Data cabling and communication room standards at Loughborough University
## Revision History

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<tr>
<td>2/4/14</td>
<td>0.1</td>
<td>Jonathan Oakden</td>
<td>Initial Draft</td>
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<td>Jonathan Oakden</td>
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<td>Added FM Ducts information &amp; alternatives to HT cabling</td>
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Introduction

This document is intended to act as guidance for any new build, refurbishment or minor works at Loughborough University that incorporates any networking related element of Information Technology (IT). It is impossible to provide for every situation in such a document, however it should cover most frequently asked questions and related issues expected to arise in such projects.

Adherence to this document should ensure potential problems are minimised and handovers completed in a straightforward and timely fashion.

Deviations from this document will only be allowed by written permission from Loughborough University IT Services Head of Infrastructure and Middleware, IT Services Director or their nominee.
IT Standards Specification

Copper Data Cabling
The internal copper cabling is to be a Category 6a U/FTP installation conforming to ISO/IEC 11801:2002 Generic Cabling for customer premises, and ANSI/TIA/EIA 568-A-5. This covers installation and testing, and the University would expect a minimum warranty of 15 years covering the cable work.

The cable must be low smoke zero halogen sheathed.

The components to be used should be complete Hellerman Tyton (RW Data) cabling systems with associated components. This is our preferred cabling system. Other systems can be used with permission from IT Services but they must be Category 6a compliant.

At least two installations engineers shall have successfully completed the chosen cabling system installation training course. One of these engineers shall be present on site when any works are being undertaken.

All internal cable will radiate from the specified Communications Rooms.

The structured cabling system provided must be based on a star-wired topology, incorporating 258A (T568B) wired, four pair, balanced twisted pair cable running from user patch panels to the work area telecommunication outlets.

The framework of the system must incorporate RW Data industry standard RJ45 plug and socket presentation and IDC cable terminations. Other systems may be used with permission from IT Services.

The cable should be a U/FTP 4 pair, 24AWG 100 Ohm solid copper conductor, to a minimum performance level of Category 6a, as specified in the documents created by TIA TR41.8.1 and ISO/IEC JJC 1/SC 25/WG3.

The cable must be supplied and approved by Hellerman Tyton (RW Data), thus ensuring that a full system guarantee can be issued. This is our preferred cabling system. Other systems can be used with permission from IT Services but they must be Category 6a compliant.

The length of cable from patch panel to room outlet will not exceed 90 metres.

All cables shall be continuous from the user patch panel to the work area telecommunications outlet. Where a cable becomes damaged due to broken conductors or the sheath becomes torn
or cut, the entire cable shall be removed and replaced with a known good one. The practice of 
jointing cables shall not be accepted.

A plastic cable tie will secure the cable to the termination block.

Cables will be secured together in groups of no more than 48 by velcro straps to avoid cable 
damage.

Room Outlets
The data outlets will be Hellerman Tyton (RW Data) unshielded RJ45 presentation and modular 
in design wired to 258A (T568B) presentation. This is our preferred cabling system. Other 
systems can be used with permission from IT Services but they must be Category 6a compliant 
A spring-loaded shutter must cover the entrance to the RJ45 jack.

The outlet printed circuit board (PCB) and the patch panel PCB must utilise PCBs from RW 
Data to ensure complete system compatibility.

Port labelling and identification should be by way of a printed slide label running under a 
protective polycarbonate mask.

Room outlet accessories should match the general electrical installation.

Patch Panels
The Patching Panels must be Hellerman Tyton (RW Data) style panels, managed in groups of 
24 RJ45 ports in each 1U segment. This is our preferred cabling system. Other systems can be 
used with permission from IT Services but they must be Category 6a compliant

Each circuit should be individual modular PCB, wired to 258A (T568B) specification.

Label identification should be by way of a printed slide label running under a protective 
polycarbonate mask.

Cables should enter the patch panel from the side.

Cable Containment
The cable containment system will have usable space (BS EN 50174-1:2000, Section 4.8.2) 
that allows for double the initial quantity of cables.

Labelling
The patch panels will be labelled as follows:
A fibre number to be provided by IT Services
The destination building and room identifier of the far end of the cable

Testing
All test equipment used to characterise the performance of the installation shall be approved by the cabling system manufacturer, prior to system testing.

Prior to system hand-over, a 100% test shall have been conducted on the installed cabling. The testing shall identify any faults due to open circuits, cross or split pairs as well as a series of performance faults.

The testing must satisfy the manufacturers installation guidelines in order to carry the manufacturer backed warranty. In some cases a representative of the manufacturer may be required to witness the testing.

Loughborough University reserves the right to witness some of the testing.

All test results shall be recorded and certification handed to IT Services on completion.

Any cabling failures will require resolution of the fault and retesting before completion.

Fibre Optic Data Cabling
All buildings on campus are normally to be connected to two other identified buildings within the relevant campus park by diverse cable routes.

Fibre optic cables that span parks will follow a duct route to be identified by IT Services.

All buildings require both singlemode OS2 (9/125) and multimode OM3 (50/125) fibre cores. A minimum of eight cores of each type of fibre are required to each connected building.

Fibre routes should be kept separate as far as practically possible both within and without the building as well as within the communications room.

The current campus infrastructure has both traditional multicore fibre as well as blown fibre varying by location. The project must identify with the aid of IT Services what sort of fibre installation will be suitable.

All fibres will be installed in one continuous length without any intermediary joints. Any cable faults found on installation will require replacement of the faulty cable.

Patch Panels
All fibre optic cores are to be terminated in 19" rack mount patch panels.
The fibre bundle will enter the patch panel through a cable gland at the rear of the panel.

The patch panel will be equipped with Duplex LC connectors. The LC connectors will be colour coded such that singlemode connectors are white and multimode connectors are aqua.

**Cable Containment**
The most suitable cable containment method must be indicated before work is undertaken. Normally this would be basket, or tray work for large amounts of cable but pvc may be suitable for small amounts of cable.

Tray work or basket must be initially installed with no more than 75% of the capacity used to allow for expansion in future.

Existing tray work along the cable path can be reused. If the existing containment is full then IT Services should be consulted in order to determine whether or not the exiting containment should be replaced or supplemented.

**Labelling**
All fibre tubes should be labelled at each building entry point with their fibre number and the names of the buildings at each termination point.

**Testing**
Post installation a random selection of cable containment will be visually inspected to ensure that the provided cable containment meets any agreed standards and principles.

**Patch Leads**
All patch leads for the project will be supplied by IT Services. Patch leads from any other supplier will not be used.

The following colour patch leads are in use:
- Grey - ordinary data (PC’s, VoIP etc)
- Yellow - analog telephony (deprecated)
- Green - WiFi AP
- Orange - Xover
- Red - Emergency telephone
- Pink - VoIP ATA’s
- Black - ISDN

Other colours may only be used by approval from IT Services
Ducts and Groundworks

All data ducts should be coloured green and constructed of a non-porous durable material; which should have smooth internal walls. Sections should be jointed to prevent the ingress of foreign material. The minimum duct external diameter should be 110mm unless specified by the Project Manager / Facilities Management Services. Metallic marker tape should be laid and buried with the duct to help with locating the duct in future. Ducts should be cut flush where they enter buildings and access chambers.

All underground ducts should be sealed to prevent the ingress of gases, water or rodents at points of entry to buildings. The sealing material should be of a composition such that it may be easily removed for cable installation purposes and re-instated to form an effective seal. To facilitate the pulling in of additional cables a draw rope, of suitable non-rotting material, should be left and secured within the ducts. To maintain the facility, another draw rope should be pulled in with each new length of cable to replace the original.

All ducts should be laid as per Appendix B

Jointing/Access chambers

To facilitate cabling operations, jointing/access chambers should be built on duct routes where required. These chambers should be constructed from concrete and can withstand the passage of vehicles if this is a potential hazard. Light duty chambers with round lids are unacceptable. If ducts are installed in carriageways, a ‘carriageway inspection pit’ should be installed. A draw-pit should be installed every 30 metres and where there is major change of direction (greater than 45 degrees). All chambers must be a minimum size of 1200 x 600mm (1200 in direction of fibre) with a sump of 500mm below the level of the duct pipes, with soak-away drainage.

Draw-pit design (including lid design) must be agreed with the Project Manager or Director of Facilities Management Services prior to installation to ensure it is adequate for the purpose. Lids will be heavy-duty and secured to prevent access by unauthorised personnel.

All data ducts are to be buried to a depth of 1 metre with marker tape buried above.

Communications Rooms

Cabinet Space

Where more than 1 cabinet is installed in a single comms room the cabinets can be joined together at the side to form a row.

There should always be 1 metre of clear space around each aide of the rack, or row of racks to allow for people and installation/maintenance of equipment. Any protrusions in the room should be deducted from this allowance.

Walls should be painted white or cream for maximum light.
Sufficient lighting must be present in the room to illuminate every side of the racks. If motion detection is used to control the lights the sensor must be able to detect a single person in any position in the room.

**Electrics**

Each cabinet within the comms room shall be provided with two dedicated 16A BS4343/IEC309 outlet. These need to be switched/interlocked type and a suitable plug supplied with each socket installed. Each socket must be on a dedicated radial socket. Also, where these socket outlets are installed beneath raised floors, the socket outlet must be fully accessible once the data cabinet is in place. Exceptions may be made in small installations to use one or more 13A BS1363 outlet instead under agreement with IT Services.

If the room has a raised floor the outlets can be mounted beneath the raised floor. In this instance the electrical outlets must not be mounted under any tiles that can not be lifted.

In the absence of a raised floor the outlets can either be mounted immediately above the rack at a height not exceeding 2500mm or on a nearby wall. If wall mounted it must be possible to feed a suitable cable from the rackmount PDU to this outlet in such a way that the cabinet can still be fully closed and the cable not present a trip hazard.

Each cabinet must be individually connected to earth in accordance with BS7671:12008 and all published amendments.

Each cabinet must be fitted with a suitable 16A input APC switched PDU capable of being managed by ethernet. In a 42U floor standing rack this should be a ZeroU PDU vertically mounted at the rear of the rack with C13 outlets. In a wall mounted rack this should be a 1U PDU mounted horizontally at the front of the rack with C13 outlets. PDU’s from other manufacturers may be considered with permission from IT Services.

**Secure Communications Rooms**

Certain communications rooms on campus have enhanced security requirements depending on their contents or strategic importance.

Where required the additions below must be specified for the location.

Loughborough University IT Services will advise whether or not these considerations will be required.

These locations will not be shared with departmental or tenants equipment.

**Construction**

Masonry walls or studding reinforced with steel mesh

Metal door and frame to insurance standard LPS 1175:
- Internal door with alarm - level 1
- external door with alarm - level 2
- external door with no alarm - level 3
High security lock cylinder of type Mul-t-lock (LU Suite PRS)  
Metal security bars to any windows  
Shelf for visitors log book  

Services  
Cooling appropriate for IT equipment load  
G4S proximity card access with PIN keypad  
Door ajar sounder  
G4S electronic door lock (Abloy 3 point)  
Security alarm (Honeywell Galaxy panel)  
Intruder PIR movement detectors  
Wall mounted trembler alarms  
BOLD alarm interface unit  
CCTV to external view of door + internal to room  
PIR control of lighting  

IT  
IT cabinet with lockable door and side panels  
High security cabinet chains as appropriate  

Cabinet  
The ‘Prism’ range of cabinets are preferred but others may be considered by approval of IT services.  

Floor standing 42U cabinets are much preferred however it is understood that this is not always possible or practical. In such situations a smaller floor standing cabinet is preferred to a wall mounted installation.  

No more than 336 room outlets shall be terminated in a single 42U rack without explicit permission from IT Services.  

The cabinet will have 19” rack mounting strips to both the front and rear.  

The front mounting strip will be recessed at least 150mm from the front door.  

Where more than one cabinet is in any one location, all cabinets shall be connected together side by side using the manufacturers baying kit. All internal sides shall be removed.  

Cable tray/basket will be mounted inside the rack and to the side for the full height of the rack.  

A clearance space in the centre of the rack of 450mm must be maintained to allow fitting of equipment.  

Where a floor standing cabinet is used:
The cabinet must be at least 800mm x 800mm

Where a wall mounted cabinet is used:
The depth of the cabinet must be at least 450mm
The cabinet must either hinge away from the wall for access or allow the side panels to be removed. Removable side panels must be able to be locked.
The cabinet must not be mounted with the top of the cabinet at a point higher than 2.1m above floor height.
## Cabinet Layout

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<td>15</td>
<td>access switch</td>
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<td>cable management bar</td>
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<tr>
<td>42</td>
<td>UTP patch panel</td>
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Data Centres
Data Centres are where data is stored and held in some form rather than a communications room where data is in transit. Broadly speaking if an IT room has a server in it it should be considered a data centre. They have differing requirements and as such have been added to this document as appendix A. Where these requirements are in contradiction to the communications room standards then the data centre requirements must be used.

Wireless
Loughborough University’s strategy for wireless networking is to implement ubiquitous wireless access in all buildings. This means all buildings should have complete coverage in the interior and, where identified, at the exterior of the building.

IT services will be solely responsible for the procurement of the relevant wireless network equipment. Third party suppliers equipment must not be used. This will be at cost to the project.

Projects must supply a suitable floor layout plan to IT Services. IT services will then return a labelled plan showing where data sockets should be installed to connect the wireless access point. We prefer the data point to be installed in a discrete/unseen location but must be accessible. The contractor must provide a wire-way (conduit) from this point to the location of the wireless access point. This will accommodate the patch lead to connect the wireless access point to the data socket. This process should be iterative between the project and IT Services to identify unsuitable or improved locations for the access point. this may be due to building materials, cable containment or similar. The fitting of the wireless equipment will be responsible by the project.

Access points should be installed on a horizontal plane for best performance. Installations on a vertical plane will only be considered in consultation with IT Services. This may be because the ceiling is above fixed furniture or equipment which would hinder access for maintenance or installation, or it may be that the ceiling is too high for access with ladders.

Wireless access points can be installed on false ceiling grid systems, plasterboard or concrete using suitable fixings

Network Switches
Loughborough University IT Services will be solely responsible for the procurement and fitting of network switches within campus buildings. Network switches or any other active network equipment provided by third parties will not be used.
Project Management

It is important to establish an early and clear dialogue with IT Services on projects that have any sort of IT impact. Failure to do so may result in delays to the project or incorrect installation which will not be accepted.

Communication

Larger projects should contact either:
Jonathan Oakden - Network Applications Team Lead (email - J.P.Oakden@lboro.ac.uk, phone - 01509 226070)
or
Matthew Cook – Assistant Director (Infrastructure & Operations) (email - M.S.Cook@lboro.ac.uk, phone - 01509 226013).
Smaller projects should contact the IT Services Service Desk (email - IT.Services@lboro.ac.uk, phone 01509 222333) in order that the request is directed to the correct person.

Documentation

Where suitable IT Services should be issued with the following documentation:
Floor layouts plans
Communication room locations and layouts
Cabling containment route plans
Number of data outlets terminated at each comms room
List of all building network connected services (e.g. BMS, intruder alarms etc)

Costs and Budgets

The project is responsible for funding all IT costs.
This includes but is not limited to:

Construction work to connect into the data duct system
Installation of specified fibre optic cables
Installation of internal building fibre and copper cabling
Purchase and installation of data cabinets
Purchase and installation of power distribution units within each rack
Purchase of active networking equipment (switches, wifi and optics)
Purchase of patch cabling
Purchase of network installation equipment
Appendix A

Data Centre room standards at Loughborough University

Revision History
Date Version Author Comment
15 December 2014 0.1 ccjd/ccobs/ccmjn First draft
17 December 2014 0.2 ccjd/ccmjn/ccobs Added in details and example part numbers
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1. Introduction

This document is intended to act as guidance for any new build, refurbishment or minor works at Loughborough University that incorporates any Server housing with respect to access, racking, power supply, cooling, monitoring, remote console access and so on. It is impossible to provide for every situation in such a document; however it should cover most frequently asked questions and related issues expected to arise in such projects.

A good example of several racks used for servers can be seen in the implementation of APC equipment as a POD, installed for the i2012 project. One POD is in Haslegrave and uses and external UPS, one is in Holywell Park and uses an internal UPS. However, this configuration is not totally compliant with this document.

Final racking, cooling and power solution shall be certified by APC as being viable.

Adherence to this document should ensure potential problems are minimised and handovers are completed in a straightforward and timely fashion.

Deviations from this document will only be allowed by written permission from Loughborough University IT Services Head of Infrastructure and Middleware, IT Services Director, or their nominee.
2. Racking

a) Racks shall be APC SX ones, 1200mm deep, 42U high. Unless specified, the racks shall be 600mm wide. (Example “NetShelter SX 42U 600mm Wide x 1200mm Deep Enclosure”)  
b) Where racks are ganged, they shall be closed/covered between racks, with an option be open, and covered at the ends of the racks.  
c) There shall be a minimum of 1200mm clearance front and rear of the racks. There shall be a minimum of 1000mm to each side  
d) The racks shall have top and bottom covers with glands or holes to allow access for cables, cooling etc.  
e) The racks shall be fitted with lockable mesh doors at the front, and lockable, split mesh doors at the back. (e.g. “NetShelter SX 42U 600mm Wide Perforated Split Rear Doors Black” and “NetShelter SX 42U 600mm Wide Perforated Curved Door Black” with “Door lock assembly (Qty 2) for NetShelter SX / SV / VX Enclosures”)  
f) “NetShelter SX 600mm wide by 12 mm deep roof”  
g) Any collection of 3 or more racks shall have monitoring equipment explicitly for those racks installed. Such monitoring shall include temperature of each rack, monitoring of power usage on a per-PDU bank. (see section on Power for more information) (e.g. APC “Rack PDU 2G, Metered by Bank with Switching, ZeroU, 20A, 230V, (21) C13 & (3) C19”), using e.g. Netbotz as required for project.  
h) For more than 3 racks, there shall be a mechanism for cooling air to be fed to the fronts of the racks, thermally isolated from the rear of the racks. See section of cooling for more information)  
i) Current locations in the University where these standards will apply to new equipment include the Haslegrave datacentre, Holywell POD, GV01a Datacentre, LDS Datacentre. Future locations that will contain computing equipment shall use these guidelines.  
j) Some racks may need to have space available for power, cooling of monitoring and control. The overall rack size must not exceed 42U internally.
3. Power

a) For each rack, there shall be two recessed Power Distribution Units (PDU), one each side at the rear of the rack. Each PDU shall have a minimum of two, C19 sockets and a minimum of sixteen C13 sockets. Each power socket on each PDU shall be individually switchable remotely. (Example “Rack PDU 2G, Metered by Outlet with Switching, ZeroU, 20A, 230V, (21) C13 & (3) C19”)

b) Power cables from computing equipment to the PDUs shall not interfere with any racked servers or similar equipment.

c) Each rack shall have a Power Transfer Switch (e.g. “RACK ATS, 16A/230V, C20 IN, (8) C13 (1) C19 OUT”) installed at the rear of the rack, in slot 40. The PTS shall be fed from a socket on each of the installed PDUs. The PTS shall be capable of switching a minimum of 16 A.

d) Each rack shall be protected from loss of power by using an uninterruptable power supply. In some cases the UPS will be located outside of the Datacentre. If the UPS is to be internal to the Racking solution it must be appropriately sized for the Project with spare capacity to double the load.

e) If the UPS is external to the racks, the solution shall include a mechanism to isolate each other piece of electrical equipment in the racks. The individual circuits must be protected by a circuit breaker sized to the circuit concerned. The use of an extendable PDU is recommended for each set of ganged racks. (e.g. “Infrastruxure Modular IT Power Distribution Unit 138 kW 200A 400V 18 pole”)
4. Cooling

a) If more than one rack is to be installed, or the overall number of racks is greater than three then a hot/cold air containment system shall be used. This may be achieved by a hot air corridor between two rows of back-to-back racks, or isolated front-to-back baffle or similar. This will be achieved using APC’s 300 mm In-Row Coolers.

b) If a hot or cold air containment system is installed, then a suitable number of ACRC units shall be installed to cater for the maximum intended heat load. This can be achieved by one or more In-Row Cooler (e.g. “InRow RA, 300mm, Pumped Refrigerant, 200-240V, 50/60Hz “) or equivalent.

c) If possible, existing (external) chillers are to be used. If new plant is to be installed, this work must be done as directed by Loughborough University Facilities Management, who has responsibility for all University buildings and grounds.

d) A good example of cooling for several racks used for servers can be seen in the implementation of the 12012 Project “POD” in Haslegrave and Holywell Park at the University.

e) Racks shall include, if in-row or similar cooling is used, a water detection sensor on the floor to detect leaks before rack-mounted equipment can be damaged.

f) There shall be at least one humidity sensor per In-Row cooler.
5. Flooring

a) Where any new racks are to be placed into an existing Datacentre, the existing tiles and flooring arrangements must be used. Care will need to be taken not to exceed maximum floor loading
6. Monitoring

a) There shall be a means to monitor temperature for each rack. This point will be to the front each rack, centre of the door.

b) There shall be a means to monitor humidity for each rack. This point will be to the front, centre of the doors.

c) There shall be a means to monitor power consumption of each rack. This will be on a per-bank of switched out lets, on each PDU, or as appropriate for the contents of the rack (eg InRow coolers)

d) The in-Row coolers shall also have sensors for temperature of air at front and rear of the rack, the temperature of incoming and exhaust coolant, and power consumption as a minimum.
Appendix B

M & E DUCTS & GROUNDWORKS

Utility apparatus can be vulnerable to damage from works carried out within the grounds of the University. The safety of operatives and the public/students is of paramount importance. It is therefore in the interests of all parties to make every effort to minimise both the occurrence and effect of damage. All works are to adhere to:

http://www.lboro.ac.uk/media/wwwlboroacuk/content/facilitiesmanagement/downloads/fmhealthsafety/annexes/Annex%20DD-excavations.pdf

These guidelines apply to utility apparatus placed beneath:

a) Footways  
b) Carriageways  
c) Cycle tracks  
d) Verges  
e) Service strips  
f) Footpaths  
e) fields / open areas etc

These recommendations are based upon a two-metre-wide footway, which is the minimum width required to accommodate the full range of utility services.

On new development sites where utility apparatus is installed by the principle contractor or a third party, the guidelines contained within this section for the positioning and colour coding of underground apparatus should be followed. Any deviation from these guidelines should only be conducted with the agreement of the Director of Facilities Management Services or a nominated deputy. Any variation to depth of cover must permit access to all utility apparatus.

These guidelines include a recommended colour coding scheme facilitating the identification of apparatus within the University to create a safer working environment.

In addition to Loughborough University’s general requirements specialist advice should also be obtained when works are undertaken over, under or near to the following:

Bridges, culverts, cellars, voids, manholes and trees.

In these situations, the appropriate department or Project Manager should be able to offer advice and assistance.

IDENTIFICATION
Pipe / Duct Identification and Recommended Depths

Tables 1 below gives the recommended industry and other underground apparatus depths and colour identification for ducts, pipes and cables.

TABLE 1 – Recommended Colour Coding of Underground Utilities Apparatus

<table>
<thead>
<tr>
<th>Utility</th>
<th>Duct</th>
<th>Pipe</th>
<th>Cable</th>
<th>Marker Systems</th>
<th>Recommended Minimum Depths</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>Footway/Verge / Carriageway</td>
</tr>
<tr>
<td>Electricity HV (High Voltage)</td>
<td>Black or red duct or tile</td>
<td>N/A</td>
<td>Red or black</td>
<td>Yellow with black and red legend or concrete tiles</td>
<td>450-1200mm / 750-1200mm</td>
</tr>
<tr>
<td>Electricity LV (Low Voltage)</td>
<td>Black or red duct or tile</td>
<td>N/A</td>
<td>Black or red</td>
<td>Yellow with black legend</td>
<td>450mm / 600mm</td>
</tr>
<tr>
<td>Gas</td>
<td>Yellow</td>
<td>*** See row below</td>
<td>N/A</td>
<td>Black legend on PE pipes every linear metre</td>
<td>600mm footway / 750mm verge / 750mm</td>
</tr>
</tbody>
</table>
| *** PE - up to 2 bar - yellow or yellow with brown stripes (removable skin revealing white or black core pipe). - between 2 to 7 bar - orange. Steel pipes may have yellow wrap or black tar coating or no coating. Ductile Iron may have plastic wrapping. Asbestos & Pit / Spun Cast Iron – No distinguishable colour.

| Water non Potable & Grey Water | N/A | Black with green stripes | N/A | N/A | 600 – 750mm |
| Water - Firefighting | N/A | Black with red stripes or bands | N/A | N/A | 600 – 750mm |
| Oil / fuel pipelines | N/A | Black | N/A | Various surface markers Marker tape or tiles above red concrete | 900mm / All work within 3 metres of oil fuel pipelines must receive prior approval |
| Sewerage | Black | No distinguishing colour / material (e.g. Ductile Iron may be red; PVC may be brown) | N/A | N/A | Variable / Variable |
| Communications | Grey, white, green, black, purple | N/A | Black or light grey | Various | 250 – 350mm / 450 – 600mm |
| Water | Blue or Grey | Blue polymer or blue or uncoated iron / GRP. Blue polymer with brown stripe (removable skin revealing white or black pipe) | N/A | Blue or Blue/black | 750mm / 750mm minimum |
| Water pipes for special purposes (e.g. contaminated ground) | N/A | Blue polymer with brown stripes (non-removable skin) | N/A | Blue or blue/black | 750mm / 750mm minimum |
MARKER / WARNING SYSTEMS

Laying New Marker Systems

When installing new apparatus appropriate marker systems are laid some distance above the plant. Insulated wire or tapes incorporating a metal strip or passive electronic marker systems should be laid as an aid to the location of non-metallic pipes and ducts.

HV cables - The covers shall comply with ENA TS 12-23. The covers shall be Centriforce Stock Board Cable Covers 1000mm x 300mm. These boards shall be laid at a depth of 300 mm from the finished surface level.

LV cables - A pre-printed yellow heavy gauge polyethylene tape with printed warning of “Caution Elec Cable Below” c/w detectable strip shall be laid at a distance of 300mm above the cable along its entire buried route.

Data – A pre-printed green heavy gauge polyethylene tape with printed warning of “Caution Fibre Below” c/w detectable strip shall be laid at a distance of 100mm above the fibre along its entire buried route.

Water – A pre-printed blue heavy gauge polyethylene tape with printed warning of “Caution Water Pipe Below” c/w detectable strip shall be laid at a distance of 300mm above the pipe along its entire buried route.

Gas - A pre-printed yellow heavy gauge polyethylene tape with printed warning of “Caution Gas Pipe Below” c/w detectable strip shall be laid at a distance of 300mm above the pipe along its entire buried route.

Identifying Existing Services

When exposing existing marker systems care should be taken that they are not disturbed, damaged or removed. Any displaced marker system should be replaced. Whilst marker systems may have value in warning an operator of the presence of buried plant, they are of strictly limited value as a means of identification. Marker systems should not be taken as an accurate indication of buried plant.

All apparatus must be treated with caution until a positive identification has been made. Every effort must be made to avoid damage to all apparatus as the consequences are costly and dangerous.

The recommended primary method of identification of small buried mains and services and their associated ducts is by colour coding (see Table 1 – ‘Recommended Colour Coding of Underground Utilities Apparatus’ and Table 2 – ‘Recommended Colour Coding of Other Underground Apparatus’. In addition to colour coding, other methods of identification may be used (see sub-section ‘Marker / Warning Systems’.)

Reference should also be made to HSE Publication HSG 47, ‘Avoiding Danger from Underground Services’
POSITIONING OF APPARATUS IN A TWO-METRE-WIDE FOOTWAY

Figure 1 below illustrates the industry recommended minimum depths of cover to the crown of the apparatus.

FIGURE 1 - Recommended Positioning of Utility Apparatus in a 2 metre Footway

Note: The same positioning should apply in the carriageway/service strip (if safe and practical to do so) where a development has no footway(s) available for services and/or the boundary of the property is on the carriageway (please refer to minimum depths in carriageways). For further advice please contact the asset owner.

Note: This diagram is not to scale.
INSTALLING APPARATUS IN THE CARRIAGEWAY

In the event of congestion of apparatus in the footway / verge (e.g. where less than 2 metres wide) or where a development has no footway, normal distribution mains, pipes, cables and ducts may have to be sited and positioned within the carriageway. Transmission and trunk main pipes and cable ducts are invariably of larger dimensions and therefore may also need to be located in the carriageway.

Ducts

Where practicable pipes and cables which cross the carriageway should be laid in ducts for ease of future maintenance and the avoidance of congestion.

INSTALLING APPARATUS IN OPEN AREAS

Loughborough University Minimum Depths of Cables, Ducts & Mains

The minimum depths to the top of cables / ducts / mains for the various laying conditions are shown in the following tables:

Electricity

<table>
<thead>
<tr>
<th>Voltage</th>
<th>Good agricultural land</th>
<th>Footpaths, verges, uncultivated land, pasture agreed to be permanent and land not open to vehicular traffic</th>
</tr>
</thead>
<tbody>
<tr>
<td>132kV</td>
<td>910 mm</td>
<td>900 mm</td>
</tr>
<tr>
<td>66kV</td>
<td>910 mm</td>
<td>750 mm</td>
</tr>
<tr>
<td>33kV</td>
<td>910 mm</td>
<td>750 mm</td>
</tr>
<tr>
<td>20kV</td>
<td>910 mm</td>
<td>600 mm</td>
</tr>
<tr>
<td>11kV</td>
<td>910 mm</td>
<td>450 mm</td>
</tr>
<tr>
<td>LV &amp; Services</td>
<td>910 mm</td>
<td>450 mm</td>
</tr>
</tbody>
</table>

Water and Waste Water

<table>
<thead>
<tr>
<th>Minimum Deep ploughing</th>
<th>Good agricultural land</th>
<th>Footpaths, verges, uncultivated land, pasture agreed to be permanent and land not open to vehicular traffic</th>
</tr>
</thead>
<tbody>
<tr>
<td>All situations</td>
<td>Rural</td>
<td>Urban</td>
</tr>
<tr>
<td>Minimum Deep ploughing</td>
<td>900 mm</td>
<td>900 mm</td>
</tr>
<tr>
<td>As agreed</td>
<td>As agreed</td>
<td>As agreed</td>
</tr>
</tbody>
</table>
Communications

<table>
<thead>
<tr>
<th></th>
<th>Good agricultural land</th>
<th>Footpaths, verges, uncultivated land, pasture agreed to be permanent and land not open to vehicular traffic</th>
</tr>
</thead>
<tbody>
<tr>
<td>All situations</td>
<td>350 mm</td>
<td>350 mm</td>
</tr>
<tr>
<td>Rural</td>
<td>350 mm</td>
<td>350 mm</td>
</tr>
<tr>
<td>Urban</td>
<td>350 mm</td>
<td>350 mm</td>
</tr>
<tr>
<td><strong>Deep ploughing</strong></td>
<td>As agreed</td>
<td>As agreed</td>
</tr>
</tbody>
</table>

Gas

<table>
<thead>
<tr>
<th>Open fields and agricultural land</th>
<th>Service Diameters ≤63 mm / 2”</th>
<th>All Other Pipes</th>
</tr>
</thead>
<tbody>
<tr>
<td>Min.</td>
<td>1100 mm</td>
<td>2 bar or below</td>
</tr>
<tr>
<td></td>
<td></td>
<td>&gt; 2 bar to 7 bar</td>
</tr>
<tr>
<td>Deep ploughing</td>
<td>By agreement</td>
<td>&gt; 7 bar to 16 bar</td>
</tr>
<tr>
<td></td>
<td></td>
<td>&gt; 16 bar</td>
</tr>
<tr>
<td>Paved footways</td>
<td>450 mm</td>
<td>1100 mm</td>
</tr>
<tr>
<td></td>
<td>By agreement</td>
<td>1100 mm</td>
</tr>
<tr>
<td>Uncultivated land, pasture agreed to be permanent and land not open to vehicular traffic</td>
<td>1100 mm</td>
<td>1100 mm</td>
</tr>
<tr>
<td></td>
<td>By agreement</td>
<td>1100 mm</td>
</tr>
<tr>
<td>Rural &amp; urban locations</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
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<tr>
<td></td>
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</tr>
</tbody>
</table>

Contact must be made with the Gas Network Operator before any installation or excavation work is undertaken

TRENCH SHARING

Trench sharing may be beneficial in reducing disruption to both vehicular and pedestrian traffic, as well as offering cost savings in construction methods and reinstatement liability for utilities. Trench sharing can also be useful in maximising the limited available space in the highway. Wherever practical and appropriate trench sharing should be considered. When trench sharing is an option it is essential that early consultation takes place with representatives all other interested parties. Agreement on the positioning of apparatus within a shared trench together with the reinstatement specification should be made between all interested parties (including the FM Management Team) as early as possible as part of the planning.
DISTRICT HEATING

A district heating installation typically consists of a highly insulated "heat main" of flow and return pipes distributing hot water (or steam) to buildings which are connected via junction points. The proximity of district heating apparatus may affect the efficiency and operation of other underground apparatus. Before such apparatus is laid contact must be made FM Management Services to authorise. Installers of district heating should consider the location, spacing and depth of cover to avoid potential conflict with other existing underground apparatus.

SEALING

Immediately after laying and before backfilling the trench, the ends of the cable ducts shall be sealed temporarily with suitable plugs. Draw lines shall be secured outside the plugs.

On completion of cabling within the ducts shall be re-sealed with rise duct seal or other suitable proprietary duct sealing system that can easily be removed (excluding expanding foam).

DRAW LINES

Wherever there is a change of direction in the route of cable ducts a draw pit shall be built.

Cable ducts shall include a nylon, or equal and approved draw cord, both before and on completion of the cable installation. The cord shall have a breaking strength of not less than 550N and shall be at least 4m longer than the duct run.

Draw lines shall be prevented from being able to be pulled back into the duct

UPDATING PLANS

As laid plans should be provided to Facilities Management Services so the site services drawing can be updated.

The plans for newly installed services should show how they have been laid, not how they were designed. Contractors may need to amend the design drawings accordingly.

GPS is the preferred method for recording the exact position of services along the entire route.