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Standard Document

LHR IT Physical Infrastructure

Version 3.0
April 2015

About this standard

This document defines the minimum standards, specifications and requirements for the design and installation of IT Physical Network Infrastructures at all LHR sites. These requirements are in addition to the Building Regulations.

The standard has been endorsed by the LHR standards endorsement committee for group-wide application.

It is intended for use by all those associated with the design, installation, modification, administration, testing, documentation and maintenance of copper and fibre network infrastructure and associated environments and equipment including:

LHR project boards, project managers and project coordinators, commissioning managers, design engineers, architects, contractors, construction managers, facility managers and manufacturers.

This standard complements the following Heathrow standards.

- Electrical Distribution
- Cable and containment identification

With the growing dependencies on an IT networking infrastructure to deliver airport operational systems, there is the need to govern and control the working practices and installation methods that are used when installing IT cabling infrastructure.

You are invited to contribute to the continuing development of this standard. If you have any points you wish to make on design/specification issues, please contact:

All parties below must approve any changes to this document;

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Introduction

IT Physical Infrastructure is the term used to cover the physical systems, equipment and spaces designed and installed to distribute telecommunications services including data, voice and video. Included are equipment rooms, fibre and copper cabling systems, cable containment systems, cabinets and enclosures.

The standard does not cover the design or selection of active equipment, e.g. network switches, PCs, PABXs etc.

It is a requirement that IT physical network infrastructures at Heathrow sites are professionally installed and maintained to provide the levels of performance and reliability required to support the business needs of Heathrow, its customers and partners.

This must be achieved without compromising the Health & Safety of travellers, employees, contractors, visitors and the public and must be in accordance with current Health & Safety legislation.

The safe, effective and reliable distribution of telecommunications services is essential to the operation of Heathrow and many of the business critical systems rely on this to deliver these services to where they are needed.

It is down to the project manager that supervising the install of the physical infrastructure and all its components, to ensure that all items required to supply a LHR IT service whether it is there deliverable or not are installed to the standards stated in this document

Contents

1 Mandatory requirements

A mandatory requirement is a specific performance required to meet the Heathrow business need. Each mandatory requirement has been risk assessed during the development of the standard by a business focus group to ensure that it is appropriate for the business. All Heathrow projects **must comply** with the requirements in this section.

Exemptions from the above are not normally considered - however, where the project team feels there is a strong business case for non-compliance with a particular requirement, this business case should be forwarded to the standard's owner. This must have supporting documentation - including a full risk assessment - for final consideration by the Standards Endorsement Committee (SEC). The project team should allow a period of two weeks to obtain the final decision.

2 Design guidance

This section draws on Heathrow's past experience on projects and offers design guidance for the various Facilities within the Terminal. Methods on how to satisfy the mandatory requirements may be included and, whilst these do not have to be adopted, it is expected that the project team give them consideration when conducting option selection assessment. Where the project team proposes to adopt an alternative design approach, this must be discussed with the standard's owner to ensure suitability.

3 Essential tools

This section contains essential information for the correct design and installation of IT Physical Infrastructure.

1 Mandatory requirements

Contents

1.1 IT Physical Infrastructures covered by this standard

All IT physical infrastructure installations installed within Heathrow properties

1.2 Standards and Statutory Regulations

It is a requirement that IT Physical Infrastructures are designed and installed in compliance with the latest editions of the relevant British and Harmonised European Standards including all statutory regulations, associated memoranda and Heathrow, Design Standards, in particular the following:

- BS6701:2004 Telecommunications equipment and telecommunications cabling – Specification for installation operation and maintenance.
- BS EN 50174-1:2009 +Amendment 1: 2011 Information technology – Cabling installation – Part 1: Specification and quality assurance.
- BS EN 50174-2:2009 +Amendment 1: 2011 Information technology – Cabling installation – Part 2: Installation planning and practices inside buildings
- BS EN 50174-5:2007 Information technology – Cabling installation – Part 3: Installation planning and practices outside buildings
- BS EN 50173-1:2011 Information Technology – Generic cabling systems – Part 1: General requirements and office areas
- BS EN 50173-2 :2007 + A1 2010 Information Technology – Generic cabling systems – Part 2: Office Premises
- BS EN 50310:2010 Application of equipotential bonding and earthing in buildings with information technology equipment
- IS11801:2002 – Information Technology – Generic Cabling System for Customer Premises.
- Fibre Optic Industry Association – FIA-TDS-2000-1-1 LAN Application Support Guide issue 3. 01 November 2003.
- TIA/EIA – 568-B.2-1 Transmission Performance Specification for 4 pair 100 Ohm Category 6 cabling.
- EIA/TIA – Electrical Industries Association/Technical Industries Association
- Construction (Design & Management) Regulations (CDM)
- Electricity at Work Regulations
- Memorandum of Guidance on the Electricity at Work Regulations – Health & Safety Executive Booklet HS (R) 25
- BS 7671 IEE Wiring Regulations

- Guidance Notes on the IEE Wiring Regulations published by the IEE
- British Standards (BS) and harmonised European Standards (e.g. BS EN)
- Health & Safety at Work Act and other Statutory Health & Safety documents
- Building Regulations England & Wales
- Building Standards (Scotland) Regulations (applicable only to Scotland)
- Local Electricity Company Regulations
- BT Regulations
- European Directives
- Electrical Equipment (safety) Regulations
- Heathrow Design Standards
- Heathrow Electrical Safety Rules
- Heathrow Engineering Directors Safety Alerts
- Heathrow Engineering Instructions

The requirements of the following bodies shall be complied with:-

- Heathrow, Fire Officer and Local Authority Fire Officer
- Heathrow, Building Control Officer
- Heathrow, Environmental Health Officer
- Heathrow, Airport Safety Officer

1.3 Manufacturer's requirements

Manufacturer's requirements and installation methods shall be complied with to ensure that equipment and systems are designed and installed as they were intended and that warranty conditions are met.

All infrastructure installation 3rd party contractors **must be** TE Connectivity Accredited Installers and able to supply a TE Connectivity Warranty at the end of an installation.

2 Design guidance

Contents

2.1 PRE-INSTALLATION GUIDELINES

The installer shall:

Execute the installation in a manner, which shall ensure the safety of the general public, customers, employees of Heathrow, the contractor themselves and any adjoining property owners and occupiers.

The implementation of any new design or layout that may have an effect on support or differs from the current network infrastructure standards, it must first be presented to the network standards working group, before installation for approval, otherwise the installation will be rejected and not taken into support.

Take all measures as appropriate or desirable and advise Heathrow IT of the action taken to protect any person from being injured *and/or* any property *from* being damaged as a result of the installation and be responsible for adhering fully to National Health and Safety at Work and Street Works Regulations.

Establish that the routes defined in the installation specification are accessible and available according to the installation programme. The installer shall advise Heathrow IT of all proposed variations.

Verify that the environmental conditions within the routes and the installation methods to be used are suitable for the cables to be installed.

Verify that the cable containment is sufficient for the planned capacity and any future expansion requirements.

Identify the proposed locations at which drums (or reels) are to be positioned during the installation programme and establish the accessibility and availability of those locations.

Identify proposed locations of cable and establish their accessibility and availability according to the installation programme.

Ensure that all necessary installation accessories are available.

Identify proposed locations of closures and establish their accessibility and availability according to the installation programme.

Ensure that closures are located *so* that subsequent measurements, repair, expansion or extension of the installed cabling can be undertaken with minimal disruption and in safety.

Ensure that earthing and bonding of all metallic pathway systems have been undertaken according to the installation specification.

2.2 GUIDELINES AND INSTALLATION PRACTICES

Proper installation practices must be observed for cabling to ensure performance of the cabling system over its life cycle. Performance specifications for cable and connecting hardware *assumes* the use of proper installation practices and cable management techniques according to these guidelines and those supplied with the components used.

If recommended cable handling practices and installation methods are not observed, it is possible that specified transmission capabilities of cabling components will not be achieved.

During cable installation, appropriate techniques shall be followed:

- Make sure that the cabling components have acclimatised at the recommended environmental condition before installation.
- Cable management precautions that shall be observed include the elimination of cable stress as caused by tension in suspended cable runs and tightly cinched cable bundles.
- Minimum bend radio shall never be less than those specified in all current standards.
- 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 and external cables must be protected from environmental danger.
- No forces shall be allowed that causes pressure marks (e.g. through improper fastening or crossovers) on the cable sheath or the cable elements.
- The maximum pulling tensions of cables taken from the cable manufacturer's specifications shall be observed.
- When installing cables into cable management systems they shall be properly secured.
- When installing cabling runs in backbone risers, it is recommended to lower cables rather than to pull them up the riser.
- The installation of all equipment relating to the network must be in a position where the cable maintainers can maintain the equipment without having to seek the assistance of a 3rd party for access or permanent access arranged.

2.2.1 Category 5E and Category 6

- All horizontal Cat 5e and Cat6 cabling (TE CONNECTIVITY) installed on the Heathrow campus must have the following printed on the outer sheath

Full "will be" print example:

BAA DATA CABLE CATEGORY 6 UTP LSZH **405766 1347** IEC 60332-1 4/24 AWG INDEPENDENTLY VERIFIED TO TIA/EIA-568-C, ISO/IEC 11801:2002, EN 50173-1:2011 CATEGORY 6 TN6TZI-ORMB-BAA **131202001** (Sequential No) M CE

- The choice of use of Category 6 cabling or Category 5E cabling (with BAA Logo)is to be based on the following guidelines:
- The naming conversion for new Communications rooms should follow the same standard as the Terminal/building location they are to be built in, or have a proper location name that would make sense to anyone trying to find the location, not just named after a family member or a favourite TV show.
- As a minimum requirement a dual data outlet should be installed at the requested location (A dual outlet must comprise of 2 cabled positions) (only exception will be phones in back of house locations (Service corridors & plant rooms)
- All new building/location installations (unless explicitly required and technically agreed) must be installed using a Category 6 unshielded solution (UTP) System.
- All new Datacentre and Communication room fit outs (DSCR, PCR, SCR etc.) must be installed using a Category 6 unshielded solution (UTP) System.
- Category 5e UTP cabling may be installed where a floor or area is being added to and there is an existing Category 5e infrastructure in place and it technically meets the requirements.
- Certain areas may require a shielded solution (STP) due to potential environmental and interference issues and this will be agreed in advance with the project stakeholders and the choice of Category 6 or Category 5e will be made on a case by case basis.
- Certain external areas/ facilities may require an external solution (PVC) due to potential environmental issues; this will require the use of external grade cable for connection to the outlet connector, to be terminated into a transition point upon entry to the building (within 2 mts) for conversion to LSZH to be terminated back to the required Comms room. Where the cabling specification for the facility is category 6, only external category 5e cable is to be used for the external portion of the route.
- In certain situations where the installation is temporary (less than 12 months) Category 5e can be installed as long as it meets the bandwidth demands and technology solution required. Approval must be obtained by architectural services.

2.2.2 Cable installation

When running cable through floors, the recommended method is to lay the cable into position. Run the cable on top of the false floor to determine the required length and dress into the containment on completion.

When a small number of cables are required to be pulled through false floors, installation technicians should use flexible conduit to protect the cables.

When preparing to pull cable, the cable boxes should be placed in the correct multiples for outlets, i.e. single, double quad and the total number of outlets up to a maximum of 12 cables at high level of above the ceiling level, and 24 cables at low level or under raised floor. Ensure that all cable lengths are clearly marked with the outlet number, jack position and any other markings required for identification.

Cable bundle sizes should ideally be no more in size than the patch panel capacity itself, i.e. in bundles of twenty-four. However, on occasions when the cable bundle size has to increase beyond the Heathrow recommendation of cable bundle size, it is advised that the bundle size is no more than 48 cables.

The desired length of the cable must be ascertained by using a measuring wheel. Make sure that you have accounted for vertical drops and rises. When pulling the cable there should only be one person actually pulling, with other team members helping to feed the cable. When installing cable you should identify essential areas where you can safely fleet the cable out to protect it. Fleeted cable should be coiled in a figure of eight pattern for cable pulled from a drum and a coil for cable from boxes. It is important not to exceed the minimum bend radius when pulling the cable.

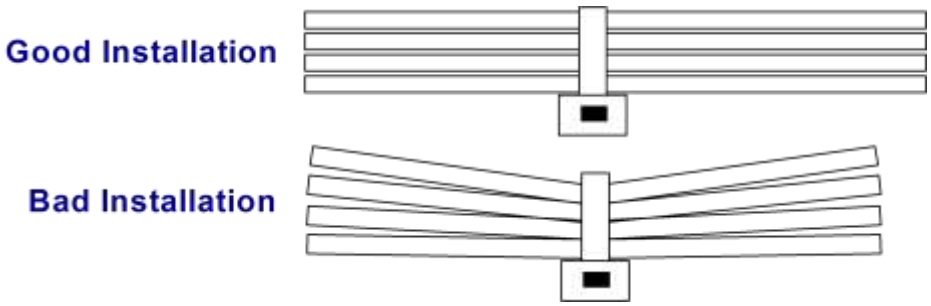
All life safety and security end devices (CCTV' MAID) must have a direct horizontal connection back to a comms room; these devices **cannot** be connected via a Consolidation Point (CP).

When the horizontal cabling runs back to a HAL IT room that utilizes switch looms as part of the link, the total length of the link including (switch looms & patch cords) **must not** exceed 100 meters.

2.2.3 Cable dressing

Where cables pass from vertical to horizontal cable trays, it is essential that the cables be protected from the tray edges

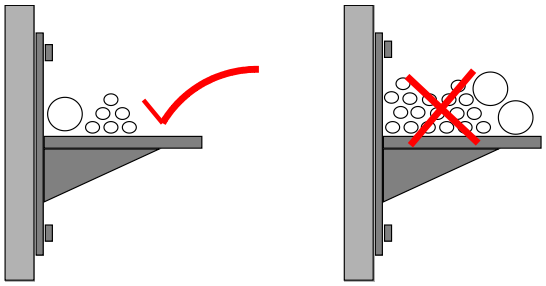
When cable has been laid into the cable trays, it must be secured into place with cable ties or Velcro straps. However care must be taken not to over-tighten cable ties as this may crush or pinch the cable and this will greatly affect the network performance.



When dressing cable into containment 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 ensure that we will maintain the minimum bend radius and that we have enough slack for re-termination if required.

Cable ties must be placed every 500mm on a horizontal stretch and 300mm on a vertical stretch. It is also recommended that a cable bundle size should not exceed 24 cables. Where horizontal cable tray runs are installed directly onto the ceiling or wall the cable ties must be placed at 300mm intervals. Best practice suggests that sleeves or neoprene padding should be used to help protect the cables.

If cable bundles are to be laid onto cantilever supported trays then it makes sense to ensure that larger cable bundles are placed to the rear of the tray (nearest to the wall) as this will help reduce the any leverage on the wall fixings.



When trying to dress cable up either risers or vertical trunking supporting the cable is paramount and Velcro ties should not be used. However, most trunking products do not supply any fixings for cable ties. Use holes through the trunking into the supporting wall and introduce tie plugs for support of cables.

Where cables are to be installed in shared routes then maximum care shall be taken to prevent damage to existing cables or fragile structures within those routes.

The design of duct, conduit and trunking should allow *for* installation and removal of the cable without risk of damage.
Routes should have a draw rope installed, prior to the installation of the cable as required. Under no circumstances should draw ropes be installed concurrently with the cable.

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 nominated by Heathrow IT and appropriate action shall be agreed and undertaken.

2.2.4 Cable joints

Joints within balanced twisted pair cabling are **strictly forbidden**. If cables are damaged along the run of cable then they must be removed and replaced with new cable.

2.2.5 Cable protection

The delivery of cables shall be monitored to ensure that no mechanical damage occurs during off-loading from vehicles. Documentation supplied with the cable shall be checked for compliance with the procurement specification and retained.

Electronic test results must be made available when requested by Heathrow IT personnel.

The cable must be stored in a suitable place until required. Consideration shall be given to security and environmental conditions. The cable shall not be unpacked until required.

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 appropriate edge protection will be used.

Where both information technology cabling and mains power cabling are contained within a closure then current electrical and safety standards must be followed in addition to BS6701:2004 and manufacturer's guidelines.

2.2.6 Floor and ceiling voids

The Contractor will be responsible for the removal, and reinstatement to the original condition, of any tiles and panels required during the installation (even if works are subcontracted to a 3rd party).

2.2.7 External cable installations

The drum must be supported on a cable trailer or drum jacks. If the jacks do not extend sufficiently the correct plinths shall be used.

Cable socks, stockings or grips can only be used on external cable installations when used in conjunction with a designated Fibre Optic Cable Puller or by hand. **No other mechanical device** (cars; vans; 4x4 vehicles) to be used for the installation of eternal cables. Directly applied rope, which is tied or bonded to the cable for pulling purposes, is also forbidden. The only device that may be used is a Central Strength Member 22mm Swivel with the correct fuse rating for the installation. The use of a Central Strength Member Universal is acceptable but only with an independent Swivel.

The contractor to check that any device used meets the pull rate for the cable and has Console mounted line tension indicator with pre-set limiting facility.

It is the responsibility of the 3rd party contractor to replace at their cost any damage caused to existing cables infrastructure during the installation of new cabling.

Cable guides and rollers shall be used to protect the cable at all entry and exit points to pits. Bell-mouth guides shall be used at all pit locations, to assist the cable entering another section of duct.

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.

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 fleeted in a 'figure of 8' and the area guarded off with barriers and cones.

When cable is installed on cable trays they must be strapped at 1m intervals in the horizontal and 1m in the vertical and within 1m from the point where the cable changes direction or passed through walls.

Where fire stop materials exist e.g. between different levels, sections or walls, the contractor must reinstate the fire stopping to its original state which may involve replacement with new materials.

The Contractor is solely responsible for all measurement, laying out and cutting-off of each section of cable prior to installation.

2.2.8 Cable drums

Cable drums often have a directional arrow mark, which is sprayed onto the side of the drum. This indicates the *direction* in which the drum must be rolled or turned, *while* the drum still has cable wound onto it.

While manoeuvring the drum on site and during the installation, as the drum is being turned, the same restrictions above apply.

2.2.9 Cable Winches

Winches must be fitted with a dynamometer to ensure that the cable is not damaged and the winch will cut the tension if a section of duct proves to have some unforeseen difficulties. The use of winches is forbidden if each member of the installation team does not have a hand held portable radio (not mobile phones) for communication and safety purposes.

2.2.10 Working area installations

Gate guards must be used to guard the area in which the contractor works. The guards shall be of the high visibility type. These are to keep all unauthorised personnel away from the hazard.

2.2.11 Floor protection coverings

The contractor must use a suitable floor protection cover whilst stripping the cables.
The cover will contain the spillage of the stripping compounds or fluids during cable preparation. The cover also prevents the grease or cable gel from marking the carpet or floor covering of computer or equipment rooms or occasionally office areas.

2.3 CABLING SPECIFICATION

2.3.1 Balanced twisted pair cabling

The following section details the methods, principles, installation, construction, electrical performance and testing for Balanced Pair Cabling used by Heathrow IT.

TE CONNECTIVITY is the chosen partner for Heathrow fixed cabling infrastructure installations for both fibre and balanced twisted pair copper cables installations throughout all Heathrow locations.

Only TE CONNECTIVITY installation will receive full acceptance into operational support by LHR. Only products labelled Truenet (ADCKrone /TE) should be utilised & not products labelled TE Amp.

Only in extreme exception will any other fully compliant system be considered for handover and support, as long as a sound business case is in existence that is fully signed off by the project board, LHR custodians and LHR Operational stakeholders. (Service Support – Currently SITA)

The Installation Guidelines for Balanced Pair Cabling are designed for use throughout the whole of the Heathrow network. These procedures relate only to internal installation of cabling. At no time should these cables be routed externally of any building structure.

Where an information outlet (IO) is to be installed at a height above 3 meters, than it shall not be placed more than 1 meter away from the equipment it is required to supply the service of.

Where the outlet is to be presented at height, it must be installed at the lowest point possible. This is to enable ease of maintainability and support. **For example;** if a FIDS screen that is hanging from the ceiling, the outlet would be installed at the bottom section of the FIDS screen housing and ensuring that it can still be accessed without having to fully remove the screen, or it could be secured to the back of the housing. It should not be installed above the FIDS screens mounting poll in the ceiling. The outlets should be installed in a manner that the outlet numbers can be easily read

As a minimum a dual outlet (2 x RJ45 presentations) will be installed at each location.
In the case of a workstation area at least 4 x RJ45 outlets shall be provided and hence the quad outlet is the preferred Heathrow IT work station configuration unless otherwise advised by Heathrow representative.

All permanent links should be presented to an information outlet (IO) above floor level with the appropriate style of back-box for the installation, not just a fly lead protruding from the floor.
If any outlet has to be presented at floor level than the correct type of floor box should be used, that will supply enough space to maintain the correct bend radius for the patch leads that are to be used.

All white PVC faceplates installed in office and front of house locations will have embossed LHR logo as standard.

Lockable outlets may be required in certain circumstances. This will add an additional option for HAL or the other customer to supply extra security to the network? This could be used for ACS, baggage, CCTV and any over location where de-patching of outlets could cause an issue or is required to be prevented unwanted access to the network in customer areas. Type of security device to be approved by a HAL reprehensive prior to use & installation,

Power poles are not recommended for use at Heathrow IT, unless agreed in writing with a Heathrow IT representative.

Cabinet presentations must be made with 1 U 24 way RJ45 modular presentation patch panel.

All free copper ports on a patch panel should be used before the installation of a new patch panel.

Patch panels **MUST NOT** be installed in the rear of the communications cabinets.

All panels must have enough slack on them to allow them to be pulled out of the cabinet for the purpose of re-termination & testing.

Cable management must be provided on the basis of 1U of horizontal management for every 1U outlet panel installed or in case of a more densely populated cabinet 1U horizontal management for every 2 U of outlet presentation

Vertical cable management is provided with every cabinet that is installed by Heathrow; additional vertical management will be agreed by a Heathrow representative when required.

The cabling system terminations must be in accordance with T568B.

Contractors will design the system *so* that sufficient slack remains to enable re-termination of the outlets a minimum of twice and a limited scope for movement of the cabinets. Coils of excess cables underneath the cabinets are unacceptable.

All routes and locations will be agreed with the appointed representative from Heathrow IT prior to installation.

All data horizontal cabling will not exceed 90m in length.

Although both UTP and S/FTP cable options are available, it is Heathrow IT policy to adopt UTP solutions wherever possible and a minimum of Cat 6 must be installed unless otherwise directed by a Heathrow representative.

2.3.2 Work Area

Category 6 – Modular Jacks

TrueNet® RJ45 UTP and STP Modular KM8® Jacks

The KM8 jack uses the keystone design, the global standard ensuring compatibility with the diverse range of faceplates systems throughout the world. The cable manager holds cable pairs in place up to the termination point.
This prevents untwisting and buckling of the conductors thereby guaranteeing performance for every installation.

Cable Parameters;
Conductor diameter 0.5-0.65mm (AWG 22-24) Cable diameter range with insulation 0.7-1.6mm

Test Specification;
Exceeds a specification according to ISO/IEC 11801:2002, EN 50173-1:2002 and TIA/EIA 568-B

TrueNet® RJ45 UTP and STP Modular CL Jacks

The CL jack is a low profile design which requires less than 35mm of depth (including bend radius of Category 6 cable) making it the perfect solution for shallow trunking, back boxes and floor box applications. In addition, the CL comes complete with an integrated spring dust shutter.

Cable Parameters
Conductor diameter 0.5-0.65mm (AWG 22-24) Cable diameter range with insulation 0.7-1.6mm

Test Specification
Exceeds a specification according to ISO/IEC 11801:2002, EN 50173-1:2002 and TIA/EIA 568-B
Industrial – DIN Rail Distributor IP20

DIN Rail Distributor IP20

The TrueNet DIN Rail Distributor is used for the configuration of RJ45 based industrial Ethernet cabling as well as building control and Enterprise structured cabling systems. This module is designed for indoor or outdoor use in distribution cabinets, space saving wall mounted distributors or boxes. The modules are simply snapped onto DIN rails commonly used in distribution cabinet production and in the field of process automation.

High density, compact consumer friendly design and outstanding transmission capacities highlight the DIN rail distributor from all other similar products in the marketplace

Industrial Outlet IP67/65

The TrueNet industrial outlet from TE CONNECTIVITY allows the installation of RJ45 based Ethernet connections in extreme environmental conditions like industrial production facilities, outdoors or rooms with high security requirements.
The industrial outlet offers protection according to IP67/65 against humidity, steam and dust as well as resistance against mechanic destruction or unauthorised access, combined with quick installation and simple operation.

Fibre Optic Wall Outlet

The TrueNet® Fibre Optic Wall Outlet from TE CONNECTIVITY is used to terminate horizontal fibre cable at the work station in Fibre to the Desk applications (FTTd).

Formed from a polycarbonate material (PC/ABS polymer), the wall outlet is assembled as two light-weight and robust mouldings. The base moulding can be fixed into a standard (BS4660) double gang back box to secure the whole assembly. The front or user facing moulding is able to drop down giving the installer access to work on the spooling, routing or splicing of up to eight secondary buffered fibre cables. This wall outlet is suited to deployment using direct or spliced pigtail terminations. Positions for 'clip-on' heat shrink splice holders are included

2.3.3 CONSOLIDATION POINTS

2.3.3.1 General

Consolidation points shall form part of the 90m fixed link for horizontal copper cables providing connectivity to tenant demise areas & office locations
The protective covers for consolidation points shall be supplied with all necessary accessories for cable management and cable and outlet protection.
Consolidation points shall be of a robust construction for fixing to the structural elements of the building at ceiling height, or for fixing to the cable containment or supporting struts.
Each copper consolidation point shall provide connectivity for 8 No. or 12 No. horizontal fixed link extensions using individual 4-pair cable extensions terminating at a final telecommunications outlet location.

The CP must be used as an interconnect and not as a cross-connect, i.e. incoming and outgoing cables are to be directly connected and not connected using cross connect wires or cords

The CP to TO (Telecoms Outlet) cable length must be at least 3 meters but ideally longer (10 - 15 meters). The maximum length must not compromise the overall channel length and not be so long as to be unmanageable. The use of RJ45 CP connectors and stranded core cables can be considered more appropriate to the use of MUTOAs (Multi user Telecommunications Outlets Assembly). These types of consolidation points should **NOT** be located in a raised floor void.

All cabling within the permanent link (including the CP to TO) must consist of cables with solid conductors i.e. not stranded conductors

The horizontal connections to a multiple TO or CL distribution box must be run in a suitable mechanical protection t. This is to protect the horizontal cables. This maniacal protection must run from just below the floor lever or containment all the way up to the T0/ CL distribution box

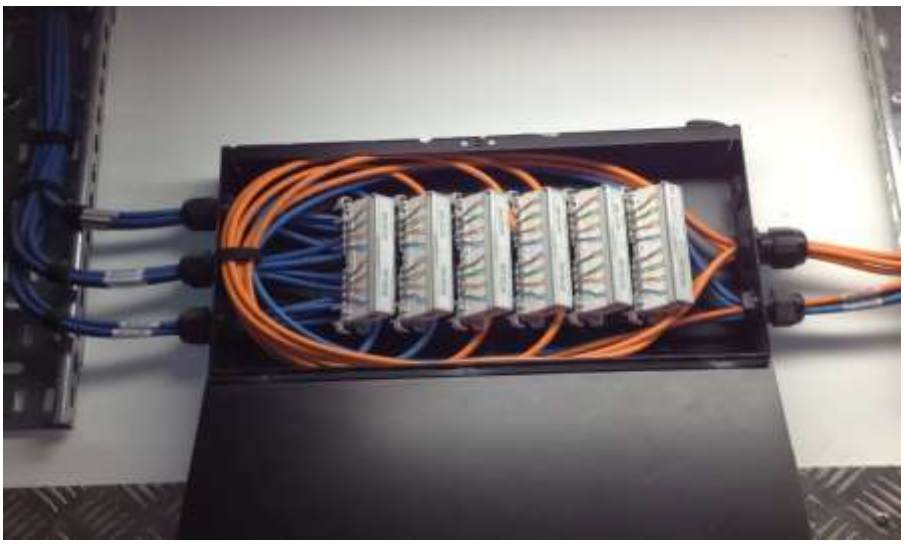
The HAL standard for connecting hardware in CPs is IDC/IDC i.e. high-band / Ultimate modules manufactured by TE Connectivity

CPS should be sited in readily accessible locations to permit safe maintenance and moves, add and changes (MACs). The use of cabling zones served by CPs may simplify location selection

2.3.3.2 Types

The following types of consolidation points shall be used:

- Metal Consolidation Box (Black) with 6 No. Highband Category 6 IDC 8-pair modules housed within, with a hinged & lockable protective cover. (T5)



- LSA Connection Boxes

Each of the standard 500 Series boxes is equipped with stainless steel back mount frames to support either 100, 200 or 400 pairs. Additional features include jumper rings as standard for tidy cable management; lockable doors with 180 degree access, doors can also be removed for installation and then hinged either right or left depending on the physical environment.
510, 520, 530 and 540 box support normal.

510, 520, 530 and 540 box support normal capacities of 340, 680, 1020 or 1340 pairs.

- Distribution Boxes (20, 50 & 100 Pairs)

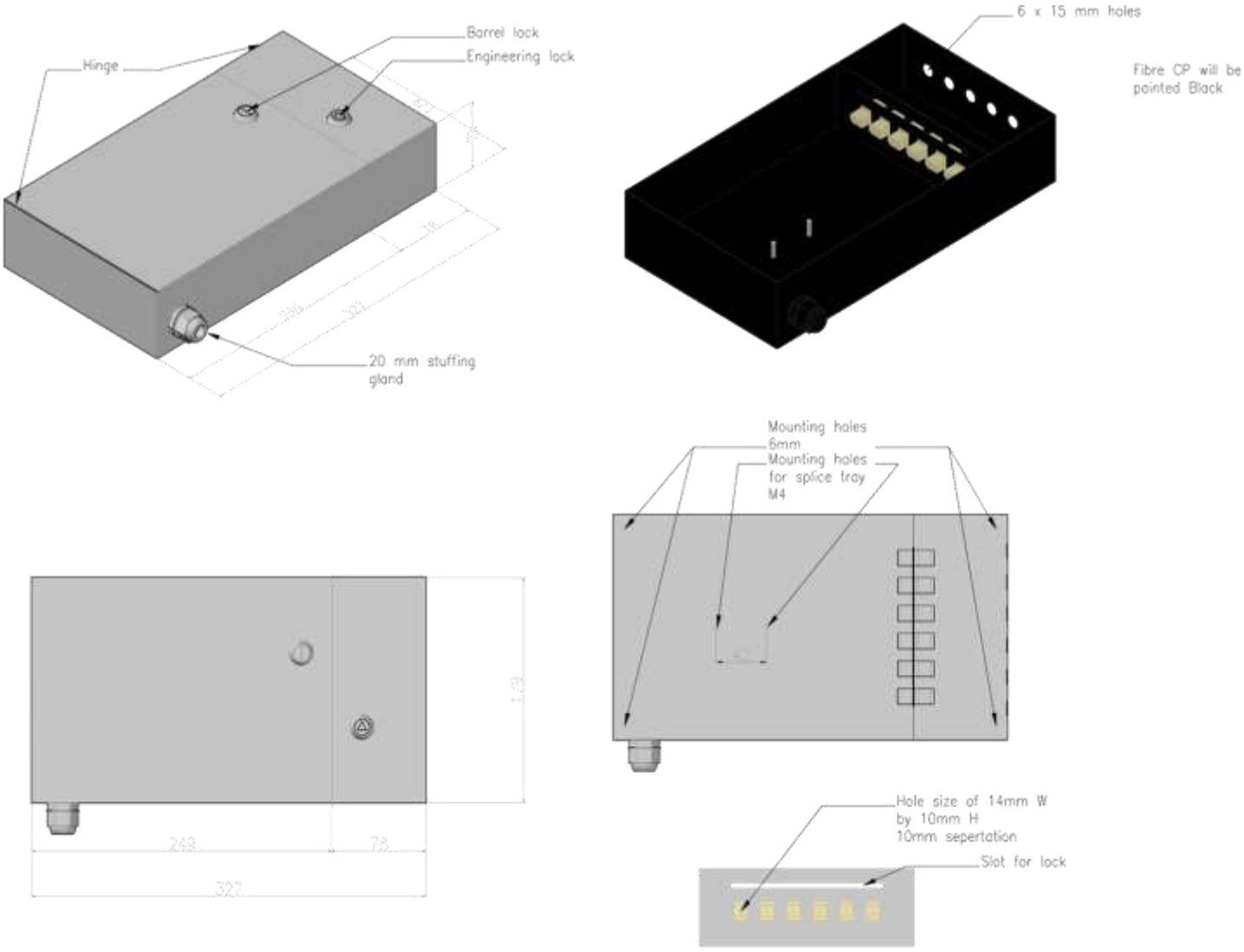
Housing with hinged cover (opening approximately 110°)
Space for owner´s label on the cover (approximately 24 mm x 100 mm)
Space for additional label on the cover (approximately 65 mm x 100 mm)
Back mount frame for LSA-PLUS® 10-pair modules
Prepared for overvoltage protection
Earth wire up to Ø 4 mm possible
Sheath grounding clamp
Locking optional

Product Specifications

Material

- **Housing**: - PC/ABS, UV-stabilized, UL 94 V-0, grey
- **Cover: -** Fiberglass reinforced polyester H UP 19/23, grey
- **Screws (for cover): -** Polyamide UV-stabilized
- **Grommets: -** Synthetic rubber, or polyethylene, black
- **Backmount frame: -** Stainless steel
- **Earthing: -** Brass, nickel plated and stainless steel
- **Screws: -** Stainless steel
- **Protection class: -** IP 54 (optional IP 64 with sealing)

The Connection Box 500 Series (1 x 10 way) are to be used as transitions boxes from internal to external cabling, these are not to be used as consolidation points and placed under raised floor.



- Metal Fibre Optic Consolidation Box (Black) with 6 No. Dual LC modules housed within, with a hinged & lockable protective cover. (T2)

2.3.3.3 Characteristics

- The bespoke metal consolidation box contains 6 x 8-pair Highband Category 6 modules. These modules perform to Category 6 requirements as stated in BS EN50173-1 and TIA/EIA-568-B. The modules are housed within connection box with protective cover

- The TE CONNECTIVITY Category 6 CL Distribution box is a high density distribution box, enabling multiple connections at the desktop. It can be desk-mounted, wall-mounted or fit into standard floor boxes. It is an extruded aluminium case with black plastic moulded end caps containing 12 No. Category 6 CL Jacks. The jacks perform to Category 6 requirements as stated in BS EN50173-1 and TIA/EIA-568-B. Sufficient slack must be left on the UTP cabling to allow the box to be removed from its current position to allow maintenance works to be carried out

- Bespoke metal fibre optic consolidation box contain 6 x duplex LC connectors. The modules are housed within connection box with protective cover. (Retail CP's in T2)

2.3.4 Fibre optic cabling

The following section details the methods, principles, installation, construction, optical performance and testing for the fibre optic cabling infrastructure used by Heathrow IT.

When terminating multi core fibre, the multimode must be presented first followed by the single mode cores. If any core is not to be terminated, then it must be left coiled in the fibre presentation device and space left for it to be terminated at a later date if required in the correct position. **Unused cores are not to be cut off.**

Heathrow has now moved to being a single mode fiber estate. All future fibre installs should be carried out using single mode fibre (All new major works, T2 & T5 single mode only, no modified hybrid cables are to be used). If multimode or a hybrid fibre cable is required for a specific reason then a concession will be required. We are aware that multimode is required in datacentre's, and will not require a concession as long as the fibre cable does not leave the room.

2.3.4.1 Optical connectors and assemblies

The preferred Heathrow IT fibre connector for all new installations should only be;

- Standard Data – LC.
- PMR – APC LC.

All terminations must be fusion spliced of pigtails onto incoming fibre cables. It is not acceptable to use mechanical or direct termination fibre connectors.

Fibre optic fixed links must be terminated within either *an* Optical Distribution Frame (ODF) or Optical Distribution Panel (ODP) depending on presentation and cable core count. Space must be left for un-terminated cores.

All External fibre cables entering a building must be terminated in to an Entrance Facility (EF) and then run to the final location on internal grade cabling. This will only apply at the present to both T2 & T5. There are expectations where one end of the external grade cable may be terminated directly into a cabinet with the correct termination / glanding and protection being used, these are T3, T4, Head of Stand cabinets, Sub stations and any remote stand.

When fibre optic cables are terminating into Optical Distribution Panel (ODP) mounted in comms cabinets, the gland from the fibre cable connected to the copex gland via a suitable sized coupling & than from a copex gland connected to the back of the ODP.
Note: No main cables terminated into the ODP as in T2

If the cable size is 48-core or below and the 48-core is terminating onto 1 ODP, than the cable should terminated onto a cable gland and then with a reducer into a 10-15mm flexible conduit to the ODP

If the cable is a 48-core or above, or the 48-core is terminating onto more than one ODP, than the cable should be glanded into an cable manifold (breakout) and then the cores into 10-15mm flexible conduit to the ODP's

A critchly label must be connect to all flexible conduit tubes, at the entry point on the rear of the ODF / ODP detailing the cable ID & the fibers cores installed in the tubes.

Permission must be sought to install Fibre outlets to the end location (E.G not a fixed link). *In* certain circumstances, permission will be granted to install smaller core count fibres to fibre outlet, one example being CCTV cameras.

2.3.4.2 Service/Maintenance Loop

The cable will be brought into the cabinet and an allowance for one service loop will be made where bend radius permits. *Where* external grade fibre is brought into a cabinet the armouring that surrounds the cable must be glanded to the cabinet before entry.

2.3.4.3 Cin Bin

The use of a Cin bin for the disposal of all fibre cut shards will be employed whilst working for Heathrow IT. Proof of your Cin bin disposal methods will be requested.

2.3.4.4 Cleaning of bare fibres

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.

If the internal 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.

The use of manifold is mandatory when installing external grade cables prior to presentation into an ODP or ODF.
Strength member earth bonding must be carried out with the manifold

2.3.4.5 External joint enclosure

The external joint closure to be used is manufactured 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.

The joint will provided 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.

2.3.4.6 Fibre optic cable builds

There are 2 Fibre Cable types, which are authorised by Heathrow IT:

Internal Build (Medium Duty):
Applications include:
Internal routes within communications rooms
Internal use between cabinet locations
Internal use between adjoining buildings.

External Build (Heavy Duty):
Heavy Duty applications are long haul and all external applications.

New World Fibre Type	Fibre Build			
	Fibre Count	Single Mode Cores	Multi-Mode Cores	Cable Category
1	96	96	0	External SWA
2	48	48	0	External SWA
3	24	24	0	External SWA
4	48	32	16	External SWA
5	96	64	32	External SWA
6	24	12	12	External SWA

Internal Build

New World Fibre Type	Fibre Build			
	Fibre Count	Single Mode Cores	Multi-Mode Cores	Cable Category
1	24	24	0	Internal Build
2	48	48	0	Internal Build
3	8	8	0	Internal Build
4	24	12	12	Internal Build
5	48	32	16	Internal Build(to be phased out, only used while stocks last)
6	96	64	32	Internal Build(to be phased out, only used while stocks last)

These fibre types replace all previous specifications.

Light Duty has been withdrawn from the specification.

Only to be used if explicitly specified by Heathrow IT. Use of this fibre type is restricted to project specific requirements.

The use of Fibre patch cords within flexible conduit (Twinzip) in order to provide a connection between end locations is strictly forbidden.

Fibre patch cords are only to be used to provide connections between fibre presentations that appear within the same patching field or at the end locations.

Fixed links with panel presentation must be used when connection is sought from one bay of cabinets to another or when running from one location to another that is not adjoining.

The Fibre Cable used shall have the following characteristics:

2.3.4.7 Optical fibre characteristics

Multi-mode fibre for use on the Heathrow network has the following optical characteristics:

50/125 micron graded index, dual window (850/1300 nm)
OM3 grade
Modal bandwidth overfill launch (guaranteed): 500/800Mhz.km (850/1300nm)
Modal bandwidth laser launch (guaranteed): 2000/f.f.s. Mhz.km (850/1300nm)

Single-mode fibre for use on the Heathrow network has the following optical characteristics.

9/125 micron step index, dual window (1310/1550 nm).
Attenuation (max): 0.4/0.35dB/km (1310/1550nm) – SMF-28
Numerical aperture: 0.13
Fibre Optic Bending Radius
Manufacturer's minimum bend radius MUST be observed at all times.
Refer to Section 3 of the standards document for datasheets and details.

2.3.4.8 Internal build (medium duty) fibre construction

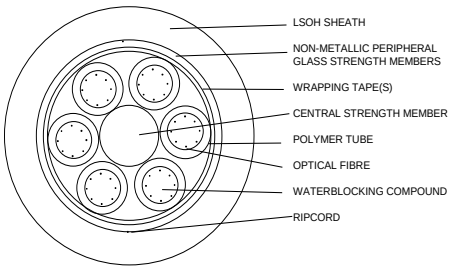
48 Fibre 6 ELEMENT NON-METALLIC DUCT CABLE with LSOH sheath
FTL4/GM
The cable consists of 6 elements stranded around a Glass Reinforced Plastic (GRP) central member. The elements are a combination of water blocked loose tubes (each containing up to eight optical fibres), and fillers to give the required fibre count. The cable core interstices are dry water blocked. The core is wrapped with binders/tapes (as required to aid manufacture).
Two layers of non-metallic peripheral glass strength members are stranded around the core followed by two ripcords applied 180° apart and an over sheath of LSOH (Low Smoke Zero Halogen) material.

The sheath is printed in white with the following legend:

llll M		HAL T/COM	*48F*	*50/125*	*48F*	*50/125*
llll	=	Sequential Length Mark				

Technical Details:

Tube Size	: 2.2 mm	
Cable Diameter (nominal)	: 11.7 mm	
Cable Weight (nominal)	: 150 kg/km	
Tensile Strength	: 4000 N	IEC 60794-1-E1B
Minimum Bend Diameter	: 240 mm (Static)	IEC 60794-1-E11A
Crush Resistance	: 2500 N/100mm	IEC 60794-1-E3
Impact	: 5 Joules	IEC 60794-1-E4
Temperature Performance	: -25°C to +70°C	IEC 60794-1-F1
Water Penetration	: 3m, end on, 24hrs	IEC 60794-1-F5B
Fibre	: Multi mode 50/125	



Fibre Count	*Elements*					
048 (MM)	R8FT	N8FT	N8FT	N8FT	N8FT	G8FT

R8FT = Red 8 Fibre Tube, N8FT = Natural 8 Fibre Tube, G8FT = Green 8 Fibre Tube
Fibre Colours No's 1-8, Blue, Orange, Green, Brown, Grey, White, Red & Black.

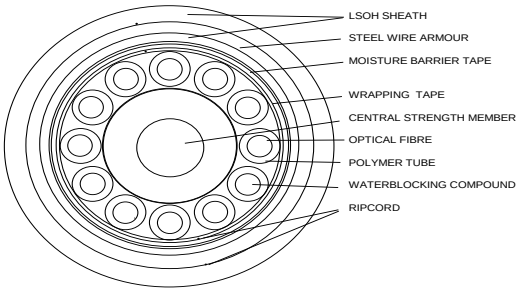
2.3.4.9 External Build (Heavy Duty) Fibre construction

Typical INT/EXT direct buried CABLE
96F SINGLEMODE (FTL4/A5MFM)
The cable consists of 12 elements stranded around a coated steel central strength member. The elements are a combination of water blocked loose tubes (each containing up to eight optical fibres), and fillers to give the required fibre count. The core is wrapped with binders/tapes (as required to aid manufacture).
An aluminium laminated moisture barrier tape is applied longitudinally over the cable core together with two ripcords (applied 180° apart) and an inner sheath of Black LSOH (Low Smoke Zero Halogen) material. A layer of galvanised steel wire armour is applied helically over the cable inner sheath followed by two ripcords (applied 180° apart) and an outer sheath of Black LSOH (Low Smoke Zero Halogen) material.

The sheath is printed in white with the following legend:
//// M HAL T/COM *96F 9/125* *96F 9/125*
//// = Sequential Length Mark

Technical Details

Tube Diameter (nominal) : 2.2 mm
Cable Diameter (nominal) : 21.5mm
Cable Weight (nominal) : 755kg/km
Tensile Strength : 9500 N
Minimum Bend Diameter : 430 mm (Static), 860mm (Dynamic)
Crush Resistance : 3000N/100mm
Temperature Performance : -25°C to +70°C
Fibre : Singlemode



Fibre Count	***Elements***											
	1	2	3	4	5	6	7	8	9	10	11	12
96	R8FT	N8FT	N8FT	N8FT	N8FT	N8FT	N8FT	N8FT	N8FT	N8FT	N8FT	G8FT

R8FT = Red 8 Fibre Tube, N8FT = Natural 8 Fibre Tube, G8FT = Green 8 Fibre Tube

2.3.4.10 Fibre optic installation resilience guidelines

Core to Core Locations
Separate fibre cable sheath should be installed
100% resilient cable route
Separate building entry
Separate room entry
A small number of splices are acceptable on a core to core link. This should be limited to the minimum possible and signed off by the design team. Any patching in this link is forbidden and shouldn't be installed under any circumstances

Core to Distribution Locations
Separate fibre cable sheath should be installed
100% resilient cable route
Separate building entry
Separate room entry
A small number of splices are acceptable on a core to core link. This should be limited to the minimum possible and signed off by the design team. Any patching in this link is forbidden and shouldn't be installed under any circumstances.

Distribution to Distribution Locations
Separate fibre cable sheath should be installed
100% resilient cable route
Separate room entry
A small number of splices are acceptable on a core to core link. This should be limited to the minimum possible and signed off by the design team. Patch leads are acceptable in this link as long as the link adheres to the dB loss budget supplied by the design team and in line with this document.

Distribution to Edge Locations
Separate fibre cable sheath should be installed where possible
Fibre Cables can share the same route

For edge switches that are fed from a single cable we must notify the operations department detailing the location of the device, number and type of users attached to the devise and the cost of installing a resilient cable.

Any numbers of patch leads are acceptable in this link as long as the link adheres to the dB loss budget supplied by the design team and in line with this document.

2.3.5 Voice copper cabling

The following section details the methods, principles, installation, construction and testing for the copper voice cabling infrastructure used by Heathrow IT. When carryout jumpering for analogue voice services, the following colour jumper wire must be used.

- VG224 – blue & yellow.
- Command & control – red & white.

2.3.5.1 Cat 3

Consideration need to be given to the use of Cat 3 backbone cabling where digital telephony applications are to be supported or where voice backbone links are excessively long (e.g. over 1000mts long)

2.3.5.2 Additional capacities

All voice cabling installed should allow for a minimum of 25% spare capacity over and above the initial requirements stated in the specification for the works.

2.3.5.3 General

Voice grade cable CW1308 with a conductor diameter between 0.5(min) and 0.65mm (max.). The jacket construction of this cable must be LSZH and provided in the Contractors proposal for the work.

External runs of voice cabling will utilise cable of type CW1128 which will be jointed to CW1308 within 2mts of entering a building, using standard TE CONNECTIVITY box connections and Series II Blocks (237A) and label holder (51A)

Internal cables entering communications rooms will be terminated utilising Series II Blocks (237A) and label holder (51A) mounted onto a voice distribution frame (108A) or box connection for distribution to communication cabinets. All new voice services should be presented to the end location over horizontal cabling (Cat5e or Cat6) that emits from the network cabinet. Voice services should no longer be presented at the outlet position onto a LJU connection or over CW1308 to the customer location. Multi-pair CW1308 should only be used for the connection between the network cabinet / entrance facilities and the distribution voice frames located in the DSCR's or the main voice frame locations for the older terminals\buildings

A minimum of a 25-pair voice grade cable should be installed from the voice frame to the cabinet.

When terminating a voice cable. No matter how many pairs are to be utilised, all pairs of the voice cable must be terminated at the wall frame on Series II Blocks (237A) and labelled with the correct voice cable ID. Only the pairs above 25 can be left un-terminated at the cabinet end, with enough slack left for them to be terminated onto another voice patch panel or panels when required.

The voice multi-core cable functional earth (cream) to be connected at one end (frame end)

2.3.5.4 Terminations

Terminations will be made using an TE CONNECTIVITY IDC punch tool fit for purpose.

The incoming cables will have all pairs terminated at both ends.

A minimum of 1 pair modularity is required per circuit.

TE CONNECTIVITY PSTN Master, PABX master and secondary RJ45-LJU Converters may be used, dependent upon the main telephone switch requirements.

Contractors shall design the system such that sufficient slack remains to enable re-termination of the cables or limited scope for movement of the cabinets
Testing of voice cabling will be carried out for continuity and polarity.

2.4 IT Equipment Patching and Patch Cord Management

2.4.1 Cable Management Hardware

All cable management hardware (both vertical and horizontal) shall be sufficiently sized to accommodate the initial patching requirement plus a minimum 100% expansion. The hardware shall be designed so as to maintain manufacturer's minimum bend radius requirements. Particular attention should be given to CAT-6 (or above) installations where cable diameters and minimum bend radii are increased over CAT-5.

2.4.1.1 Horizontal Cable Management

All horizontal cable management panels shall be a minimum of **170mm** deep with minimum 4 No. rings manufactured of metal and finished in black. The rings shall be the full 1U or 2U high and sufficiently sturdy to support the weight of the patch cords without deformation of the rings or cords. The minimum requirement is:

- 1No. 1U panel for every 1U Cisco switch
- 1No. 1U panel for every 2No.1U patch panels or 1No. 2U patch panel
- 1No. 2U panels per cabinet >15U (for cords to traverse sides)
- 1No. 2U panels per 27U cabinet (for cords to traverse sides)
- 1No. 2U panel per cabinet </= 15U (for cords to traverse sides)
- 1No. 1U panel per ODF

2.4.1.2 Vertical Cable Management

All vertical cable management rings shall be a minimum of 110mm x 100mm installed every 3U on all verticals. The rings shall be sufficiently sturdy to support the weight of the patch cords without deformation of the rings or cords

2.4.1.3 Front to Back Cable Management

Where required there shall be a minimum on 1No. 3U telescopic cable management tunnel to route cables from front to back. The use of both sides of a cabinet is normally to be avoided.

2.4.1.4 Inter Cabinet Connections

Patch cords shall not be routed between cabinets. Inter cabinet connections shall be made using cabinet interlinks which can be either: If inter cabinet links cannot be installed due to cabinets being fully utilized then fibre patch leads may be run between the cabinet on overhead basket. No patch leads to be installed under floors. Copper connects must use cabinet links as patch lead longer than 5 meters cannot be utilised.

• Panel to panel (fibre or copper) or
• plug (factory terminated) to panel for copper switch harnesses

When installing copper cabinet interconnects (patch panel to patch panel, between cabinets) then the number of cable being installed must be in multiples of 24. i.e the whole panel must be used. This is a recommendation and will be down to the client's requirements & cost, but never less than 12 cables

2.4.1.5 Switch Harnesses

When a network device is installed into a Cat6 environment that has more than 12 copper connections, a specially designed support bracket must be installed under the device, with the cables secured to it by Velcro ties. This is to ensure the correct bend radius is maintained on the patch and to reduce any excess strain that may be placed on the device connection from having to support the weight of the cables.

Where switch harnesses are used, cables can all route from one side. In the case of Cisco 3750 switch harnesses, they must all route from the left hand side (front view) to allow access to the fibre connections on the right hand side. Cable support bars, especially where cat6 UTP is being installed must be installed to support each switch harness.

Switch looms should not exceed a length of 10 meters and if there is an instance where this happens than the permanent link cables will have to be reduced to keep the overall channel stays at 100 meters including patch leads.

The following photo shows a 3750 with copper switch ports properly cabled.

When installing the switch looms patch panel into a passive cabinet, and the switch stack doesn't utilize the maximum number of switches allowed in a stack (4 devices). Then space must be left for future expansion for the A1 switch looms panels to be installed before the A2 stack ones are installed

When installing an active cabinet where all the switches located in it utilize a switch loom system, then the right hand side (looking at the front of the cabinet) vertical management rail / system is to be removed to enable the switch looms easy and free access to connect to the switch without having any

restrictions on the cabling. Prism cabinets only

When installing switch looms in to a passive cabinet, the switch loom patch panels must be kept in sequence of the switch stack.

2.4.1.6 Vertical Profiles

The vertical profiles shall be set sufficiently back to accommodate the cable management hardware and bend radius of the cords. The cabinet door shall be able to fully close and lock without contacting any patch cords. Particular attention shall be made to active equipment which may sit forward of the profiles when mounted.

2.4.1.7 Switches

When Switches are installed, they should only be installed horizontally in communications cabinets of suitable depth to allow for the installation of patch leads/switch looms at the front and power at the rear. Switches must **NOT** be installed in vertically in space saver cabinets.
Spacing between switches must be at least 1U. In cabinets where switch looms are not utilized switches must be spaced out in the cabinet to help prevent congestion of patch leads

Twenty five per cent (25%) spare capacity must be left on each device.

When installing switches into a purely active cabinet, and the switch stack doesn't utilize the maximum number of switches allowed in a stack (4 devices). Then space must be left for future expansion of A1 stack before the A2 stack is installed.

No LHR Switches are to be installed into 3rd party cabinets. To enable a connection between 3rd party cabinet and LHR active equipment, copper link cables or switch looms should be used.

2.4.2 Patch Cords

2.4.2.1 Patch Cord Manufacturer

Patch cords shall be supplied by Heathrow's approved cabling system manufacturer. Other manufacturers' cords are not permitted. Under no circumstances shall patch cords be field terminated with plugs. All patch cords must match the category & type as the installed UTP/STP cabling

All services running on the managed LAN must use an orange colour patch lead. All 3rd party services that are not connected HAL devices i.e BA must use a Blue sheathed patch lead and all analogue / voice services must use a grey colour sheathed patch lead. This only applies to T2 & T5 only

2.4.2.2 Patch Cord Sheath

All patch cords shall have an orange Low Smoke Zero Halogen (LSZH) sheath as a minimum.
PVC sheathed cords must not be used.
All patch leads must match the category of the horizontal cabling that it is being used in conjunction with.

2.4.2.3 Patch Cord Length

Patch cords shall be the shortest possible length to achieve the connection whilst being properly routed through the cable management hardware. Excessive length cords will quickly congest a cabinet.

2.4.2.4 Colour Coding and Labelling

Patch cords shall not be colour coded or labelled. The exception is for British Airways (BA) patch cords used in a common passive infrastructure model. These shall be blue sheathed. Individual cables within switch harnesses shall be labelled at both ends with computer printed wrap around labels.

2.4.2.5 Fibre Optic Patch Leads

All fibre optic patch leads must follow the requirement that multimode cables are orange in colour and single mode are yellow, they are all so required to have the following information on the cable at both ends,

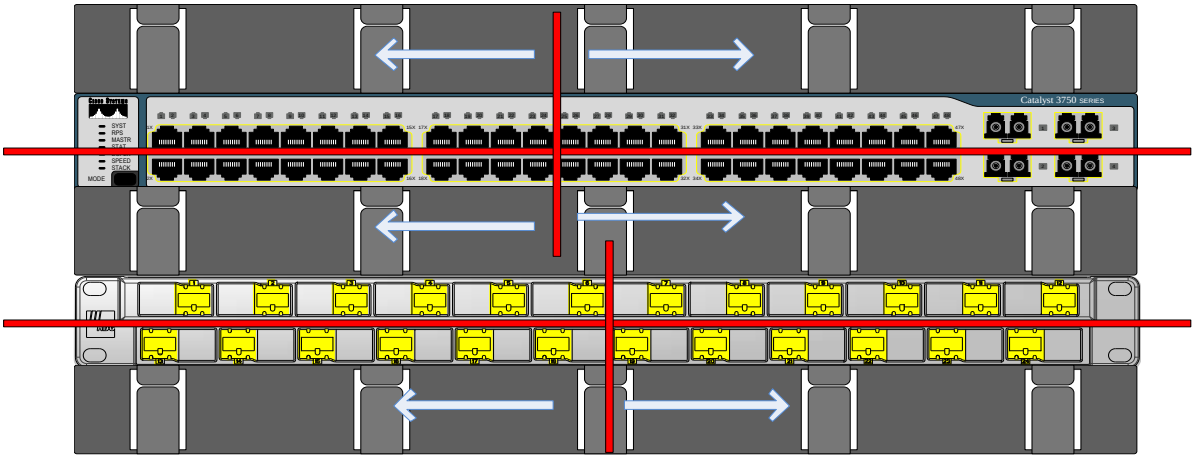
- The length of the patch lead
- A unique identification number
- Manufactures part number

2.4.3 Patch Cord Installation

2.4.3.1 Patch Cord Routing

Patch cords shall be routed to the horizontal cable management panel above or below without crossing over other connections i.e. the top row of RJ45 ports on a network switch or patch panel shall route above and the bottom row shall route below. Similarly patch cables shall be routed either left or right so that the left most 50% of connections route left and the remainder route right. The following diagram illustrates this with no cords crossing red lines:

Patch Lead Direction



Note: **No Patch Leads to be run under a raised floor,**

2.4.3.2 Fibre Patching

When patching the fibre uplinks between the distribution device and access device the following must be followed. The connections back to the D1 distribution device must be installed into the first fibre uplink port of the switch (SFP port on the switch) and the D2 link should be installed in to the second fibre port on the switch. On a set of stacked switches the first fibre port on the second switch will be used for the D2 uplink.

2.4.3.3 Patching & Celsius

All horizontal / vertical / patching and fixed end devices are now being documented in Celsius for all

new builds (currently T2 ,T5, WIB and T3IB) so this information has to be handed over to the support team along with test results. A fixed device is any device that connects to the HAL infrastructure, that is unlikely to be moved once deployed. This ranges from CCTV, ACS, Wirless, FIDS, Emergency phones, Back of house phones, baggage, this can be completed via the Celsius Engagement CRQ template.

2.5 CONTAINMENT

The contractor shall be responsible for the cutting, filling and making good decorations on walls, floors and ceilings etc.
All tray work, metallic trunking and associated mounting hardware shall be of galvanised steel.

The gauge of metal and width of tray shall be fit for purpose. The fixings for the required materials shall be at a distance appropriate to the individual installation requirement.

LSZH non-metallic trunking will be permitted within office areas. The fixings of such material shall be at 300mm centres.

When LSZH trunking is used then suitable end caps, tees and corners are to be used.

It is a recommendation that conduit installations be secured every 0.9m with brackets on a vertical run and 1.2m on a horizontal run. Conduit bends must have a fixing saddle within 50mm of the bend radius and joined with suitable couplers. There must be no more than two bends in a single run of conduit.

As a minimum 25mm conduit will be installed where a dual outlet is required.

If there are more than two bends in a single run then a pull box must be used to ensure that the minimum bend radius to adhered too.

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

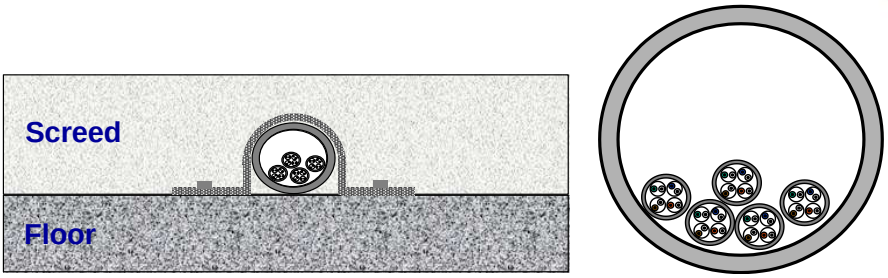
All burrs and sharp edges are to be removed prior to the pulling of cable.

When working with metal conduit it is advisable when closing each joint that a waterproof barrier, such as PTFE tape is used to prevent against sealing the joint permanently.

Metal trays, conduit (plastic or metal) and trunking must allow for expansion of the system. On new installations, it is advised that only 50% of the conduit may be utilised, which will allow for future expansion. The guidelines also state that conduit; tray and trunking must only be filled to a total of 50% total capacity, and that each conduit pipe includes a draw rope.

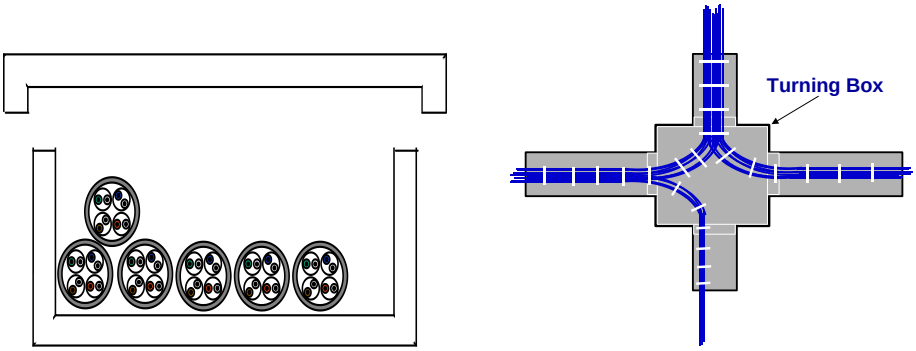
To prevent against snagging while running cable through conduit, it is recommended to use the correct lubricant. The use of washing liquid and other detergents to lubricate shafts is not permitted, as these cause damage to the cable insulation.

Older installations or 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



Where flexible conduit (metal or plastic) is utilised as part of an installation, the correct type of glands for each type the flexible conduit used must be used at both ends and connected via a locking nut or conduit box, ODP, cable tray or any finalised equipment.

Plastic trunking is subject to the same rules as conduit and tray work. The same capacity rules apply (must not exceed 50%), the all sharp edges and burrs are removed and that plastic trunking must not be placed through fire stops, anywhere there is a risk of damage, electrical interference or used for fire prevention. Plastic trunking is also more susceptible to environmental changes and therefore should not be contained within an area where it cannot expand by up to 1.2mm, per meter of length.



Cable must not be pulled through trunking, it laid or placed into position and any curves or bends that are required it is important to understand the band radius for the type of cable being used.

Turning boxes are used to maintain cable bend radius to prevent against attenuation and other faults within the cable being generated. It is important to note that up to 50% of trunking capacity can be lost due to bends in cable.

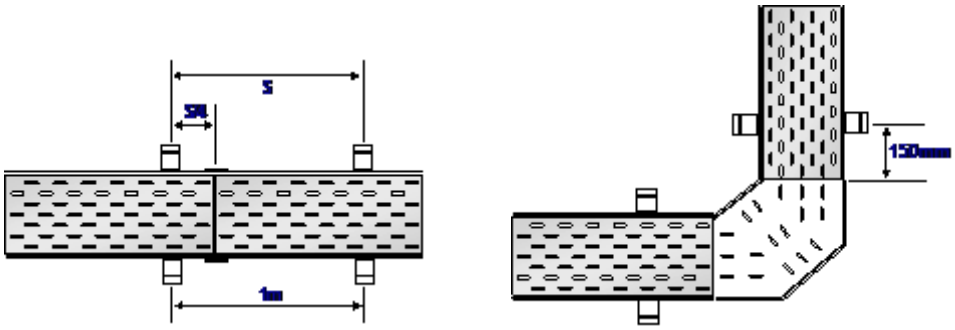
Back boxes should be fitted at every point where cables are presented at outlet location; these boxes should be metal or plastic, surface or flush depending on circumstances or location, (e.g. metal back boxes at back of house locations). The boxes should be a minimum of 40mm deep.

Bespoke and floor boxes at locations where required.

2.6 TRAYWORK

Tray work will be installed where necessary for the installation and the Contractor must ensure that the life expectancy will exceed 15 years in the environment in which it is to be installed.

All angles fitted to the trunking will be gusset or radius type enabling the installation of cables without exceeding the minimum bend radius.
It is essential that the tray is able to carry the estimated weight over the required distances. It is essential that support brackets be used when jointing together crosspieces, T-pieces, corner and bend sections.

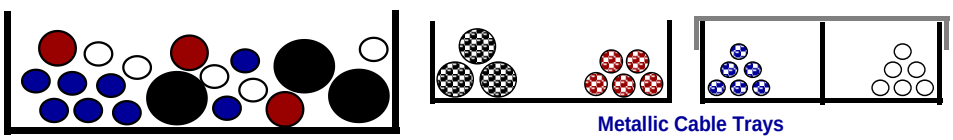


When fitting horizontal tray to the floor, it is advisable to use standoff brackets, which allow access to underneath the tray. When joining trays to support brackets that the bolt head is installed within the tray, this is to prevent against cable snagging and becoming damaged. Tray sections must have all sharp edges and burrs removed to prevent against cable damage and protective covering may be used. Metal trays must be bonded together in accordance with BS 7671

Tray work & pathways must be installed so that the Public cannot get access to it.

2.7 PHYSICAL CABLE SEPARATION

Copper cables, which are installed into cable management systems, must ensure that they follow the guidelines for cable separation.
The current standard states that data cables and power cables must not share the same duct or conduit.



Metallic Cable Trays

It is not recommended that power cables, or cables that supply auxiliary and sensitive circuits be contained with the data cables.

The correct method is to place the correct types of cable into the right type of cable management device. This can be achieved by placing all the power and auxiliary circuits within one tray and copper cables for data, voice and sensitive services in an alternate cable management.

Media Type	Balanced		Classification
	Unscreened	Screened	
S/FTP		7	d
F/UTP		5 or 6c	c
U/UTP		5 or 6b	b
Other	Other		a

Classification 'a' shall be applied if:

- The applications to be supported are unrestricted
- The type of cabling to be installed is unrestricted

Classification 'b' and above shall be applied if the applications are supported by the EN 50173 series of standards.

Classification	Cable Management System			
	None (mm)	Open Metallic Containment (mm)	Perforated Metallic Containment (mm)	Solid Metallic Containment (mm)
d	10	8	5	0
c	50	38	25	
b	100	75	50	
a	300	225	150	

Qty of Circuits	Separation Multiplier
≤60A	0.2
≤120A	0.4
≤180A	0.6
≤240A	0.8
≤300A	1
≤600A	2
≤900A	3
≤1200A	4
≤1500A	5
≥1500A	6

Each circuit is defined as 230V ac 20A single phase. A three phase circuit will be treated as three separate single phase circuits. Circuits greater than 20A are to be treated as multiple 20A circuits. i.e. 32A circuits shall be defined as 2 circuits.

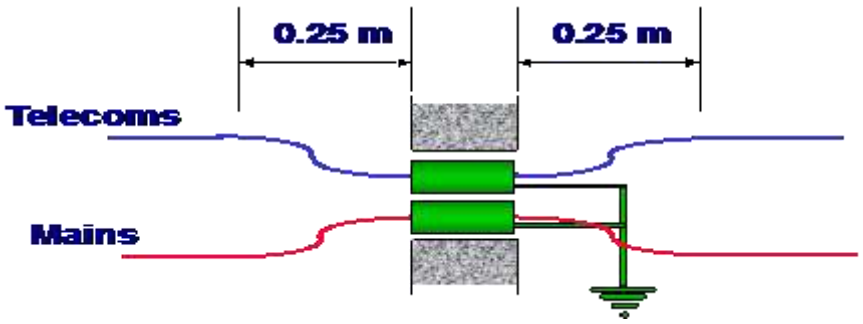
E.g. a category 6 U/UTP cable is to be run within plastic trunking next to 3 off 20A circuits.
The total separation is 100mm x 0.2 = 20mm.

There are exceptions to these rules where a zero separation distance is allowed. The rules are defined as:

- The power conductors form a single phase
- and provide a maximum current of 32A
- and the power conductors are maintained within a single sheath i.e. twin and earth
- and the IT cable falls with the classifications b, c or d
- or the applications to operate over the IT cabling supports zero electrical segregation

LHR is aware that there are times when data and power cables may have no other choice than to be forced together. It is therefore recommended that when power cables operating at voltages exceeding 240V AC or 240v DC have to pass through either a wall or some form of fire segregation that the separation distances may be reduced, provided that the following parameters at met:

The total distance that copper 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.



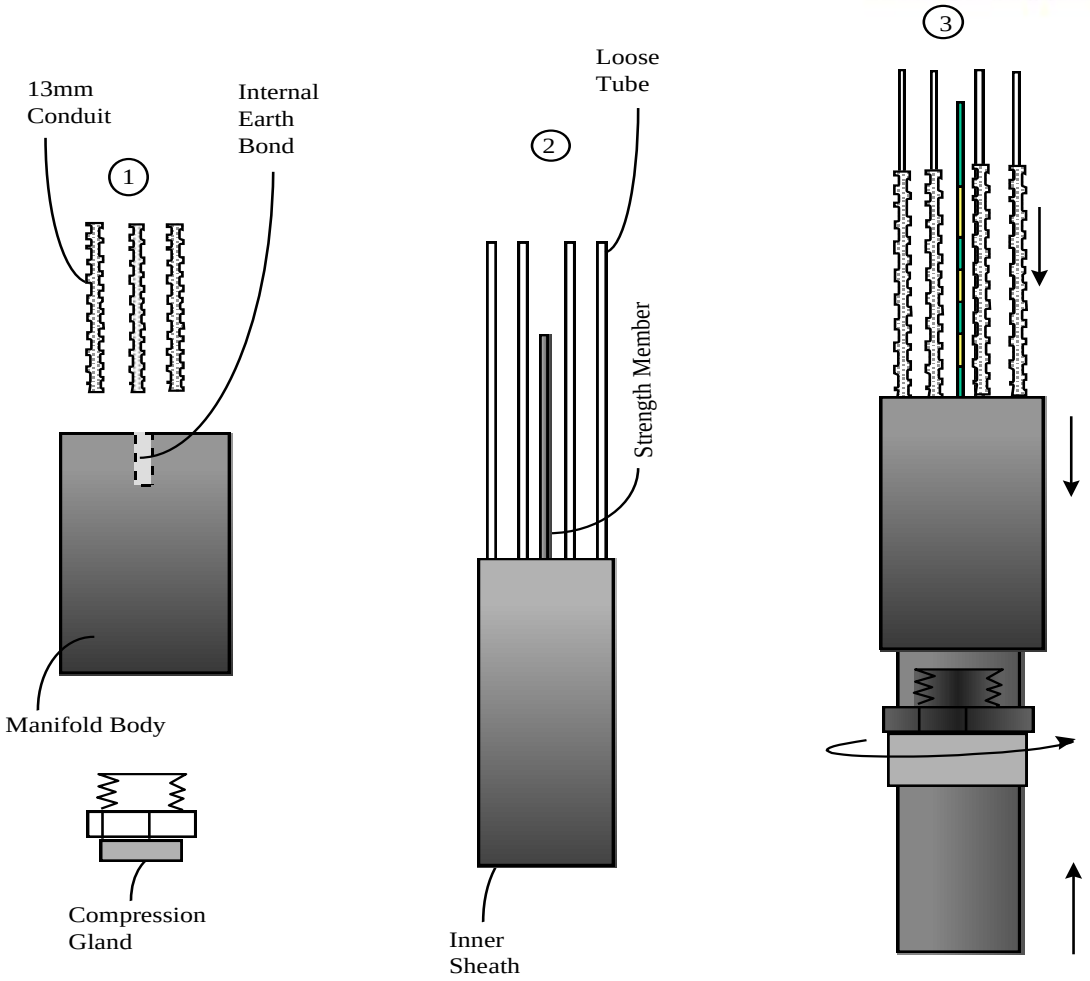
2.8 CABLE MANIFOLD

The manifold is used to arrange the cable into the correct tube termination format, via a mechanical breakout unit. One end is a cable shroud and a cable compression gland which covers the unit and the cable sheath, whilst the other end is an arrangement of 13mm conduit ports.

Conduit from these ports transports 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 labelled with the appropriate tube number at each end prior to termination.

Where two different cables share the same manifold then each conduit tube exiting the manifold must have its cable ID attached to it with a critchley label.

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 screwed into manifold body.



2.9 EARTHING AND BONDING

2.9.1 Earthing

All cabinet electrical systems are to be designed, installed and certified **in accordance with (iaw)** the requirements of:

- **BS 7671:2008 '**Requirements for Electrical Installations ~ IEE Wiring Regulations'.

BS7671 has been extensively referred to in **Health and Safety Executive (HSE)** guidance over the years. Electrical installations that conform to this standard are regarded by the HSE as likely to achieve conformity with the relevant parts of the **Electricity at Work Regulations 1989**

Earthing & Bonding

BS 7671:2008 'Requirements for Electrical Installations ~ IEE Wiring Regulations' **Chapter 45 '**Earthing Arrangements and Protective Conductors'

SI 1989 No 635 'The Electricity at Work Regulations' requires at:

- **Regulation 8** 'Precautions shall be taken , either by either by earthing or by other suitable means, to prevent danger arising when any conductor (other than a circuit conductor) which

may reasonably foreseeably become charged as a result of either the use of a system, or a fault in a system, become so charged'.

- **Regulation 9** ' If a circuit conductor is connected to earth or to any other reference point, nothing which might reasonably be expected to give rise to danger by breaking the electrical continuity or introducing high impedance shall be placed in that conductor unless suitable precautions are prevent that danger

To comply with **Regulations 8 & 9,** all parts of the cabinet, including doors, side panels and mounting frames are to be individually bonded to the cabinet MET by insulated multi strand flexible cables with cross sectional area not less than 4 mm^2 (or 2.5 mm^2 if mechanical in additional to green/yellow insulation is provided)

Additional bonding is to be made to all equipment cases provided with an earth terminal unless the terminal is provided for Functional Earthing (FE), in which case FE paragraph.

Earthing is to be provided to connect each PDU earth terminal to the cabinet MET.

Each cabinet will be **individually earthed** back to the nearest building earth bar, which will be will be connected to the main earth system in accordance with BS 7671

Daisy chaining of earth connections from one cabinet to another is **not permitted.**

Daisy chaining of earth connections from one patch panel to another within the cabinet is **not permitted.**

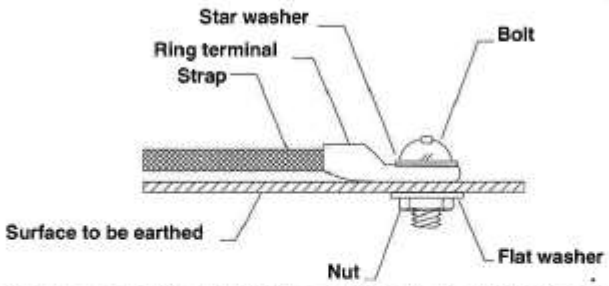
All metal parts of the cabinet, doors, side panels etc. must be bonded to the main body of the cabinet utilising the cabinet manufactures bonding kit.

A 10 mm (Sq.) earth is required from the distribution board to the earth point in the cabinet where the cabinet is below 21u.
A 16 mm (Sq.) earth is required from the distribution board to the earth point in the cabinet where the cabinet is above 21u.

Suitable sized bonding cables may need to be specified by the electrical design engineer depending on the location and size of the cabinet.

Earthing requirements detailed within product information guides supplied with the components **must be adhered** to at all times.

Ring terminals should be bolted to all surfaces using the correct size of bolt, flat washer (used to increase surface area), star washer and nut.



All metallic elements must be earthed, including cabinet doors. Patch panels will have an earthing screw and lug fitted at the time of manufacture to demonstrate this requirement. Doors of most manufacturers' cabinets will have an area of exposed metal so the door can be bonded to the cabinet. When earthing patch panels to the frame and such like, an earth cable with a cross sectional area of 2.5mm^2 square should be used.

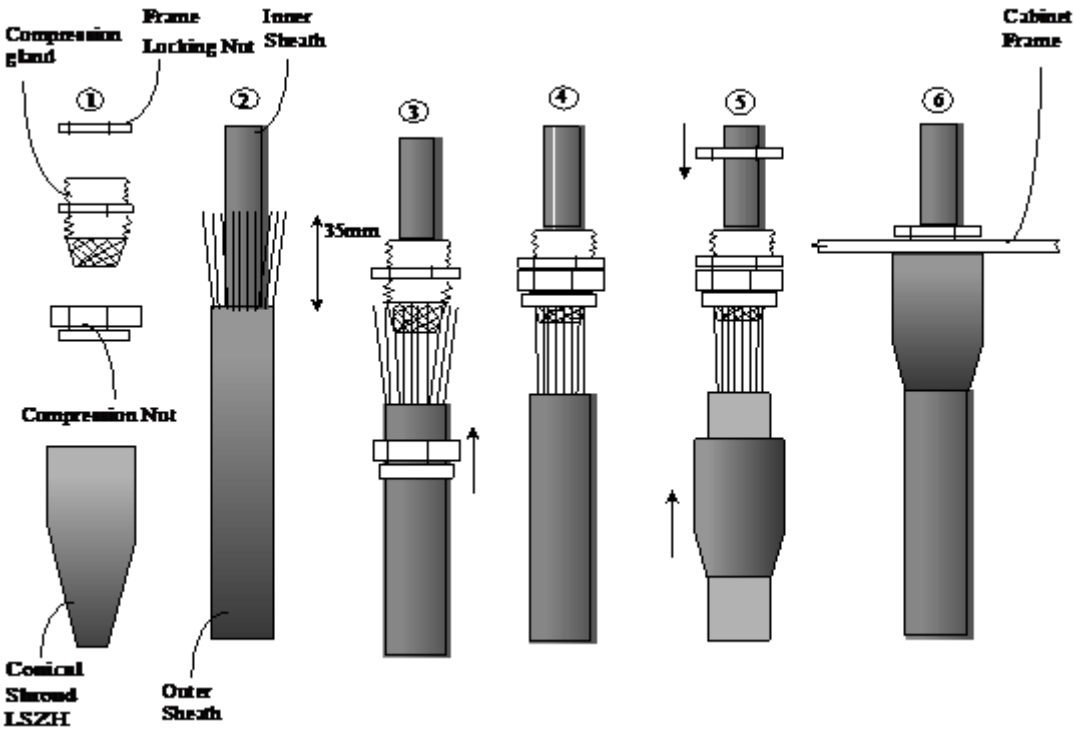
When external grade cables enter a building they must be connected to the nearest earthing bar at point of entry to the building (within 2 metres). The connection will be made by exposing 30mm of the SWA and attaching an earth clamp. This earth clamp will be connected to the earthing bar using a minimum of 16mm green and yellow earth cable.

When cables are only transiting through buildings and are not connecting to any services, there is no requirement to bond the cable upon entry or exit of these buildings. (T1, T3 & T4)

All new builds should have as part of the installation a transition point at every position where cables enter or leave the building.

2.9.2 Armouring glands

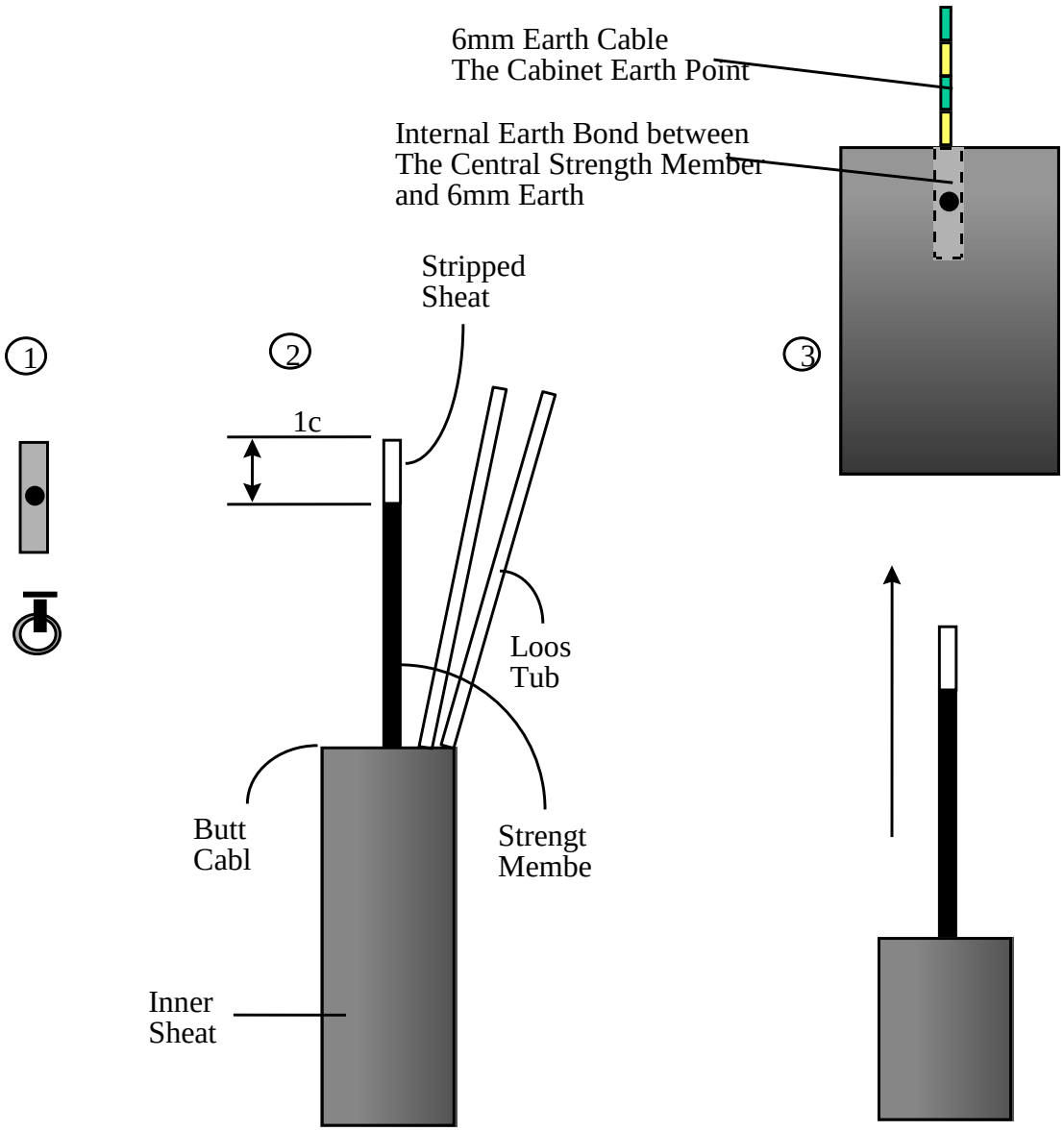
1. Gland piece parts.
2. Outer sheath and armour preparation.
3. Compression nut offer up to the body.
4. The nut compresses the armouring onto the body.
5. Cable is installed into the cabinet. The frame locking nut and the cable shroud are offered up to the body.
6. Finished gland secured into the frame of the cabinet.



2.9.3 Bonding

Fibre optic cables are totally immune to electrical interference and are often laid with or alongside power cables throughout the internal riser and external duct networks. 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.

1. Internal Bonding Piece Parts.
2. Strength Member Preparation.
3. Earth Wire and Central Strength Member connected via the Internal Bond within the Manifold Body.



2.10 CABINETS

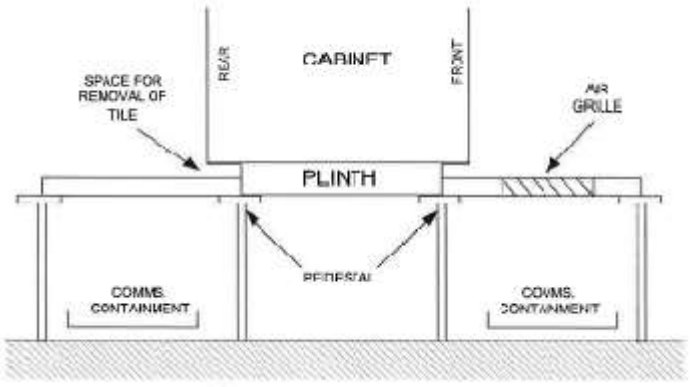
This section details the construction, layout and labelling specifications for the network cabinets, in which any equipment, whether passive or active is installed. The enclosures have been designed and built to ensure that the integrity of the network remains intact throughout its complete operational and financial life cycle.

All Cabinets are to be manufactured by Prism.

Third party equipment must not be installed in the same cabinet as LHR active or passive equipment due to security reason. They must be installed in their own cabinets, by using a colo cabinet design and link back to a LHR active or passive cabinet via an inter-cabinet copper of fibre link.

When installing non rack mountable equipment in a cabinet, the equipment should be installed on to a 19" network cabinet shelf. If the equipment has to be secured to this shelf, then the shelf must be on runners so it can be pulled out to enable full access to the equipment

The majority of 800mm x 800mm cabinets shall be fixed to raft style plinths (size depending on quantity of cabinets) safely located on the floor grid, allowing removal of adjacent tiles to the front & rear of the cabinet.



Where no raised access floor is available the cabinets will be mounted directly on the communications room floor with the power & communications cables entering from the top of the cabinet.

When counting the U height of the cabinet, U1 is always located at the bottom of the cabinet.

2.10.1 FLOOR MOUNTED CABINETS

2.10.1.1 LHR CABINET SPECIFICATION (Type 6/1)

	Our Part No: FI-CAB4588-BAA-T6/1-LHRH
	Description
	• 1 x Bolted aluminium frame construction • 1 x Enclosed mesh front door (83% open area) Flat style • with quick release hinge system and 3 point locking solution and common suite key **HINGED ON RIGHT HAND SIDE (Viewing from Front of Cabinet)** • 1 x Enclosed mesh rear door (83% open area) Flat style • with quick release hinge system and 3 point locking solution and common suite key **HINGED ON LEFT HAND SIDE (Viewing from Rear of Cabinet)** • 1 x Pair of split sliding panels • 1 x Vented top cover with 4 x 300mm x 80mm cable entry points and brush strip fitted • 4 x 19Universal style (heavy duty) adjustable mounting • profiles (positioned 100mm from front of cabinet and 450mm between front and rear profiles) • 2 x 45U 300mm cable tray (1 x fitted each side at rear) • 4 x Vertical cable management panels with 70mm x 70mm jumper rings fitted on front management and 70mm x 100mm fitted on rear management • 1 x 10mm earth fixing point (fitted at rear left of cabinet) • 2 x 12 way vertical power units with angled UK sockets, 5mtr mains lead and 32 amp BS4343 commando plug • 1 x Raft style plinth • 1 x BAA Logo • 1 x Prism Logo • Finished in Graphite Grey • Overall Height 2285mm. Width 800mm. Depth 800mm. • Weight -: 125KGS

2.10.1.2 LHR CABINET SPECIFICATION (Type 6/2)

	Our Part No: FI-CAB4588-BAA-T6/2-RHLH
	Description
	• 1 x Bolted aluminium frame construction • 1 x Enclosed mesh front door (83% open area) Flat style • with quick release hinge system and 3 point locking solution and common suite key **HINGED ON RIGHT HAND SIDE (Viewing from Front of Cabinet)** • 1 x Enclosed mesh rear door (83% open area) Flat style • with quick release hinge system and 3 point locking solution and common suite key **HINGED ON LEFT HAND SIDE (Viewing from Rear of Cabinet)** • 1 x Pair of split sliding panels • 1 x Vented top cover with 4 x 300mm x 80mm cable entry points and brush strip fitted • 4 x 19□□Universal style (heavy duty) adjustable mounting • profiles (positioned 100mm from front of cabinet and 450mm between front and rear profiles) • 2 x 45U 300mm cable tray (1 x fitted each side at rear) • 4 x Vertical cable management panels with 70mm x 70mm jumper rings fitted on front management and 70mm x 100mm fitted on rear management • 1 x 10mm earth fixing point (fitted at rear left of cabinet) • 2 x 12 way vertical power units with angled UK sockets, 5mtr mains lead and 32 amp BS4343 commando plug • 1 x Raft style plinth • 1 x BAA Logo • 1 x Prism Logo • Finished in Graphite Grey • Overall Height 2285mm. Width 800mm. Depth 800mm. • Weight -: 125KGS.

2.10.1.3 LHR CABINET SPECIFICATION (Type 7/1)

	Our Part No. Code FI-CAB4588-BAA-COLO-T7/1-LHRH
	Description
	• 1 x Bolted aluminium frame construction (with 4 compartments) • 1 x Vented top cover with 4 x 300mm x 80mm cable entry points and brush strip fitted • 1 x BAA Logo • 1 x Prism Logo **Each compartment will consist of:** • 1 x Enclosed mesh front door (83% open mesh) flat style with quick release hinge system and 3 point locking solution complete with 3 barrel combination lock and master key over ride **HINGED ON LEFT HAND SIDE (Viewing from Front of Cabinet)** • 1 x Enclosed mesh rear door (83% open mesh) flat style with quick release hinge system and 3 point locking solution complete with 3 barrel combination lock and master key over ride **HINGED ON RIGHT HAND SIDE (Viewing from Rear of Cabinet)** • 2 x Sliding side panels • 4 x 19” Universal style (heavy duty) adjustable mounting profiles fitted on single offset brackets. Positioned 160mm from the front of cabinet and 500mm between front and rear profiles with tubular management fitted to front profiles • 1 x 10mm earth fixing point (fitted at rear left of cabinet) 3 part 80mm x 100mm secure cable trunking (fitted each side) • 2 x Lengths of power trunk (1 x each side at rear 50mm x 50mm) • 1 x 2 part dividing plate with front and rear support bar • 2 x Bespoke power distribution units with single 32 amp feed - 4 x 6 way filtered horizontal mounted power units with UK sockets. (part numbers SPS-32-16A-42-06-RH & SPS-32-16A-42-06-LH) • 1 x Raft style plinth • Finished in Graphite Grey • Overall Height 2285mm. Width 800mm. Depth 800mm. • Weight -: 215KGS

2.10.1.4 LHR CABINET SPECIFICATION (Type 7/2)

	Our Part No: FI-CAB4588-BAA-COLO-T7/2-RHLH
	Description
	• 1 x Bolted aluminium frame construction (with 4 compartments) • 1 x Vented top cover with 4 x 300mm x 80mm cable entry points and brush strip fitted • 1 x BAA Logo • 1 x Prism Logo **Each compartment will consist of:** • 1 x Enclosed mesh front door (83% open mesh) flat style with quick release hinge system and 3 point locking solution complete with 3 barrel combination lock and master key over ride **HINGED ON RIGHT HAND SIDE (Viewing from Front of Cabinet)** • 1 x Enclosed mesh rear door (83% open mesh) flat style with quick release hinge system and 3 point locking solution complete with 3 barrel combination lock and master key over ride **HINGED ON LEFT HAND SIDE (Viewing from Rear of Cabinet)** • 2 x Sliding side panels • 4 x 19” Universal style (heavy duty) adjustable mounting profiles fitted on single offset brackets. Positioned 160mm from the front of cabinet and 500mm between front and rear profiles with tubular management fitted to front profiles • 1 x 10mm earth fixing point (fitted at rear left of cabinet) 3 part 80mm x 100mm secure cable trunking (fitted each side) • 2 x Lengths of power trunk (1 x each side at rear 50mm x 50mm) • 1 x 2 part dividing plate with front and rear support bar • 2 x Bespoke power distribution units with single 32 amp feed - 4 x 6 way filtered horizontal mounted power units with UK sockets. (part numbers SPS-32-16A-42-06-RH & SPS-32-16A-42-06-LH) • 1 x Raft style plinth • Finished in Graphite Grey • Overall Height 2285mm. Width 800mm. Depth 800mm. • Weight -:215KGS

2.10.1.5 LHR CABINET SPECIFICATION (Type 8)

	Our Part No. HDPF45-BAA-T8
	Description
	• Strong welded steel construction • An individual free standing unit • Designed to be installed side-by-side and back-to-back • Reduction in the amount of required floor space in relation to the number of structured cabling lines i.e. 1080 connections within an area of 750mm x 450mm • Large base and top apertures to allow ease of installation up to 1080 cables per frame • 28 x Tubular management arms • 1 x Lockable Wardrobe style mesh front doors • 1 x Front door clip frame assembly • 1 x 750 x 450mm Reptile style tile (35mm deep with 650 x 240mm aperture) • Wall and floor fixing points • 1 x Earth bonding Stud • 1 x BAA Logo • 1 x Prism Logo • Finished in Graphite Grey • Overall Height 2294mm. Width 750mm. Depth 450mm. • Weight -:75KGS **NB Please specify if doors are to be hinged left or right sided** **Optional side panels are available**

2.10.1.6 LHR CABINET SPECIFICATION (Type 10)

	Our Part No. FI-CAB4588-BAA-IP54-T10
	Description
	• 1 x Bolted aluminium frame construction • 1 x Solid metal front door with quick release hinge system and 3 point locking solution, lever latch lock. Internal IP gasket for door • 1 x Solid metal rear door with quick release hinge system and 3 point locking solution, lever latch lock. Internal IP gasket for door • 2 x Internally fixed side panels with (4 x filtered fan units) 2 x at the top and bottom of each side panel. Internal IP gasket for side panels • 1 x Non-vented top cover • 4 x 19 Universal style (heavy duty) adjustable mounting profiles centrally located. • 2 x Vertical cable management panels • 2 x 45U 150mm cable tray (fitted each side at rear) • 1 x 10mm earth fixing point (fitted at rear left of cabinet) • 2 x 12 way vertical power units with angled UK sockets, 5mtr mains lead and 32 amp BS4343 commando plug • 1 x 800 x 800mm x 100mm(h) fixed Plinth • 1 x BAA Logo • 1 x Prism Logo • Finished in Graphite Grey • Overall Height 2285mm. Width 800mm. Depth 800mm. • Weight -:145KGS **N.B Please specify if doors are to be hinged left or right sided** **Optional spare fan filters available**

2.10.1.7 LHR CABINET SPECIFICATION (Type 11)

	Our Part No. FI-CAB45812-BAA-T11
	Description
	• 1 x Bolted aluminium frame construction • 1 x Enclosed mesh front door (83% open area) Flat style • with quick release hinge system and 3 point locking solution and 3 barrel combination lock • 1 x Enclosed mesh rear doors (**wardrobe style**) (83% open area) Flat style • with quick release hinge system and 3 point locking solution and 3 barrel combination lock • 2 x Pairs of split sliding panels • 1 x Vented top cover with 4 x 300mm x 80mm cable entry points and brush strip fitted • 4 x 19□□Universal style (heavy duty) adjustable mounting • profiles (positioned 100mm from front of cabinet and 895mm between front and rear profiles) • 2 x 45U 300mm cable tray (1 x fitted each side at rear) • 4 x Vertical cable management panels with 70mm x 70mm fitted on rear management • 1 x 10mm earth fixing point (fitted at rear left of cabinet) • 2 x 24 way vertical power units with 20 x C13 sockets and 4 x C19 sockets, top fed 3mtr mains lead and 32 amp BS4343 commando plug. IP power monitoring and local ammeter - **To Be Signed off by LHR before installation** • 1 x 41mm deep reptile with 2 x full depth x 80mm wide apertures (1 down each side) with Brush Strip fitted. • 1 x Cabinet baying kit • 1 x BAA Logo • 1 x Prism Logo • Finished in Graphite Grey • Overall Height 2285mm. Width 800mm. Depth 1200mm. • Weight -: 135KGS **N.B Please specify if doors are to be hinged left or right sided**

2.10.1.8 LHR CABINET SPECIFICATION (Type 13) LHRH

	Our Part No. FI-CAB45810-BAA-IP54-T13
	Description
	• 1 x Bolted aluminium frame construction • 1 x Solid metal front door with quick release hinge system and 3 point locking solution, lever latch lock. Internal IP gasket for door • 1 x Solid metal rear door with quick release hinge system and 3 point locking solution, lever latch lock. Internal IP gasket for door • 2 x Internally fixed side panels with (4 x filtered fan units) 2 x at the top and bottom of each side panel. Internal IP gasket for side panels • 1 x Non-vented top cover • 4 x 19□□Universal style (heavy duty) adjustable mounting profiles centrally located, U height ID markings. • 2 x 19□□Mid style (heavy duty) adjustable mounting profiles centrally located • 2 x Vertical cable management panels • 2 x 45U 150mm cable tray (fitted each side at rear) • 1 x 10mm earth fixing point (fitted at rear left of cabinet) • 2 x 12 way vertical power units with angled UK sockets, 5mtr mains lead and 32 amp BS4343 commando plug • 1 x 800 x 1000mm x 100mm(h) fixed Plinth with Stabilising Arms • 1 x Plinth air flow baffle • 1 x BAA Logo • 1 x Prism Logo • Finished in Graphite Grey • Overall Height 2285mm. Width 800mm. Depth 1000mm. • Weight -:170KGS **N.B Please specify if doors are to be hinged left or right sided** **Optional spare fan filters available**

2.10.1.9 LHR CABINET SPECIFICATION (Type 14) LHRH

	Our Part No. FI-CAB4588-BAA-COLO-IP54-T14
	Description
	• 1 x Bolted aluminium frame construction (with 4 compartments – Each compartment to have independent front and rear Ali support bars both top and bottom of compartment) • 1 x Solid Top Cover with 2 x cut outs for Splitter Power cable c/w 2 x 2 part cover plates fitted with Cable Grommet (FI-IP-COLO-ROOF88-NEST) • 1 x BAA Logo • 1 x Prism Logo **Each compartment will consist of:** • 1 x Solid Metal front door with quick release hinge system and 3 point locking solution complete with 3 barrel combination lock and master key over ride. Internal IP gasket for door **HINGED ON LEFT HAND SIDE (Viewing from Front of Cabinet)** • 1 x Solid Metal front door with quick release hinge system and 3 point locking solution complete with 3 barrel combination lock and master key over ride. Internal IP gasket for door **HINGED ON LEFT HAND SIDE (Viewing from Rear of Cabinet)** • 2 x Side panels internally fixed with secure locking clamps. Internal IP gasket side panels • 4 x 19” Universal style (heavy duty) adjustable mounting profiles fitted on single offset brackets. Positioned 160mm from the front of cabinet and 500mm between front and rear profiles with tubular management fitted to front profiles • 1 x 10mm earth fixing point (fitted at rear left of cabinet) 3 part 80mm x 100mm secure cable trunking (fitted each side) • 2 x Lengths of power trunk (1 x each side at rear 50mm x 50mm) • 1 x Solid, single piece dividing plate with front and rear support bar • 2 x Bespoke power distribution units with single 32 amp feed - 4 x 6 way filtered horizontal mounted power units with UK sockets. (part numbers SPS-32-16A-42-06-RH & SPS-32-16A-42-06-LH) • Finished in Graphite Grey • Overall Height 2285mm. Width 800mm. Depth 800mm. • Weight -:215KGS

2.10.1.10 LHR CABINET SPECIFICATION (Type 15) LHRH

	Our Part No. FI-CAB2788-BAA-IP54-T15
	Description
	• 1 x Bolted aluminium frame construction • 1 x Solid metal front door with quick release hinge system and 3 point locking solution, lever latch lock. Internal IP gasket for door • 1 x Solid metal rear door with quick release hinge system and 3 point locking solution, lever latch lock. Internal IP gasket for door • 2 x Internally fixed side panels with (2 x filtered fan units) 1 x at the top and bottom of each side panel. Internal IP gasket for side panels • 1 x Non-vented top cover • 4 x 19 Universal style (heavy duty) adjustable mounting profiles centrally located, U height ID markings. • 2 x Vertical cable management panels • 2 x 27U 150mm cable tray (fitted each side at rear) • 1 x 10mm earth fixing point (fitted at rear left of cabinet) • 2 x 12 way vertical power units with angled UK sockets, 5mtr mains lead and 32 amp BS4343 commando plug • 1 x BAA Logo • 1 x Prism Logo • Finished in Graphite Grey • Overall Height 1360mm. Width 800mm. Depth 800mm. • Weight -:95KGS **N.B Please specify if doors are to be hinged left or right sided**

2.10.1.11 LHR CABINET SPECIFICATION (Type 16)RH/LH

	Our Part No. FI-CAB3988-BAA-T16
	Description
	• 1 x Bolted aluminium frame construction • 1 x Enclosed mesh front door (83% open area) Flat style • with quick release hinge system and 3 point locking solution and common suite key **HINGED ON LEFT HAND SIDE (Viewing from Front of Cabinet)** • 1 x Enclosed mesh rear door (83% open area) Flat style • with quick release hinge system and 3 point locking solution and common suite key **HINGED ON LEFT HAND SIDE (Viewing from Rear of Cabinet)** • 1 x Pair of split sliding panels • 1 x Vented top cover with 4 x 300mm x 80mm cable entry points and brush strip fitted • 4 x 19□□Universal style (heavy duty) adjustable mounting • profiles (positioned 100mm from front of cabinet and 450mm between front and rear profiles) • 2 x 39U 300mm cable tray (1 x fitted each side at rear) • 4 x Vertical cable management panels with 70mm x 70mm jumper rings fitted on front management and 70mm x 100mm fitted on rear management • 1 x 10mm earth fixing point (fitted at rear left of cabinet) • 2 x 12 way vertical power units with angled UK sockets, 5mtr mains lead and 32 amp BS4343 commando plug • 1 x Raft style plinth • 1 x BAA Logo • 1 x Prism Logo • Finished in Graphite Grey • Overall Height 1951mm. Width 800mm. Depth 800mm. • Weight -: 110KGS

2.10.1.12 LHR CABINET SPECIFICATION (17)

	Our Part No. FI-CAB45810-BAA-T17
	Description
	• 1 x Bolted aluminium frame construction • 1 x Enclosed mesh front door (83% open area) Flat style • with quick release hinge system and 3 point locking solution and 3 barrel combination lock • 1 x Enclosed mesh rear doors (**wardrobe style**) (83% open area) Flat style • with quick release hinge system and 3 point locking solution and 3 barrel combination lock • 2 x Pairs of split sliding panels • 1 x Vented top cover with 4 x 300mm x 80mm cable entry points and brush strip fitted • 4 x 19□□Universal style (heavy duty) adjustable mounting • profiles (positioned 100mm from front of cabinet and 695mm between front and rear profiles) • 2 x 45U 300mm cable tray (1 x fitted each side at rear) • 4 x Vertical cable management panels with 70mm x 70mm jumper rings fitted on front management and 70mm x 100mm fitted on rear management • 1 x 10mm earth fixing point (fitted at rear left of cabinet) • 2 x 12 way vertical power units with angled UK sockets, 5mtr mains lead and 32 amp BS4343 commando plug • 1 x 41mm deep reptile with 2 x full depth x 80mm wide apertures (1 down each side) with Brush Strip fitted. • 1 x 45U Vertical Earth Bar • 1 x Cabinet baying kit • 1 x BAA Logo • 1 x Prism Logo • Finished in Graphite Grey • Overall Height 2285mm. Width 800mm. Depth 1000mm. • Weight -: 130KGS **N.B Please specify if doors are to be hinged left or right sided**

2.10.1.13 LHR CABINET SPECIFICATION (Wall Mounted Cabinet)

	Our Part No.
	Description 700 X 600MM WALL MOUNTED CABINET WITH THE FOLLOWING FEATURES:
	• 1 X ENCLOSED PERSPEX FRONT DOOR WITH SLAM LATCH LOCK • 2 X ADJUSTABLE MOUNTING PROFILES SET 55 MM FROM FRONT • 2 X VERTICAL CABLE MANAGEMENT PANELS • 2 X LOCKABLE AND REMOVABLE LIFT OFF SIDE PANELS • CABLE ENTRY TOP, BOTTOM AND REAR • 10 x 1U JUMP RINGS 5 X FITTED TO CM EACH SIDE • 1 X EARTH BONDING KIT • 1 X 6 WAY FILTERD PDU (PW103BA0UA02-MOV) • BRUSCH STRIP FITTED TO TOP & BOTTOM CUT OUTS • 1 X BAA LOGO • GRAPHITE GRAY AVALABLE IN 9U, 12U AND 15U

2.10.2 Floor Cabinet Installation

The floor-mounted cabinet consists of aluminium extruded frame construction that is bolted via socket head screws and captive fixings.

All of the external doors and sliding side panels are constructed from 2mm mild steel incorporating a box fold to increase strength and rigidity whilst minimizing product weight.

The internal mounting profiles are constructed from 2mm mild steel and have been designed to meet the needs of today's IT equipment.

The vented top cover supplied with this product is fitted with two cable entry points with brush covers. The dimensions of these entry points are 290mm wide x 80mm deep and are located at the front and rear of the top cover.

The specification denotes an 800(W) x 800(D) x 100(H) mm cabinet plinth constructed from 1.6mm mild steel. This product is supplied with cable access panels at the rear and both sides of the plinth. The dimensions of these entry points are 430mm wide x 50mm high.

The front and rear doors supplied with the above cabinet are constructed of 2mm steel with 3 point locking system and ventilation slots for full airflow.

Additional side panels can be supplied for the free standing cabinet (these items need to order as extra components if required) these sliding side panels can be fitted at the end of a bay of cabinets or between bayed cabinets without interfering with baying kits. There are no locks required on these side panels due to their track system fixings.

A copper earth bar is fitted within the floor standing cabinets and has been pre-drilled with 6mm holes for fixings.

The floor standing cabinet has extensive cable management as part of the specification, this includes the following:

Front and rear vertical cable management panels fitted to front and rear mounting profiles.
16 x 100 x 70mm jumper rings fitted to front cable management to assist horizontal cable management.
16 x 70 x 70mm jumper rings fitted to the rear cable management to assist horizontal cable management.

All cabinets are finished in Graphite grey (Sandtex) powder coated finish.

Each cabinet specified will be supplied with a LHR corporate logo fitted to the product as per approved design.

Cabinet Doors are to close towards the exit of the Comms Room.

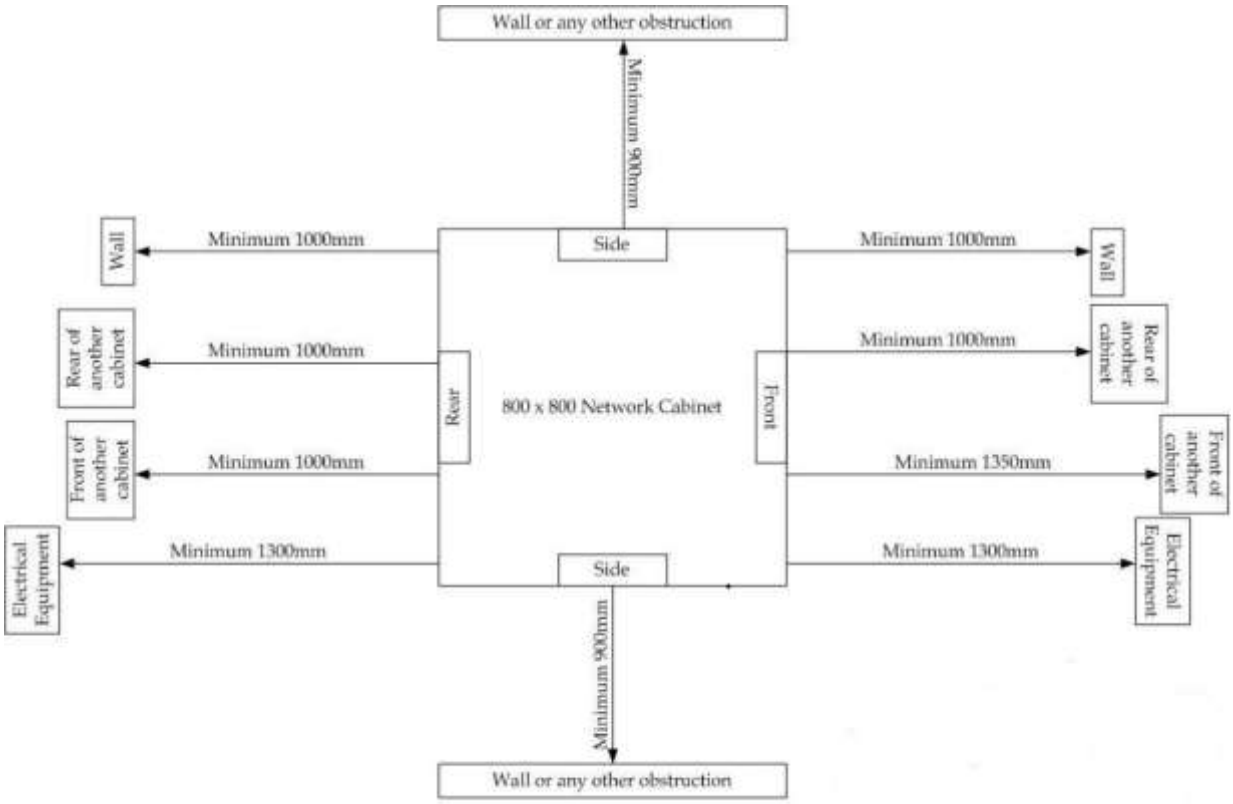
All cabinets installed in HAL IT rooms that are to contain 3rd party equipment must be fitted with a Prism combination lock to both the front & rear doors.

All cabinet elevations drawings will be required to be produced once a new piece of work has been carried out and to confirm what space is left in the cabinets. To be completed via the Celsius Engagement CRQ

****The swing-out variety of floor standing cabinets shall not be used unless agreed by the local Heathrow IT engineer.**

2.10.3 Floor Cabinet Spacing

The cabinet spacing below are not best working practice distance, they are H & S requirements. Standalone cabinets can be situated against a wall with 3-sided access



Cabinets installed in a row will adhere to the above but must be bayed together utilising the correct manufactured supplied baying kits.

2.10.4 Wall mounted

Wall mounted cabinets are only to be used as an exception when there is not enough room in the termination location to house a floor standing cabinet or by explicit request by a LHR representative.

The cabinet shall have a component enclosure of 700(W) x 9 - 15U (H) x 600(D). 9U is the minimum height and 15U.

The wall mounted cabinet should not be mounted above 3mts to the bottom of the cabinet & **never** installed in a suspended ceiling void.

This cabinet is supplied with lockable and removable side panels, so as to allow access to the rear of the ODP, Voice and Data Panels without the need to access the cabinet through the front of the cabinet.

The wall mounted cabinet specified is supplied complete with and enclosed Perspex front door and lever latch lock to the LHR agreed specification. This door has a quick release hinge system fitted to make door removal easier for maintenance.

The removable and lockable side panels are constructed for 1.4mm mild steel and also incorporate the same hinge system. The locks on these panels are barrel type and meet with the same LHR specification. The wall mounted cabinet has extensive cable management as part of the specification, this includes the following:

Vertical cable management panels are fitted to the adjustable mounting profiles.
50 x 50mm jumper rings are fitted to these panels within the wall mounted specification. Within the 9U wall cabinet there are 6 in total (3 each side) and in the 12U there are 8 in total (4 each side).

Within the wall mounted cabinet there are 3 cable access points, which have the following dimensions: 300(W) x 80(D) mm. At the top and the bottom of this wall mounted cabinet the access panels have brush cable entry with a metal gland plate cover.

Power distribution for the wall mounted cabinets specified consist of the following requirements, 1 x unit is supplied with each wall mounted cabinet:

6x sockets, angled at 45^0 within unit.
1x neon switch indicator.
1x full switch guard protection system.
3mtr of mains cable with moulded specified connection.
Surge protection fitted within unit.

The wall-mounted variety of cabinet shall not be used unless agreed by the local Heathrow IT engineer

2.10.5 Wall mounted Fibre presentation boxes

The provision of TE Connectivity wall mounted fibre presentation boxes

- Fibre Wall Mount Box Supplied with Cable Glands,
- Grommets and One Splice tray Holder (Holds up to 4 SpliceTrays)
- Splice Tray for Fusion Splice With Sleeve (Holds 12 Splices)
- Optional Lock – 1 Lock Required Per Door.
-

For Indoor Use Only – Supports Top and Bottom Cable Entry – Knock Out Ports for Cable Glands or Grommets.

Dimensions– H 400mm x D 355mm x W 130mm

The fibre wall mount box supports up to a maximum of 6 snap in adaptor plates, the adaptor plates can be supplied in 12 fibre or 24 fibre densities, the maximum fibre density is as per below:

Using 12 Fibre Adaptor Plates – 72 Fibres
Using 24 Fibre Adaptor Plates – 144 Fibres

These boxes must have a LHR cabinet Identification and terminated cable IDs attached to the outside of the box

An internal label must be installed onto the inside of the break out box door, detailing where each fibre is terminated, like label as detailed in 2.14.13.3

2.10.6 Cable gland provision

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 to the requirements of the Heathrow IT Representative.

2.10.7 Fixing of cabinets

All floor mounted cabinets will be fixed to the floor, in an appropriate way, to prevent the cabinet from tipping.

Wall mounted cabinets will be secured in such a way that they cannot be pulled off the supporting wall, special attention is to be paid when attempting to fix to a non-structural wall.

Cabinets will be fixed in such a way that easy access can be gained, without causing risk of head injury.

Cabinets located side by side must be bayed together with the correct kits from the cabinets manufacture

2.11 OVERVOLTAGE PROTECTION

Overvoltage protection systems are used wherever communication lines are distributed and connected. Overvoltage protection fulfils various requirements, depending on the type of installation to be protected. In conventional switching equipment, overvoltage protection is used primarily to protect people. In highly sensitive electronic switching equipment installations, however, comprehensive protection measures are necessary in order to protect not just people, but also the valuable installation itself.

2.11.1 Basic Protection Magazine for LSA-PLUS® Series 2 Blocks

This basic protection magazine is recommended for use as a basic overvoltage protection in analogy and digital telecommunication systems. The magazines are designed for the complete equipping of LSA-PLUS or LSA PROFIL disconnection or connection modules. For installation in LSA PROFIL distributors, earth contact clips are required to establish earth contact with the profile rods.

Features

- Designed for use with 2- or 3-poleovervoltage arrestors
- Overvoltage arrestors and fail-safe elements are replaceable
- Installation height is approximately25 mm above the LSA-PLUS or LSA PROFIL module

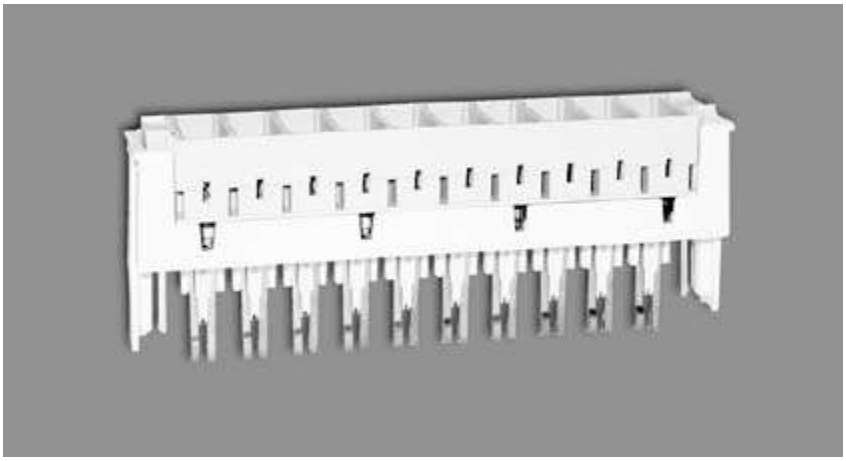
Magazine 2/10 for 3-pole gas discharge tubes (GDT)

2.11.2 ADSL Protection for HighBand® 10 Modules

The protection magazine for the HighBand 10 modules is recommended as basic overvoltage protection in analogy telecommunication systems. The magazine completely equips HighBand 10 disconnection modules. To establish an earth contact, the magazine requires the use of earth contact clips when it is installed in an LSA PROFIL distribution frame. If unequipped magazines are ordered, corresponding overvoltage arrestors (GDT) must be ordered to guarantee optimal performance.

Features

- Overvoltage arrestors and fail-safe contacts are replaceable
- Accepts three-pole overvoltage arrestors
- Installation height is approximately 25mm above the HighBand 10 module



ADSL protection magazine

2.11.3 3-Pole Overvoltage Arrestors

The 3-pole overvoltage arrestor (metal/ceramic) is filled with noble-gas and features optional fail-safe (type 8x13) and offers effective 3-point protection for MDF 71

Features

- Reliable limitation of over voltages
- Diversion of high currents
- Thermal protection by means of fail-safe

2.11.4 2-Pole Overvoltage Arrestors

These arrestors are used as replaceable basic protection elements. The 2-pole overvoltage arrestors (with dimensions of 8 x 6 mm) have a metal/ceramic construction. The electrical properties depend on the noble-gas mixture. In order to protect 10-pairs, 20 overvoltage arrestors must be installed.

Features

• Reliable limitation of over voltages
• Diversion of high currents
• Thermal protection by means of fail-safe contacts

2.12 ELECTRICAL CONNECTION

At network core and distribution locations or where Cisco chassis based equipment is installed or where the cabinet is larger than 27u in high, the minimum shall be 2 x 32 amp commando socket presentation from 2 separate electrical distribution boards both on the same phase, these commando should be installed in such a way to avoid accidental disconnection.

Note

BS 7671:2008 'Requirements for Electrical Installations ~ IEE Wiring Regulations'

Clause 537.2.1.3 - Where an installation or an item of equipment or enclosure contains live parts connected to more than one supply, a durable warning notice shall be placed in such a position that any person before gaining access to live parts, will be warned of the need to isolate those parts from the supplies unless an interlocking arrangement is provided to ensure that all the circuits concerned are isolated.

Example Dual Power Supply Warning Label

UNINTERRUPTIBLE POWER SUPPLIES

BS EN 62040-1:2008 'Uninterruptible power systems (UPS), General and safety requirements for UPS'. **Clause 5.1.5,** 'Emergency switching (disconnect) device'.

In accordance with the requirements of **BS EN 62040-1** all hard wired or rack mounted UPS are to incorporate controlled output switching or be installed complete with a 'Remote Power Off Device'. Whichever system is employed, it is to be integrated with the cabinet and/or facility Emergency Switching device

SI 1998 No 2306 'The Provision and Use of Work Equipment Regulations' requires at:

- **Regulation 23** 'Every employer shall ensure that work equipment is marked in a clearly visible manner with any marking appropriate for reasons of health and safety'.

- **Regulation 24** 'Every employer shall ensure that work equipment incorporates any warnings or warning devices which are appropriate for reasons of health and safety'.

To comply with the above regulations, all cabinets fitted with an internal UPS are to display a suitably sized hazard warning notice, posted in a prominent position at each entry to the cabinet, consisting of the electricity hazard symbol and a suitable supplementary text

SI 1996 No 341 'Safety Signs and Signals Regulations

BS 5499-5:2002 'Graphical symbols and signs ~ Safety signs, including fire safety signs, Signs with specific safety meanings'.

Example UPS Warning Label

The electrical supply at other cabinet locations shall be a minimum of a single 16 amp Commando presentation

The distribution panel shall be fitted with a dedicated circuit breaker and properly labelled.
The PDU must be properly labelled to show which distribution panel or circuit breaker is feeding the cabinet.

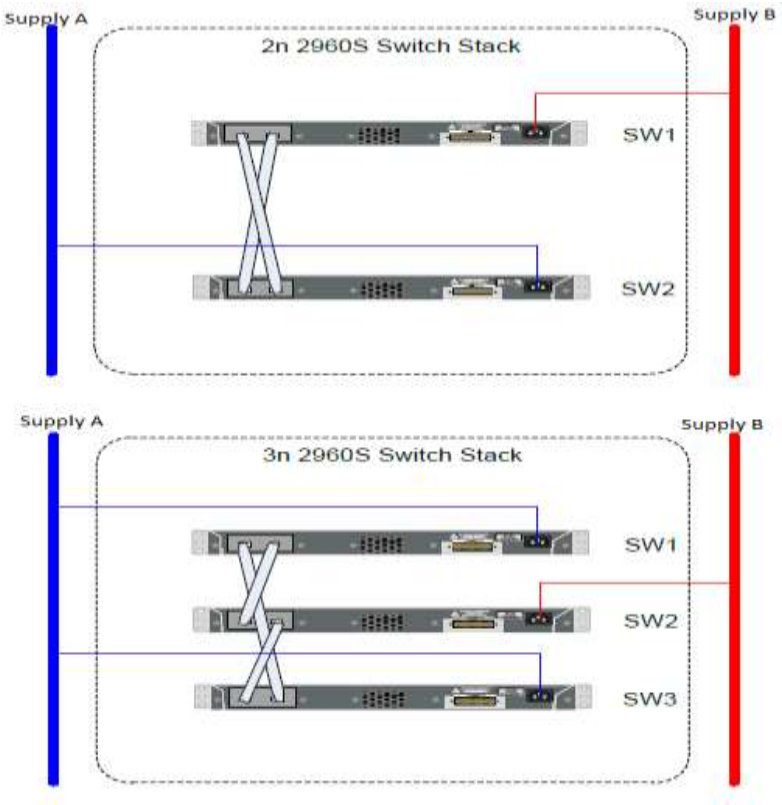
Any power lead connecting to a PDU or commando outlet is not to be secured with the use of plastic cable ties. The cables shall be placed in the rear management of the cabinet; where there is no management to keep the cables tidy then Velcro ties shall be used.

PDUs should be secured to the network rack, and not left free floating in the cabinet. PDU's are also not allowed to be daisies chained off each other.

The cabinet shall be earthed in accordance with BS 7671.

All cabinet electrical supplies shall be properly protected and segregated so that they comply with the current IEE wiring regulations.

When switches are stacked and there is two PDU's on separate power supplies in the cabinet each switch should be alternated between PDUs.



If a PDU is being feed by a UPS then this must be identified on the PDU
Warning PDU feed via UPS (followed by power circuit number)

VG224 Power requirements

APC7721 Automatic Power Switch (front).

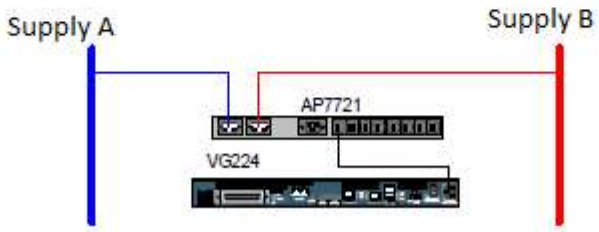
In order to provide resilient mains power to the Cisco VG224 Voice Gateways they will be connected to the mains supplies via an APC AP7721 Automatic Power Switch.

APC7721 Automatic Power Switch (rear).

The APC AP7721 has two IEC-320 C14 mains input connections. These will be connected to the North and South Supplies. The AP7721 has twelve IEC-320 C13 mains output connections that will be used to provide power to the VG224.

Cisco VG224 & APC7721 Power Supply Configuration.

The VG224 and AP7721 should be connected as per the figure below.



2.13 SURVEY ROD AND ROPING

When installing/relocating IT cabling infrastructure within Heathrow pit and duct systems a rod and rope survey must be carried out.

The contractor shall ensure that his actions do not cause any damage to existing cables. For this purpose the contractor will use Leader and Follower devices on the ends of the rods.

The practice of blowing a rope using a compressor and a chute shall not be tolerated. Only one draw rope may be installed into a duct at one time.

The contractor shall be responsible for the lifting and replacement of all pit & duct covers (Using the correct methods and tooling), safety barriers, night illumination and any other protection deemed necessary for working sites.

The contractor shall be responsible for provision of all rodding, temporary roping and any pumping and drainage equipment necessary to clear any flooded installation whilst following current LHR regulations for disposal of extracted waste.

2.14 NUMBERING AND LABELLING

2.14.1 Equipment Types

Communications equipment in the Airport Campus that shall be labelled includes:

- Cables.
- Cabinets.
- Frames & Sub-Racks.
- Patch Panels.
- Designation Strips.
- Telecommunications Outlets.
- Outlet Boxes.
- Splice Boxes.
- Consolidation Points.
- Transition Points, including Entrance Facilities.
- Switch Links.
- Network equipment labels.

2.14.2 Label Characteristics

Labels shall: -

- Be permanently fixed, legible, durable and robust.
- Be wrap-around, on horizontal cables, with laser-printed black characters on a white background.
- Backbone cable label (exterior / interior), polyester with tie wraps.
- Be made of a durable polyester base, with the rear of the label covered with a high performance self-adhesive, where applicable.
- Have a thickness, type face of size and font, and labelling scheme as indicated for each type of cable below.
- Have an operating temperature range of -30^{o}C to 150^{o}C

2.14.3 Label Locations

2.14.3.1 Backbone cables

Critchley labels shall be fixed longitudinally along the outer sheath of cables and secured with tie wraps.

Labels shall be fixed on cables, within 100mm of:-
- Entering and exiting a pit or duct.
- Entering and exiting a building.
- Either side of a wall / slab penetration.
- Entering an equipment cabinet.
- Vertical risers.

All backbone cables must have a unique cable ID and must not use the same number with an increment. I.e. where two cables are joined in a transition point or entrance facility the joining cable should not be ID up as below

HAL T/COM LHR09/0309-1

Labels shall also be fixed on cables within 30mm of being terminated at:-
- Patch panels.
- Splice points.
- Transition points.

2.14.3.2 Horizontal Cables

Brady labels shall be fixed on cables, within 30mm of being terminated at:
- Patch panels.
- Designation strips.
- Telecommunications outlets.
- Consolidation points (On cables exit of flexible conduits).
- Network switches connections (Switch links) at both ends.

Exclusions
- No patch cords will be labelled

2.14.3.3 Communications Rooms

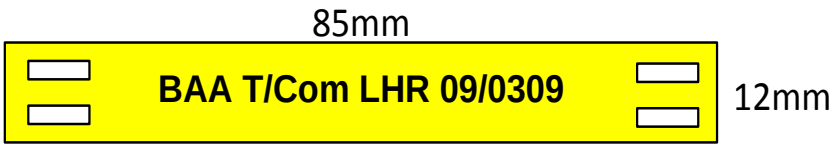
All communications rooms or room locations that have IT equipment located in them must have an Identification sticker attached to the door either comms room Name IE SCR-02 Comms room 1 or HAL T/COM

2.14.4 Campus & In-Building Backbone 'Cable Labels'

2.14.4.1 Optical Fibre Cable

ITEM	DESCRIPTION
Label type	Critchley (Polyester - laser printed)
Label thickness	175-micron
Label size	85mm x 12mm - yellow
Font type	Arial Bold - black
Font size	8mm
Eastern Campus labelling scheme	**LHR T/Com LHRxx/yyyy**

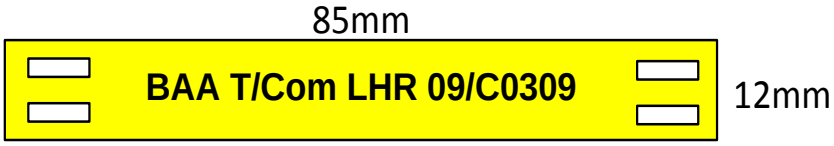
Example



2.14.4.2 Category 3 & 5 Copper Multi-pair cable labels

ITEM	DESCRIPTION
Label type	Critchley (Polyester - laser printed)
Label thickness	175-micron
Label size	85mm x 12mm - yellow
Font type	Arial Bold - black
Font size	8mm
Eastern Campus labelling scheme	**LHR T/Com LHRxx/Cyyyy**

Example



2.14.5 Horizontal Cables

2.14.5.1 Category 5 & 6 UTP 'Cable Brady Labels' (Internal)

ITEM	DESCRIPTION
Label type	Brady (Plastic - laser printed)
Label thickness	Paper
Label size	25mm x 13mm - white
Font type	Arial - black - Laser printed
Font size	3mm
Eastern Campus labelling scheme	**(Cabinet ID)/zzz**, for a cable to a Telecommunications Outlet **(Cabinet ID)/zzz**, for a cable to a Consolidation Point **(Cabinet ID)/zzz**, for a cable from a Consolidation Point to a Telecommunications Outlet zzz= panel port number used

Example

25mm

22055-001 13mm

OUTLET AND BRADY NUMBERING SCHEME	AREA
1001/001	Terminal 1
22001/001	Terminal 2
3001/001	Terminal 3
4001/001	Terminal 4
05000/002	Terminal 5
6001/001	Central Terminal Area
7001/001	Cargo
8001/001	Perimeter
9001/001	Airfield Substations

2.14.5.2 Brady Labels' (Switch looms)

The following brady label needs to be attached to the switch loom cable at both ends.

XXXX UCC YY
`
WWWW UAA SS

Where; XXX is the active cabinet ID the switch is located in and the loom connects to.
CC is the U number the switch is installed in the active cabinet and the loom

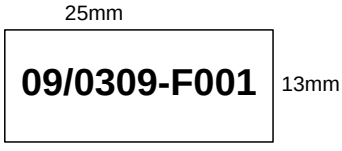
Connects to; YY is the port number on the switch the loom cable connects to.
WWWW is the passive cabinet ID the switch loom patch panel is located in.
AA is the U location the patch panel is installed in the passive cabinet.
SS is the port number on the patch panel.

Example 2311 U38 048
23120 U27 048

2.14.5.3 Horizontal Optical Fibre 'Cable Brady Labels'

ITEM	DESCRIPTION
Label type	Brady (Plastic - laser printed)
Label thickness	Paper
Label size	25mm x 13mm - white
Font type	Arial - black - Laser printed
Font size	3mm
Eastern Campus labelling scheme	**Cable ID (Remove 'LHR T/Com LHR') xx/yyyy-Fzzz** zzz= panel port number used

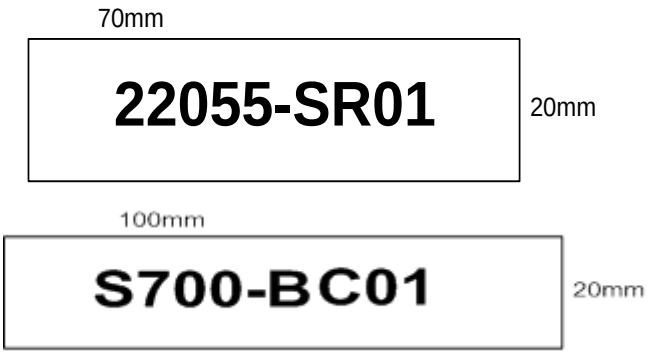
Example



2.14.6 Voice TE CONNECTIVITY Frames, Wall boxes & Sub-racks

ITEM	DESCRIPTION
Label type	Traffolyte
Label thickness	50-micron
Label size	70mm x 20mm – white
Font type	Arial – black
Font size	10mm
Eastern Campus labelling scheme Wall Frames Sub Racks Box Con Wall Boxes	**RoomID-Wxxxx**, E.G. **SCR-A2-00-W2900** (Where xxxx is assigned cabinet ID from Celsius. This will depend on location of installation)) **CabID-SRyy**, E.G. **22055-SR01** **RoomID-BCyy** (yy = 01 onwards)

Example



2.14.7 Patch Panels

2.14.7.1 Optical Fibre Panels

ITEM	DESCRIPTION
Label type	Traffolyte
Label thickness	50 micron
Label size	422mm x 13mm – white
Font type	Arial - black
Font size	4mm
Eastern Campus labelling: Fibre Link Panel	**LHR T/Com LHR0x/xxxx** **Fyy-yy** (yy-yy = Fibre cores presented from cable)

Example

422mm

BAA T/Com LHR09/0309 F01-48 13mm

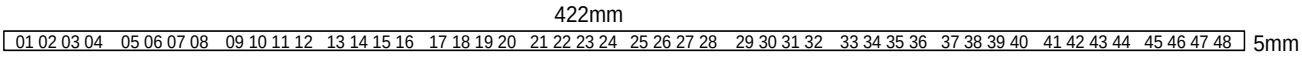
- If not all the fibre cores are being terminated, the label must reflect this on the main label.

For example: LHR T/COM LHR09/0309 F01-048 **049-096 NT**

2.14.7.2 Fibre Panel Port Identifications

ITEM	DESCRIPTION
Label type	Traffolyte
Label thickness	50 micron
Label size	422mm x 5mm – white
Font type	Arial - black
Font size	4mm
Eastern Campus labelling: Fibre Link Panel	Panel port number 01 - 48, 49 - 96

Example



- If a single Fibre Cable terminates across two Fibre Patch Panels, the numbering sequence must be a continuation from the first Patch Panel.

For example First Patch Panel 01 – 48

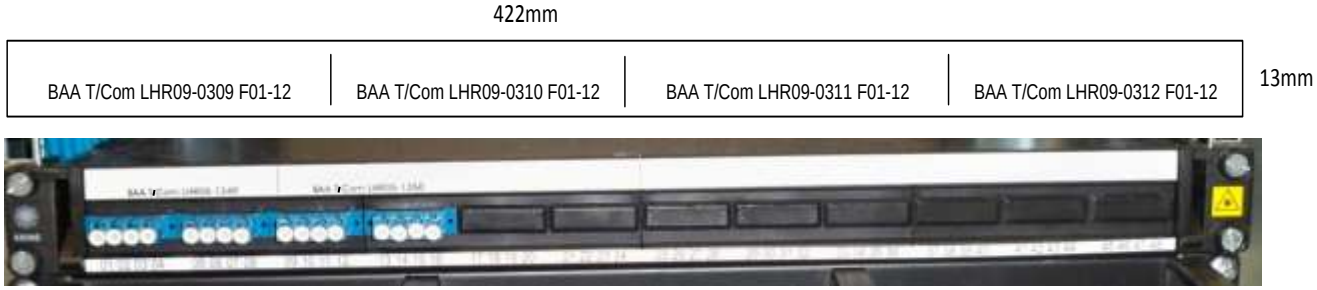
Second panel 49 – 96

2.14.7.3 Multiple Fibre Cables within one Panel

Where multiple cables are presented on a single patch panel the label is split accordingly to incorporate the required cable identification. The label split may show up to six separate cable identifications.

ITEM	DESCRIPTION
Label type	Traffolyte
Label thickness	50 micron
Label size	422mm x 13mm – white
Font type	Arial - black
Font size	4mm
Eastern Campus labelling: Fibre Link Panel Fibre Panel ID (Top left hand corner): -	**LHR T/Com LHR0x-xxxx** **Fyy-yy** (yy-yy = Fibre cores presented from cable) **(CAB ID)-FPzz**

Example



- Each newly installed Cable must start from 01 (not as per the above picture).

An example would be:

LHR T/COM LHR09-0309 F01 – 08

01 02 03 04 05 06 07 08

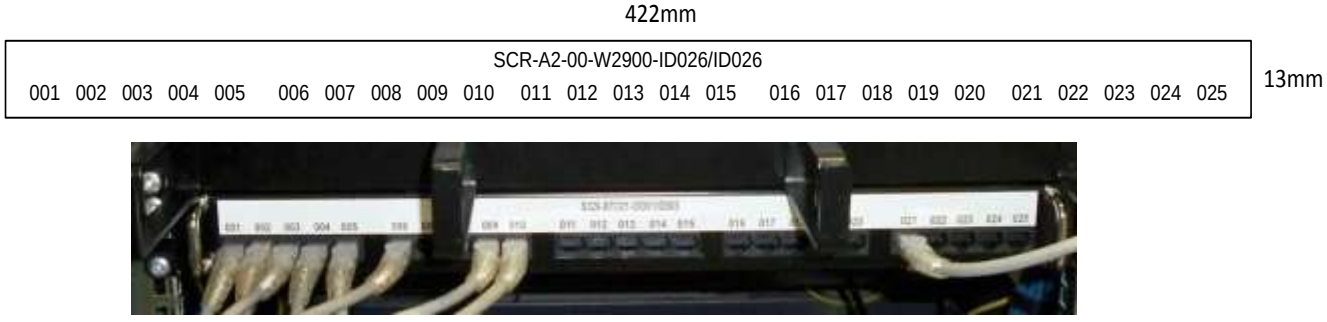
LHR T/COM LHR09-0310 F01 – 08

01 02 03 04 05 06 07 08

2.14.7.4 Cat 3

ITEM	DESCRIPTION
Label type	Traffolyte
Label thickness	50 micron
Label size	405mm x 18mm – white
Font type	Arial – black
Font size	4mm
Eastern Campus labelling: Cat3 (1-pair modularity) Destination Info Port No.	'to' room id, TE CONNECTIVITY wall frame id (W59xx) & blocks/panels used (ID0yy/ID0zz) for each cable entry. Destination panel/block number shall be shown above each set of port numbers used. Starting with '01' and ending with '25' (voice) multiples of 25 onwards.

Example

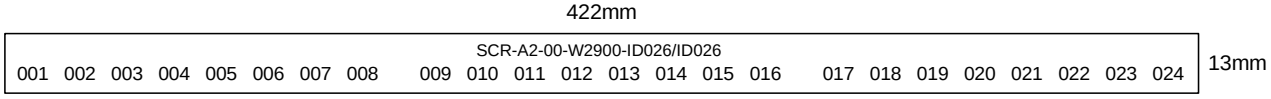


- For a 50 Pair Cable, the Patch Panel Ports would run from 01 – 50
- For a 100 Pair Cable, the Patch Panel Ports would run from 01 – 100

2.14.7.5 Cat5

ITEM	DESCRIPTION
Label type	Traffolyte
Label thickness	50 micron
Label size	405mm x 18mm – white
Font type	Arial – black
Font size	4mm
Eastern Campus labelling: Cat5 (4pr modularity) Copper CCTV Link	*'to' room id, TE CONNECTIVITY wall frame id (W59xx) & blocks/panels used (ID0yy/ID0zz) for each cable entry.*
Destination Info	Destination panel/block number shall be shown above each set of port numbers used.
Port No.	starting with '01' and ending with 'xx' (voice)

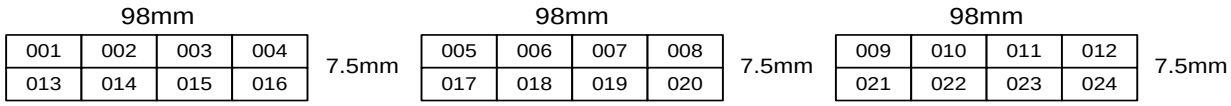
Example

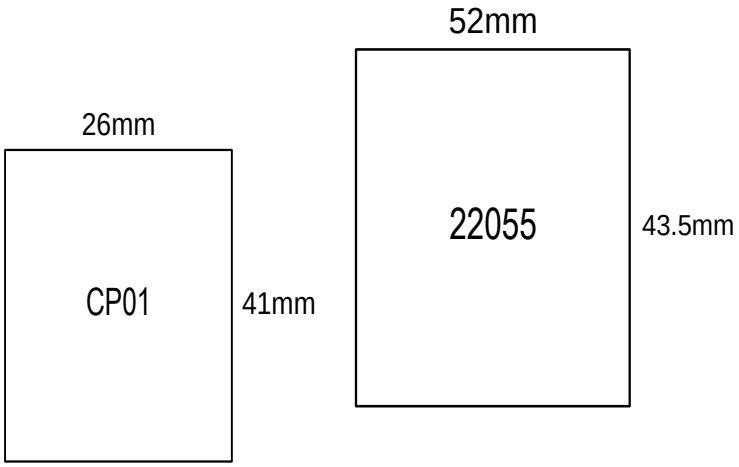


2.14.8 Patch panels – RJ45 UTP & STP Horizontal

ITEM	DESCRIPTION
Label type	Traffolyte
Label thickness	50 micron
Label size	26mm x 41mm – white & 3 @ 98mm x 7.5mm
Font type	Arial - black
Font size	& 3mm
Eastern Campus labelling scheme Copper Horizontal:	**(CAB ID)** Ports start with '001' and end with 'xxx' per cab

Example



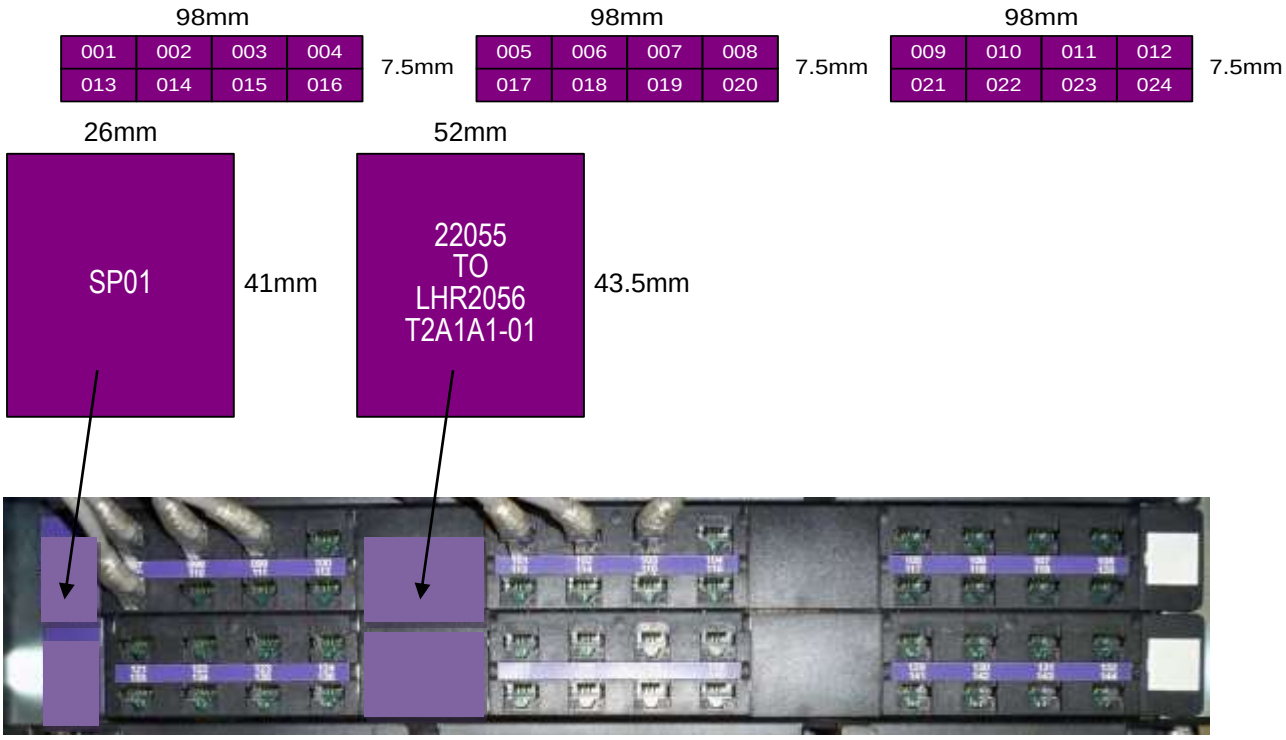


2.14.9 Switch link labels

- Switch numbers are to be provided by the NI only.

ITEM	DESCRIPTION
Label thickness	50 micron
Label size	26mm x 41mm – Purple & 3 @ 98mm x 7.5mm
Font type	Arial - White
Font size	3mm
Eastern Campus labelling scheme Switch Loom:	**(CAB ID)-SPyy** (yy = 01 onwards) Ports start with '001' and end with 'xxx' per cab Destination switch number shall be shown on the panel.

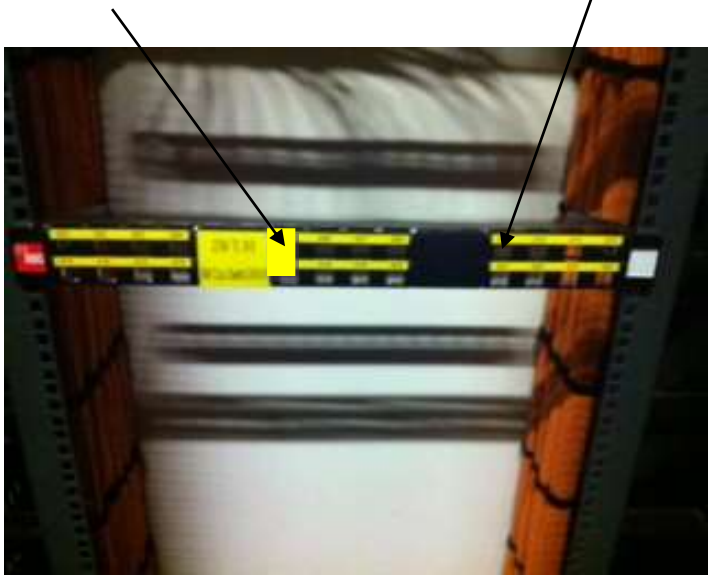
Example



The port numbers on the switch looms patch panels must represent what port it connect to on the switch and not just to be incremented through all the switch loom panels located in one cabinet. i.e if two 48 port switches have been installed in to an active cabinet then the switch loom panels should run from 1 – 48 and then 1 to 48 again for the other switch loom

Link Cable Colour Codes

CoLo Switch Loom Example ETC



ITEM	DESCRIPTION
Label thickness	50 micron
Label size	26mm x 41mm – See background table below. & 3 @ 98mm x 7.5mm
Font type	Arial - White
Font size	3mm
Eastern Campus labelling scheme Switch Loom:	**(CAB ID)-SPyy** (yy = 01 onwards) Ports start with '001' and end with 'xxx' per cab Destination switch number shall be shown on the panel.
Link Cable Type	**Background Colour**
LHR Switch Loom	Purple
Horizontal Cabling	Blue
Voice Cabling	White
CoLo Switch Looms (All Airlines)	Yellow

2.14.10 Voice Designation Strips

ITEM	DESCRIPTION
Label type	Traffolyte
Label thickness	Voice designation strip - 50 micron
Label size	104mm x 11mm – white
Font type	Arial - black
Font size	4mm
Eastern Campus labelling scheme for 237a TE CONNECTIVITY strips in wall boxes, sub racks, copper transition points & voice connection boxes. Pair numbers show first and last cable pairs used. Cable Number ID's to on the inside of the 51A strip on the 1st & last strip for each cable	Block label showing 'From frame and block to room id, cab id & panel id i.e. **01** | **W2917-ID001 to SCR-A2-00-02612-MP01** | **10** Or Block label showing 'From copper transition point and block to room id, connection box & block id **11** | **TPC026-ID07 to SCR-A2-00-BTC01-ID11** | **20**

Example

104mm

001	**W2917-ID001 to SCR-A2-00-02612-MP01**	010	11mm

2.14.10.1 VG224 Labelling

VG225 labelling will start from 0 and run to 024

104mm

000	**LHR20155T2A-VG01**	009	11mm

104mm

010	**LHR20155T2A-VG01**	024	11mm

2.14.11 Cabinets

The labels for the cabinet will be of unique design for the Airline cabinets and LHR cabinets respectively.

2.14.11.1 Airline Label Description

Labels shall:

- Be permanently fixed, legible, durable and robust.
- Be machine-printed or laser-etched.
- Be made of a durable Traffolyte base, with the rear of the label covered with a high performance self-adhesive / a suitable contact adhesive.
- Have an operating temperature range of -30°C to 150°C.
- Have the characteristics indicated in the table below.

ITEM	**DESCRIPTION** Cabinets as sample with separate Traffolyte type base label showing EC label scheme.
Label thickness	50 micron
Label sizes	(Traffolyte) 140mm x 20mm
Font type	Arial
Font size	10mm
Labelling scheme (Depending on Location)	**1xxx or 11xxx**

***In addition – A voltage warning label is required, (Danger 415V)**

- Labels shall be fixed at the front of each cabinet.
- Traffolyte cabinet ID labels shall be fixed to the frame of a cabinet

2.14.11.2 LHR Cabinet Labels

These labels are only controlled and supplied only by instruction of LHR IT Operations. Labels shall be fixed at the front of each LHR cabinet or Transition point. This label will contain a cabinet reference number along with relevant warnings and contact numbers.

LHR Equipment Cabinet

2.14.11.3 CoLo Cabinet Labels

Each section of a CoLo Cabinet shall have its own label.

The label for each section shall be the same as all other Cabinets.

Colo Cabinet A2-00

- Voice Frames, Entrance Facilities etc. all require the same Label format.

2.14.12 Telecommunications Ports / Outlets

2.14.12.1 Telecommunications Ports

ITEM	DESCRIPTION
Label type	Traffolyte
Label thickness	50 micron
Label size	24mm x 8mm - white
Font type	Arial Bold - black
Font size	3mm
Labelling scheme Copper Outlet Port: Fibre Outlet Port:	**CAB ID-yyy**, for a Category 5 or 6 Telecommunications outlet port. yyy = panel port number used. **Cable ID-Fyy-yy**, for an optical fibre Telecommunications outlet port. yy = panel Port number used.

'Fibre Outlet Port' example

24mm

09/0309-F01-02 8mm

'Copper Outlet Port' examples

24mm

22055-001 8mm

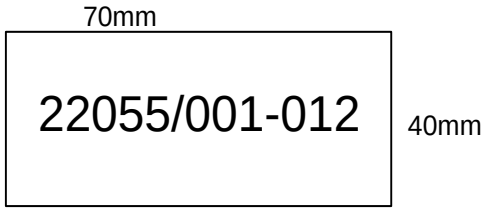
2.14.12.2 Consolidation Points

Exterior CP Label

- The label below is to be applied to Consolidation Point lid and includes the length from cabinet to CP.

ITEM	DESCRIPTION
Label type	Traffolyte
Label thickness	50 micron
Label size	70mm x 40mm – white
Font type	Arial Bold – black
Font size	10mm
Labelling scheme	Cab / outlet range 22055/001-012

Example

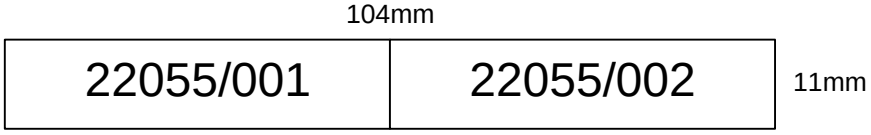


2.14.12.3 Interior CP labels

- The label format below is to be applied to interior of Consolidation Point, Designation strips.

ITEM	DESCRIPTION
Label type	Traffolyte
Label thickness	50 micron
Label size	104mm x 11mm – white
Font type	Arial Bold – black
Font size	10mm
Labelling scheme	**CAB ID/yyy**. yyy = panel port number used.

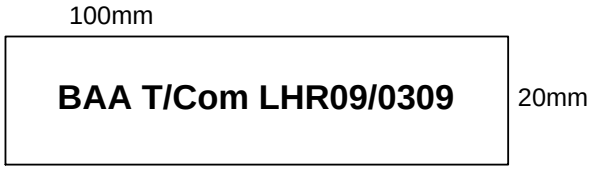
Example



2.14.12.4 Splice enclosure

ITEM	DESCRIPTION
Label type	Traffolyte
Label thickness	50 micron
Label size	100mm x 20mm – white
Font type	Arial Bold - black
Font size	6mm
Labelling scheme For Labelling within Splice boxes For wall mounted Splice Boxes ID see Fibre Transition Point details below.	**LHR T/Com LHRxx/yyyy**

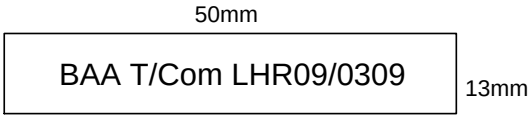
Example; Fibre ID for all cables



2.14.12.5 Transition Points

ITEM	DESCRIPTION
Label type	Traffolyte
Label thickness	50 micron
Label size	100mm x 20mm - white
Font type	Arial Bold - black
Font size	10mm
Labelling scheme For Copper Transition Point: For Fibre Transition Point: LHR Cabinet ID to be added to transition Point	 **LHR T/Com LHRxx/Cyyyy** **LHR T/Com LHRxx/yyyy**

Example



2.14.12.6 Network Equipment labels

ITEM	DESCRIPTION
Label type	Traffolyte / Dymo
Label thickness	50 micron
Label size	50mm x 5mm - white
Font type	Arial Bold - black
Font size	5mm
Labelling scheme Switch label	**LHRxxxx??yy-Az (Subsequent switches will be labelled #2, #3 etc. depending on stack position)** need to enter AP Host name convention XXX-APYYY where XXX is the switch name the AP connects to and YYY is the AP number LHR2055T2A1-A1-AP00065 And ECAP ID HAL-ECAP YYYYYY where YYYYY is number assigned by ECAP team HAL-ECAP 2345-65

- LHR Network Switch Identifications are only provided by the relevant network team on an authorised installation only.
- Visible label to be mounted front & rear of network equipment.

Example

50mm

LHR2055T2A1-A1#2 5mm

2.14.13 Cabinet labelling by Location

Cabinets/nodes(including cable joints)
The following node numbering scheme exists for all LHR sites:

HEATHROW CABINET NUMBERING SCHEME

NUMBERING SCHEME	AREA
1000 – 1999	Terminal 1
2000 – 2999	Terminal 2
3000 – 3999	Terminal 3
4000 – 4999	Terminal 4
05000 – 05999 & 55000 - 55999	Terminal 5
6000 – 6999	Central Terminal Area
7000 – 7999	Cargo
8000 – 8999	Perimeter
9000 – 9999	Airfield Substations

ABERDEEN CABINET NUMBERING SCHEME

NUMBERING SCHEME	AREA
1000 – 1999	Terminal
2xxx	Future Expansion
3xxx	Future Expansion
4xxx	Future Expansion
5xxx	Future Expansion
6000 – 6999	Central Terminal Area
7000 – 7999	Cargo
8000 – 8999	Perimeter
9000 – 9999	Airfield Substations

GLASGOW CABINET NUMBERING SCHEME

NUMBERING SCHEME	AREA
1000 - 1999	Terminal
2xxx	Future Expansion
3xxx	Future Expansion
4xxx	Future Expansion
5xxx	Future Expansion
6000 - 6999	Central/Other
7000 - 7999	Cargo
8000 - 8999	Perimeter
9000 - 9999	Airfield Substations

2.14.13.1 Other locations:

London Offices
Medici Court, New Bond Street – 8000 Series
Stockley House, Wilton Road – 8000 Series
Paddington – 8000 Series
Runneymede – 8000 Series
Saxley Court- 8000 Series
Pease Pottage- 8000 Series
BSC and Drumsheugh - 8000 Series

The node numbers are unique and are centrally allocated by LHR IT.
LHR IT will allocate the numbering scheme as part of the project process.
e.g.: cabinet number, contact/access details and also acts as a safety warning (see below). This label shall be placed on the front of all cabinets on the top left hand corner

2.14.13.2 Fibre and voice backbone cable labelling

Critchly laser printed labels secured by cable ties are to be used.

Installed fibre infrastructure must be labelled as follows:

Within every pit
At building entry/exit points
At every 5mts along an internal tray or containment route
Upon entry to the cabinet gland
Upon entry to a manifold
Individual tubes that exit the manifold
Cable and core identification labels must be fixed to the final termination

The following numbering scheme will be applied to fibre cables installed at all HAL sites;

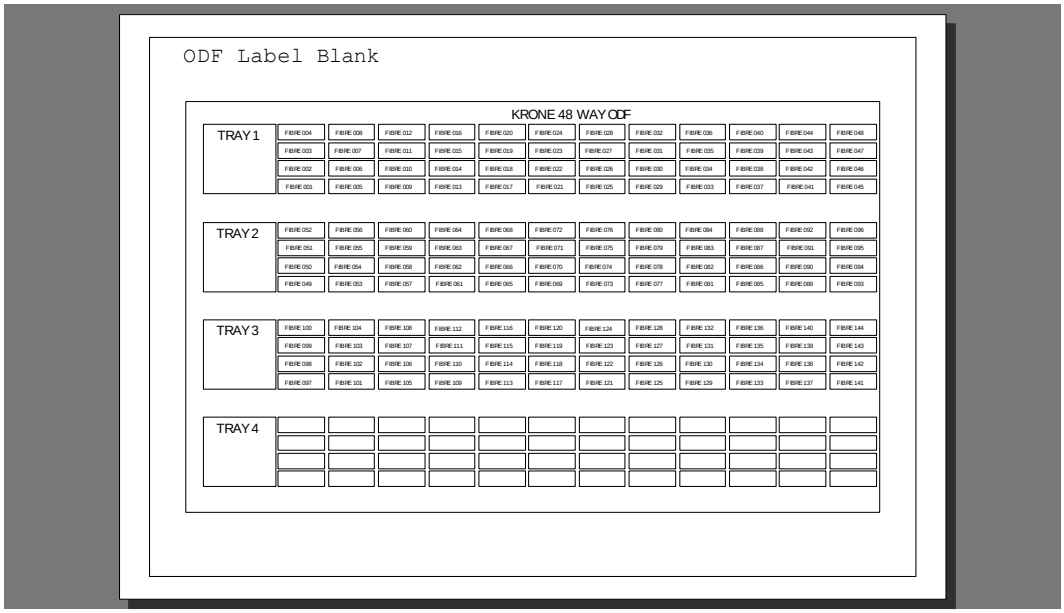
Location	**Label**
Heathrow	HAL T/Com LHRxx/yyy
Glasgow	HAL T/Com GLAxx/yyy
Aberdeen	HAL T/Com ABZxx/yyy
Southampton	HAL T/Com SOUxx/yyy
Business Support Centre	HAL T/Com BSCxx/yyy
Corporate/Other	HAL T/Com CORxx/yyy

Where;
xx is the year issued
yyy is the incremental unique cable number

The fibre numbers are unique and are centrally allocated by HAL IT.
HAL IT will allocate the numbering scheme as part of the project process

2.14.13.3 Optical Distribution Frame (ODF) labelling

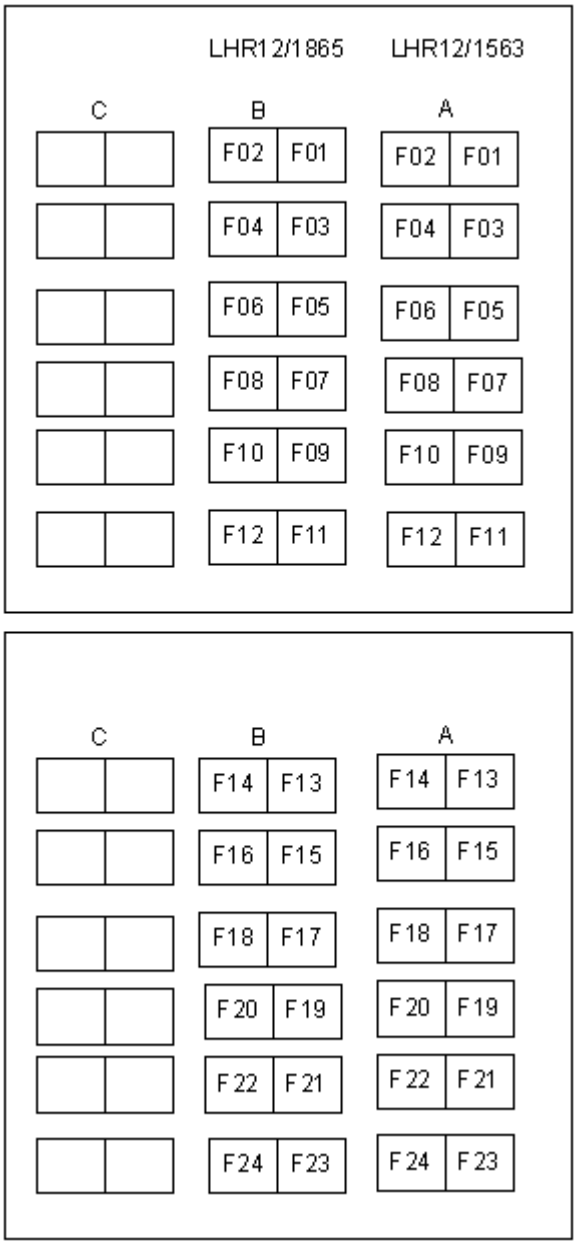
Optical distribution frames will be labelled in the following manner both internally with a machine printed label (supplied by Celsius representative). As shown.



And externally with a plastic engraved (Traffolite) label, as shown.

All new cable and cabinet ID's are allocated by the SITA IT Celsius team.
To obtain a new number prior to installation you must contact your HAL representative who will contact the Celsius team.

The new style fibre box needs to be terminated as shown in the below diagram, and the label with all fibre termination and positions on the device needs to be presented on to the inside of the front door like the ODF.



2.15 Testing

100% of the installed cabling links must be tested and must pass the requirements of the current industry standards

2.15.1 Unshielded Twisted Pair and Multi-core Copper Cabling

Unshielded Twisted Pair cabling is often referred to as Balanced Cabling (NB Foil Twisted Pair and Shielded Twisted Pair Cabling are also referred to as Balanced Cabling) and consists of 4 pairs of cables that are twisted together in pairs with different twist ratios. The relative twist ratio and the separation of the pairs give the cable its transmission characteristics.
The rationale for using Balanced Cabling systems for communications is that they use separate twisted pairs and a rising EMF (Electro Motive Force) in one pair is negated by a descending EMF in the opposing pair. A perfectly balanced system will therefore neither emit nor couple noise**.**

EN50173-1:2002 (2) specifies the following for balanced cabling systems.

Class A is specified up to 100 kHz
Class B is specified up to 1 MHz
Class C is specified up to 16 MHz
Class D is specified up to 100 MHz
Class E is specified up to 250 MHz
Class F is specified up to 600 MHz

Cabling systems are classified according to the bit rate and transmission frequency they support, these are summarised in Table 1.

Table 1 Cable Classification of Cabling Systems.

Class	Category	Class Cable	Frequency	Bit Rate (MBps)
A	1	100 KHz	Voice Grade	
B	2	1 MHz	1	
C	3	16 MHz	10	
D	5e	100 MHz	1000	
E	6	250 MHz	1000 +	
F	7	600 MHz	1000 ++	

Category 5 components provide Class D balanced cabling performance.

Category 6 components provide Class E balanced cabling performance Balanced pair testing

This document is concerned with the testing of Class D and E cabling systems. The testing of Category 3/5 multi core voice cabling is dealt with in Section 11. The testing regime described for

Category 3, 5 and 6 cabling installations within this document is compliant with ISO 11801, EN50173-1:2002 (2)

2.15.2 Permanent Link and Channel Configurations

The installed common cabling system can be separated into 2 separate entities. These are Permanent Link & Channel.

2.15.2.1 Permanent Link

The Permanent Link is categorised as being the transmission path between 2 test interfaces and includes the connections at the ends of the cabling under test.
The Permanent Link is a subset of the Channel and is considered to be:

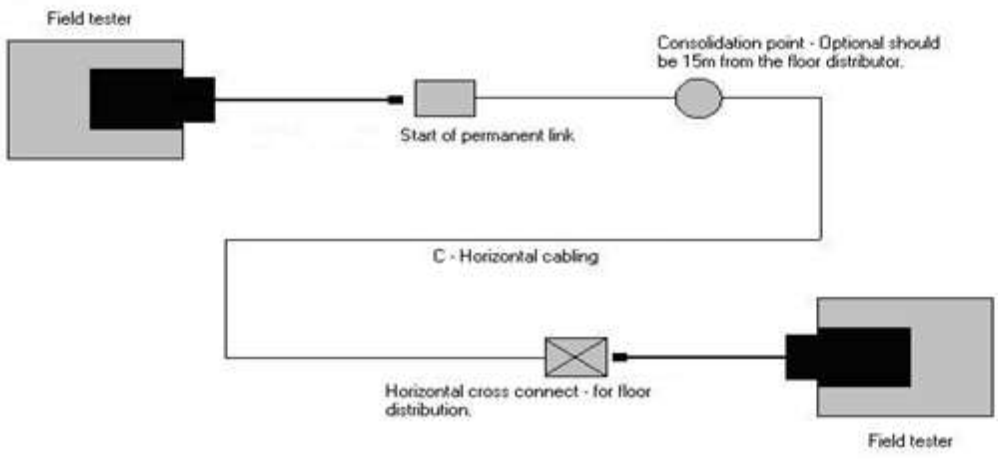
Terminal Outlet at the Workstation Area

Horizontal Station Cable (optional Consolidation Point may be present).

Patch Panel or Terminating Frame in the Equipment Room

The Permanent Link test configuration represents the permanent telecommunications cabling in the horizontal run, up to a maximum length of 90 metres, with test equipment cords of a maximum total of 4 metres to attach to the test instruments.

There is one mated connector at each end of the Permanent Link span length for a total of two connections. Links are tested during the detection of cabling faults. A Permanent Link is illustrated in Figure 1.



Permanent Link Configuration – Transmission Path Between 2 Test Interfaces

All cabling shall be tested for Permanent Link compliance.

2.15.2.2 Channel

The Channel is considered to be the:
Workstation drop cable (fly lead)

Terminal Outlet at the workstation area.

Horizontal station cable (optional Consolidation Point may be present)

Patch Panel or Terminating frame in the equipment room

Horizontal cross connect patch cords.

Equipment panel.

Equipment cable going from the equipment panel to the active Hub /switch

The Channel test configuration includes 90 metres of total horizontal cable, 10 metres total of patch cable and two mated connectors at each end for a total of 4 connections

The Channel is therefore viewed as the transmission path between IT equipment (LAN Switch or Hub) and the terminal equipment and consists of the horizontal cabling (subsystem) and all work area and equipment cords. Channels can be formed by linking 2 or more subsystems together. A Channel configuration is illustrated in Figure 2.

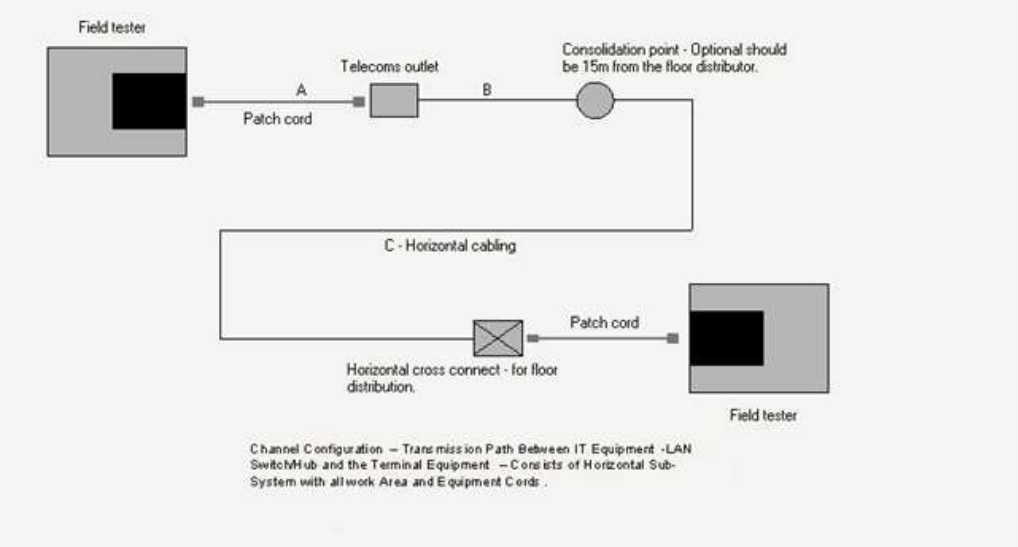


Figure 2 Channel Configuration

In channels where a multi user Terminal Outlet assembly is used the length of the work area cord shall not exceed 20metres. Where a Consolidation Point (CP) is used it should be located at least 15 metres from the Floor Distributor and the length of patch cords and jumpers shall not exceed 5 metres.

True Channel testing should only be undertaken with the patch cord to be used with that particular Channel (Channels should not be tested with the same set of patch cords).

The maximum length of the fixed horizontal cable will depend on the total length of the Consolidation Point cables and cords to be supported in the Channel.
The Channel testing shall take into account all of the equipment cords in conjunction with the length of the Permanent Link, typically the longest and shortest Permanent Links shall be initially selected for Channel Testing and a representative sample of Channels tested as they are patched through in their final configurations.

2.15.3 Test Equipment

Only the Fluke DTX 1800 tester and its associated firmware shall be used. Any field tester shall be calibrated as follows before any testing is performed, typical field measurements show a difference in signal transmission giving rise to delay skew and difference in length between pairs in the same cable. The Nominal Velocity of Propagation (NVP) and transmission delay of a 4 pair cable is determined by its insulation material and the twist rates of the different pairs. The 4 different twist rates results in 4 unique NVP values and 4 unique transmission delays, the length of the pair having the shortest electrical delay and the maximum velocity of propagation is used as the reference or standardised length measurement.

Test instrumentation use different internal procedures to find the pair with the shortest electrical delay, on site calibration is the only way of initialising the field tester with the correct NVP for the particular type of cable that is being tested. On site calibration will result in more accurate length measurements resulting in less variation in length between the different pairs within the cable.

To calibrate the Fluke DTX test equipment the following equipment is required:

- 2 DTX-PLA001
- Latest version of Link Ware software
- DTX software version 1.1 or higher.

When calibrating the tester the operative should protect the personality module from damage due to an electrostatic discharge by touching a grounded conductive surface before handling the module. NB The calibration procedure deletes saved test results from the memory, any saved data should be uploaded to a PC or Laptop via the LinkWare software prior to the calibrating the universal link adapters. The calibration procedure also deletes custom cable configurations from the test tool memory, this data should be written down on an appropriate form.

2.15.4 Calibration

The calibration procedure is as follows:

1) Verify the universal permanent link adapters are securely attached to the DTX main and remote units.

2) Connect the main unit to the PC with a PC interface cable. Turn on the main unit.

3) Start the LinkWare software on the PC/Laptop.

4) From the DTX Utilities menu, select “Permanent Link Cal”; then click continue:

5) Remove the personality module from the universal permanent link adapter cable. Place the module in its original static bag protection.

6) Attach the universal permanent link adapter cable to the calibration artefacts “OPEN” connector and then click continue. (If an error message appears verify the universal link adapter is securely attached to the test tool and the adapter cable is securely attached with the thumbscrew to the correct connector on the calibration artefact. Click continue to retry the step.

7) Repeat step 6 for the artefacts “SHORT” and “LOAD” connectors. The test tool will restart when the calibration is complete.

8) Replace the personality module on the test tool’s adapter cable. Turn off the test tool.

9) Connect the PC interface cable to the remote unit. Turn on the remote unit Click “Continue”.

10) Repeat steps 5 through 9 for the remote unit. Click “Continue” when finished.

A self-test should then be run on the DTX.

1) Verify the universal permanent link adapters are securely attached to the main and remote units. Remove the personality modules and place them in their original static bag protection. Turn on both units.

2) Connect the adapter cables to the thru connectors on the calibration artefact.

3) Turn the test tools switch to SETUP

NB Select the DTX PL Self-Test limit in the twisted pair “Application” test limits.

4) Run an Autotest If the Autotest fails, do the calibration procedure again; then run the Autotest again. If the Autotest fails, do the calibration procedure again. If the test continues to fail, contact Fluke networks for assistance.

If field calibration is not possible an NVP value for the cable being installed should be obtained from TE CONNECTIVITY.

This NVP value should be kept as a default for the appropriate cable type. The calibration for NVP shall be checked by the LHR representative / Implementation Manager for every installation of cabling.

To ensure that the NVP calibration has been saved, the tester should be turned off, turned back on and then checked to see if the new NVP values for the cable type being installed are current in memory.

Portable field testers are susceptible to noise from portable radios. Under no circumstances will the Installing Contractor be permitted the use of portable radios whilst undertaking testing and other contractors shall be requested to switch any radios off whilst testing is taking place. There are other potential sources of Radio Frequency Interference (RFI). The contractor must consult with the LHR representative concerning any suspicious or anomalous test data that is generated and the reason for the anomalies identified before any testing is allowed to continue.

A pass margin of 1dB NEXT Headroom has been agreed by TE CONNECTIVITY and NTL due to the NEXT test result deviation on Fluke testers. Marginal passes and marginal fails shall be treated as failures.

The Installing Contractor shall develop uniform test practices with suitable calibration procedures and intervals being enforced; calibration of NVP for each phase will ensure that the NVP represents the value of the cable being installed.

Some variation in measurements may be expected due to variations in temperature, humidity and time. All test instrumentation is calibrated at 20 degrees Celsius. Any variation from this temperature will result in a change of 0.5dB in attenuation per degree change.

Interface adapters are sometimes required to attach the field testers to the Channel or Permanent Link under test. These adapters are an extra element in the link configuration and may affect the accuracy of the measurement. The Installing Contractor shall ensure that any adapters used are manufacturer approved types. To measure a Permanent Link with an IDC TE CONNECTIVITY interface on one end, the contractor shall provide a manufactured adapter cord with a 4 way IDC TE CONNECTIVITY end with the correct connector to the test instrument at the other end.

For Channel measurements, testers shall provide an adapter from the tester interface connector to a modular jack. The connecting interfaces to test instruments and adapters may be worn due to successive coupling and de-coupling.

The installing contractor shall ensure that the test instrument vendor’s adapter/interface life cycle guidelines are being used. Prior to the commencement of testing the installing contractor shall inspect the connectors on the test equipment for wear as any worn components may adversely affect the test results, it is estimated that high quality jacks retain their performance for 10,000 connections whilst plugs only retain theirs for 500 insertions.

It is the installing contractor’s responsibility to ensure that the test equipment used is within these tolerances. The LHR representative shall satisfy their self that the installing contractor has met these requirements.

The instrumentation interface adapters must be of high quality and the cable shall not show any twisting or kinking resulting from coiling and storing of the tester interface adapters. In order to deliver optimum accuracy preference is given to a permanent link interface adapter for the tester

that can be calibrated to extend the reference plane of the Return Loss measurement to the permanent link interface.

The contractor shall provide proof that the interface has been calibrated within the period recommended by the equipment manufacturer.
The test instrumentation set comprises two items, a main unit injector and a remote unit detector. Any field tester used must have a current calibration certificate. A copy of which shall be attached to the test results.

All test data generated shall be submitted in summary hard copy and in a suitable electronic format for direct entry into the Celsius cable management system. Summary and full test data results shall be provided in electronic format on CD-ROM. Where applicable the test data shall be stored as Adobe PDF files.

All of the installed cabling links must be tested and pass to the required standard. Any cable link failing shall be audited, diagnosed, corrected and then re-tested. Only the final and passing results of the tests shall be provided in the test result documentation.

Trained technicians who have successfully attended an appropriate manufacturer or approved 3rd party training program and who currently hold a valid certificate shall undertake the testing programme.

2.15.5 Witness Testing

The Production Leader / Test Validator shall invite a representative from (Atkins/LHR/Stakeholder) to witness test within completed rooms / areas. A representative of the end-user will select a random sample of 7.5% of the installed links to perform permanent link tests and compare with original test results. The representative (or his/her authorized delegate) shall witness these randomly selected links and the results should be within the range of EN50173:2002 (2) or those agreed with TE CONNECTIVITY for horizontal cabling run lengths of <100 metres and are to be stored in accordance with the

Documentum™ standard. The results obtained shall be compared to the testing data provided by the installation contractor. If more than 2% of the sample performance test results differ in terms of the pass/fail determination, the installation contractor under supervision of the end-user representative shall repeat 100% testing, on only the failed infrastructure in the room / area handed over (i.e. 2% of failed horizontal cables will require the 24 way panel/loom which houses the fail is to be tested completely), If the retest also fails new cabling shall be installed

2.15.6 Performance Test Parameters

The test of each Category 5 or Category 6 cabling link shall contain all of the parameters detailed below. In order to pass the link test all measurements (at each frequency in the range from 1 MHz through 100 MHz for Category 5 and 1 MHz to 250MHz for Category 6 Level III or level IV testing using the step size indicated in Table 2.

The test data must meet or exceed the limit value determined in EN50173-1:2002 (2) It is desirable for the test results to have a head room of 20% over that stipulated in the standards.

Frequency MHz	Maximum Step Size MHz		Fluke DSP-4000	
Fluke DSP-4100 MHz	Fluke DSP 4300 MHz	Fluke 1800 MHz		
CAT 3 and 5 (Class C, D)				
1-31.25	0.15	0.10	0.10	0.15
31.26 - 100	0.25	0.20	0.20	0.25
CAT 6 (Class E)				
100 - 250	0.50	0.50	0.50	0.50

Table 2 Frequency Step Size

For ease of use and rapid response times it is recommended the installing contractor use the Fluke DTX 180 test instrumentation set.

2.15.6.1 Wiremap

The Wiremap test shall report Pass if the wiring of each wire pair from one end is determined to be correct.

2.15.6.2 Length

Measurement of installed cable length is necessary to ensure that the requirements of EN50173-1:2002 are met (2). Different pairs, within a 4 pair cable, use different twist rates to improve NEXT performance and the velocity of propagation may vary between pairs due to material differences. Delay skew is the term that is commonly used to refer to the difference in the propagation delay over different pairs. The worst-case delay skew allowed in application standards is 50ns for a 100-metre Channel. The speed of light in open space, C, is 300 x 106 ms-1, a relative velocity for copper is 0.6c. The maximum difference in electrical length allowed is 9m (50 ns * 0.6c) for a 100-metre Channel.

Differences of up to 6m for length measurement of pairs in a typical cable run are not uncommon and fall within the application standards. The field tester shall be capable of measuring length of all pairs of a Permanent Link or Channel based on the propagation delay measurement and the average value for NVP. The physical length of the link shall be calculated using the pair with the shortest electrical delay. This length figure shall be reported and shall be used for making the Pass/Fail decision. The Pass/Fail criteria are based on the maximum length allowed for the Permanent Link configuration (90 meters – 295 ft.) or the channel (100 meters – 328 ft.) plus 10% to allow for the variation and uncertainty of NVP.

2.15.6.3 Delay Skew

This parameter shows the difference in propagation delay between the four wire pairs. The pair with the shortest propagation delay is the reference pair with a delay skew value of zero. Minimum test results documentation (summary results): Identify the wire pair with the worst-case propagation delay (the longest propagation delay). The report shall include the delay skew value measured as well as the test limit value

2.15.6.4 Insertion Loss (Attenuation)

This characterises the signal loss in a Channel or Permanent Link configuration, the signal loss is the sum of the attenuation of individual cabling components used in the test configuration.

Attenuation increases with frequency (square root function for both cables and connectors), attenuation at 100 MHz is almost double the attenuation at 25MHz. Adding the maximum allowed attenuation of these components results in the worst case attenuation of the test configuration Insertion Loss is a measure of signal loss in the Permanent Link or Channel. The term 'Attenuation' has been used to describe' Insertion Loss'.

2.15.6.5 NEXT Loss - pair-to-pair

NEXT represents the unwanted coupling of transmit pair to the receive pair at the near end within a Basic or Channel Link. A voltage sum model is used to sum the individual NEXT components to obtain the NEXT of the Basic or Channel Link.

This model assumes that the entire NEXT coupling occurs within the first 20 metres of the cabling. Therefore the effect of remote connectors is ignored when determining the NEXT of the entire Channel or Permanent Link.

The model assumes that all of the contributing components are adjacent to one another and hence the NEXT coupling always occurs in phase. For a Channel Link, the equipment and horizontal cords are added together as one contributing element and the two-mated connections also added as contributing sources.

NEXT causes undesired leakage from the transmit pair onto the near end receive pair of the cabling. As frequency increases the channel crosstalk becomes dominated by the closest cable.

Cable NEXT is virtually independent of length. NEXT loss is NEXT expressed as a positive dB value. Bigger dB values of NEXT mean better performance or better isolation.
Pair-to-pair near-end cross talk loss (abbreviated as NEXT Loss) shall be tested for each wire pair combination from each end of the link (a total of 12 pair combinations). This parameter is to be measured from 1 through100 MHz and 1 through 250MHz. NEXT Loss measures the crosstalk

Disturbance on a wire pair at the end from which the disturbance signal is transmitted (near-end) on the disturbing pair.

The maximum step size for NEXT Loss measurements shall not exceed the maximum step size defined in the standards as shown in Table 2.

The minimum test results documentation should: identify the wire pair combination that exhibits the worst case NEXT margin and the wire pair combination that exhibits the worst value. NEXT is to be measured from each end of the link-under-test. These wire pair combinations must be identified

for the tests performed from each end. In each case the frequency at which it occurs, as well as the test limit value at this frequency, shall be recorded.

For a Permanent Link there is only one mated connection at the near end and hence only one cable and one mated connection are taken into account.

2.15.6.6 PSNEXT Loss

Power Sum NEXT (PSNEXT) is the sum of the NEXT power from all other pairs in the cable. The measurement is applicable for parallel transmission schemes where more than one pair in the cable is energised at once. For 4 pair cabling PSNEXT can be up to 4.8 dB worse than pair to pair cabling.

Power Sum NEXT Loss shall be evaluated and reported for each wire pair from both ends of the link-under-test (a total of 8 results). PSNEXT Loss captures the combined near-end crosstalk effect (statistical) on a wire pair when all other pairs actively transmit signals.

Like NEXT this test parameter must be evaluated from 1 through 100 MHz and 1 through 250MHz the step size may not exceed the maximum step size defined in the standards as shown in Table 2.

Minimum test results documentation (summary results): Identify the wire pair that exhibits the worst-case margin and the wire pair that exhibits the worst value for PSNEXT. These wire pairs must be identified for the tests performed from each end. Each reported case shall include the frequency at which it occurs as well as the test limit value at this frequency.

2.15.6.7 ELFEXT Loss, pair-to-pair

ELFEXT is the ratio of the desired receive signal on the receive pair to the undesired noise coupled onto the receive pair from a transmit signal coming from the other end of the channel. EFLEXT is the equivalent of ACR for far end coupling.

The Pair-to-Pair Far End Cross Talk (FEXT) Loss shall be measured for each wire-pair combination from both ends of the link-under-test. FEXT Loss measures the unwanted signal coupling (crosstalk disturbance) on a wire pair at the opposite end (far-end) from which the transmitter emits the disturbing signal onto the disturbing pair. FEXT is measured to compute ELFEXT.

ELFEXT measures the relative strength of the far-end crosstalk disturbance relative to the attenuated signal that arrives at the end of the link. This test yields 24 wire-pair combinations. ELFEXT is to be measured from 1 through 100 MHz and 1 through 250 MHz the maximum step size for FEXT Loss measurements shall not exceed the maximum step size defined in the standards as shown in Table 2.

Minimum test results documentation must: identify the wire pair combination that exhibits the worst-case margin and the wire pair combination that exhibits the worst value for ELFEXT. These wire pairs must be identified for the tests performed from each end. Each one identified shall include the frequency at which it occurs as well as the test limit value at this frequency.

2.15.6.8 PSELFEXT Loss

Power Sum ELFEXT is the sum of ELFEXT power from all other pairs in the cable. This measurement is applicable for parallel transmission schemes when more than two pairs in the cable are used to transmit in each direction e.g. Gigabit Ethernet (1000Base-T). For 4 pair cabling PSELFEXT can be up to 4.8dB worse than ELFEXT.

Power Sum ELFEXT is a calculated parameter that combines the effect of the FEXT disturbance from three wire pairs on the fourth one. This test yields 8 wire-pair combinations. Each wire-pair is evaluated from 1 through 100 MHz and 1 to 250 MHz in frequency increments that do not exceed the maximum step size defined in the standards as shown in Table 2.

Minimum test results documentation should identify the wire pair that exhibits the worst-case margin and the wire pair that exhibits the worst value for PSELFEXT. These wire pairs must be identified for the tests performed from each end. Each one identified shall include the frequency at which it occurs as well as the test limit value at this frequency.

2.15.6.9 Structural Return Loss

This characterises the impedance roughness of a cable and is a parameter that is measured in a laboratory environment and is not specified as a field measurement for either Links or Channels in TIA/EIA 568A or ISO 11801. Such a measurement is not required.

2.15.6.10 Return Loss

Return Loss is the ratio of the transmit signal to the reflected signal of the cabling. Return Loss is important for bi-directional transmission schemes – where one pair is used to transmit and receive at the same time.

Return Loss is a measure of reflected signal and is used to characterise either individual components or links. When characterising links, return loss is an indication of impedance mismatches of different components within links. Return Loss (RL) measures the total energy reflected on each wire pair. Return Loss is to be measured from both ends of the link-under-test for each wire pair.

This parameter is also to be measured form 1 through 100 MHz and 1 through 250 MHz in frequency increments that do not exceed the maximum step size defined in the standards as shown in Table 2. Minimum test results documentation must identify the wire pair that exhibits the worst-case margin and the wire pair that exhibits the worst value for Return Loss. The wire pairs must be identified, and shall include the frequency at which it occurs as well as the test limit value at this frequency

2.15.6.11 ACR (Attenuation to Cross Talk Ratio)

ACR provides an indication of bandwidth for the two wire-pair network applications. ACR is a computed parameter that is analogous to ELFEXT and expresses the signal to noise ratio for a two wire-pair system. ACR is the ratio (difference in dB) between the size of the desired signal to the size of the undesired Near-End Crosstalk and is therefore a measure of Headroom or usable Bandwidth. This calculation yields 12 combinations – six from each end of the link.

Minimum test results documentation should identify the wire pair combination that exhibits the worst-case margin and the wire pair combination that exhibits the worst value for ACR. These wire pair combinations must be identified for the tests performed from each end. Each one identified shall include the frequency at which it occurs as well as the test limit value at this frequency.

2.15.6.12 PSACR

The Power Sum version of ACR is based on PSNEXT and takes into account the combined NEXT disturbance of all adjacent wire pairs on each individual pair. This gives 8 combinations (one for each wire pair from both ends of the link). Minimum test results documentation should identify the wire pair that exhibits the worst-case margin and the wire pair that exhibits the worst value for PSACR. These wire pairs must be identified for the tests performed from each end, and shall include the frequency at which it occurs as well as the test limit value at this frequency.

2.15.6.13 Propagation Delay

Propagation delay is the time required for the signal to travel from one of the links to the other. This measurement is to be performed for each of the four wire pairs. Minimum test results documentation shall identify the wire pair with the worst case propagation delay. The report shall include the propagation delay value measured as well as the test limit value.

2.16 Earth Continuity

All STP cable shall be tested by means of a shield module plug. An end to end continuity test shall be carried out as well as a shield integrity detection test. These criteria shall be included within the wiremap report.

2.17 Consolidation Points

In areas where Consolidation Points are deployed a test cord with a High-band interface connector on one end shall be used. These tests cords should be manufactured and properly tested to ensure compliance with the standards, the advice of TE CONNECTIVITY and Fluke Networks should be sought as to where to source these test cords. Typical sources are the Value Added Resellers of the test instrumentation.

2.18 Multicore Category 3 and Category 5 Multi-Core Cable

TIA 569 considers 25 pair cabling to be backbone cabling and requires NEXT to conform to Power Sum requirements. Power Sum computations involve hundreds of pair combinations and several thousand data points for conformance testing; this level of testing is not required.

The Category 5 cabling will be installed to support the CCTV application and the Category 3 cabling to support the analogue voice. This cabling shall be tested for continuity and polarity of pairs, separation of pairs and isolation (High Impedance) to earth.

A Mod-Tap SLT3S can be used to test this cabling. The analogue telephone circuits will be presented as single pairs; a 1 pair LSA insertion module for connection to the 10 pair IDC TE CONNECTIVITY 237A module can be used. A standard 8 pin RJ45 plug may be used for connection to the hand held tester.

The voice cabling shall be tested between:

Test Jack Frame and Main Distribution Frame in the Primary Communications Room

Each Primary Communications Room and each Distributed Secondary Communications Room

Each Distributed Secondary Equipment Room and Secondary Equipment Room/Nodes

Nodes and Telecommunications Outlets.

NB; the installer should note that the 25 pair Category 5 cable will be connected to a power injector and some of the pairs will carry a small current and voltage level. The Production Project manager should enable the testing of the multi-core before the power injectors are connected

2.19 Coaxial TV Cabling

Each installed internal and external/internal coaxial TV distribution cable shall be tested end to end (including splitters/dividers and cables) between the frequency range 75 MHz and 3 GHz, the following parameters shall be tested:

Return Loss (SWR)
Cable Loss
Coupling Loss

The test results shall verify the usability of the co-axial cable for distribution of analogue and digital TV distribution. An Anritsu S331B/05 tester shall be used.

2.20 Permanent Link Limits for Maximum Performance

Parameter	Frequency MHz	Class C (dB)	Class D (dB)	Class E (dB)
Return Loss	16.00	15.00		
	100.00	N/A	12.00	14.00
	250.00	N/A	N/A	10.00
Attenuation / Insertion Loss	16.00	12.20	7.70	7.10
	100.00	N/A	20.40	18.50
	250.00	N/A	N/A	30.70
Near End Cross Talk	16.00	21.10	45.20	54.60
	100.00	N/A	32.30	41.80
	250.00	N/A	N/A	35.30
Power Sum NEXT	16.00	N/A	42.20	52.20
	100.00	N/A	29.30	39.30
	250.00	N/A	N/A	32.70
Parameter	**Frequency MHz**	**Class C (dB)**	**Class D (dB)**	**Class E (dB)**
Attenuation Cross Talk Ratio	16.00	N/A	37.50	47.50
	100.00	N/A	11.90	23.30
	250.00	N/A	N/A	4.70
Power Sum ACR	16.00	N/A	34.50	45.10
	100.00	N/A	8.90	20.80
	250.00	N/A	N/A	2.00
ELFEXT	16.00	N/A	34.50	40.10
	100.00	N/A	18.60	24.20
	250.00	N/A	N/A	16.20
Power Sum EFLEXT	16.00	N/A	31.50	37.10
	100.00	N/A	15.60	21.20
	250.00	N/A	N/A	13.20

Delay Skew 044 (Max) Micro Seconds for 16,100 and 250MHz for Class C, D and E.

Propagation Delay 496 (Max) Micro Seconds for 16MHz for Class C, D and E

Propagation Delay 491 (Max) Micro Seconds for 100MHz for Class D and E

Propagation Delay 490 (Max) Micro Seconds for 250MHz for Class E

2.21 Channel Results for Maximum Performance

Parameter (Frequency MHz)	Frequency MHz	Class C dB	Class D	Class E dB		dB
Return Loss	16.00	15.00		17.00		18.00
	100.00	N/A		10.00		12.00
	250.00	N/A		N/A		8.00
Attenuation	16.00	14.40		9.10		8.30
	100.00	N/A		24.00		21.70
	250.00	N/A		N/A		35.90
NEXT (Pair to Pair)	16.00	19.40		43.60		53.20
	100.00	N/A		30.10		39.90
	250.00	N/A		N/A		33.10
Power Sum NEXT	16.00	N/A		40.60		50.60
	100.00	N/A		27.10		37.10
	250.00	N/A		N/A		30.20
Attenuation Cross Talk Ratio	16.00	N/A		34.50		44.90
	100.00	N/A		6.10		18.20
	250.00	N/A		N/A		-2.80
Power Sum Attenuation Cross Talk Ratio	16.00	N/A		31.50		42.30
	100.00	N/A		3.10		15.40
	250.00	N/A		N/A		-5.80
EFLEXT	16.00	N/A		33.30		39.20
	100.00	N/A		17.40		23.30
EFLEXT (Cont.)	250.00	N/A		N/A		15.30
PS EFLEXT	16.00	N/A		30.30		36.20
	100.00	N/A		14.40		20.30
	250.00	N/A		N/A	1	2.30

Delay Skew 0.05 Micro Seconds for Class C, D and E

Direct Current Loop Resistance 40, 25 and 25 Ohms respectively for Class C, D and E

2.22 Testing – Optical Cabling Component

Fibre optic cabling links in the installation shall be tested in accordance with the field test and performance specifications as defined by the ISO/IEC 14763-3 standard

The purpose of this section is to describe the testing regime to be undertaken on the newly installed optical fibre cable across the Airport sites. The reasons for testing of newly installed cabling is to ensure that it has been installed and terminated correctly and complies with the installation specification and qualifies for the TE CONNECTIVITY Technologies 28 year Application Assurance and Product Warranties.

The generated data shall act as a reference point thus enabling any degradation in performance over time to be monitored and shall also bench mark any future scheduled preventative maintenance and audit tests, thereby enabling the management of the installed cabling plant.

Upon the delivery and offloading of a new fibre optic cable drums, it is the responsibility of the contractor to carry out bare end testing of the cable to check that newly delivered cable meets required standards and lengths required and is suitable for installation.

If on installation, the final cable acceptance tests show anomalous and unacceptable results, outside the specified and agreed acceptance criteria, the Installing Contractor shall immediately inform the Production Leader and the appropriate remedial action taken.

All new installed fibres shall have 1-pair tested for length (bare end tests will be acceptable) prior to splicing or connecting to other fibre cables.

This specification details the use of Optical Time Domain Reflectometer (OTDR Noyes M100) and Optical Light Source/Power Tester/Meter (Noyes OLTS - SMLP 5-5 includes OPM 5-2D and OLS 4 - 850/1300nm multimode & 1310/1550nm single mode) combinations to assess the characteristics of the optical link/channel, also the use of the Fluke DTX with SPM2 fibre heads is permitted for testing airfield and external fibres.

The Link is the transmission path excluding the work area cords, equipment cords, patch cords and jumpers but includes TP's (Transition points) and the connection at either end.

The Channel is the complete transmission path between the transmitting and receiving equipment it can contain a number of individual links together with other passive components, splices splitters etc. but excludes the connecting hardware into the application specific equipment as defined in EN 50173-1. (2).

The use of an OTDR is specified to ensure that the cable has been laid correctly with no undue twists, sharp bends etc. occurring. The Light/Source Power Meter combination is used to measure the attenuation of the optical link/channel after all work has been undertaken.

The use of OLTS combinations ensures compliance with Telecommunications Industry Association (TIA) ANSI-/TIA/EIA-568-B2.1 (8) standard and CENELEC (Comite European de Normalisation Electrotechnique – EN50173 1:2002 (2). Where the Link is in excess of 1Km this will only be able to be assessed by the Noyes M100 OTDR.

The Standards referenced (2-9) define the passive cabling network and include the cable, connectors and splices (where present) between the connecting hardware (optical fibre patch panels).

The tests undertaken shall include the representative connector performance at the connecting hardware associated with the mating of patch cords when tested in the Channel configuration. The tests do not include the performance of the connector at the interface with the test equipment.

Only TE CONNECTIVITY certified technicians of the Installation Contractor, who have completed, passed and possess a valid operator's certificate shall be allowed to perform the tests, the technicians shall supply the relevant Production Project Leader with a copy of their certificate.

Prior to the commencement of any testing the Installation Contractor shall submit current and valid calibration certificates for the instrumentation to the LHR representative; these certificates shall be included with the Cabling Audit report. The client organisation (LHR) shall witness the field-testing.

The LHR representative will witness testing within completed rooms / areas. A representative of the end-user will select a random sample of 7.5% of the installed links on the day of testing. The representative (or his/her authorized delegate) shall witness these randomly selected links and the results are to be stored in accordance with the Documentum™ standard. The results obtained shall be compared to the data provided by the installation contractor. If more than 2% of the sample performance test results differ in terms of the pass/fail determination, the installation contractor under supervision of the end-user representative shall repeat 100% testing, on only the failed infrastructure in the room / area handed over (i.e. 2% of failed horizontal cables will require the 24 way panel/loom which houses the fail is to be tested completely).

If more than 20% of the sample results differ in terms of the pass/fail criteria (0.5% of the sample), the Installation contractor under supervision of a LHR representative will retest 100% of the installed cabling. If the retest results show faults and losses outside the acceptable range an agreed course of remedial action should be undertaken (cable re-pulled, re-terminated and then re-tested).

Any failing link must be documented, diagnosed and corrected, to prove that the corrected link meets the standard's performance requirements it shall be followed by a complete re-test with OTDR and Light Source /Power Meter combinations.

Upon completion of testing the Installing Contractor shall apply to TE CONNECTIVITY Technologies for the Application Assurance and Product Warranty certificates. These certificates must be returned to LHR representative within 60 days of completing the installation

ALL test results are required to be handed over to the support team (SITA) for fibre optic cabling. These would be;

- Link results for newly installed cables.
- Channel results for all fibre circuits irrespective of new or old cabling being used.

2.23 Performance Test Parameters

EN50173 Class E and ISO/IEC 11801 (7) specify that the link attenuation is represented by the following formulae:

Link Attenuation = Cable Attenuation + Connector Attenuation + Splice Attenuation

Cable Attenuation (dB) = Attenuation Coefficient (dB/km) * Length

2.24 Attenuation Coefficient Values

The table below illustrates the given Attenuation coefficient for different cables geometries.

Optical Fibre	Wavelength (nm)	Attenuation Coefficient (dB/km)
Multi-mode 50/125 um	850	3.5
	1300	1.5
Single-mode	1310	0.35
	1550	0.21

The total Cable Attenuation is calculated by multiplying the cable length (Km) by the Cable Attenuation (dB/Km)
Connector Attenuation (dB) = Number of Connector Pairs * (Connector Loss+ Connector Deviation).

The maximum allowable Connector Loss is = 0.3 dB (LC mated connector). The connector deviation is approximately 0.05dB per mated connector pair (this occurs due to manufacturing tolerances).

Splice Attenuation (dB) = number of splices (s) * splice loss (dB).

The maximum allowable splice loss according to the standards is = 0.3dB, typical splices losses are dependent on the type of optical fibre and fusion splice equipment used however typical splice losses should be in the order >0.1dB (0.03 – 0.09dB).

The maximum allowable Link Attenuation loss is 3.5dB.

NB Link Attenuation does not include any active or passive devices other than the cable, connectors and splices and does not include optical bypass switches, couplers, repeaters or optical amplifiers.

2.25 Worked Examples

There are 2 Primary Equipment Rooms, 8 Distributed Secondary Equipment and 78 Secondary Equipment Rooms distributed across the campus some optical power budgets have been calculated for Link/Channel lengths up to 4Km, with an estimated number of splices and mated connector pairs allowed for these can be found in Appendix 1.

2.26 Methodology

The installed cabling shall be tested by using an Optical Time Domain Reflectometer (OTDR) and Optical Power/Meter Light Source combinations (OLTS set). All test equipment must have a current and valid calibration certificate. A copy of this shall be given to the LHR representative prior to the commencement of testing.

The Installing Contractor shall adhere to BS EN 50174 (Part 1 and 2 Information Technology Cabling Installation (3, 4), BS EN 50173 Information Technology - Generic Cabling System (2).

All optical fibre cable shall be tested by a suitable OTDR that can operate at the 850, 1300, 1310 and 1550nm testing windows. Multi-mode optical fibre (50/125) shall be tested at
850 nm and 1300nm, Single mode optical fibre shall be tested at 1310 and 1550nm.

2.27 Fluke DTX Fibre Testing

Only the Fluke DTX 1800 tester and its associated firmware shall be used. When using the Fluke DTX 1800 for fibre testing, initial setup shall be done according to manufacturer's instructions, using the SFM2 fibre test heads this tester can be used for testing all fibre installations.

The following test specifications are for the purpose of obtaining an TE CONNECTIVITY warranty, no other test standard shall be accepted as part of a hand over procedure unless previously agreed to by the relevant PM and approved by the TDA.

Equipment	Fibre	Length	Test Limit
Fluke DTX with SPM2	SM, OS1	Up to 2Km	EN50173 OF-2000 Channel
Fluke DTX with SPM2	SM, OS1	2Km up to 5Km	EN50173 Fibre Optic Link
Noyes OLTS & OTDR	SM, OS1	Over 5Km	N/A

Some variation in measurements may be expected due to variations in temperature, humidity and time. All test instrumentation is calibrated at 20 degrees Celsius.
The installing contractor shall ensure that the test instrument vendor's adapter/interface life cycle guidelines are being used. Prior to the commencement of testing the installing contractor shall inspect the connectors on the test equipment for wear as any worn components may adversely affect the test results.

In order to protect the end faces of the test cord connectors, cleaning shall be required prior to the commencement of testing. This may modify the desired results. The cleaning materials used shall be those approved by TE CONNECTIVITY Technologies and the test equipment manufacturer.

The LHR representative shall prove by reference to the relevant test data and the look up table in Appendix 1 that the planned optical loss budget for the link length is sufficient for current and future intended.

2.28 OTDR Testing.

The OTDR shall be suitable for the optical fibre under test and shall operate at all 4 transmission wavelengths (850, 1300, 1310 and 1550nm). It shall have been calibrated in accordance with recognised national standards and shall have a valid calibration certificate.
When measuring attenuation it may be necessary to apply a correction as a function of the wavelength any correction factor used shall be recorded.

Saturation and noise effects within the OTDR can make the assessment of Attenuation Coefficient for a given critical length of optical fibre inaccurate as it shall be made to appear non-linear. The Installing Contractor shall inform the LHR representative as to the value of this critical length, for the particular type of OTDR to be used during testing. No measurement shall be attempted beyond this critical length.

TE CONNECTIVITY and LHR have specified the use of Noyes M100 OTDR or latest model

The resolution of an OTDR can make the assessment of loss events in close proximity inaccurate. In such circumstances assessment may be made against the combined optical loss specification of the two events.

The suitability and acceptability of the OTDR prior to the commencement of testing shall be determined after consultation with the LHR representative.

2.29 OTDR labelling scheme and basic Configuration

The OTDR apparatus should be optimally configured to produce a launch condition of minimum power required for unambiguous results and maximum resolution for the length of the optical fibre under test. The correct value for the core material refractive index shall be input directly to the OTDR apparatus

NB The use of the correct refractive index is important for the accurate measurement of length only.

The following shall be recorded by direct input into the OTDR:

Date and time of test;

Label details in accordance with project labelling scheme.

In order to protect the end faces of the launch connector, cleaning may be required prior to the commencement of testing. This may modify the desired results. The cleaning materials used shall be those approved by TE CONNECTIVITY Technologies and the test equipment manufacturer.

Under no circumstances shall the Installing Contractor try and improve the test results by rubbing the test connector end face with their clothing or any other non-approved materials.
Index-matching fluid shall not be used between the connector end faces during testing.

The OTDR apparatus shall have facilities for the storing of the test data in memory and also provide a hard copy printout on non-thermal paper and storage on CD-ROM, and Hard Disk. The format of the stored data shall be compatible with that of the cable management system and shall also be converted to Adobe PDF format.

The test shall be undertaken in accordance with the instructions produced by the manufacturers of the OTDR apparatus. The following parameters shall be recorded:

Attenuation Coefficient: measured in dB/Km

Localised Attenuation: local connector and other mated connector insertion loss values (dB), permanent insertion loss values (dB)
Splice Loss (dB)

Optical fibre length and continuity: measured by placing one cursor or marker at the local end of the optical fibre under test, placing the other cursor at the remote end of the optical fibre under test (just before the Fresnel end reflection) and measuring the intervening distance.

2.30 Guidelines for OTDR test parameters:

Test results should be passed to PM's. The results will consist of:

- A random 20% test of all fibre cores, evenly distributed across the loose tubes, bi-directionally tested by an OTDR
- OLTS measurements for every core, of all fibres.

Pulse width – Shorter pulse widths provide the shortest event and attenuation dead zones

Wavelength (nm)	Cable length	Pulse width
MM 850	Less than 1km	30nm*
MM 1300	Less than 1km	30nm*
SM 1310	Less than 2km	30nm*
SM 1310	Greater than 2km	100nm*
SM 1550	Less than 2km	30nm*
SM 1550	Greater than 2km	100nm*

*Recommended guideline only

Averages – Increasing the number of averages reduces trace noise, therefore, makes it easier to see events at the end of a long fibre.

Average	Test time	Recommended for
8	11 Seconds	Link less than 0.5km
16	16 seconds	Link greater than 0.5km

Index – The refractive index of an optical fibre determines the speed of light in the fibre.

(Use the default standard)

Wavelength, nm	Index of Refraction
MM 850	1.4960
MM 1300	1.4870
SM 1310	1.4675
SM 1550	1.4681

Backscatter – The backscatter coefficient is used to calculate a reflectance value.

(Use default values)

Wavelength	Backscatter Coefficient
850 nm	-68
1300 nm	-76
1310 nm	-80
1550 nm	-83

2.31 Launch Leads – OTDR

The lead shall connect to the OTDR with a minimum loss and via an easily accessible coupling. It shall be made from the same specification as the optical fibre under test. It shall produce an equilibrium distribution of fully populated modes, within the optical fibre under test, with an absence of cladding modes.

This equilibrium length is dependent upon the geometry of the optical fibre under test and the type of equipment used. The launch lead length shall be in excess of the equilibrium length of the OTDR apparatus. For 50/125 micron cable a launch lead of 500 metres, for the 8.5/125 micron cable a launch lead of 1Km shall be used.

Specially manufactured launch leads, that achieve mode scrambled and mode stripped launch conditions may be used on the multimode optical fibre as their shorter lengths enable ease of operation. The LHR representative shall agree the type of launch leads to be used and must be satisfied that equilibrium launch conditions (in multimode optical fibre) are being obtained.

The launch lead shall be terminated at one end with a connector of the same design, style and manufacturer as used on the fibre optic link to be tested. Insertion loss measurement methods shall comply with recognised international standards.

2.32 Measurement Parameters – Measurements

An OTDR can only assess cabling components for compliance with individual component specifications and does not provide overall optical loss measurement for fibre optic links. The following shall be assessed by the OTDR:

- optical fibre attenuation and attenuation coefficient measured in dB/Km;
- optical fibre length;
- stress and damage at the core / cladding interface, abnormal extrinsic attenuation events;
- connector and permanent joint losses;
- continuity;

The length measured in an optical fibre under test may be different to that of the length of the optical cable. This is due to two effects:

- In loose tube constructions, the optical fibre may be longer than the optical cable.
- Outer layers of the cable contain longer lengths than those layers close to the axis of the optical cable.

The OLTS testing shall be undertaken after all of the OTDR testing has been completed and when the patch panel has been finally secured in the cabinet

Two sets of acceptance tests are to be conducted. Pre-termination tests cover the testing of cable on the drum and the laid cable before termination. Tests prior to termination cover the acceptance of the laid cable after termination.

2.33 Pre-Termination tests – (Bare cable test)

These tests shall be performed before termination; their purpose is to ensure the cable is suitable for termination. All optical cables shall be physically inspected by the supplier Project Manager on the drum and the manufacturing batch number and certificate of conformance recorded.

For Single Mode Cables the cable shall be OTDR tested on the drum, at 1310nm by the Installing Contractors 15% of the cores shall be randomly tested. ***For Multimode Cables the cable shall be tested on the drum at 850 and 1310nm.***A suitable ferrule with snap connector shall be used to terminate the core to be tested.

Any drum of cable that indicates an adverse attenuation or fault characteristic (incorrect reeling, over sheathing fault etc.) shall be marked as unusable and not installed.

The Installing Contractor shall immediately inform the relevant LHR representative of any case of non-compliance between the test data and the certificate of conformance and shall not install that particular batch of cable. The LHR representative shall invite the cable manufacturer's representative to the site to repeat the test(s).

The reason for the failure may be due to the incorrect reeling of the cable on the drum. If this is proven to be the case the manufacturer's representative shall remove the drum from site.

Results shall be presented in a standard OTDR hard copy trace format that is to the maximum scale and an electronic format suitable for direct entry into the Celsius cable management system.

All of the test results shall be handed over to the relevant LHR representative. On passing the drum test the cable is suitable for installation and can be pulled into the buildings.

2.34 Tests prior to termination (Laid Cable Acceptance Tests)

After installation and prior to termination a random 15% of the fibre cores (evenly distributed across the loose tubes) are to be bi-directionally tested by an OTDR at 1310 nm for Single Mode cables ***and 850nm and 1300nm for Multimode cables***:

- Uniformity and Continuity - (breaks in cable)
- Length

If these results are conformant with the expected and predicted values the cable can then be terminated.

A full set of tests shall be undertaken, in accordance with the following schedule after termination.

The purpose of these tests is to ensure correct cable installation and conformance with specification and it has been pulled around and between the buildings correctly without the fibres being broken or the cable being bent through too tight a bend radius.

The OTDR trace must be examined. There shall be no lengths of the cable that display adverse extrinsic attenuation events. Such events are observed as sharp transient spikes or steps in the OTDR trace. These events indicate that the cable has been incorrectly pulled in and the fibre has either broken or been bent beyond the permitted bend radius. If such events are observed the cable run shall be reinstalled.

In the case of concatenated links the overall loss budget shall be calculated. (Appendix 1)

The attenuation shall be measured between the end of the launch pulse to the start of the Fresnel end reflection. The overall measured attenuation of the cable must be less than the planned optical power budget.

2.35 Uniformity and Continuity

The measured length of the total link, as displayed by the OTDR, shall be recorded. Optical fibre length results shall be compliant with quoted or predicted values. Bi-directional measurements shall produce identical lengths for a given optical fibre under test

2.36 Tests Post Termination (Final tests)

After installation and termination, final attenuation measurements of the link shall be made by the use of a suitably calibrated OLTS operating at the correct wavelength, every core which has no predetermined transmission direction, shall be measured bi-directionally.

Cleaning of all test equipment will be done prior to the commencement of testing. The cleaning materials used shall be those approved by TE CONNECTIVITY Technologies and the test equipment manufacturer. The cleanliness of the launch lead could affect the desired result.

The purpose of these final tests is to ensure conformance with specification for the LHR representative Production sign-off and to qualify for the TE CONNECTIVITY Technologies 28 year Application Assurance and Product Warranties.

2.37 Physical installation

The optical cable and termination boxes shall be physically audited by the LHR representative and a contractors representative in accordance with the Installed Cabling Audit Report. All cabinets and enclosures shall be physically inspected for their condition regarding optical cable and fibre management, the presence or absence of dust caps on bulkhead connectors, presence or absence of cable strain relief glands.

All tested cables shall be identified with the agreed labelling scheme for each Airport facility/ terminal.

2.38 Splice and Connector Loss – Light Source and Power Meter (OLTS)

The location of any apparent discontinuities shall be consistent with the design of the cable link

True Insertion Loss shall be assessed by taking the average of the two bi-directional measurements, combined assessment may be used as the basis for compliance, and this shall be notified to the LHR representative. The measured True Insertion Loss from each mated connector pair shall be less than -0.30 dB.

The measured True Insertion Loss from each fusion splice / bulkhead connector pair shall be less than -0.3 dB (Typically splice losses should be in the order of <0.1dB).

Light source and power meter combinations (OLTS) are used to undertake optical loss measurements and are used in association with launch and tail leads. Power measurements are made with a launch lead directly connected between the light source and the power meter, representing the reference measurement. This result shall be recorded. Launch and tail leads shall be made of the same optical fibre type as those to be tested typical lengths for the OLTS launch and tail leads shall be a 5 metre patch cord of the same optical fibre to be tested. A single lead or double lead method may be use. When measuring attenuation it may be necessary to apply a correction as a function of the wavelength. The correction factor used shall be recorded.

The total optical loss of the link (combined bulkhead connector, mated connector and cable attenuation loss) and optical power budget shall be such as to guarantee communications integrity.

The LHR representative shall prove by reference to the relevant test data and the look up table in Appendix 1 that the planned optical loss budget for the link length is sufficient for current and future intended.

2.39 Link

The backbone link shall be tested in both directions at both operating wavelengths to account for attenuation associated with the wavelength. For Multi-Mode cables these wavelengths shall be 850nm and 1300nm.

To ensure support of Gigabit Ethernet the cabling shall be tested with test equipment based on Category 2 (Coupled Power Ratio) laser light sources (under filled launch conditions). Category 1 (LED Sources) typically yield unacceptable high attenuation results.

Each optical fibre link terminated with an optical adapter that does not impose a transmission direction should be tested bi-directionally, as the direction of the signal transmission cannot be predicted at the time of the installation.

None of the measurements made are absolute, as they are valid for the particular test leads used. The test leads must be kept by the LHR representative in a manner that safeguards them from damage. Any test leads used shall be handed over by the supplier to LHR representative at the end of testing, as these baseline the testing that has been undertaken.

An OLTS is normally battery operated. The light source and also the power meter accuracy shall decrease as the battery runs down. A reference measurement shall be made by connecting the Light

Source and the Power Meter directly via a patch cord (>3m), this reference measurement shall be recorded. The reference measurement shall be re-established after every patch panel has been tested and if a greater than 0.3dB drift is noted in the reference measurement, the battery or batteries should be replaced. The reference measurement shall then be re- established and testing restarted.

2.40 Channel Testing

As backbone cable length and the number of splices and patch cords in a channel vary, end to end channel test shall be carried out. All testing shall be carried out bi-directionally and Channels based on paired optical fibre cores in multi-fibre cables shall be tested to verify polarity. Insertion loss measurements and length shall be recorded and verified against (2, 3 & 4).

2.41 Launch Leads - Light and Power Meter

Test leads (launch and tail leads) used in OLTS combinations should conform to the following:

The geometry and overall specification of the optical fibre within the launch lead should be compatible with that of the optical fibre to be tested.

The test leads should also be terminated with connectors of the same design, style and manufacture as used upon the fibre optic span to be tested.

The lead should be of a length that produces equilibrium launch conditions and an equilibrium modal distribution at the point of connection to the optical fibre under test. This ensures that the transmission modes within the optical fibre are fully populated with an absence of cladding modes.

Testing of multi-mode optical fibre using LED based equipment uses launch leads that have typical equilibrium launch lengths of 10 metres.

2.42 Acceptance and Witness Testing.

To calculate the optical loss of an end to end optical cable link (the Channel configuration), it is best to draw the diagram of the link and then ascribe the maximum allowed loss for each item, a summation of each items loss is then made. The result of the summation is the total loss allowed for the Channel.

Full Channel configurations shall be witness tested by LHR for all Channels commissioned; this testing shall be undertaken uni-directionally (in the direction of the transmitting Channel)

NB The standards differ in their allowable Channel Attenuation characteristic with ISO 11801 (2002) (7) and BS EN50173 (3) specifying 3.5dB total loss for a fibre channel. However table E.3 specified in EN50173-1 2002 (2) for the following LAN Standards specifies the following:

Network Application	Single Mode Fibre Max Channel Attenuation @1310nm (dB)	EN50173 Channel Supported on
ISO/IEC 8802-3 1000 BASE LX	4.56	OS1 Optical Fibre OF2000
See Note		
IEEE 802.3 10G BASE LR/LW	6.20	OS1 Optical Fibre OF2000
See Note		

Note the Channel Length on single mode optical fibre may be longer but lies outside the scope of EN-50173-1:2002, for a bandwidth limited application for the Channel Lengths shown the use of lower attenuation components to achieve Channel Length values exceeding those stipulated in EN-50173 is not recommended.

Note 2 From FIA (Fibre Optics Industry Association – FIA-TSD-2000-1-1 LAN Application Support Guide Issue 3.01 November 2003 (9), the maximum Optical Power Budget and Channel Length for all Single Mode LAN applications are given as:

Wavelength (nm)	Mb/s	Application	Optical Power Budget	Maximum Channel Length
1310	1000	IEEE 802.3 1000 BASE LX	4.57	5000

3. Essential Tools

3.1 New Build Primary Communications Room Data Sheet:

doc. number:		lead author:	
Version:	**1.0**	approved by:	
status:	**Released**	date:	
purpose:	**for Approval**		

0.0	**FACILITY**	
0.1	Facility	HAL Primary Computer Room
0.2	Function	To act as the main distribution, switching and processing point for IT systems and services.
0.3	Location	
0.4	Code Reference	HAL PCR
0.5	Area m^2	190 m^2
0.6	Dimensions (internal)	Footprint TBC, Min. Headroom 3.5m
0.7	Occupancy	4 frequent intermittent.
0.8	Security	High – Permit to work obtained from HAL IT
1.0	**ELEMENTS**	
1.1	Floor Type	Raised – min. 800mm clear
1.2	Floor Loading	High – Uniformly distributed > 12.0 kn\m^2
1.3	Walls	Sealed and Dust proof finish
1.4	Ceiling	False ceiling not required.
1.5	Windows / Glazing	None
1.6	Apertures	Numbers and Sizes to be determined during detailed design.
1.7	Doors	Min of 2 No. 2 leaf, high security, self-closing.
1.8	Other	
1.9	Signage	Emergency Exit signage likely in the larger rooms.
2.0	**FITTINGS / SPECIAL**	
2.1	Furniture	To be advised by HAL IT
2.2	Special Requirements	
2.3	Special Agreements	
2.4	Facilities for the Disabled	Not required
3.0	**MECHANICAL SERVICES**	
3.1	Acoustic Requirements	To be defined
3.2	Air Conditioning	(Total sensible) 500 W/m^2
3.3	Temperature ^OC	18°C to 24 °C (max change 3°C per hour)
3.4	Humidity RH%	30 – 70 % (max change 10% rh per hour)
3.5	Air Changes	Min. fresh air rate to meet statutory and pressurisation requirements.
3.6	Pressure	Positive pressurisation required
3.6	Noise Level NC	NR. 65
3.7	Emergency Actuation Devices	None to be provided except for large plant and unless statutory requirement.
4.0	**PUBLIC HEALTH & DOMESTIC SERVICES**	
4.1	Cold Water	None
4.2	Hot Water	None
4.3	Drinking Water	None
4.4	Gas	None
4.5	Soil	None
4.6	Other	None

5.0	**LIGHTING**	
5.1	Level	Maintained illuminance - 500 lux (vertical on cabinets)
5.2	Fittings	CIBSE Category 2 luminares
5.3	Switching	Manual switching
5.4	Emergency	Yes
5.5	Signs	Yes
5.6	Other	
6.0	**POWER**	
6.1	Single Phase 13 amp	n/a
6.2	Single Phase 32 amp	Cabinet supplies via 2 No. dedicated PDUs each fed from different sub-station or Transformers within the same sub station
6.3	Three Phase	To be confirmed for IT. (Mechanical plant circuits not from IT PDUs)
6.4	Emergency	None
6.5	UPS	Yes
6.6	Other	Power requirement 500W/m^2
6.7	Distribution Concept	Power distributed at high level to equipment cabinets or within raised floor.
7.0	**COMMUNICATIONS**	
7.1	Fixed Voice Services (e.g. telephone or intercom)	Yes
7.2	Fixed Data Services (e.g. Printer, PC, modem)	Yes
7.3	Public Address / Voice Alarm	Yes
7.4	CCTV	No
7.5	TV	No
7.6	Alarm System / Intruder Detection / panic alarm	Yes
7.7	Master Clock System	No
7.9	Security System / Access Control	Yes
7.10	Radio Systems	Coverage required
7.11	Airport Information (incldg. Flight Information Display	No
7.12	Other	
8.0	**SERVICES GENERAL**	
8.1	Landlord's Services Requiring Access	
9.0	**FIRE REQUIREMENTS**	
9.1	Detection	Yes – Early Detection Type.
9.2	Fire Alarm	Yes
9.3	Smoke Extraction	Yes – if required by Fire authorities.
9.4	Suppression	Yes – water suppression, system to be confirmed by Building Team
9.5	Sprinkler & Hose reel	No unless required to satisfy insurance company or for property protection.
9.6	Compartmentation	2 hour.
9.7	HMRI Requirements	N/A
9.8	Section 12 Requirements	N/A
10.0	**HEALTH & SAFETY**	***Consider Hazards Associated with the room & its contents (e.g.):*** *ACCESS TO FACILITIES, PRESENCE OF CONFINED SPACES, USE OF SUBSTANCES, REMOVAL & REPAIR OF PLANT, HAZARDS IN ADJACENT ROOMS, NOISE, PRESENCE OF VOIDS (IN SLABS ETC).*
10.1	Installation Hazards (Construction Phase)	
10.2	Cleaning & Maintenance Hazards (Operational Phase)	

3.2 New Build Secondary Communications Room Data Sheet: (SCR)

doc. number:		lead author:	
version:	**1.0**	approved by:	
status:	**Released**	date:	
purpose:	**for Approval**		

0.0	**FACILITY**	
0.1	Facility	Secondary Computer Room (SCR)
0.2	Function	To act as a local network distribution and cable termination point to serve floor areas and facilities.
0.3	Location	To be advised
0.4	Code Reference	SCR.
0.5	Area m^2	27 m^2
0.6	Dimensions	3m x 9m, min. headroom 3.5m
0.7	Occupancy	2 (for maintenance only.) Low and occasional occupancy
0.8	Security	High – Permit to work obtained from HAL IT
1.0	**ELEMENTS**	
1.1	Floor Type	Raised – min. 450mm clear
1.2	Floor Loading	Medium – Uniformly distributed > 8.0 kn\m^2
1.3	Walls	Sealed and Dust proof finish
1.4	Ceiling	False ceiling not required.
1.5	Windows / Glazing	None
1.6	Apertures	Numbers and sizes to be determined during detailed design.
1.7	Doors	1 No.2 leaf, high security self-closing. Door located in corner of room.
1.8	Other	
1.9	Signage	Emergency Exit signage likely in the larger rooms.
2.0	**FITTINGS / SPECIAL**	
2.1	Furniture	None
2.2	Special Requirements	
2.3	Special Agreements	
2.4	Facilities for the Disabled	Not required
3.0	**MECHANICAL SERVICES**	
3.1	Acoustic Requirements	To be defined.
3.2	Air Conditioning	300 W/m^2 (total sensible) – Min. of 2 units required each capable of 100% total cooling duty.
3.3	Temperature ^OC	18°C to 24 °C (max change 3°C per hour)
3.4	Humidity RH%	30 – 70 % (max change 10 %rh per hour)
3.5	Fresh Air	Min. fresh air rate to meet statutory and pressurisation requirements.
3.6	Pressure	Positive pressurisation required.
3.7	Noise Level NC	NR. 65
3.8	Emergency Actuation Devices	If statutory requirement.
4.0	**PUBLIC HEALTH & DOMESTIC SERVICES**	
4.1	Cold Water	None
4.2	Hot Water	None
4.3	Drinking Water	None
4.4	Gas	None
4.5	Soil	None
4.6	Other	None

5.0	**LIGHTING**	
5.1	Level	Maintained illuminance - 500 lux (vertical on cabinets)
5.2	Fittings	CIBSE Category 3 luminaires
5.3	Switching	Manual switching
5.4	Emergency	Yes
5.5	Signs	As required by HAL Standards.
5.6	Other	
6.0	**POWER**	
6.1	Single Phase 13 amp	n\a
6.2	Single Phase 32 amp	Cabinet supplies via 2 No. dedicated PDUs each fed from different sub-station or Transformers within the same substation (Commando)
6.3	Three Phase	None required for IT. Mechanical plant circuits not to be fed from IT PDUs.
6.4	Emergency	None.
6.5	UPS	Local where required and installed within owner's equipment cabinet
6.6	Other	Power requirement 300W/m^2
6.7	Distribution Concept	Power distributed in raised floor or from high level to equipment cabinets.
7.0	**COMMUNICATIONS**	
7.1	Fixed Voice Services (e.g. telephone or intercom)	Yes – for internal extension.
7.2	Fixed Data Services	Yes- for Printer, modem, laptop
7.3	Public Address / Voice Alarm	Yes – for annunciation.
7.4	CCTV	No
7.5	TV	No
7.6	Alarm System / Intruder Detection / panic alarm	No
7.7	Master Clock System	No
7.8	Security System / Access Control	Yes
7.9	Radio Systems	Yes
7.10	Airport Information (incldg. Flight Information Display	No
7.11	Other	No
8.0	**SERVICES GENERAL**	
8.1	Landlord's Services Requiring Access	
9.0	**FIRE REQUIREMENTS**	
9.1	Detection	Yes
9.2	Fire Alarm	Yes
9.3	Smoke Extraction	Yes
9.4	Automatic Suppression	No
9.5	Manual Suppression	Yes (Portable extinguishers required in the room).
9.6	Sprinkler & Hose reel	No unless required to satisfy insurance company or building protection.
9.7	Compartmentation	1/2 hour depending on location.
9.8	HMRI Requirements	N/A
9.9	Section 12 Requirements	N/A
10.0	**HEALTH & SAFETY**	***Consider Hazards Associated with the room & its contents (e.g.):*** *ACCESS TO FACILITIES, PRESENCE OF CONFINED SPACES, USE OF SUBSTANCES, REMOVAL & REPAIR OF PLANT, HAZARDS IN ADJACENT ROOMS, NOISE, PRESENCE OF VOIDS (IN SLABS ETC).*
10.1	Installation Hazards (Construction Phase)	
10.2	Cleaning & Maintenance Hazards (Operational Phase)	

3.3 New Build Edge Communications Room Data Sheet:

doc. number:		lead author:	
version:	**0.1**	approved by:	
status:	**Released**	date:	
purpose:	**for Approval**		

0.0	**FACILITY**	
0.1	Facility	Edge Computer Room (ECR)
0.2	Function	To act as a local network distribution and cable termination point to serve small floor areas and facilities.
0.3	Location	To be advised
0.4	Code Reference	To be developed.
0.5	Area m^2	9 m^2
0.6	Dimensions	3m x 3m, min. headroom 3.5m
0.7	Occupancy	2 (for maintenance only.) Low and occasional occupancy
0.8	Security	High – Permit to work obtained from HAL IT
1.0	**ELEMENTS**	
1.1	Floor Type	No false floor required.
1.2	Floor Loading	Medium – Uniformly distributed > 8.0 kn\m^2
1.3	Walls	Sealed and Dust proof finish
1.4	Ceiling	False ceiling not required.
1.5	Windows / Glazing	None
1.6	Apertures	Numbers and sizes to be determined during detailed design.
1.7	Doors	1 No.2 leaf, high security self-closing. Door located in corner of room.
1.8	Other	
1.9	Signage	
2.0	**FITTINGS / SPECIAL**	
2.1	Furniture	None
2.2	Special Requirements	
2.3	Special Agreements	
2.4	Facilities for the Disabled	Not required
3.0	**MECHANICAL SERVICES**	
3.1	Acoustic Requirements	None.
3.2	Air Conditioning	Local AC (if any)
3.3	Temperature ^{O}C	18°C to 24 °C (max change 3°C per hour)
3.4	Humidity RH%	30 – 70 % (max change 10 %rh per hour)
3.5	Fresh Air	Min. fresh air rate to meet statutory and pressurisation requirements.
3.6	Pressure	No pressurisation required.
3.7	Noise Level NC	None
3.8	Emergency Actuation Devices	If statutory requirement.
4.0	**PUBLIC HEALTH & DOMESTIC SERVICES**	
4.1	Cold Water	None
4.2	Hot Water	None
4.3	Drinking Water	None
4.4	Gas	None
4.5	Soil	None
4.6	Other	None

5.0	**LIGHTING**	
5.1	Level	Maintained illuminance - 500 lux (vertical between cabinets)
5.2	Fittings	CIBSE Category 3 luminaires
5.3	Switching	Manual switching
5.4	Emergency	Yes
5.5	Signs	As required by HAL Standards.
5.6	Other	
6.0	**POWER**	
6.1	Single Phase 13 amp	n\a
6.2	Single Phase 32 amp	Cabinet supplies via 2 No. dedicated PDUs (Commando)
6.3	Three Phase	None required for IT. Mechanical plant circuits not to be fed from IT PDUs.
6.4	Emergency	None.
6.5	UPS	Local where required and installed within owner's equipment cabinet
6.6	Other	Power requirement 300W/m^2
6.7	Distribution Concept	Power distributed in raised floor or from high level to equipment cabinets.
7.0	**COMMUNICATIONS**	
7.1	Fixed Voice Services (e.g. telephone or intercom)	Yes – for internal extension.
7.2	Fixed Data Services	Yes- for laptop
7.3	Public Address / Voice Alarm	No
7.4	CCTV	No
7.5	TV	No
7.6	Alarm System / Intruder Detection / panic alarm	No
7.7	Master Clock System	No
7.8	Security System / Access Control	Yes
7.9	Radio Systems	No
7.10	Airport Information (incldg. Flight Information Display	No
7.11	Other	No
8.0	**SERVICES GENERAL**	
8.1	Landlord's Services Requiring Access	
9.0	**FIRE REQUIREMENTS**	
9.1	Detection	Yes
9.2	Fire Alarm	Yes
9.3	Smoke Extraction	Yes
9.4	Automatic Suppression	No
9.5	Manual Suppression	Yes (Portable extinguishers required in the room).
9.6	Sprinkler & Hose reel	No unless required to satisfy insurance company or building protection.
9.7	Compartmentation	1-2 hour depending on location.
9.8	HMRI Requirements	N/A
9.9	Section 12 Requirements	N/A
10.0	**HEALTH & SAFETY**	***Consider Hazards Associated with the room & its contents (e.g.):*** *ACCESS TO FACILITIES, PRESENCE OF CONFINED SPACES, USE OF SUBSTANCES, REMOVAL & REPAIR OF PLANT, HAZARDS IN ADJACENT ROOMS, NOISE, PRESENCE OF VOIDS (IN SLABS ETC).*
10.1	Installation Hazards (Construction Phase)	
10.2	Cleaning & Maintenance Hazards (Operational Phase)	

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Appendix A Worked Example – Look up Table.

To calculate the total allowed attenuation, the individual loss components are added together. The loss shall be dependent on the wavelength of light used, as the refractive index of a material varies with the wavelength of the incident radiation.

Typical Loss Budget

A simple look up table for the Channel and link length being tested should therefore be constructed for the witness testing.

Wavelength nm	Cable Attenuation - dB	Cable Length (Km)	Attenuation - Length dB/Km	Number Mated Connector Pairs	Connector Pairs Total Loss-dB	Connector Deviation (Total) dB	Number of Splices	Splice Attenuation (Total - Worse Case 0.3dB)	Maximum Permissable loss
1310	0.35	0.50	0.175	1	0.35	0.05	2	0.60	1.175
1310	0.35	1.00	0.350	1	0.35	0.05	2	0.60	1.350
1310	0.35	1.50	0.525	1	0.35	0.05	2	0.60	1.525
1310	0.35	2.00	0.700	3	1.05	0.05	2	0.60	2.400
1310	0.35	2.50	0.875	5	1.75	0.05	4	0.60	3.275
1310	0.35	3.00	1.050	1	0.35	0.05	2	0.60	2.050
1310	0.35	4.00	1.400	3	1.05	0.05	4	1.20	3.700

Notes - Worse case splice losses have only been allowed for typical splice losses will be <0.1dB. Assumed a total of 2 splices. Assumed 2 mated connector pairs with loss of 0.3dB each and a deviation loss for each connector of 0.05dB these losses are due to manufacturing tolerances.

Appendix B Negative loss readings - DTX Fibre Modules.

New to DTX 1.3 (**Current Version is 2.24**), at the end of the Fibre Autotest, if there is a negative loss of more than -0.09 dB, a warning will be given. "How can I get a negative loss? Isn't that a gainer?" The principle causes of negative loss readings are:

1. Poor quality reference leads
2. Incorrect test reference method
3. Not allowing the source to stabilize
4. Reality

The following articles include a step to verify your Test Reference Cords.

- ANSI/TIA-568-C testing LC to LC Duplex Multimode
- ANSI/TIA-568-C testing LC to LC Duplex Singlemode
- ANSI/TIA-568-C testing SC to SC Duplex Multimode
- ANSI/TIA-568-C testing SC to SC Duplex Singlemode
- ANSI/TIA-568-C testing SC/APC to SC/APC Duplex Singlemode
- ANSI/TIA-568-C testing ST to ST Duplex Multimode
- ANSI/TIA-568-C testing ST to ST Duplex Singlemode

- ANSI/TIA-568-C testing LC to LC Duplex Multimode
- ANSI/TIA-568-C testing LC to LC Duplex Singlemode
- ANSI/TIA-568-C testing SC to SC Duplex Multimode
- ANSI/TIA-568-C testing SC to SC Duplex Singlemode
- ANSI/TIA-568-C testing SC/APC to SC/APC Duplex Singlemode
- ANSI/TIA-568-C testing ST to ST Duplex Multimode
- ANSI/TIA-568-C testing ST to ST Duplex Singlemode

Poor quality reference leads

When you purchase patch cords, you will normally see a loss value enclosed with the patch cord. The generic standard for a mated fibre connection is better than 0.75 dB. Most patch cord vendors will achieve a mated loss better than this. What you may not know is that there is a standard for a reference mated connection. In IEC 14763-3, a mated reference connection is defined as being better than 0.1 dB for multimode and 0.2 dB for singlemode. It is possible with the DTX CableAnalyzer to verify the performance of your reference leads.

Incorrect test reference method

For testing in the local area network, use Method B. If you have the DTX-xFM without the interchangeable adapters, you can do a true Method B with an SC installation only. If your cabling system contains LC connectors for example, then Adapted Method B should be used to produce equivalent results. Both methods are highly dependent on the quality of your reference leads.

Not allowing the source to stabilize

When you set a reference, the CableAnalyzer will store the received power from the output. For example, with a DTX-SFM the receive power may be -6.50 dBm. With your reference leads still in place, running an AUTOTEST should yield 0.00 dB. But, let's assume that the source was not allowed to stabilize (warm up). When the source warms up, the output power of the source will increase. Taking the previous example here, the receive power increased to -6.70 dBm. Running the AUTOTEST again would yield a negative loss of -0.20 dB. How long should it take for the source to stabilize? This will depend on where it was stored and the ambient temperature you are testing at. It can be as little as 5 minutes and as long as 30 minutes if the instrument was stored in a very cold place. Checking to see of the source has stabilized is easy. After setting the reference, run an AUTOTEST. It is not uncommon to see anything from -0.04 dB to 0.04 dB. But, if you see it drifting more than this, keep repeating the AUTOTEST until a stable value is observed.

Reality

This may seem a strange sub heading, but the reality is when testing singlemode links less than 100 m (328 ft.) with factory polished pigtails, which have been fusion spliced onto the fibre, your loss may be as little as 0.15 dB. The slightest drift in the source or a less than perfect reference could result in this link being -0.10 dB for example. In this case, you may not need to reset your reference and retest all the links. However, if you start seeing an increase in the negative loss reading value, you should stop and verify the reference leads again.

Appendix C Additions & Omissions from previous version

Additions

Page 15

When the horizontal cabling runs back to a HAL IT room that utilizes switch looms as part of the link, the total length of the link including (switch looms & patch cords) **must not** exceed 100 meters.

2.3.1 Balanced twisted pair cabling

Only TE CONNECTIVITY installation will receive full acceptance into operational support by LHR. Only products labelled Truenet (ADCKrone /TE) should be utilised & not products labelled TE Amp.

2.3.3.3 Characteristics

Sufficient slack must be left on the UTP cabling to allow the box to be removed from its current position to allow maintenance works to be carried out

2.3.4.1 Optical connectors and assemblies

A critchly label must be connect to all flexible conduit tubes, at the entry point on the rear of the ODF / ODP detailing the cable ID & the fibers cores installed in the tubes

2.3.5 Voice copper cabling

The following section details the methods, principles, installation, construction and testing for the copper voice cabling infrastructure used by Heathrow IT. When carryout jumpering for analogue voice services, the following colour jumper wire must be used.

- VG224 – blue & yellow.
- Command & control – red & white

2.3.5.3 General

Voice services should no longer be presented at the outlet position onto a LJU connection or over CW1308 to the customer location. Multi-pair CW1308 should only be used for the connection between the network cabinet / entrance facilities and the distribution voice frames located in the DSCR's or the main voice frame locations for the older terminals\buildings

2.4.1.1 Horizontal Cable Management

All horizontal cable management panels shall be a minimum of **170mm** deep with minimum 4 No. rings manufactured of metal and finished in black. The rings shall be the full 1U or 2U high and sufficiently sturdy to support the weight of the patch cords without deformation of the rings or cords. The minimum requirement is:

2.4.1.5 Switch Harnesses

When a network device is installed into a Cat6 environment that has more than 12 copper connections, a specially designed support bracket must be installed under the device, with the cables secured to it by Velcro ties. This is to ensure the correct bend radius is maintained on the patch and to reduce any excess strain that may be placed on the device connection from having to support the weight of the cables

2.3.1 Balanced twisted pair cabling

Where the outlet is to be presented at height, it must be installed at the lowest point possible. This is to enable ease of maintainability and support. **For example;** if a FIDS screen that is hanging from the ceiling, the outlet would be installed at the bottom section of the FIDS screen housing and ensuring that it can still be accessed without having to fully remove the screen, or it could be secured to the back of the housing. It should not be installed above the FIDS screens mounting poll in the ceiling. The outlets should be installed in a manner that the outlet numbers can be easily read

2.3.3.1 General

The horizontal connections to a multiple TO or CL distribution box must be run in a suitable mechanical protection t. This is to protect the horizontal cables. This maniacal protection must run from just below the floor lever or containment all the way up to the T0/ CL distribution box

2.3.4 Fibre optic cabling

When terminating multi core fibre, the multimode must be presented first followed by the single mode cores. If any core is not to be terminated, then it must be left coiled in the fibre presentation device and space left for it to be terminated at a later date if required in the correct position. Unused cores are not to be cut off.

2.4.3.2 Fibre Patching

When patching the fibre uplinks between the distribution device and access device the following must be followed. The connections back to the D1 distribution device must be installed into the first fibre uplink port of the switch (SFP port on the switch) and the D2 link should be installed in to the second fibre port on the switch. On a set of stacked switches the first fibre port on the second switch will be used for the D2 uplink

2.10.2 Floor Cabinet Installation

All cabinets installed in HAL IT rooms that are to contain 3rd party equipment must be fitted with a Prism combination lock to both the front & rear doors.

All cabinet elevations drawings will be required to be produced once a new piece of work has been carried out and to confirm what space is left in the cabinets. To be completed via the Celsius Engagement CRQ

2.10.4 Wall mounted

The wall mounted cabinet should not be mounted above 3mts to the bottom of the cabinet & **never** installed in a suspended ceiling void

Omissions

Category 6 - Surface Mount Boxes

To be used under a shallow raised floor where the space is limited. These must be approved by the LHR reprehensive prior to installation. **Only to be used as a temporary solution.**

- **Product Description:** Surface Mount, Category 6 KM8 UTP, 2 Port
- **Product Number:** 6690 1 603-00
- **Application:** Work Area
- **Dimensions:** 64x26x66 (mm)