Communications
Commission
of Kenya

GUIDELINES FOR SUPPLY, INSTALLATION AND MAINTENANCE OF INTERNAL COMMUNICATION INFRASTRUCTURE

CCK 2012

Table of Contents **Page**

FOREWORD

The telecommunications industry has been rapidly developing in the recent past and now plays a critical role in the socio-economic development of the nation.

The phenomenal growth and evolution in modern technology has made it possible for the provision of modern telecommunications facilities and services to the general public much easier and affordable. Along with the array of modern telecommunications services is a host of modern network terminal equipment with features that enable provision of value added services.

Since the liberalization of telecommunications wiring and terminal equipment in 1991, the supply side has been gradually improving towards meeting the diversity of customer' demands for new facilities and services.

The trend of pre-wiring of buildings is also expected to further reduce the time to telecommunications facilities and services. Through the introduction of structured cabling, wiring in buildings has become more convenient because of the use of the same cabling for telephone and data transmission services.

Currently provision of terminal equipment and wiring services is through registered suppliers/contractors. This has enhanced the choice of the end-users in procuring telecommunications services, which in turn has highly stimulated the telecommunications market. The diversity in the provision of customer premises equipment coupled with continuous technological improvement and the competitive environment is considered Ideal for product innovation and general improvement in services delivery to the consumer.

The above notwithstanding there is need to ensure the maintenance of telecommunications network integrity through the processes of equipment type approval, inspection & certification of all telecommunications wiring and terminal equipment installations. Consequently Code of regulations and guidelines has been developed to for the guidance of all the players within the telecommunications industry. The said regulations and guidelines are the subject of this publication.

We take this opportunity to reiterate the commitment of the Communications Commission of Kenya the provision of a wide range of high quality and affordable telecommunications services in Kenya's. Through efficient and enabling regulation and private participation, we believe that the growth in the communications sector will not only be sustainable but will also contribute more effectively to the country's overall development.

Charles J. K. Njoroge
DIRECTOR GENERAL

1. INTRODUCTION

1.1. Preamble

Prior to June 1991, provision of public telecommunication services was the preserve of the defunct Kenya Posts and Telecommunications Corporation (KP&TC). In June 1991, however, the Government through KP&TC set out a 2 phase liberalization process of the "non-strategic" segments of the Telecommunications Network namely; the supply installation & maintenance of telecommunications wiring and supply, install and maintain telecommunications Terminal equipment.
At the time of the establishment of the Communications Commission (CCK) to act as the regulatory authority, there were 483 registered companies dealing with vending, installation, wiring (both external and internal) as well as maintenance of telecommunications wiring and terminal equipment.

With the current fully liberalised telecommunications environment, there are not only numerous licensed telecommunication network operators and services providers but also licensed equipment vendor, contractors and technical personnel. All these players are expected to meet certain basic quality of services standards.

1.2. Standards

As players in the telecommunications sector, the licensed network operators, vendors, contractors and individuals are expected, as provided for in the relevant section of the Kenya Information and Communications Act, 1998, Kenya Communications (Amendment) Act, 2009 and Kenya Communications Regulations, 2001, to observe the prescribed and the universally recognised standards and specifications in order to ensure sustainable development of the sector.

The guidelines prescribed in this document are therefore based on the relevant standards such as those adopted by the International Telecommunication Union (ITU) and the Kenyan Standards. This document should, therefore, be read together with the said standards and in particular the Kenya Standards ref: KS 1588: Part 1, Part 2 and Part 3. Where there is conflict between these guidelines and the Kenyan Standards, the provisions of the Kenyan Standards will prevail.

1.3. Regulations

Being the sector regulatory authority, CCK shall ensure that the players within the sector adhere to the prescribed regulations, standards and specifications. In this respect, therefore, CCK shall among others undertake the following activities: -

i. License and regulate network operators, vendors, contractors, and technical personnel to ensure that all players not only meet the necessary qualifications to provide communications services but also to ensure adherence to high quality standards,

ii. Organise and conduct educational and sensitisation seminars for all the players,

iii. Type-approve all communications equipment for use and sale in the Kenyan market prior to deployment,.

iv. Conduct inspection and certification exercises of completed and commissioned communication installations.

1.4. Scope of this guidelines

In the liberalised environment, CCK expects fair competition to prevail among all Network operators, vendors and contractors, in the following activities:

i. Manufacturing of telecommunications wiring, terminal equipment and accessories.

ii. Marketing, Supply, installation and maintenance of all telecommunications networks, wiring and terminal equipment.

1.5. Business Ethics

All licensed Network Operators, vendors and contractors shall be bound by the rules of fair play and good business ethics.

2. GENERAL INFORMATION ON LICENSING AND AUTHORIZATION

2.1. Introduction

2.1.1. All companies / entities wishing to carry out communications business in Kenya must be licensed or authorised by CCK.

2.1.2. Individuals wishing to carry out installation and/or maintenance of communications wiring and equipment must be licensed by CCK

2.1.3. The categories of Licenses and authorisations will be as per the market structure issued by the Commission from time to time.

2.1.4. A Contractor wishing to carry out any telecommunication wiring installations shall be expected to have the knowledge of this handbook and other related ITU recommendations and Kenya standards

2.2. Requirements and conditions for Licensing as a Contractor

The requirements shall be as set out in the relevant application forms available in the Commission's website (www.cck.go.ke).

The terms and conditions of licensing contractors are as per the provision of; the Kenya Information and Communications Act, 1998, Kenya Communications (Amendment) Act, 2009, the Kenya Communications Regulations, 2001, the licence and other regulations and directives as may be issued from time to time.

2.3. Requirements for Licensing of Technical personnel

The requirements for licensing of technical personnel shall be as set out in the relevant application forms available in the Commission's website (www.cck.go.ke).

2.4. Technical Personnel Licence Classification

See Requirements for Technical personnel in 2.3 above.

3. TYPE APPROVAL

3.1. Introduction

3.1.1. All telecommunications equipment intended for connection to the Public Telecommunication networks must be tested, evaluated and type approved by CCK before sale and/or use.

3.1.2. All radio communications equipment must also be tested evaluated and type approved before they are deployed.

3.1.3. Only duly authorized / licensed Vendors are allowed to market terminal equipment in Kenya. They must also first obtain type approval from the Commission for each model of equipment they intend to market if such model has not previously been Type Approved for marketing by another vendor.

3.1.4. Type Approval shall not be granted to the manufacturer of the equipment unless it is authorized as a vendor by the Commission.

3.1.5. Type approval for marketing purposes is to be done only once for every model of equipment.

3.1.6. Individuals who procure terminals of models that have already been granted Type Approval for marketing are not required to seek further type approval.

3.2. Application for Type Approval

The application procedures and requirements for Type Approval can be obtained from the Commission's website (www.cck.go.ke).

3.3. Type Approval Scenarios

Type approval may be granted either for marketing or individual use. Type Approval consideration applies to the following:

i. Equipment not yet imported.
ii. Equipment held by customs.
iii. Equipment already in the country.
iv. Auctioned Terminal equipment.

3.4. Radio communication Equipment

The use of radio equipment after type approval shall be subject to separate authorisation (frequency licensing) by CCK.

3.5. Provision of After Sales Service by Vendors/Contractors.

3.5.1. Local Office

Licensed Vendor & Contractor are required to maintain a local office from where efficient after sales service shall be provided.

3.5.2. Staff / technical personnel

Licensed Vendors & Contractors are required to have in their establishment, licensed technical personnel commensurate with the category of equipment they deal with in terms of installation and/or maintenance.

3.5.3. Workshop

Licensed Vendors & Contractors are required to have a workshop where repair and maintenance work shall be done. The workshop shall be examined for the following basic requirements:-

- Sufficient space for repair of equipment should include:-
  - Reception office
  - Despatch office
  - Diagnostic Bench
  - Spare Stores
  - Repair Area
  - Working bench equipped with adequate power points
- Relevant tools for trouble-shooting such as multi-meters, oscilloscopes, frequency counters and any other specialised test gear and tools depending on the type of terminal equipment being handled.

3.5.4. Liaison

It will be obligatory for the licensee to liaise with CCK from time to time to ensure that no equipment is advertised in the local media unless they have been type approved by CCK

3.5.5. The Vendor/Contractor shall undertake to:

i. provide efficient after sales service for the equipment supplied.

ii. maintain sufficient stock of spares to guarantee full economic life of the equipment supplied.

3.6. Rights of the Commission

CCK reserves the right to withdraw from use any communications equipment from the public or private networks. The cost of such withdrawal and recovery shall be borne by the vendor or owner of the equipment.

4. INSTALLATION OF CABLES/WIRES

4.1. Introduction

4.1.1. Definition of communications cabling

This refers to cable installation that facilitates access to the communication networks and shall be subject to network operator's / CCK's inspection and acceptance. CCK will certify these installations.

4.1.2. Contractors Requirements

i) The contractor is required to have a valid CCK licence to carry out cabling installations.

ii) The contractor will be free to hire services of any technical personnel licensed by CCK who will supervise the installation work. A contractor is allowed to undertake works commensurate with category/categories the company has been registered for.

4.2. Procedures

a. A subscriber wishing to have wiring done in his premises will be required to enter into a private agreement with any wiring contractor licensed by CCK**.**

b. Any contractor intending to carry out a wiring installation for a client will be required to submit to the Network Operator and/or CCK the under mentioned requirements:

i. Clear drawings on electrical wiring plans for the building.

ii. Wiring drawings for the intended installation which should include:

- All communications points
- Conduits routings and their internal diameter
- Main distribution frame especially in large installations
- Telecommunications cable risers their sizes, and the facilities provided for securing cables where applicable

iii. Copy of cables specifications for all cables to be used

iv. Commencement of work notice duly completed

c. As Regards Wiring Drawings:

i. One copy of the wiring drawings shall be submitted to the Network Operator and/or the Commission where applicable.

ii. The Contractor shall install the wiring in accordance with the wiring drawings and the wiring standards as laid down by CCK and also section 4.3.

iii. On completion of the cabling installation, the Contractor shall submit to the Commission and/or Network Operator where applicable the “Completion of Works Notice" (refer to Chapter 9 for this form). The Contractor shall clearly detail and certify any amendments in the drawing made during implementation.

iv. For all completed wiring installation the network operator and/or the Commission where applicable shall confirm compliance to the wiring standards by physically inspecting the installation.

v. Network Operator’s representative shall inspect the wiring within five (5) working days from the date of receipt of "Completion of Works Notice” form to ensure compliance with the CCK guidelines, regulations and as per the approved drawings.

vi. It is recommended that the licensed engineer/technician who supervised the wiring Installation on behalf of the Contractor accompany the network operator's inspection team while carrying out the commissioning tests.

vii. In case the Inspection Officer finds any defects with the installation, he shall point them out to the Contractor's Engineer or follow it in writing within five (5) working days after the inspection date. Details of the defects and the proposed corrections shall be clearly highlighted.

viii. The Contractor shall be required to rectify the defects within fourteen (14) days from the date of inspection. After the Contractor has rectified the defects, he shall write to the Network Operator to make arrangements for the completed work to be re-inspected. If the Contractor does not rectify the defects within the fourteen (14) days, a fresh "Commencement work Notice" shall be submitted to the Network Operator.

ix. The network operator and the contractor shall on monthly basis separately submit to CCK a Summary of all Completed and Commissioned Wiring Installations carried out by contractors on their network by the use of relevant form

d. Other Requirements:

i) The Network Operator shall maintain clear records of all wiring installation carried out and connected to their network and may be required to avail the records to the Commission when the need arises.

ii) Safety and security for both the wiring and the personnel working around the installation be ensured.

iii) Copies of wiring drawings and the installation particulars shall be safely kept within the premises where the wiring installation has been provided, for easy reference.

4.3. Cabling Instructions

4.3.1. Cabling in buildings

i. General

This Instruction describes the methods to be followed when installing cables in subscriber's premises. It deals with running of cables on walls, across floors, ceilings and recovery of the wiring on cessation of service.

Kenya Standard KS 1588 Parts 1 and 3 provides detailed specification for cabling systems for small office, residential and commercial premises. KS 1588 part 2 provides specifications for telecommunication pathways and spaces for commercial buildings

ii. Selection of Cable Route

Before cabling is commenced the most suitable run for the cable must be carefully selected bearing in mind the following:

- economy in use of cable
- use of existing facilities (e.g. pipes and risers) to conceal cables.
- protection against damage, dampness, heat, corrosion or mechanical injury
- avoidance of contact with electrical wiring or conduits.
- accessibility for maintenance purposes.

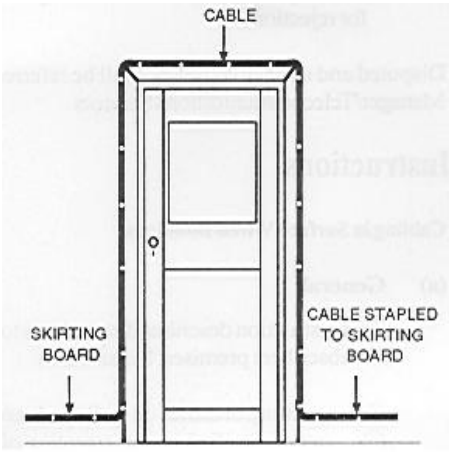
iii. Relations With Subscribers

The subscriber's permission shall be obtained before cabling work is commenced. When it is required to run cables at the back of removable furniture or at the back of shelves, the subscriber should be asked to remove the furniture or any fragile articles resting on the shelves, which would prevent adequate access to the position in which the cable is to be run. If however the removal works is not considerable and there is no danger of damage being caused, the Contractor may move other items. Care must be taken to avoid making walls and paint work dirty. Stepladders must be used where possible. Where a stepladder is unsuitable, a section or sections of an extending ladder may be used provided that the upper ends of the ladder are bound with clean rag to avoid damage to walls and paint work.

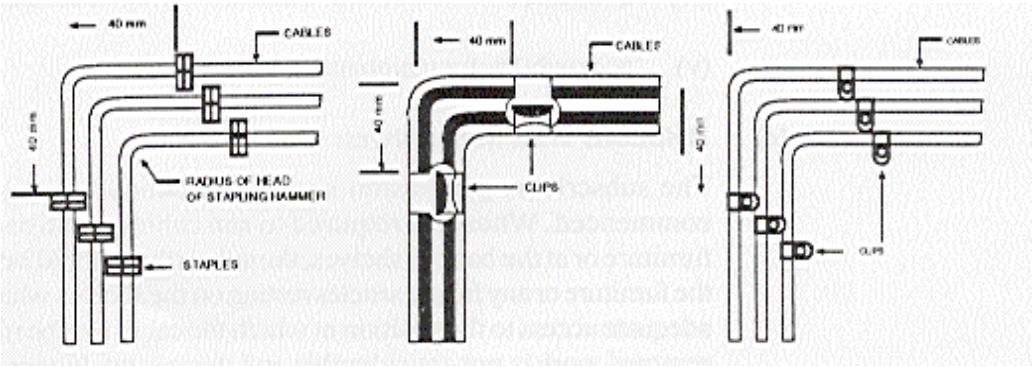
iv. Running of Cables

Cables shall always be run in either a horizontal or vertical direction except when following a special architectural feature. For horizontal runs, a picture rail or skirting board where provided, could be utilised and for vertical runs the most suitable position for the cable is usually the framework of a door or a window, or in the corner of the room. A right-handed person should work from right to left so that the cable can be held taut with the left hand while the staples are driven in with the right hand. It is easier to work downwards on a vertical run rather than upwards. Kinks in the cable can cause breakage of conductors and should be avoided. As the cable is fixed it should be wiped to remove all unwanted bends. The running of cable across ceilings should be avoided except in locations such as store-rooms.

If it is necessary to run two or more cables together they should be run side by side as close to each other as possible and staples or clips should overlap as shown in Fig 4.2. When turning cables through a right angle on a flat surface the head of the stapling hammer should be used to obtain the correct bend in small cables; with larger cables the bend should be of larger radius. When two or more cables running side by side have to be bent through a right angle, the fixings should be staggered so that for each cable they are the same distance from its bend.



(Fig 4.1 – Horizontal and vertical Cable Runs)



(a) (b) (c)

(Fig 4.2 – Stapling around Bends)

v. Use of Clip Wiring

The use of clips wiring should only be adopted where appearance of secondary importance such as in storerooms, factories and workshops, or where frequent wiring changes are anticipated. This method has the advantage that the running, diversion or recovery of cables on the route can be performed with a minimum amount of work.

vi. Use of PVC trunkings

The use of trunkings along the skirting boards, picture rails or along the walls is highly recommended. This way the cables are sealed inside the trunkings and leaves the room smart, telecommunications cables are well separated from power cables and makes the work of tracing faults easier.

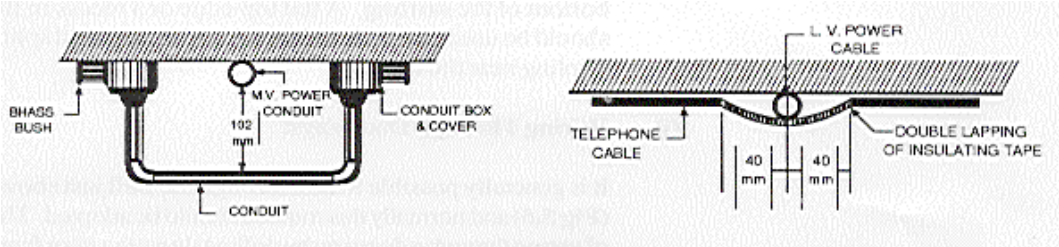
vii. Precautions

It is necessary for the purpose of safety to keep telephone services entirely separate from electricity supply service. Where telephone cables run alongside or cross electric power cables, the following minimum separations must be allowed:

a. High voltage (HV) exceeding 650 volts measured to earth potential: 460 mm from single core HV cable and 300 mm from multi-core HV cable.

b. Medium voltage (MV) exceeding 250 volts and not exceeding 650 volts measured to earth potential: 102 mm. At crossings both the telephone and electricity cables must be in conduit; the conduit for the former is to be insulated from earth and the conduit for the latter is to be suitably earthed

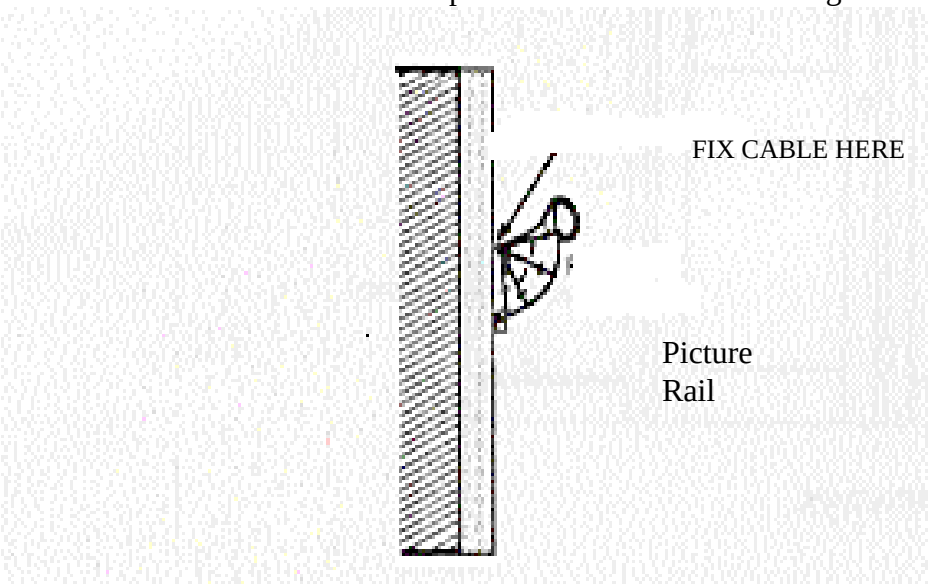
c. Low voltage (LV) not exceeding 250 volts measured to earth potential: 51 mm. At crossings, a double lapping of insulating tape over the telephone cable extending for at least 40 mm from the electric cable must be provided.
d. General information on separation of electricity and telecommunication lines can be obtained in ITU-T Recommendation K.6 and K.19



(**Fig 4.3 – Minimum Power infringement separation)**

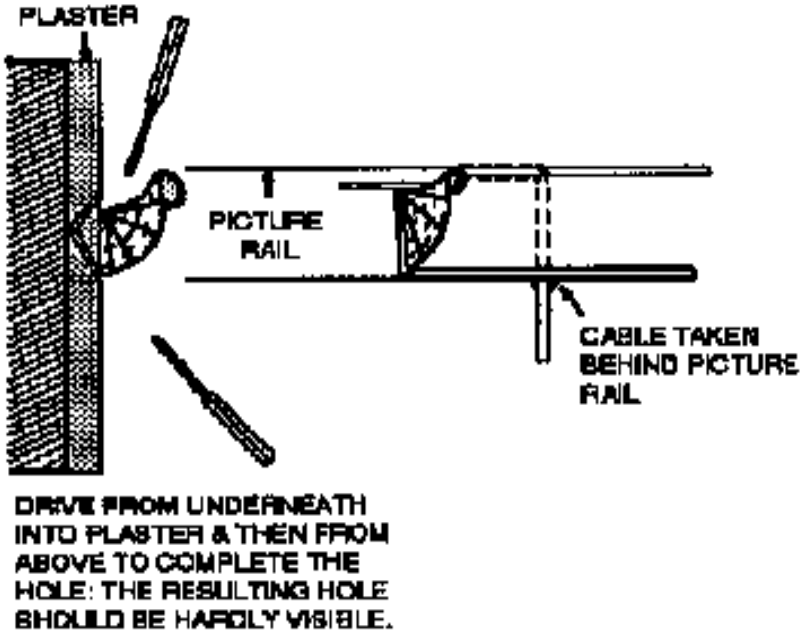
viii. Use of Picture Rails

A picture rail provides an economical means for carrying cable in a horizontal direction round a room or office or along a corridor. . Care should be taken to keep the cable at the back of the picture rails as illustrated in Fig 4.4.



(**Fig 4.4 – Cabling along the picture rails.)**

When leading away from a picture rail in a downward direction the cable should be taken behind the picture rail by making a hole with a raw-plug bit. Fig 4.5 shows how a hole may be driven first upwards from underneath the rail and then downwards from above to join up As little plaster as possible should be removed so that when the cable is run the hole is hardly visible.



(**Fig 4.5 – Cabling behind picture rails.)**

ix. Use of Skirting

a) A skirting board is a useful aid for fixing cables, but extra cable length is involved when it is necessary to pass a doorway.

b) The cable should be run as close as possible to the top of skirting to avoid damage from kicking, cleaning operations and chair legs.

c) It should not be run along the floor at the bottom of the skirting.

d) A flat top edge or a recess in the moulded portion should be used.

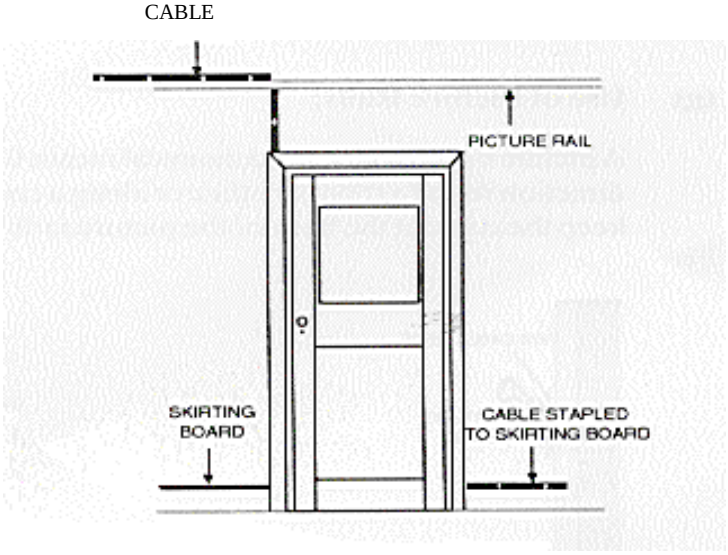
e) Great care should be taken to avoid splitting the wood when stapling near the edge.

x. Wiring Through Doorways

a. It is generally possible to drill through the wall just above the doorway and normally this method should be adopted.

b. The alternative method of wiring through a doorway by drilling through a door frame should be adopted only as a last resort.

c. Never run the cable through the doorway.



(Fig 4.6– Cabling through doorways.)

xi. Wiring Across Floors

a) Cables should be run across floors only when the required position of the telephone is such that no other routing is available for the cable.

b) The cable should be run across the floor to the nearest point to the required telephone position and be protected with the appropriate PVC capping

c) Whenever practicable the cable should be terminated on the telephone block terminal which should be screwed to the floor in a safe position.

d) Where this is not possible and the subscriber agrees to the telephone block terminal being screwed to the desk or table, **a six inch loop of cable** should be left between the floor and the desk, to permit occasional slight movement.

xii. Methods of Fixing Cables

a) Insulated staples should be used when fixing cables of up to 7 mm diameter to any surface to which a secure fixing can be obtained. Whenever possible the staples should be of the same colour as the cable and should be of suitable size.

b) They should be evenly spaced 300 mm to 370 mm apart. The stapling hammer is approximately 300 mm long and can be used as an aid to even spacing of staples

c) Staples should not be driven in too tightly or the insulation on the conductors or sheath may be damaged.

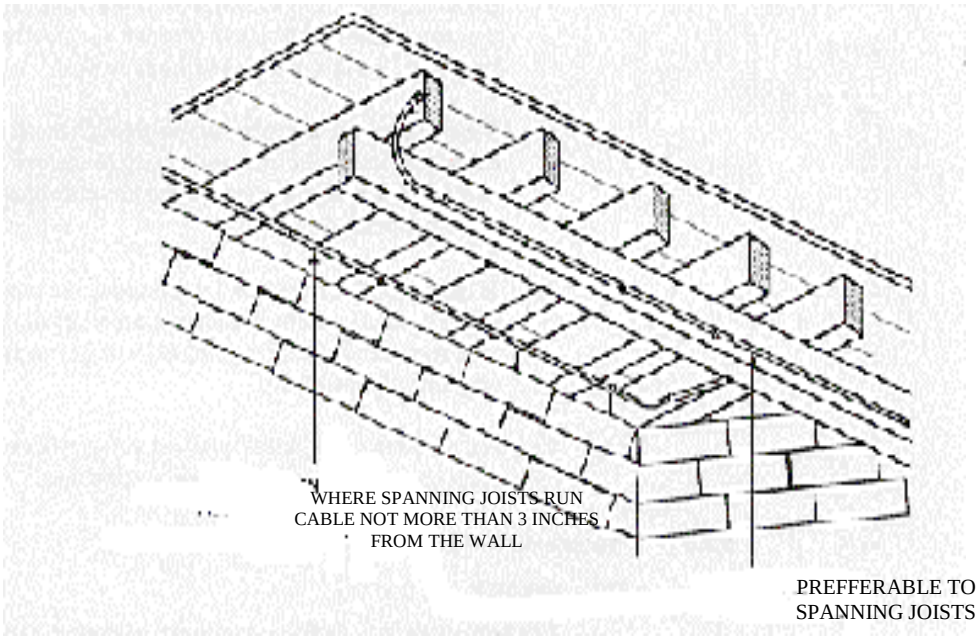
d) Where the use of wiring clips has been adopted they should be fixed steel pins which are available in 5/8" and 7/8" lengths. This slips should be evenly spaced 300 m to 370 mm apart and the cables pulled taut when closing the slip in order to prevent sagging.

xiii. Protection and Concealment of Cables

a) In store rooms, cables should be fixed in a position where it will not be damaged or become inaccessible by the accumulation of stores.

b) Where cables run across ceilings in store rooms, workshops and factories the spanning of open spaces is undesirable but if unavoidable the cables should be run not more than 75 mm from a wall so as to reduce the possibility of mechanical damage.

c) Fig 4.7 shows this together with a preferred method which should be adopted wherever possible.



(Fig 4.7– Spanning Across and Across Joists)

d) In factories and workshops cables should be run well away from machinery and driving belts. Positions where the cable may be subjected to mechanical injury (for instance from moving trolleys) should be avoided by running at a fairly high level.

e) Cables should not be run over ceiling joists when an alternative run is available. Where there is no alternative the cable must not be left loose but must be fixed along the roof beams or joists.

xiv. Recovery of Cabling When a Subscriber's Line is Ceased

When a subscriber's line is ceased the associated cabling is normally left in place. However, if it is the subscriber's wish that the cable be recovered, his request must first be obtained in writing.

xv. Clearing up Before Leaving a Subscriber's Premises

An inspection should be made by the contractor and the client to verify that loose staples and screws are not left about the floor and any dirt or dust which has resulted from work carried out should be cleared up before leaving the premises.

4.3.2. Use of Draw Wires in Telephone Conduits

i. General:

a) Draw wires are normally provided in conduits to be used for telecommunications wiring when a building is being constructed.

b) It is the responsibility of the proprietor to ensure building Contractors provide draw wires where conduits are to be installed for telephone wiring

c) The type of draw wire used will normally be the same as that provided in conduits for electrical wiring.

d) The object of providing draw wires is to assist in drawing telecommunications cables through the conduits already provided. So that additional cables can be provided at a later date. It is essential that the draw wires are replaced in the conduit after use.

ii. To replace the draw wire the following procedures should be followed:

a. Tie the cables to be drawn in firmly to the end of the draw wire.

b. Add an extra wire of adequate length, which will be used to pull the draw wire back into place when the cables have been pulled through the conduit. This can be a wire similar to the draw wire or any suitable steel wire. Tie this wire also to the draw wire.

c. When the cables have been drawn through the conduit, detach the cables and secure the draw wire to additional wire to pull the draw wire back through the conduit and leave the draw wire in place so that it can be used again.

d. In buildings which have multiple rising ducts or conduits, or in case where conduits are difficult to locate, a label should be tied to the draw wire at each end of the run giving information on the floor served and any other relevant details.

e) The procedures above must be followed so that difficulties in pulling telephone cables through conduits can be reduced to a minimum.

4.3.3. Termination of Internal Cables

i) General

This Instruction deals with the termination of internal cables in subscribers' premises with special reference to block terminals, connection boxes, distribution frames and to tag connections.

ii) Connections to Screw Terminals

a. The ends of cables and wires should be made off neatly.

b. The bare ends of the wires should not be longer than necessary.

c. When connecting a screw terminal, the end of the wire should be taken from left

to right round the screw so that the action of screwing up the terminal tends to tighten the wire.

d. Never over-wrap the wires round the screws so that tightening up pulls the wire too close to the screw as this may tend to break the wire.

e. The washer should always be between the head of the screw and the wire.

f. When the terminal has a hole with a screw grip, the wire should be doubled back on itself before being inserted into the hole in the terminal.

g. It is important that screwdrivers are kept in good conditions so that heads of screws are not damaged.

iii) Connections to Soldered Tags using Soldering Iron

a. The essential requirements for a successful operation are a hot, properly tinned bit and a clean surface in the area when the solder is to be applied.

b. Tinning is carried out by heating up the bit, making sure that the bit itself is clean and by applying solder to obtain a uniform coating.

c. When soldering a wire to a tag, the bit should be held at such an angle that the solder flows evenly over the tag and wire

d. When soldering horizontal tags, the bit should be held under the tag to avoid blobs of solder forming underneath it.

e. To avoid damage to the insulation cover of the wire, and insulating material between the tags, too great a heat for too long an application of the soldering iron bit must be avoided.

f. Excessive heating can cause the covering of the wire to run back, thus leaving the conductors exposed and liable to contact with other wires. Care must be taken to avoid damage to adjacent wires and they must be moved clear before the tag is soldered.

iv) Connections. Using Wrapped Joints

a. This technique is a solder-less procedure by which wires can be securely connected to relays or terminal strips. Although currently limited to crossbar exchange wiring, it is likely to be applied progressively to wiring in subscriber's premises, especially at main frames.

b. The most commonly used tool at present is the wire wrapping tool No 1B which is a motor driven tool operating on 240 volts AC. It can be used to wrap wires round any type of shaped terminal.

c. The wrapping bit has two holes; the smaller one is for inserting the wire and the larger one for inserting the terminal.

d. The procedures for use are:

- Insert the wire into the smaller hole for the wrapping bit

- Fit the larger hole over the terminal.

- Pull the trigger of the wrapping tool. The bit is rotated and the wire is wrapped tightly round the terminal.

v) Lacing of Forms:

a. When a cable or cables have to be formed for termination on a switchboard, main distribution frame or distribution case of other similar termination, the individual wires or group of wires should be led out in the required order and the complete form laced with the appropriate lacing twine according to the size of wire in the form.

b. The lacing should be commenced near the butt, one turn being made round the cable at each point at which a wire or group of wires is brought out.

c. If the distance between the points at which the wires are brought out exceeds 25 mm, lacings should be made between these points at approximately 25 mm intervals.

d. The lacings should always be spaced. The knots should be made so that the ends come to come out from under the loop on the opposite side to the knot and the loops should be pulled as reasonably tight as consistent with the neatness. (See figs 4.8 to 4.11 below) Excessively tight lacing may cause damage to the insuration of the wires or cables

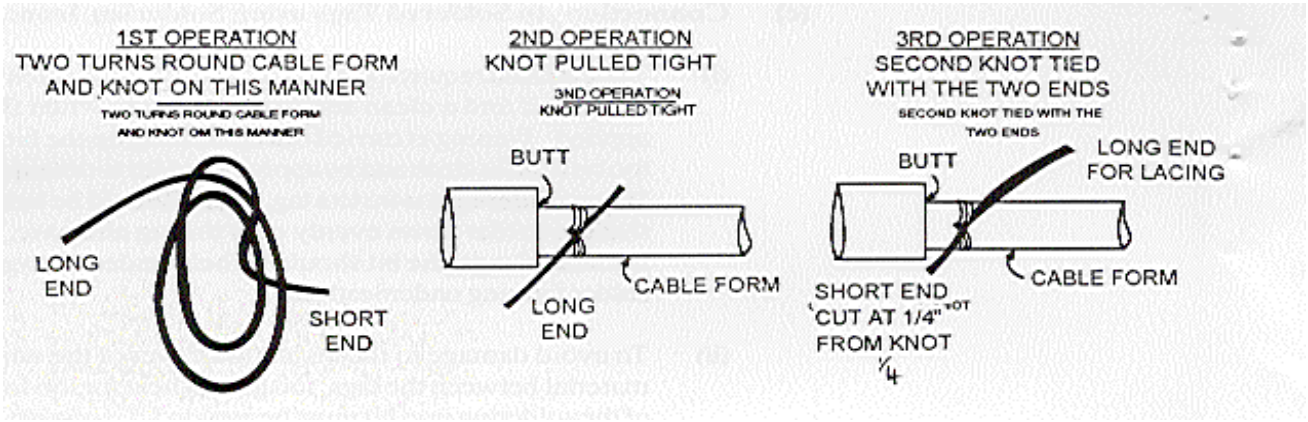
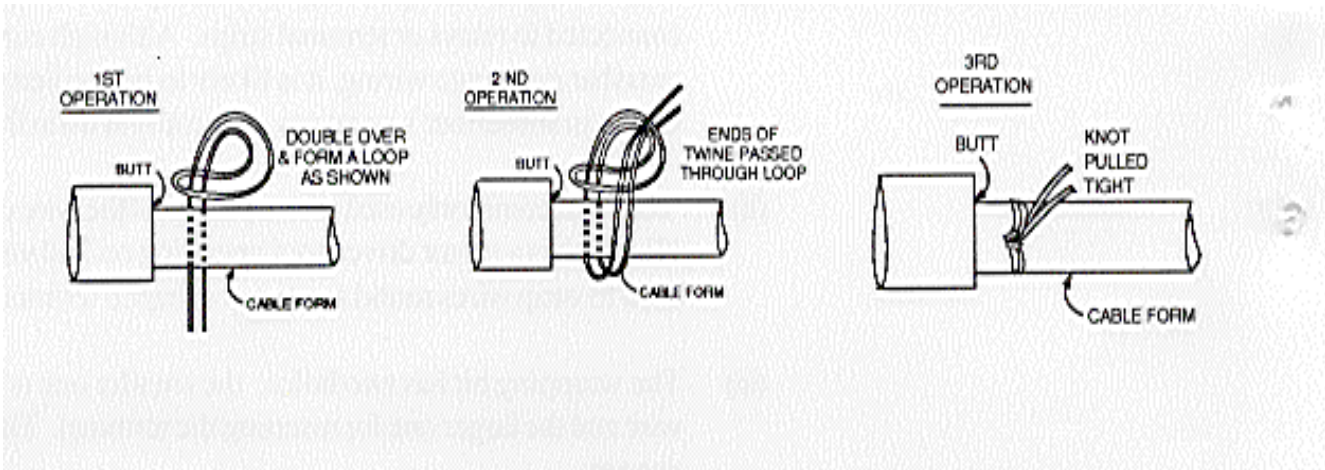
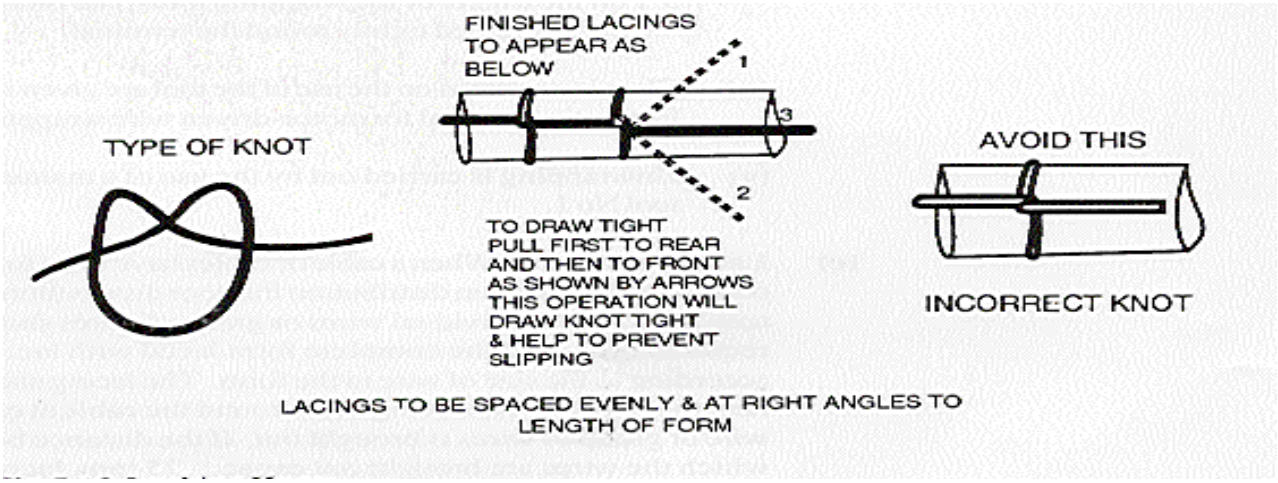


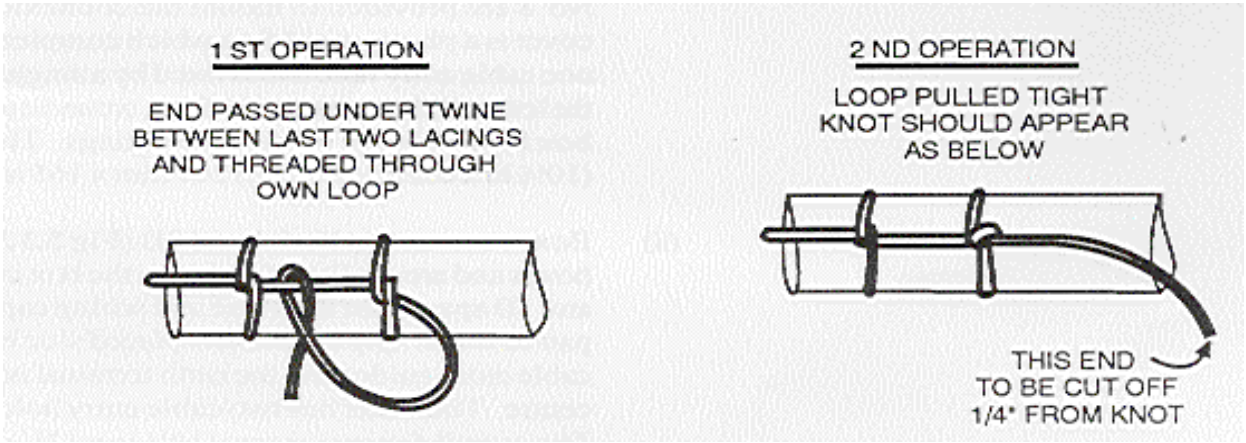
Fig. 4 8 Single twine lacing



(Fig 4.9 Double Twine lacing)



(Fig 4.10 Locking Knots)



(Fig 4.11 Lace Terminations)

4.4. Wiring Accessories

4.4.1. Box Connections

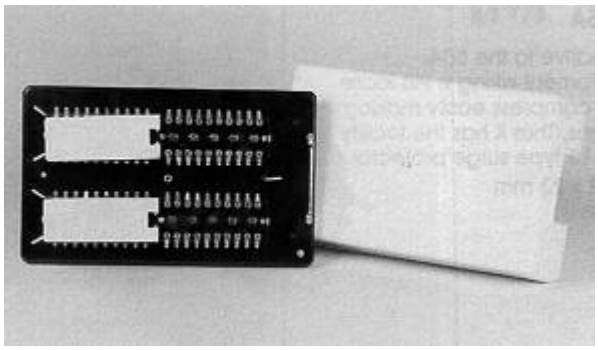
i. General

This instruction describes box connexion (e.g. Nos. 1A, 1B, 2A and 2B) which are used as general purpose terminal blocks or distribution cases in the cabling schemes of large buildings. Box connexion No 1A and 2A are coloured grey and boxes connexion No 1B and 2B are coloured ivory. Apart from colour the boxes are identical.

ii. Description

a. The connexion boxes are available in two sizes: 40 pair and 80 pair, Figs 4.12 and 4.13 show the boxes with covers removed. The terminal strips are of the 10 pair

type used with the Block Terminal, 27.



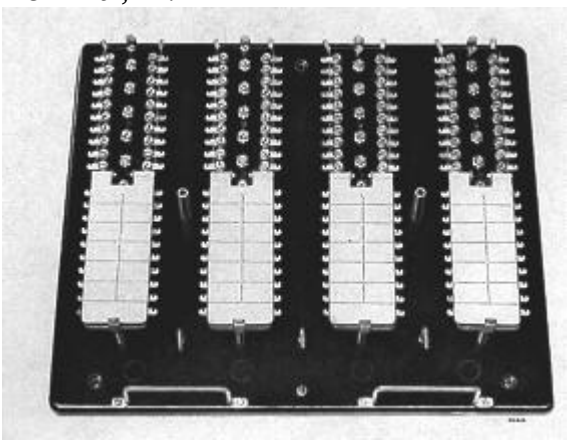


Fig 4.12 Box Connection No 1A and 1B **Fig 4.13 Box Connection No 2A and 2B**

b. Boxes connexion No 1A and 1B (Fig 1). These are 40 pair boxes and consist of four main parts: a base, to pair terminal strip assemblies placed side by side and a cover. Each 20 paid terminal strip assembly consists of two 10 pair terminal strips fitted end to end on a brass bar which serves as the earth common; a metal label, painted matt white, is higher at the centre point of the assembly.

c. The two terminal strip assemblies are fitted to the base with spacing bushes which allow room for the cable form. The base is a black plastic moulding fitted with jumper hooks, a cable entry guide and an earth terminal. The earth terminal (at the lower left hand corner) is commoned at the rear via the spacing bushes to the brass bars of both terminal strip assemblies.

d. Three countersunk holes for screws wood, countersunk head, mild steel. No 8 are provided to mount the connexion box to walls, etc. The cover is a plastic moulding which completely covers the base. It has one cable entry hole and is fixed by a single captive screw, which has the letters GPO in monogram form, around it to distinguish the connexion box from those of other undertakings. The overall dimensions are (10½ in x 6½ in x 2 5/8 in) 267 mm x 165 mm x 67 mm.

e. Boxes connexion No 2A and 2B (Fig 4.13). These are 80 pair boxes and are similar in design to the box connexion No 1A and 1B and 1B apart from their size and wiring capacity: they have four 20 pair terminal strip assemblies placed side by side.

f. The base has two cable entry guides and the earth terminal is situated at the lower centre. The cover has two cable entry holes and two fixing screws. The overall dimensions are (10½ in x 12¼ in x 2 5/8 in) 267 mm x 311 mm x 67 mm.

iii. Mounting

Each type of connexion box is fitted to the wall by three wood screws No 8. If the central screw at the top is fitted first it will take the weight of the box while the other two screw holes are marked.

iv. Terminal Numbering

Both sizes of connexion box may be used either as a terminal block or as a distribution

point with cross-connecting facilities, and the terminal numbering is varied to suit each particular application.

v. Terminal Block:

When used as a terminal block the terminals are numbered in relation to the incoming cable as shown in Fig 5.14 odd numbers down the left hand side of the terminal strip and even numbers down the right hand side.

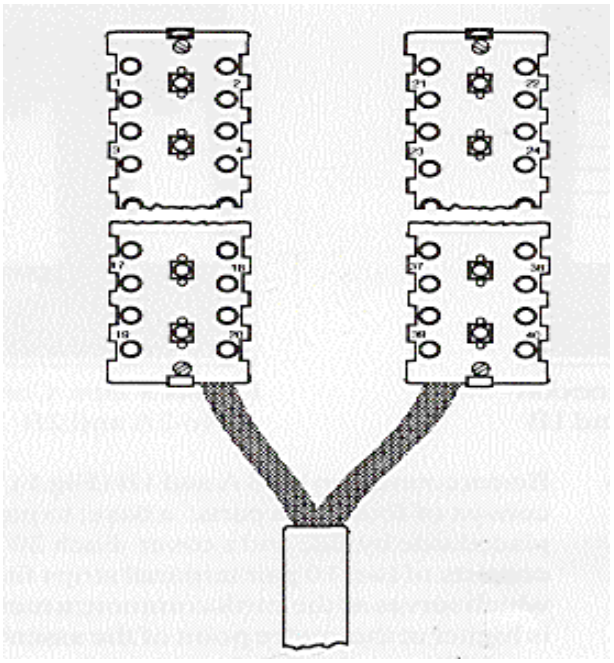
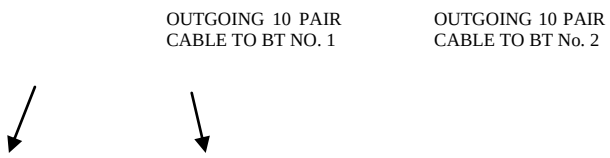


Fig 4.14 Terminal Block Numbering

vi. Distribution Point:

When used as a distribution point the numbering to be adopted is shown in Fig 4.14. The terminals associated with the incoming cables are numbered down the left hand side of the terminal **strip** and those associated with the outgoing cables numbered down the right hand side.*This method of numbering allows simple direct jumpers to be used as described in 4.4.2(f).



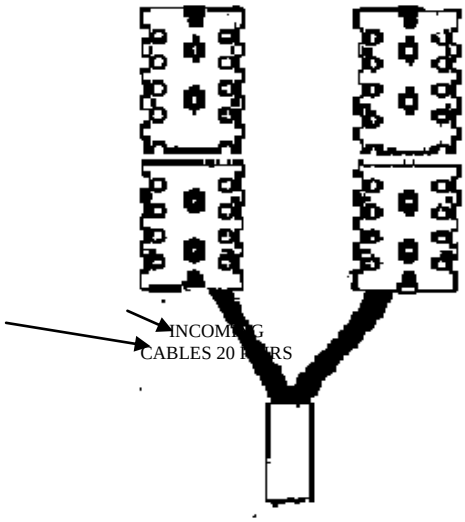


Fig 4.15 Distribution Point Numbering

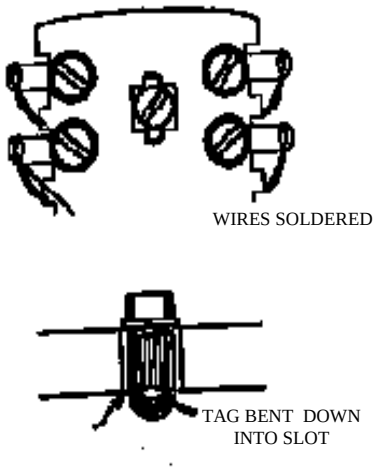
The method of wiring depends on whether the box is used as a terminal block or as a distribution point.

vii. Wiring as a terminal block:

a. The incoming cable(s) are formed out in the order of terminal numbering described in 5.4.2(d)(i) and tied to the terminal strip assembly fixing posts for support. The wires are soldered to the tags which are then bent down into the slot in the side of the terminal strips as shown in Fig 4.16. This prevents the tags from rotating when screwed connexions are subsequently made to the line terminals and also protects the wiring and improves its appearance.

b. The outgoing cables whether two wire, three wire or otherwise should be screw-connected to the line terminals as shown in Fig 4.17. When the third wire or a three wire cable is used as an earth connexion (which is usual it should be connected to the appropriate earth terminal adjacent to the line terminal.

c. Both the incoming and outgoing cables are formed out in the order described in 4.4.1(vii) (a) and shown in Fig.4.16 The wires are soldered and the tags bent down into the slots as described in (a).



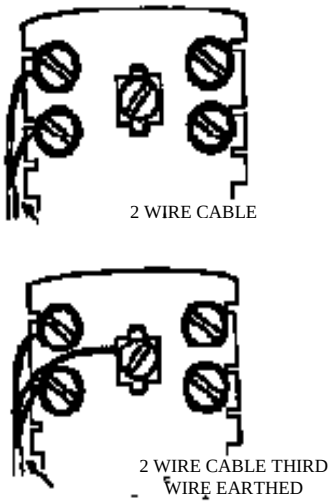


Fig 4.16 Bending Tags into Slots **Fig 4.17 Screw Connection**

Wiring as a distribution point:

viii. **Cross-connexion Facilities**

a) When a connexion box is wired as a distribution point, full flexibility between the incoming and outgoing cables is provided by jumper wiring, but the capacity of the box is halved, e.g. the box connexion No 2A or 2B then has 40 pairs in and 40 pairs out.

b) The terminal numbering allows the use of short direct jumpers across the terminal strip, e.g. in Fig.4.15 incoming pair 1 can be joined by direct jumper to outgoing pair 1 of terminal block 1 and similarly incoming pair 11 to outgoing pair 1 of terminal block 2. When it is not possible to use direct jumpers in the manner described the cross-connexion should be via the jumper hooks.

c) To keep the bulk of wiring in the jumper field to a minimum, wire PVC, No 3, 1 pair 6½, blue and blue/white or, if available, scrap lengths of cable, PVC No 1 with the sheath removed, should be used for jumper wiring.

ix. **Labelling**

a) The hinged label shown in Fig 4.18 is divided into rectangular panels with the centre line terminated in an arrow ahead. It can be secured in either the upper or lower position by small metal clips fixed at each of the terminal strip assemblies.

b) When the label is clipped in the upper position the arrow head points down indicating that the information shown refers to the lower half of the terminal strip. conversely, when the label is clipped in the lower position the information shown refers to the upper half of the terminal strip.

c) Circuit designations, eg exchange line, extension, private wire numbers, should be recorded on the label when the connexion box is used as a terminal block and incoming pair numbers and distant terminal block paid numbers when it is used as a distribution point.

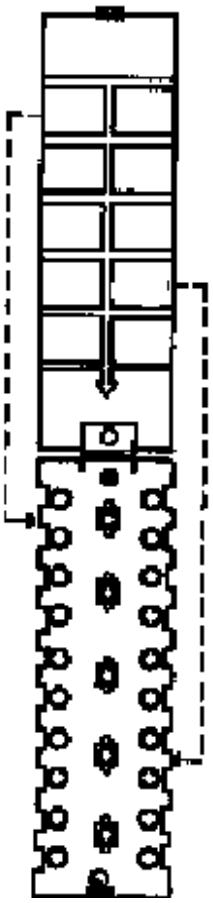


Fig 4.18 Hinged Label

4.4.2. **Box Connection**

i. **General**

Box connection (e.g. No 301A) krone type which excels in features and facilities, is equipped with the necessary fittings and is recommended for use as a Main Distribution Frame (MDF) or a Distribution Point (DP) for external and internal cable terminations. It may also be used as discase for wiring and PBX extensions.

Photographs 4.1 to 4.8 show various views and sections of box connection No 301A.

ii. Fittings

a. These consist of back mount frame with hole patterns, earth connection and ten pair modules each consisting of ten incoming and ten outgoing pairs with built in jumper rings on each side and cable form holder at its back.

b. A complete box connection No 301A has a capacity for one hundred incoming and one hundred outgoing pairs making a total of two hundred terminations.

c. Box connection No 301A is superior to the existing box connections because of the added three point ten pair protection magazine (earth module) whose nominal operating voltage is 230V with a tolerance range of ±20%.
The cover is grey in colour with two built in screws.

iii. Mounting

The box connection No 301A is always mounted on a wall in suitable positions specially selected and designed for easy access, wiring and maintenance. There are four holes designed for the mounting screws. More than one box connection No 301A may, depending on purpose and facilities required, be fitted vertically or horizontally adjacent to each other. The cover sides are removable for interconnecting to suit the purpose intended.

iv. Terminal Wiring on Modules

Terminal wiring modules are numbered horizontally from left to right in rows of ten pairs.

v. Terminations

The cable pairs starting from the top module and for identification purposes are first properly formed, laced and passed through the built in jumper ring of each module.
Termination is done by means of a special krone type Insertion tool.

vi. Cross Connection

Cross connection is done by jumper wires using the krone type insertion tool through the built in jumper rings.

vii. **Flexibility**

Flexibility is achieved by means of jumpering between the incoming and outgoing pairs or cables.

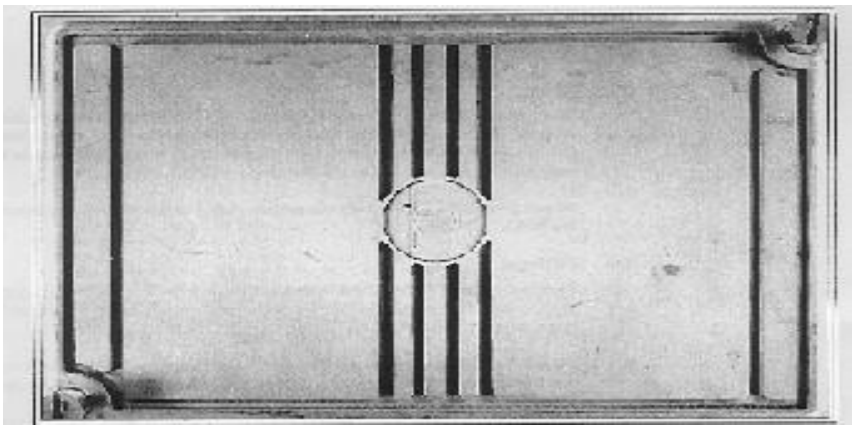


Photo 4.1 Front view

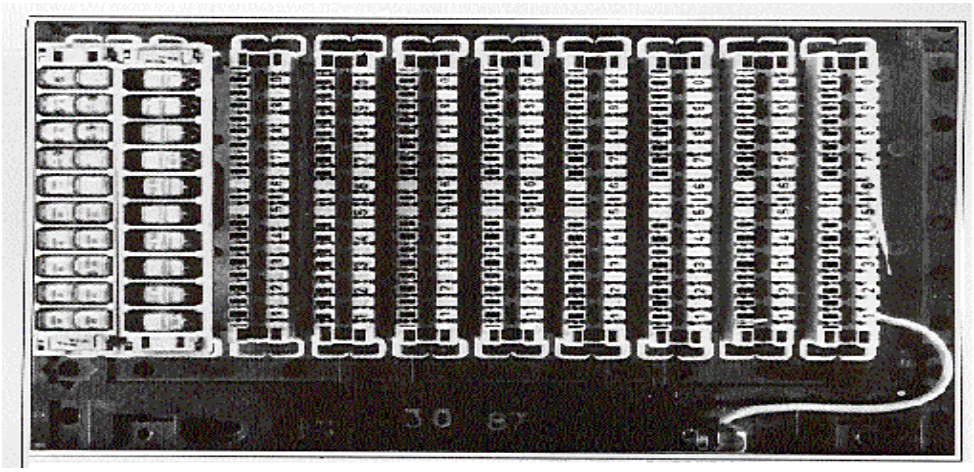


Photo 4.2 Front View of a Fully Equipped Box Connection With Cover Removed

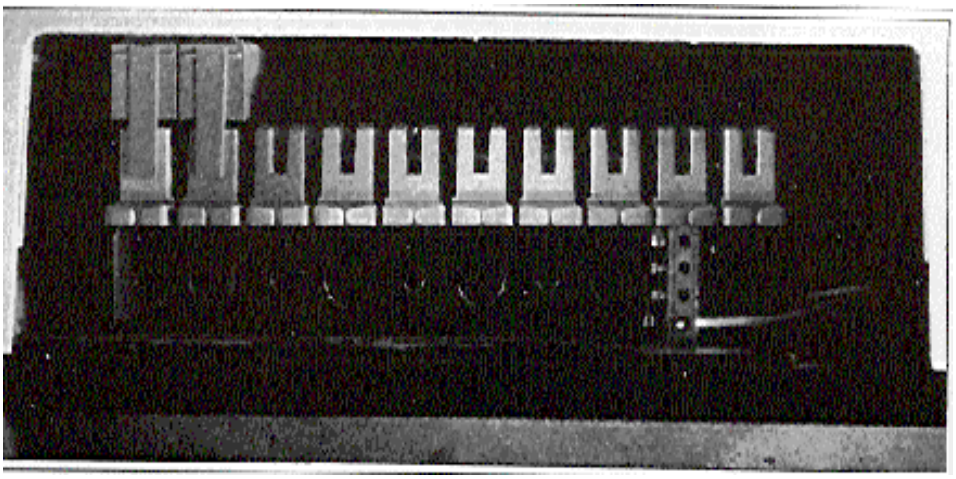


Photo 4.3 Right Hand Side View Showing the Removable Portion of the Cover

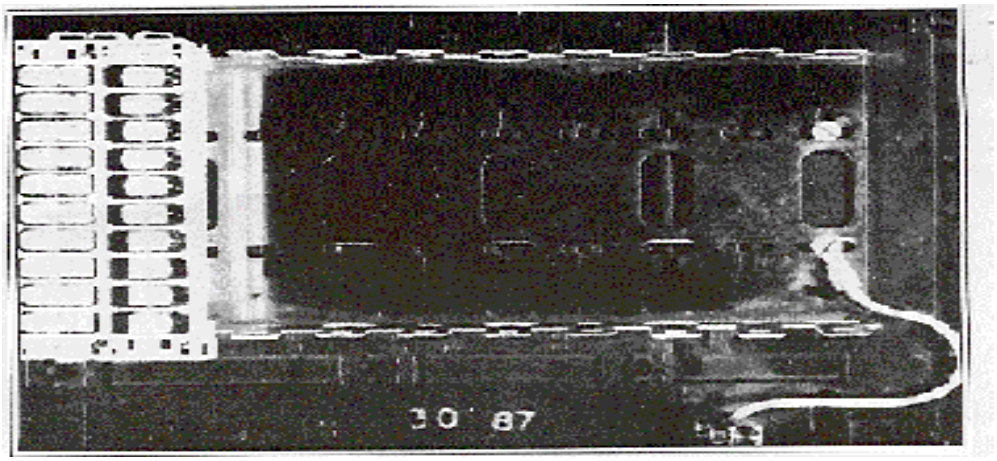


Photo 4.4 "U" Channel

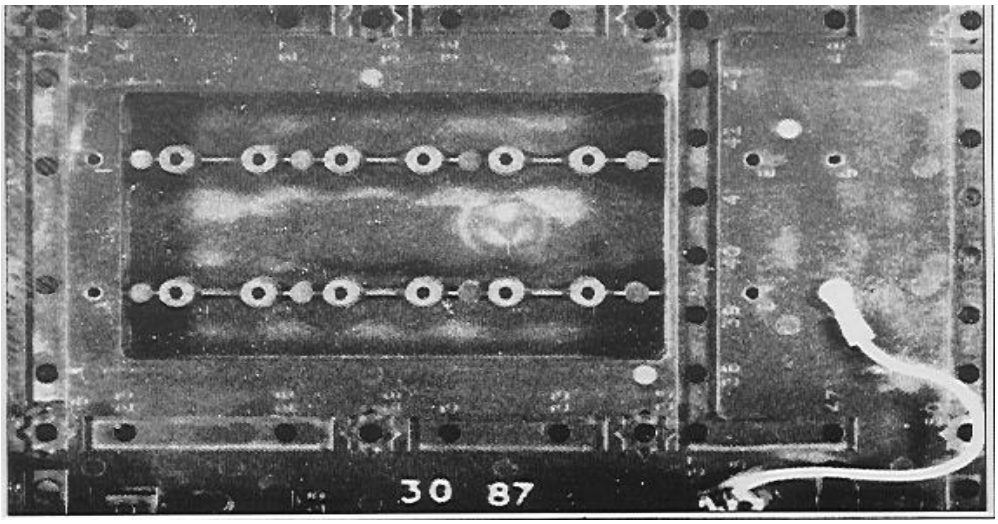


Photo 4.5 Back Mount for the "U" Channel

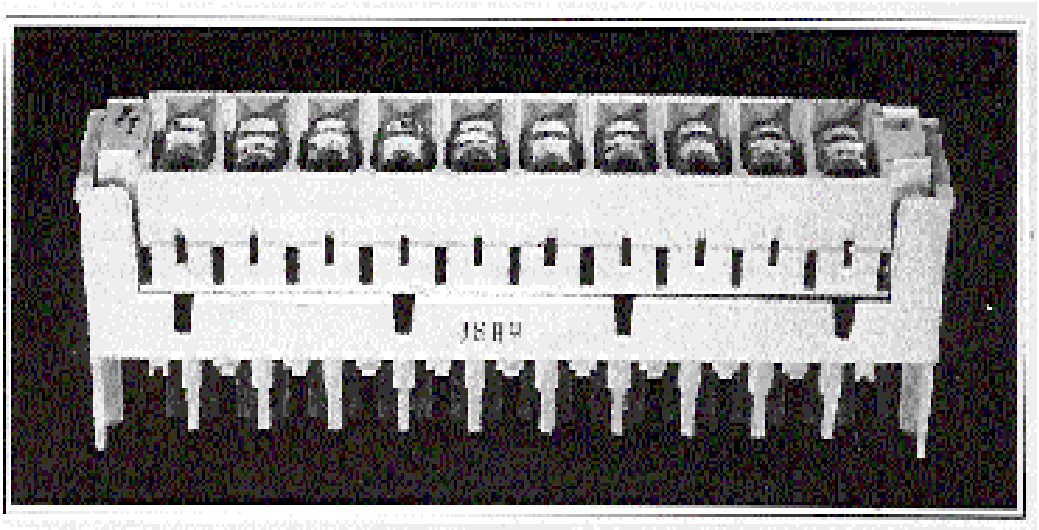


Photo 4.6 Protector Module

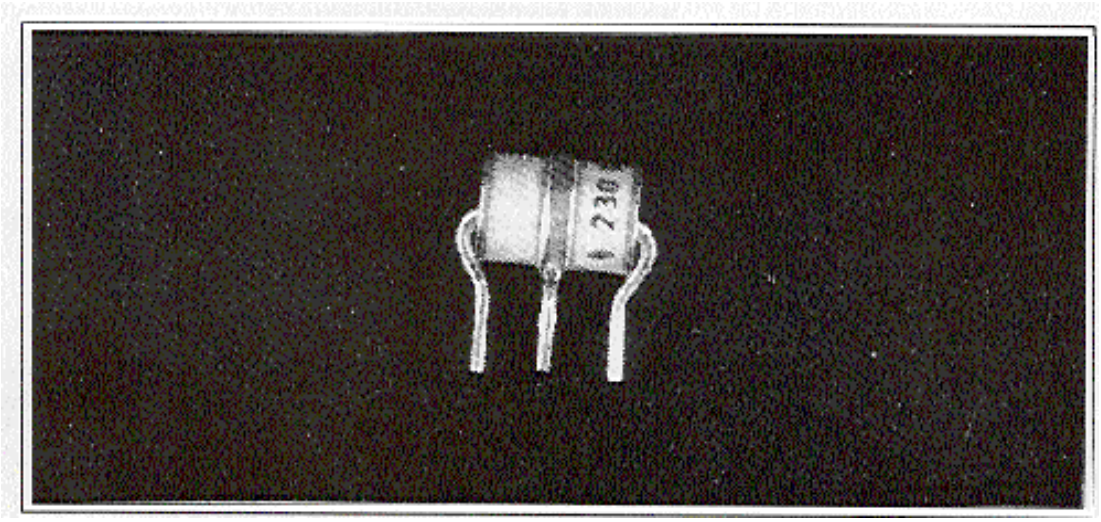


Photo 4.7 Over-Voltage Arrestor

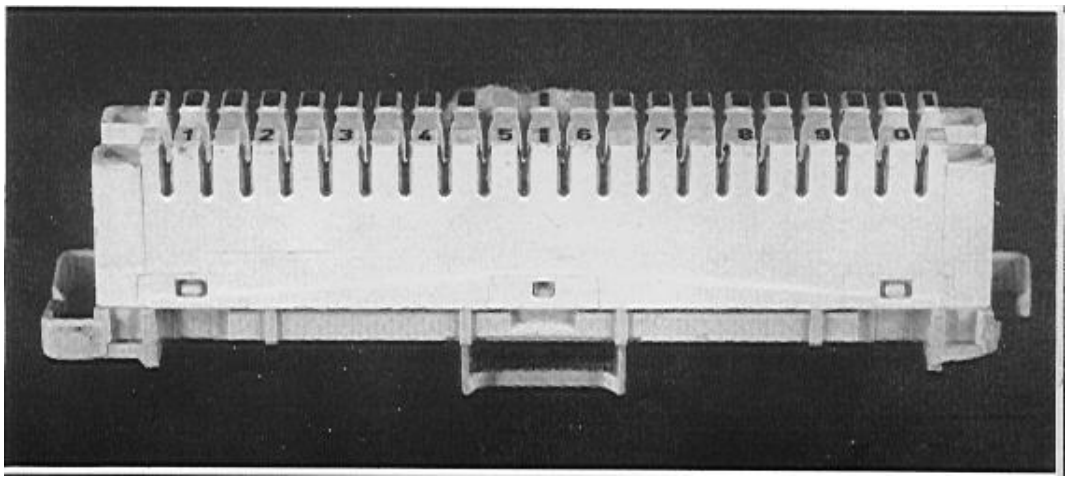


Photo 4.8 Ten Pair Module

4.4.3. **Block Terminal**

i. **General**

Block terminal (e.g. No 27A) is recommended for use as a small Distribution Point (DP) for external and internal cable terminations in estates, flats or apartments.

It may also be used as extension discase for wiring and PBX extensions. Photograph 4.9 and 4.10 show the front view and terminal tags respectively.

ii. **Fitting**

Block terminal No 27A consists of ten pairs strip thus ten tags on one side and ten on the other for soldering after terminations. There are therefore ten incoming pairs terminated on the tags and ten outgoing pairs on the screws. It has an earth strip for protection purposes.

iii. **Mounting**

Block terminal No 27A is always mounted on a wall or in an inspection box at a suitable

position especially designed for easy access, wiring and maintenance.
More than one can be fitted depending on the purpose and facilities required.

iv. Terminal Wiring

Terminal wiring is on tags and numbered vertically from left pairs one to five and six to ten on the right.

v. **Terminations**

The cable pairs are properly formed and laced. Pliers wiring and stripers are used to strip the insulation before the wires are terminated and soldered on he tags.

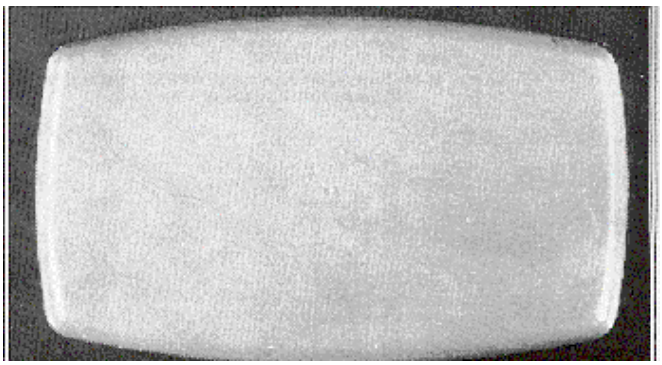


Photo 4.9 Front View

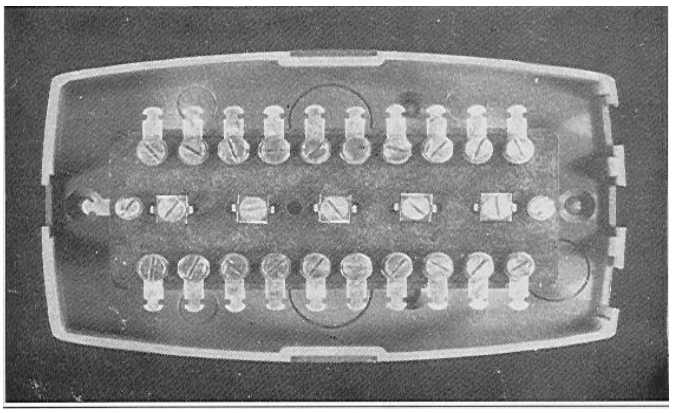


Photo 4.10 Terminal Tags

4.4.4. Standard MDF For Use at Subscribers Premises

i. This instruction describes the standard wall mounted Main Distribution Frame (MDF), which will be, used on all new work at subscribers premises where the capacity for telephone service so demands. The frame is referred to as vertical No 4.

ii. A typical vertical No 4 is manufactured in standard units of two verticals with a capacity of 10 block disconnection No 71.

iii. All vertical units shall be manufactured and equipped with jumper rings.

iv. The frame may be extended to the right or left and each extension must consist of one complete unit of two verticals. The extension unit is bolted to the existing frame by fish plates which are shown as item 9 and 13 in drawing No K6770.

v. Typical lead-in arrangements are shown in Fig.4.19 and Fig 4.20 which shall be used only when the MDF is located at the ground floor of a building without a basement below the MDF. There will be no requirement for a cable trench when the MDF is located either at basement or at the first floor.

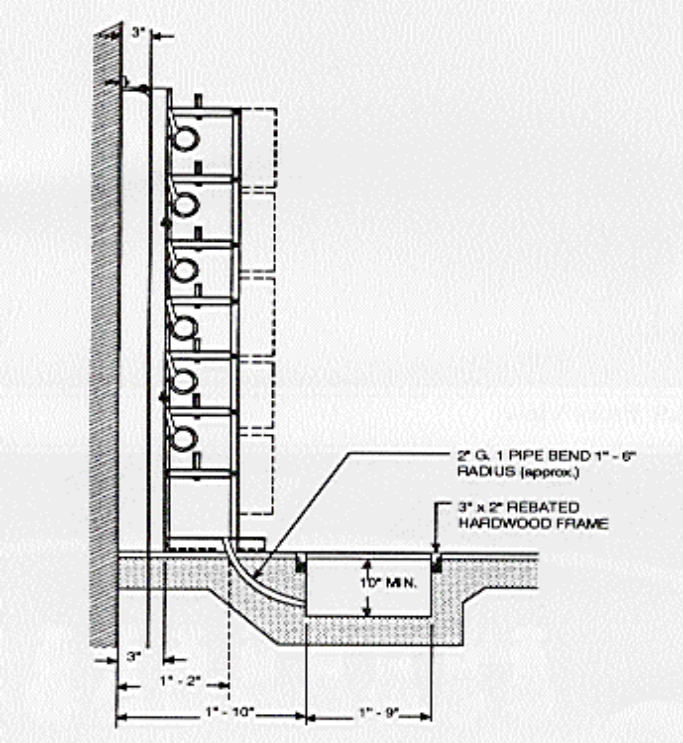


Fig 4.19 Standard Distribution Frame for Use at Subscribers Premises: Side View

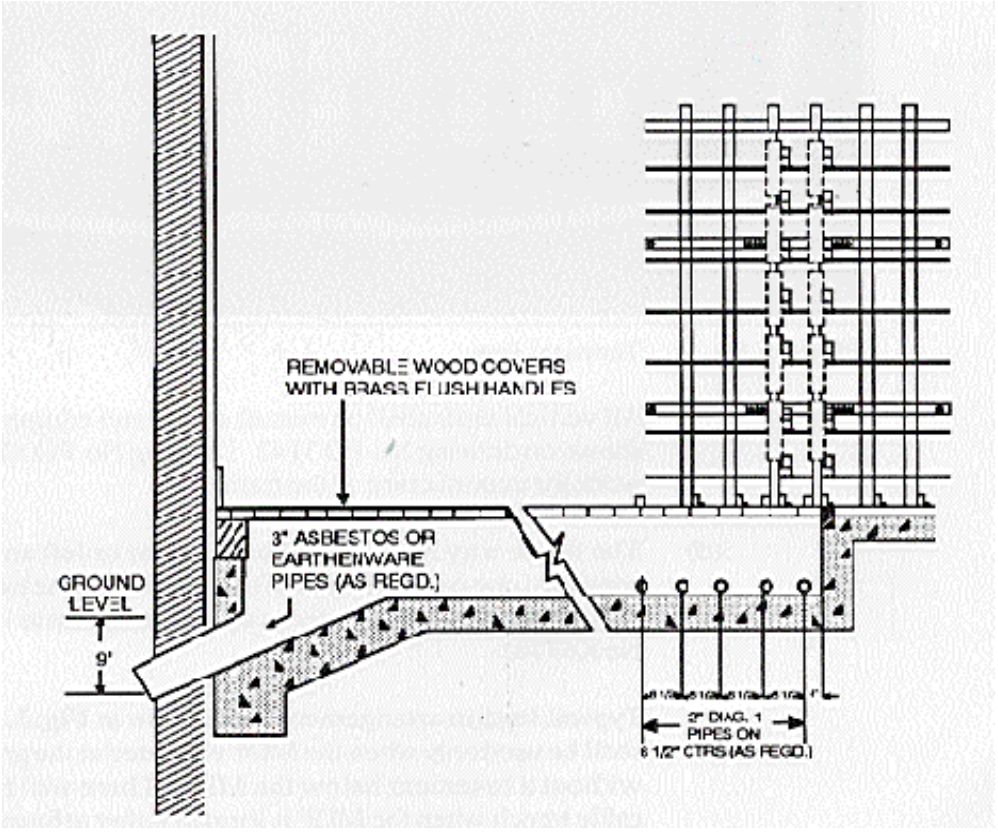


Fig 4.20 Standard Distribution Frame for Use at Subscribers Premises: Front View

viii. Depending on the location, the external cables will approach the MDF from the top or bottom through a riser. Details of external cable approach will in all cases be determined at the time of building design.

ix. Copies of the drawings mentioned in the text may be requisitioned from Network operators

4.4.5. Block Disconnecting

i) General Description

a) This instruction describes the block disconnecting (e.g. No 71), its use and methods of mounting. It is fitted on the line side of the MDF in a vertical mode or on the exchange side of the MDF in a horizontal mode.

b) The blocks disconnecting No 71 has a capacity for terminating of 100 pairs of wires.

c) The connection technique employed on Blocks precludes the need for soldering, wire wrapping or insulation stripping of the wires to be terminated.

d) The contacts utilised on the block will ensure that a perfect connection is made with wires of diameter 0.32 mm to 0.63 mm and with an overall insulation diameter of 0.66mm to 1.4 mm (See Fig 4.21).

ii) Over-Voltage Protection

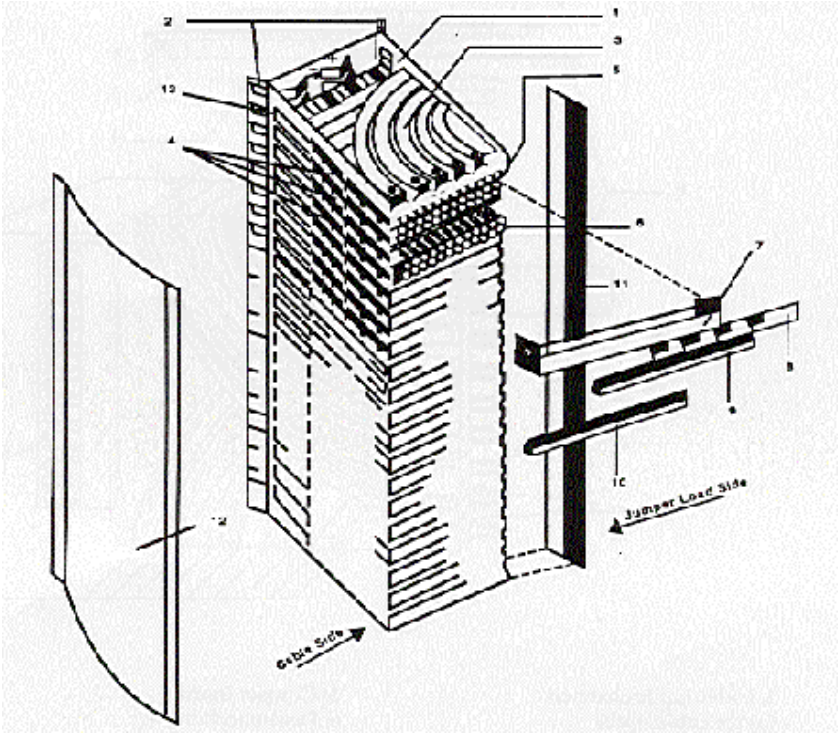
When used in areas where subscriber lines may be subjected to over-voltage risks, arrestor magazines can be incorporated through slide in slots. The arrestors do not react until a voltage of over 200 volts is reached. (See Photos 4.11 and 5.12)

iii) Composition of Block

The Unit consists of a U-shaped, nickel plated housing in which are slotted wire guide elements and contact elements. The wire guide elements provide ducts for the wires leading from points at the sides to the terminals. Contact insert elements are of break type and can be disconnected using plastic disconnecting plugs or interrupted with test plugs for testing or alternatively test cords to apply TOS facilities to the exchange (See Fig 4.22).

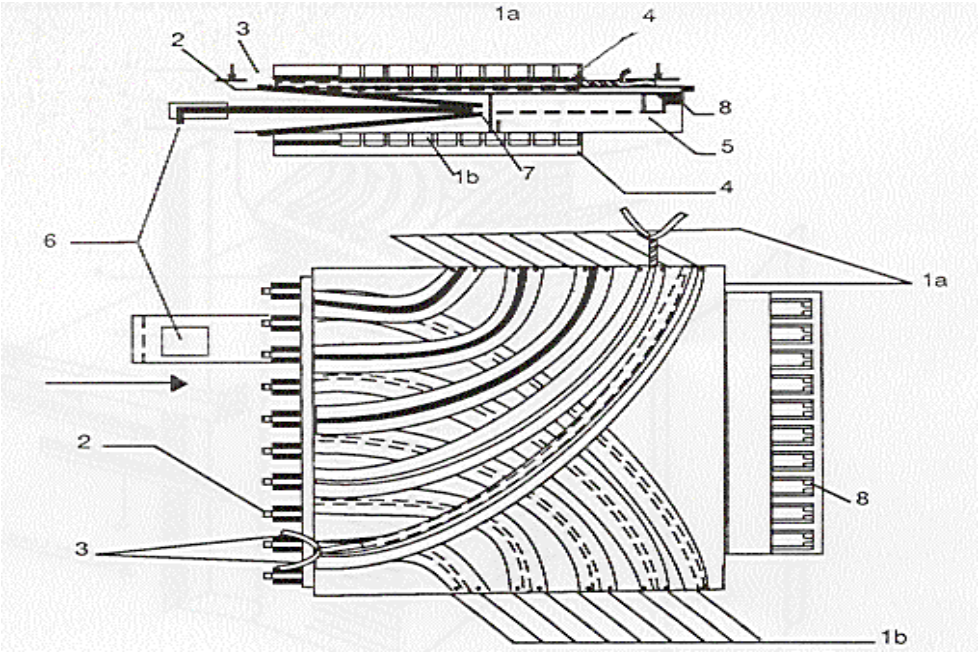
iv) Mounting of Blocks

The blocks are mounted in either side of the MDF using the integral threaded studs which are part of the U-shaped metal housing. The studs are threaded and of 4 mm diameter and come complete with toothed washers and hexagonal nuts. The studs are spaced at 210 mm fixing centres.



1. U-shaped metal trunking 2. Wire guides 3. Wire guide ducts
4. Contact inserts 5. Opening for disconnecting 6. LSA1-71 contact
7. Sign Frames 8. Lettering signs 9. Covering strips
10. Covering and designation strips 11. Designation strip with covering strips 12 .Protection cover
13. Opening for magazine over-voltage

Fig 4.21 Blocks Disconnecting No 71



1. **Cable Guide Channels**
   a. **for cable wires**
   b. **for jumper wire**
2. **LSA 1 contact**
3. **Switched in wire**
4. **cable guide duct**
5. **Contact insert**
6. **Disconnecting plug**
7. **Closed circuit contactr disconnected by disconnecting plug**
8. **contact overvoltage arrestors**

Fig 4.22 Wire Guide Elements

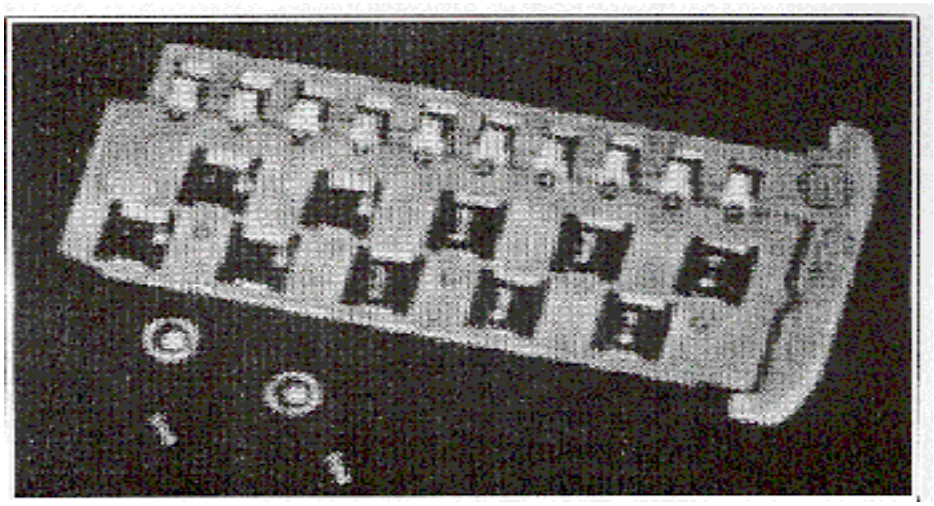


Photo 4.11 Magazine 71

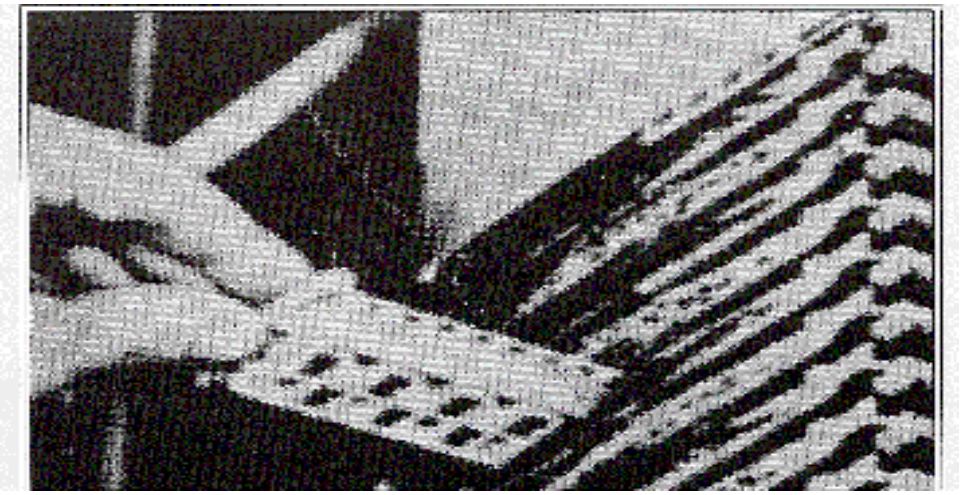


Photo 4.12 Insertion of Magazine 71

v) Connection and Termination of the wires

i. Incoming permanent wires are fed through the wire guides on the left hand side of the vertical blocks or on the lower side of the horizontal block.

ii. LSA contact technique is an insulation displacement connection (IDC). The contact consists of a stud and a spring. Both parts have an electroplated silver finish and are assembled in a way such that two contact slots are formed (See Figs 4.23 and 4.24)

vi) **Disconnection of Wires**

Disconnection of connected wires is done by means of a suitably shaped pair of pliers which fit on the contact as shown in photograph 4.13 and Fig 4.25.

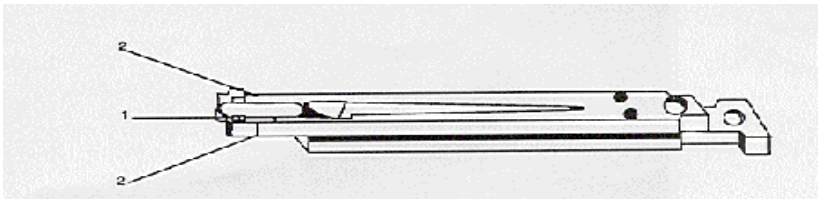


Fig 4.23 Stud and Spring Assembly

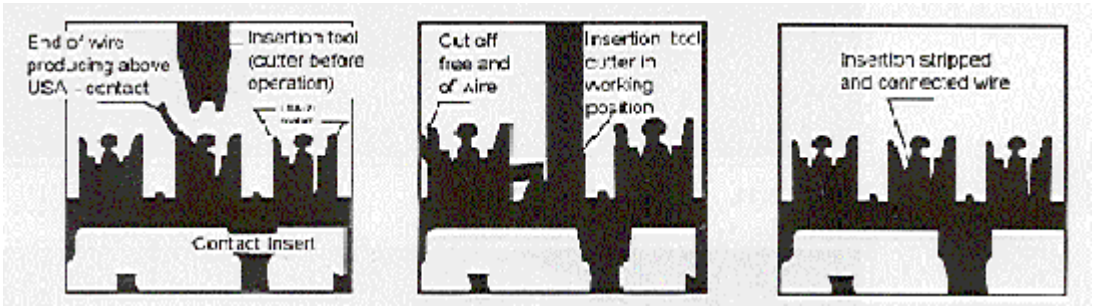


Fig 4.24 Wire Insertion

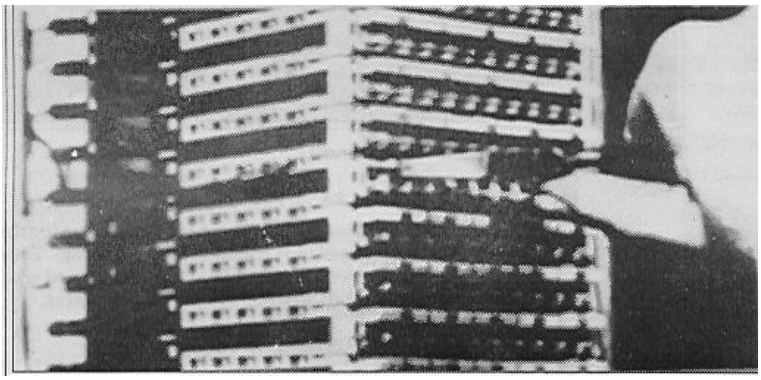


Photo 4.13 Wire Disconnection

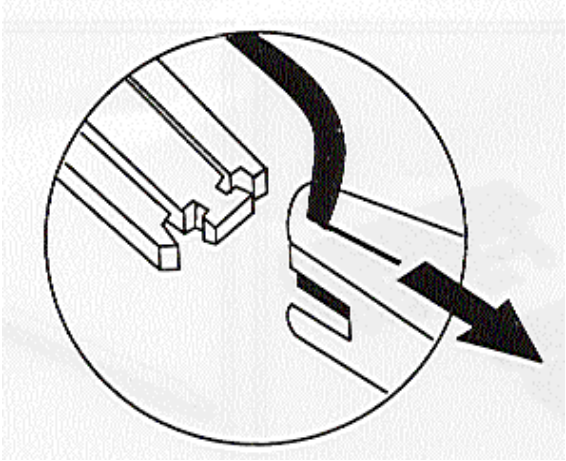


Fig 4.25 Close up of Photo 4.13

vii) **Labelling and Numbering of Blocks**

Labelling and numbering of blocks is done by imprinted numbers on the cable side of the U-shaped housing and a printed designation strip is fitted on the jumper side of the block. The block is supplied with 20 covering and designation strips stencilled 1 to 10 see Fig 4.26.

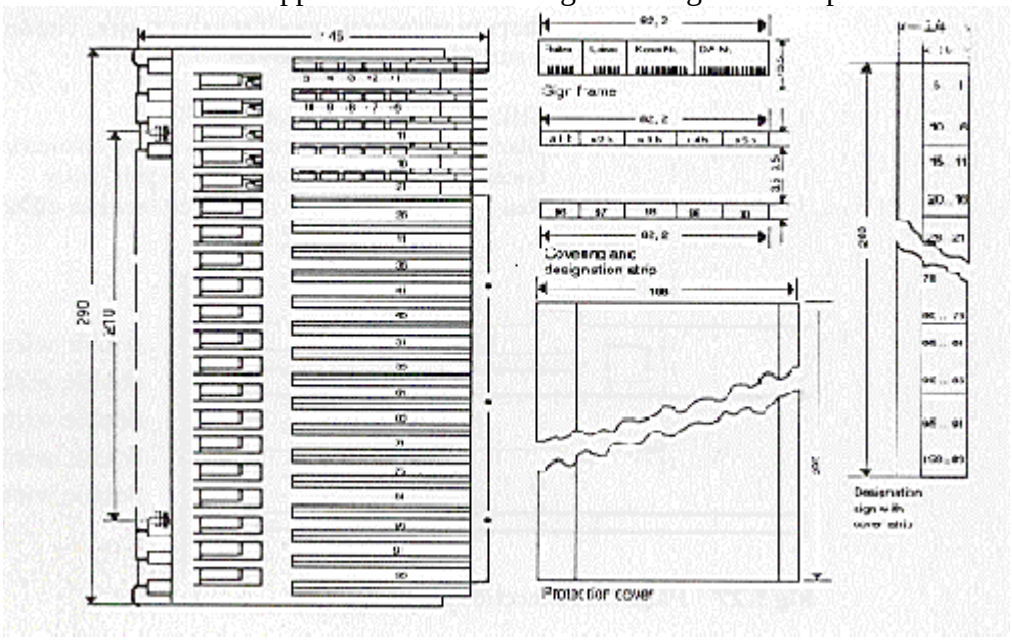
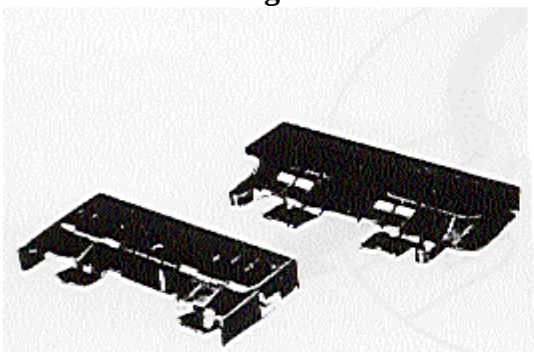


Fig 4.26 Labelled and Numbered Disconnection Block

viii) Tools used with disconnecting strip No 71 are shown in Photos 4.14 to 4.17.

Photo 4.14 Inserting Tool Wire No 1 **Photo 4.15 Pliers Extraction No** 2



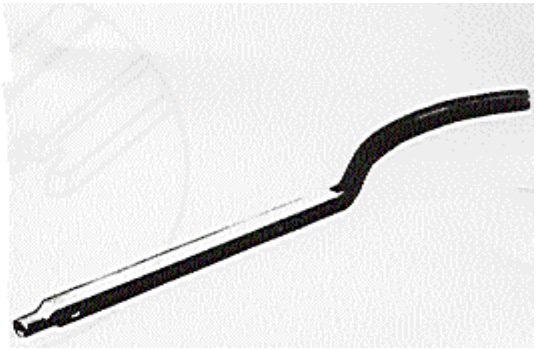


Photo 4.16 Tool Extraction No 1 **Photo 4.17 Tool Extraction No 2**

ix) Test accessories for Blocks Disconnection No 71

a) Plugs disconnection No 1 is used to disconnection the circuit between the permanent wiring and the jumper wire. The disconnecting Plug No 1 are obtained in five colours:

Yellow - Subscriber TOS
Black - Subscriber awaiting connection
Green - Subscriber UG pair faulty
Red - Subscriber left receiver off hook

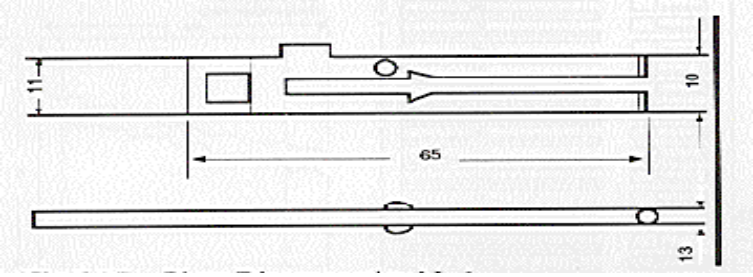


Fig 4.27 Plugs Disconnection No 1

b) Plugs dummy No 1 ensures that no test plug or disconnecting plug can be inserted inadvertently thus breaking the circuit.

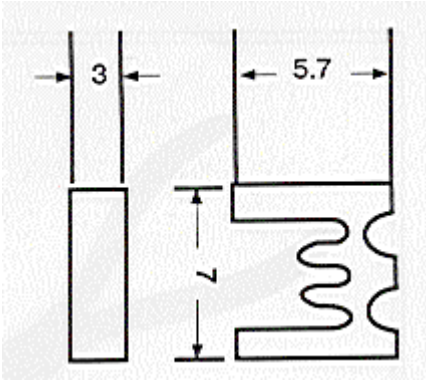


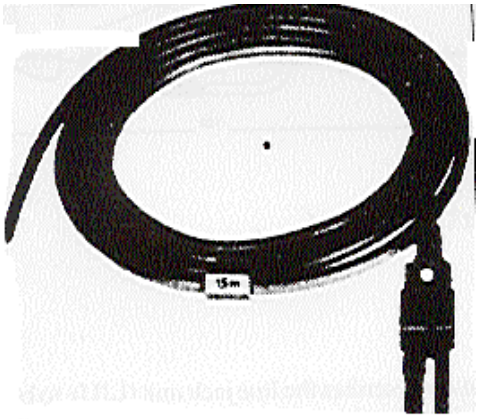
Fig 4.28 Plugs Dummy No 1

c) Marker identification No 1 is fitted after the jumper wire is inserted and once fitted, the jumper wire cannot be removed until the marker is removed.

x) Test Cords complete with Test Plugs

a) Cords test No 1 is used on the vertical side of the MDF and connects the subscribers line under test to the test Unit No 71/A.

b) Cords test No 2 are used to connect subscribers lines on TOS on the horizontal side of the MDF see Photo 5.18 and Fig 5.29.



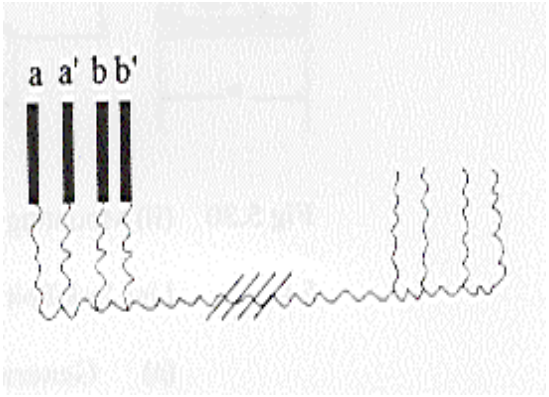
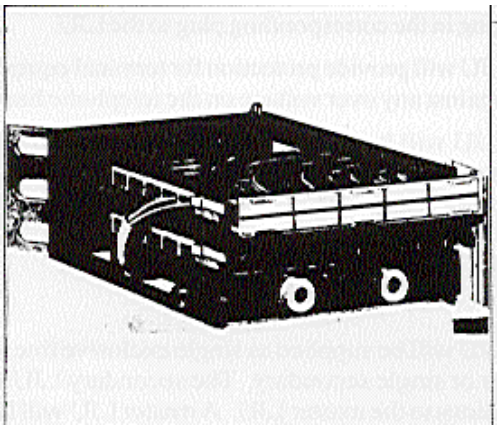


Photo 4.18 Measuring Cord **Fig 4.29 Circuit Diagram**

xi) **Test** Unit No 71/A is coloured green. The unit should be mounted on middle of the vertical between blocks No 4 and 5. All tests on subscriber lines must be carried out on the vertical (lines) side of the MDF.



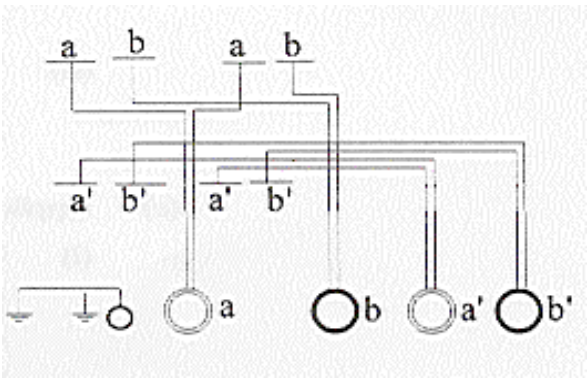


Photo 4.19 Test Unit No 71/A **Fig 4.30 (i) Circuit Diagram**

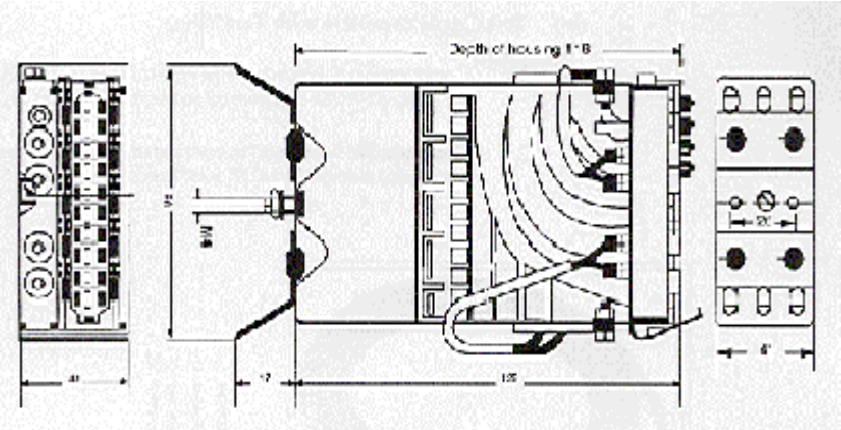


Fig 4.30 (ii) Mounting of Test Unit No 71/A

4.4.6. Line Jack Unit

i. General

a. This Specification describes the line jack unit (LJU), to be used in subscribers premises as an interface between the telephone line and subscriber terminal equipment. The LJUs are intended to replace the current widely used Block Terminal (BT).

b. The subscriber terminal equipments to be connected to the telephone line shall be fitted with special cords and plugs that match the LJU. Connection to the telephone line will be achieved by simply plugging the terminal equipment into the LJUs.

ii. Purpose of LJU

a. To facilitate easy installation of any subscriber equipment by simply plugging in the corresponding plug to the LJU.

b. The LJU will provide protection for terminal equipment and hence the user against any over voltage on the telephone lines.

c. The LJU will have the necessary network termination devices to facilitate line testing by Network operators personnel even in the absence of the subscriber equipment.

iii. Application

a. Type

1. The LJU will be supplied as single exclusive line master, single PBX master or single secondary. The secondary LJU will be installed as extensions to the master LJU. A master LJU will have if required one or more secondary LJUs.

2. The master LJU will have the necessary network termination devices while the secondary LJU will contain only the wiring connection points.

b. Description

1. The line jack units will have screw terminals for conductors of 0.4 to 0.9 mm with maximum of four conductors per terminal.

2. The dimensions of the line jack (with box) shall be 68 x 68 x 29 mm.

3. A captive bar shall be supplied to prevent removal of telephone cord in certain locations eg hotel bedrooms, factories etc.

4. The sockets must accept all plugs having the same polarization code. When the plug is removed the aperture must be automatically closed.

5. The mounting of the LJUs on wall shall either be surface or flush.

6. The socket must be mounted on a PWB

c. Materials

The casing for the LJU shall be hard plastic and the standard colour shall be white. Where aesthetic considerations are of importance, other types of LJU shall be provided.

d. Circuit Devices

1. The LJU components shall be mounted on a PWB.

2. The ('Master' jack components shall comprise of a socket, the bell capacitor of 1.8 microfarad, a requisite resistor of 470 K Ohms, a gas discharge tube for protection against induced voltage surges and an atmosphere discharge and six screw terminals for conductors 0.4/0.9 mm for the line connections.

3. Fig 4.31 shows the mechanical and electrical diagrams of the LJU (e.g. No 1).

4. PBX master jack shall not require lightning protector nor the resistor, the protection is provided at the PBX and resistor cannot serve any purpose in this situation.

5. The secondary jack shall have only the connection and jack features.

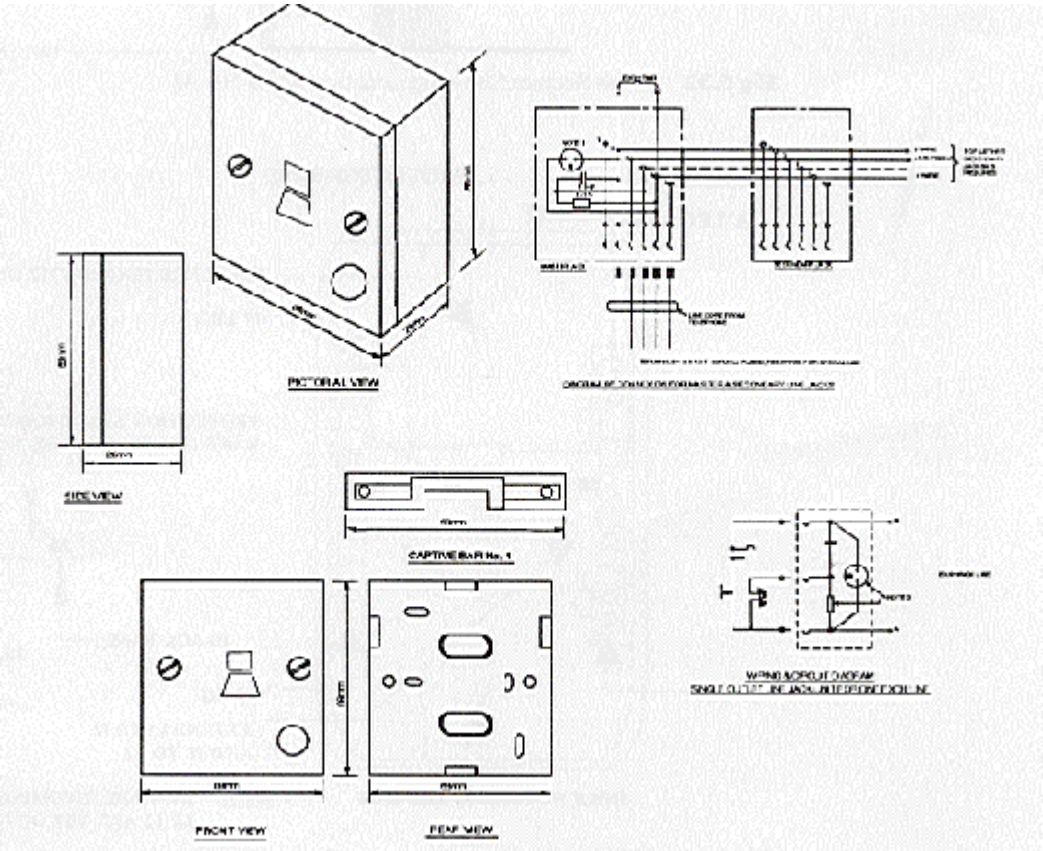


Fig 5.31 Telephone LJU (No 1)

4.4.7. Protector Unit

i. General

a. This specification specifies the standard Protector Unit (PU), e.g. *Protector Unit No 41,* used at residential subscribers premises as an interface between the internal wiring and the incoming drop wire.

b. The PU is to be located at the inside of the facia board nearest to the public road. Fig.32 shows the location of the PU.

ii. Purpose of PU

To provide protection to both the subscribers line and equipment against over voltages which may be caused by lightning and contacts with commercial power.

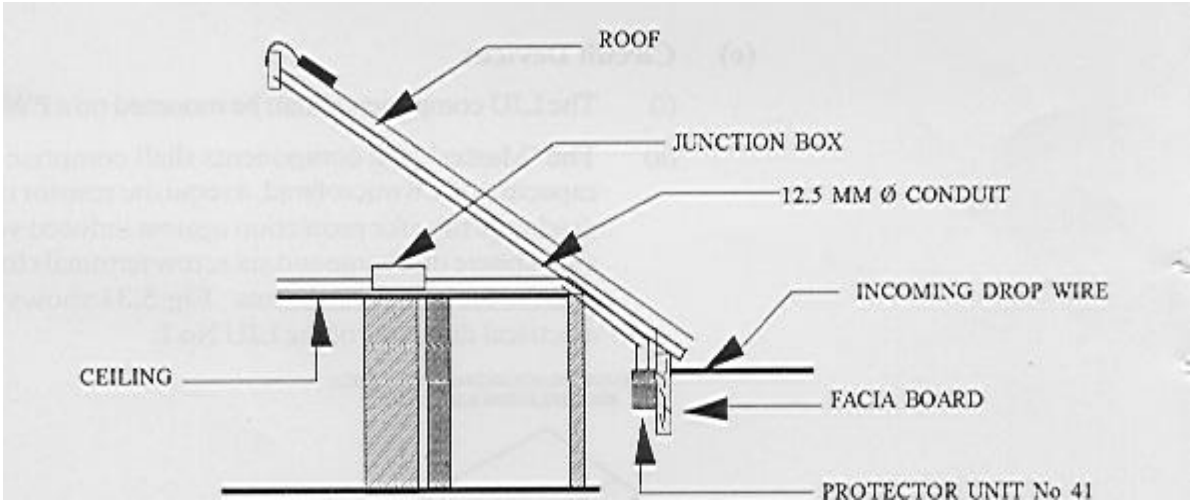


Fig. 4.32 Cross Section showing location of PU No. 41

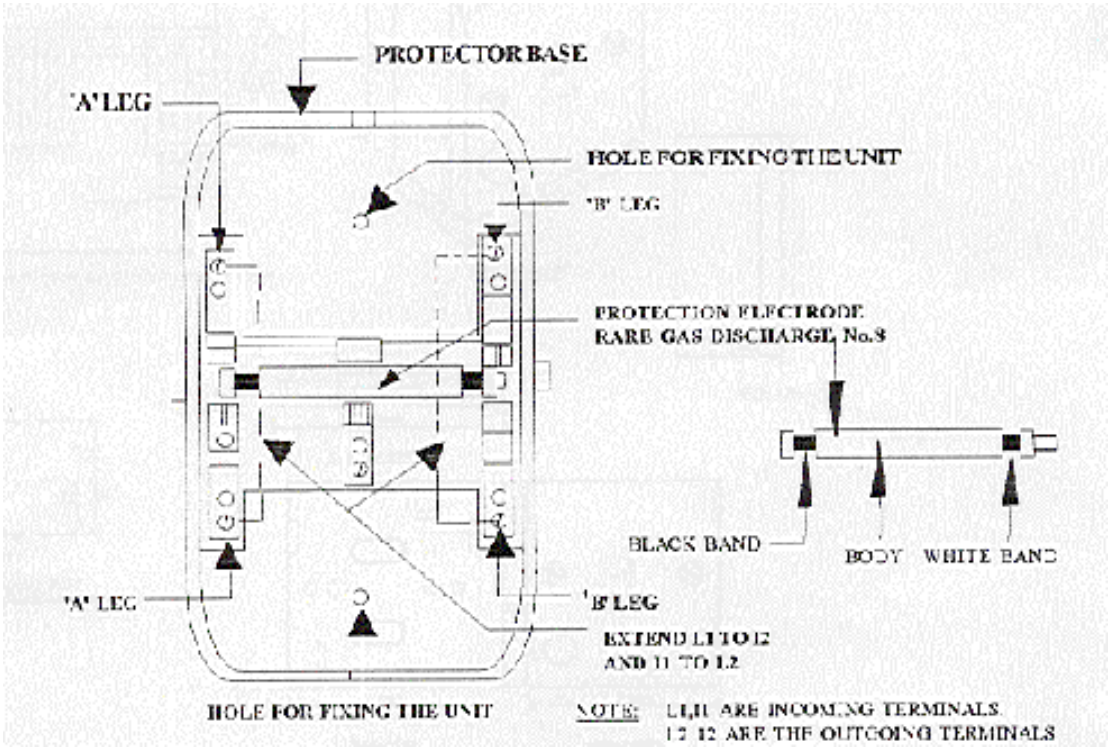


Fig. 4.33 PU No. 41 with cover removed

iii. Application

a) Description

The PU No 41 consists of a base and cover. On the base there are five screw terminals marked L1, L2, 11, 12 and E. L1 and 11 are terminals for the incoming drop wire, L2 and 12 are terminals for the internal wires while E is for the earth terminal. There is also provision for fitting the protector Electrode Rare Gas Discharge No 8 (See Fig 4.33).

The dimensions of the PU No 41 with cover 103 mm x 65 x 23 mm (See Fig 4.34).

b) Mounting

The PU No 41 has two holes on the base provided for mounting the Unit by means of screws. It should be mounted on the inside of a facia board or any other firm base away from rain contact.

c) Materials

The base and the cover the PU No 41 are made of hard plastic. The standard colours are dark grey for the cover while the base is black. Where aesthetic considerations are of importance, other colours may be used.

d) Wiring

1. The internal pair shall be terminated at terminals L1 11 and extended to terminals L2 and 12 by means of single insulated wires.

2. The earth wire which should be copper soft stranded type 3/20 should be provided and terminated at terminal E and firmly connected to the nearest water pipe.

3. Where a water pipe is not available the earth wire should be led into the ground and a minimum of a two meter length of wire with insulation removed coiled and buried under a 300 mm wet soil cover. Where the wire runs on the wall surface, it should be protected by means of a capping steel or PVC for a height of not less than 2 metres from point of entry into the ground.

4. Protection electrode rare gas discharge No 8 consisting of 3 electrode tube AE1 type 16A is fitted in the position provided. It's striking Voltage is 150-350V. Fig 4.33 shows the protection electrode rare gas discharge No 8.

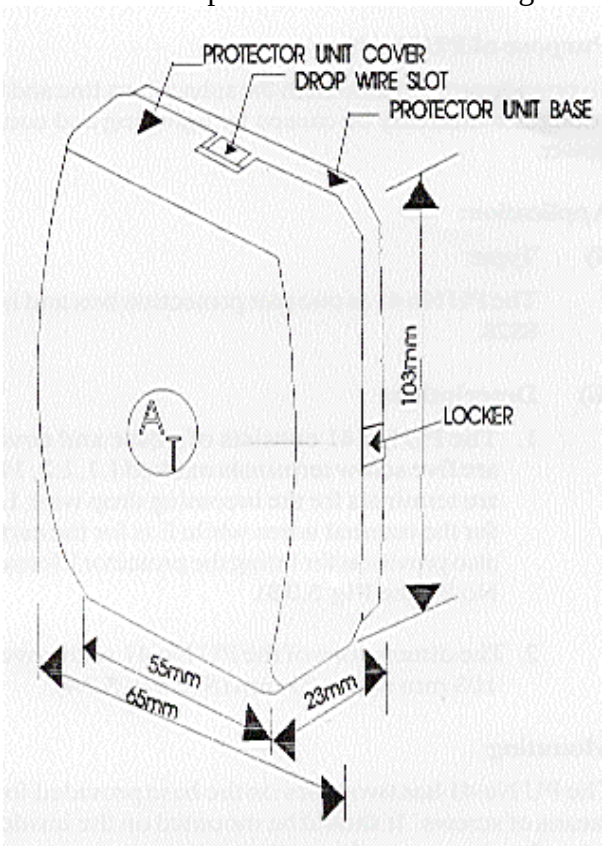


Fig 4.34 PU No 41 with Cover

4.4. Minimum Wiring Standards

4.5.1. Introduction

The minimum standards stated here are intended to give guidance to both building and electrical wiring industries in as far as provision of basic infrastructure and wiring for telephone service is concerned.

Proprietors are at liberty to provide additional facilities over and above the basic requirements provided such additions are in compliance with the specified standards

4.5.2. Bungalows and Maisonettes

i) Conduits

a. To facilitate wiring, the building contractor will be required to provide a minimum of a 12.5 mm lead-in conduit from a point at the inside of the front facia board, along a convenient rafter to inside the house but above the ceiling; then along a joist if necessary to a point where it would be led down through the wall.

b. The conduit, which should be exclusive for telephone service use, should then run down to predetermined points both at the master bedroom and the lounge where telephone may be located. See fig 4.35

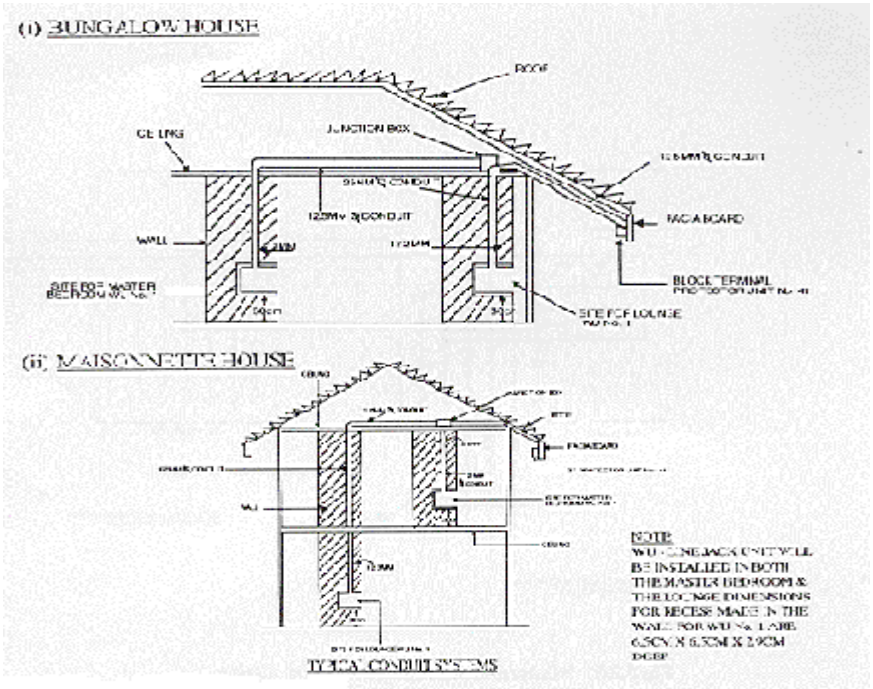


Fig 4.35 Typical Conduits Systems

c. Inspection facilities should be provided at points where the conduits sharply change directions in order to ease cabling operations.

d. Inspection boxes to accommodate Line Jack Units (LJUs) should be provided at the end of the conduits being located approximately 30 cm from the room floor level.

e. The dimensions for the inspection boxes should be 8.6 cm x 8.6 x 2.9 cm deep i.e. enough to fit the above unit.

f. A draw wire should be provided throughout the length of the conduit system.

ii) Wiring

a The internal wiring contractor will provide and install an external block terminal with protection facilities using suitable protector unit =at the inside of the facia board point where the lead-in conduit starts.

b This will form the interface point between the drop wire and the internal wiring. It will also provide a testing point.

c From the external Block Terminal (BT) the contractor shall provide a minimum of six wire cable to all telephone points and terminate them at the LJUs as shown in Fig 4.36 pairs should be tested for continuity, contact and insulation resistance.

Note: The LJUs will be installed in all rooms with intended telecommunications points.

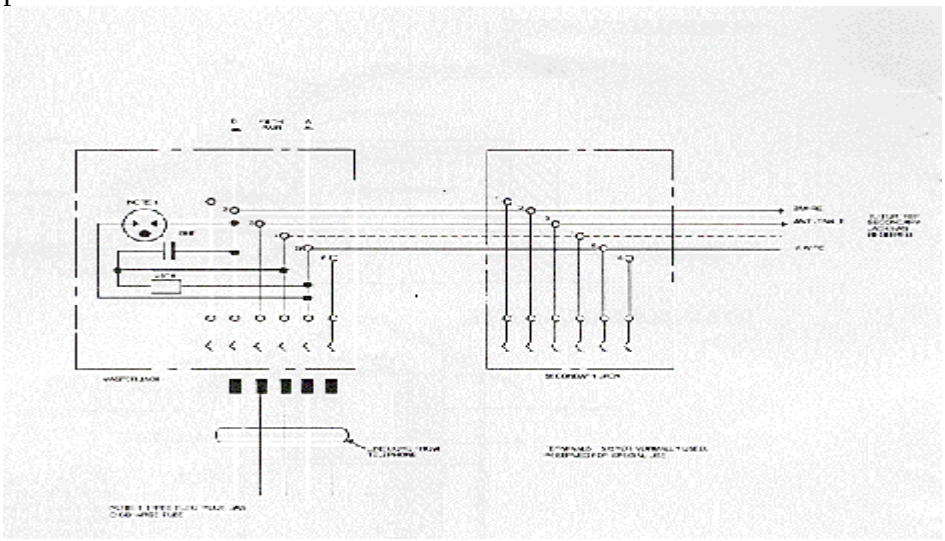


Fig 4.36 Sample Master and Secondary LJUs Connection

4.5.3. Block of Flats

i) Conduits

a To facilitate wiring, the building contractor will be required to provide an exclusive conduit system and a lockable main inspection box located at the first floor near the beginning of the stairs.

b The inspection box should be provided at not less than 1.5 m from the floor level below it and not more than 1.0 metre from the front vertical corner; Fig 4.37.

1. The system shall be linked to all flats with a common staircase. The minimum dimensions for the inspection box are 400mm long x 360mm wide x 100mm deep.

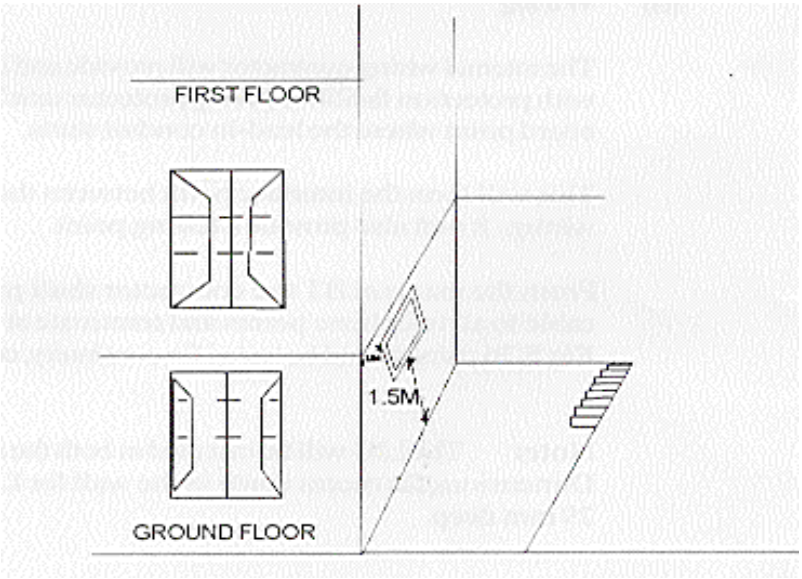


Fig 4.37 Inspection Box Location

2. The box will be the interface point between internal wiring and external cabling. The building contractor will be required to provide a 50 mm diameter lead-in conduit system to a point at the road reserve and at not less than 450 mm below the ground level.

3. For a block of more than six flats a conduit system of 100 mm will be provided. The terminal point for this conduit will be determined at the time of the building design. The conduits so provided shall be plugged at both ends to prevent entry of rats, snakes etc.

4. Suitable Inspection boxes, which should not be easily accessible, by members of the public should be provided at all points where conduits spur off to the flats to facilitate smooth cabling operations.

5. The minimum diameters of the conduits to be provided within the flat units shall not be less than 12.5 mm. The minimum diameter for the riser conduit shall be not less than 50 mm for a maximum of six flats.

6. The ground floor flats may have direct conduits from the main inspection box. For a block of flats having more than six units but less than twelve units an additional 50 mm diameter riser conduit will be provided.

7. At each flat the conduits should run to the required telephone locations. The conduits should be terminated at inspection boxes, which should be provided, at points 300 mm from room floor level.

ii) **Wiring**

a. For a block of flats of up to six units the internal wiring contractor shall provide and install a box No 1A or 1B at the main inspection box and LJUs at the telephone points.

b. The contractor shall then run and terminate a minimum of six wire (3 pair) Cables as per Specification No CW21 (M) (*refer to Annex 2 for detailed specifications for internal cables*) from the box to the LJUs. Genrally the cable used shall comply with Kenya Standards KS 1059.

c. The cable pairs should be tested for continuity, contact and be labelled approximately at the box for ease of identification. Fig 4.38 is a typical block-wiring diagram for a block of six flats.

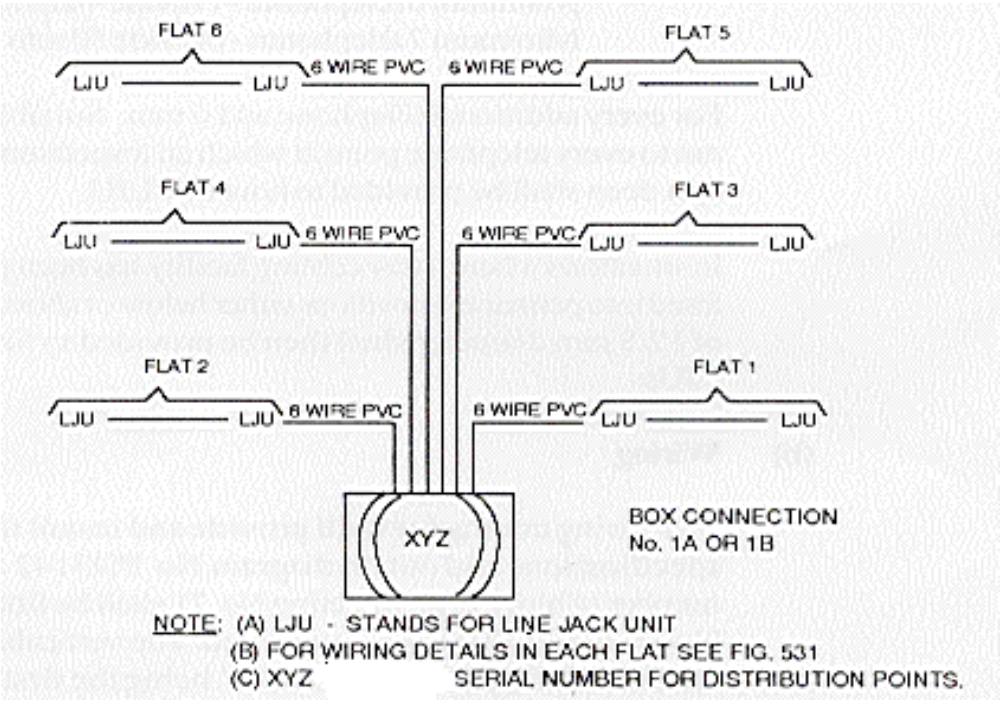


Fig 4.38 Typical wiring for a Block of 6 Flat

4.5.4. Commercial Buildings

i. Conduits and Risers

a. To facilitate wiring installation in commercial buildings, the building contractor will be required to provide an exclusive and complete conduit system from the MDF room to all the floors and rooms where telephone services will be required.

b. An MDF room, which is a security area, shall be provided either at the basement, ground floor or first floor.

c. The minimum dimensions for the room are 2500 mm high x 3000 mm x 3000 mm.

d. The MDF room shall be proved with adequate ventilation, natural or artificial lighting and a power socket at a point near the proposed MDF location.

e. The floor of the MDF room shall have a good finish and the room painted like any other ordinary room within the building.

f. The building contractor will provide 2 x 100 mm of lead-in pipes and/or trays, depending on the location of the Main Distribution Frame (MDF) room, from a point at the road reserve where cables will approach the building to the MDF room . This point will be determined at the time of building design.

g. The riser system to be provided may consist of an open riser with batten (s) fitted for cleating on cables and fitting box No 301A (Annex 1) or pipes running down the height of the building to the MDF room and/or trays to carry the cables to the riser in

cases where this is not directly above the MDF room. The minimum dimensions for the riser are 30 cm x 30 cm. A lockable access to the riser should be provided at every floor.

h. Conduits from the riser should be provided to each and every room. These may be in the form of pipes or enclosed box tray running along the permanent walls of the building.

i. The pipes or trays should be provided as close as possible to the skirting board. Minimum diameter for the conduits to telephone points should be estimated as follows:-

- Minimum 3 telephones - Provide 25 mm conduit
- Minimum 4 telephones - Provide 32 mm conduit
- Minimum 5 telephones - Provide 38 mm conduit
- Minimum 6 telephones - Provide 44 mm conduit
- Minimum 7 telephones - provide 50 mm conduit for every additional telephone add 6 mm.

j. Suitable size conduits should be run to every telephone point at which an inspection box with typical dimensions of 68 mm x 68 mm x 29 mm deep should be provided to house an LJU.

k. In situations where a tray cabling facility has been provided, the LJU shall be fitted into permanent positions either below or above the tray system. Conduits of 12.5 mm diameter shall then be provided to link the tray system and the LJUs.

ii. **Wiring**

a. The verticals of the MDF shall be letter labelled from left to right thus 'A' being the first vertical. Termination of cable pairs should start from the top block disconnecting No 71 of vertical A progressing down to the third and then continuing to the top of vertical B and so on. Over-voltage protection magazines No 17 shall be fitted.

b. Cables shall be properly laced and secured against the battens provided in the riser or trays. They should be terminated to the MDF and box in accordance with the wiring specifications. No intermediate cable joints are allowed on internal cable block wiring.

c. From the box s a minimum of six wire cables shall be provided and terminated at each LJU.

d. All pairs shall be tested for continuity, contact and their routing details documented both in tabulated and diagrammatic formats.

e. The routing shall indicate the termination vertical pair position, box number and pair position, and floor number. Fig 4.39 shows a typical wiring diagram for a commercial Building

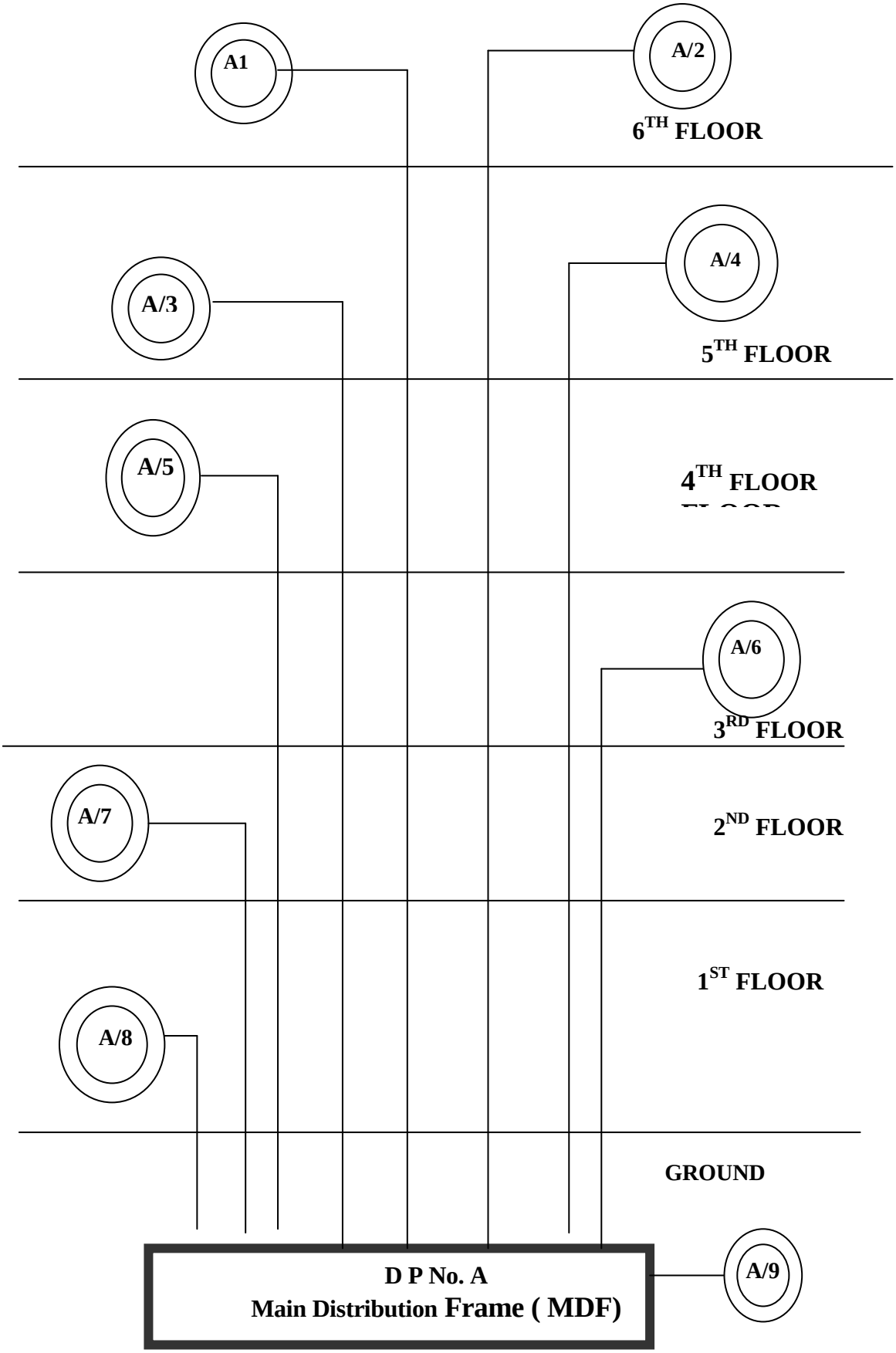


Fig 4.39 Typical Wiring for a Commercial Building

4.7. Structured Cabling

4.7.1. General

i) Structured Cabling systems are designed and supplied for use in accordance with the international standards such as EIA/TIA 568A and ISO/IEC 11801

ii) The most common systems are based on both UTP (Unshielded Twisted Pair) and FTP (Foiled or Twisted Pair) cable. Fibre optic cabling both in the backbone and to the desk may also be provided if required.

iii) Some of the structured cabling systems mostly in use are:-

- Mod Tap system 100
- Mayflex system 5
- Amp
- Siemon

4.7.2. What is Structured Cabling

i) In the past, buildings could have several different cabling systems for different communications for example: block wiring for voice, coaxial for Ethernet, multipair for RS232 etc.

ii) Structured cabling replaces all the different cablings with a single cabling system which covers the whole building for voice and data (CCTV and video) requirements.

iii) Structured cabling systems consist of outlets which provide the user with RJ45 presentation. User outlets are usually supplied as either one or two RJ45 connectors mounted in a standard single gang face plate, or a single snap-in in modules which can be fitted into floor boxes:-

- Single gang face plate can provide for up to two modules
- Dual gang face plate can provide for up to four modules

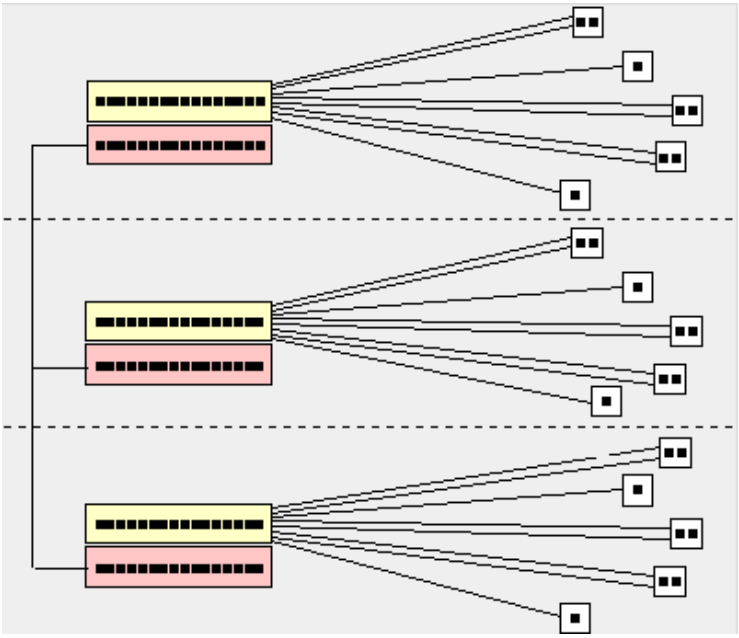


Fig. 4.40 A Generalised Structured Cabling System

4.7.3. Horizontal Cabling

i) Each user outlet is cabled back to a hub using an individual cable containing four twisted pairs. The cable can either be unshielded known as UTP or shielded known as STP. The cable used in this system are known to meet category 5 British Specification. The cable is connected to the back of the user outlet by means of an IDC (insulation Displacement Connection) connector.

ii) The maximum length of cable between the hub and any outlet must be 90 metres to comply with EIA/TIA and ISO requirements.

iii) The Standards allows another 10 meters for connecting and patch leads., making a total drive distance of 100 meters.

iv) Some suppliers will warrant systems with longer drive distances, depending on the protocol being used.

v) In structured cable systems, the horizontal cabling and user outlets are the same for all services, so that any outlet can be configured for voice, ethernet , RS 232 video or other services. As user requirements change, by simply changing the patching configuration in the equipment room can change the services provided on the outlets. If necessary an adaptor is used in the outlet to convert it to the service being provided (eg a video balun will provide the standard RGB or composite video outputs required for CCTV)

vi) When structured cabling system is installed the floors are usually 'flood wired' with outlets being installed on a grid layout to a specified density, rather than to individual user positions. This allows more flexibility without having to re-cable when changes are made to the layout of the building in the future.

vii) At the hub, the individual 4 pair cables from the user outlets are terminated on the patch panels. These patch panels usually have IDC (Insulation Displacement Connection) connectors on the rear for terminating the 4 pair cables, and provided an RJ45 presentation on the front for patching. Patch panels are usually mounted in a standard 19 inch racks, either wall mounted or free standing. RJ45 patch panels usually come in multiples of 16 connectors, panels containing 16, 32 and 48 RJ45 connectors.

viii) The hubs are connected together and the main computer or equipment room using 'riser' or 'backbone' cables (these can either be copper or optical). In most systems optical cables are used for the data backbone cables and multi-pair copper cables are used for the voice backbone cables.

ix) The equipment cabinets usually also contain equipment for the data network. Depending on the equipment used, the data channels may be presented in one of two different ways.

x) Each data channel on the equipment may be fitted with an RJ45 connector, so that channels can be patched directly to the patch panels terminating the horizontal cables.

Fig 4.41 Equipment fitted with RJ45 connectors

xi) Alternatively, the equipment may be fitted with 'Telco' connectors. These are 25 pair connectors each of which carries several (usually 12) data channels.

Fig 4.42 Equipment fitted with 'Telco' Connectors

xii) If the equipment is fitted with Telco connectors, then these must be connected to the 'equipment side' patch panels using mass termination cables (25 pair cables fitted with "Telco" connector one end, and no connectors at the other end, so that they can be punched down onto IDC connectors) to provide RJ45 connector for each data channel.

xiii) If an optical fiber backbone is used, the hubs must also contain equipment to enable the optical cable to interface with the copper cables.

xiv) Backbone cables are terminated on patch panels at the hub. Copper cables are terminated on RJ45 patch panels the same as those used for the horizontal cabling. Optical cables are terminated in the patch panels which usually provide the user with an STII presentation.

xv) Fiber optic cables can be terminated by either fusion splicing pigtails, with factory fitted connectors, onto each fiber in the cable or by directly fitting the 'field mountable' to each of the fibers.

xvi) Patch leads are used to connect the horizontal to either the data equipment or to the voice backbone cable, depending on to which service is required at the user outlet.

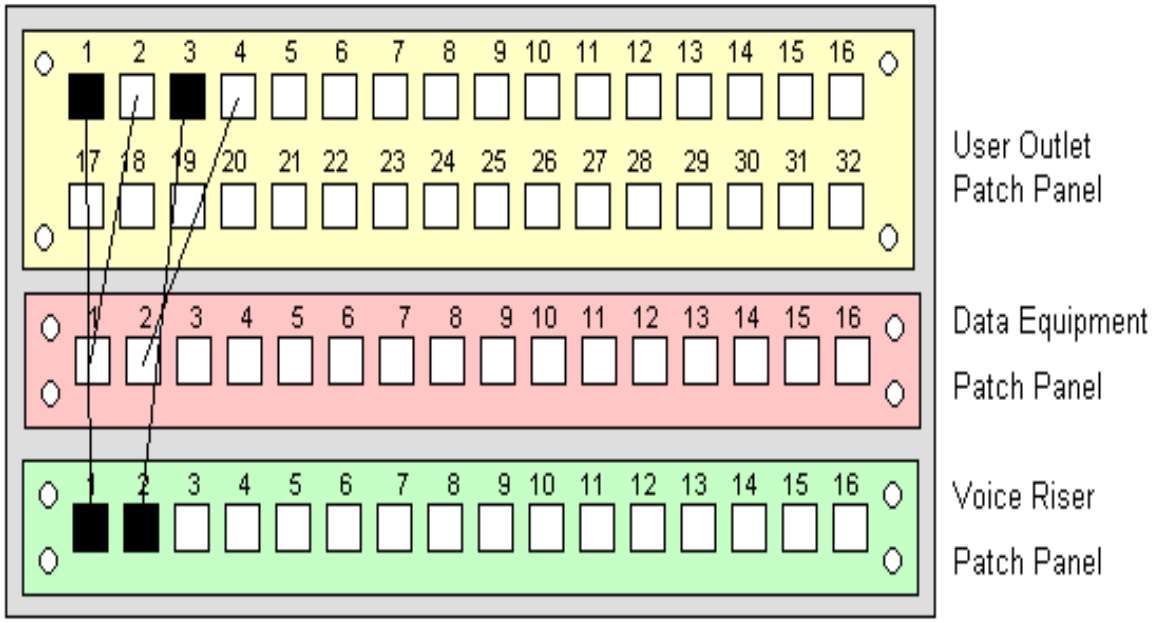


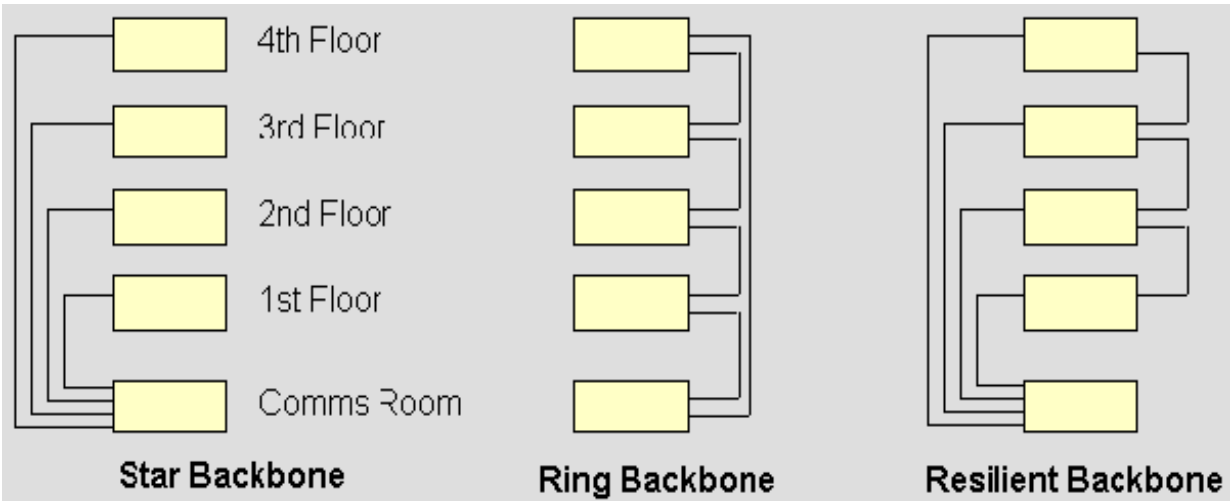
Fig 4.43 Patch Panels

xvii) Cable tidies are used in the hub cabinets to enable patch leads to be routed neatly, these are 1U high 19 inch panels fitted with jumper rings. A 1U cable tidy is usually used below every 3U patch panels.

xviii) The data backbone can be in either a star or ring configuration, depending on the equipment used. In a star configuration data backbone cables are usually taken patch panels in the to main computer (or equipment) room.

xix) Voice backbone cables are nearly always in a star configuration, and are taken to an MDF(Main Distribution Frame) or BDF (Building Distribution Frame). The MDF or BDF is usually a 'Krone' type frame utilising 10 pair IDC connection strips.A star and ring backbone can be combined to provide resilience.

xx) In the event of the failure of any of the cable in the backbone, the signal can be re-routed via another available route. This can be carried out automatically by the equipment, or by manually re-patching backbone. (as shown on the diagrams below)



A star and a ring backbone can be combined to provide resilience. In the event of the failure of any one cable in the backbone, the signal can be re-routed via another available route. This can be carried out automatically by the equipment, or by manually re-patching the backbone.

5. TERMINAL EQUIPMENT INSTALLATION

5.1. General

Terminal equipment are the Type Approved equipment connected at the users' end of any communications network. These are equipment like PABXs, telephone sets, teleprinters, modems, fax, mobile telephones, cordless telephones, radio and can be obtained from any vendors in Kenya licensed/ authorised by CCK.

Network Operators/Contractors and their technical personnel shall all be registered and/or licensed by CCK and shall be expected to be conversant with the installations' regulations and procedures.

5.2. Applicant's Responsibilities

The Applicant shall be required to make necessary arrangements with any vendor or contractor licensed by CCK to obtain suitable terminal equipment and associated accessories for installation.

The applicant is also required to provide suitable spacious easily accessible accommodation where it is proposed to install the terminal equipment. The area should be well ventilated with adequate lighting and at least one 13 Amp mains socket.

5.3. Contractor's Responsibilities

The Contractor shall advise the Network Operator of the proposed date of commencement of the installation work using "Commencement of Work Notice" form. A copy of this document should be submitted to CCK.

The Contractor shall install the terminal equipment and associated wiring in accordance with the installation guidelines of the particular equipment and CCK's laid down standards.

5.6. Installation Procedures

a. New Installations

i. The Applicant requests for a completely new service. In this case the Applicant does not have any service at the location where service has been applied.

ii. Applicants/Contractors shall submit to the Network operator duly completed "Commencement of Work Notice" form.

iii. The Contractor shall attach to the Commencement of Work Notice form a dimensioned floor plan sketch for all indoor equipment accommodation indicating the floor number. The sketch shall be signed and dated.

iv. The Contractor shall install the terminal equipment in accordance with the contracts agreement and the CCK's set standards.

~~v.~~ Contractors shall submit to the network operator duly completed "Completion of Work Notice" form when the installation work is completed and ready for inspection and

commissioning. A copy of Completion of Work Notice to be submitted to CCK within five (5) working days.

vi. After the receipt of the 'Completion of Work Notice' the network operator and the contractor's engineer shall make for commissioning the installation. This duration should not exceed 15 working days from the time the installation was completed.

vii. It is of utmost importance that the terminal equipment be thoroughly inspected by the Network operator for the purpose of network integrity and security. Inspection standards are included in chapter 6 of this publication. The certification committee's recommended checklist is also included in Chapter 8 of this publication.

viii. If there are any doubts on the equipment connected or the method used, the client / contractor/network operator may seek advice from CCK.

ix. In case the Inspection Officer finds any defects with the installation, he shall advise the Contractor in writing within five (5) working days after the inspection date. Details of the defects shall be clearly indicated

x. The Contractor shall rectify the defects within fourteen (14) days from the date of inspection, then he shall inform the network operator immediately so as to make arrangements for the re inspection of the repeated work.

xi. If the Contractor does not rectify the defects within the fourteen (14) days, a fresh 'Commencement of Work notice" form shall be submitted to the Network Operator and a copy to CCK.

xii. The Network Operator will be required to submit to CCK quarterly summary of all completed and commissioned terminal equipment connected to their network by contractors.

xiii. Each contractor will also be required to submit quarterly summaries of all completed and commissioned terminal equipment installations they have connected network using appropriate forms available on the CCK website.

xiv. The Certification Committee will at any time without notice to the Network Operator, the Contractor or Subscriber, inspect and certify these Terminal Equipment installations and any other aspects of the completed and commissioned work.

xv. The Certification Committee shall confirm that all mandatory requirements as listed on the summarised checklist as shown on Chapter 8 of this publication have been complied with.

xvi. The Certification Committee will communicate in writing to the contractors and the network operators through issuance of "Report of defects" for each defective installation found during the certification exercises.

xvii. This report shall point out the defective areas and recommendations for the rectification of the defects. CCK requires that the stated defects be rectified within fourteen (14) days from the when the report was mailed to the contractor

xviii. For the terminal equipment installation fully complying with CCK's recommended standards CCK will issue "PERFORMANCE CERTIFICATES" to the Contractor and /or the Network Operators who carried out the installation(s). A certificate may be issued upon request for fully compliant installation

b. Replacements and additional lines

i) Replacements of equipment, installations and additional lines will be done in accordance with the contract agreement between the Network operator, the contractor and the client.

ii) For all completed work, the Network Operator will also be required to submit to CCK the returns mentioned above.

5.4. Security

5.7.1. Contractors must secure authority to enter any of Network Operator's restricted areas such as exchanges and radio stations.

5.7.2. Contractors must secure authority to work on Network Operators' underground or aerial cables, cabinets, manholes, joint boxes, pillars and Distribution Points.

5.7.3. It is the responsibility of the building proprietor and equipment owner to ensure that communications facilities fitted in his premises are secure and free from vandalism and tampering.

5.7.4. Installation Contractors working in buildings shall register the company and names of licensed technical personnel with the proprietor, estate officer or his agent.

5.7.5. Indoor equipment and installations (MDF rooms and common distribution points) should be locked up all the time and anybody wishing to gain access to them should be authorized by operator.

5.5. Installation Equipment and Tools

5.9.1. Network Operators/Contractors shall maintain appropriate installation equipment, tools and test gears.

5.9.2. The Commission may at any time without notice visit the Network Operator's/Contractor's workshop to confirm adequate installation equipment, tools and test gears are available.

5.6. Room Specifications for Communications Facilities

The facilities discussed here will cover all internal installations including wireless installations such as hot spots

5.6.1. ***Internal DP/MDF***

i) The size of any internal DP/MDF room and the type of fitting shall be determined by the number of telecommunication points and the number and size of external and internal pairs to be terminated.

ii) The floor shall be cemented or covered with PVC sheeting or tiles. Standard painting shall be ideal for the room. Adequate ventilation and natural or electric lighting shall be provided. At least one 13 Amps power socket shall be provided.

5.6.2. ***Wall Mounted Box Connection as Internal DP/MDF***

A minimum area required shall be 2.0 square metres. Sufficient space shall be left to allow free working movements during survey, installation and maintenance.

5.6.3. ***Wall Mounted Box Vertical As Internal DP/MDF***

i) The base area of a vertical e.g. type 4 or equivalent to 0.5 sq metre.

ii) One wall-mounted vertical shall require an area of 1.5 square metres.

iii) Two complete wall mounted vertical type 4 shall require an area of 2 square metres.

iv) 10% added to each area will give an average size of internal DP/MDF room which will be sufficient for survey, installation and maintenance.

5.6.4. ***Free Standing Vertical Type 4 Internal DP/MDF***

i) The base area of a free standing vertical type 4 is one square meter.

ii) One free standing vertical type 4 shall need an area of 2.5 square metres; two shall require 3 square metres; and three shall require an area of 3.5 square metres.

iii) 10% added to each calculated area will give the size of an internal DP/MDF room which will be sufficient for survey, installation and maintenance.

iv) The site for the cable joint box, external lead-in ducts, trunking and trays, PBX and battery room shall be determined by the position of the internal DP/MDF room.

v) The DP/MDF, PBX/***PABX*** and battery rooms shall be separate. A lockable door shall be provided.

5.6.5. ***Switch /PABX and operator console Accommodation***

i) The **Switch /**PABX and other internal equipment accommodation shall be determined by their physical dimensions.

ii) The minimum height from floor to ceiling shall be 2.5 metres.

iii) The room shall be cemented or covered with PVC sheeting or tiles. Air conditioning shall be provided where specified.

iv) Adequate artificial or electric lighting shall be provided.

v) The **Switch /**PABX or other internal equipment shall be protected from dust, corrosion and humidity.

vi) The **Switch /**PABX box connection shall be located adjacent to the **Switch /**PABX cabinet. The bottom of the box connection shall be at least one metre from the floor.

vii) At least one 13 Amp power socket shall be provided. A cable tray, trunking or passage for the equipment cables shall be provided.

viii) The **Switch** /PABX room shall preferably be separate and adjacent to the DP/MDF room.

ix) Anti-static protection shall be provided where necessary.

x) Sufficient working space for survey, installation and maintenance shall be provided.

5.6.6. ***Battery Room***

i. The physical dimensions shall determine the size of a battery room and number of the batteries and other associated parts to be fitted.

ii. The floor shall be cemented and preferably covered with PVC sheeting or tiles.

iii. A battery stand shall be fitted to hold the batteries.

iv. Direct sunrays shall be prevented from entering the battery room.

v. Adequate ventilation shall be provided. An extractor fan must be provided to extract fumes from the battery room.

vi. A water sink, hydrometer and thermometer shall be provided in all battery rooms in which lead acid batteries are installed.

vii. Trunking, tray or passage shall be provided between the battery and the **Switch** /PABX room.

viii. The battery room shall preferably be separate and adjacent to the internal DP/MDF or **Switch/PABX** room. A 13 Amp power socket shall be provided.

5.6.7. ***Wireless Equipment/Systems***

A wireless system would include indoor and outdoor radio systems. The requirements for installation of a wireless equipment will be similar to that of wired telecommunication equipment. However for wireless systems/equipment, care shall be taken to ensure human safety or the effect of radio frequency radiation on human is minimized. ITU-T recommendation K.71 provides requirements to minimize the risk of injury to users of the service and damage to equipment. It provides requirements to achieve protection of telecommunications and video content antenna systems, including satellite antennas, against lightning discharges and mains contact including contact with aerial power service leads.

When protection against direct lightning discharges is not required, this ITU-T K.71 requires protection against mains contact to minimize the risk of injury to users of the service and to network operator personnel.

6. INSPECTION

6.1. General

The design, planning, implementation, operations and maintenance of the telecommunications networks is based on the internationally agreed standards and regulations. This ensures high quality of services and enhances network reliability. Each and every component of the network has a direct impact on this quality of service and reliability. It is required that these standards are maintained. Therefore CCK considers it imperative for all network operators to inspect all telecommunications installations intended for connection to their networks before commissioning them. Additionally, private networks and other networks that would not connect to public networks shall be inspected and certified by CCK before commissioning.

6.2. Contractor's Responsibilities

6.2.1. The Contractor shall carry out all installation according to the laid down installation guidelines and procedures in chapters 4 and 5.

6.2.2. On completion of the work, the Contractor shall submit "Completion of Works Notice" within five (5) days and await inspection by the network operator. A copy of this form should be submitted to CCK.

6.2.3. During inspection the Contractor's and the network operators licensed engineer(s) shall be present and sign the inspection document.

6.3. Network Operator's Responsibilities

6.3.1. On receipt of **"**Completion of Work Notice" the network operator shall arrange and inform the Contractor of the intended inspection date.

6.3.2. The inspection time frame agreed between the contractor and the network operator should not exceed 15 days from the completion date.

6.3.3. During inspection the network operator and the contractor shall follow the inspection tests and procedures described in this chapter and sign the inspection document.

6.3.4. The Network operator shall complete and issue to contractors provisional acceptance of completed work document for an installation which complies with the required standards.

6.3.5. The Network operator shall complete and issue to contractors a report of defects of completed work for an installation which does not comply to the required standards

6.3.6. The Network operator shall prepare and submit monthly Summaries of all completed and commissioned Telecommunications Installations to the Commission

The contractor shall prepare and submit Monthly Summaries of all completed and commissioned Telecommunications Installations to the Commission.

6.4. Commission Responsibilities

6.4.1. On receipt of the summaries from Network operators and Contractors, CCK will reconcile these returns.

6.4.2. The Commission will then randomly visit the sites and inspect drawings, wiring, terminal equipment and any other aspects of the completed communications installations.

6.4.3. For an installation which fails to meet the required standards the Commission will communicate in writing to the Contractor and/or Network Operator of the defects found on the inspected installations pointing out the defective areas and the recommendations for rectification of the defects.

6.4.4. For communication installations that fully comply with required standards and specifications, the Commission will issue a "Performance Certificate" to the Contractor/Network Operator who carried out the Installations.

6.5. Inspection Standards

6.5.1. General

These are the minimum requirements which the Network operator's and Contractor's inspection officers are required to check and confirm before the installation can provisionally be accepted. One inspection form shall be used for each installation inspected. The checklist is available at the Commission's website (refer to 9.2) and the requirement summarised hereafter in 6.6 to 6.8.

Network Operator's Inspection Officer and Contractors licensed technical personnel to countersign the completed checklist.

6.6. Wiring for Flats, Maisonettes, Bungalows and Single Floor Go downs

6.6.1. Local Distribution Points on Walls

i. Drop wires provided up to the protector units are accessible for maintenance purposes and fitted at protected points.

ii. Conduits, trunkings, skirting boards and telephone sockets are provided.

iii. PVC cables from protector units are properly run in conduits or trunkings, cleated, stapled and/or clipped on the skirting boards.

iv. Line Jack Units (LJUs) are accessible and protected for maintenance purposes.

v. Pairs are properly terminated and soldered where necessary.

vi. Carry out insulation and continuity tests to ensure compliance with CCK's network specifications and standards.

vii. Power infringement separation between telecommunications and power cables is maintained and proper protection is maintained.

6.6.2. Accommodation for Local Internal Distribution Points

i. The space is big enough and facilitates easy access for survey, installation and maintenance.

ii. The floor is cemented and preferably covered with PVC sheets or tiles.

iii. The room has adequate natural and/or electric lighting.

iv. The network operator's lead-in UG [underground]cable ducts are properly sealed to stop water and rodents from entering the room.

v. An earth protection system of 0 to a maximum of 2 ohms is provided and properly terminated. Indicate exact value measured.

vi. All earth wiring for the entire building is commoned to avoid different earth potentials [common bonding]

vii. Conduits leaving to various flats, rooms and offices are as per the specification and originate from the local internal DP room and as per wiring drawing.

6.6.3. Block Terminal/Box Connection Fitting

i. Block terminal/box connection is fitted at a suitable position accessible for survey, installation and maintenance.

~~ii.~~ Underground exchange cable pairs are terminated on E side (exchange side) of the terminal block/box connection

iii. Terminated pairs are soldered and labelled.

iv. The cover of the block terminal/box connection must be sign written with the appropriate DP serial number.

6.6.4. Cabling

i. Conduits, trunkings, skirting boards and telephone sockets are provided.

ii. PVC cables from block terminal/box are properly run in conduits or trunkings. Surface mounted cables should be cleated, stapled or clipped.

iii. All lead-in PVC cables are properly terminated and soldered on the D sides of the terminal block/box .

iv. All terminated pairs are labelled indicating flat/room/office number.

v. All LJUs are properly fitted at suitable, accessible and protected positions.

vi. Carry out and record insulation and continuity tests to ensure compliance with CCK's Network specifications and standards.

vii. Locking facilities shall be provided to secure the DP whose serial number shall be sign-written on the outside of the cover.

6.7. High Rise Buildings

6.7.1. Rooms for Local Internal DPs and MDFs

i. Th**e** room is big enough and facilitates easy access for survey, installation and maintenance.

ii. **T**he floor is cemented and preferably covered with PVC sheets or tiles.

iii. The room is at least 2.5 metres high.

iv. The room has adequate natural or electric lighting.

v. The room has enough ventilation and/or air conditioning facilities.

vi. The room has at least one 13 Amps power socket.

vii. Where applicable, the room has a proper UG joint cable chamber and cover.

viii. Lead-in ducts are sealed to prevent water rodents and vermin from entering the DP/MDF room.

ix. An earth protection system zero (0) to a maximum of 2 ohms is provided and properly terminated. Indicate exact value measured.

x. Cable trays and trunkings of correct sizes are provided to various risers.

6.7.2. **Fittings for Local Internal DPs and MDFs**

i. Box Connection Nos 1A, 1B, 2A and 2B are properly fitted in singles or doubles. Pairs and covers are properly labelled for ease of survey, installation and maintenance works.

ii. Box Connection No 301A are properly fitted in singles or doubles. Pairs and covers are labelled for ease of survey, installation and maintenance.

iii. Vertical type No 4 has properly been fitted.

iv. Disconnection blocks are properly fitted, protected and labelled.

6.7.3. **External Cabling in Local Internal DPs and MDFs.**

i. Network operators external line underground cables are neatly arranged, formed and laced.

ii. Network operator's ***external*** line UG pairs are terminated according to the–standard telecommunications wiring colour code, soldered and labelled.

iii. An earth protection system of zero to maximum of 4 zero (0) to a maximum of 2 ohms is provided and properly terminated. Indicate exact value measured.

6.7.4. **Internal Cabling in Local Internal DPs and MDFs**

i. Wiring cables from the tray or trunking are neatly arranged and laced to avoid over-crossing.

ii. A smooth curve is maintained at the end of the cable tray or trunking to avoid cable kinks and damage to pairs.

iii. Cable pairs are sorted out as per floor or wing or discase numbers and laced.

iv. A smooth curve is maintained as the cables are led-in, formed and pairs terminated on the D side of the box connection No 1A or 1B or 2A or 2B as per the standard telecommunications wiring colour code and soldered where necessary.

v. Discases are labelled for identification.

vi. A uniform smooth curve is maintained as the cables are led-in, formed and pairs inserted in the allocated D Side of the box connection No 301A as per the standard telecommunications wiring colour code.

vii. Boxes Connections Nos 301A are sign-written and clearly labelled for identification.

viii. Spare short terminal block cross arms are identified at the end of E Side.

ix. A Uniform smooth curve is maintained and the cables are laced along the vertical bar led from either the top or ground trunking across the short terminal block cross arms.

x. The disconnection blocks No 71 are fitted on the free standing vertical type 4 as per the ***CCK's*** telecommunications network specifications and standards.

xi. Exchange side disconnection blocks shall be fitted horizontally and those on equipment side shall be fitted vertically.

xii. Cables to the terminating block or jack or disconnection block are smoothly curved and overlapped with grey or cream insulating tape. Firm knots are made using the ~~standard~~ telecommunications wiring colour code as a guide.

xiii. The pairs are formed and passed through the wire guides of the terminal blocks, jacks or disconnection block No 71 as per the CCK's telecommunications network specifications and standards.

xiv. The pairs are laced and terminated, inserted, wrapped or soldered where necessary and clearly labelled.

xv. The verticals are sign-written using block letters in alphabetical order.

xvi. The distribution side termination blocks or jacks are sign-written to indicate floor, wing and discase numbers.

xvii. Information of " Building Wiring Routing" indicating the Distribution side pairs of the wiring are kept securely in the DP/MDF room.

xviii. The current wiring distribution diagrams are kept securely in the DP/MDF room.

xix. The top four arms of the vertical type 4 are reserved for PBX cable terminations.

6.7.5. **Riser Facilities**

i. A continuous wooden plank or batten or trunking is provided along the entire riser.

ii. Strong cemented or wooden platforms are provided along the entire length of large risers.

iii. Adequate electrical lighting facilities are provided along the entire length of the riser.

iv. A lockable access to the riser is provided at every floor to facilitate installation of boxes.

v. The riser has at least one 13 Amps socket on every floor.

vi. Power infringement separation between telecommunications and power cables is maintained.

vii. Adequate conduits are provided from all risers to floor and wings.

6.7.6. Cabling in Risers

i. All cables are properly arranged, laced and clipped. The cables are arranged without crossings.

ii. The minimum-bending radius of the cables to each discase is maintained to avoid kinks and damage to internal cable pairs.

iii. An earth protection system of zero to a maximum of 2 ohms is stapled along with the clipped cables and extended to the discases.

iv. All cables are arranged and laced on the cable tray back to the MDF.

v. Power infringement separation between telecommunications and power cables is maintained.

6.7.7. Box Connection and Discases Fitted in Risers

i. Box Connection types 1A, 1B, 2A, 2B or Box Connection No 301A krone type or equivalent are fitted.

ii. Box Connection are fitted at protected and accessible positions.

iii. Discases are provided with protective devices.

iv. Cable pairs for Box Connection types 1A, 1B, 2A and 2B are properly terminated on the E side of the discases, soldered and labelled.

v. Cable pairs for Box Connection No 301A krone type are properly inserted.

vi. Discases are properly sign-written indicating discase No, floor No, wing No and riser No.

6.7.8. Floor Cabling Facilities

i. Each floor has adequate conduit and/or trunking systems.

ii. Telephone sockets and sub-discases are provided at specified positions on each floor.

6.7.9. Cabling From Discases

i. Cables of the specified sizes are properly run in conduits and/or trunkings or clipped on the skirting boards.

ii. All cables pairs on the D side of box connection type 1A, 1B, 2A and 2B are terminated, soldered and labelled indicating wing and office numbers.

iii. All cable pairs on the D side of box connection No 301A krone type are properly inserted and labelled indicating wing and office numbers.

iv. All LJUs are properly mounted onto the walls and fitted at suitable, accessible and protected positions.

6.7.10. Sub-discase Fittings

i. Block terminal No 27A or Box Connection No 1A or 1B or equivalent are properly fitted on surfaces or in accessible recesses with covers.

ii. All sub-discases are properly earthed.

iii. All sub-discase covers are clearly labelled inside and sign written outside indicating pair numbers and sub-discase numbers respectively.

6.7.11. Cabling From Discases to Sub-discases

i. Cables of the specified sizes are properly run through the conduits and/or trunkings or clipped on the skirting boards.

ii. All pairs are terminated, soldered, and labelled on the D and E sides of the discases and sub-discases.

6.7.12. Cabling From Sub-discases

i. PVC cables of the specified sizes are properly run in conduits and/or trunkings, cleated or stapled or clipped on skirting boards or any other suitable surface.

ii. All cables are terminated and labelled on the D side of the sub-discase.

iii. All cables from the sub-discases are properly terminated and soldered on the LJUs.

iv. All LJUs are properly fitted at suitable, accessible and protected positions.

6.7.13. Insulation, Continuity and Earth Tests

i. Carry out and record results of insulation and continuity tests between local MDF/internal DP and all discases, sub-discases and LJUs. Measured values should meet **CCK's** specifications.

~~ii.~~ Measure and record values of the earth protection system at the local MDF/internal DP and all discases, sub-discases and LJUs. Measured values shall be within the specified range zero to a maximum of 2 ohms

6.7.14. Drawings and Materials

i. The installation work was carried out according to the submitted and approved drawings.

ii. All cables, materials and wiring accessories used are as per the submitted and approved list and specifications.

6.8. Equipment

6.8.1. Type Approval

Check that the equipment is CCK type-approved. Read and record particulars for all the installed equipment.

6.8.2. Installation Status

i. Check if the installation is neatly arranged and well laid out.

ii. Check if Installation and commissioning manuals for all installed equipment are provided.

6.8.3. Accommodation

i. PABX

a. Measure ***PABX*** room dimensions and confirm they comply with the sketch submitted along with Application form

b. Floor is covered with PVC sheeting or tiles.

c. Adequate natural or electric lighting.

d. Room is protected from dust, humidity, vermin, rodents and has adequate ventilation and is accessible.

e. Room is clean and tidy

f. Accommodation is safe and secure

6.8.4. Commissioning Tests by contractor and network operator

a. Carry out commissioning tests in accordance with the equipment manufacturer's installation and commissioning manuals and confirm that the installed terminal equipment can access the- Operator's network.

b. If the tests are successful, provide the service and commission the equipment and the associated installations.

7. MAINTENANCE

7.1. Responsibilities

7.1.1. Wiring in Bungalows, Maisonettes and Single Floor Go-Downs

i. Network Operators shall maintain the cable network from the public exchange up to the protector unit (PU) at the subscriber premises

ii. It shall be the responsibility of the building proprietor/client to maintain the wiring from the PU up to the line jack unit (LJU). He shall do so by engaging any licensed maintenance-Contractor.

iii. It shall be the responsibility of the Estate agent, campus administrator or the proprietors to maintain any external wiring carried out by contractors licenced by CCK in such institutions. The demarcation point shall be at the main distribution frame (MDF) where network operator's cables are interconnected with the distribution cables.

7.1.2. Wiring in a Block of Flats Served by a Common Internal Distribution Point (IDP)

i. It shall be the responsibility of the Network Operators to maintain the cable network from the public exchange up to the main discase (internal distribution point)**.** The main discase complete with its terminating facilities and earth system, provided and installed by the Contractor shall be the interfacing point between the Operator's network and the internal wiring.

ii. It shall be the responsibility of the building proprietor and/or user (communication user) to maintain the wiring from the "D" side of the main discase up to the Line Jack Unit (LJU) in each flat.

7.1.3. Wiring in a Block of Flats Served by an External Distribution Point (EDP)

i. Any Contractor licensed for external wiring shall provide the drop wire between the external DP and the PU.

ii. Cable and wireless networks between the DP and the Public Exchanges shall be maintained by Network Operators.

iii. It shall be the responsibility of the building proprietor and/or user to maintain the wiring from the PU up to the LJU in each flat.

7.1.4. Wiring in High Rise Buildings

i. The Network Operator shall maintain the cable network from the public exchange up to the "E" (Exchange) side of the local main distribution frame (MDF) or box connection, at the subscriber's premises. The MDF or box connection supplied and installed by the Contractor complete with its terminating facilities and earth system shall be the interfacing point between the Network Operator's external network and the building wiring.

ii. If the building is fitted with a box connection or its equivalent, the building proprietor shall maintain the wiring from the "D" (Distribution) side of the box connection up to the LJUs.

iii. If the building is fitted with a local MDF the building proprietor shall maintain the wiring from the "D" side of the MDF including the MDF itself, jumper wire through the discases, sub-discases up to the LJUs.

7.1.5. Internal Communication Equipment

i. It shall be the responsibility of the owner of the internal communication equipment to maintain from the equipment side of the equipment box connection or local MDF including the equipment itself.

ii. It shall be the responsibility of the owner of the terminal communication equipment installed to maintain the installation from the LJU including the equipment itself.

7.2. Fault Reporting Procedures

7.2.1. The subscriber shall in the event of a fault in the wiring or terminal equipment report to the local Maintenance Control Centre (MCC) or any other such name given to such centre. Different network operators may have different fault reporting procedures, centres, numbers and codes**.**

7.2.2. The MCC will allocate and give a fault reference (slip) number to the complainant. Different network operators may have different fault recording procedures.

7.2.3. The fault shall then be diagnosed and if found to be within the subscriber owned terminal equipment and/or wiring, the subscriber shall immediately be advised accordingly. He shall then call his Maintenance Contractor to clear the fault.

7.2.4. The Maintenance Contractor will record fault details including but not limited to the date and time the fault was reported. Different Contractors may have different ways of fault recording.

7.2.5. The Maintenance contractor shall take the appropriate action without delay (48 hours). Once the fault has been cleared, the Maintenance Contractor shall report to local MCC giving location and nature of fault, date and time it was cleared.

7.2.6. In the event of the fault being localised within the network operator's cable network, then the network operator shall take the appropriate action without delay (48 hours).

7.3. Security

7.3.1. Maintenance Contractors are not authorised to enter any of network operator's restricted areas such as exchanges and radio stations, without permission and prior appointment.

7.3.2. Maintenance Contractors are not authorised to work on network operator's underground or aerial cables, cabinets, manholes, joint boxes, pillars and DPs. without permission and prior appointment

7.3.3. It is the responsibility of the building proprietor and equipment owner to ensure that communications facilities fitted in his premises are secure and free from vandalism and tampering.

7.3.4. Installation Contractors working in buildings shall register the company and names of

licensed technical personnel with the proprietor, estate officer or his agent.

7.3.5. Maintenance of works order or any such document is a necessary document and all network operators are required to encourage the maintenance Contractors working on their networks to use them .The reference numbers may differ though.

7.4. Maintenance Spares, Tools and Test Equipment

7.5.1. Contractors shall stock maintenance spare parts as recommended by the manufacturer or supplier of the equipment.

7.5.2. The Commission may at any time without notice visit the Contractor's workshop to confirm adequate maintenance facilities, tools and test gears are available.

7.5. Maintenance Targets

CCK requires that all faults affecting client's wiring and equipment be cleared immediately (maximum in 48 hours). It also expects that any Network operator should have minimal fault accumulation records.

8. FEES AND CHARGES

The Communications Commission of Kenya (CCK) charges the following licence fees for postal, telecoms, radio operators and also for type approval of the equipment they market or use. This categorization and accompanying fees are reviewed from time to time.

8.1. POSTAL*/COURIER OPERATORS*

The current charges and fees for Postal / Courier operators are available on the Commission's website at http://www.cck.go.ke/postal_courier_licence_fees/. This may change from time to time and users of this information need to consult this link frequently.

8.2. *REGISTRATION AND LICENCING FEES FOR TELECOMMS OPERATORS AND SERVICES*

The current registration and license fees for telecoms operators and services are available on the Commission's website at http://www.cck.go.ke/telecomms_licence_fees/. This may change from time to time and users of this information need to consult this link frequently.

8.3. FREQUENCY SPECTRUM FEE SCHEDULE

The current frequency spectrum fees schedule is available on the Commission's website at http://www.cck.go.ke/spectrum_fees/. This may change from time to time and users of this information need to consult this link frequently.

8.4. TYPE APPROVAL CHARGES AND FEES

The current type approval fees schedule is available on the Commission's website at http://www.cck.go.ke/type_approval_fees/.

This may change from time to time and users of this information need to consult this link frequently.

9. *FORMS*

9.1. *Telecommunications Services Registration and Licensing*

Forms for telecommunications services authorization and licensing are available on the Commission's website at http://www.cck.go.ke/license_application_forms-telecommunications/ .

The forms may be amended from time to time and users of this information need to consult this link frequently and use the right forms.

9.2. *Telecommunications Standards (Inspection & Certification)*

Forms for inspections and certification purposes are available on the Commission's website at http://www.cck.go.ke/telecomms_licence_enforcement/.

The forms may be amended from time to time and users of this information need to consult this link frequently and use the right forms.

9.3. *Type Approval*

Forms for type approval are available on the Commission's website at http://www.cck.go.ke/type_approval_forms/ . The forms may be amended from time to time and users of this information need to consult this link frequently and use the right forms.

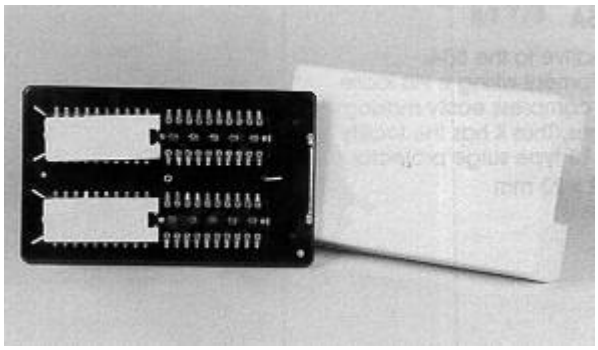
9.4. Radio and Television Frequencies Application Forms

Forms for frequency licensing purposes are available on the Commission's website at http://www.cck.go.ke/licence_application_forms/ . The forms may be amended from time to time and users of this information need to consult this link frequently and use the right forms.

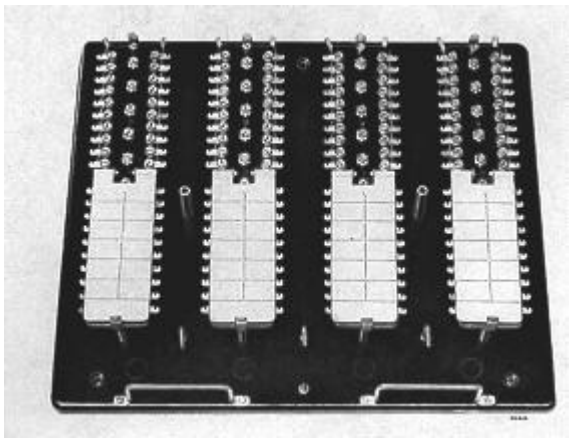
Note Please note that the Originals of these form should consist of CCK's LOGO

ANNEX 1: BOX CONNECTIONS

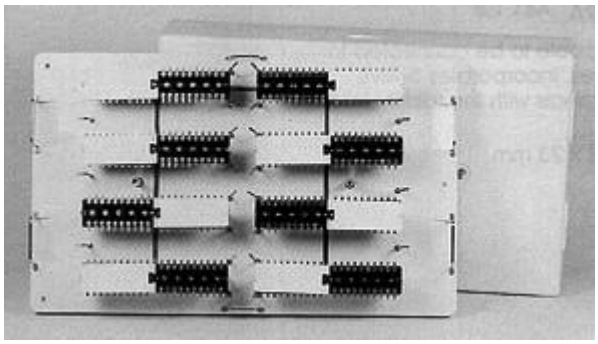
Box Connection No. 1B
40 pair screw/solder block
268 x 168 x 64mm
Cover in grey or ivory.
For internal use.



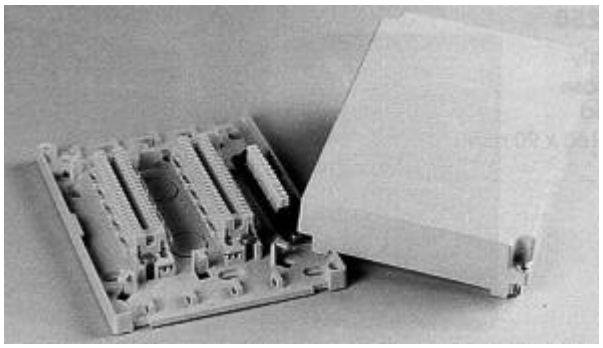
Box Connection No. 2A
80 pair screw/solder block
10.5 x 12.25 x 2.5 inches
Cover in grey or ivory.
For internal use.



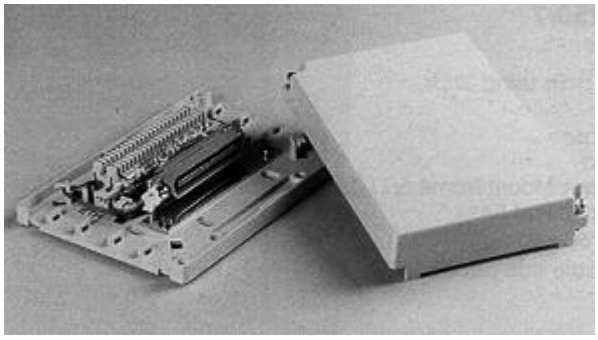
Box Connection No. 3B
160 pair screw/solder block
584 x 368 x 89mm
Cover in grey or ivory
For internal use



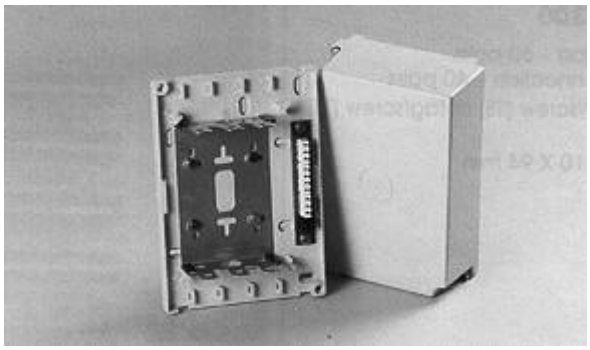
Box Connection No. 201
20 pair IDC block
170 x 120 x 35mm
For internal use



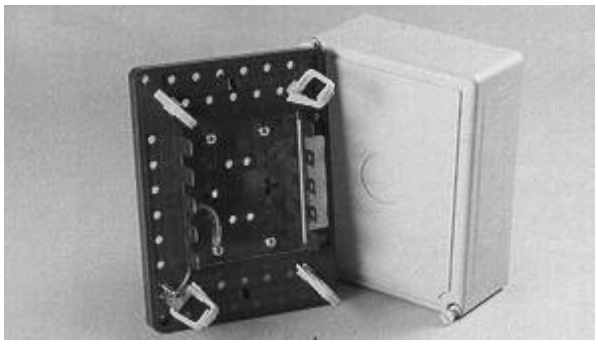
Box Connection No. 203
8 pair IDC - 226 connector
170 x 120 x 35mm
For internal use.



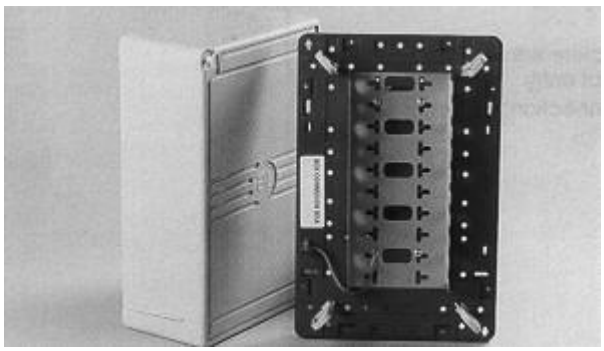
Box Connection No. 220
Provision for 3 strips Connection 237
170 x 120 x 65mm
For internal use.



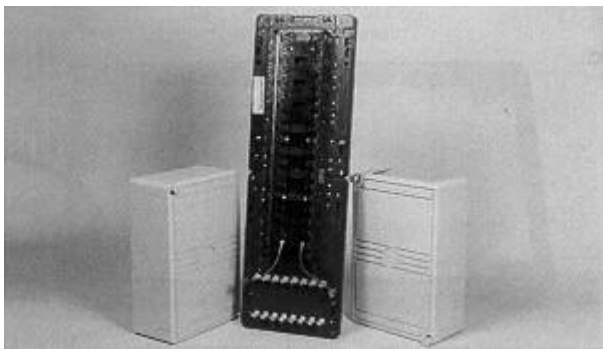
Box Connection No. 251
Provision for 5 strips connection 237
210 x 160 x 90mm
For internal use.



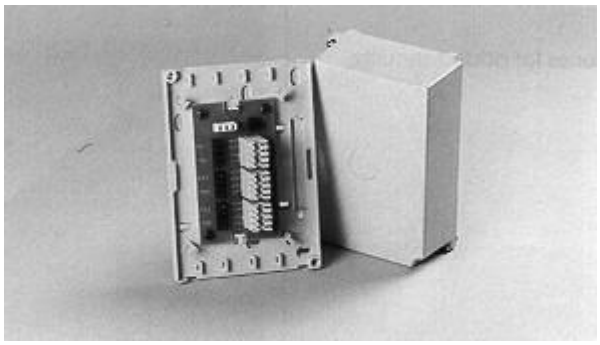
Box Connection No. 301
Provision for 10 strips connection 237.
320 x 210 x 120mm
For internal use.



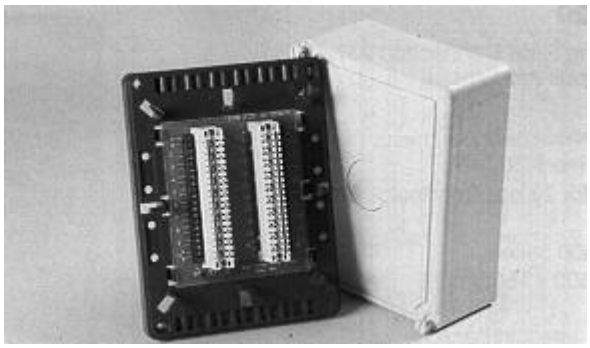
Box Connection No. 304
Provision for20 strips connection 237
Provision for 8 connectors 226
640 x 210 x 120mm
For internal use.



Box Connection No. 222
6 pair screw - IDC. Used as an NTT**P**
170 x 120 x 65mm
For internal use

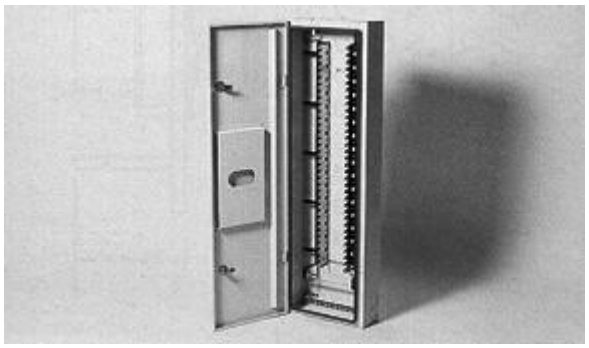


Box Connection No. 254
20 pair screw - IDC. Used as an NTTP.
210 x 160 x 90mm
For internal use.

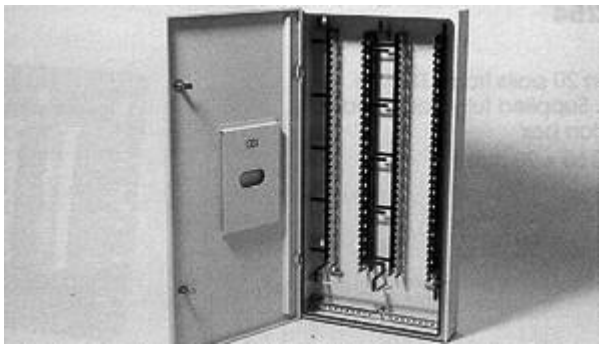


Box Connection No. 501
Provision for 100 pairs. Lockable. 1 frame
350 x 240 x 110mm
Box Connection No. 502
Provision for 200 pairs. Lockable. 1 frame
700 x 240 x 110mm
Box Connection No. 503
Provision for 200 pairs. Lockable. 2 frames
350 x 420 x 110mm
Box Connection No. 504
Provision for 400 pairs. Lockable. 2 frames
700 x 420 x 110mm

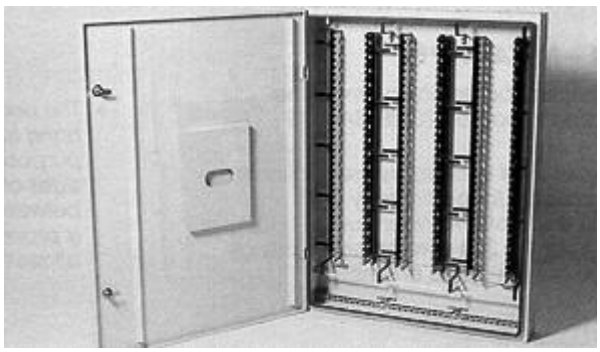
Box Connection No. 510
Provision for 34 strips connections 237
Lockable.
1000 x 300 x 150mm
For internal use.



Box Connection No. 520
Provision for 68 strips connection 237
Lockable.
1000 x 500 x 150mm
For internal use.



Box Connection No. 530
Provision for 102 strips connection 237
Lockable.
1000 x 925 x 150mm
For internal use.



Annex 2: Specification No CW21(M) for internal cable

General

This specification details cable with tinned copper conductors, PVC insulation and PVC sheath used by network operators and wiring contractors for general internal cable distribution and wiring.

4.6.1. Conductors

i. Materials

Each conductor in the cable shall consist of a solid wire of annealed high conductivity copper, smoothly drawn, circular in cross-section, uniform in quality, free from defects and uniformly coated with pure tin.

ii. Dimensions

The diameter of the tinned conductor in the completed cable shall be in accordance with Table 1.

iii. Electrical Requirement

The resistance of the tinned conductor shall be in accordance with Table 1.

iv. Mechanical Requirements

a. The extent to which the tin coating permits easy soldering shall be determined by the solder bath method detailed in Clause 4.6.10.4

b. The elongation at break of any sample of bare conductor taken from the completed cable shall not be less than 14% at 20 degrees C. The test shall be made on a suitable test piece such that the gauge length between the jaws of the testing machine shall be 200 mm or 250 mm. The rate of separation of the jaws shall be about 100mm/min.

c. Joints in the conductor shall be kept to a minimum. The ultimate tensile force of a 250mm length of conductor containing a joint shall not be less than 90% of that of an adjacent length of conductor not containing a joint.

4.6.2. Insulation

i. Material

The material shall be coloured and shall comply with requirements of PVC compound type 2 in BS6746.***

a. The test for colourfastness to daylight in BS6746 (Test Method L) shall apply to one and two-colour wires.

b. The test for bleeding and blooming of colour in BS6746 (Test Method M) shall apply but only to one colour wires.

c. The heat shock test in BS6746 (Test Method G1) shall be carried out on one and two-colour single wires. The samples shall be wound as specified in a close helix of six turns round the mandrel. The ends shall extend at right angles to the mandrel in opposite directions for a length of 25 mm. After the test, in addition to meeting the requirements of the BS, the retraction on each 25 mm length shall not exceed 1.5 mm and the insulation colours shall remain readily identifiable.

ii. **Colours**

a. One-Colour Wire: The colour shall be incorporated in the insulating compound.

b. Two-Colour Wire: The colours shall be uniform in the form of either continuous spiral or ring markings, which shall be readily identifiable in every 15 mm of length. The purpose of the marking is to provide easy identification of wires. Markings in the finished wire shall reasonably match the colours shown in BS6746C.

1. Spiral markings shall be effected by the application of one or more ink stripes on a base colour or by direct extrusion.

2. Ring markings shall consist of ink bands applied on a base colour at right angles to the axis of the conductor. The registration of the half bands and complete encirclement of the wire is not critical.

3. Base colours are indicated in Table 2 by the use of capital letters.

4. The ink for wires identified by colour combinations incorporating black stripes shall meet the surface leakage test requirement given in para. 10.10.3.

iii. **Dimensions**

The conductor shall be uniformly covered with the specified PVC having radial thickness and diameter over insulation in accordance with Table 1.

iv. **Joints**

Joints in the insulated conductor shall be kept to a minimum and shall be made only by approved method.

4.6.3. **Cabling Elements**

i. **Cabling Element**

A cabling element shall consist of one of the following:

a. A single insulated conductor.

b. A pair of insulated conductors uniformly twisted together and designated the a-wire and the b-wire respectively.

c. A triple of insulated conductors uniformly twisted together and designated the a-wire, the b-wire, and the c-wire, respectively.

d. A quad of insulated conductors uniformly twisted together and designated the a-wire, the b-wire, the c- wire and the d-wire. The conductors shall be so arranged that their sequence is a, c, b and d, coloured BLUE, GREEN, ORANGE and BROWN respectively.

ii. **Lay Length**

The lay length for pairs, triples and quads in the finished cable shall not exceed 100 mm.

iii. Stranding

The elements shall be laid up in layer construction unless the PO designation in Table 3B has the suffix 'U'. In this case the cable shall be laid up in unit construction.

iv. **Layer Construction**

a) The elements shall be laid up to form a compact and circular cable.

b) The colours of the wire in the various sizes of cable shall be as given in Table 3.

c) The sequence of loading of the stranding machine shall be in accordance with Table 3, the first named element being in the centre.

d) Inter-layer tapes consisting of an open lapping of polyethylene terephthalate or polypropylene tape may be applied at the discretion of the manufacturer.

v. **Unit Construction**

a. The elements in these cables shall be pairs and shall be laid up as units or sub-units.

b. Each unit shall consist of 20 pairs, coloured in accordance with Table 2, cabling elements 1 to 20.

c. The 20 pairs shall be formed into a single unit or into two sub-units of 10 pairs each as specified in Table 4. The first sub-unit shall be pairs 1 to 10, the second, 11 to 20.

d. An open lapping of polyethylene terephthalate or polypropylene tape shall be applied over each unit or sub-unit. The colour of the tape shall be as specified in Table 4. For 20 pair cables this lapping may be omitted.

e. The units and sub-units so formed shall be laid up as specified in Table 4 into a compact and circular cable core.

vi. **Cable Core Protection**

Except for cables containing 12 wires or less when this protection may be omitted, the stranded cable core shall be covered overall, prior to sheathing, with polyethylene terephthalate tape by one of the following methods:-

a. A single tight lapping having an overlap of 25% nominal.

b. Two tapes applied breaking joint

c. One tape applied longitudinally with an overlap of not less than 10 mm or 30% of the tape width, whichever is the smaller.

d. Two similar tapes applied longitudinally with overlaps of 50% of the tape width or 10mm, whichever is the smaller.

4.6.4. Identification

The manufacturer's identification thread (BS Document PD 2379) shall be separately incorporated in the cable. This may be omitted from 1-wire cables.

4.6.5. Rip-Cord

A non-metallic rip-cord which may incorporate the manufacturer's identification colours, shall be laid under the sheath. It shall provide an effective means of slitting the sheath longitudinally to facilitate removal.

The rip-cord may be omitted from 1-wire cable.

4.6.6. Sheath

i) **Material**

The sheath material shall be coloured and shall comply with the requirements of PVC compound type TM1 in BS 6746.

ii) **Colour**

The sheath shall be cream or grey as ordered.

iii) **Dimensions**

The dimensions of the sheath shall conform to Table 3 but in determining the minimum sheath thickness the indentation caused by the rip-cord and/or the identification thread shall be ignored.

iv) **Mechanical Requirements**

The sheath shall be continuous and of a thickness as uniform as possible. The sheath shall be applied to fit closely to the cable core, but shall not adhere to any underlying core protection or to the insulation of the conductors. Any regular marking due to underlying construction shall not be regarded as a defect.

v) **Stripability**

It shall be possible to strip 50 mm of insulation from the wire taken from completed cable with a force which does not exceed that shown in Table 5. The preparation of the sample and the performance of the test shall be based upon the method described in IEC Recommendation 189-1, clause 3.4, second method.

4.6.7. Electrical And Mechanical Requirements

i) **Capacitance Unbalance**

a. Except for quad cables, pair-to-pair capacitance unbalance measurements shall be made at a suitable frequency. The first and second conductor of a triple constitute a pair. All conductors other than those under test shall be connected to earth.

b. The measurements shall be corrected as follows, lengths less than 100m being considered as 1000m.

c. The measured values shall be divided by 0.5[L/500 + □L/500] where L is the length **in metres of the cable under test.**

d. Not more than 1% of the corrected capacitance unbalance measurements between adjacent pairs shall exceed the values shown in Table 6.

ii) **Insulation Resistance**

Insulation resistance measurements shall be made with not less than 500 V dc. After steady electrification for one minute, the insulation resistance measured between each conductor in the cable and the remaining conductors together, shall not be less than the value specified in Table 7.

iii) **Surface Leakage**

Black ink used for either spiral or ring marked cores shall be tested in the "as received" condition. A sample of the ink shall be applied without brushing i.e. by casting or spraying, on to a flat sheet of moulded PVC to form a uniform film. The prepare specimen shall be conditioned at 75 ±2% relative humidity for 24 hours at 20 ±2 degrees C. A surface resistivity test shall be carried out using method 203A of BS 2782. The minimum value of surface resistivity (log 10 ohms) shall be 11. The test on the specimen shall be completed within three minutes of its removal from the controlled atmosphere.

iv) **Solder Bath**

a A test piece consisting of a suitable length of wire shall be taken from the cable. One end shall be stripped of insulation to expose 15 ±1mm of the tinned conductor.

b The solder bath used for the test shall be of sufficient volume to ensure that the temperature of the solder remains constant when introducing the conductor. Precautions shall be taken to maintain a uniform temperature of 270 ±10 degree C throughout the mass of solder and also to ensure that the conductor shall not be heated by direct radiation prior to insertion into the bath.

c The surface of the bath shall be kept clean and immediately before immersion of the conductor, a piece of solder 12 mm long and 1.6 mm diameter, shall be dropped into middle of the bath. The solder shall be 60/40 tin-lead alloy with a non-activated resin core. No other flux shall be used for this test.

d As soon as the added solder has melted, the stripped end of the conductor shall be immersed to a length of approximately 10 mm into the bath of a period of 2+/-0.5

seconds.

e The conductor shall be examined for quality of solder coating. Good quality shall be evidenced by free flowing of the solder with wetting of the conductor end.

4.6.8. Resistance to Flame Propagation

The cable shall conform to POTH Specification M231.

4.6.9. Sealing Of Ends

After completion of the electrical tests, the ends of the cable shall be sealed to prevent the ingress of moisture.

4.6.10. Specification No CW21(M) Reference Tables

These tables are for use with section 4.6 of the "Guidelines to Contractors for Supply, Installation and Maintenance of Telecommunications Internal Wiring and Terminal Equipment"

Conductor		**Insulation**	**Insulated Conductor**
Diameter	Resistance per 1000m @ 20 deg. C	Radial thickness	Overall diameter
Nominal mm	Maximum Ohms	Maximum mm	Maximum mm
0.4	153	0.15	0.85
0.5	97.8	0.15	0.95
0.63	67.9	0.15	1.05
0.9	29.6	0.25	1.6

Table 1: Conductor and Insulation

Cabling Element	**Colour of the insulation**		**Cabling element**	**Colour of the insulation**	
	a-wire	**b-wire**		**a-wire**	**b-wire**
1.	WHITE	BLU E	26.	RED-Blue	BLU E
2.	WHITE	ORANGE	27.	RED-Blue	ORANGE
3.	WHITE	GREEN	28.	RED-Blue	GREEN
4.	WHITE	BROWN	29.	RED-Blue	BROWN
5.	WHITE	GREY	30.	RED-Blue	GREY
6.	RED	BLU E	31.	BLUE -Black	BLU E
7.	RED	ORANGE	32.	BLUE -Black	ORANGE

Cabling Element	Colour of the insulation		Cabling element	Colour of the insulation	
	a-wire	b-wire		a-wire	b-wire
8.	RED	GREEN	33.	BLUE -Black	GREEN
9.	RED	BROWN	34.	BLUE -Black	BROWN
10.	RED	GREY	35.	BLUE -Black	GREY
11.	BLACK	BLU E	36.	YELLOW- Blue	BLU E
12.	BLACK	ORANGE	37.	YELLOW- Blue	ORANGE
13.	BLACK	GREEN	38.	YELLOW- Blue	GREEN
14.	BLACK	BROWN	39.	YELLOW- Blue	BROWN
15.	BLACK	GREY	40.	YELLOW- Blue	GREY
16.	YELLOW	BLU E	41.	WHITE -orange	BLU E
17.	YELLOW	ORANGE	42.	WHITE -orange	ORANGE
18.	YELLOW	GREEN	43.	WHITE -orange	GREEN
19.	YELLOW	BROWN	44.	WHITE -orange	BROWN
20.	YELLOW	GREY	45.	WHITE -orange	GREY
21.	WHITE-Blue	BLU E	46.	ORANGE -Red	BLU E
22.	WHITE-Blue	ORANGE	47.	ORANGE- Red	ORANGE
23.	WHITE-Blue	GREEN	48.	ORANGE -Red	GREEN
24.	WHITE-Blue	BROWN	49.	ORANGE -Red	BROWN
25.	WHITE-Blue	GREY	50.	ORANGE -Red	GREY

Note: The e-wire if any shall be coloured turquoise in all triples

Table 2a Wire Identification colours (I. E. C. Publications 189- 2 and 189 – 3)

Cabling Element	Colour of the insulation		Cabling Element	Colour of the insulation	
	a-wire	b-wire		a-wire	b-wire
51.	ORANGE-Black	BLU E	86.	RED-Brown	BLU E
52.	ORANGE-Black	ORANGE	87.	RED-Brown	ORANGE
53.	ORANGE-Black	GREEN	88.	RED-Brown	GREEN
54.	ORANGE-Black	BROWN	89.	RED-Brown	BROWN
55.	ORANGE-Black	GREY	90.	RED-Brown	GREY
56.	YELLOW-Orange	BLU E	91.	BROWN-Black	BLU E
57.	YELLOW-Orange	ORANGE	92.	BROWN-Black	ORANGE
58.	YELLOW-Orange	GREEN	93.	BROWN-Black	GREEN
59.	YELLOW-Orange	BROWN	94.	BROWN-Black	BROWN
60.	YELLOW-Orange	GREY	95.	BROWN-Black	GREY
61.	WHITE-Green	BLU E	96.	YELLOW-Brown	BLU E
62.	WHITE-Green	ORANGE	97.	YELLOW-Brown	ORANGE
63.	WHITE-Green	GREEN	98.	YELLOW-Brown	GREEN
64.	WHITE-Green	BROWN	99.	YELLOW-Brown	BROWN
65.	WHITE-Green	GREY	100.	YELLOW-Brown	GREY
66.	GREEN-Red	BLU E	101.	WHITE-Grey	BLU E
67.	GREEN-Red	ORANGE	102.	WHITE-Grey	ORANGE

Cabling Element	Colour of the insulation		Cabling Element	Colour of the insulation	
	a-wire	b-wire		a-wire	b-wire
68.	GREEN-Red	GREEN	103.	WHITE-Grey	GREEN
69.	GREEN-Red	BROWN	104.	WHITE-Grey	BROWN
70.	GREEN-Red	GREY	105.	WHITE-Grey	GREY
71.	GREEN-Black	BLU E	106.	GREY-Red	BLU E
72.	GREEN-Black	ORANGE	107.	GREY-Red	ORANGE
73.	GREEN-Black	GREEN	108.	GREY-Red	GREEN
74.	GREEN-Black	BROWN	109.	GREY-Red	BROWN
75.	GREEN-Black	GREY	110.	GREY-Red	GREY
76.	YELLOW-Green	BLU E	111.	GREY-Black	BLU E
77.	YELLOW-Green	ORANGE	112.	GREY-Black	ORANGE
78.	YELLOW-Green	GREEN	113.	GREY-Black	GREEN
79.	YELLOW-Green	BROWN	114.	GREY-Black	BROWN
80.	YELLOW-Green	GREY	115.	GREY-Black	GREY
81.	WHITE-Brown	BLU E	116.	YELLOW -Grey	BLU E
82.	WHITE-Brown	ORANGE	117.	YELLOW -Grey	ORANGE
83.	WHITE-Brown	GREEN	118.	YELLOW -Grey	GREEN
84.	WHITE-Brown	BROWN	119.	YELLOW -Grey	BROWN
85.	WHITE-Brown	GREY	120.	YELLOW -Grey	GREY

Note: The e-wire if any shall be coloured turquoise in all triples

Table 2b (Continued) Wire Identification colours (I. E. C. Publications 189- 2 and 189 – 3*)*

Cable Designation	Cabling Element (Table 2)		Sheath		***Maximum Overall Diameter***
	Pairs	Triples	**Colour**	**Maximum Thickness**	
Cr 1 Pr W&B	1		Cream	0.4	3.3
Cr 1 Pr. W& O	2		Cream	0.4	3.3
Cr 1 Pr. W&G	3		Cream	0.4	3.3
Cr 1 Pr W&Bn.	4		Cream	0.4	3.3
Cr 1 Pr. W& Gy	5		Cream	0.4	3.3
Cr 3 Pr	1-3		Cream	0.5	5.3
Cr 6 Pr	1-6		Cream	0.6	6.8
Cr 6 Tr		1-6	Cream	0.6	7.9
Cr 10 Pr	1-10		Cream	0.6	8.3
Cr 12 Pr	1-12		Cream	0.7	8.9
Cr 10 Tr		1-10	Cream	0.7	9.6
Cr 16 Pr	1-16		Cream	0.7	9.8
Cr 20 Pr	1-20		Cream	0.7	10.4
Cr 25 Pr	1-25		Cream	0.8	11.1
Gy 25 Pr	1-25		Grey	0.8	11.1
Cr 10 Pr 10 Tr	1-10	1-10	Cream	0.8	11.1
Gy 10 Pr 10 Tr	1-10	1-10	Grey	0.8	11.1
Cr 20 Tr		1-20	Cream	0.8	11.8
Cr 40 Pr	1-40		Cream	0.9	13.8
Cr 50 Pr	1-50		Cream	0.9	14.1
Cr 60 Pr	1-60		Cream	1.0	15.8
Cr 72 Pr	1-72		Cream	1.1	17.3
Cr 100 Pr	1-100		Cream	1.2	20.3

Table 3a: Make-up and dimensions of cable 0.4 mm conductors

Cable Designation	**Cabling Element (Table 2)**			**Sheath**		**Maximum Overall diameter**
	Single,or Quad (b-wire colour)	Pairs	Triples	**Colour**	**Maximum Thickness**	
Cr 1 W B	1			Cream	0.4	2.2
Cr 1 W O	2			Cream	0.4	2.2
Cr 1 W G	3			Cream	0.4	2.2
Cr 1 W Bn.	4			Cream	0.4	2.2
Cr 1 W Gy	5			Cream	0.4	2.2
Cr 1 Pr W& B		1		Cream	0.4	3.3
Cr 1 Pr W&O		2		Cream	0.4	3.3
Cr 1 Pr. W&Gn		3		Cream	0.4	3.3
Cr 1 Pr W&Bn.		4		Cream	0.4	3.3
Cr 1 Pr W&Gy		5		Cream	0.4	3.3
Cr 1 Tr W& B&Te			1	Cream	0.4	3.5
Cr 1 Tr W&O&Te			2	Cream	0.4	3.5
Cr 1 Tr W&Gn&Te			3	Cream	0.4	3.5
Cr 1 Tr W&Bn&Te			4	Cream	0.4	3.5
Cr 1 Tr W&Gy&Te			5	Cream	0.4	3.5
Cr 1 Q	See 4.7.4(iv)			Cream	0.4	4.0
Gy 1 Q	See 4.7.4(iv)			Grey	0.4	4.0
Cr 3 Pr.		1-3		Cream	0.4	4.0.
Cr 4 Pr		1-4		Cream	0.5	5.3
Gy 4 Prt		1-4		Grey	0.5	5.8
Cr 6 Pr		1-6		Cream	0.6	6.8
Gy 6 Pr.		1-6		Grey	0.6	6.8
Cr. 8 Pr		1-8		Cream	0.6	7.8
Cr 10 Pr.		1-10		Cream	0.6	8.3

Cable Designation	**Cabling Element (Table 2)**			**Sheath**		**Maximum Overall diameter**
	Single,or Quad (b-wire colour)	Pairs	Triples	**Colour**	**Maximum Thickness**	
Cr. 12 Pr		1-12		Cream	0.7	9.1
Gy. 12 Pr		1-12		Grey	0.7	9.1
Cr 14 Pr		1-14		Cream	0.7	9.5
Gy 15 Pr.		1-15		Cream	0.7	9.8
Cr. 10 Tr			1-10	cream	0.7	9.8
Cr 16 Pr.		1-16		Cream	0.7	10.0
Cr. 20 Pr		1-20		Cream	0.7	10.7
Cr. 20 Pr	/	1-20		Cream	0.7	10.7
Cr. 20 Pr	/	1-20		Cream	0.7	10.7
Gy 20 Pr U		1-20		Grey	0.7	10.7
Cr 24 Pr IS		1-24		Cream	0.8	11.3
Gy 24 Pr IS		1-24		Grey	0.8	11.3
Cr 25 Pr.		1-25		Cream	0.8	11.4

Table 3b Make-up and dimensions of cable- 0.5mm conductors

Cable Designation	Cabling Element (Table 2)			Sheath		Maximum Overall diameter
	Single,or Quad (b-wire colour)	Pairs	Triples	**Colour**	**Maximum Thickness**	
Gy 25 Pr.		1-25		Grey	0.8	11.4
Cr 10 Pr. 10 Tr		1-10	1-10	Cream	0.8	11.4
Cr 28 Pr.		1-28		Cream	0.8	11.5
Cr 30 Pr.		1-30		Cream	0.8	12.2
Cr 20 Tr			1-20	Cream	0.8	12.2
Cr 20 Tr. IS			1-20	Cream	0.8	12.2
Cr 35 Pr.		1-35		Cream	0.9	12.9
Cr 25 Tr.			1-25	Cream	0.9	13.4
Cr 40 Pr. U		1-40		Cream	0.9	14.2
Cr 42 Pr.		1-42		Cream	0.9	14.2
Cr 28 Tr.			1-28	Cream	0.9	14.5
Cr 50 Pr.		1-50		Cream	1.0	15.7
Cr 53 Pr.		1-53		Cream	1.0	15.7
Cr 60 Pr.		1-60		Cream	1.0	15.9
Cr 40 Tr.			1-40	Cream	1.0	16.3
Cr 25 Pr. 25 Tr.		1-25	1-25	Cream	1.1	16.3
Cr 46 Tr.			1-46	cream	1.1	16.7
Cr 75 Pr.		1-75		Cream	1.1	17.2
Cr 50 Tr.			1-50	Cream	1.1	17.8
Cr 80 Pr. U		1-80		cream	1.2	17.8
Cr 80 Pr.		1-80		Cream	1.2	21.8
Cr 100 Pr.		1-100		cream	1.4	22.6
Cr 120 Pr.		1-120		Cream	1.5	25.2
Cr 50 Pr. 50 Tr		150	1-50	Cream	1.6	27.2
Cr 100 Tr			1-100	Cream	1.7	28.0

Cable Designation	Cabling Element (Table 2)			Sheath		Maximum Overall diameter
	Single,or Quad (b-wire colour)	Pairs	Triples	**Colour**	**Maximum Thickness**	
Cr 160 Pr. U		1-160		Cream	1.7	29.8
Cr 320 Pr. U		1-320		Cream	2.2	39.1

Table 3b (Continued) Make-up and dimensions of cable- 0.5mm conductors

Cable Designation	Cabling Element (Table 2)		Sheath		Maximum Overall diameter
	Pairs	Triples	Colour	Maximum Thickness	
Cr 1 Tr		1	Cream	0.4	3.7
Cr 3 Pr.	1-3		Cream	0.5	5.3
Cr 6 Pr.	1-6		Cream	0.6	7.1
Cr 10 Pr	1-10		Cream	0.7	8.9
Cr 10 Tr.		1-10	Cream	0.8	10.1
Cr 20 Pr.	1-20		Cream	0.8	11.2
Cr 10 Pr 10 Tr.	1-10	1-10	Cream	0.9	12.9
Cr 20 Tr.		1-20	Cream	0.9	13.4
Cr 25 Tr.		1-25	Cream	1.0	15.5
Cr 40 Pr.	1-40		Cream	1.0	15.5
Cr 20 Pr. 20 Tr.	1-20	1-20	Cream	1.1	16.5
Cr 50 Pr.	1-50		Cream	1.1	15.5
Cr 60 Pr.	1-60		Cream	1.1	18.0
Cr 40 Tr.		1-40	Cream	1.1	18.0
Cr 25 Pr. 25 Tr.	1-25	1-25	Cream	1.2	18.5
Cr 46 Tr.		1-46	Cream	1.2	19.3
Cr 50 Tr.		1-50	Cream	1.2	19.3
Cr 80 Pr	1—8o		Cream	1.3	22.0
Cr 100 Pr.	1- 100		Cream	1.5	24.6

Table 3c: Make-up and Dimensions of cable 0.6 mm Conductore

Conductor Diameter	Maximum Stripping Force N(@ 20 deg. C)
0.4	4.4
0.5	5.9
0.6	7.3
0.8	9.1
0.9	9.8

Table 4. Stripping Force

Conductor Size (mm)	Capacitance Unbalance (pF)
0.4 (25, 50 and 100 Pair sizes)	200
0.4	300
0.5	500
0.6	300
0.9	300

Table 5: Capacitance Unbalance

Temperature at which insulstion Resistance is Measured (deg. C)	Insulation Resistance Mohms (f0r 1000m)
10	500
11	400
12	310
13	250
14	190
15	150
16	120
17	110
18	79
19	62
20	50
21	41
22	32
23	28
24	23
25	19
26	16
27	13
28	11
29	9

Temperature at which insulstion Resistance is Measured (deg. C)	**Insulation Resistance Mohms (f0r 1000m)**
30	8