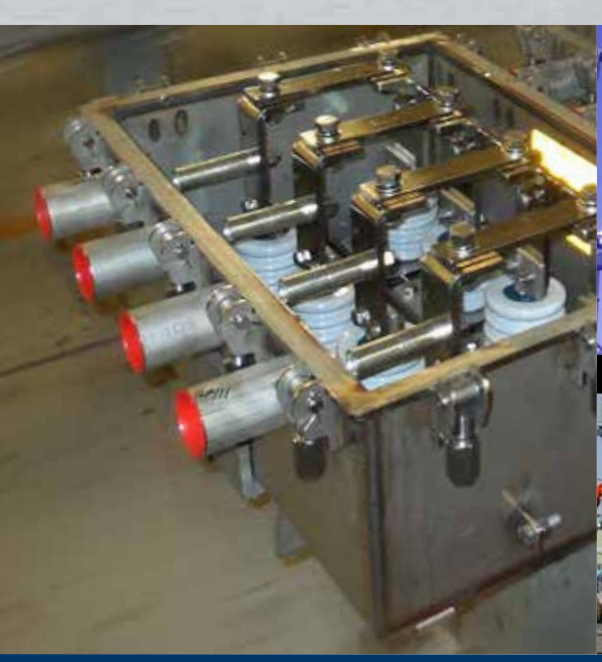
PREFORMED LINE PRODUCTS
The connection you can count on.

COMMUNICATIONS ENERGY SYSTEM ENCLOSURES SPECIAL INDUSTRIES



LINK BOXES

The Connection You Can Count On

Why Link Boxes?

Underground power cable system design presents unique design and installation challenges not found in the overhead power cable environment. Poorer thermal dissipation, confined spaces, lack of visibility, more difficult fault diagnosis, circulating earth currents, and frequent joints in an unfriendly environment are all problems that cable engineering must overcome to deliver a reliable long term installation.

Minimisation Of Sheath Current Losses

To eliminate or minimise circulating sheath currents following steps are widely used:

1. Transpose the position of the cables relative to each other every joint bay. This ensures that sheath induction is balanced in each cable.

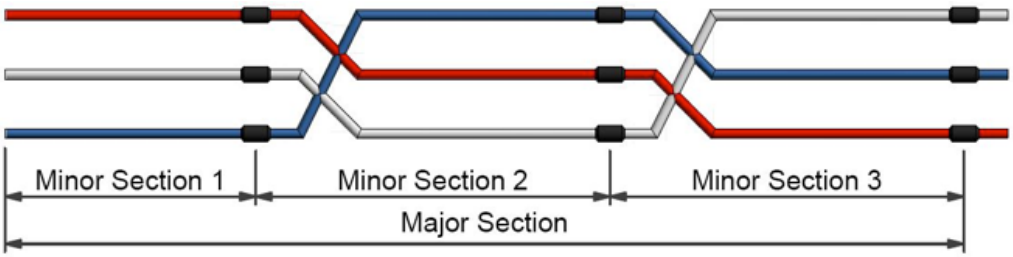


Figure 1: Load Conductor Transposition (Sheaths not shown)

2. Use a cross bonding link box at every transposition or splice point to transpose the metallic cable sheaths, connecting them to the sheath on adjacent phase cable. Each collection of three minor sections is termed a major section. This rotation of the sheaths effectively cancels circulating sheath currents. It is common practice to earth bond at each major node.

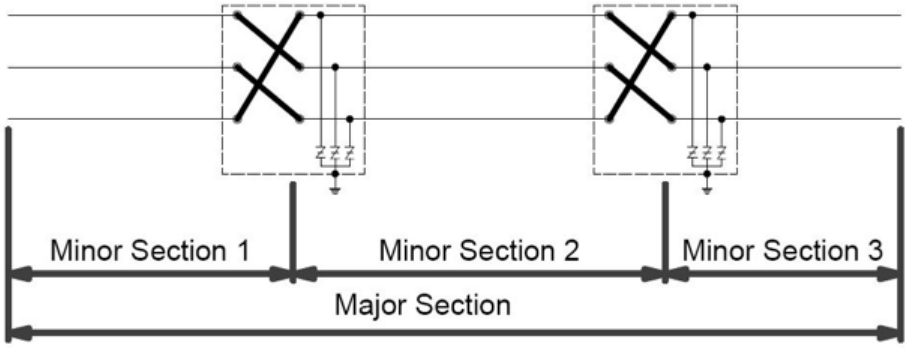


Figure 2: Cable Sheath Transposition (Load conductors not shown)

3. If the practical length of the cable run does not permit a whole number of major sections, one or two minor sections are used, single point earth bonded so no sheath current can circulate. The load current will induce an increasing voltage between sheath and earth to a maximum at the non-earthed end.

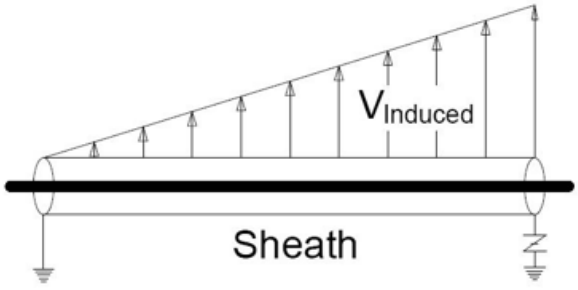


Figure 3: Single Point Earth Bond (One phase only shown)

Surge voltage limiters or arrestors are routinely used between sheaths and earth to limit induced voltage spikes that may occur during transient and fault conditions.

PLP Link Boxes

PLP Link Boxes are used by Utilities, Contractors and Cable Manufacturers for earthing and bonding cable sheaths of underground power cables, installed in a flat formation, so that the circulating currents and induced voltages are eliminated or reduced.

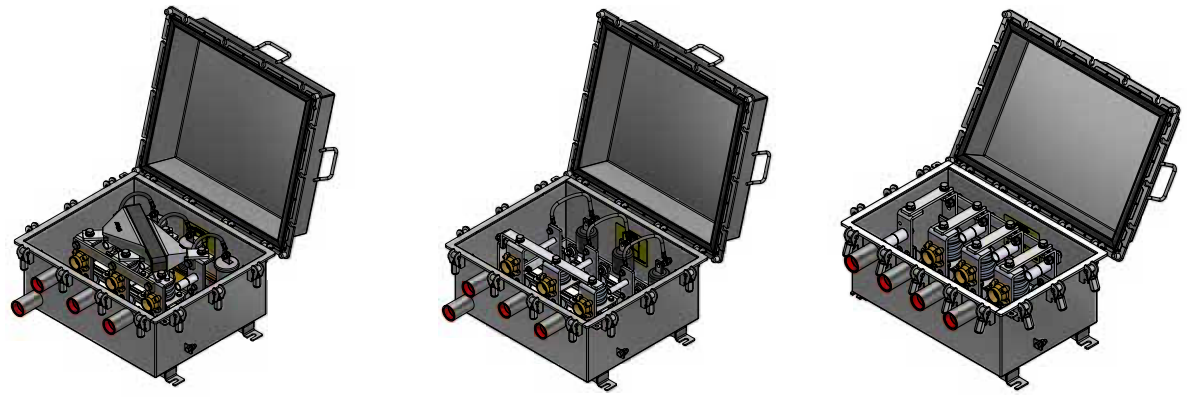
Using robotic welding technology, PLP can deliver a robust design capable of withstanding all mechanical and environmental conditions a link box may endure. PLP's designs are type tested to 250kPa, constructed of SS316 with an IP68 rating, which is achieved by using a multi lip vulcanised lid seal and high quality sealing materials for the cable entries. A 100% routine pressure testing process ensures that each link box provides a moisture free environment for the cable metal sheath connections and links.

The clam shell design of the link box uses a smart flange and an encapsulated swing bolt system, allowing the lid to be hinged on all sides or fully removed. This provides the operator improved access to the cable connections and links, thus reducing installation and testing times. The vulcanised lid seal is attached to the lid and not to the box, as per other manufacturers designs, this is to avoid damage during the installation process.

PLP link boxes are used for a wide range of HV cable systems, to eliminate or reduce sheath currents and provide sheath over voltage protection. Different cable sheath earthing practices require a number of link box designs. These designs are suitable for either single core or concentric bonding type termination cables, and can be directly earthed or earthed through a specialised surge arrester.
The most common designs are:

- **Cross bonding**
- **Single point bonding**
- **Earthing**

Figure 4: Most common types shown



PLP Link boxes are type tested to UK EA (United Kingdom Electricity Association) Engineering Recommendation C55/4	
Short Circuit Rating	50kA for 1 second
Electrical resistances:	
• Links	< 5 μΩ
• SVL connections	<10 μΩ
• Links & earth to furthest SVL	<30 μΩ
Pressure type test	250 kPa Internal
Pressure Routine test	100 kPa 15 minutes
AC Voltage withstand	20kV rms 5 minutes
DC Voltage withstand	40kV DC 1 minute
Lightning Impulse Withstand	70kV phase to phase, 37.5kV phase to earth

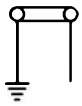
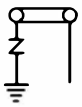
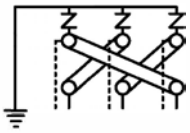
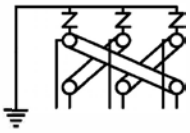
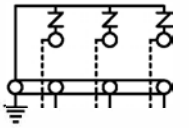
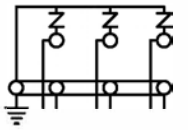
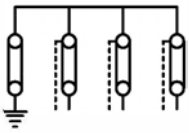
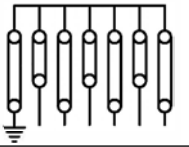
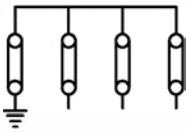
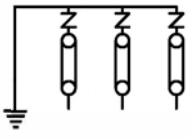
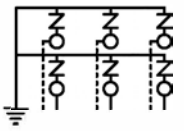
Manufacturing, Testing & Installation

ROBOT WELDING

ASSEMBLY & TESTING

INSTALLATION

Typical Schematic Diagrams

DIAGRAM	SERIES	DESCRIPTION
	A8406	SINGLE PHASE DIRECT SHEATH EARTHING
	A8407	SINGLE PHASE SVL SHEATH EARTHING
	A8400 & A8411	CROSSBONDING CONCENTRIC CABLES
	A8401	CROSSBONDING SINGLE CORE CABLE
	A8402	SINGLE POINT BONDING CONCENTRIC CABLE
	A8412	SINGLE POINT BONDING SINGLE CORE CABLE
	A8404	DIRECT EARTHING CONCENTRIC CABLE
	A8408	DIRECT EARTHING SINGLE CORE CABLE
	A8405	DIRECT EARTHING SINGLE CORE CABLE
	A8409	SVL EARTHING SINGLE CORE CABLE
	A8493	SVL EARTHING SINGLE CORE CABLE

Sheath Voltage Limiter (SVL)

These special surge arresters are of relatively low continuous operating voltage.

The correct sheath voltage limiter (SVL) is dictated by the need to withstand the highest external transient voltages that can occur from switching, faults and lightning, which generate damaging over-voltages.

The SVL used in PLP link boxes use Class III zinc oxide blocks capable of withstanding high current surges and have the capacity to absorb and dissipate this energy.

SVL Type		**A8473-01**	**A8473-02**	**A8473-03**	**A8473-04**	**A8473-05**
Ur (Rated Voltage)	kVrms	3	4.5	6	7.5	9
Uc (Continuous Operating Voltage)	kVrms	2.4	3.6	4.8	6.0	7.2
MCOV (Maximum Continuous Operating Voltage)	kVrms	2.50	3.75	5.00	6.25	7.5
Rated 8/20µs current	kA	20	20	20	20	20
20kA 8/20, 20 shot duty cycle with power frequency voltage applied 1s/shot	kVrms	3.6	5.4	7.2	9	10.8
High current 4/10µs withstand	kVrms	100	100	100	100	100
Low current rectangular 2000µs duration withstand(20) shot	A	>700	>700	>700	>700	>700
Energy absorption (on each of 20 shots)	kJ	10	15	20	25	30
Maximum 8/20µs residual voltage at: 1.5kA	kV	6.7	10.0	13.3	16.6	20.0
3kA	kV	7.0	10.4	13.9	17.4	20.9
5kA	kV	7.3	10.9	14.5	18.1	21.8
10kA	kV	7.7	11.6	15.5	19.3	23.2
20kA	kV	8.5	12.7	17.0	21.2	25.5
40kA	kV	9.6	14.4	19.3	24.1	28.9
65kA (4/10µs)	kV	13.2	18.9	26.5	32.1	39.7
Residual at 15kA 1µs current rise time	kV	9.1	13.0	18.1	22.0	27.2
Resistance at 2500Vdc	MΩ	>100	>100	>100	>100	>100
Resistance at 1500Vdc	MΩ	>100	>100	>100	>100	>100
Temporary over-voltage (TOV) 1s withstand:						
from no prior load	kVrms	3.3	4.95	6.6	8.25	9.9
TOV of 5kV dc withstand time	S	0.1	∞	∞	∞	∞
TOV of 3.5kV dc withstand time	S	24h	∞	∞	∞	∞
TOV of 2.5kV dc withstand time	S	∞	∞	∞	∞	∞
Current at 5kV dc	A	0.0011	0.00001	<0.000001	<0.000001	<0.000001
Reference Current	mA DC	1	1	1	1	1
Reference Voltage (minimum) kV	DC	4.3	6.4	8.6	10.7	12.9

Notes

PREFORMED
LINE PRODUCTS

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