



## **Installation Specification for the Installation and Commissioning of Optical Fibre & Copper Cabling Systems**

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# 1.0 Introduction

## 1.1 Overview

This document defines the specification for network infrastructure.

This document is intended to be used by those associated with the fibre and copper networks.

The aim is to provide a cabling infrastructure which has high reliability, is easy to maintain and can provide our customers with the applications and services which they need today and may demand in the future.

This document details the minimum requirements for installation, testing and commissioning of both fibre and copper networks.

The infrastructure provided in line with this document shall add to the safe and efficient running of sites. The system specifications have been made to ensure that a cost-effective solution is provided without compromising any standards or safety issues.

To ensure consistent design and installation practices this document shall be adhered to as the standard for the design and implementation of a telecommunication infrastructure for services into and out of a single building and all interconnections linking the two.

## 1.2 Specification of Criteria

Two levels of criteria are specified; mandatory and requested. The mandatory requirements are described by the word “shall”; whilst as requested are described by the words “should”, “may” or “desirable”. Mandatory requirements must be adhered to under all circumstances and may not be changed. Requested requirements are the desired ways of design or implementation that may be changed depending on individual circumstances.

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## 2.0 Definition of Terms

### 2.1 Overview

To provide detailed information regarding the definitions of terms that are pertinent to this standard.

### 2.2 Definition of Terms

#### 2.2.1 Data centre

A building used for the express purpose of housing telecommunications related equipment for the transmission and reception of data, voice, video etc, signals and any related processing of the signal content.

#### 2.2.2 Backbone cable

A cable that connects any combination of carrier and network devices for the transmission of multiplexed signals.

#### 2.2.3 Channel

ISO/IEC 11801:2002 (2002:p20) defines a channel as *“The end to end transmission path connecting any two pieces of application specific equipment. Equipment and work area cords are included in the channel, but not the connecting hardware into the application specific equipment.”*

#### 2.2.4 Computer room

A room within the data centre that houses all the telecommunications transmission and processing equipment.

#### 2.2.5 Consolidation point

ISO/IEC 11801:2002 (2002:p20) defines a consolidation point as *“A connection point in the horizontal cabling subsystem between a floor distributor and a telecommunication outlet.”*

#### 2.2.6 CP cable

ISO/IEC 11801:2002 (2002:p20) defines a CP cable as *“A cable connecting the consolidation point to the telecommunications outlet(s).”*

### 2.2.7 CP Link

ISO/IEC 11801:2002 (2002:p20) defines a channel as *“The part of the permanent link between the floor distributor and the consolidation point, including the connecting hardware at each end.”*

### 2.2.8 Cross connect

ISO/IEC 11801:2002 (2002:p20) defines a cross connect as *“An apparatus enabling the termination of cable elements and their cross-connection, primarily by means of patch cords or jumpers. Incoming and outgoing cables are terminated at fixed points.”*

### 2.2.9 Entrance room

A room within the data centre that caters for the entry of cables into the building.

### 2.2.10 Solution

An end to end network of active and interconnecting passive devices that are required to transmit and process a stream(s) of client or application specific data.

### 2.2.11 Pit

A box, joint box, manhole or cable chamber.

### 2.2.12 Pit Cover

A covering lid used to seal a pit.

## 2.3 Abbreviations

a.c.	Alternating current
ACR	Attenuation to Crosstalk Ratio
BD	Building distributor
CD	Campus distributor
CP	Consolidation point
d.c.	Direct current
EQP	Equipment
ER	Equipment room
FD	Floor distributor
ISO	International Standards Organisation
LAN	Local area network
PBX	Private branch exchange
TE	Terminal equipment
TO	Telecommunications outlet



## 3.0 Installation

The following procedures detail the installation, construction, commissioning etc. required of a structured wiring installation to allow the system performance to achieve Category 5e or 6 compliance.

Contractors must be Krone Validated and **certified proof of validation will be required.**


Although both UTP and STP cable options are available, it is the policy to adopt UTP solutions wherever possible.

European and International standards specify the basic requirements for the planning, implementation and operation of information technology cabling using balanced copper cabling and optical fibre cabling.

### 3.1 Pre-Installation Copper and Fibre Cable

#### 3.1.1 Pre-Installation

1. Establish routes specified in installation specification are accessible and suitable.
2. Establish routes are available as according to installation programme.
3. Advise Client of any proposed variations to the above.
4. Verify the environmental conditions of the routes are acceptable for the cable type.
5. Any enclosed environments within the routes shall be tested for asphyxiating and explosive gases. Such environments include ducts, (manholes temporary or permanent) cable chambers and any other enclosed, unventilated structures. Should a gas hazard be detected the installer shall contact the site contact.
6. Verify the installation methods proposed are suitable for the cable type.
7. Identify location, accessibility and availability of proposed location for cable drums/boxes according to the installation programme.
8. Identify location, accessibility and availability of proposed location for cable service loops according to the installation programme.
9. Ensure that all necessary installation accessories are available.
10. Identify location, accessibility and availability of proposed location closures according to the installation programme.
11. Identify location, accessibility and availability of proposed location for cable service loops according to the installation programme.

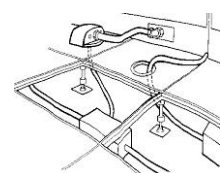
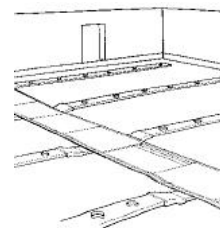
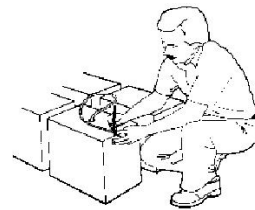
12. Ensure that closures are located such that subsequent measurements, repair, expansion or extension of the installed cabling can be undertaken with minimal disruption and in safety.
  13. Ensure that earthing and bonding of all metallic pathway systems have been undertaken according to the installation specification.
- 

## 3.2 Installation Copper and Fibre Cable

It must be noted that these installation guidelines only apply to internally run cables. At no time must these guidelines be applied to external cable types.

### 3.2.1 Installation

1. Acclimatise the cables to the manufacturers recommended time period before installation. Cable boxes and reels must not be unpacked before acclimatised and ready for use.
2. The storage location for cables and other equipment must take into consideration security.
3. Position the cable boxes/reels at the nominated and surveyed location. Cable boxes/reels should be placed in the correct multiples for outlets, i.e. single, double quad and the total number of outlets.
4. For telecommunication cables the cable size must cater for 25% additional pair capacity over & above the pair requirements stated in the specified requirements of the proposal for works.
5. Ascertain the approximate cable length required and make allowances for termination wastage and a margin of error.
6. Mark the box/reel with the starting meterage (after each run subtract the distance pulled and mark the box/reel with the new figure).
7. Check box/reel has enough cable to complete the run. If no then replace the box/reel and save for a suitable distanced run.
8. Clearly mark each cable end to be pulled in with the outlet number, jack position and any other markings required for identification. Marking must be of such a nature as to be legible after installation is complete.
9. One person should pull the cable in with other people feeding the cable at suitable locations.
10. One person must always be at the boxes/reels checking for the smooth exit from the boxes/reels and into the containment.
11. If only one person is installing the cable then it must be flected out in a figure of eight at suitable locations.
12. Where cable is pulled up vertical risers it must be temporarily secured to relieve any stress prior to being dressed in.
13. When running cable through floors, it is important not to pull cable through trunking. Run the cable on top of the floor to determine the required length and dress into the trunking on completion.
14. Cable to be pulled through conduit or ducting must be lubricated with talcum powder or chalk dust. Liquids are not permitted.
15. Where cable is routed around bends it is important to allow for enough slack to



dress the cable suitably onto/into the containment.

16. When a small number of cables are required to be pulled through false floors, installation technicians should use flexible conduit to protect the cables.
17. When installing the cable, regardless of containment type, the following must be achieved:
  - Maintain minimum bend radii during pulling. As defined by the standards and Manufacturers. For fibre cables the bend radii must not be less than ten times the diameter of the cable.
  - Cables shall not be exposed to humidity and temperature exceeding their specified limits, this includes localised heating such as hot air blowers or gas burners
  - No forces shall be allowed that cause pressure marks (e.g. through improper fastening or crossovers) on the cable sheath or the cable elements.
  - The maximum pulling tensions of cables must not be exceeded. As defined by the standards and Manufacturers.
  - When installing cabling runs in backbone risers, it is recommended to lower cables rather than to pull them up the riser.
  - Cables must not be kinked.
18. On completion check that the distance for copper does not exceed 90m or for the fibre ensure that the calculated budget distance is not exceeded. For telecommunication cable the switch manufacturers recommended distances must be adhered to.
19. Where the cable enters a cabinet it should be clearly labeled at the point of entry with the labeling scheme 3.13.

### 3.3 RJ45 Patch Panel Termination

All jacks must be terminated to the instructions given by Krone.

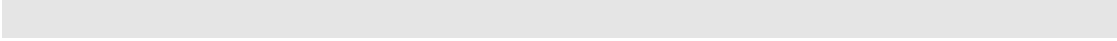
#### 3.3.1 Installation

1. Position patch panel on outrigger at final installation position within the cabinet.
2. Arrange cables into bundles of 24. Each bundle of 24 must correspond to a single patch panel.
3. Dress cable bundles onto cabinet cable tray securing every 300mm with Krone millities. Enough slack must be allowed to enable a limited repositioning of the cabinet. Excess coils beneath the cabinet are unacceptable.
4. Dress cables from right hand side of cabinet (when viewed from the rear) through the corresponding gland and onto the patch panel.
5. Tie each cable into the patch panel, ensuring that it is in it's correct position.
6. Check the temporary cable number and label the cable 30mm from the point of termination according to the labeling scheme detailed in section 7.13.
7. Cut sheath back to required length.
8. Terminate RJ45 as to TIA/EIA 568B as detailed by Krone installation instructions provided with the patch panel, through Krone training course, enclosed instruction sheet, Krone web site or available on request. A Krone insertion tool must be used.

Pair	RJ45 Pin	Pair Colour	
1	5	<b>Blue</b>	White
	4	White	<b>Blue</b>
2	1	<b>Orange</b>	White
	2	White	<b>Orange</b>
3	3	<b>Green</b>	White
	6	White	<b>Green</b>
4	7	<b>Brown</b>	White
	8	White	<b>Brown</b>

9. Ensure that that the cable sheath is as close to the point of termination as possible. It must be no more than 13mm.
10. Label patch panel according to the labeling scheme detailed in section 7.13.
11. Remove patch panel from the outrigger, remove outrigger and screw patch panel into it's final position.
12. Earth the patch panel at one side using a 2.5mm<sup>2</sup> earth cable. This will connect to the earth point of the cabinet. This applies to shielded and unshielded panels.

13. For every two patch panels fit a 1U 19" jumper bar.



## 3.4 RJ45 Outlet Termination

All outlets must be terminated to the instructions given by Krone.

### 3.4.1 Installation

1. Dress cable bundles into outlet back box ensuring bend radii, crushing and kinking rules are adhered to.
2. Check the temporary cable number and label the cable 30mm from the point of termination according to the labeling scheme detailed in section 7.13.
3. Cut sheath back to required length allowing enough slack to reterminate the outlet at least twice.
4. Terminate RJ45 as to TIA/EIA 568B as detailed by Krone installation instructions provided with the patch panel, through Krone training course, enclosed instruction sheet, Krone web site or available on request. A Krone insertion tool must be used.

Pair	RJ45 Pin	Pair Colour	
1	5	<b>Blue</b>	White
	4	White	<b>Blue</b>
2	1	<b>Orange</b>	White
	2	White	<b>Orange</b>
3	3	<b>Green</b>	White
	6	White	<b>Green</b>
4	7	<b>Brown</b>	White
	8	White	<b>Brown</b>

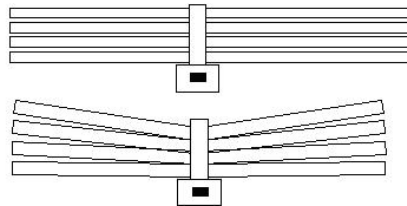
5. Ensure that that the cable sheath is as close to the point of termination as possible. It must be no more than 13mm.
6. Label outlet according to the labeling scheme detailed in section 7.13.
7. Screw the outlet onto the backbox being careful not to over tighten.
8. Fit blanking inserts where required.

## 3.5 Dressing Copper and Fibre Cable

It must be noted that these installation guidelines only apply to internally run cables. At no time must these guidelines be applied to external cable types.

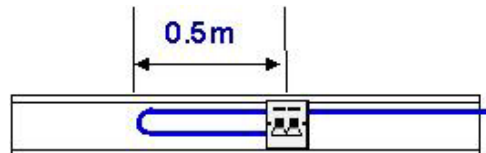
### 3.5.1 Dressing

1. Comb out of the cable bundles any slack and tangles.
2. Check for damaged cables and replace as required. Damaged cables that require replacing must be recovered where damage to other cables can be minimised.
3. Sort cables into bundles of 24. Where the installation programme permits the bundles should correspond to complete patch panels.
4. Where the bundle size must increase beyond 24 then the absolute maximum shall be 90 cables.
5. When dressing the cables onto horizontal tray work they must be secured every 500mm with velcro straps or Krone millieties.
6. When dressing the cables onto vertical tray work they must be secured every 300mm with velcro straps or Krone millieties.
7. Velcro straps and millieties must not be tightened to the stage where cables are

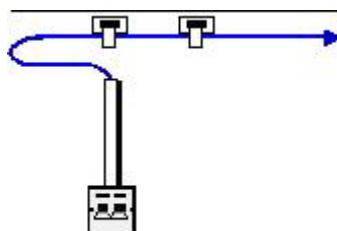


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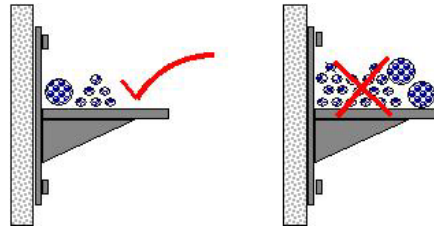
8. Where cables pass from vertical to horizontal tray work the cables must be swan necked out so that they do not touch the tray work on the bend.
9. When dressing cable into trunking for connection to outlets it is recommended that a metre be left, as slack. This can be achieved by creating a loop past the jack and then bringing back to the outlet. This practice will maintain the minimum bend radii and provide slack for re-termination, if required.



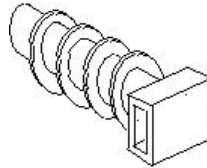
10. When dressing cable from ceiling voids into conduit/trunking for connection to outlets it is recommended that a 0.25 metre be left, as slack. Create a swan neck in the cable before it passes into the containment. This practice will maintain the minimum bend radii and provide slack for re-termination, if required.



11. Where cable bundles are to be laid onto cantilever supported trays the larger cable bundles must be placed to the rear of the tray (nearest to the wall).



12. All cables in vertical containment over 1m must be secured to the vertical structure to relieve strain. Where the containment does not cater for vertical restraint tie plugs must be installed at intervals of 300mm. Only one bundle of 24 may be secured to each tie plug.



13. Reasonable precautions must be taken where cables are to be installed in shared routes to prevent damage to existing cables or fragile structures within those routes.
14. Where cables are to be installed on catenary wires they must be checked for suitability and condition. Where the catenary wire is unacceptable other means of support must be used or the wire and brackets replaced. The cable must be secured to the catenary wires every 300mm.
15. Cables that pass through the infrastructure of the building will be suitably protected against damage. Through walls and floors this will involve an appropriate type of sleeve, through any form of metalwork or stiff plastic then a rubber grommet will be used.

## 3.6 Mains Segregation

### 3.6.1 Segregation

- Where possible the following segregation distances must be adhered to:

Type of Installation	Separation Distance		
	Without or Non Metallic Divider	Aluminium Divider	Steel Divider
Unscreened power and unscreened IT cable	200mm	100mm	50mm
Unscreened power and screened IT cable	50mm	20mm	5mm
Screened power and unscreened IT cable	30mm	10mm	2mm
Screened power and screened IT cable	0mm	0mm	0mm

- The minimum distance between data cables and lamps (neon, fluorescent, mercury vapour, or any other high-intensity discharged lamp) must be 1300mm.
- If three-phase electrical power (>415v AC) is in use then the following rules apply:
  - Unshielded power lines or electrical equipment which is close to non-metallic non-grounded pathways: 127mm
  - Unshielded power lines or electrical equipment close to grounded metallic pathways: 64mm
  - Transformers and or electric motors: 1016mm
- Data cables and power cables must not share the same duct or conduit, as stated by the British European Standard BS EN 50174 – 2.
- Data cables and power cables that share the same trunking must be segregated by a divider that conforms to BS 6701.
- Where power cables operating at voltages exceeding 240V AC or 240v DC have to pass through either a wall or some form of fire segregation, the separation distances between data and power may be reduced, provided that the following parameters are met:
  - The total distance that the cables are allowed to converge is the distance of the fire barrier plus 0.5m. The cables are then allowed 0.25m either sides to return to the correct separation distances. The cables must be enclosed within separate metallic earthed trunking for the duration of the convergence.

## **3.7 Cable Joints**

### **3.7.1 Jointing Cables**

1. It is not acceptable to joint copper data cable once damaged. Damaged cables must be replaced with new.
2. Voice cables may be jointed using Krone 237A modules (series II) and Krone connection boxes/cabinets/frames. All work must be conducted in accordance to BS6701.
3. It is not acceptable to joint fibre data cable (internal) once damaged. Damaged cables must be replaced with new.

## 3.8 Shared Enclosures

### 3.8.1 Service Sharing

1. Where both information technology cabling and mains power cabling are contained within a closure then:
  - If the closure is metallic, it shall be earthed in accordance with the relevant wiring regulations for protective earth;
  - The compartment in the closure shall have a barrier (either conducting or non-conducting) between the two cable types. If compartment barriers are conductive, they shall be earthed in accordance with the current wiring regulations for protective earth;
  - The front plates on the closure shall allow separate access to the information technology cabling and the mains power cabling and shall be retained such that the use of a tool is necessary to gain access thereby preventing inadvertent misconnection between the mains power and the information technology cabling;
  - The entry plate for the information technology cables and the mains power cables shall be separate and the separation of the cables shall conform to current standards.

## 3.9 Ceiling Tile/Panel Removal

### 3.9.1 Installation

1. Survey room for route of cable.
2. Ascertain which tiles to remove. The minimum number of tiles to complete the work must only be removed.
3. Move and equipment located below to the ceiling tile to be removed to a safe area.
4. Install a dust sheet below the ceiling tile.
5. Wear suitable protective clothing.
6. Ensure protective gloves are free from dust, grease or other containment that may mark or otherwise stain the ceiling tile.
7. If no protective gloves are being used then ensure that t
8. Slowly remove ceiling tile as per the manufacturer's instructions checking for any objects that may be resting on top.
9. Damaged ceiling tiles must be replaced.

## 3.10 Cabinets

### 3.10.1 Installation

1. Survey room for location, ensuring ease of access without causing risk of injury.
2. Survey wall and/or floor construction.
3. Test wall and/or floor for mains cabling, pipe work, etc.
4. Unpack cabinet and assemble to manufacturer instructions.
5. Secure to wall and/or floor in such a way that it cannot be pulled off.
6. Repeat steps 1 to 5 for additional cabinets.
7. Bay cabinets together.
8. Install cabinet accessories.
9. Earth all cabinet assemblies to BS 7671.
10. Install a 13 amp, double pole non-switched fused spur, neon indicating to BS 7671.
11. Must be within 100m of the distribution board.
12. Floor mounted cabinets will have the spur point located on the top right hand side of the cabinet nearest the front.
13. Fit mains block fly lead into spur through a suitable hole with a strain relief grommet. If the incoming mains feed enters the spur from above then gland off as normal to the spur.
14. If the incoming mains feed enters from the underside of the cabinet, then the cable is to be glanded in the base plate as normal, and the remaining cable is to be protected in LSZH kopex all the way through the cabinet.
15. Mains blocks for floor standing cabinets are to be placed in such a way that any mains lead points into the cabinet and NOT to the adjacent door.
16. The LSZH kopex replaces the need to re-gland the kopex or earth it
17. Wall cabinets have no integral mains block, therefore the following procedure is to be adopted:
  18. The non-switched fused spur is to be secured externally to the side/top of the non-swing part, secured to the cabinet. If a mains block is not factory fitted a double gang switched socket is to be located centrally within the back of the non-swing part of the cabinet. The mains cable linking the spur to the socket is to be either MICC or cable within conduit/kopex. The holes that are required to be drilled are to have grommets as required but only drilled within the fixed back plane of the cabinet.
  19. Where cabinets are not provided with pre-drilled holes or a pre-punched plate to accept the cable armouring glands for the fibre optic cables & local copper cabling, then holes must be drilled by the contractor.
  20. Fit dedicated fuse or miniature circuit breaker.

21. Label circuit breaker showing cabinet.
22. Label fused spur showing distribution board and MCB.
23. Earth adjacent cabinets together, in accordance to BS 7671.
24. Each cabinet will then be earthed using a 2.5 mm<sup>2</sup> earth cable, to a Telecoms Room Bus Bar, which will be earthed using an earth cable to the Main Building Earth (MBE), all in accordance to BS 7671.
25. Label cabinet with the following scheme. Scheme to be discussed with Project Management Team

<b>Numbering Scheme</b>	<b>Area</b>
1xxx	1
2xxx	2
3xxx	3
4xxx	4
5xxx	5
6xxx	Stores
7xxx	Reception
8xxx	Manufacturing Plant
9xxx	Management Suite

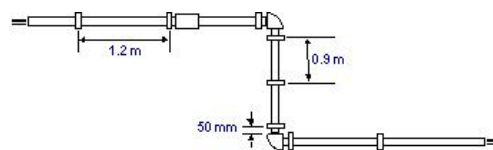
Where xxx is the next sequential number.

All labels must be of adequate manufacture so as not to peel off, or be easily removed. All labelling must be LSZH.

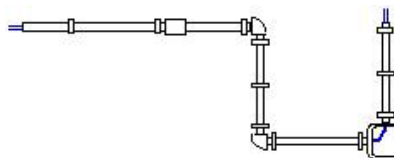
## 3.11 Conduit and Trunking

### 3.11.1 Installation

1. Survey room for location, ensuring ease of access without causing risk of injury.
2. Survey wall and/or floor construction.
3. Test wall and/or floor for mains cabling, pipe work, etc.
4. Ensure that conduit and trunking has been acclimatised.
5. Remove burrs from conduit and trunking.
6. Fix double sided adhesive tape to back of trunking or conduit.
7. Mark out position of trunking or conduit using a spirit level and tape measure to obtain height.
8. Temporarily position trunking or conduit to surface using double sided tape.
9. Check level of trunking or conduit and adjust if required.
10. Drill through trunking and into the wall.
11. Insert correct fixing plug into drilled hole.
12. Screw trunking or conduit onto wall using correct sized washer and screw.
13. Secure next piece of trunking or conduit using manufacturers jointing method, bends, 'T' piece etc. It is not acceptable to mitre cut trunking or butt joint trunking.
14. Conduit installations be secured every 0.9m with brackets on a vertical run and 1.2m on a horizontal run.
15. Conduit bends must have a fixing saddle within 50mm of the bend radius and joined with suitable couplers.
16. There must be no more than two bends in a single run of conduit.

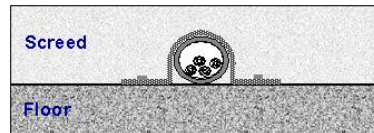


17. If there are more than two bends in a single run a turning box must be used to ensure that the minimum bend radii is to adhered to.

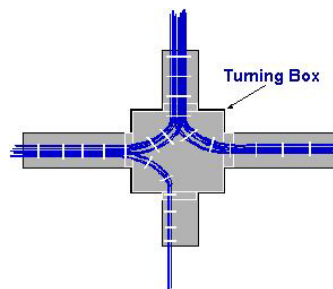


18. Metal conduit must be used where there is risk of potential damage, fire risk or electrical interference. Plastic conduit may be used otherwise.

19. Metal trays, conduit (plastic or metal) and trunking must allow for expansion of 50% of the installed system.
20. Conduit; tray and trunking must only be filled to a total of 75% total capacity.
21. Conduit pipe must include a draw rope.
22. Installations that require the conduit to run through a floor must be made of metal and not plastic. Conduits contained within screed must be secured to the floor by suitable saddles every 1.2m.



23. Where trunking passes through a fire stop plastic trunking must not penetrate the fire stop.
24. Plastic trunking must not be used where there is a danger of electrical interference.
25. Plastic trunking should not be used where the environmental conditions may vary it's length by more than 1.2mm per metre length.
26. Turning boxes must be used for cross road junctions of trunking.

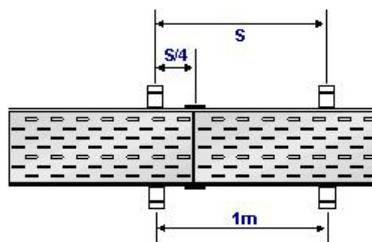


## 3.12 Tray Work

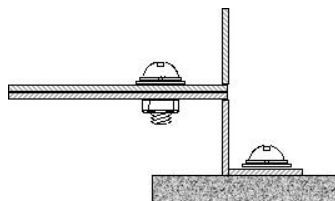
The Contractor must ensure that the tray work must be guaranteed for a minimum period of 15 years.

### 3.12.1 Installation

1. Survey room for location, ensuring ease of access without causing risk of injury.
2. Survey wall and/or floor and/or ceiling slab construction.
3. Test wall and/or floor and/or ceiling slab for mains cabling, pipe work, etc.
4. Ensure that tray has been acclimatised.
5. Mark out position of tray making sure that it runs parallel, where possible, with existing walls.
6. Mark out position of stand off brackets, cantilever brackets and trapeze brackets. These must be positioned at a maximum distance of 1m. When jointing trays the brackets must be positioned at  $\frac{1}{4}$  the span from the joint.

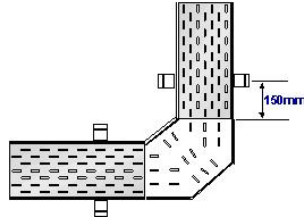


7. Drill correct sized hole(s) for fixtures.
8. Secure bracket(s) to fixings.
9. Cut tray to length.
10. Remove burrs from tray.
11. Screw tray onto bracket(s) making sure that the coach head of the bolt is on the face side of the tray.



12. Earth tray work to BS 7671.
13. When joining multiple lengths of trays they must be joined using the manufacturer's proprietary joints.
14. Where trays require cross roads, T pieces,  $90^{\circ}$  horizontal bends and  $90^{\circ}$  vertical bends then the manufacturers proprietary products must be used.

15. Secure next piece of tray using manufacturer's jointing method, bends, 'T' piece etc. It is not acceptable to mitre cut tray or butt joint tray.
16. All angles fitted to the tray will be gusset or radius type enabling the installation of cables without exceeding the minimum bend radius.
17. Where cross roads, T pieces, 90° horizontal bends and 90° vertical bends are used there must be a support bracket at 150mm from each point of exit.



## 3.13 Copper Patch Panel and Outlet Labelling

### 3.13.1 Labelling

1. Print labels so that the height and width of the characters is suitable for the size of the label. A laser printer must be used. Hand written or Dymo labels are unacceptable.
2. The labeling scheme shall be XXXX/YYYY, where:
  - XXX is the cabinet number;
  - YYY is the outlet number.
3. Remove label window from outlet or patch panel.
4. Insert label in position provided.
5. Refit label holder.

## Cable Management Software

A cable management software package shall be utilized. It shall be of type using barcode labeling relating to a central database. This shall be of Cormant Technologies Cablesolve. For further information please contact Wood Communications Ltd @ 01-4501898.

## 3.14 Telecommunication Termination 237's

### 3.14.1 Termination

1. Dress cable into box, frame or cabinet to the correct position.
2. Strip off outer sheath.
3. If the cable is an external grade with steel wire armour the armour must be cut back and earthed.
4. External cables must be of type CW1128. Where the cable enters a building it must be terminated onto a cable type CW1308 within 3m of the point of entry.
5. If the cable is an external grade gel filled then the gel must be removed with a suitable solvent.
6. Ascertain the pair bundles according to the coloured marker tapes and tie off each bundle with it's own marker tape. The tape must not be cut off to achieve this.
7. Install an outrigger at it's final location and mount the 237 onto the outrigger.
8. Dress the corresponding pairs through the outrigger.
9. Dress pairs through the loop at the back of the 237 and the guide clips. Each wire must be held in place by it's corresponding guide clip.
10. Punch down wires and dispose of cut off wire.

## 3.15 Telecommunication Termination Patch Panels

### 3.15.1 Termination

1. External cables must not be terminated onto patch panels.
2. Position patch panel on outrigger at final installation position within the cabinet.
3. Dress cable bundles onto cabinet cable tray securing every 300mm with Krone millities. Enough slack must be allowed to enable a limited repositioning of the cabinet. Excess coils beneath the cabinet are unacceptable.
4. Dress cables from right hand side of cabinet (when viewed from the rear) through the corresponding gland for the patch panel(s).
5. Cut sheath back to required length.
6. Ascertain the pair bundles according to the coloured marker tapes and tie off each bundle with it's own marker tape. The tape must not be cut off to achieve this.
7. Lace all bundles for a given patch panel together.
8. Dress bundles onto patch panel from the right hand side.
9. Label the cable.
10. Terminate 2 pairs per RJ45 as follows:

<b>4-Wire System:</b>	
<b>RJ11</b>	<b>RJ45 Pin No.</b>
2	5
5	4
3	1
4	2

11. Where required a KRONE PSTN Master, PABX Master and Secondary RJ45-BT Converters may then be used, dependent upon the main telephone switch requirements.
12. Remove patch panel from the outrigger, remove outrigger and screw patch panel into it's final position.
13. Remove patch panel from the outrigger, remove outrigger and screw patch panel into it's final position.

## 3.16 Fibre Installation

### 3.16.1 Installation

1. Survey route and mark manholes to be lifted on a drawing.
2. Lift manholes and survey potential ducts that can be used. Mark on drawing.
3. Note whether the ducts to be used have suitable draw ropes installed. If not then mark on the drawing the requirement for a rope to be installed. It is not acceptable to use another duct that has a draw rope.
4. Manholes that require cordoning off from the public or vehicles must be reported and suitable approval sought.
5. On delivery of cable drum to site each fibre must be tested with a light source.
6. Establish the position of the drum.
7. Position drum jacks or drum trailer at a suitable distance from the manhole.
8. Ensure that the jacks/trailer jacks are level.
9. Note the directional arrow on the drum and ensure that the cable is pulled from the bottom of the drum.
10. Lift the cable drum onto the jacks using a suitable sized pole between the jacks.
11. Level the drum.
12. Set up safety barriers, illumination and any other protection necessary.
13. Lift the pit cover and test for gas.
14. If required pump out any water.
15. If the duct to be used has no draw rope then a new rope must be installed with 3m sectional rods or continuous using a suitable 'leader' and 'follower'. Installation of the draw rope must not damage existing cables.

A properly designed draw rope dispenser or 'A' frame is to be used during roping operations.

The practice of blowing a rope using a compressor and a chute is not acceptable.

The contractor shall be responsible for provision of all roding, temporary roping and any pumping and drainage equipment necessary to clear any flooded installation.

Only one rope must be installed at any one time.

16. Establish the position of the winch.
17. The winch must have a suitable dynamometer and be set to the tolerance of the cable plus a suitable margin.
18. Ensure that the winch is always manned by a competent operator with a two way radio (mobile phones are not acceptable). This person must be in contact with other personnel at each pit and the drum operator.

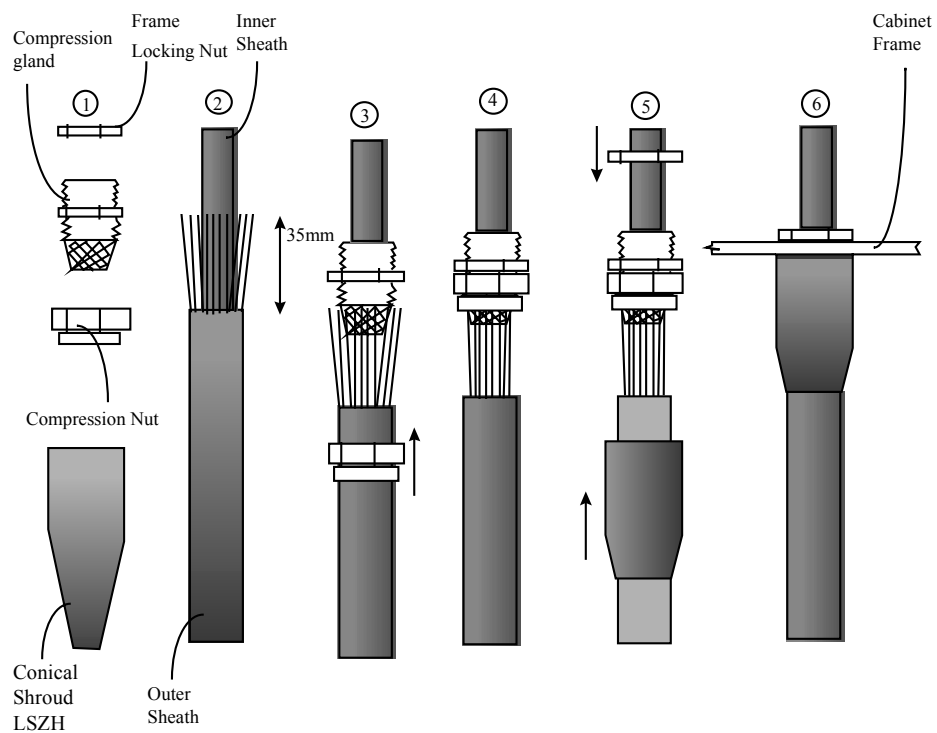
19. Set up cable guides and rollers at all entry and exit points to pits.
20. Set up bell-mouth guides at all pit locations, to assist the cable entering another section of duct.
21. Fit a central strength member 22mm swivel with the correct fuse rating for the cable. The use of a Central Strength Member Universal is acceptable but only with an independent Swivel.  
  
Cable socks, stockings or grips are strictly forbidden to be used on fibre optic cable. Directly applied rope, which is tied or bonded to the cable for pulling purposes, is also forbidden
22. Attach the winch to the draw rope.
23. Attach a suitable sized brush to the other end of the draw rope.
24. Attach a new draw rope to the rear of the brush.
25. Pull the brush through the duct.
26. Repeat steps 22 to 25 attaching a suitable sized mandrel behind the brush.
27. Attach the fibre to the draw rope.
28. Attach the winch to the draw rope and pull the fibre cable in. The operator of the drum must be in conversation with the winch operator by use of 2 way radios.
29. If the cable has to be 'temporarily stored' above ground, due to a change of direction or the installation was started in the middle of the route, the cable should be correctly flected in a 'figure of 8' and the area guarded off with barriers and cones.
30. When pulling the cable from the ducting to a internal building section 7.2 Installation of Copper and Fibre Cable shall apply, as well as the below instructions.
31. The contractor shall employ the use of guides and rollers to protect the cable from snagging or chaffing on any protruding elements.
32. Cables must be strapped to the tray at 5m intervals in the horizontal and 1m in the vertical and within 1m from the point where the cable changes direction or passed through walls.
33. Where fire stop materials are employed between different levels, sections or walls, the contractor must replace the old material with new.
34. The Contractor shall be solely responsible for all measurement, laying out and cutting-off of each section of cable prior to installation, while ensuring that due allowance is made for the specified 20m length of cable 'tail' to be provided at each location for termination purposes. 10m of the 'tail' is for the provision of a service loop, which is to be mounted on a 'doughnut' of cable tray external to the cabinet. Where additional loops of cable are specified on drawings, due allowance shall be made in the length calculations. See diagram's overleaf.
35. Self-amalgamating tape or cable boots shall be fitted to each end of the cable, after the cable has been installed in the duct and pit network, to stop the intrusion of water or moisture through capillary action.

### 3.17 Fibre Armoured Gland Installation

The cable armouring glands are available in two diameter sizes, 20 and 25mm. They incorporate a locking nut, for securing the unit to the cabinet. The gland provides the earthing point for the cable's armour.

#### 3.17.1 Installation

1. Gland piece parts
2. Outer sheath and armour preparation.
3. Offer compression nut up to the body.
4. Tighten compression nut to clamp armour to the body.
5. Cable is installed into cabinet. Frame locking nut and shroud offered up to the cabinet.
6. Tighten frame locking nut to secure cable to the cabinet.



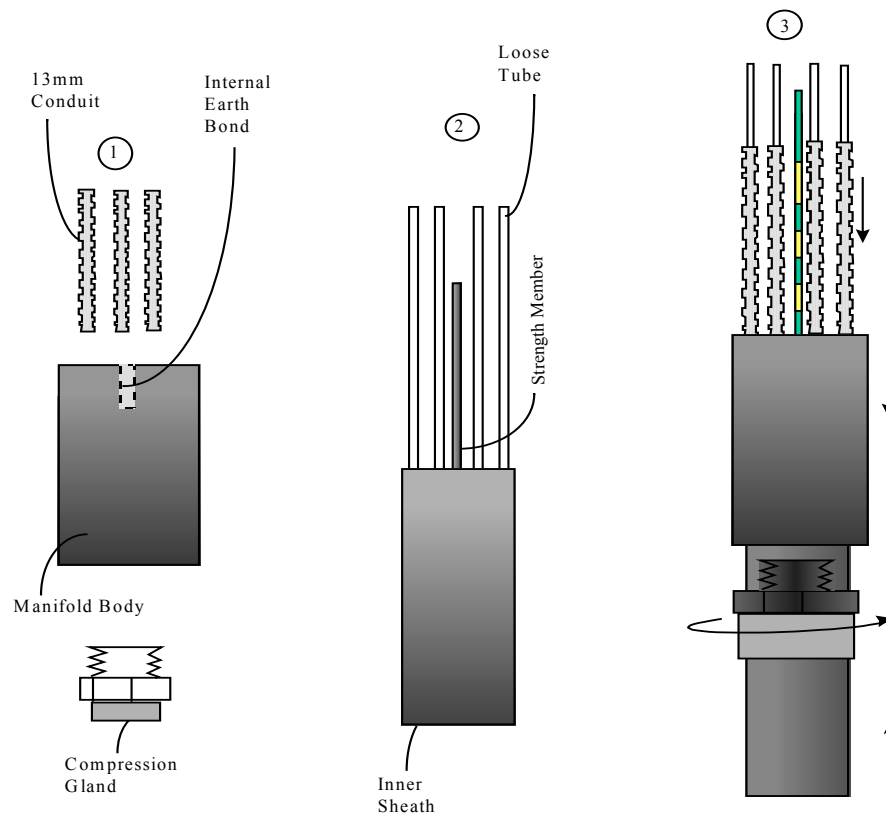
### 3.18 Fibre Armoured Gland Installation

The manifold is for breaking the cable down into loose tube format, via a mechanical breakout unit. At one end is a cable shroud and a cable compression gland which covers the unit and the cable sheath, at the other end is an arrangement of eight 13mm conduit ports.

Conduit from these ports transport the loose tubes from the breakout unit, onto the desired trays, where the units are broken down into fibre format, ready for splicing. The earth connection to the cable central strength member takes place inside the box body part of the manifold assembly. Where multiple manifolds are fitted these shall be staggered within the cabinet. The 13mm conduit is to be labeled with the appropriate tube number at each end prior to termination.

#### 3.18.1 Installation

1. Manifold piece parts.
2. Cable preparation and earth bonding to central strength member.
3. Loose tubes fed through the conduit, conduit fixed into manifold body, compression gland screw into manifold body.



## 3.19 Fibre Armoured Gland Installation

The termination practices, fibre and splice layouts are designed for the 'best installation and operational practices' for the communications network. Any non-standard termination practices or installation could result in the contractor(s) being removed from site and withdrawn from the approved contractor list.

### 3.19.1 Installation

1. Close of work area with 1m high gate guards. Where gate guards are used external they must be of the high visibility type.
2. The contractor must use a suitable floor protection cover, such as a tarpaulin (2m x 3m), for protection of spilt fluids and debris whilst stripping the cables.
3. The cable will be brought into the rear of the cabinet and measured for one complete loop into the side of the cabinet, plus 2.5 metres for termination purposes.
4. Whilst the cable is being brought into the cabinet the cable armouring gland is to be fitted to the cable. The loop will come up from the rear of the cabinet, across the top and down the rear side towards the base of the cabinet.
5. If the cable is to be terminated into an ODP, the cable will bend into the rear of the panel. Strength member earth bonding and termination must be performed inside the panel.
6. Use white spirit to clean down and remove gel from within the cables prior to any terminating. The use of a "bath" to remove the gel is a recognised practice but it is to be used with caution. A full risk and COSHH assessment is to be completed prior to any use of this method. The preferred maximum quantity is one litre.
7. Isopropyl Alcohol is the only permitted method of cleaning fibre at the cladding prior to splicing. No more than 200ml of Isopropyl Alcohol can be in any one location at any time.
8. Prepare cable as shown in [sections 3.17, 3.18, 3.21](#) and to the manufacturers instructions.

## 3.20 Copper Patch Panel and Outlet Labelling

### 3.20.1 Labelling

1. The cables must be labelled at the cable manifold as well as the front of the ODF/ODP.
2. A label shall be fixed to each panel or frame indicating the physical position of the first fibre.
3. Each tray is to be labelled with the fibre numbers.
4. The following carcus numbering scheme will be applied to fibre cables installed;

Location	Label

Where;

xx is the year issued

yyy is the incremental unique cable number

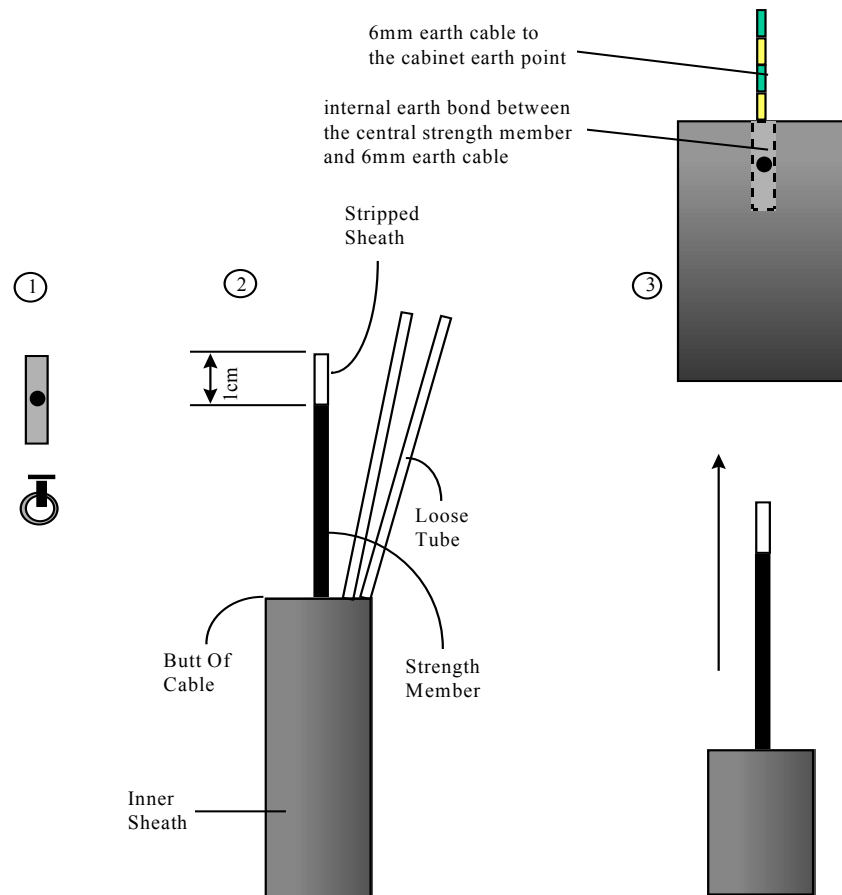
5. The fibre numbers are unique and are centrally allocated by "Client"

### 3.21 Fibre Optic Cable Earth Bonding

It is important that installers correctly bond the cable armouring and the central strength member to an earth point. The bonding requirement for the central strength member is shown below.

#### 3.21.1 Installation

1. Internal bond piece parts.
2. Strength member preparation.
3. Earth wire and central strength member connect via the internal bond within the manifold body.

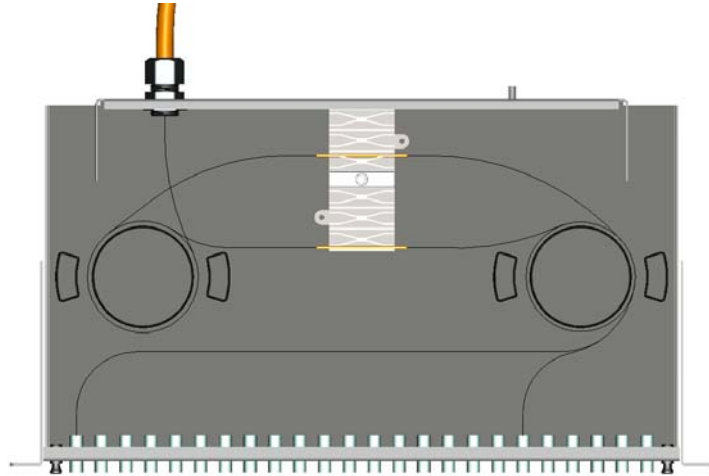


## 3.22 Fibre Patch Panel Termination

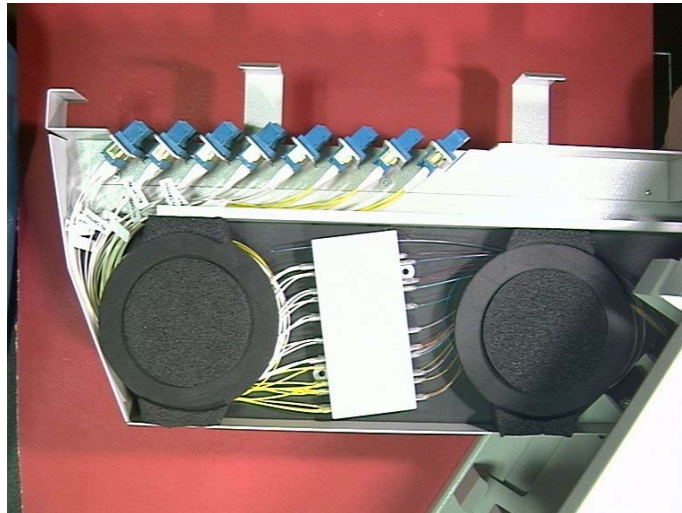
### 3.22.1 Installation

1. Position patch panel on outrigger at final installation position within the cabinet.
2. Arrange cables into bundles of 24. Each bundle of 24 must correspond to a single patch panel.
3. The cable will be brought into the rear of the cabinet and measured for one complete loop into the side of the cabinet, plus 2.5 metres for termination purposes.
4. Gland the cable to the cabinet.
5. Prepare cable as shown in sections 3.17, 3.18, 3.21 and to the manufacturers instructions.
6. Dress cables from right hand side of cabinet (when viewed from the rear) through the corresponding gland and onto the patch panel.
7. The use of a Cin bin for the disposal of all fibre cut shards will be employed.
8. For armoured fibre (not SWA), the cable must enter the rear of the **ODP** via the gland point. The loose tubes will be removed 10mm from the butt of the gland thereby reducing the cable to fibre format.

The remaining 1.2m of bare fibre will be measured into the fibre management system prior to spicing.



9. Three loose tubes will enter the rear of each tray within the **ODF** via the 13mm conduit, where they are held in place by a two part clamp unit. The loose tubes will be removed 10mm from the butt of the conduit, reducing the cable to fibre format. The remaining 1.2m of bare fibre will be measured into the fibre management system prior to spicing.



10. Fusion splice connector pigtail onto cable. The preferred fibre connector is the LC.
11. LC adapters used will follow the following convention with regard to the alignment sleeve in the unit:
  - Singlemode – zirconia sleeve for the alignment of ferrules containing 9/125  $\mu\text{m}$  fibre;
  - Multimode – phosphor bronze for the alignment of ferrules containing 50/125  $\mu\text{m}$  fibre.
12. Splice loss will be no greater than 0.12dB in either direction, when checked with an Optical Time Domain Reflectometer (OTDR) at a wavelength of 1550nm.
13. Label patch panel according to the labeling scheme.
14. Remove patch panel from the outrigger, remove outrigger and screw patch panel into it's final position.
15. Check the temporary cable number and label the cable 30mm from the point of entry into the cabinet.

## 3.23 Fibre Joint Closure

### 3.23.1 Closure

1. The external joint closure to be used is produced by Miniflex. Instructions are provided with all closures. These are to be rigorously followed. Failure to do so will result in the joint being remade at the cost to the contractor.
2. The joint provides continuous or through bonding of the central strength member and the armouring of the cables within the joint. This is to allow the future tracing of the cable route if required. Electrically isolated through bonding is required for the strength member and the armouring.
3. The contractor shall obtain and complete a Hot Works Permit before they start working with Heat Shrink material or heat generating equipment of any kind. Every effort should be made to use methods that do not require the use of applying direct heat. The external cable joint (Para. 23) has been specified for this reason. This applies equally to Gas and Electric Heat Guns.



## 4.0 Test and Test Documentation

All installed fibre and copper links be tested to the following procedures. These testing procedures are essential as they:

- Maximise the longevity of the system
- Minimise downtime and maintenance
- Facilitate system upgrades or reconfigurations

### 4.1 Post Installation Contractor Copper Testing

**Prior** to installing horizontal links it is important to establish the operational parameters of the cable.

One test per batch of cable must be tested and must pass the requirements of “Permanent Link” performance limits specification as defined in ANSI/TIA/EIA-568-B.2-1.

Only trained personnel who have passed an independent training programme shall execute the tests. Appropriate training programs include but are not limited to installation certification programs provided by BICSI or the ACP (Association of Cabling Professionals).

The test equipment (tester) shall comply with or exceed the accuracy requirements for level III field testers as defined in ANSI/TIA/EIA-568-B.2-1. The tester including the appropriate interface adapter must meet the specified accuracy requirements.

#### 4.1.1 Installation

1. Inspect all cables, cable reels, and shipping cartons to detect possible cable damage incurred during shipping and transport.
2. Visibly damaged goods are to be returned to the supplier and replaced at no additional cost to the client.
3. Copies of manufacture performance data, if supplied, are to be kept for inclusion in the Documentation and made available to the client upon request.
4. Unreel 25m of the cable.
5. Lay out flat ensuring that there are no kinks, crush points or coils.
6. Terminate one RJ45 at each end.
7. Check that the tester is in calibration (proof of independently calibration by Vendor may be requested). If out of calibration do not use.
8. Check condition of permanent link test heads. If worn or damaged replace.
9. Ensure that the plug is fully tightened.

10. Power on tester and remote.
11. Connect both units with the calibration module.
12. Remove calibration module and set tester to TIA permanent link cat 5e.
13. Select correct NVP for cable.
14. Plug tester and remote into permanent link and test.
15. If the result is a PASS or PASS\* then the permanent link shall be regarded as a PASS and the cable batch may be used.
16. If the result is a FAIL or FAIL\* then all boxes/reels associated with the batch must be quarantined and the manufacturer contacted for rectification process.

## 4.1 Installation Contractor Copper Testing

The installed horizontal links shall be tested from the Floor Distributor (FD) distribution panel in the telecommunications room to the telecommunication wall outlet (TO) in the work area against the “Permanent Link” performance limits specification as defined in ANSI/TIA/EIA-568-B.2-1.

100% of the installed cabling links must be tested and must pass the requirements of ANSI/TIA/EIA-568-B.2-1. Any failing link must be corrected and re-tested.

Only trained personnel who have passed an independent training programme shall execute the tests. Appropriate training programs include but are not limited to installation certification programs provided by BICSI or the ACP (Association of Cabling Professionals).

The test equipment (tester) shall comply with or exceed the accuracy requirements for level III field testers as defined in ANSI/TIA/EIA-568-B.2-1. The tester including the appropriate interface adapter must meet the specified accuracy requirements.

### 4.1.1 Installation

1. Check that the tester is in calibration (proof of independently calibration by Vendor may be requested). If out of calibration do not use.
2. Check condition of permanent link test heads. If worn or damaged replace.
3. Ensure that the plug is fully tightened.
4. Power on tester and remote.
5. Connect both units with the calibration module.
6. Perform calibration. Repeat steps 5 and 6 every 150 permanent link tests.
7. Remove calibration module and set tester to TIA permanent link cat 5e.
8. Select correct NVP for cable.
9. Check tester has the correct date. Change if incorrect.
10. Check tester has the correct time. Change if incorrect.
11. Enter Engineers name performing the test.
12. Enter site name.
13. Plug tester and remote into selected permanent link and test.
14. If the result is a PASS or PASS\* then the permanent link shall be regarded as a PASS. If the result is a FAIL or FAIL\* then rectification of the permanent link must be undertaken until a PASS or PASS\* is achieved.
15. Save test results as defined by section XXXX.

## 4.2 Client Copper Testing

The Client reserve the right to conduct witness field testing. The Installation Contractor shall be notified of the start date of the testing phase 5 business days before testing commences.

A representative of the Client will select a random sample of 5% of the installed links.

The results obtained shall be compared to the data provided by the installation contractor. If more than 2% of the sample results differ in terms of the pass/fail determination, the installation contractor under supervision of the Client shall repeat 100% testing and the cost shall be borne by the installation contractor.

The test equipment (tester) shall comply with or exceed the accuracy requirements for level III field testers as defined in ANSI/TIA/EIA-568-B.2-1. The tester including the appropriate interface adapter must meet the specified accuracy requirements.

### 4.2.1 Installation

1. Check that the tester is in calibration (proof of independently calibration by Vendor may be requested). If out of calibration do not use.
2. Check condition of permanent link test heads. If worn or damaged replace.
3. Ensure that the plug is fully tightened.
4. Power on tester and remote.
5. Connect both units with the calibration module.
6. Perform calibration. Repeat steps 5 and 6 every 150 permanent link tests.
7. Remove calibration module and set tester to TIA permanent link cat 5e.
8. Select correct NVP for cable.
9. Check tester has the correct date. Change if incorrect.
10. Check tester has the correct time. Change if incorrect.
11. Enter Engineers name performing the test.
12. Enter site name.
13. Plug tester and remote into selected permanent link and test.
14. If the result is a PASS or PASS\* then the permanent link shall be regarded as a PASS. If the result is a FAIL or FAIL\* then the permanent link shall be regarded as a failure.
15. Save test results as defined by section XXXX.

## 4.3 Copper Test Documentation

### 4.3.1 Documentation (Copper – category 5e or 6)

1. Enter the valid outlet number against the test.
2. Save summary information of test into the handheld testers memory.
3. On completion of all testing, at the end of each day or when the handheld testers memory is full download test data transferred into a Windows™-based database utility. Test data must include:
  - Site name
  - Data of test
  - Name of test Engineer
  - Time of test
  - NVP
  - PASS/FAIL result
  - Name of link – to BAA Carrier Service numbering requirements.
  - Name of standard and test used
  - Date and time test results were saved to the tester
  - Identification of the tester interface
  - Manufacturer, model and serial number of the tester
  - Revision of the tester software
  - Revision of the test standards database in the tester
  - Worst case margins for all test and pair combinations
4. Submit guarantee that data has been unaltered from the handheld tester and the data is relevant and correct for each permanent link or channel.
5. Store test data and software tools for viewing, analysis and printing onto a CD-ROM.
6. Archive CD-ROM in secure manner at a chosen location by the Installation Contractor.
7. Submit a copy of the CD-ROM to Client
8. Submit a copy of any manufacturers supplied data.
9. Submit a copy of the CD-ROM to Krone for warranty approval.
10. Submit a paper copy to the Client.

## 4.4 Installation Contractor Fibre OTDR Testing

Under no circumstances should the sources used for optical testing contravene safety standards as defined in BS EN 60825.

The installed fibre links shall be tested from end to end excluding the patch cords at each end.

100% of the installed cabling links must be tested and must pass the requirements of BS 7718. Any failing link must be corrected and re-tested.

Only trained personnel who have passed an independent training programme shall execute the tests. Appropriate training programs include but are not limited to installation certification programs provided by BICSI or City and Guilds.

The test equipment (tester) shall comply with or exceed the accuracy as defined in BS 7718. The tester including the appropriate interface adapter must meet the specified accuracy requirements.

The light source and OTDR must operate within the range of  $850 \pm 30\text{nm}$  or  $1300 \pm 20\text{nm}$  for multimode testing in accordance with ANSI/EIA/TIA-526-14.

The light source and OTDR must operate within the range of  $1310 \pm 10\text{nm}$  or  $1550 \pm 20\text{nm}$  for single-mode testing in accordance with ANSI/EIA/TIA-526-7.

### 4.4.1 Installation Contractor OTDR Test Procedure

1. Check that the tester is in calibration. If out of calibration do not use.
2. Submit calibration certificate and tester serial number to the Client.
3. Submit calibration certificate and tester serial number to the Client.
4. Calculate length required for launch cable to eliminate deadzone. This must not be less than 500m.
5. Select correct grade of fibre launch lead to match the fibre under test.
6. Check condition of test leads. If worn or damaged replace.
7. Insert launch lead into tester.
8. Power unit on.
9. Select test parameters for fibre type.
10. Select correct pulse for launch lead and fibre under test.
11. Test fibre cable at both wavelengths
12. Repeat test for remote end.
13. Save test plots as defined by section XXXX

## 4.5 Client OTDR Fibre Testing

The Client reserve the right to conduct witness field testing. The Installation Contractor shall be notified of the start date of the testing phase 5 business days before testing commences.

A representative of the Cleint will select a random sample of 5% of the installed links.

The results obtained shall be compared to the data provided by the installation contractor. If more than 2% of the sample results differ in terms of the pass/fail determination, the installation contractor under supervision of the Cleint shall repeat 100% testing and the cost shall be borne by the installation contractor.

The test equipment (tester) shall comply with or exceed the accuracy as defined in BS 7718. The tester including the appropriate interface adapter must meet the specified accuracy requirements.

### 4.5.1 Client OTDR Test Procedure

1. Check that the tester is in calibration. If out of calibration do not use.
2. Submit calibration certificate and tester serial number to the Client.
3. Calculate length required for launch cable to eliminate deadzone. This must not be less than 500m.
4. Select correct grade of fibre launch lead to match the fibre under test.
5. Check condition of test leads. If worn or damaged replace.
6. Insert launch lead into tester.
7. Power unit on.
8. Select test parameters for fibre type.
9. Select correct pulse for launch lead and fibre under test.
10. Test fibre cable at both wavelengths
11. Repeat test for remote end.
12. Analyse plots to determine
  13. Link loss (both ends, dual wavelength)
  14. Link return loss (both ends, dual wavelength)
  15. Link length
16. Analysis plots and report on
  17. Distance to highlighted events
  18. Loss of individual connectors and splices
  19. Return loss of individual connectors and splices
20. Any failures of individual component or the overall link will be regarded as a FAIL.

## 4.6 Installation Contractor Fibre Power Meter Testing

Under no circumstances should the sources used for optical testing contravene safety standards as defined in BS EN 60825.

The installed fibre links shall be tested from end to end including test patch cords at each end.

100% of the installed cabling links must be tested and must pass the requirements of BS 7718. Any failing link must be corrected and re-tested.

Only trained personnel who have passed an independent training programme shall execute the tests. Appropriate training programs include but are not limited to installation certification programs provided by BICSI or City and Guilds.

The test equipment (tester) shall comply with or exceed the accuracy as defined in BS 7718. The tester including the appropriate interface adapter must meet the specified accuracy requirements.

### 4.6.1 Installation Contractor Power Meter Test Procedure

1. Check that the tester is in calibration. If out of calibration do not use.
2. Submit calibration certificate and tester serial number to the Cleint.
3. Select two patch leads (must be 3m) of the correct grade to match the fibre under test.
4. Check condition of patch leads. If worn or damaged replace.
5. Insert one of the patch leads into power meter.
6. Insert the other end of the same patch lead into light source.
7. Power both units on.
8. Select lower wavelength for correct grade of fibre.
9. Test patch lead.
10. Record figure and use to subtract from final figure or, where the equipment permits it, zero the power meter.
11. Remove light source and cover fibre end to eliminate dust ingress.
12. Take light meter to remote end and attach to the link using the second 3m patch lead.
13. Test the link.
14. Repeat steps five to thirteen for the second wavelength.
15. Repeat steps five to fourteen with the power meter at the far end.
16. Save test plots as defined by section XXXX

## 4.7 Client Fibre Power Meter Testing

The Client reserve the right to conduct witness field testing. The Installation Contractor shall be notified of the start date of the testing phase 5 business days before testing commences.

A representative of the Client will select a random sample of 5% of the installed links.

The results obtained shall be compared to the data provided by the installation contractor. If more than 2% of the sample results differ in terms of the pass/fail determination, the installation contractor under supervision of the Client shall repeat 100% testing and the cost shall be borne by the installation contractor.

The test equipment (tester) shall comply with or exceed the accuracy as defined in BS 7718. The tester including the appropriate interface adapter must meet the specified accuracy requirements.

### 4.7.1 Client Power Meter Test Procedure

1. Check that the tester is in calibration. If out of calibration do not use.
2. Select two patch leads (must be 3m) of the correct grade to match the fibre under test.
3. Check condition of patch leads. If worn or damaged replace.
4. Insert one of the patch leads into power meter.
5. Insert the other end of the same patch lead into light source.
6. Power both units on.
7. Select lower wavelength for correct grade of fibre.
8. Test patch lead.
9. Record figure and use to subtract from final figure or, where the equipment permits it, zero the power meter.
10. Remove light source and cover fibre end to eliminate dust ingress.
11. Take light meter to remote end and attach to the link using the second 3m patch lead.
12. Test the link.
13. Repeat steps five to thirteen for the second wavelength.
14. Repeat steps five to fourteen with the power meter at the far end.
15. Any insertion loss failures for the overall link will be regarded as a FAIL.

## 4.8 Fibre Test Documentation

The results detailed below must be presented to the Client.

### 4.8.1 Documentation (Fibre – Single and Multimode)

1. Enter the valid link number against the test.
2. Save plot information (OTDR) or power meter readings into the testers memory.
3. On completion of all testing, at the end of each day or when the handheld testers memory is full download test data transferred into a Windows™-based database utility. Test data must include:
  - Site name
  - Data of test
  - Name of test Engineer
  - Time of test
  - PASS/FAIL result
  - Name of link.
  - Name of standard and test used
  - Date and time test results were saved to the tester
  - Identification of the tester interface
  - Manufacturer, model and serial number of the tester
  - Revision of the tester software
  - Revision of the test standards database in the tester
  - Plots (OTDR)
  - Insertion loss figures minus the calibrated out patch lead figure (power meter)
4. Submit guarantee that data has been unaltered from the tester and the data is relevant and correct for each link.
5. Record power meter figures on the 'LS&PM Performance Record'.
6. Store OTDR and power meter test data and software tools for viewing, analysis and printing onto floppy disc. One onto floppy disc for each fibre type repeated at both ends i.e a multimode fibre cable will have two disks submitted where as a composite single and multimode fibre would have four disks.
7. The fibre codes and titles for the Title/Header page on the OTDR must be completely filled in and available on the discs. The title information will be defined in the Installation Package that is supplied with all installation projects.
8. If the Title/Header details have been omitted, the onus is on the contractor to request them from the client. Failure to include the Title/Header information will result in the contractor completing the test(s) again, at their own expense.
9. Label floppy disc with link number.
10. Archive onto floppy disc in secure manner at a chosen location by the Installation Contractor.
11. Submit a copy of the onto floppy disc to the Client.
12. Submit a copy of any manufacturers supplied data.
13. Submit a copy of the onto floppy disc to Krone for warranty approval.

14. Submit a paper copy to the Client.