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ENGINEERING CONSTRUCTION STANDARD

ECS 02-0019

INSTALLATION OF UNDERGROUND CABLES - LV TO 132KV

Network(s): EPN, LPN, SPN

Summary: This Standard details the minimum requirements acceptable for the installation of new LV, 11kV, 20kV, 33kV, 66kV and 132kV cables, plus associated pilot and telephone cables.

Owner:	Paul Williams	**Date:**	02/06/2015
Approved By:	Steve Mockford	**Approved Date:**	22/07/2015

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Applicable To

UK Power Networks

- ☐ All UK Power Networks
- ☒ Asset Management
- ☒ Capital Programme
- ☒ Connections
- ☐ HSS&TT
- ☒ Network Operations
- ☐ UK Power Networks Services
- ☐ Other

External

- ☒ G81 Website
- ☒ Contractors
- ☒ ICPs/IDNOs
- ☐ Meter Operators

Revision Record

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Date	02/06/2015	**Author**	Paul Williams
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Minor changes on drawings on section 6			
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33kV cable types and sizes revised			
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Date	24/10/2005	**Author**	Paul Williams
Re-written for all EDF Energy Networks			

Contents

1 Scope

This Standard covers the minimum requirements for the installation of new low voltage, pilot and telephone, 11kV, 20kV, 33kV, 66kV and 132kV cables and the types of cable that shall be installed in particular operating environments.

2 Glossary and Abbreviations

Term	Definition
HAUC Specification	Specification for the Reinstatement of Openings in Highways: Highways & Utilities Committee Code of Practice
Rayflate®	Inflatable cable duct sealing system.
Stokbord®	Cable protection tile manufactured from recycled plastic.
UK Power Networks	UK Power Networks (Operations) Ltd consists of three electricity distribution networks: • Eastern Power Networks plc (EPN). • London Power Network plc (LPN). • South Eastern Power Networks plc (SPN).

3 General Requirements

The general requirements of this engineering construction standard are as follows:

- Guidance on the types of cable that shall be installed in different operating environments.
- Minimum acceptable depths of cover for all types of new cable.
- Installation guidelines for new cables and cable ducts.
- Installation guidelines of new cable marker tape and Stokbord®.

4 On Site Requirements

4.1 Street Works

All staff and subcontractors employed to carry out the works described in this document shall comply with the requirements of UK Power Networks' Street Works Policy (SWP) and the UK Power Networks' Excavation and Cable Installation Manual.

4.2 Plans and Records

On completion of all works, as-built drawings shall be provided as laid down in EDS 09-0100 UK Power Networks' engineering design standard for the Site Recording of Cables, Plant and Equipment.

5 Cable Types for New Installations

5.1 Direct Buried Installations

Direct burial of new cable circuits should always be preferred over other methods of installation, except where on-site conditions dictate otherwise.

Only the following types of cable shall be permanently installed either directly in the ground or in cable ducts:

If it is necessary to install any of these types of cable in an in-air environment (i.e. a cable tunnel, cable pit or cable basement), it shall be protected with one of the methods described in UK Power Networks' engineering design standard EDS 02-0031 Installation of Power Cables and Joints in Air.

5.1.1 LV Service Cables

The following table details the sizes and types of Concentric and Split Concentric cable with black PVC sheaths that shall be used in direct buried or ducted situations:

Cable Type	Conductor Size	UK Power Networks' Stores Code
Single Phase Concentric	4mm^2 Copper	05860K
Single Phase Concentric	25mm^2 Aluminium	01284D
Single Phase Concentric	35mm^2 Aluminium	05886L
Three Phase Concentric	35mm^2 Aluminium	05903U
Single Phase Split Concentric	35mm^2 Aluminium	05887R

5.1.2 LV Mains Cables

The following table details the sizes and types of Waveform cable with a black PVC sheath that shall be used in direct buried or ducted situations:

Cable Type	Conductor Size	UK Power Networks' Stores Code
Three Phase Waveform	95mm^2 Aluminium	05577P
Three Phase Waveform	185mm^2 Aluminium	05579J
Three Phase Waveform	300mm^2 Aluminium	05588H
Three Phase Waveform	300mm^2 Copper	05587X

5.1.3 11kV Cables

The following table details the sizes and types of Triplex and Single Core XLPE cable with a red polyethylene outer sheath that shall be used in direct buried or ducted situations:

Cable Type	Conductor Size	UK Power Networks Stores Code
Triplex	95mm^2 Aluminium	06000B
Triplex	185mm^2 Aluminium	06001L
Triplex	300mm^2 Aluminium	06002V
Triplex	185mm^2 Copper	05145N
Triplex	300mm^2 Copper	06003F
Single Core	400mm^2 Copper	06020T*
Single Core	500mm^2 Copper	06021D*
Single Core	630mm^2 Copper	06022N*
Single Core	800mm^2 Copper	06023X*

* Available as a non-stock item from UK Power Networks' Logistics.

5.1.4 20kV Cables

The following table details the sizes and types of Triplex XLPE cable with a red polyethylene outer sheath that shall be used in direct buried or ducted situations:

Cable Type	Conductor Size	UK Power Networks' Stores Code
Triplex	300mm^2 Copper	06060D*

* Available as a non-stock item from UK Power Networks' Logistics.

5.1.5 33kV Cables

The following table details the sizes and types of Single Core XLPE cable with a black polyethylene outer sheath that shall be used in direct buried or ducted situations:

Cable Type	Conductor Size	UK Power Networks' Stores Code
Single Core	300mm^2 Aluminium	06115R
Single Core	400mm^2 Copper	06102D*
Single Core	500mm^2 Aluminium	06116B
Single Core	630mm^2 Aluminium	06117L
Single Core	1000mm^2 Aluminium	06118V*
Single Core	630mm^2 Copper	06104X*
Single Core	800 mm^2 Copper	06105H*

* Available as a non-stock item from UK Power Networks' Logistics.

5.1.6 66kV Cables

Single core XLPE cables with a black polyethylene outer sheath shall be used which fully comply with UK Power Networks' Engineering Approval Standard EAS 00-0002. These are generally purchased on a project by project basis.

5.1.7 132kV Cables

Single core XLPE cables with a black polyethylene outer sheath shall be used which fully comply with UK Power Networks' Engineering Approval Standard EAS 00-0002. These are generally purchased on a project by project basis.

5.1.8 Auxiliary Multi-core and Multi-pair cables

Multi-core and Multi-pair cables with black PVC outer sheaths shall be used which fully comply with UK Power Networks' Engineering Approval Standard EAS 00-0002. These are generally purchased on a project by project basis.

5.1.9 Cables under River, Stream and Canal Crossings

Cables installed under rivers streams or canals shall be placed in a duct of appropriate size. Where the lining of a river, stream or canal is broken through it shall be promptly restored in accordance with the reasonable requirements of the managing authority.

Appropriate measures, including the provision of notice boards and route marker posts, shall be taken to avoid, as far as reasonably practical, the incidence of hazards or damage arising from the activities of other parties during the life of the installation.

5.2 In Air Installations

Only the following types of cable shall be permanently installed in cable tunnels, cable basements and other situation where the cable is exposed to the air:

In these situations cable joints should only be installed as a last resort, but if required these shall be fitted with the appropriate flame retardant materials as detailed in UK Power Networks document EDS 02-0031 Installation of Power Cables and Joints in Air.

For all other voltages between 33kV and 132kV, the requirement to paint polyethylene and PVC sheathed cables with intumescent paint when installed in air shall apply.

5.2.1 LV Service Cables

The following table details the sizes and types of concentric and split concentric cable with a black flame retardant sheath that shall be permanently installed in cable tunnels, cable basements and other situation where the cable is exposed to the air:

Cable Type	Conductor Size	UK Power Networks' Stores Code
Single Phase Concentric	35mm^2 Aluminium	05550D
Three Phase Concentric	35mm^2 Aluminium	05552X
Single Phase Split Concentric	35mm^2 Aluminium	05553H
Three Phase Split Concentric	35mm^2 Aluminium	05554S*

*Available as a non-stock item from UK Power Networks' Logistics.

5.2.2 LV Mains Cables

The following table details the sizes and types of Waveform cable with a black flame retardant sheath that shall be permanently installed in cable tunnels, cable basements and other situation where the cable is exposed to the air:

Cable Type	Conductor Size	UK Power Networks' Stores Code
Three Core Waveform	95mm^2 Aluminium	05594C
Three Core Waveform	185mm^2 Aluminium	05595M
Three Core Waveform	300mm^2 Aluminium	05596W
Four Core Waveform	95mm^2 Aluminium	05555C*
Four Core Waveform	185mm^2 Aluminium	05556M*
Four Core Waveform	300mm^2 Aluminium	05557W*

* Available as a non-stock item from UK Power Networks' Logistics.

5.2.3 11kV Cables

The following table details the sizes and types of Single Core XLPE cable with a red flame retardant outer sheath that shall be permanently installed in cable tunnels, cable basements and other situation where the cable is exposed to the air:

Cable Type	Conductor Size	UK Power Networks' Stores Code
Single Core	95mm^2 Aluminium	06004Q
Single Core	185mm^2 Aluminium	06005A
Single Core	300mm^2 Aluminium	06006K
Single Core	300mm^2 Copper	06007U
Single Core	400mm^2 Copper	06024H*
Single Core	500mm^2 Copper	06025S*
Single Core	630mm^2 Copper	06026C*
Single Core	800mm^2 Copper	06027M*

* Available as a non-stock item from UK Power Networks' Logistics.

5.2.4 20kV Cables

The following table details the sizes and types of Single Core XLPE cable with a red flame retardant outer sheath that shall be permanently installed in cable tunnels, cable basements and other situation where the cable is exposed to the air:

Cable Type	Conductor Size	UK Power Networks' Stores Code
Triplex	300mm^2 Copper	06061N*

* Available as a non-stock item from UK Power Networks' Logistics.

5.2.5 33kV Cables

Single core XLPE cables with a black flame retardant outer sheath shall be used which fully comply with UK Power Networks' Engineering Approval Standard EAS 00-0002. These are generally purchased on a project by project basis.

5.2.6 66kV Cables

Single core XLPE cables with a black flame retardant outer sheath shall be used which fully comply with UK Power Networks' Engineering Approval Standard EAS 00-0002. These are generally purchased on a project by project basis.

5.2.7 132kV Cables

Single core XLPE cables with a black flame retardant outer sheath shall be used which fully comply with UK Power Networks' Engineering Approval Standard EAS 00-0002. These are generally purchased on a project by project basis.

5.2.8 Auxiliary Multi-core and Multi-pair Cables

Multi-core and multi-pair cables with black flame retardant outer sheaths shall be used which fully comply with UK Power Networks' Engineering Approval Standard EAS 00-0002. These are generally purchased on a project by project basis.

5.3 Joint Bays

All joint bays shall be designed and constructed so that they are large enough to accommodate the size and type of joint to be installed in them.

Where reasonably practicable, all exposed cables and joints in joint bays shall be blinded with sand or covered with sand bags, before they are being energised, to protect them against mechanical damage and to prevent the possible spread of fire.

In situations where this is not possible consideration should be given to the use of other appropriate methods to protect cables, plant and equipment from fire damage, as detailed in UK Power Networks document EDS 02-0031 Installation of Power Cables and Joints in Air.

For existing in air installation all joints should be protected with suitable flame retardant materials, as detailed in EDS 02-0031 Installation of Power Cables and Joints in Air.

6 Cable Installation Depths

All cables shall be installed to the following minimum depths of cover, where the depth is measured to the top surface of either the cable or the duct containing the cable.

Cables and ducts shall never be installed at increased depths unless there is no other alternative, as increased depth reduces a cables rating, which will increase cable conductor size and precludes easy access to the asset in the future.

In instances where these minimum depths cannot be achieved, the cables shall be installed with additional mechanical protection, in the form of either steel plates or steel ducts.

All steel plates and ducts shall be protected with a suitable cable protection tape or Stokbord® as specified in section 6.1.

In this case, all steel plates shall be a minimum of 1000mm x150mm x 6mm and painted with a single coat of Bitumastic paint (UKPN Stores Code = 03088L).

Steel ducts shall be of the same internal diameter as the plastic ducts, normally used for the type of cable to be installed and shall have a smooth internal bore with no internal welds or burrs.

6.1 Cable Protection Tapes and Covers

All cables and ducts shall be protected by a cable protection tape or a Stokbord®, the tape used depends upon the highest voltage to be protected, which are available from UK Power Networks Supply Chain:

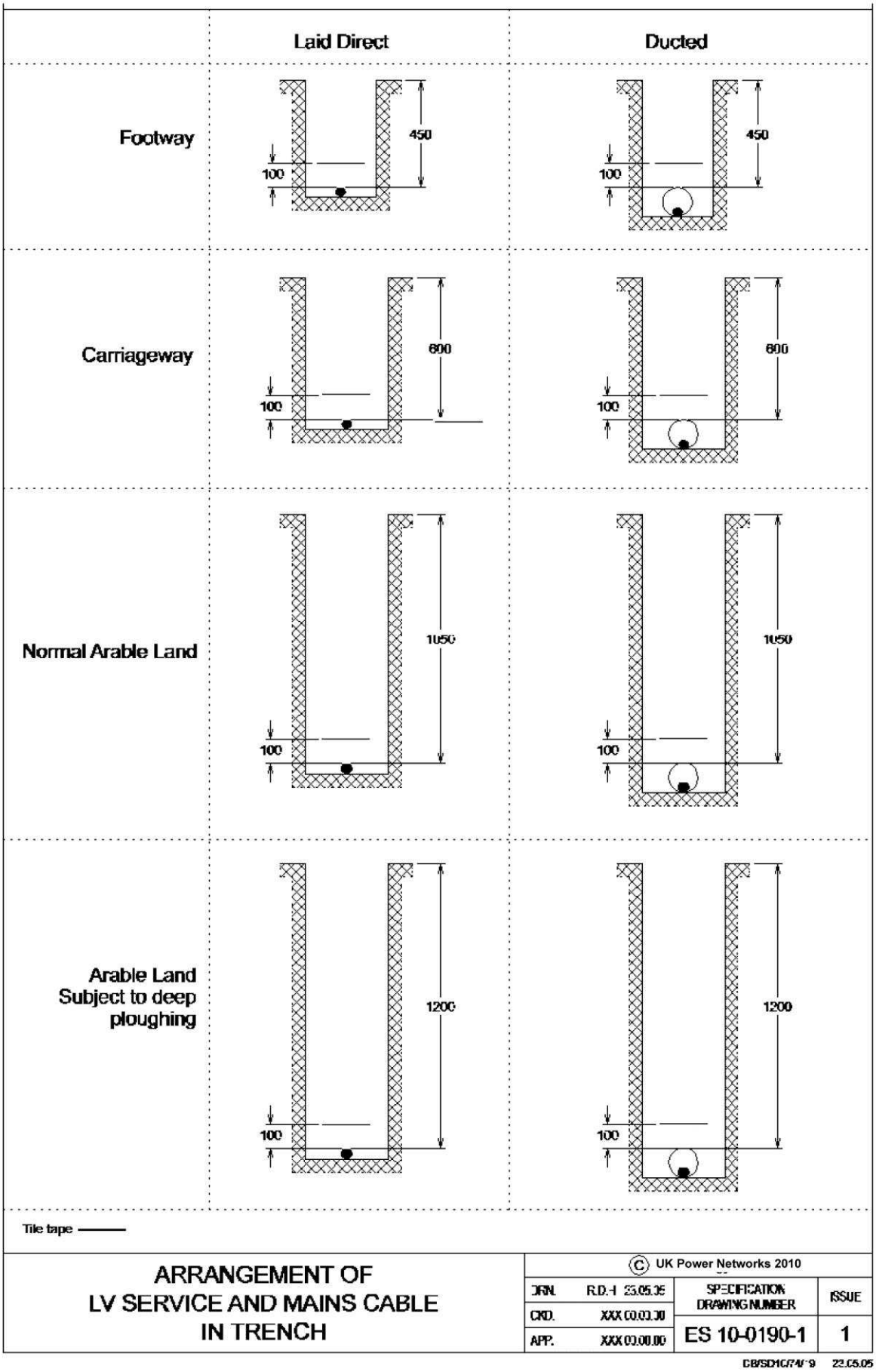
- LV Service = Tile tape (40m x 200mm x 2.5mm) – UKPN Stores Code = 04040C.
- LV Mains = Tile tape (40m x 200mm x 2.5mm) – UKPN Stores Code = 04040C.
- 11kV = Tile tape (40m x 200mm x 2.5mm) – UKPN Stores Code = 04040C.
- 22kV = Tile tape (40m x 200mm x 2.5mm) – UKPN Stores Code = 04040C.
- 33kV = Stokbord® (1000mm x 244mm x 9mm) – UKPN Stores Code = 04041M.
- 66kV = Stokbord® (1000mm x 244mm x 9mm) – UKPN Stores Code = 04041M.
- 132kV = Stokbord® (1000mm x 244mm x 9mm) – UKPN Stores Code = 04041M.

Cable protection tape or covers shall be installed so that they fully cover the width of the cable or cable duct installed below them.

6.2 Low Voltage Service and Mains Cables

All Low Voltage (LV) cables shall be installed to the following minimum depths, whether they are laid direct or installed in suitable ducts:

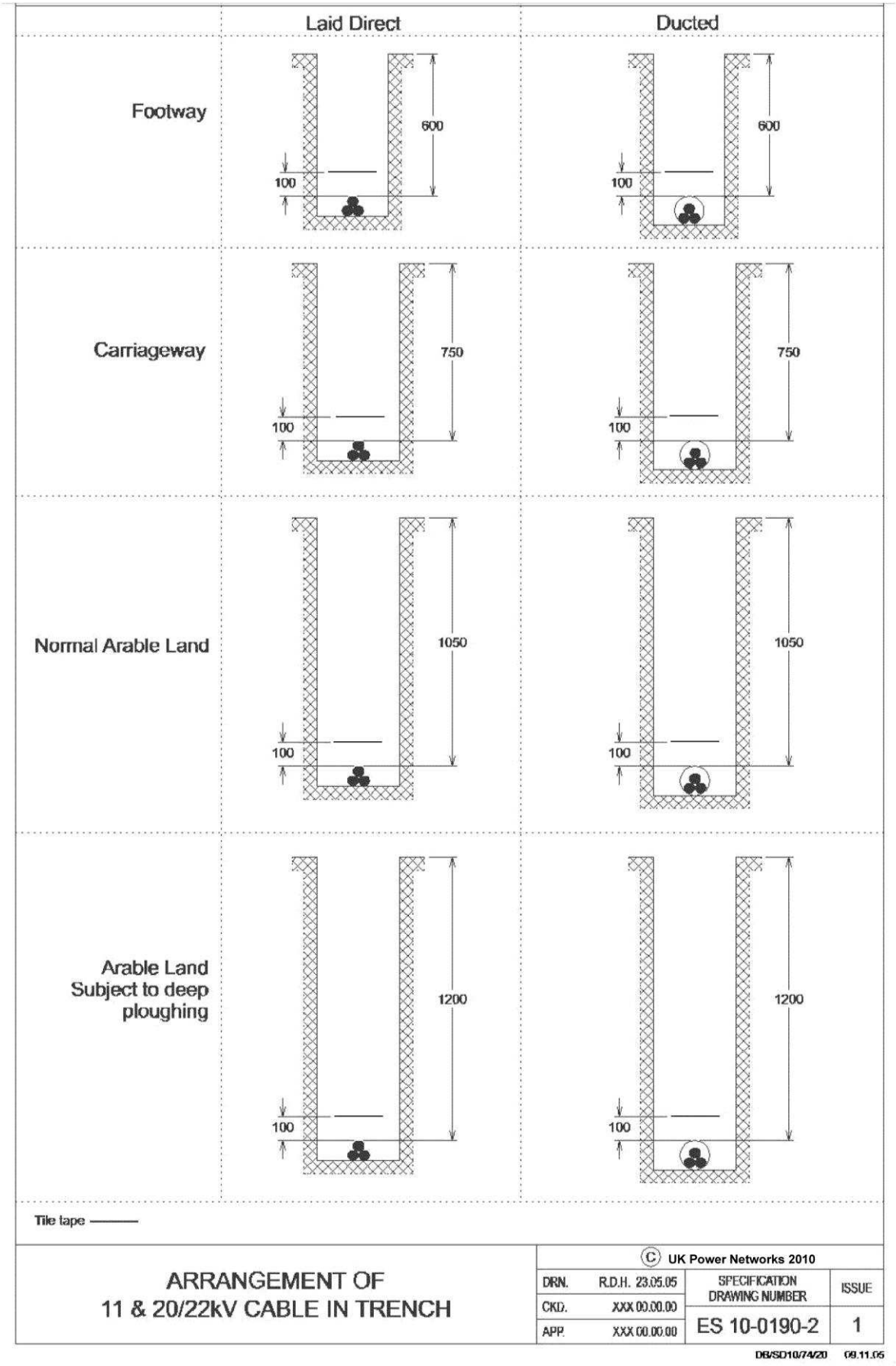
- Footways, grass verges or private property = 450mm;
- Carriageways (including road crossings) = 600mm;
- Normal agricultural land (not subject to deep ploughing) = 1050mm;
- Agricultural land subject to deep ploughing = 1200mm.



6.3 11 and 20kV Cables

All 11 and 20kV cables shall be installed to the following minimum depths, whether they are laid direct or installed in suitable ducts:

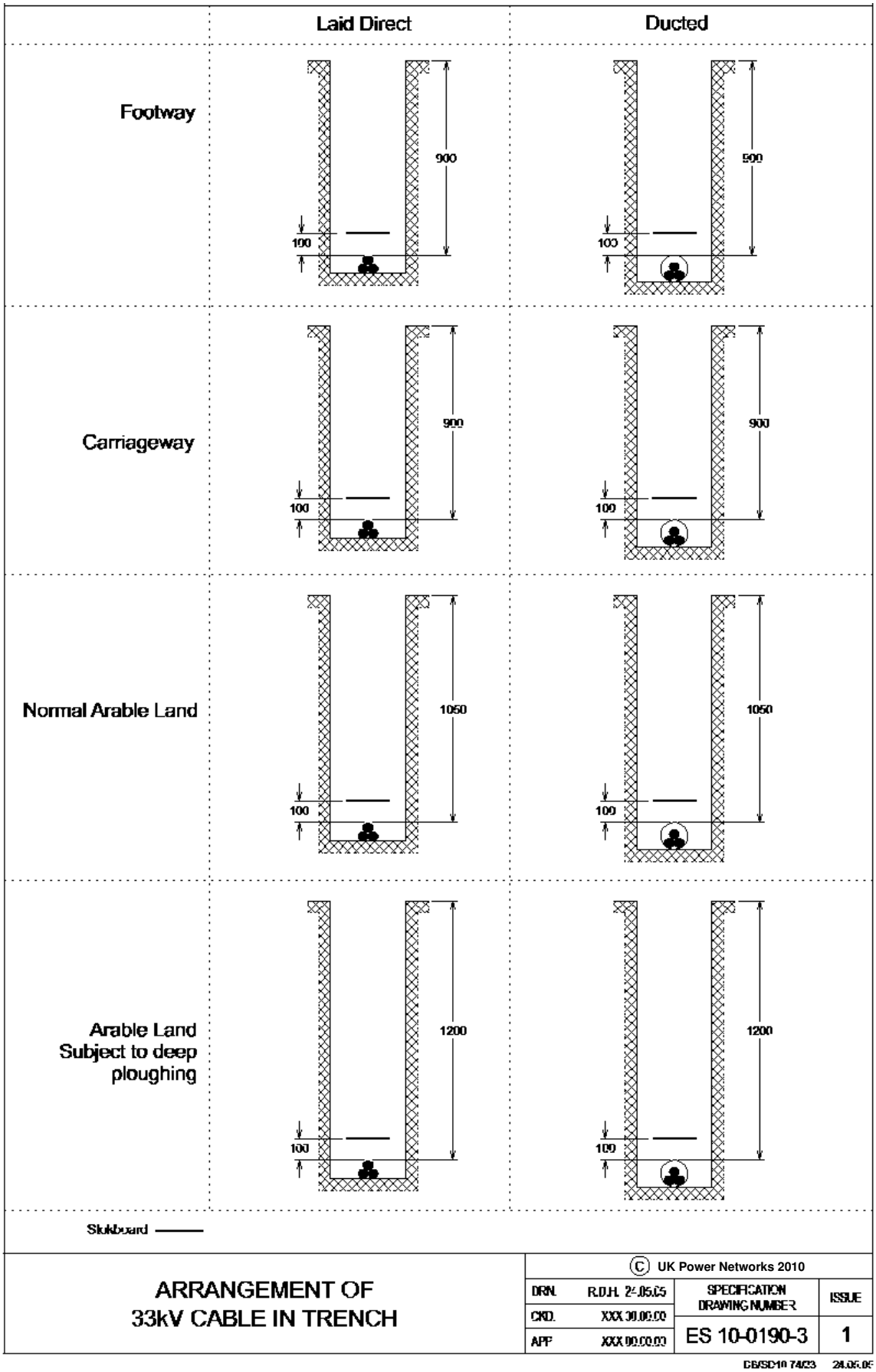
- Footways, grass verges or private property = 600mm;
- Carriageways (including road crossings) = 750mm;
- Normal agricultural land (not subject to deep ploughing) = 1050mm;
- Agricultural land subject to deep ploughing = 1200mm.



6.4 33kV Cables

All 33kV cables shall be installed to the following minimum depths, whether they are laid direct or installed in suitable ducts:

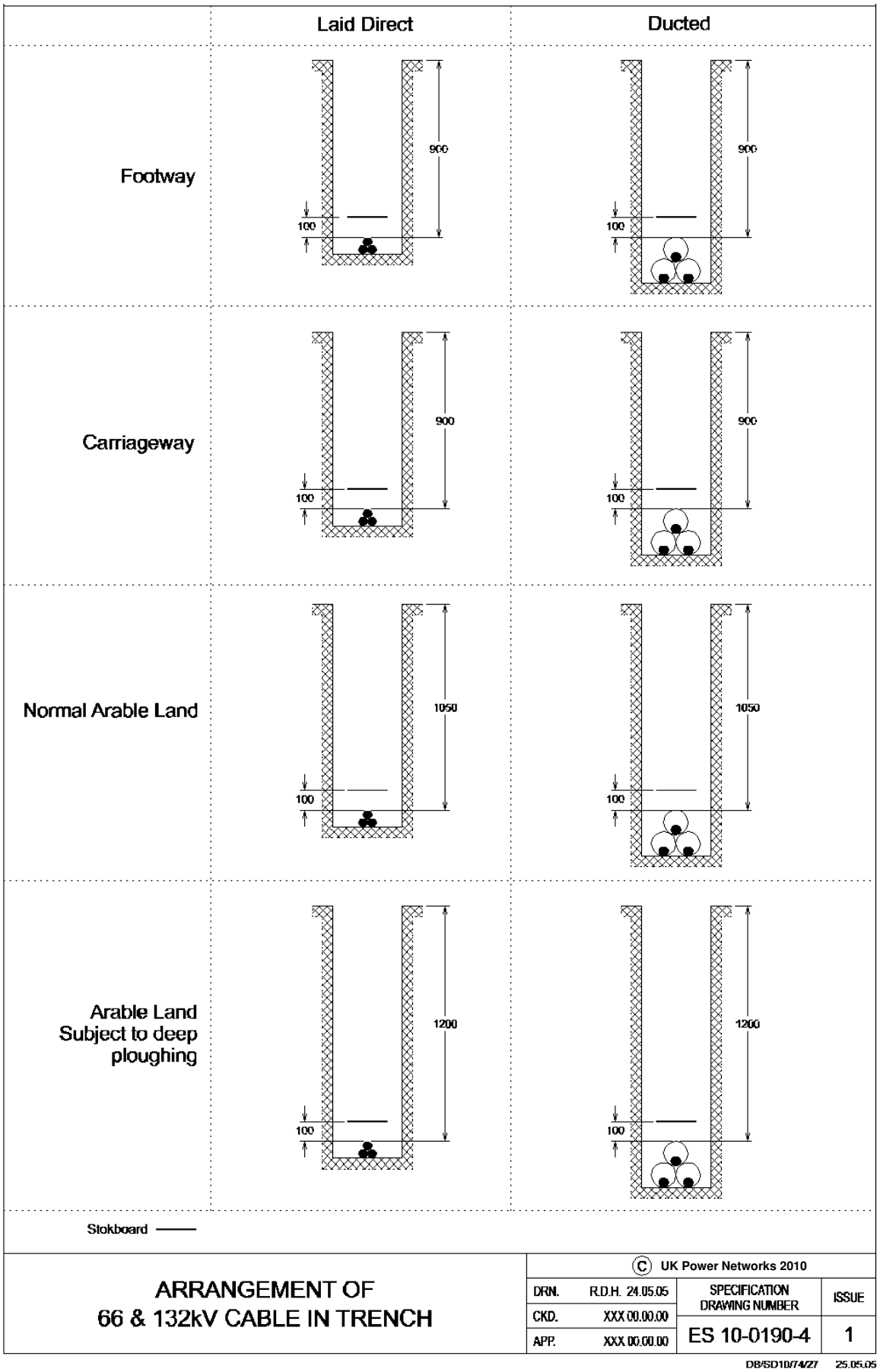
- Footways, grass verges or private property = 900mm;
- Carriageways (including road crossings) = 900mm;
- Normal agricultural land (not subject to deep ploughing) = 1050mm;
- Agricultural land subject to deep ploughing = 1200mm.



6.5 66kV and 132kV Cables

All 66kV and 132kV cables shall be installed to the following minimum depths, whether they are laid direct or installed in suitable ducts:

- Footways, grass verges or private property = 900mm;
- Carriageways (including road crossings) = 900mm;
- Normal agricultural land (not subject to deep ploughing) = 1050mm;
- Agricultural land subject to deep ploughing = 1200mm.



6.6 Auxiliary Multi-core and Multi-pair Cables

Auxiliary multi-core and multi-pair cables are usually laid at similar depths to the power cable with which they are associated, the following minimum depths and conditions shall apply, whether they are laid direct or installed in suitable ducts:

- All normal methods of protecting the cables from damage (i.e., Tile tape and/or Stokbord®);
- Footways, grass verges or private property = 450mm;
- Carriageways (including road crossings) = 600mm;
- Normal agricultural land (not subject to deep ploughing) = 1050mm;
- Agricultural land subject to deep ploughing = 1200mm.

6.7 Typical Trench Layouts

When cables of differing voltages are to be installed in a common trench all the minimum of depths of cover detailed in section 6 of this engineering instruction shall be maintained.

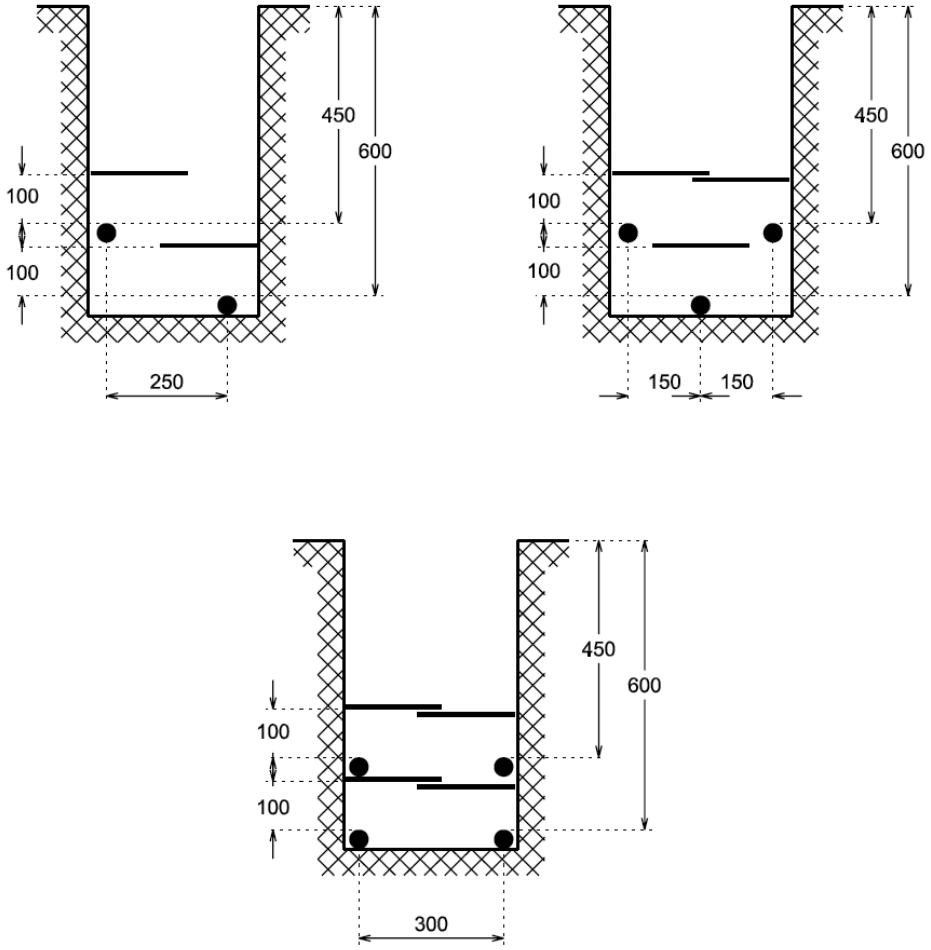
Drawings DB/SD10/74/21 to DB/SD10/74/25 show a number of example installations for guidance.

For clarity not all ducted installations are shown, cables installed in ducts shall be installed to the same standard except that the measurement for the minimum depth of cover is from the final finished surface of the ground to the top surface of the duct.

Pilot and telephone cables installed alongside 11kV and 33kV cable circuits shall normally be installed at LV cable minimum depths of cover, unless operation reasons dictate that they are laid at the same depth as the power cable.

Combined LV and 11 or 20kV Cables

In Footpaths etc.



Tape Tiles

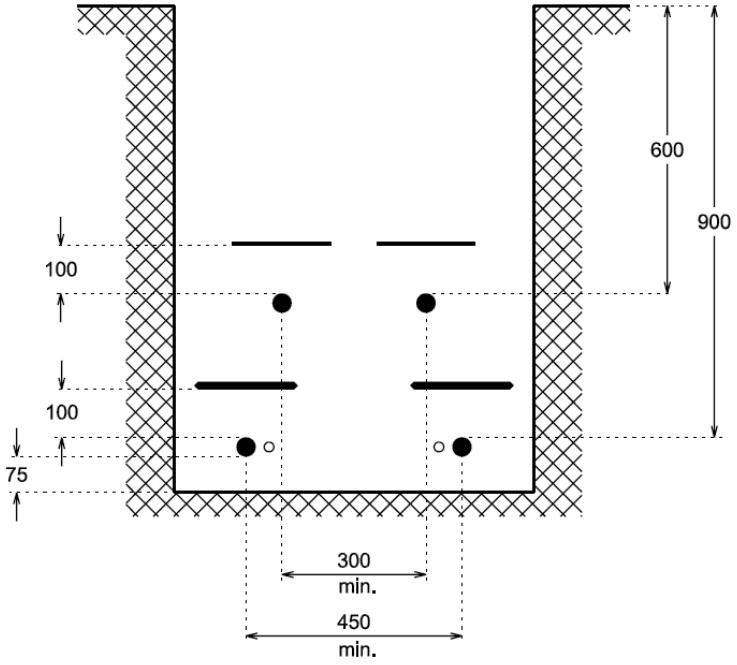
ARRANGEMENT OF COMBINED
L.V. AND 11 OR 20kV CABLES IN TRENCH

DRN. RDH 11.04.95	DRAWING NUMBER	ISSUE
CKD. P.W. 15.12.04	DB/SD10/74/22	3
APP. P.W. 15.12.04		

15.09.09

33kV and 11 or 20kV Cable

Laid Direct in Footpath etc.



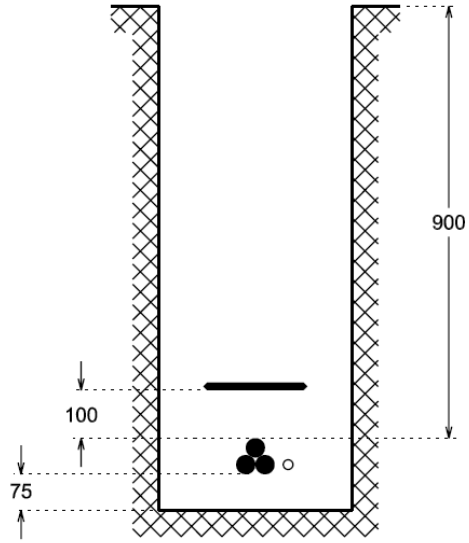
Tape Tiles ——— Stok Boards ———

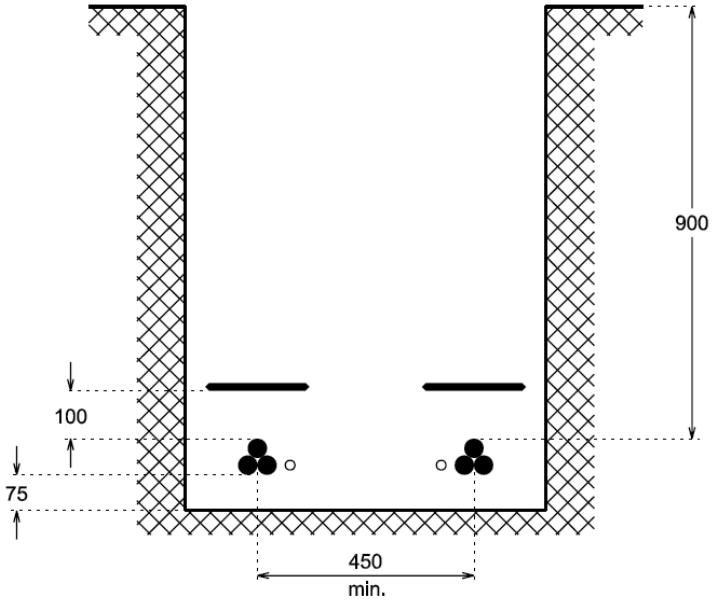
ARRANGEMENT OF 33kV AND 11 OR 20kV CABLE IN TRENCH	© UK Power Networks 2010		
	DRN. RDH 28.02.95	DRAWING NUMBER	ISSUE
	CKD. P.W. 15.12.04	DB/SD10/74/21	3
	APP. P.W. 15.12.04		

15.09.09

33 or 132kV Cables

Road or Footpath





Laid direct. No extra depth for ducts.
If bedding is not required reduce depth by 75mm.

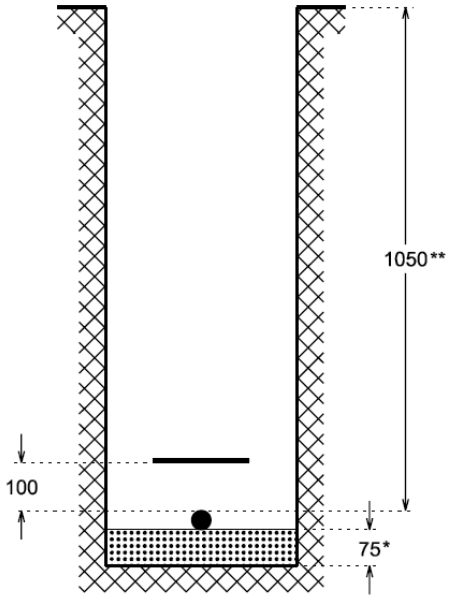
Stok Boards

ARRANGEMENT OF 33/132kV CABLES IN ROAD OR FOOTPATH	© UK Power Networks 2010		
	DRN. RDH 11.04.95	DRAWING NUMBER	ISSUE
	CKD. P.W. 18.05.04	DB/SD10/74/23	4
	APP. P.W. 18.05.04		

15.09.09

All Cables, 33kV and below

Laid in Agricultural Land



* 75mm sand bed for 33kV cables only.

** Depth of cover increased to 1200mm if agricultural land is subject to deep ploughing.

*** Use Stok Boards in place of Tape Tiles for 33kV cables only.

Tape Tiles*** ———

ARRANGEMENT OF CABLES IN TRENCH IN AGRICULTURAL LAND	© UK Power Networks 2010		
	DRN. RDH 28.02.95	DRAWING NUMBER	ISSUE
	CKD. P.W. 18.05.04	DB/SD10/74/25	3
	APP. P.W. 18.05.04		

15.09.09

7 Cable Installation

7.1 Trench Bedding

All cables shall only be laid directly onto the bottom of the trench, if the surface is unlikely to cause damage to the outer sheath.

For LV and 11kV cable installations, a sand bedding material needs to be used for the base of a trench, the depth of the trench shall be increased by the appropriate amount to ensure that the required minimum depth of cover is achieved.

For 33, 66 and 132kV cable installations, a cement bound sand bed, complying with the requirements of ENA TS 97-01 shall be installed, except where cable rating calculations prove that a stabilised backfill material is not required.

All bedding layers shall be compacted to a depth of 75mm and shall be installed covering the full width of the trench.

The trench depth shall be increased to ensure that the required minimum depth of cover is maintained.

7.2 Cable Ducts

Electricity, pilot and telephone cables shall only be installed into electricity cable ducts, complying with UK Power Networks' Engineering Approval Standard EAS 00-0002.

New cable ducts shall be black in colour and marked with the legend 'Electric Cable Duct' on two diametrically opposite sides.

Cable shall only be installed in ducts that are suitable sized to accommodate them, Appendix A details the minimum internal duct diameters allowable for the most common types of cable used by UK Power Networks.

All cable duct joints shall be installed in accordance with the manufacturers' instructions or recommendations and should be installed in such a way to prevent those damaging cables as they are installed.

All cable ducts and tubes entering substations or buildings shall be sealed with the appropriate RDSS Rayflate® duct seal, as specified in UK Power Networks' Engineering Approval Standard EAS 00-0002 to prevent the ingress of gas and water, even if the ducts do not contain a cable.

Where reasonably practicable, before a cable is installed, all duct lines shall be checked and cleared of all obstructions. To ensure that the duct is suitable for the type of cable to be installed, a 3 metre length of the cable to be installed shall be pulled through the complete length of duct. This shall then be examined for damage, before any attempt is made to install the complete cable. If the sample of cable is found to have deep scores and tears in its outer sheath, which are more than half the thickness of the outer sheath, the duct route shall be repaired before any attempt is made to install the final length of cable.

33kV, 66kv or 132kV cables; and their associated pilot and telephone cables shall be installed in appropriately sized ducts installed a cement bound sand material, complying with the requirements of ENA TS 97-01, except where cable rating calculations prove that a stabilised backfill material is not required.

When a thermally stable duct filling material (such as Bentonite) is to be used as specified in Appendix C of ENA TS 09-02, the duct shall be installed in a cement bound sand material, complying with the requirements of ENA TS 97-01, except where cable rating calculations prove that a stabilised backfill material is not required and the joints in the pipe or duct shall be effectively sealed to prevent the migration of the material and preserve it's moisture content under service conditions.

7.3 Cable Drums

Where reasonably practicable, before installing a cable, the delivered cable required for the job shall be inspected to ensure that it is undamaged, the ends are sealed, and the correct size, length and voltage type required for the job has been delivered. Any damage or non-conformity shall be rectified immediately.

33kV, 66kV and 132kV cables are normally provided with a conductive outer sheath coating (graphite or an extruded semi-conducting material) and a sheath test as specified in engineering operating standard EOS 09-0001 shall be carried out whilst the cable is still on the drum.

All cable drums shall be placed on firm and stable surface before the cable is removed. On installation the cable shall always be pulled from the top of the drum to avoid damage.

Where it is necessary to move the drum into position the drum shall only be steered by the use of purpose made slewing bars.

All cable jacks and spindles shall be checked to ensure that they are in good condition and of the appropriate size for the weight of the drum and cable to be installed.

To avoid any risk of injury all nails shall be removed and made safe only once the drum is in its final position.

All unused cable and other unused UK Power Networks' materials shall be stored safely and securely on site and returned to the issuing depot as soon as is practical after the project or project phase is complete.

Cable drums shall be returned to the cable manufacturer, using the free phone number displayed on the drum.

All non-returnable cable drums shall be disposed of in accordance with the Environmental Protection Act.

7.4 Cable Caps

Manufacturer's factory fitted cable caps are only installed to prevent the ingress of moisture during transportation and shall not be used during the installation of cables on-site.

Prior to the installation, each length of cable shall be fitted with a properly installed suitably sized heatshrink cap.

7.5 Pulling Cable

All cables shall be pulled as specified in Appendix B of ENATS 09-02.

The cable shall be examined and checked for damage during and immediately following installation.

Any damage that occurs, no matter how small, shall be reported immediately so the necessary repairs can be made.

Minimum cable bending radii shall be observed at all times and be as specified in Appendix A. Sufficient labour and equipment to install the cable without causing damage to it or other services shall be used at all times.

Cable shall only be laid when the ambient air temperature is above 0°C and has been so for the previous 24 hours, or the cable has been stored in an environment where the temperature has been maintained above 0°C, thus avoiding the risk of mechanical damage during handling.

Where a winch is to be used it shall have a swivel eye fitted. The swivel eye must be in good working order and able to freely rotate to prevent the cable twisting. The bond wire must be pulled in from the far end and tensioned to ensure it does not damage other apparatus crossing the trench.

Only serviceable winches shall be used to pull cable with an accurate dynamometer or an adjustable tension limiting switch fitted. The maximum pulling force must not exceed the values shown in Appendix A.

All pilot and telephone, LV, 11, 20, 33, 66 and 132kV cables shall normally be pulled in using a correctly sized cable stocking which is securely fixed to the cable. More difficult pulls may require the use of a pulling eye attached directly to the cable conductors, which has been installed by the manufacturer.

Rollers shall always be used when pulling cables. All rollers used shall be in serviceable condition moving easily on their spindle and with rolling surfaces free from damage.

A leading roller shall be placed at the trench side at the pulling end, with slide rollers on bends and hoop rollers along straight sections. Inverted skid plates shall be used to prevent the cable or pull wire rising into obstructions. At duct entries a bell mouth shall be attached at each end with rollers positioned to give central access into the bell mouth.

Immediately following installation of cables and/or their testing, the ends of each cable shall be sealed against the ingress of moisture. Where more than one cable is being installed, both ends of each cable shall be clearly identified by the use of numbered tapes or a similar product.

7.6 Sheath Testing

Following the installation all new lengths and prior to the jointing of polymeric sheathed 6.6kV, 11kV, 20kV, 33kV, 66kV and 132kV cables a sheath test shall be carried out in accordance with engineering operating standard EOS 09-0001 and specifically engineering construction procedure ECP 11-0505.

7.7 Support and Blinding of Cables

Sand filled bags shall be used to support cables, joints or ancillary equipment when necessary.

All accumulated water shall be pumped from the excavation before blinding the cable or duct.

Following installation, all cables shall be blinded to a compacted depth of 100mm above the cable or cable joint with soil taken from the excavated material or imported material. The blinding shall be free from materials that may damage the cable.

Imported material for blinding (sand) shall only be used for cables 20kV or below if all the excavated material is unsuitable.

All 33, 66 and 132kV cables shall be blinded with cement bound sand, complying with the requirements of ENA TS 97-01, except where cable rating calculations prove that a stabilised backfill material is not required, to a compacted depth of 100mm above the cable.

All blinding material over and around the cable and joint in joint bays shall be compacted by hand.

7.8 Installation of Cable Protection Covers

Marker tile tape or Stokbords® shall be installed over the cables as shown in the appropriate trench drawings shown in section 6 of this document.

There is no requirement to install either above approved ducts installed using trenchless techniques (i.e. directional drill), but either may be installed if it is deemed that additional protection is required.

Tile tape when used shall be cut cleanly and installed so that fully covers the cable or duct installed below it along its whole length.

Similarly, Stokbords® shall be installed so they fully cover the cable or duct below them and any gaps between individual Stokbord® shall be covered by an additional board applied over the top.

7.9 Reinstatement of Trenches

After the cables have been blinded all excavations in the highway shall be filled and reinstated in accordance with the requirements of the HAUC Specification for the Reinstatement of Openings in Highways or, in other situations, as otherwise specified.

All temporary supports and timbers shall be removed from the installation as reinstatement proceeds.

8 Trenchless Installation

8.1 General

All excavation and reinstatement work involved with trenchless methods shall be carried out in accordance with this Engineering Design Standard.

When the ground conditions are suitable, cables and ducts (up to 250mm internal diameter) can be installed using trenchless installation techniques.

The entire cable or duct length shall be installed at a depth not less than the standard depth appropriate to the cable operating voltage (section 6). Where it is necessary to install a cable or a duct deeper than the standard depth, account for the increased depth in respect to a reduced rating, which will increase cable conductor size and future access to the asset should be taken in to account.

All ducts and couplings shall comply with UK Power Networks' Engineering Approval Standard EAS 00-0002.

Duct lengths shall only be connected by either butt fuse or electro fuse welding. The method used shall not reduce the internal diameter by more than 5mm.

9 Provision of Cable Records

A complete record of all LV to 33kV cable installations shall be recorded as required in Engineering Operating Standard EOS 09-0100.

All 33kV, 66kV and 132kV cable installations shall be recorded as specified in section 3.19 and Appendix D of ENA TS 09-02.

10 References

EAS 00-0002	Approved Equipment List - Cables and Joints
ECP 11-0505	Polymeric Cable Sheath Testing Procedure
EDS 02-0031	Installation of Power Cables and Joints in Air
EOS 09-0001	High Voltage Insulation Testing Policy
EOS 09-0100	Site Recording of Cables, Plant and equipment
ENA TS 09-02	Supply, Delivery and Inspection of Power cables with Operating Voltages in the Range 33kV to 400kV and Associated Auxiliary Cables
ENA TS 97-01	Special Backfill for Cable Installations
SWP 001	Street Works Policy

UK Power Networks' Distribution Safety Rules (DSR) & associated Codes of Practice

UK Power Networks' Excavation and cable Installation Manual

Appendix A - Cable Maximum Pulling Tensions, Minimum Duct Sizes and Bending Radii

A.1 LV Service and Waveform Cables

Cable Size (mm^2) & Type		Maximum Pulling Tension Newton (kgf)	Minimum Duct Internal Diameter (mm)	Minimum Bending Radius (mm)
4	1ph copper XLPE/PVC concentric	manual	32	75
25	1ph Aluminium XLPE/PVC concentric	manual	32	100
35	1ph Aluminium XLPE/PVC concentric	manual	32	125
35	3ph Aluminium XLPE/PVC concentric	manual	41	210
95	3ph Waveform	3000 (306)	100	550
185	3ph Waveform	7000 (714)	100	700
300	3ph Waveform	7000 (714)	100	850
600	Single core aluminium PVC/PVC	manual	125	350
740	Single core aluminium PVC/PVC	manual	125	400

A.2 11kV Cables

Cable Size (mm^2) & Type		Maximum Pulling Tension Newton (kgf)	Minimum Duct Internal Diameter (mm)	Minimum Bending Radius (mm)
95	Triplex Aluminium XLPE	8380 (855)	100	920
185	Triplex Aluminium XLPE	16300 (1665)	110	1060
185	Triplex Copper XLPE	9075 (925)	110	1120
300	Triplex Aluminium XLPE	26475 (2700)	125	1210
300	Triplex Copper XLPE	14700 (1500)	125	1290

A.3 20kV Cables

Cable Size (mm^2) & Type		Maximum Pulling Tension Newton (kgf)	Minimum Duct Internal Diameter (mm)	Minimum Bending Radius (mm)
300	Triplex Copper XLPE	14700 (1500)	150	1250
400	Triplex Copper XLPE	19600 (2000)	150	1350

A.4 33kV Cables

Cable Size (mm^2) & Type		Maximum Pulling Tension Newton (kgf)	Minimum Duct Internal Diameter (mm)	Minimum Bending Radius (mm)
300*	Single core Aluminium XLPE	8900 (910)	150	1000
400*	Single core Copper XLPE	19600 (2000)	150	1050
500*	Single core Aluminium XLPE	14700 (1500)	150	1500
630*	Single core Aluminium XLPE	18600 (1900)	190	1600
630*	Single core Copper XLPE	19600 (2000)	190	1600
800*	Single core Copper XLPE	19600 (2000)	190	1700

* In situations where three single core cables are pulled into a single duct using a single winch the above maximum pulling tensions still apply.

A.5 Multi-core and Multi-pair Cables

Cable Size (mm^2) & Type	Maximum Pulling Tension Newton (kgf)	Minimum Duct Internal Diameter (mm)	Minimum Bending Radius (mm)
4 pair - 0.8mm Multi-pair	2040 (208)	85	165
7 pair - 0.8mm Multi-pair	2620 (267)	85	185
19 pair - 0.8mm Multi-pair	5210 (531)	85	260
37 pair - 0.8mm Multi-pair	8940 (911)	85	340
61 pair - 0.8mm Multi-pair	13620 (1388)	85	420
4 core - 2.5mm Multi-core	1125 (114)	85	120
7 core - 2.5mm Multi-core	1462 (149)	85	140
12 core - 2.5mm Multi-core	2508 (255)	85	180
19 core - 2.5mm Multi-core	3530 (359)	85	215
27 core - 2.5mm Multi-core	4700 (479)	85	250
37 core - 2.5mm Multi-core	5710 (582)	85	275