

University of Oxford IT Services Infrastructure Specification Project

ISP-03-002: Direct-connect cabling - Recommendations: Telecommunications infrastructure

1 INTRODUCTION

1.1 Scope

This document specifies the recommended design features of the direct-connect distribution cabling used to deliver University of Oxford IT Services to LJUs in customers' premises. This document uses the definitions and abbreviations of clause 1.3 of ISP-00-001.

NOTE: any IT services equipment, e.g. consoles, that can be damaged or caused to malfunction (including the "blowing" of fuses) shall be directly-connected to the BDF.

An overarching objective of this series of documents is to ensure that University of Oxford IT Services, the customer (defined as the college or University, as appropriate) together with those organisations delegated with design and planning responsibilities have discharged the obligations of "the owner of the premises" as specified in BS 6701 and by the other standards referenced normatively from BS 6701; specifically but not exclusively BS 7671, BS EN 50174-1, BS EN 50174-2 and BS EN 50310.

1.2 Applicable external standards

Failure of the customer to install, operate and maintain direct-connect distribution cabling in accordance with the requirements of BS 6701 may result in withdrawal of service support by University of Oxford IT Services. Some critical elements of BS 6701 and its referenced standards are included in this document but customers are strongly advised to be aware of the full requirements of the standard.

2 ELEMENTS OF DIRECT-CONNECT CABLING

As shown in Figure 1, direct-connect cabling comprises:

- distribution cables;
- distribution panels;
- LJU cables;
- LJUs.

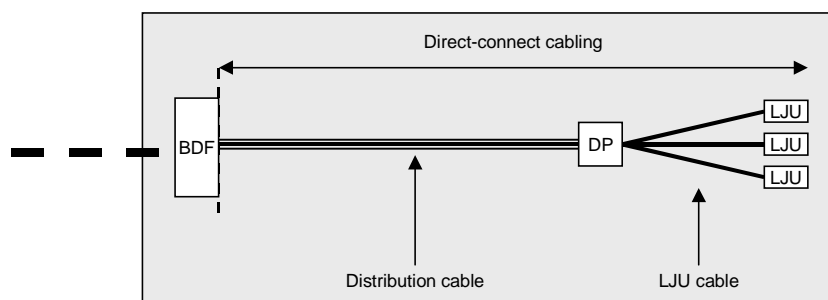


Figure 1 - Schematic of direct-connect distribution cabling

3 DESIGN SENSITIVITIES

It is assumed that the number of directly-connected will increase by 25 % over the initial planned quantity. The components used need to reflect this potential growth.

Direct-connect cabling is allocated on a one-pair per line basis. The allocated number of LJUs connected to a given distribution panel is assumed to be 25 % above the initial planned quantity. As a result the capacity of the distribution panels and the distribution cables should take this growth into account. In addition the connection of the distribution cables to the BDF shall also consider any such expansion and leave an appropriate number BDF pair locations unterminated.

4 THE SPECIFICATION OF DIRECT-CONNECT CABLING

4.1 Distribution panel

Distribution panels should be selected from the series of products also used for BDF closures detailed in ISP-01-001. All equipment should utilise standard Insulation Displacement Connection (IDC) technology, typically Krone LSA PLUS connectors.

4.2 Distribution cable

4.2.1 Mechanical and electrical performance

The cables should be in accordance with BT specification CW1308 which features the following:

- internal grade construction;
- insulated 0,5 mm diameter conductors in pairs;
- outer sheath colour: white.

A functional earth conductor (1.38 mm diameter) is optional as it is not terminated at either end.

The physical characteristics may be selected from the following:

- 10 pairs;
- 20 pairs;
- 25 pairs;
- 50 pairs;
- 100 pairs.

Such cables are available from a wide range of manufacturer/distributors and no specific part numbers are mandated.

It is possible to use CW1308 complaint cables without a functional earth. In such cases or a separate earth of in accordance with BS 6701 shall be provided. The functional earth conductor shall be connected at the distribution panel and at the BDF.

4.2.2 Fire performance

BS 6701:2016 Amendment 1:2017 requires certain cables inside buildings to meet EuroClass C_{ca}-s1b,d2,a2 of BS EN 13501-6. As a result, cables that do not meet the requirements of BS 6701:2016 Amendment 1:2017 shall not be installed inside buildings and other structures without the express authority of the Network Operations Manager.

4.3 LJU cable

4.3.1 Mechanical and electrical performance

The cables should be in accordance with BT specification CW1308 which features the following:

- internal grade construction containing 4 pairs;
- insulated 0.5 mm diameter conductors in pairs;
- outer sheath colour: white.

A functional earth conductor (1.38 mm diameter) is optional as it is not terminated at either end.

4.3.2 Fire performance

BS 6701:2016 Amendment 1:2017 requires certain cables inside buildings to meet EuroClass C_{ca}-s1b,d2,a2 of BS EN 13501-6. As a result, cables that do not meet the requirements of BS 6701:2016 Amendment 1:2017 shall not be installed inside buildings and other structures without the express authority of the Network Operations Manager.

4.4 LJU

Line Jack Units should be 3/1A Master (see Figure 2) or an agreed equivalent. The termination of the LJUs should be as shown in Table 1.

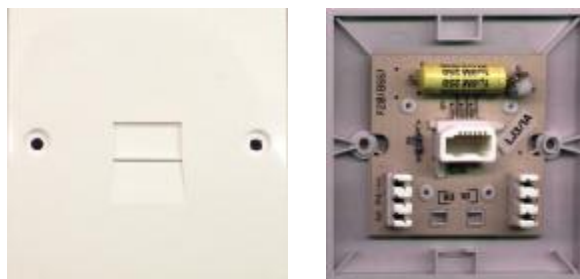


Figure 2 – LJU 3/1A Master

Table 1 - Pin-out of LJU cable at distribution panel and LJU

Blue/White	Pin 2
White/Blue	Pin 5
Orange/White	Not terminated and left spare for future use
White Orange	
Green/White	
White/Green	
Brown/White	
White/Brown	

5 ACCOMMODATION OF THE FUNCTIONAL ELEMENTS

5.1 General

This document specifies the pathways and pathway system(s) accommodating:

- the distribution cables;
- LJU cables.

In addition, this document specifies the accommodation of:

- distribution panels;
- LJUs.

5.2 Accommodation for distribution and LJU cables

5.2.1 Pathways at BDF and distribution panels

The pathway selected shall provide the segregation between intermediate cables and mains power cabling described in 5.2.2 and 5.2.3.

In order to prevent the ingress of contaminants into the closures via the cable gland (if present) pathways shall enter:

- box- or cabinet-based BDFs from below;
- distribution panels from below.

There are no requirements for the pathway routes into frame-based BDFs.

5.2.2 General segregation requirements for distribution and LJU cables and mains power cabling

The segregation of distribution and LJU cables and mains power cabling shall be in accordance with BS 6701 with regard to safety and protection. Segregation in accordance with the requirements of this document will ensure conformance to BS 6701 for mains power cabling of up to 600 VAC.

5.2.3 General segregation requirements for distribution and LJU cables and electromagnetic interference sources

5.2.3.1 General

BS EN 50174-2 contains clear requirements regarding segregation of balanced cables and power supply cables. This document applies the requirements of BS EN 50174-2 in total but provides the sub-clauses 5.2.3.2 and 5.2.3.3 as a simple reference to the basic requirements.

5.2.3.2 Segregation of distribution and LJU cables and power supply cabling

The separation requirement "A" is calculated by multiplying the minimum separation distance "S" obtained from Table 2 by the power cabling factor "P" from Table 3.

Where mains power cables (other than single core cables operating at voltages exceeding AC 600 V) pass through a fire barrier it is possible to reduce the calculated separation requirements of this sub-clause provided that:

- the total distance over which the reduction in the separation occurs is not greater than the thickness of the fire segregation barrier plus 0,5 m on either side;
- the external balanced cables and mains power cables are enclosed in separate metal trunking or conduit;
- national regulations concerning fire barriers are complied with;
- the requirements of BS 7671 are complied with.

Table 2 - Minimum separation distance "S" for external balanced cables

Separation without electromagnetic barrier	Containment applied to information technology or mains power cabling		
	Open metallic containment ^a	Perforated metallic containment ^{b, c}	Solid metallic containment ^d
300 mm	225 mm	150 mm	0 mm
^a Screening performance (0 MHz to 100 MHz) equivalent to welded mesh steel basket of mesh size 50 mm x 100 mm (excluding ladders). This screening performance is also achieved with steel tray (trunking without cover) of less than 1,0 mm wall thickness and/or more than 20 % equally distributed perforated area. ^b Screening performance (0 MHz to 100 MHz) equivalent to steel tray (trunking without cover) of at least 1,0 mm wall thickness and no more than 20 % equally distributed perforated area. This screening performance is also achieved with screened power cables that do not meet the performance defined in footnote d. ^c The upper surface of installed cables shall be at least 10 mm below the top of the barrier. ^d Screening performance (0 MHz to 100 MHz) equivalent to a steel conduit of 1,5 mm wall thickness. Separation specified is in addition to that provided by any divider/barrier. The assumption underlying the material performance of the conduit is that the product of the permeability and conductivity is greater than 38 H•S/m ² . This performance is not provided by stainless steel, aluminium and non-magnetic materials.			

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Table 3 - Power cabling factor

Electrical circuit type ^{a, b, c}	Quantity of circuits	Power cabling factor <i>P</i>
20 A 230 V 1-phase	1 to 3	0,2
	4 to 6	0,4
	7 to 9	0,6
	10 to 12	0,8
	13 to 15	1,0
	16 to 30	2
	31 to 45	3
	46 to 60	4
	61 to 75	5
	> 75	6
^a 3-phase cables shall be treated as 3 off 1-phase cables. ^b More than 20 A shall be treated as multiples of 20 A. ^c Lower voltage AC or DC power supply cables shall be treated based upon the their current ratings, i.e. a 100 A 50 V DC cable = 5 of 20 A cables (<i>P</i> = 0,4).		

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154 **5.2.3.3 Separation of balanced cables and specific electromagnetic interference sources**

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The separation requirements of Table 4 shall be applied where information technology cabling is installed in proximity to the

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Table 4 - Separation requirements for specific EMI sources

Source of disturbance	Minimum distance (mm)
Fluorescent lamps	130
Neon lamps	130
Mercury vapour lamps	130
High-intensity discharge lamps	130
Copiers	400

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160 **5.2.4 Pathway system selection**

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BS EN 50174-1 and BS EN 50174-2 contain clear requirements regarding selection of pathway systems. This document applies the requirements of BS EN 50174-1 and BS EN 50174-2 in total but details the following requirements as a simple reference.

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Pathway systems of the types listed below shall comply with the relevant European standards:

- non-flame propagating conduit systems: BS EN 61386-1 and the relevant part 2 (see Bibliography);
- non-flame propagating trunking and ducting systems: BS EN 50085-1 and the relevant part 2 (see Bibliography);
- non-flame propagating tray and ladder systems: BS EN 61537.

Unless the express authority of the Network Operations Manager has been obtained then pathway systems shall be of a non-flame propagating type as defined the standards listed above.

The dimensions of the pathway systems between a BDF and LJUs shall enable the maximum allocated number of telecommunications cables to be installed;

- on a phased basis without risk of damage to the cables;
- while maintaining the bend radius of the cables.

The following recommendations apply:

- enclosed shapes provide the best electromagnetic protection to the installed cables by reducing the common mode coupling;
- trays with small slots, for easy attachment of cable, parallel to the axis of the tray provide the best electromagnetic protection to the installed cables;
- tray with slots, for easy attachment of cable, perpendicular to the tray axis should not be used.

5.2.5 Pathway system installation

BS EN 50174-2 contains clear requirements regarding installation of pathway systems. This document applies the requirements of BS EN 50174-2 in total but details the following requirements as a simple reference.

Pathway systems shall be installed:

- in accordance with instructions provided by the manufacturer(s)/supplier(s) of the pathway systems;
- to allow installation and removal of the cable without risk of damage to the cable;
- without sharp edges or corners that could damage the cabling installed within or upon them;
- to ensure that water or other contaminant liquids cannot collect.

Where a conducting pathway system is installed, sections shall be bonded to earth in accordance with BS 7671 in order that the pathway system acts as a parallel earthing conductor (PEC).

5.2.6 Cable installation

BS EN 50174-2 contains clear requirements regarding installation of cables. This document applies the requirements of BS EN 50174-2 in total but details the following requirements as a simple reference.

When installing cables, cords or jumpers appropriate techniques shall be applied to:

- eliminate cable stress as caused by:
 - tension in suspended cable runs;
 - tightly cinched cable bundles;
- ensure that minimum bend radii are never less than those specified in the product standard (rollers or other devices shall be used to avoid damage);
- ensure that the maximum pulling tensions taken from the cable specifications are not exceeded;
- prevent pressure marks (e.g. through improper fastening or crossovers) on the cable sheath or the cable elements;
- avoid joints other than those in accordance with the installation specification.

When installing cables into cable tray, the bundles created shall be lower than the sidewalls of the tray.

The installation process shall not degrade the intended environmental performance of the pathway/pathway system e.g. water seals and fire barriers shall be re-fitted upon completion of the installation.

Cables that are not terminated in a cabinet, frame or rack should not be routed within the physical boundaries of that cabinet, frame or rack.

Cable ends shall remain sealed during installation to prevent the ingress of water and other contaminants.

5.3 Accommodation for distribution points and LJUs

5.3.1 General

BS EN 50174-1 and BS EN 50174-2 contain clear requirements regarding location and accommodation of termination points and the closures housing those termination points. This document applies the requirements of BS EN 50174-1 and BS EN 50174-2 in total but details the following requirements as a simple reference.

5.3.2 Location

The location of distribution points and LJUs shall allow:

- subsequent measurements, repair, expansion or extension of the installed cabling to be undertaken without risk of injury to personnel;
- adequate clearances for the closure containing the termination point to be installed without damage to cabling components and in accordance with the minimum bend radii (installation and operating);
- be in accordance with national or local regulations.

The location of LJUs should reflect the proposed occupancy of the premises, based upon floor area or upon a specific application requirement but allowing for any foreseeable future variations.

5.3.3 Closures

5.3.3.1 General

Distribution points and LJUs shall provide the necessary levels of physical and climatic protection for the cables and the connecting hardware. The closures or the connecting hardware shall achieve the necessary protection by their location, design features or a combination of both.

The cable entrance to distribution points and LJUs shall:

- maintain the environmental performance of the distribution points or LJU;
- provide the necessary cable support and prevent kinking at the point of entry;
- provide strain relief for the cable if not already done by separate fixtures;
- be capable of accepting suitable glands.

5.3.3.2 Floor-boxes

Where LJUs are housed in floor-boxes, a service loop of 3 m length should be provided to allow the floor-box to be repositioned.

6 ADMINISTRATION SYSTEMS

It is a strategic objective and a normative requirement of BS EN 50174-1 to apply an integrated administration system to the cabling infrastructures of, and supported by, University of Oxford IT Services.

Although it is not necessary to define the specific administration tools in this document, the format of documentation containing the details of the fixed infrastructures is critical to future integration.

The data supplied by installers should allow a full and proper completion of the fields applicable to the cabling sub-system.

ISP-00-001 shows a common format for direct-connect cabling implementations. This type of administration system allows an integrated record keeping system to be implemented as shown in ISP-00-001.

7 OTHER DOCUMENTS IN THIS SERIES

IIS-00-001: Infrastructure Installation Specification Strategy: Overview

IIS-00-002: Infrastructure Installation Specification Strategy: Distributed building services

IIS-01-001: Assessment of balanced cabling test results

IIS-01-002: Installation and acceptance testing of singlemode optical fibre cabling

ISP-00-001: Infrastructure Specification Project: Overview

ISP-00-002: Access to University of Oxford IT Services facilities (later)

ISP-01-001: University of Oxford IT Services Entrance Facilities - Product and design specification

ISP-01-002: University of Oxford IT Services Entrance Facilities - Accommodation requirements

ISP-02-001: University of Oxford IT Services Intermediate cabling (INTI-ENTI) - Product and design specification

283 ISP-02-002: University of Oxford IT Services Intermediate cabling (INTI-ENTI) - Accommodation requirements
284 ISP-03-001: Distribution cabling - Recommendations: Overview
285 ISP-03-003: Distribution cabling - Recommendations: IT infrastructure
286 ISP-03-004: Distribution cabling - Recommendations: Distributed building services infrastructure
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290 **NORMATIVE REFERENCES**

291 The following documents are required to be applied in a normative manner (i.e. mandated) by the users of this document.

292	BS 6701:2016 + Amendment 1:2017	Telecommunications equipment and telecommunications cabling - Specification for installation, operation and maintenance
	BS 7671:2018	Requirements for electrical installations: IEE Wiring Regulations: 18th edition
	BS EN 13501-6	Fire classification of construction products and building elements. Classification using data from reaction to fire tests on electric cables
	BS EN 50174-1:2018	Information technology - Cabling installation - Part 1: Installation specification and quality assurance
	BS EN 50174-2:2018	Information technology - Cabling installation - Part 2: Installation planning and practices inside buildings
	BS EN 60332-1-2	Tests on electric and optical fibre cables under fire conditions. Test for vertical flame propagation for a single insulated wire or cable. Procedure for 1 kW pre-mixed flame

293 **BIBLIOGRAPHY**

296 The following documents are considered useful reference sources for the users of this document.

297	BS EN 50085-1:2005 + Amendment 1:2013	Cable trunking systems and cable ducting systems for electrical installations. General requirements
	BS EN 50085-2-1:2006 + Amendment 1:2011	Cable trunking systems and cable ducting systems for electrical installations. Cable trunking systems and cable ducting systems intended for mounting on walls and ceilings
	BS EN 50085-2-2:2008	Cable trunking systems and cable ducting systems for electrical installations. Particular requirements for cable trunking systems and cable ducting systems intended for mounting underfloor, flushfloor, or onfloor
	BS EN 50085-2-3:2010	Cable trunking and cable ducting systems for electrical installations. Particular requirements for slotted cable trunking systems intended for installation in cabinets
	BS EN 50085-2-4:2009	Cable trunking systems and cable ducting systems for electrical installations. Particular requirements for service poles and service posts
	BS EN 50310:2016	Information technology - Telecommunications bonding networks for buildings and other structures
	BS EN 61386-1:2008	Conduit systems for cable management. General requirements
	BS EN 61386-21:2004 + A11:2010	Conduit systems for cable management. Particular requirements. Rigid conduit systems
	BS EN 61386-22:2004 + A11:2010	Conduit systems for cable management. Particular requirements. Pliable conduit systems.
	BS EN 61386-23:2004 + A11:2010	Conduit systems for cable management. Particular requirements. Flexible conduit systems
	BS EN 61386-24:2010	Conduit systems for cable management. Particular requirements. Conduit systems buried underground
	BS EN 61537:2007	Cable management. Cable tray systems and cable ladder systems

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