

# CONDUIT TECHNICAL STANDARD

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THIS STANDARD APPLIES FOR THE INSTALLATION OF  
POWER AND COMMUNICATION CONDUITS BY  
DEVELOPERS AND EVOENERGY PERSONNEL

This standard provides an overview of the conduit installation in terms of depth, bends, protection, regulations etc.

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# 1. PURPOSE

To state the technical standards for power and communication cable conduits.

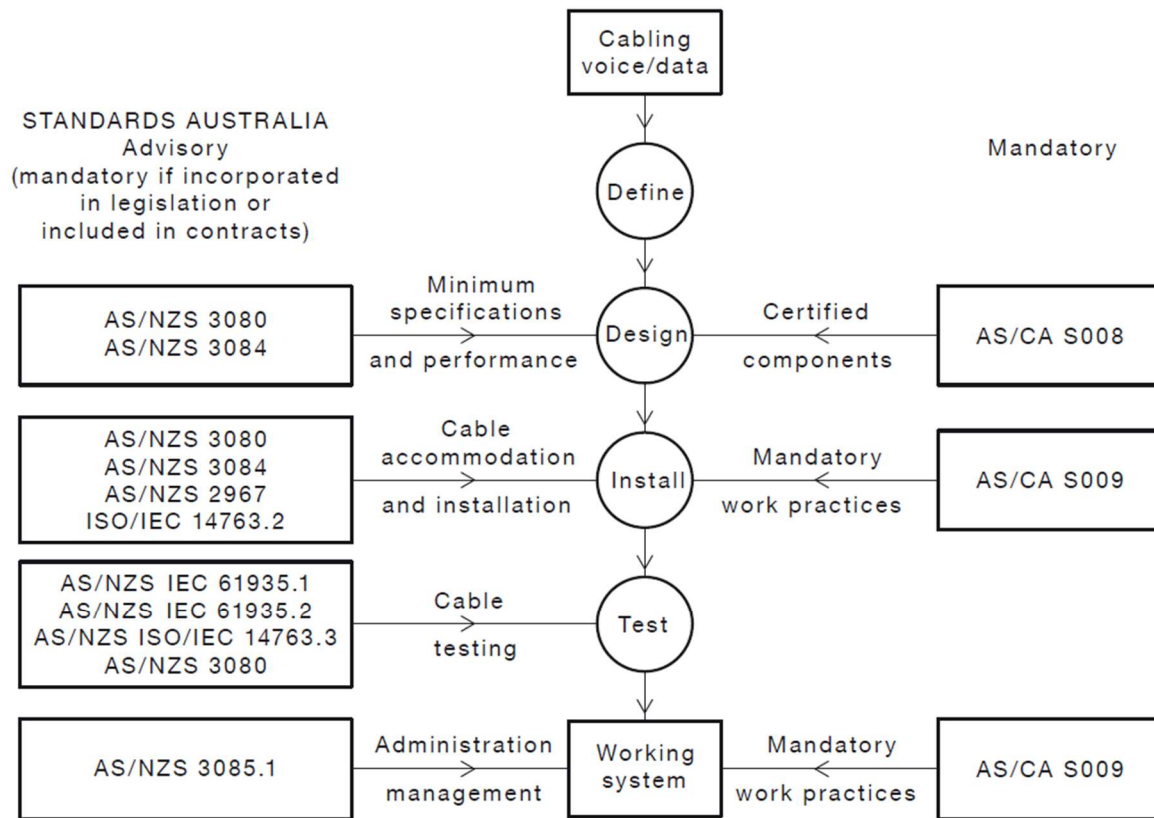
# 2. PROCEDURE

## 2.1 Conduit Locations

In major private developments and new suburb developments, Evoenergy will provide a drawing or will approve a developer’s drawing detailing the numbers, size, location and types of all conduits required together with cable jointing pits if necessary.

## 2.2 Standards and Legislation

Figure 1 provides an overview of the Australian Standards documentation in relation to communications cabling [reference AS/NZS 3080: 2013, page 195]



(a) In Australia

**FIGURE 1.** OVERVIEW OF THE AUSTRALIAN STANDARDS DOCUMENTATION

Conduits must comply with:

- 📄 AS 2053 Conduits and fittings for Electrical Installations;
- 📄 AS 3000 SAA wiring rules;
- 📄 AS 1477 Un-plasticised PVC (UPVC) Pipes and fittings for pressure applications; and
- 📄 AS 1074 Steel Tubes and Tubulars.

All insulating conduits must be coloured light orange.

All metal conduits must be galvanized to comply with AS1650.

Standards:

- 📄 ISO 9001 Section 7.3;
- 📄 ISO 14001 Section 6.1.2; and
- 📄 ISO 45001

## 2.3 Conduit Sizes

The following are standard sizes and strengths used by Evoenergy:

- 📄 20mm heavy duty insulating conduit orange to AS2053.2;
- 📄 20mm medium duty insulating conduit grey to AS2053.2;
- 📄 20mm medium duty flexible corrugated insulating conduit grey to AS2053.5;
- 📄 25mm medium duty insulating conduit grey to AS2053.2;
- 📄 25mm medium duty flexible corrugated insulating conduit grey to AS2053.5;
- 📄 25mm medium duty galvanized steel tube (water pipe) to AS1074;
- 📄 32mm medium duty flexible corrugated insulating conduit grey to AS2053.5;
- 📄 32mm medium duty insulating conduit grey to AS2053.2;
- 📄 40mm medium duty galvanized steel tube (water pipe) to AS1074;
- 📄 50mm heavy duty insulating conduit orange to AS2053.2;
- 📄 63mm heavy duty insulating conduit orange to AS2053.2;
- 📄 125mm heavy duty insulating conduit orange to AS2053.2;
- 📄 125mm class 9 or class 12 pressure pipe to AS1477;
- 📄 125mm medium duty galvanized steel tube (water pipe) to AS1074;
- 📄 150mm heavy duty insulating conduit orange to AS2053.2;
- 📄 150mm class 9 or class 12 pressure pipe to AS1477; and
- 📄 150mm medium duty galvanized steel tube (water pipe) to AS1074.

Notes:

- 📄 AS2053.2 refers to Rigid plain conduits of insulating material.
- 📄 Insulating materials include Unplasticized PVC (UPVC).
- 📄 Conduits to AS2053.6 – Profile wall, smooth bore conduits are not acceptable.

## 2.4 Conduit Marker Tape

A marker tape must be installed above the following conduits:

- 📄 Heavy duty conduits to AS2053.2;
- 📄 Class 12 pressure pipes to AS1477; and
- 📄 Medium duty galvanized steel tubes (water pipe) to AS1074

The marker tape must be placed at a minimum of 200mm above the conduit, conform to AS2648.1 and be of minimum width 150mm and coloured light orange with black lettering stating

**“DANGER ELECTRIC CABLES”**

## 2.5 Conduit Protection

Additional mechanical protection must be installed with the following conduits:

- 📌 Medium duty conduits to AS2053.2; and
- 📌 Class 9 pressure pipes to AS1477.

The additional mechanical protection must be:

- 📌 Precast concrete slabs or electric bricks with the word “ELECTRIC” indented in letters 25 mm high and complying with the requirements of AS3000;
- 📌 75 mm of poured 15MPa concrete; or
- 📌 Polymeric cable cover strip of a material equivalent to conduit to AS2053.2 and having a thickness not less than 3 mm and installed in accordance with AS3000.

The mechanical protection must be placed not more than 75 mm above the conduit, shall be not less than 150 mm wide and shall overlap the conduit or conduits by at least 40 mm.

Where polymeric cable cover strips are used, marker tape as discussed in Section 2.4 is not required.

## 2.6 Conduit Installation by Boring

Conduits installed by boring do not require a marker tape or additional mechanical protection and must be installed in line with PO0793 Civil Works Field Manual Chapter 2 of 2. However, the depth to the top of the conduit must be a minimum of 750mm where high voltage cables are proposed to be installed and 600mm for low voltage and service cables.

Where the conduit passes beneath a load bearing structure such as a roadway or stormwater drain, the clearance below any element of the structure should be increased to 1200mm.

Any bore pipes are to have an internal diameter equivalent to the internal diameter of conduit specified. All relevant conduits to bore pipe connections are to be made in a trade-like manner using commercially available connectors that ensure a water tight seal is made.

## 2.7 Minimum Depth of Cover

Depth of cover is measured between the upper surface of the conduit and the finished surface level.

Conduits when laid in a shared trench must have cover depths as per the shared trench agreement drawing 393-010 or 393-011 or 393-012 (as per project requirement).

All other conduits must have minimum depths of cover as shown in Drawings 393-007 ‘Cable trench details for cable installations not covered by shared trench agreement’ and 390-002 ‘Conduit installation – Roadways and driveways’.

At all times the electrical conduits shall pass under gas lines and there must be a minimum separation clearance of 150mm between the electrical conduits and the gas line.

Conduits must not be installed to a depth greater than 1.5 metres without prior approval from Evoenergy’s Design Officer. In no circumstances shall the ends of the conduits be at a depth such that an excavation greater than 1.5 metres is required to install cables into the conduits. This requirement is to avoid shoring of trenches.

For conduits installed by boring refer to Section 2.6 *Conduits Installation by Boring*.

## 2.8 Conduits Under Roadways

Conduits under roadways must be designed, as per Drawing 393-003 and continue at least 1000mm beyond kerb, roadway edge, property line and/or obstructions along with bell mouths on conduit. Obstructions include all gas lines, Telstra plant, water mains, storm water mains, pram crossings and footpaths.

## 2.9 Inside the property boundaries

Where the conduits are to be laid in a common trench inside property boundaries, including town house developments and battleaxe blocks, this shall be done in accordance with AS3000.

## 2.10 Draw Wire

All conduits must be provided with a general-purpose synthetic polypropylene filament rope of minimum 6 mm diameter.

## 2.11 Conduit Installation General

Shared trench arrangements must be as per the drawing 393-010 or 393-011 or 393-012 (as per project requirement).

Metal and PVC conduits and fittings must have no internal burrs. All cut ends shall be deburred.

All joints and bellmouths must be glued using Type N PVC solvent cement. A suitable primer must be used first on both mating surfaces. PVC solvent cement shall then be applied to bond the primed surfaces. All joints must be properly made to eliminate the entry of water and foreign matter into the installed conduits.

Conduit ends must be plugged or capped with a non-perishable cover to prevent the entry of foreign material. The plugs or caps are to be fitted such that dislodgment prior to cable installation is prevented.

All conduit runs between cable jointing pits must be straight as far as possible. Where conduits are to be installed on curves, these must be assembled in several lengths before attempting to form large radius bends (see Section 2.14 Bends and Bending Radii).

Maximum conduit run length between the cable haulage pits must not exceed 200m.

Vehicular access is required to cable jointing pits.

All conduit entry points to substations should have fire stopping according to the Evoenergy chamber substation design standard PO07201 Chamber Type Substation Design and Construction Standard.

## 2.12 Recommended Maximum Number of Cables in Conduits

Refer to Appendix A for two matrices detailing the maximum number of cables of varying sizes recommended to be put inside the conduits specified.

## 2.13 Drainage of Conduits

Where the ground level at the street end of a conduit is above the floor level of the building in which the conduit terminates, a drain shall be provided from the conduit to ensure the conduit is drained and water does not enter the switchboard. One of the following methods shall apply:

- ☞ Where the conduit rises on the outside of the building the drain shall be in the form of a 10mm diameter hole in the conduit, arranged to point towards the wall approximately 300mm above ground level so that the entry of water and debris is minimised.
- ☞ Where the conduit is not on the outside of the building, a 15mm PVC pipe shall be solvent-welded into the conduit without protruding into the bore. It shall be arranged to discharge to the exterior of the building, approximately 300mm above ground level.
- ☞ A special drainage pit may be required in some cases such as an indoor substation etc. Evoenergy's Design Officer is to be contacted in the first instance for details.

## 2.14 Bends and Bending Radii

Unless otherwise specified, the sum of conduit bend angles must not exceed 90 degrees in a single run. A common exception is where each end of the conduit is turned up into street lighting columns.

Bending radii must not be less than:

- 📌 Nominal 32/25 conduit - 250mm.
- 📌 Nominal 63/50/40 conduit - 310mm.
- 📌 Nominal 100, 125 and 150mm conduit - 1200mm.

## 2.15 Conduit Marking

For conduits which pass under existing concrete areas such as driveways, curbs, substation boundary fences, an aluminium marker disk shall be fixed to the concrete, e.g. by drilling a suitable hole and inserting a masonry nail, directly above the conduits. Same marking methods should also be used where conduits are installed at less than nominal depth.

Where the conduit contains electrical cables, the disk must have the text “Evoenergy Electrical” stamped on it.

Where the conduit contains an optical fibre cable, the marker disk must have text “Evoenergy Optic Fibre” stamped on it.

Conduits under kerbed roads in new development areas shall have their location marked by means of a 100mm high “E” stamped into the kerb face directly above the centre of the conduit(s).

In Town House style developments, following conduit inspection and subsequent backfilling of conduits terminating at property line or open spaces, a marker peg shall be provided to indicate the end of the conduit. This peg shall be labelled clearly with the letter “E”. Prior to the installation of underground cables, the developer shall expose the conduit ends.

## 2.16 Conduit Inspection

### 2.16.1 General

All conduit installations are subject to inspection by Evoenergy Design Officers. Refer to Evoenergy document PO0792 – Civil Works Field Manual Chapter 1 of 2 for further detail on this process.

A minimum of 24 hours’ notice must be provided to Evoenergy’s Design or Compliance Officer to arrange the conduit inspection.

Evoenergy will not undertake the installation of underground permanent cables on site until the conduit installation has met with its approval and an “As-Executed” plan or sketch has been provided by the builder/developer detailing the location of the conduit(s). A copy of the plan must also be located within each main switchboard or meter box for each unit.

### 2.16.2 Private Developments

Evoenergy’s Design or Compliance Officer will inspect the conduit installation and provide a report to the developer indicating whether the conduit installation is in accordance with the Conduit Requirements drawing and these standards or not. This report will also indicate the extent of defects etc.

Subsequent inspection will be necessary until the conduit installation meets Evoenergy’s approval.

### 2.16.3 Suburb Developments

Upon completion of the conduit installation written advice of this is to be forwarded to Evoenergy so that conduit marks may be inspected and recorded.

Where conduit marks have been omitted the contractor must prove that the relevant conduits exist and shall provide the marks as required.

The developer must expose the ends of any conduits if so required by Evoenergy.

Where excavation fails to prove the existence of conduits the developer must be responsible for the installation of the missing conduit(s) and all reinstatement of the excavated area/s.

If bitumen or concrete surfaces are to be excavated, by Evoenergy, for conduit repairs or to install missing conduits, within the normal 12 month liability period, the developer is responsible for the reinstatement of the excavated surface. The developer is also responsible for all relevant permit approvals.



## 2.16.4 Communications

Telecommunications services such as telephone connections to the public network, carrier service leased lines, and any other third party carriage service provider network, should be installed in white conduit, and conform to rules and regulations for the Telecommunications industry.

Optical Fibre cables used for the protection, control and operation of the electrical network, which may be installed alongside Evoenergy's electrical cables, are to conform to the following requirements:

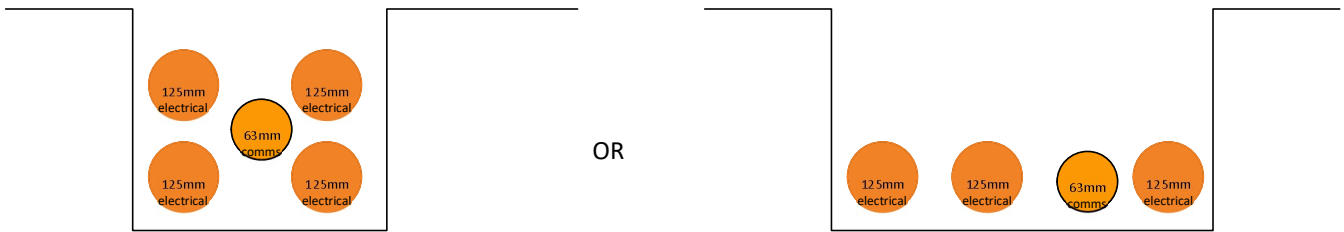
- 📌 Orange PVC, heavy duty grade, with minimum size, 63mm OD;
- 📌 All bends to be long radius bends;
- 📌 Installed Conduit size must make provision for an additional cable to be hauled in at a later date;
- 📌 Conduits for Optical Fibre cables, which in the future could be used for protection circuits must be arranged below the level of the electrical conductor cables;
- 📌 Pits to be installed as per Evoenergy document SM1153 "Telecommunications Pits and Installation";
- 📌 Where the conduit is in a trench by itself it must have a warning marker tape for Optical Fibre Cable, and the tape shall include a stainless steel conductor suitable for use with cable locator equipment. The conductor must be available in the pit next to the conduit for ease of connection to the cable locator equipment. Where the conduit and marker tape crosses under a substation boundary fence there shall be a break in the stainless steel conductor for a distance of 3 metres to eliminate risk of transferred voltages from the substation earth system;
- 📌 All such conduit runs are to be continuous, pit to pit, and fitted with draw wire or draw rope;
- 📌 All joints and bell mouths to be glued using Type N PVC solvent cement;
- 📌 100mm communications conduits may be installed with 3 x 32mm subducts; and
- 📌 Marker disks must be installed on concrete curbs, substation boundaries, edge of concrete driveways etc, with appropriate text on it, as per Section 2.15.

Where the conduit comes out of the ground, e.g., onto cable trays or Gatic style trenches in the substation environment, then the conduit must have "Optical Fibre Cable" marker tape wrapped around the conduit at 3 metre intervals, and other locations where the conduit is visible, and as appropriate.

Conduits holding protection fibre cable will not be made available for third party access and must retain at all times sufficient spare capacity to install an additional fibre cable under fault conditions.

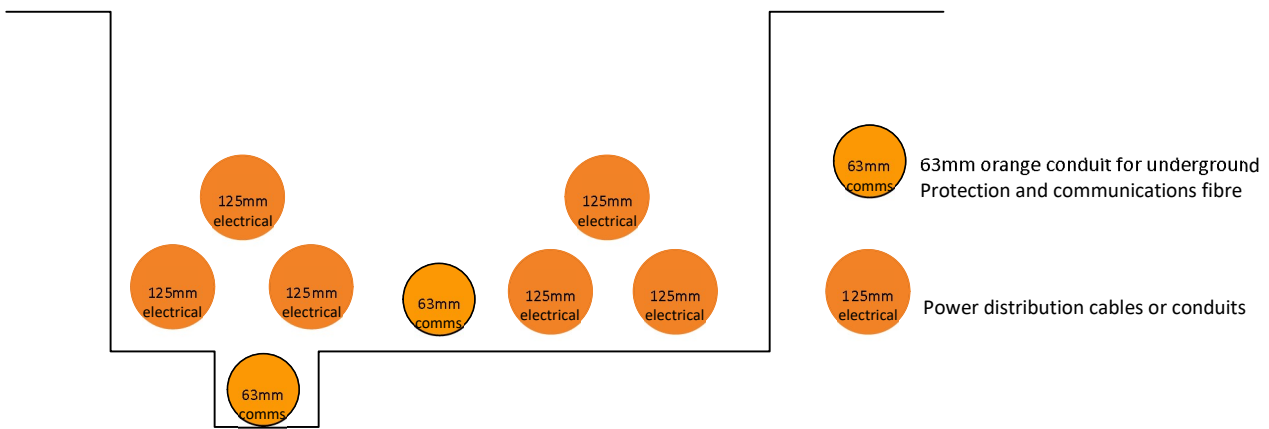
When selecting the conduit to be used for protection fibres from a nest of conduits, the planner or designer will need to consider the future possible electrical build activity, such that the fibre will not be affected by that work. Typically, select a conduit on the side of the nest and second from the top. Conduits holding protection fibres are not to be above the electrical conductors (i.e. cables or electrical conduits must offer a minimum of one layer of cover).

Communications conduits will also be provided by default with HV buried cable or conduit installations. The typical configuration is as shown in Figure 2 below:



**FIGURE 2.** TYPICAL CONDUIT INSTALLATION DETAILS

When installing communications conduits for critical protection that requires diversity and is to be installed in the one trench, use two 63 mm orange conduits in the arrangement indicated in Figure 3 below.



**FIGURE 3.** DIVERSE COMMUNICATIONS CONDUIT LOCATION IN A SINGLE TRENCH

The key feature of the arrangements is that one is below the feeder and the other is between the feeders. In this way we can mitigate the risk from vertical excavation damaging only one or a horizontal excavation damaging only one, without first coming into contact with the HV cables.

Communications conduits and subducts must be labelled as Evoenergy assets.

Evoenergy communications conduits must also:

- 📌 be installed below or between HV cables, as shown above, OR with 900mm cover outside Evoenergy substation fence and 500 mm cover inside the fence; and
- 📌 have a bend radius as large as feasible, but not less than 1200mm.

### 3. REFERENCES

EVOENERGY DOCUMENTS	
Document number	Document title
PO07201	Chamber type substation design and construction standard
PO07401	Network Design Standard for Telecommunications Pits including Specification and Installation
PO07173	Service and Installation rules
PO07335	Conduit Technical Specifications
PO0792	Civil Works Field Manual Chapter 1 of 2

PO0793	Civil Works Field Manual Chapter 2 of 2
<b>EVOENERGY DRAWINGS</b>	
<b>Document number</b>	<b>Document title</b>
8912-02	Underground Service Conduit Requirements
390-002	Conduit Installation Roadways and Driveways
393-007	Cable trench details for cable installations not covered by shared trench agreement
393-010	Underground services in a shared trench electrical pit requirement
393-011	Underground services in a shared trench, Submersible electrical pit requirement with Gas
393-012	Underground services in a shared trench, Submersible electrical pit requirement without Gas
<b>AUSTRALIA STANDARDS</b>	
<b>Document number</b>	<b>Document title</b>
AS 2067	Substations and High Voltage Installations Exceeding 1 KV A.C.
AS/ NZS 3000	Electrical Installations
AS 60079 series	Electrical Equipment for Explosive Atmospheres-Selection, Installation and Maintenance
AS 60076.10	Power transformer, Part 10: Determination of sound levels
<b>OTHER DOCUMENTS</b>	
<b>Document owner</b>	<b>Document title</b>
TCCS	Standard specification for urban infrastructure works; Sections 2 - Earthworks and Section 3 – Underground Services

## VERSION CONTROL

VERSION	DETAILS	APPROVED
1.0	Updated into new format	31 January 2013
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4.0	Minor amendments	12 December 2014
5.0	Minor amendments	12 December 2014
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8.0	Updated for Evoenergy rebranding	02 August 2017
9.0	Minor amendments; re-formatted using IMS template	30 April 2018

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11.0	Minor amendments & updated into new format	N. Azizi; W. Cleland; 1 Sep 2020
11.1	Updated AS 4801 to ISO 45001	Safety and Compliance Auditor
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## DOCUMENT CONTROL

DOCUMENT OWNER	PUBLISH DATE	REVIEW DATE
Asset Standards Manager	17/11/2020	17/11/2023

## APPENDIX A – MAXIMUM NUMBER OF CABLES IN CONDUITS

As per AS3000, SAA wiring rules, Appendix C6 for the number of cables in a conduit has been calculated and presented below.

### GUIDE TO THE MAXIMUM NUMBER OF HV CABLES INSTALLED IN CONDUIT

CABLE				CONDUIT SIZE (Internal Diameter) WITH MAXIMUM NUMBER OF CABLES IN CONDUIT				
Type & number of Cores	Conductor cross sectional area (mm <sup>2</sup> )	Cable Diameter (mm)	Minimum Bending Radius (mm)	50mm	63mm	100mm	125mm	150mm
HV One Core	35	28	510	0	1	2	3	3
	240	37	640	0	0	1	2	3
HV Three Core	240	76	1320	0	0	0	1	1
	300	78	1430	0	0	0	1	1
	400	90	1560	0	0	0	0	1

### GUIDE TO THE MAXIMUM NUMBER OF LV CABLES INSTALLED IN CONDUIT

CABLE				CONDUIT SIZE (Internal Diameter) WITH MAXIMUM NUMBER OF CABLES IN CONDUIT				
Type & number of Cores	Conductor cross sectional area (mm <sup>2</sup> )	Cable Diameter (mm)	Minimum Bending Radius (mm)	50mm	63mm	100mm	125mm	150mm
LV One Core	70	16	150	1	2	3	4	4
	150	23	210	0	0	4	4	4
	240	28	260	0	0	0	4	4
	300	31	280	0	0	0	4	4
	500	39	360	0	0	0	4	4
LV Two Core	16	18	330	1	2	3	4	5
LV Four Core	16	22	400	1	1	2	4	5
	35	30	540	0	1	2	3	4
	240	55	990	0	0	1	1	1