw type cable cleats with galvanised back straps using galvanised bolts conforming to BS1490 with maximum spacing between supports not exceeding the following:

Overall diameter of cable (mm)	Maximum Spacing Of Fixing Vertical/Horizontal (mm)
Exceeding 9 and not exceeding 15	350
Exceeding 15 and not exceeding 20	400
Exceeding 20 and not exceeding 40	450

Cables up to and including 10 mm diameter shall be fixed by single bolt and above 40 mm diameter by 2-bolt fixing.

The correct size of cleat fixing stud must be provided to suit the cable size and to ensure that the stud does not extend below the nut.

Excess pressure of cleats on cables is to be avoided to prevent deformation of the sheathing.

2.34 CABLE ROUTING (Contd.)

Suitable supporting steelwork and/or galvanised cable tray shall be provided where cables cross open spaces of greater than 1 m distance, such steelwork to be protected by a rust inhibiting paint. Unserved aluminium sheathed cables shall not be installed in contact with walls or floors.

2.35 MINIMUM INSTALLATION RADIUS

Cables specified shall not be bent during installation to smaller radii than those shown in the following table:

Minimum internal radii of bends in cables for fixed wiring

Insulation	Finish	Overall Diameter	Factor to be applied to overall diameter of cable to determine the minimum internal radius of the bend +
Rubber or PVC (circular, or circular stranded copper or aluminium conductors)	Non-armoured	Up to 10 mm	3(2)*
		Over 10 mm, but not exceeding 25 mm	4(3)*
		Over 25 mm	6
	Armoured	Any	6
PVC (solid aluminium or shaped copper conductors)	Armoured Non-armoured	Any	8
Impregnated paper	Lead sheath	Any	12
Mineral	Copper or aluminium sheath with or without PVC covering	Any	6

+ For flat cables the factor is to be applied to the major axis.

* The figure in brackets relates to single-core circular conductors of stranded construction installed in conduit, ducting or trunking.

Note: Where a manufacturer indicates a minimum bending radius greater than that shown above, the manufacturer's recommendations shall be implemented.

2.36 JOINTING & TERMINATION

General

The jointing and termination of all paper, PVC and XLPE insulated cables shall be carried out by an experienced cable jointer trained and fully conversant with modern techniques and once the cable is cut for the purpose of making a joint or termination the work involved must be carried out and completed without interruptions. If for any reason the work cannot be carried out it is essential that the cable ends are sealed immediately as follows:

- Lead Sheathed Cables - Solder or wipe a copper or lead cap on the sheath
- Armoured PVC & XLPE Cables - Seal with PVC tape
- Joints and cable terminations shall be suitable for the environment in which they need to operate and in particular fully weatherproof kits shall be used for outdoor situations.

Paper Insulated Lead Sheathed Cables with Stranded Copper or Aluminium Conductors

a) Joints

Conductors shall be sweated with ferrules not less than the cross-sectional area of the conductor for which it is designed.

Only tinned aluminium ferrules shall be used with aluminium conductors.

Solder for making copper joints shall be Grade 'M' or Grade 'G' complying with BS219.

The flux shall be resin or other non-corrosive type.

Solder for making aluminium joints shall be of the cadmium free type.

Flux can be either organic or inorganic of a type approved by the cable manufacturer. The insulation of the joints conductors shall be either of the following:

- Impregnated cotton tape or paper cotton tape wrapped around each jointed conductor to a built up thickness over the ferrule equal to not less than one and a half times the thickness of the cable core insulation.
- Impregnated paper rolls of adequate dimensions as supplied by the manufacturers for use with a specific type and size of cable wrapped around each jointed conductor.
- Impregnated cotton tape or paper cotton tape wrapped around each jointed conductor and surrounded by a tube of paper or paper mica composition.

For 3-core cables the jointed cores shall have separators of impregnated cotton tape or paper inserted between the cores and the cores bound overall with impregnated cotton tape or paper binders.

2.36 JOINTING & TERMINATION (Contd.)

Paper Insulated Lead Sheathed Cables with Stranded Copper or Aluminium Conductors (Contd.)

a) Contd.

The insulated joints shall be housed in a compound filled lead or tinned copper sleeve plumbed to the sheath of the cable.

Solder for plumbing the sleeve to a lead sheathed cable shall be Grade 'D' complying with BS219.

The methods and materials for plumbing of aluminium cable sheath to the sleeve shall be in accordance with the manufacturer's instructions. Compound filling holes in the lead or copper sleeves shall have caps for plumbing over the holes after filling with compound. The manufacturer's recommended compound complying with BS1858 shall be used for filling the sleeve.

Outer protection boxes shall be of either cast iron or reinforced concrete of an approved type and shall be filled with a suitable compound. Cast iron boxes shall be provided with armour clamps where armoured cable is specified to provide efficient mechanical and electrical bonding of the armour across the joint.

After completion of the joint, all cast iron boxes shall be given two coats of bitumastic paint to prevent rusting of the box.

Where non-metallic outer protection boxes are used with armoured cable, suitable armour clamps and copper strip shall be used to provide electrical bonding. The copper strip shall be sized in accordance with Table 54G of the I.E.E. Wiring Regulations.

b) Terminations

Terminations shall be made in compound filled sealing boxes and no soldered ferrule or joint will be permitted inside a sealing chamber.

The cable cores shall terminate in correctly sized compression or sweating type lugs and the tails shall be wrapped with not less than two layers of bitumastic or waterproof tape.

The tails shall be colour coded to indicate phase and neutral conductors.

Tail-less terminations shall be completely compound filled.

On medium voltage networks where connecting tails are required the cable ends shall be soldered solid and PVC insulated tails jointed by suitable compression jointing sleeves, the joints being insulated with varnished cambric or other suitable insulation and the joint and tails overwrapped with bitumastic or waterproof tape.

Paper Insulated Lead Sheathed Cables with Stranded Copper or Aluminium Conductors (Contd.)

b) Contd.

The lead or aluminium shall be neatly plumbed to the gland on the sealing chamber. Where armoured cable is specified the armouring is to be clamped to the gland, the armouring being neatly arranged and the serving cut and bound below the plumbed joint.

XLPE Insulated Armoured Cables, PVC & LSF Sheathed with Stranded Copper or Aluminium Conductors

Jointing and termination techniques may be either:

a) As for paper insulated cables (clause 2.34) using the manufacturer's recommended joint boxes and cold pouring compound, or

b) Compression techniques as for solid aluminium conductors (clause 2.34).

XLPE Insulated Aluminium Armoured PVC & LSF Sheathed Solid Aluminium Conductors

All joints are to be of the indented compression type by means of a hydraulic compression ram head and suitable compression dies according to the core size of the cable with strict adherence to the cable manufacturers recommendations on accessories, ferrules, compression pressure and jointing techniques.

Joint boxes shall be as specified. Where cast iron or earthenware boxes are employed the box shall be filled with a bitumen compound whose pouring temperature shall not exceed 140°C.

Where plastic boxes are used an approved polyester resin shall be used to fill the joint box.

Particular attention should be paid to ensure electrical continuity of the cable armouring.

Note: Unless specified otherwise, all cables shall have stranded copper conductors. Reference to solid aluminium conductors is for situations where they are specifically required elsewhere in this document.

Terminations shall be made using the indented compressions method with sockets of soft aluminium shaped to match the profile of the conductor core.

Suitable approved aluminium cable glands with bonding lugs shall be used and shall be protected with PVC/LSF cable shrouds. All metal joints at termination joints, gland to armour contact and dissimilar metal joints shall be smeared with Denso tape.

2.37 PRESSURE TESTING

After installation the cable shall be pressure tested by the Contractor in the presence of the Engineer. The Contractor must notify the Engineer in writing, seven days before such tests are to be carried out and shall submit to the Engineer duplicate copies of a test certificate on completion.

The Contractor shall be responsible for rectifying any faults on any part of the installation which fails or breaks down as a result of the pressure tests. Tests shall be made on each separate length of cable and for this purpose isolators and fuse switches must be in the open position and wedges in feeder pillars must be removed.

The tests shall be carried out with DC, the voltage to be applied and increased gradually to the full value and maintained for 5 minutes between conductors and between earth conductor and sheath.

Cable Voltage	DC Test Voltage	
	Between Conductors (Volts)	Between All Conductors & Sheath (Volts)
600/1000	3500	3500
1900/3300	10000	7000
3800/6600	20000	15000
6350/11000	34000	25000
8750/15000	-	37000
12700/22000	-	50000
19000/33000	-	75000

SECTION 2 GENERAL TECHNICAL CLAUSES

PART 9 MINERAL INSULATED CABLES

2.38 CABLES

Cables shall comply with BS6207, Part 1 (with B.A.S.E.C. approval) having copper conductors and seamless copper sheath (or welded, seamed copper sheath where the mineral insulation is moisture resistant).

They shall be of the 750 Volt (heavy duty) grade except for single phase final circuits where 500 Volt (light duty) grade cables may be used.

All M.I. cables shall have an LSF (BICC 'Fire Safe' or equal) outer covering.

Cables buried underground shall have a PVC outer covering.

Cables shall be of only one manufacturer for a particular Contract and shall be delivered to site having the manufacturer's seal and identification labels intact.

All accessories (glands, seals, saddles, clips, etc.) shall be of the same manufacture as the cable.

All cables shall have a B.A.S.E.C. or B.A.S.E.C. <HAR> marking on the outer sheath as appropriate.

2.39 INSTALLATION

Cables shall be securely fixed to the structure using copper saddles at a maximum spacing in accordance with the manufacturers recommendations and to the I.E.E. Wiring Regulations.

Where several cables are run together, multiple saddles shall be used, fixings being as detailed for conduit. Where multiple runs occur in plant rooms, roof spaces and ducts, etc. the cables shall be run on cable tray, having saddles fixed with brass round head screws and nuts. Unsheathed copper cables shall be secured with copper clips or saddles fixed with brass screws.

Covered cables shall be secured with copper saddles (with covering compatible with the respective cable covering i.e. LSF or PVC) with brass screws. Not less than 24 hours after installation and completion of seals, cables shall be tested by the Contractor in the presence of the Consulting Engineer or his representative.

Alterative fixings will be considered (e.g. BICC Pyrotenex - 'Pyro Ties'), however express written permission shall be obtained by the Contractor from the Consulting Engineer for the use of any such alterative. Non-metallic cable clips or cable ties are <u>not</u> acceptable for securing mineral insulated cables.

Any cables not giving an insulation resistance reading of more than 100 megohms on a 500 volt tester (for light duty cable) or on a 1000 volt tester (for heavy duty cable) shall be resealed by the Contractor at his own expense.

2.39 INSTALLATION (Contd.)

Cables shall be tested before and after being covered with concrete, plaster or buried in the ground. Cables shall be protected from mechanical damage while in storage and during installation especially when floor screens and wall finishes intended to cover cables are not applied immediately following the cable installation.

Cables shall be protected by fibre sleeves where passing through floors, walls, ducts, etc. After passing through a floor an exposed cable shall be protected on the wall by conduit or trunking to a height of 300 mm above floor level. Cables shall be run at least 150 mm clear of non-electrical services.

Cables shall be installed only by tradesmen fully conversant with M.I. installation and jointing techniques and only those tools recommended by the cable manufacturer shall be used.

Where connections are to be made to motor and equipment where vibration or movement due to expansion, etc. is likely to occur the cable shall be formed into one complete loop immediately before entering into the equipment terminal box. Surge voltage diverters as recommended by the cable manufacturers shall be connected across the tractive coils of all motor starters and star connected surge diverters connected in the motor terminal box on all motors rated 2 kW (3 h.p.) or less.

When laid direct in ground cables shall be protected with sand and cable tiles as specified for armoured cables (in accordance with BS6207).

Where subsidence is likely to occur the cable shall be 'snaked' along the route.

a) Jointing & Termination

Except at termination at an appliance or fitting, joints shall not be allowed without the Consulting Engineer's consent. If allowed these shall be made using only manufacturers' accessories and connections may be either soldered or crimped. Crimping shall only be carried out with a tool which ensures that once the crimping operation has begun it must be completed.

Buried joints or joints in corrosive situations must be protected with layers of self-amalgamating tape.

Terminations shall be made using cold seals of the type recommended by the cable manufacturer to suit the size and type of cable or as specified (in accordance with BS6207).

Tails shall be protected by neoprene sleeves in accordance with BS2848 and 3858, colour coded as prescribed in the I.E.E. Wiring Regulations.

Conductors 16 sq. mm and above shall be terminated using cone grip lug type cable sockets.

At equipment in which terminals are not provided connection of the tails to the equipment tails shall be made using pinching screw terminals or flat clamp type connectors.

2.39 INSTALLATION (Contd.)

a) Contd.

The M.I. cable tails shall be provided long enough to connect directly to the equipment.

Joints in these tails shall not be allowed.

Cable glands shall be of the same manufacture as the cable.

When served cables are used, serving removed for the purpose of termination shall be replaced with tape to match the serving and the whole gland assembly protected with a shroud (to match the serving). Damaged serving will not be accepted.

Cables are not to be concealed in plaster unless specified or with the consent of the Consulting Engineer, but where this is unavoidable, terminations shall be made using cold seals having circuit protective conductors incorporated.

The CPC shall be insulated by neoprene or PVC sleeving and shall terminate in the junction box at 2BA or 5 mm tapped screw inside the box.

When it is specified that glands shall not be fitted because of space restrictions, the cables shall be securely fixed to the outlet box using suitable clamps fitted to the box. Where the CPC is to be carried through a lighting fitting a three way connector can be used in the conduit box, the third way being used to carry the CPC.

b) Continuity & Earthing

Where boxes without screwed spout entries are used, the M.I. cable gland shall be secured to the box by means of a smooth bore male brass bush and earthing coupling with compression washers used. An insulated circuit protective conductor shall be connected from the box to the equipment fixed to the box. This requirement shall not apply when terminations using integral circuit protective conductors are used.

SECTION 2 GENERAL TECHNICAL CLAUSES

PART 10 CABLES IN CONDUIT & TRUNKING

2.40 CABLES

Cables to be drawn into conduit or trunking systems shall be PVC insulated single core 450/750 volt grade with copper conductors to BS6004 Table 1 for situations where the ambient temperature does not exceed 65°C.

Where conditions are such that this temperature may be exceeded the cable shall be of the elastomer-insulated type, 300/500V (150°C) or 450/750V (85°C) grade to BS6007 and shall be type GP1 rubber insulated and braided for temperatures up to 85°C. and type E1 2 rubber insulated and braided for temperatures up to 150°C.

The elastomer-insulated cables shall be identified throughout the length of the cable by legends "Heat Resisting 85" for e.p. or butyl rubber insulated and "Heat Resisting 150" for silicone rubber insulated. Identification shall be either on an internal tape or shall be embossed externally, the gap between legends being not more than 300 mm.

The situations in which elastomer-insulated cables shall be used and the type to be installed, shall be as specified and/or on the drawings.

Stranded 2.5 mm² cable to BS6231 may be used as an alternative to the BS6004 2.5 mm² cable.

Cable which must be B.A.S.E.C. approved shall be delivered to site with each coil having its seal intact and bearing the name of the manufacturer, classification, size, description, length and grade.

All cables shall have a B.A.S.E.C. or B.A.S.E.C. <HAR> marking on the outer sheath as appropriate.

2.41 INSTALLATION

Cables shall be installed only when both the cable and ambient temperatures are not less than 5°C. and have been so for the previous 24 hours, or when special precautions have been taken to maintain the cable at or above this temperature.

No joints shall be allowed except at termination at an appliance or fitting.

Cable sizes shall be as detailed or as shown on the drawings, however, the minimum cable size for lighting circuits shall be 1.5 mm² and for 32 amp ring circuits 2.5 mm². Cables shall be colour coded in accordance with Table 51A of the I.E.E. Wiring Regulations.

Colour sleeves shall only be used with the written consent of the Consulting Engineer.

Cables shall not pass through lighting fittings unless they are of the heat resisting type to BS6007, Table 7 and shall not be connected direct to a lampholder or other appliance where temperatures are likely to exceed the maximum operating temperature for the insulation specified in the appropriate B.S.

2.41 INSTALLATION (Contd.)

Conductors shall be terminated by one of the following methods unless stated otherwise.

a) Sweated lugs.

b) Compression type lugs.

c) Pinch screw type terminals of the type that do not spread the conductors.

d) Clamp type terminals.

For all single connections of conductor sizes up to and including 2.5 mm^2, the conductor shall be doubled back on itself at the termination.

SECTION 2 GENERAL TECHNICAL CLAUSES

PART 11 PVC INSULATED & SHEATHED CABLES

2.42 CABLE

Cables shall be B.A.S.E.C. approved of the 300/500 volt grade to BS6004 Table 5 and BS6346 being flat twin core PVC insulated PVC sheathed cable with integral circuit protective conductor. Cable sizes shall be as specified.

All cables shall have a B.A.S.E.C. or B.A.S.E.C. <HAR> marking on the outer sheath as appropriate.

2.43 INSTALLATION

Cables shall be concealed or run on the surface as specified.

Cables buried in wall finishes shall be protected throughout their entire length by either rigid PVC conduit as previously specified, or rigid PVC channel fixed to the wall with proprietary corrosion resistant fixings. The protective conduit or channel shall be continuous over the length of run to be protected and shall be free from burrs and rough edges.

Entries to accessory boxes and fittings shall be fitted with suitable grommets to prevent damage to the cable sheath.

Accessory boxes shall be bonded where of metal construction. Cables shall not be buried in floor screens without the written approval of the Consulting Engineer but when this is authorised they shall be protected throughout their entire length by rigid PVC conduit as specified in clause 2.22 having a minimum of 35 mm cover of screed, conduit and channel buried in plaster shall have a minimum cover of 13 mm. Cables on walls shall be run vertically or horizontally and in ceiling spaces and on ceilings shall be run parallel to the external walls.

Diagonally run cables shall not be allowed.

Cables shall be fixed using suitable clips or saddles not exceeding the following:

Overall diameter of cable (mm)	Maximum Spacing of Fixings	
	Vertical	Horizontal
Not exceeding 9	250	400
Exceeding 9 and not exceeding 15	300	400
Exceeding 15 and not exceeding 20	350	450
Exceeding 20 and not exceeding 40	400	550

Fixings shall not be more than 70 mm on either side of a fitting, accessory or bend. Cables running along joists shall be run on a level clear of ceiling boards and as near as possible to the centre of the joist.

Where multiple runs (i.e. more than 2 No. cables together) occur in ceiling voids, ducts, etc. cables shall be fixed to galvanised cable tray.

2.43 INSTALLATION (Contd.)

Where run in intermediate floors, cables shall be threaded through holes not exceeding 25 mm diameter drilled at half joist depth and at least 50 mm clear of top/bottom of floor or ceiling finishes.

Cables shall not be installed in direct contact with any form of polystyrene.

Conductors shall be terminated as stated for PVC cables in conduit. Joints shall not be allowed, except at termination at an appliance or fitting, the conductors being terminated as specified for PVC cables in conduit.

Cables shall be installed only when both the cable and ambient temperature are not less than 5°C and have been so for the previous 24 hours, or when special precautions have been taken to maintain the cable at or above this temperature.

2.44 FLEXIBLE CORDS

These shall be of the 300/500 volt grade or 300/500 volt grade to BS6500 or 6141. The type of insulation, number of cores, size of conductors, braiding and sheathed will depend on the service for which the cable is intended and shall be as specified.

No cable smaller than 0.75 mm^2 shall be used.

SECTION 2 GENERAL LIGHTING CLAUSES

PART 12 LIGHTING

2.45 LUMINAIRES

The Contractor shall provide all luminaires which shall comply with BS4533 and BS2818 as listed in the lighting schedule and as shown on the drawings.

2.46 CONNECTION OF LUMINAIRES

Luminaires shall be connected as specified in one of the ways detailed below:

a) The cabling or conduit system shall terminate in a B.S. conduit box mounted on the structure in the ceiling void. A 3-pin plug-in type ceiling rose shall be fitted to this box. A 3-core (one core being the circuit protective conductor) 1.0 mm^2 flexible cord (insulation and sheath as specified) shall be run from the plug in the ceiling rose to the terminals of the luminaire. The flexible cord shall pass through a brass stuffing gland fixed in the wall of the luminaire.

The luminaire shall be suspended from the structure, unless otherwise stated using rod or conduit suspensions.

Luminaires shall not be directly suspended from a PVC conduit box.

b) The cabling or conduit system shall terminate in a B.S. conduit box mounted on the structure. A ceiling rose to BS67 incorporating a circuit protective terminal shall be fitted to this box.

A 3-core (one core being the circuit protective conductor) 1.0 mm^2 flexible cord (insulation and sheath as specified shall be run to the terminals of the luminaires which shall be fitted with a brass stuffing gland for cable entry.

Suspension of luminaires shall be as in (a) above.

c) The cabling or conduit system shall terminate in a metal conduit box to BS31 or BS4568 mounted flush with the ceiling and supported from the structure.

Wiring shall terminate in a porcelain connector from which a 3-core 0.75 mm^2 or 1.0 mm^2 glass fibre insulated flexible cord for 5A and 10A circuits respectively shall be run to the luminaires which shall be mounted directly beneath the box. Boxes shall be fitted with break rings when the luminaires does not overlap the box.

Luminaires shall be suitably supported directly from the structure, unless stated otherwise. When terminating the PVC final circuit cables in a BSconduit box to which a close ceiling tungsten luminaires is to be attached, care should be taken to ensure that the PVC tails are as short as possible and that the extra length on tails required to install the luminaires is left on the heat resisting tails specified. This is to prevent the PVC tails coming into contact with the luminaire and subsequently resulting in insulation failure due to the excessive heat.

2.46 CONNECTION OF LUMINAIRES (Contd.)

d) For pendant luminaires the cabling or conduit system shall terminate at ceiling height in a flush mounted conduit box supported from the structure to which shall be fitted a ceiling rose to BS67 incorporating a protective conductor terminal. A length of 1.0 mm² heat resisting flexible cord shall be provided from the ceiling rose to the luminaires. (The length of cord or alternatively the mounting height of the luminaires shall be specified elsewhere)

At the luminaire the flexible cord shall terminate in a heat resisting bayonet cap lampholder.

For rod type pendant luminaires the wiring system shall terminate in a porcelain connector housed within the conduit box. A heat resisting flexible cord (0.75 mm² or 1 mm² for 5A and 10A circuits respectively), shall be connected between the connector and the luminaires lampholder.

Break-joint rings shall be fitted between the conduit box and the luminaires which shall be mounted at the height specified.

The Contractor shall allow for cutting and making good rod-pendants where non-standard lengths are specified.

e) For surface installations the conduit or cable installation shall terminate in a metal BS31 conduit box fixed to the structure.

Wiring shall terminate in a porcelain connector from which a 3 core 0.75 mm² or 1.00 mm² for 5A and 10A circuits respectively shall be run to the luminaires which shall be supported from the structure directly beneath the box.

f) For wall mounted lighting luminaires connected to concealed cable or conduit systems the conduit or cable installation shall terminate in a recessed junction box accommodating a porcelain connector as described previously, however, the Contractor shall ensure that the junction box employed is small enough to be completely covered by the luminaires.

Luminaires with tube suspensions shall be fitted with non-rigid joints of ball and socket type which shall be independent of the ball joint.

2.47 LAMPHOLDERS

Lampholders for use with tungsten filament lamps (up to 150W) shall be white finish, heat resisting, bayonet cap, to BS5042 or BS5101 as applicable, having a cord grip facility and shade carrier ring when used in conjunction with a flexible cord.

Lampholders incorporated in weatherproof luminaires shall be of porcelain or brass and when of brass shall be effectively bonded.

2.47 LAMPHOLDERS (Contd.)

Unless otherwise specified, lampholders shall be of the types scheduled below:

ELV Lamps	B15 d (Small Bayonet Cap Type)
LV Tungsten Halogen Lamps	Bi-pin to suit specific lamp type
Lamps up to and including 150W	B22 d (Bayonet Cap Type)
200W Lamps	B27 (Edison Screw Type)
300W Lamps and above	E40 (Giant Edison Screw Type)
Fluorescent Tubes	Bi-pin Type

The ES and GES type shall be fitted with porcelain interiors.

Lamp holders shall have HO skirts where used in bathrooms or damp situations.

2.48 LAMPS

All luminaires shall be provided with the appropriate lamps which must suit the supply voltage.

Fluorescent lamps shall be of the colours specified.

Tungsten lamps shall be of the pearl type and for 100 watt rating and below shall be of be the coiled coil pattern. Tungsten lamps above 150 watts shall be of the clear type.

Unless otherwise specified lamps shall comply with the following British Standards:

Tungsten Lamps	BS161 or BS6179
Fluorescent Lamps	BS1853
High Pressure - Mercury Lamps	BS3677
Low Pressure - Sodium Lamps	BS3767

2.49 LIGHTING SWITCHES

Switches shall comply with BS3676. Flush mounting switches shall be rated as specified and mounted in pressed steel boxes with cover plates, as specified.

Unless otherwise specified, switches shall be fitted in boxes with adjustable grids and fixing flanges to allow for variations in the thickness of building finish. Grids and boxes shall be fitted with protective conductor terminals which shall be bonded using insulated circuit protective conductors of equal size to the maximum CPC present at the switch position.

Where more than one phase is brought into a switch box segregation shall be achieved in accordance with the I.E.E. Wiring Regulations by the provision of steel barriers within the box.

2.49 LIGHTING SWITCHES (Contd.)

Each section shall have its own cover plate with suitable engraving to warn of the maximum voltage present at the switch position.

Multi-gang switch units shall be provided where more than one switch is shown in the same position with each switch arranged to match the relevant positions of the lighting points it controls. Ceiling switches shall be fixed to B.S. conduit boxes using break joint rings. The switches shall be of the undersling type white or ivory coloured having a white operating cord terminating in a white plastic moulding 1.5 m above the floor (to BS3676)

Switches with cord outlets shall be provided with a grommet to BS1767 and a means of anchoring the flexible cord and terminating the circuit protective conductor.

Surface switches shall be of the rating, finish and type specified and shall be mounted in enamelled pressed steel boxes.

Watertight switches shall be to IP44 and mounted in malleable cast iron boxes finished galvanised with spout nipple entries.

The swing of all doors shall be checked on site before finalising any switch positions.

2.50 STREET LIGHTING

General

The installation shall be provided in accordance with the relevant items of the following:

a) Technical Memorandum BE 4/72 (Revised) published by The Department of Transport.

b) The Code of Practice for Electrical Safety Engineering, Recommendations G39 published by The Electricity Council.

Underground Services

All information possessed by the Consulting Engineer regarding the position of existing mains and services will be made available to the Contractor without any guarantee as to its accuracy. The Contractor is in no way relieved of his obligations under the conditions of contract and must make all necessary arrangements and representations with statutory bodies to ensure that no existing mains or services are damaged or interrupted.

Lighting Columns & Brackets

Where hinged columns are specified, they shall be operated on the counter balance principle using a pivot arm and no special equipment shall be required to undertake the raising and lowering operation. The lower part should fit snugly around the main column shaft.

Lighting Columns & Brackets (Contd.)

The securing of the bracket arm to the column shall be positive to ensure that the arm cannot rotate and can be fitted in any one of 4 x 90° positions in relation to the door opening. Bracket fixing screws shall be of stainless steel.

Doors on columns mounted on the outside of parapets on bridges, viaducts, raised walkways, etc. shall be captive. Non-corrodible welded link chain shall be used for this purpose and the column or door shall not be drilled to effect the securing of the chain.

Where columns are mounted on the outside of the parapets, the contractor shall ensure that the door is above the parapet guard rail, etc. and that access shall be available from the deck of the bridge, viaduct, walkway, etc.

All column doors except where captive shall be readily interchangeable amongst similar types of columns.

Columns are to be provided with rot proof, non-hydroscopic wooden back boards not less than 15 mm thick and of sufficient size to accommodate the electrical equipment on such devices so as to permit the cables to be terminated and anchored. The base board is to be positively secured to the column.

Except for post top lanterns, control gear shall be mounted in the base compartment(s). All group A lanterns utilising 135/180 watt SOX Lamps will require remote control gear installed in the base compartment of the column.

Internal Wiring of Columns

The wiring shall be 2.5 mm^2 copper single or multi-core PVC insulation and sheathed and comply with BS6004. The grade shall be 600/1000 volt.

The wiring shall be neat in appearance with sufficient length at termination points for several re-makes. Wiring going up the column shaft shall be clipped to the backboard. Appropriate colour coded cable shall be used. A circular self coloured plastic disc shall be fitted to all backboards with a brass panel pin indicating the outgoing phase of the termination 415V labels shall be attached to all cut-outs housing 3 phases.

Earthing

An earth terminal shall be fitted to the baseboard of each column and the earthing terminals of all equipment shall be bonded together and to the earth terminal. Bare earth conductors shall be sleeved with yellow/green PVC sleeving. The cable armours, earth terminal and column shall be bonded out in 6 mm^2 copper PVC insulated yellow/green cable. The whole of the installation shall be effectively earthed in accordance with BSCP 1013.

Column doors are required to be separately earthed with 6 mm^2 conductor.

Cable Laying

Cables shall be installed in accordance with clause 2.32.

Columns will require one or more 50 mm diameter flexible PVC tubes through the concrete surrounded into the cable slot to facilitate the entry of cables. The concrete shall be Class E.

All columns subject to at works inspection are checked for trueness. Off loading and stacking therefore must be carried out in such a manner that no undue stresses are placed upon the columns. An ample supply of stout wooden battens shall be provided by the Contractor for the purpose of stacking the columns. Stacks of columns shall be staked or otherwise held to prevent collapse. Any column which in the opinion of the Engineer is bent to a greater degree than that allowed for in BE 4/72 shall be replaced by the Contractor at no cost to the Consulting Engineer.

Except in the case of columns with post top lanterns of flange plates, the shaft only shall be erected. After the concrete foundation has had time to set as agreed with the Engineer, brackets, lanterns, control gear, etc. may be fitted.

Flange plates columns shall be carefully lowered onto the prepared foundations and shall be set vertically using galvanised or sheradised steel shims as necessary. Where bolts are cast into the foundation nuts and washers shall be provided. Where expandable type bolts are to be used these are to be provided by the Contractor (normally M24) after consultation with the Engineer. Nuts and bolts shall be tightened to the torque setting as recommended by the manufacturer and approved by the Consulting Engineer. Exposed nuts and/or bolts shall be protected with Denso tape.

The space between the flange plate and foundation base shall be sealed with a suitable mastic compound

The bolts shall be hot dipped galvanised to BS729 or equivalent approved protection, or be manufactured from an approved corrosive resistant material.

The approximate position of the columns are shown on the drawings. Before a column is installed its exact position shall be determined on site in consultation with the Consulting Engineer.

Unless otherwise agreed all single arm columns are to be installed with the door openings facing away from oncoming traffic. The doors on all columns in the central reservation are to face in the same direction along the centre line of the central reserve.

The direction of all hinged columns shall be determined by the Consulting Engineer.

Where detailed in the schedules, columns in the vicinity of overhead lines shall be fitted with 4 No. warning plates as shown on the drawings. Two plates back to back shall be fixed approximately 2.2 m from ground/top of column level. Luminaires shall be by means of stainless steel banding.

Erection of Lanterns

The lantern shall be fixed to the spigot in accordance with the manufacturer's recommendations.

The Contractor shall use a suitable torque wrench to all lantern to spigot luminaries to spigot fixing operations.

The lamp and all parts of the lantern affecting the photometric performance shall be cleaned before the lamp is installed.

The switching operation shall be capable of handling gas discharge lighting having a load up to 1 kW at 0.8 power factor.

The switch on level shall be 70 lux with an on/off ratio of not more than 1:2.

A delay shall be incorporated so that transient variations in ambient illuminations do not cause the lamps to be switched on or off.

In the event of a fault occurring in the photo electric cell circuit it is to fail safe (i.e. the controlled circuits are to switch on).

Underground Cabling

Single phase cables shall be 600/1000V grade two core copper XLPE SWA PVC to BS5467.

Three phase cable shall be 600/1000V grade four core copper XLPE SWA PVC to BS5467.

At feeder pillar positions and gantry intake boxes the cable shall be secured to a gland plate by means of a brass or aluminium glands depending on cable specified complete with earthing tags. The gland body is to be covered with a PVC shroud.

All cables to be B.A.S.E.C. approved.

Link Boxes

Link boxes shall be manufactured from cast iron and supplied with pits pavement frames and locking covers. They shall be suitable for accommodating one incoming and one, two or three outgoing 4 core cables of sizes.

The cover shall have a plate fixed to it engraved "Danger 415V" and the Contractor shall provide and erect a concrete marker post to indicate the position of the link box.

Termination Units

Termination units shall be detailed on the drawings.

Erection of Columns & Bracket Arms

The holes for planted root columns shall be excavated to the depth detailed below. The columns shall be placed in a hole allowing a minimum of 150 mm of clearance all round the base of the column for the full excavation depth. The column shall be surrounded by concrete of radial thickness 150 mm minimum to the depth detailed below:

Mounting Height	Planting Depth	Depth of Concrete	Approximate Volume of Concrete
5 m	800 mm	450 mm	0.068 m^3
8 m	1200 mm	900 mm	0.136 m^3
10 m	1500 mm	1000 mm	0.162 m^3
12 m	1700 mm	1200 mm	0.210 m^3

Each column shall be provided with an 8 mm minimum diameter earthing terminal with two plain washers and nuts all of which shall be of corrosion resistant material. The earthing terminal shall be so positioned as to be readily accessible through the door opening.

Root type steel columns after galvanising shall have that part of the column extending from the butt to 150 m above ground level coated internally and externally with heavy duty black bituminous solution. The coating shall be proceeded by degreasing and pre-treatment of the surface in accordance with the recommendation in CP 231 to ensure adhesion. The thickness of the protective coating shall be not less than 0.25 mm.

Six keys for each different type of door opening shall be provided to the Engineer.

Doors on columns shall be positioned facing opposite to the direction of oncoming traffic.

Cable Joints

Joints shall be made using jointing kits which shall be installed in accordance with the manufacturer's instructions.

Prior to any cable laying, the Contractor shall furnish to the Consulting Engineer evidence of the jointers competence in the use of the adopted cable joint kit. Unless agreed by the Consulting Engineer a record shall be kept to enable cable joints to be identified with the jointer responsible for the work.

Cable joints shall be made where shown in the Contract. The approval of the Consulting Engineer is required for the provision of additional joints and they shall not be provided for cables situated in a duct or trench.

Cable Joints (Contd.)

The Contractor shall notify the Consulting Engineer before jointing commences so that he may have the opportunity of inspecting the whole of the jointing operations. Jointing shall only be carried out when all materials used in the jointing are free from visible signs of moisture and joints must be left protected from the weather during the curing period.

Joints shall be adequately supported at all times. Backfilling shall not take place until the completed joint is in a fit condition to withstand any stresses which may be imposed upon it and has been approved by the Consulting Engineer.

Feeder Pillars

All feeder pillars should be as specified in clause 2.15.

Photo-electric Control Units

All PECUs shall be of the electronic type and be a one or two part unit and comply with BS5972.

Cable Terminations

A suitable street lighting type cut-out as detailed on the drawings, incorporating an earth terminal shall be provided and fitted in the base compartment of each lighting column into which cables are to be terminated.

Termination for armoured cable shall incorporate a method of making off the armour which ensures a permanent earth bond between the cables terminated to the satisfaction of the Engineer. The cable armour shall be bonded to the earth terminal block in each column.

Single phase cut-outs shall be suitable for terminating cables up to 25 mm^2 cross-sectional area and three phase cut-outs shall be suitable for terminating the cables specified.

Each cut-out shall be complete with HRC fuses(s) to BS88 or MCB of the appropriate rating to control the lighting of the column or sign in which the cut-out is fixed, as detailed on the drawings. (Where BS88 fuses are used the unit shall incorporate a lockable safety isolator (L.S.I.) as specified.

Where dissimilar metals are in contact the Contractor shall ensure that the whole area of each contact surface is clean and dry and shall then coat with Densal jointing paste or other similar paste approved by the Engineer.

Cable Joint Installation

Cable joints shall only be installed where called for on the schedules or drawings. Joints between cable drum lengths must be arranged to coincide with a specified joint position.

Cable Joint Installation (Contd.)

Cable joints shall be installed in accordance with the joint kit instructions as specified in clause 2.34. Jointing shall not take place in wet weather conditions unless suitable protection is erected to ensure that moisture cannot enter the joint during the jointing operation or during the setting time for the compound.

Cable joints shall be installed 500 mm below finished ground level on a bed of sand not less that 75 mm deep and covered by a layer of equal depth.

The Contractor shall provided the Engineer with a reasonable opportunity to inspect each joint (a) before the filing compound is inserted into the box, (b) before the joint is buried.

SECTION 2 GENERAL TECHNICAL CLAUSES

PART 13 SOCKET OUTLETS & FUSED CONNECTION UNITS

2.51 INSTALLATION

All socket outlets shall except where stated otherwise for special applications, be 13 amp 3-pin switched type to BS1363 mounted in pressed steel boxes fitted with brass protective conductor terminals. Cover plates shall be as specified and for surface installations the steel boxes shall have an enamel paint finish.

Weatherproof assemblies shall be as specified.

Fused connection units shall be of the same finish and manufacture as the socket outlets and shall be specified in detail elsewhere in this specification.

All socket outlets, spur units, plugs and lighting switches shall be of the same pattern and manufacture.

The Contractor shall show a rate for connection plugs to apparatus supplied by the Client. This rate shall be used in pricing the number of plugs connected.

SECTION 2 GENERAL TECHNICAL CLAUSES

PART 14 SINGLE PHASE & THREE PHASE EQUIPMENT

2.52 GENERAL

Plant not associated with lighting and single phase ring main circuits shall be wired as specified and as shown on the drawings.

SECTION 2 GENERAL TECHNICAL CLAUSES

PART 15 EARTHING, BONDING & PROTECTIVE CONDUCTORS

2.53 GENERAL

Earthing arrangements and protective conductors shall be in accordance with Chapter 54 of the I.E.E. Wiring Regulations.

Main equipotential bonding conductors shall connect all incoming metallic piped services to the main earthing terminal except British Telecom systems.

Main equipotential bonding conductors shall be provided and installed for each installation to connect the following extraneous conductive parts to the main earthing terminal:

a) Main water pipes.

b) Main gas pipes.

c) Other services pipes and ducting.

d) Risers of central heating and air conditioning systems.

e) Exposed metallic parts of the building structure.

f) Lightning protection system (if installed).

g) Functional earthing (data processing equipment, where applicable).

If there is more than one entry of any of the above services into the building, equipotential bonding shall be provided and installed for each entry. The equipotential bonding connection shall be made as near as practical to the point of entry of those services into the building, provided that where there is an insulating section or insert at the point, the connection shall be made to the metal work on the consumer's side of that section of insert. For a gas service, the bonding connection shall be on the consumer's side of the meter, between the meter outlet union and any branch pipework.

Extraneous conductive parts of all other separate metallic services in the building shall be bonded, including central heating, air conditioning and medical gases, etc. and exposed metallic parts of the building fabric.

All metal sinks shall be bonded locally to the sink, to the earthed electrical system and associated pipework. Cabling to be used shall be 4 mm^2, single core, PVC (Cu).

Where necessary, the extraneous conductive parts of exposed metal work shall be connected to circuit protective conductors by local supplementary bonding conductors to maintain an equipotential zone.

2.53 GENERAL (Contd.)

At all main switchgear positions, an earth conductor consisting of copper strip (physical size to be in accordance with the I.E.E. Wiring Regulations) shall be provided and all equipment, including the metal sheath and armouring of cables, metal cases of all switches, distribution fuse boards and metal frames of switch-boards shall be bonded directly to it, using copper strip or cable as appropriate.

All copper strip shall be soft high conductivity copper, untinned except where stated otherwise. The tape shall be fixed by means of purpose made brass or bronze saddles and shall not be drilled for fixings.

Joints shall be made by tinning both pieces before assembly, rivetting with at least two rivets and sweating solid.

Connections to equipment shall be made by tinning the contact area and clamping, or by drilling the tape, tinning the contact area and bolting with high tensile brass bolts, flat washers, nut and lock nuts. If corrosion is possible, then bronze fittings shall be used.

Where fixed externally, run in ground, etc. or where corrosion is likely, the strip shall be PVC sheathed, coloured green and yellow. Where run in earth, the strip shall be laid in sand and protected by cable tiles.

The earth conductor referred to above shall be connected by means of strip or cable to the earth electrode system.

Earthing of sub-main distribution equipment shall be made by means of connections to the sub-main cable. Where this is lead covered and/or armoured, mineral insulated or conduit, the installation is to be carried out in accordance with the relevant clauses of this specification. On test, the earth continuity resistance shall not exceed the value specified in the I.E.E. Wiring Regulations.

Where the electricity supply authority provides an earth terminal or earth cable sheath, the earth conductor shall, with their permission, be connected and bonded to this point.

Where an earth electrode system is specified, it shall, unless otherwise detailed, comprise solid drawn, high conductivity rods in the arrangement specified and to meet site conditions.

Earth electrode rods shall be of proprietary manufacture, 15 mm diameter driven into the ground, to a minimum depth of 2.4 m, made up in sections 1.25 mm long with internal screw and socket joints and fitted with hardened steel tip and driving cap.

Connection to the rod shall be by means of a purpose made clamp and the actual connection shall be made below ground level in a concrete inspection pit having a removable cover.

The earth resistance of the electrode system shall be tested as specified in 2-03(b) by the Electrical Contractor in the presence of the Consulting Engineer.

A removable test link of equivalent cross-section to the earthing conductor and suitably labelled shall be provided inside the building as near as possible to the earth electrode for isolation of this electrode for test purposes.

Where the system of earthing provided is that known as 'protective multiple earthing' (PME), bonding of mechanical services shall be as detailed in accordance with the supply authority's requirements.

In existing buildings, the requirements for bonding mechanical services pipework shall be as detailed in this specification. When altering or extending existing installations, the Electrical Contractor shall ensure that any existing earth system to which he wishes to connect complies with the I.E.E. Wiring Regulations.

If it is found that the system does not comply, the Electrical Contractor shall inform the Consulting Engineer immediately.

All earthing and bonding connections shall be labelled in accordance with I.E.E. Wiring Regulations 514-13.

Unless detailed otherwise, all circuits shall be provided with separate circuit protective conductors of PVC (Cu) cable of cross-sectional area sized in accordance with Table 54G of the I.E.E. Wiring Regulations. The only exception is mineral insulated cables of 10 mm^2 conductors or larger, where the sheath is acceptable.

Where a low voltage switchboard is constructed using 'loose gear', a main earth bar shall be installed at the supply intake position adjacent the switchboard.

The earth bar shall be of high conductivity hard drawn copper bar of cross-sectional area determined by the maximum prospective earth fault current of the incoming supply.

The length of the earth bar shall allow for terminating:

a) The earthing conductor from the Supply Authority earthing terminal.

b) The circuit protective conductors (CPCs) for each of the incoming or outgoing supplies from the switchboard.

c) The 'clean' or 'dedicated' earth CPCs, where applicable.

d) The equipotential bonding conductors.

e) With a spare capacity of 25% for future use.

The earth bar terminations shall consist of suitably drilled and tapped holes to accept brass set screws complete with one brass full nut, one brass half nut and two flat washers.

Each protective conductor connected to the main earth bar shall terminate in a suitably sized copper crimp type lug.

2.53 GENERAL (Contd.)

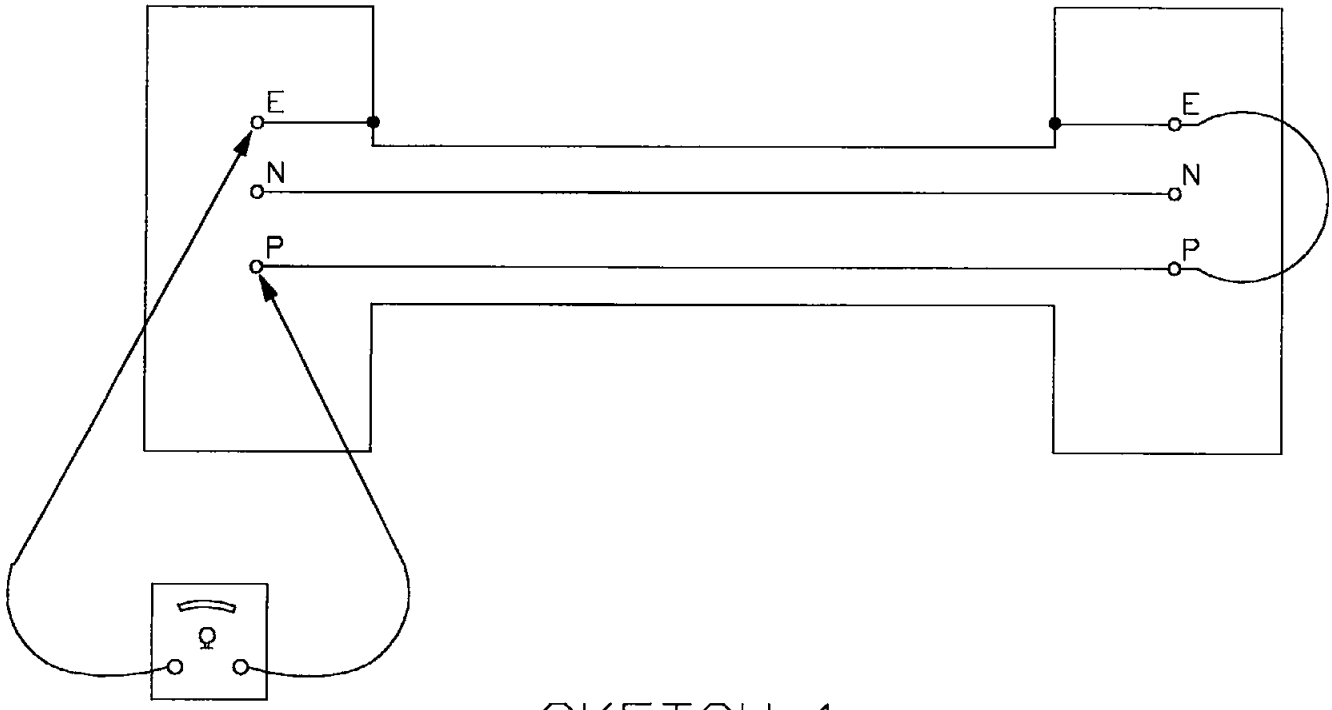
The earth bar shall be mounted on supports as manufactured by MEM Limited, List No.10BM, or other similar approved equivalent.

Where a cubicle type low voltage switchboard is specified, full earth bonding shall be required and an earth bar termination of suitable size provided adjacent each set of air circuit breaker or fuse switch cable connections. In addition, at the incoming supply cable position, the earth bar shall be provided with ten earth terminations of M10 size for the earthing conductor, equipotential bonding conductors and 'clean' or 'dedicated' earth protective conductors.

SECTION 2 GENERAL TECHNICAL CLAUSES

PART 16 APPENDICES

APPENDIX 1 TESTING



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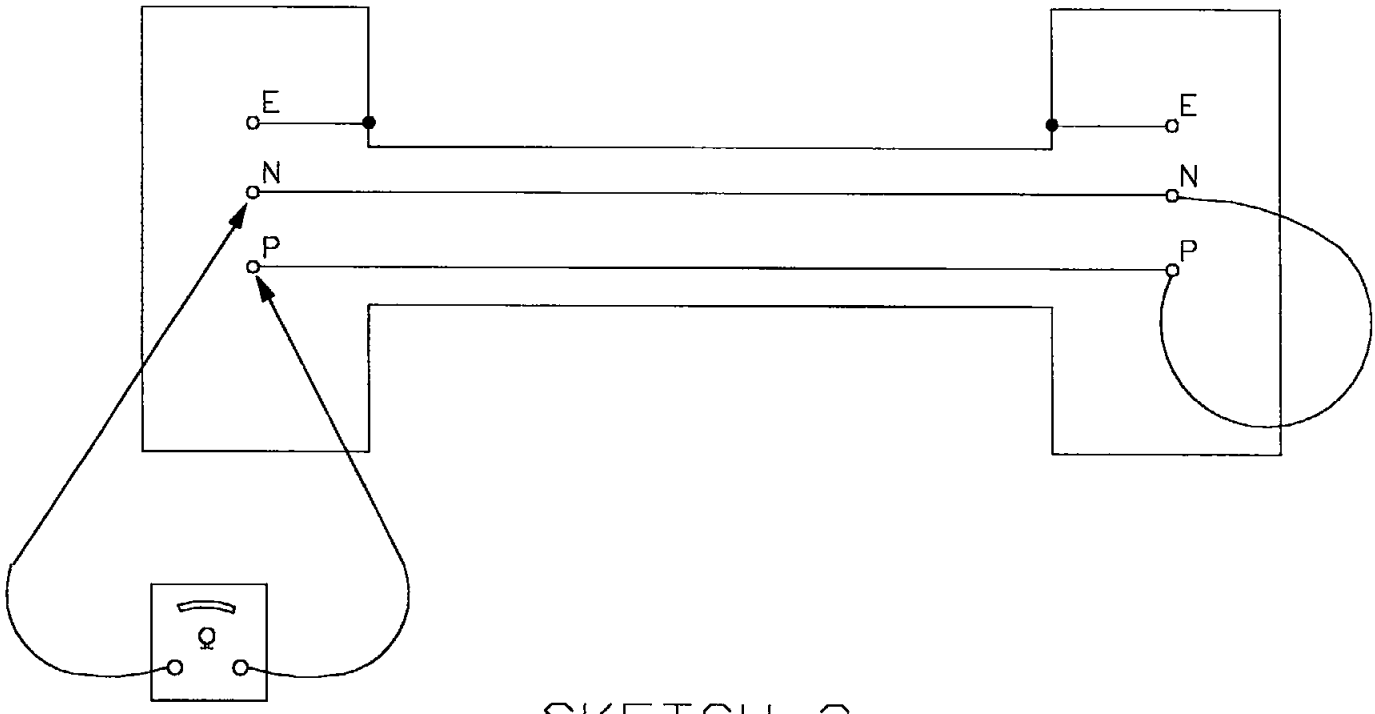

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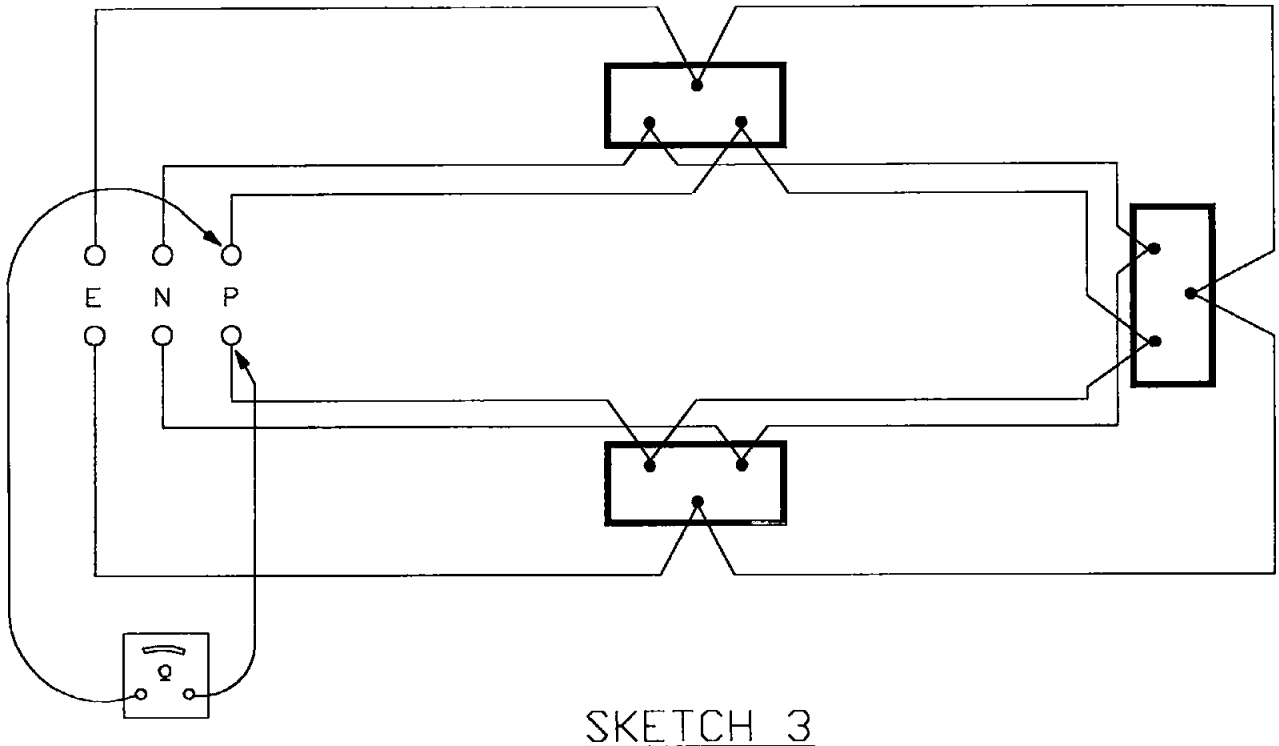

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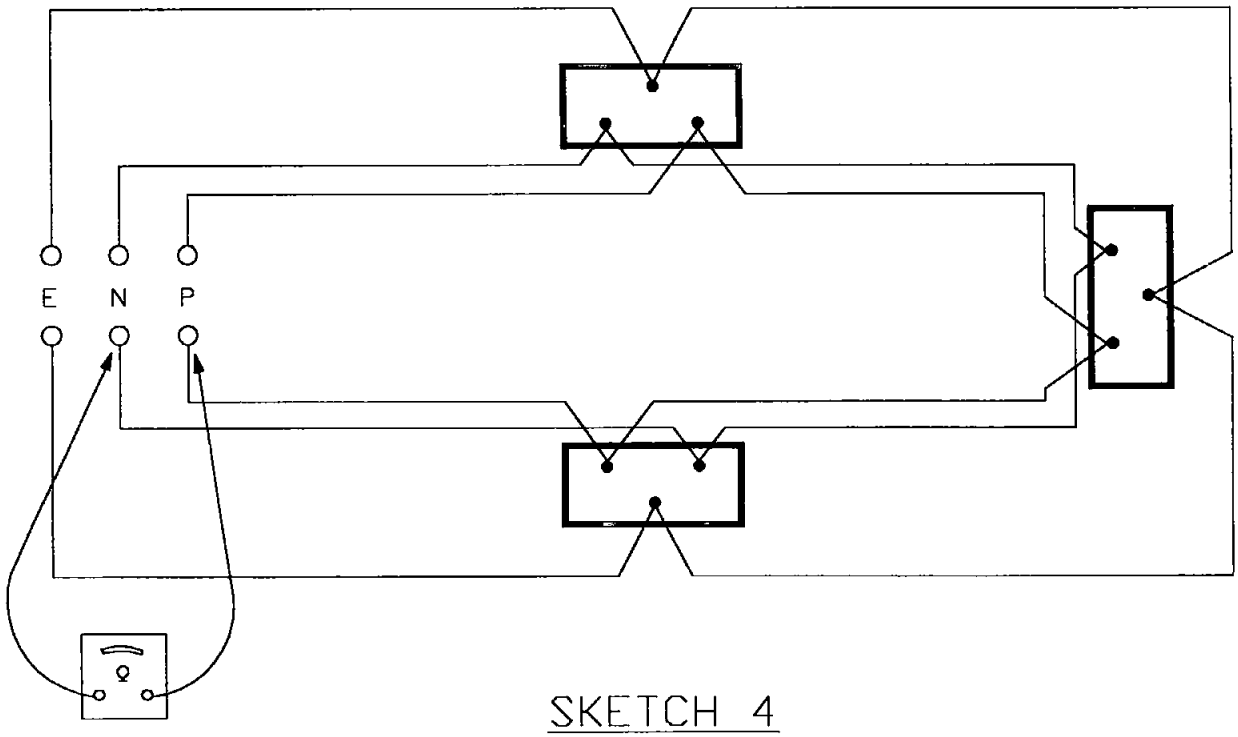

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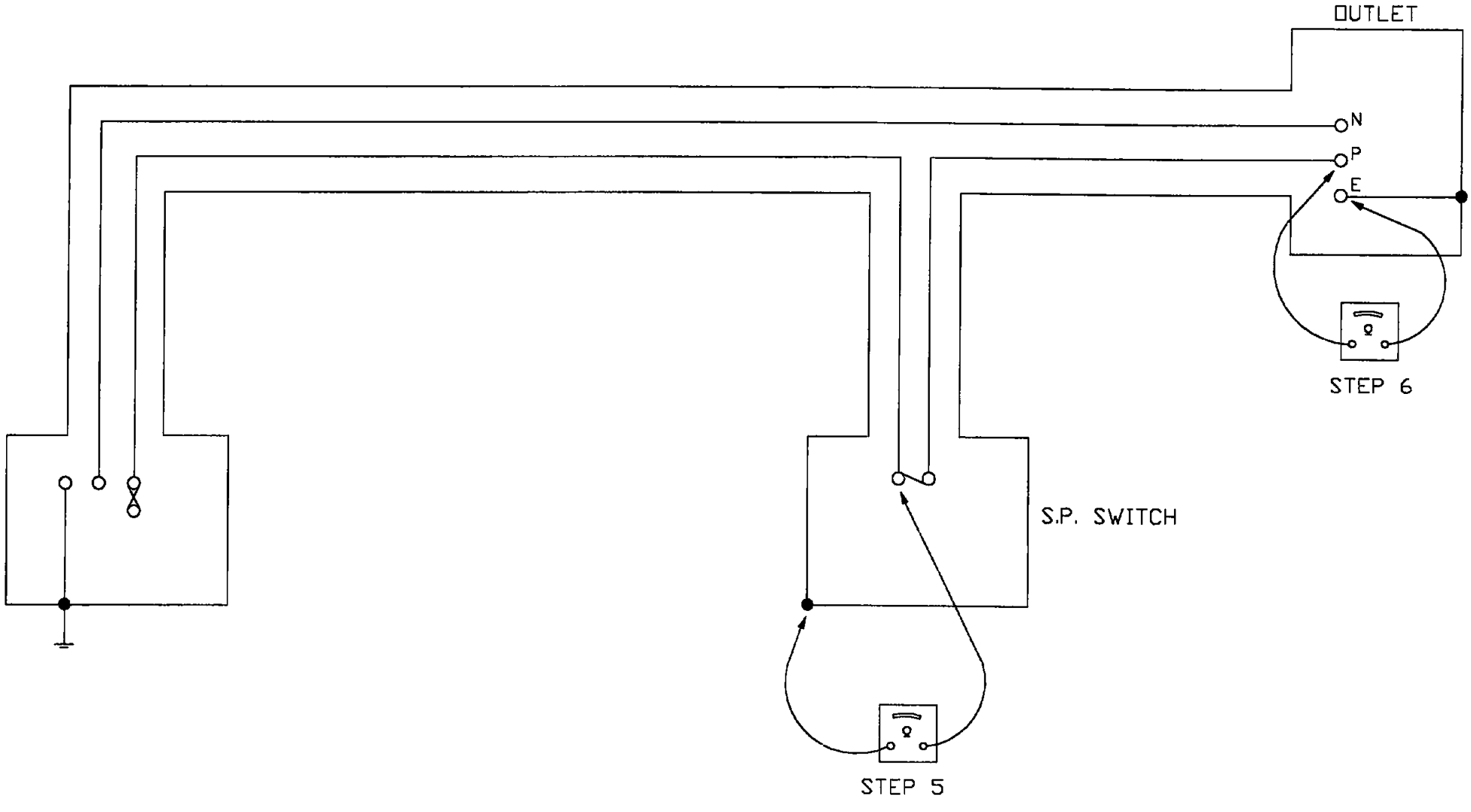

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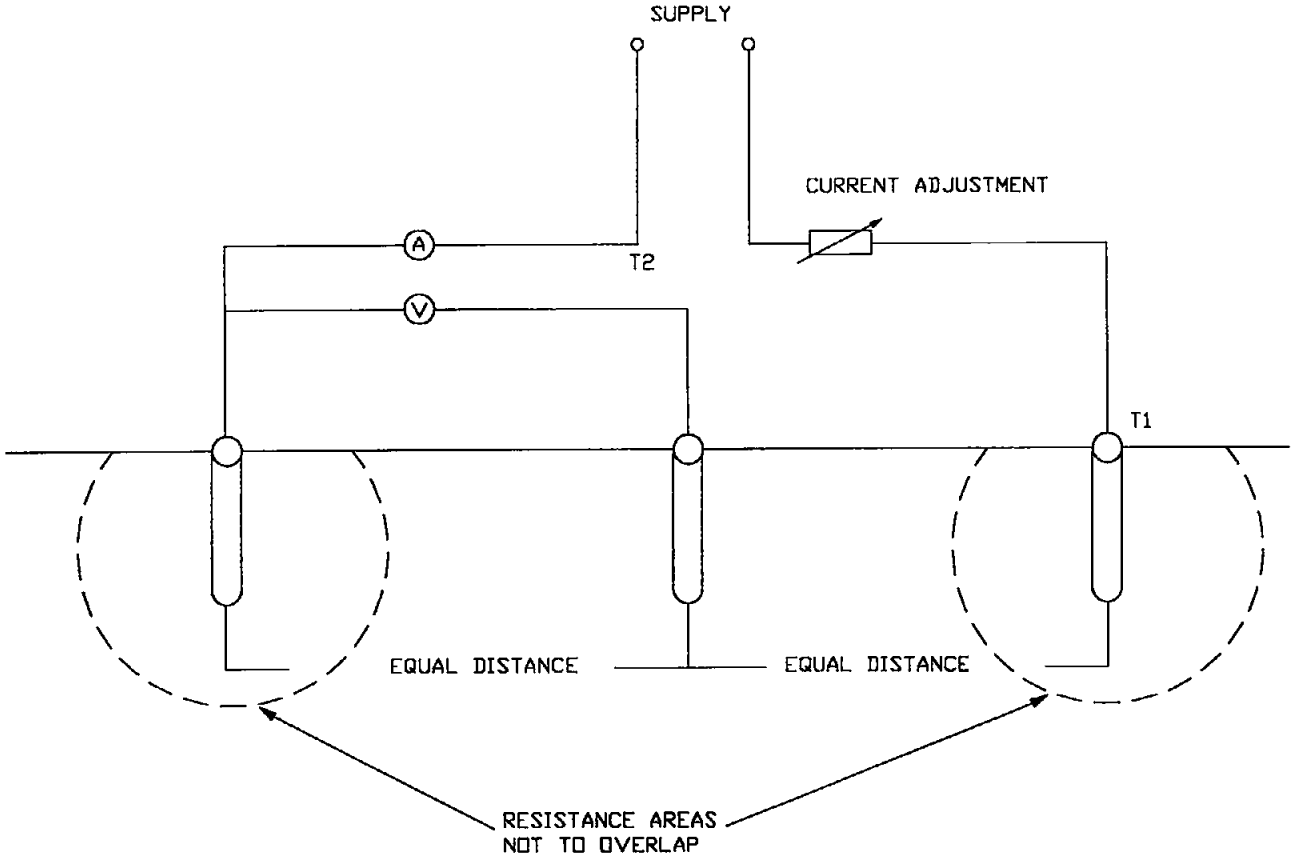

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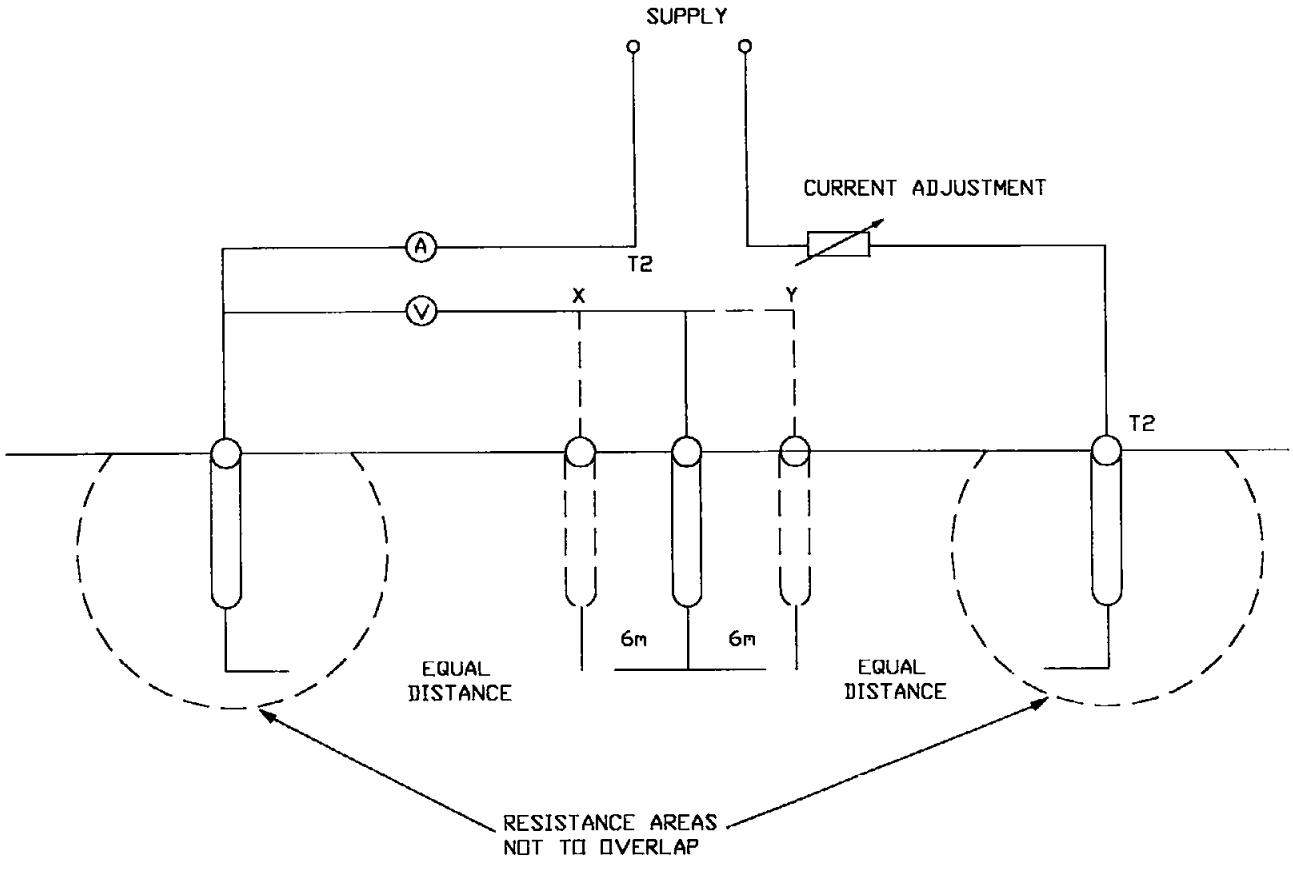

SKETCH 7

PSA WHOLESALE LIMITED

VERNON HOUSE

SICILIAN AVENUE, LONDON WC1

ELECTRICAL ENGINEERING SERVICES

SECTION 3

DETAILED SPECIFICATION

SECTION 3 INDEX

PSA WHOLESALE LIMITED

VERNON HOUSE

SICILIAN AVENUE, LONDON WC1

ELECTRICAL ENGINEERING SERVICES

SECTION 3 DETAILED SPECIFICATION

3.1 GENERAL INFORMATION

3.1.1 Introduction

The work in this contract comprises modifications to the Electrical Installation within the third and fourth floor areas of Vernon House, which are occupied by PSA Wholesale Limited. The works shall include the provision of new lighting and emergency lighting installations, stripping out of redundant elements of the data and telephone installations, and the provision of electrical wiring associated with the installation of a comfort cooling system in the area.

3.1.2 Work to be Carried Out

The Contractor shall provide a complete working installation as detailed in this specification and shown upon the drawings.

3.1.3 Site Visit

The Contractor shall arrange to visit and inspect the existing building and obtain all relevant particulars before completing the tender.

Claims for lack of knowledge in this respect shall not be considered.

3.1.4 Programme

Commencement and completion on site to be agreed with the Main Contractor, in accordance with the Main Contractor's Phase of Works and the phasing requirments of this specification.

The Contractor shall liaise with the Main Contractor and Contract Administrator before carrying out any work on the existing installation, so that all parties are aware of the work involved.

The Contractor shall arrange to visit the site to inspect and familiarise themselves with the existing installation to determine the precise extent of the alterations and extensions to the proposed premises.

The Contractor shall note that any of the above mentioned works which may have to be carried out outside normal working hours shall be included in the tender i.e. overtime or premium time.

3.1.5 Construction (Design & Management) Regulations 1994

The Contractor shall note that this project shall be carried out in accordance with the Health & Safety Executive Construction (Design & Management) Regulations 1994.

The Contractor shall include in the tender for complying with the CDM Regulations 1994 in full and as detailed in the Main Contract Preliminaries.

3.1.6 Builder's Work

The cutting or forming of any holes or trenches and the cutting of chases in walls, floors and ceilings will be carried out by the Main Contractor.

The Contractor shall be responsible for marking out all builder's work required to be completed by the Main Contractor.

All making good and painting will be carried out by the Main Contractor.

3.1.7 Co-ordination

At the commencement of the contract and before installing any equipment, the Contractor is to agree with other trades the routes of cables, trunking etc., in order to avoid friction between the trades.

3.1.8 Building Construction

a) The existing building shall be modified and extended to form the new room layout as shown on the drawings.

b) New suspended ceilings shall be installed with 600 x 600 mm (mineral fibre) removable tiles on an exposed grid system as indicated on the drawings.

c) The walls shall be either plastered or paneled.

d) The floor slab shall generally be as existing and made good where necessary.

3.1.9 Approval of Equipment or Fittings

The Contractor shall submit to the Consulting Engineer for approval, all switches, socket outlets etc., prior to ordering if required.

The Contractor shall ensure of the correctness of all plant and equipment, whether supplied under this contract or not, before such plant or equipment is connected to the installation covered by this contract.

3.1.10 Compliance with Regulations

The complete installation shall comply strictly in accordance with relevant British Standard and General Technical Clauses detailed in Section 2 of this specification.

3.1.11 Stripping Out

The Contractor shall allow for completely stripping out and removing from site any redundant equipment, and shall arrange to visit the site to determine the full extent of stripping out before submitting the tender. Claims will not be accepted for lack of knowledge in this respect.

3.1.12 Maintenance of Existing Installation

The Contractor shall note that the building will generally be occupied and in full operation throughout the works. He shall thus allow for maintaining all electrical services in operation during working hours. All change-overs, or shutdowns to electrical services which may affect any operational part of the building shall be planned to take place outside of normal working hours. All such occurances shall be shown on the Contractors programme and shall be agreed in writing, two weeks (minimum) in advance with the Consulting Engineer.

In the first week of the Contract the Contractor shall carry out a detailed survey of the electrical installation within the contract area. All electrical services which pass through the contract area, which originate within it and serve areas beyond its boundaries, or which serve areas beyond the immediate working area, shall be maintained in full operation throughout the contract period. The Contractor shall allow for all works, including temporary services, as required in order to meet this requirement.

3.1.13 Type of Installation

a) The general lighting installation shall be carried out by re-using, and modifying the existing wiring system and steel conduits. New wiring shall be provided, as required, while the conduit system shall also be extended. The Contractor shall ascertain the extent of the existing conduit and wiring system prior to submitting his tender and shall allow for the modification / extension works.

b) Except for the services cupboards and where stated otherwise, the entire installation shall be concealed in the ceiling spaces and in wall finishes as specified in Section 2.

c) The wiring asociated with the new comfort cooling installation shall be run within the ceiling voids and at roof level using multicore armoured cables, fixed to new, deicated galvanised steel cabletrays.

3.1.13 System of Supply and Metering

The existing single phase, 50Hz supplies to the Tenanted areas shall be retained and re-used. A new three phase supply shall be derived from the existing London Electricity cut out in the basement to provide electrical power for the new comfort cooling installation. The Contractor shall allow for, and carry out, all liaison with London Electrcity, and shall provide all attendance as may be necesary, in order to arrange for the provision of the new supply.

3.1.14 Services

The following services are to be included within this contract:

1. Main switchgear and distribution systems.
2. Lighting installation.
3. Emergency lighting installation.
4. General purpose power.
5. Fire alarm system.
6. Containment systems.
7. Telephone wiring systems.
8. Data wiring systems.
9. Mechanical services installation.
10. Earthing and bonding.
11. 'As installed' drawings.
12. Maintenance manuals.
13. Liaison with PSA Wholesale Limited and their Design Team.
14. Liaison with London Electricity.

PSA WHOLESALE LIMITED

VERNON HOUSE

SICILIAN AVENUE, LONDON WC1

ELECTRICAL ENGINEERING SERVICES

SECTION 3 DETAILED SPECIFICATION

3.2 MAIN SWITCHGEAR AND DISTRIBUTION SYSTEMS

3.2.1 General

The third and fourth floor areas which are to be refurbished shall continue to derive their electrical supplies from the existing electrical cupboards located at either end of the main corridor. At the beginning of the contract the electrical contractor shall fully investigate the nature and function of each circuit fed from each of the existing distribution boards. The existing final services distribution boards which serve the existing areas, shall be stripped out and replaced with new distribution boards fitted with miniature circuit breakers (MCB's) from M.E.M.'s Memshield 2 Range.

The new distribution boards shall be fed from new sub-main cables as indicated on the drawings.

The Contractor shall also supply and install a new three phase distribution board to serve the new air conditioning equipment, located as indicated on the drawings. The new distribution board shall be fed from a new 100 Amp London Electricity supply, derived from the existing service head.

The Contractor shall liaise with London Electrcity to install the new supply and, if necessary, to uprate their fuses in the existing service head. The contractor shall supply and install a new 200 Amp TP&N MEM Glasgow Switched Fuse, fused at 100 Amps, in the basement switchroom and a new multicore armoured cable routed up the electrical riser to the new distribution board.

All unused ways on each distribution board or fuseboard, whether new or existing, shall be fitted with blanks. All distribution boards, whether new or existing, shall be provided with new typed circuit identification charts on completion by the Contractor.

3.2.2 Sub Mains Cables

The Contractor shall include in his tender for all necessary works, isolation, disconnecting and reconnecting and testing on completion.

All the new sub-main cables shall comply with BS 5467 and BS 6724 and have shaped cores or identified cross sectional areas (including neutral). Cables shall be armoured and have copper conductors. All cables shall be BASEC approved.

Spacing of sub-main and all other cables and services shall be as defined in the relevant Codes of Practice and Section 2 of this specification.

3.2 MAIN SWITCHGEAR AND DISTRIBUTION SYSTEMS (Contd.)

The Contractor shall note that all work which require that electrical services feeding other parts of the building be interrupted shall be carried out outside normal working hours.

The Contractor shall provide precise programme of all such works detailing exactly how the work is to be carried out.

The programme shall be issued to the Contract Administrator for agreement with PSA Wholesale Limited.

The Contractor shall completely remove from site all redundant cables on completion of the works.

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ELECTRICAL ENGINEERING SERVICES

SECTION 3 DETAILED SPECIFICATION

3.3 LIGHTING INSTALLATION

3.3.1 General Lighting Installation

The complete lighting installation as shown on the drawings and Schedules shall be provided by the Contractor. The lighting installation shall, generally, utilise the existing wiring and containment systems which shall be modified and extended by the Contractor, to suit the new installation.

Recessed luminaires shall be installed as specified in Section 2, Clause 2.44 i.e. with wiring system terminating in a 3 pin plug-in type ceiling rose.

From this rose a 3 core, 1mm^2 glass fibre flexible cord shall be run to each fitting.

Surface mounted luminaires with concealed cabling shall be installed, as specified with a box flush with the ceiling.

Wall mounted luminaires with concealed cabling shall be installed as specified in Section 2, Clause 2.44.

For surface installations, the lighting fittings shall be installed generally as in Section 2, Method (v).

In areas with suspended ceiling the new luminaires shall be suspended from the ceiling systems. All new luminaires shall thus be complete with the relevent suspension accessories, suitable for the ceiling type. The Contractor shall pass to the Main Contractor full details of the luminaires so that the ceiling and its suspension systems may be designed and installed to carry the additional weight.

Lighting switches shall be provided as previously described in Section 2 and shall be MK 20A rated grid mounted type, with Logic plus white PVC cover plates.

The Contractor shall include in the tender for engraving all multigang lighting switch plates to indicate which area of lighting they control.

3.3.2 Luminaires

Luminaires shall be as detailed in the schedule of luminaires in Section 4 of this specification.

ELECTRICAL ENGINEERING SERVICES

SECTION 3 DETAILED SPECIFICATION

3.4 EMERGENCY LIGHTING INSTALLATION

The Contractor shall supply and install a complete emergency lighting system in accordance with BS 5266 Part 1 1988, as shown upon the drawings and described as follows.

Self Contained emergency luminaires shall be provided on escape routes, mounted surface fixed under the suspended ceiling, as indicated on the drawings.

These shall comprise of self contained emergency inverter units with a standby period of 3 hours.

The emergency luminaires shall be wired from the live side of the local lighting circuits. The Contractor shall supply and install a 20A double pole key switch test facility mounted on the adjacent grid switch to control each group of emergency lights.

The key switch shall be engraved "Emergency Light Test". All wiring shall be carried out using 1.5 mm^2 LSF/PVC single core insulated cables in steel conduit/ trunking as per the general lighting system.

The key switch shall be connected so that it isolates the supply to the associated lighting circuit where the emergency lighting fitting is connected.

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VERNON HOUSE

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ELECTRICAL ENGINEERING SERVICES

SECTION 3 DETAILED SPECIFICATION

3.5 GENERAL PURPOSE POWER

The existing general purpose power installation shall be retained and refed from the new lighting abd power distribution boards. Ciruits shall be fed from new miniature circuit breakers, sized in accordance with the requirements of the IEE Wiring Regulations.

All sockets outlets and circuit details shall be shown, in full, on the Contractors Working and As Installed Drawings.

The Contractor shall fully test the complete General Purpose Power installation.

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ELECTRICAL ENGINEERING SERVICES

SECTION 3 DETAILED SPECIFICATION

3.6 FIRE ALARM SYSTEM

3.6.1 General

The existing fire alarm system shall be retained and re-used.

Full details of the installation in the Contract area shall be shown on the Contractors As-Installed drawings.

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SECTION 3 DETAILED SPECIFICATION

3.7 CONTAINMENT SYSTEMS

3.7.1 General

The Contractor shall supply and install containment systems as indicated on the drawings.

These shall include dedicated cable trays for the new Comfort Cooling Installation.

All cabletrays shall be constructed and installed as described in the section 2 of this specification. All bends, tees and sets shall be factory manufactured items. Site fabricated units shall not to the acceptable.

The new cabletrays shall be installed through the ceiling voids in common spaces. The route shown on the drawings is indicative, for tender purposes only. The contractor shall produce working drawings to show his proposed route, fully co-ordinated with the building structure, the mechanical services and the new suspended ceiling.

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ELECTRICAL ENGINEERING SERVICES

SECTION 3 DETAILED SPECIFICATION

3.8 TELEPHONE WIRING SYSTEMS

3.8.1 General

The existing telephone installation shall be retained and re-used. The Contractor shall note that there are a number of redundant telehone outlets and associated wiring within the contract area. He shall allow for liaising with PSA Wholesale limited to determine which of the outlets are redundant and for stripping them out, together with all associated wiring and fixings. These works shall be carried out in the first week of the contract.

The Contractor shall allow for fixing all existing telephone cables, which are to be retained, within the ceiling voids to the structure so as to keep them clear of building works during the contract period.

The Contractor shall show full details of the remaining telephone installation, including the routes of retained and refixed wiring, on his record drawings.

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SECTION 3 DETAILED SPECIFICATION

3.9 DATA WIRING SYSTEMS

3.9.1 General

The existing computer data installation shall be retained and re-used. The Contractor shall note that there are a number of redundant data outlets and associated wiring within the contract area. He shall allow for liaising with PSA Wholesale limited to determine which of the outlets are redundant and for stripping them out, together with all associated wiring and fixings. These works shall be carried out in the first week of the contract.

The Contractor shall allow for fixing all existing data cables, which are to be retained, within the ceiling voids to the structure so as to keep them clear of building works during the contract period.

The Contractor shall show full details of the remaining data installation, including the routes of retained and refixed wiring, on his record drawings.

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SECTION 3 DETAILED SPECIFICATION

3.11 EARTHING AND BONDING

The whole of the installation and all equipment connected thereto shall be effectively earthed and bonded in accordance with the IEE Regulations and as detailed in Section 2 of this specification and indicated on the drawings.

PSA WHOLESALE LIMITED

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SECTION 3 DETAILED SPECIFICATION

3.10 MECHANICAL SERVICES INSTALLATION

The Mechanical Services Contractor shall supply and install the following items of equipment fixed in the positions indicated on the drawings for wiring and connection by the Electrical Contractor.

Air Conditioning Outdoor Units.
Air Conditioning Indoor Units.
Condensate Pumps.

The Mechanical Services Contractor shall hand over the following items for fixing and wiring :

Controllers & Sensors.

All cabling associated with the Mechanical Services Installation shall be multicore armoured types fixed to new, dedicated galvanised steel cabletrays, supplied and installed by the Contractor.

The wiring shall be carried out as detailed upon the drawings.

The Contractor shall liaise with the Mechanical Contractor to determine the exact location of all equipment before cables are installed. All motors and power consuming equipment shall have a suitably rated isolator. All local isolators and control equipment shall be labeled to indicate its function and shall be sutable for the environment in which it is installed.

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SECTION 3 DETAILED SPECIFICATION

3.12 'AS INSTALLED' DRAWINGS

The Contractor shall supply the "As Installed" drawings as detailed in Section 2 of this specification.

The 'As Installed' drawings shall be provided prior to the issue of the Practical Completion Certificate.

The 'As Installed' drawings shall be provided as AutoCad Release 12 .DWG files on 3½ " diskette.

4 No. printed copies of the final drawings to be provided as part of the Operating and Maintenance manuals.

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SECTION 3 DETAILED SPECIFICATION

3.13 MAINTENANCE MANUALS

The Contractor shall supply the maintenance manuals as detailed in Section 2 of the specification.

The Contractor shall note that 4 No. copies of the maintenance manuals are required.

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ELECTRICAL ENGINEERING SERVICES

SECTION 3 DETAILED SPECIFICATION

3.14 LIAISON WITH PSA WHOLSALE LIMITED

The Contractor shall include in his tender for continuous liaison with the the nominated representative of PSA_Wholesale Limited throughout the course of the contract in respect of, but not limited to, the following:

a) Obtaining permits to work.

b) Obtaining hot work permits.

c) Disconnections/break-ins to existing services.

d) Identifying redundant telephone and data outlets.

e) Agreeing detailed phasing of the works.

In respect of the above the Contractor shall note a minimum of 14 days notice is required.

In respect of any disconnection/break-ins to existing services the Contractor shall provide a detailed programme of works at the commencement of the contract together with method statements for the approval of the Consulting Engineer and PSA Wholesale Limited detailing all disconnections and temporary services to be provided to maintain the operation of all services and facilities.

The Contractor shall include in his tender for all works associated with the disconnection of existing services to be carried out, outside normal working hours and then only at a time acceptable to PSA Wholesale Limited.

The Contractor shall include in this tender for temporary services to maintain all areas outside the scope of works where affected by disconnections necessary to carry out the contract.

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ELECTRICAL ENGINEERING SERVICES

SECTION 3 DETAILED SPECIFICATION

3.15 PHASING

The accommodation occupied by the Employer will be in continuous use throughout the period of the contract.

The Electrical Contractor shall allow for continually liaising with the Employer and the Employer's Representative, and for adopting a flexible approach within the sequence of working, as specified and he should note that the works are to be executed in such manner and harmony as to cause the minimum of disturbance and inconvenience to the Employer and those occupying the remainder of the building, and all reasonable precautions shall be taken to this end. The Electrical Contractor shall be deemed to have made due allowance in his rates for carrying out the works in the manner proposed and for payment of all overtime costs, etc. incurred.

The Electrical Contractor shall liaise with the Main Contractor and Contract Administrator before carrying out any work on the existing installation, in order that all parties are aware of the work involved. If any disruption to services is necessary, alternative arrangements should be made to prevent any interruption to the running of adjacent operational areas.

The Electrical Contractor shall be deemed, at tender, to be fully familiar with the works prior to tender, and all works which have to be carried out outside normal working hours shall be included in the tender, i.e. overtime or premium time.

The Electrical Contractor shall arrange to visit site to inspect and familiarise himself with the existing installation to determine the precise extent of the works.

General Notes : All Sections

1. The Electrical Contractor shall refer to all Contract Administrator's and M&E Consulting Engineer's drawings and specifications and include for all works when the works are programmed by the Main Contractor.

2. The Electrical Contractor shall submit precise times and dates of all out of hours work to the Contract Administrator, a minimum of one week's notice being required.

3. It is essential that all rubbish and redundant materials are cleared off site and the area of the works are kept in a clean, tidy and presentable condition at all times for the duration of the works.

4. The Electrical Contractor shall allow for out of hours works to those areas that will cause inconvenience and disruption to the normal operations and activities of the building if they were carried out during normal working hours.

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ELECTRICAL ENGINEERING SERVICES

SECTION 4

SCHEDULES

SECTION 4 INDEX

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ELECTRICAL ENGINEERING SERVICES

Schedule of Drawings

4238/01	Electrical Engineering Services Existing Lighting, FA, Telephone and Data Layout Third Floor - Sicilian House
4238/02	Electrical Engineering Services Existing Lighting, FA, Telephone and Data Layout Fourth Floor - Vernon House
4238/03	Electrical Engineering Services Existing Lighting, FA, Telephone and Data Layout Fourth Floor - Sicilian House
4238/04	Electrical Engineering Services Proposed Lighting Layout Third Floor - Sicilian House
4238/05	Electrical Engineering Services Proposed Lighting Layout Fourth Floor - Vernon House
4238/06	Electrical Engineering Services Proposed Lighting Layout Fourth Floor - Sicilian House
4238/07	Electrical Engineering Services Proposed Wiring for Mechanical Services Layout Third Floor - Sicilian House
4238/08	Electrical Engineering Services Proposed Wiring for Mechanical Services Layout Fourth Floor - Vernon House
4238/09	Electrical Engineering Services Proposed Wiring for Mechanical Services Layout Fourth Floor - Sicilian House
4238/10	Electrical Engineering Services Proposed Wiring for Mechanical Services Layout Roof Level
4238/11	Electrical Engineering Services Schematic Drawings

SCHEDULE OF LUMINAIRES

PSA WHOLESALE LIMITED, VERNON HOUSE
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Code	Type	Details
A	Whitecroft Broadspread Compliance Ref: 600/BRCP/T25/W2.200/S/ 4218/SB/FTB or Thorlux Alterlux Ref: ALT-8138-S or Marlow Integrated Designs MIR60 Ref: MIR60-418 MRL2	600 x 600mm recessed modular fluorescent luminaire with 4 No. 18W linear fluorescent lamps, high power factor switchstart control gear, an LG3 Cat 2 louvre and side arm type supports.
B	Marlin Opaline Ref: 2045 T383 + 2045 ORK	450mm diameter semi recessed luminaire with white body, opal diffuser, 38W 2D lamp and semi recess kit. With high power factor switchstart control gear.
	Menvier Britelite BLN	8W 3 Hour Non-Maintained, surface fixed, self contained emergency luminaire
	Menvier Britelite BLM + LEXLABL	8W 3 Hour Maintained, surface fixed, self contained emergency exit sign with running man legend.

Notes:

1. All fluorescent lamps shall be Halophosphate 'White' 3500K types.

2. All ceiling mounted recessed luminaires shall be designed and manufactured to suit the ceilings in which they are to be installed. The Electrical Contractor shall check types prior to ordering.

3. Luminaire manufacturers and types shall be as detailed above, or equal and approved. Any deviations shall be declared with the tender. If any are not, those detailed in this Schedule will be provided.

4. All luminaires with exception of wall-lights shall have their final connections via plug-in ceiling roses.

5. All opal and prismatic diffusers shall be glass or flame retardant polycarbonate.

6. All fluorescent lamp control gear shall give a lagging power factor of 0.95 or better.

7. All luminaires shall be complete with all accessories, including lamps

8. Luminaires noted "+E" shall be fitted with integral 3 hour, non-maintained battery / charger / inverter packs.

9. Where square or rectangular luminaires are recessed into plasterboard ceilings, the Main Contractor shall provide timber/metal frames around opeings to support the luminaire. The luminaires shall have retractable side arms to support the frames. All other square and rectangular luminaires shall be supported from the structure.

10. Where circular luminaires are recessed into plasterboard or mineral fibre tiled ceilings, plywood backing boards shall be provided by the Main Contractor with cut-outs to match the luminaires. All openings in ceilings shall be properly 'trimmed' by the Main Contractor as directed by the Architect. All other circular luminaires shall be supported from the structure.

11. Where remote emergency inverter packs or remote transformers are required they shall be supported from the main building structure by suitable steel brackets.

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ELECTRICAL ENGINEERING SERVICES

SCHEDULE OF INCLUDED SUMS

The Electrical Contractor shall include in his tender the following sums.

a)	Contingency Sum		£	2,000.00
b)	Provisional Sums		£	
	i)	Temporary Reception Desk	£	1,000.00
	ii)	Upgrade of LEB Fuses	£	500.00
c)	Provisional Day Works			
	i)	Labour : £500.00 + %	£	
	ii)	Materials & Expenses : £500.00 + %	£	
	iii)	Plant : £500.00 + %	£	

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SECTION 5

SUMMARY OF TENDER

PSA WHOLESALE LIMITED

VERNON HOUSE

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ELECTRICAL ENGINEERING SERVICES

SUMMARY OF TENDER : FIXED PRICE

SECTION 1		
Preliminaries		£
SECTION 2		
General Technical Clauses		£
SECTION 3		
Detailed Specification		£
3.1	General Information	£
3.2	Main Switchgear & Distribution Systems	£
3.3	Lighting Installation	£
3.4	Emergency Lighting Installation	£
3.5	General Purpose Power	£
3.6	Fire Alarm System	£
3.7	Containment System	£
3.8	Telephone Wiring Systems	£
3.9	Data Wiring Systems	£
3.10	Mechanical Services Installation	£
3.11	Earthing & Bonding	£
3.12	'As Installed' Drawings	£
3.13	Maintenance Manuals	£
3.14	Liaison with PSA Wholesale Ltd.	£
3.15	Phasing	£
Sub-Total		
Sub-Total (C/F)		£

Sub-Total (B/F)	£	
Add 1/39th Main Contractor's Discount	£	

SECTION 4

Included Sums

a)	Contingency Sum	£	2,000.00
b)	Provisional Sums	£	
	i) Temporary Reception Desk	£	1,000.00
	ii) Upgrade of LEB Fuses	£	500.00
c)	Provisional Day Works		
	i) Labour : £500.00 + %	£	
	ii) Materials & Expenses : £500.00 + %	£	
	iii) Plant : £500.00 + %	£	
TOTAL TENDER SUM		£	

It is a condition of acceptance of tender that the tenderer completes the Summary in a proper manner. The grouping of a number of items into one sum will not be accepted.

DECLARATION

We hereby submit our Fixed Price Summary of Tender, being the sum total for the works defined in the specification and on the drawings.

We have not deviated or alternatively priced, in any way, from the specified articles, nominated suppliers, subcontractors or materials, or the manner in which they are specified to be fixed.

Signed ..... Date .....

For & On Behalf Of .....

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