



Committed to service

PANDROL

Cable/ Rail Welding



KLK weld

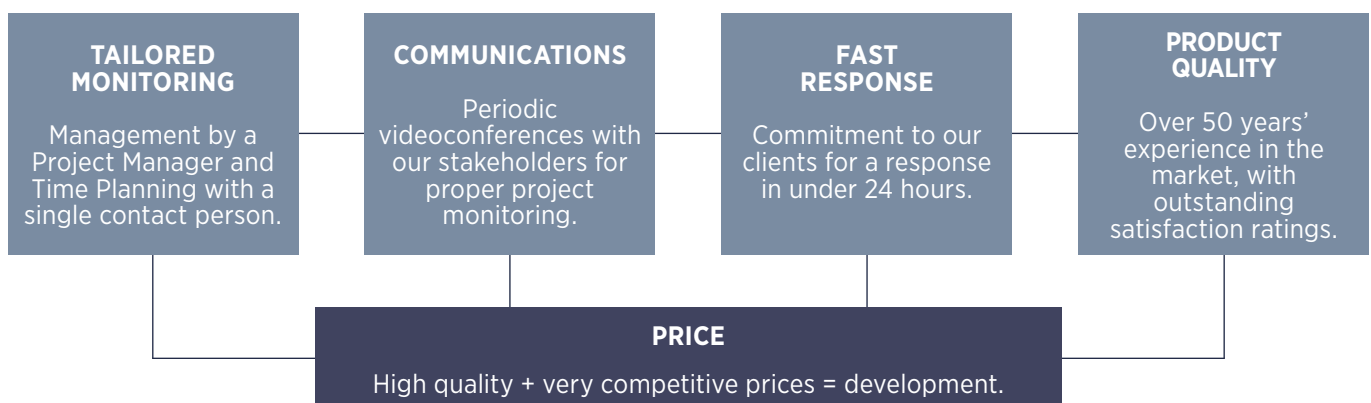
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KLK is

An organisation that has always been committed to quality, safety and health at work. Throughout its history, KLK has kept evolving, based on our process of continuous improvement in all business areas, paying particular attention to the safety of people, the quality of our work and the protection and conservation of the environment.

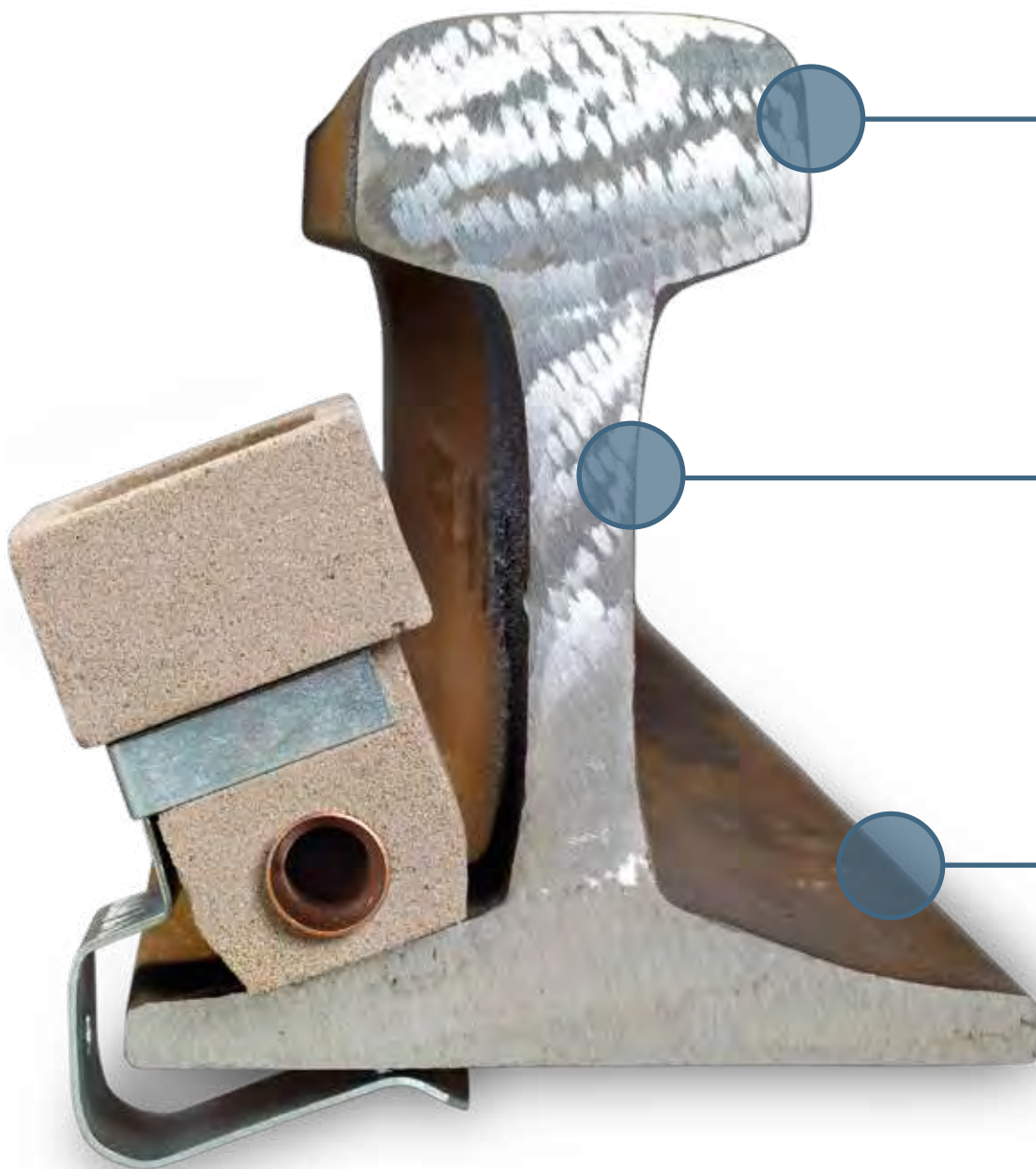
With this philosophy, we apply Quality, Safety and Health, Environment policies, throughout our business activities, based on the ISO 9001, ISO 45001 and ISO 14001 standards.



Rail connections

Are elements connected to the rail to perform technical functions required by the different systems that complement railway traffic.

They are used in electrification and safety installations, to ensure quality and functionality for proper railway operations.



Connection types

To Head.

These are mainly made using flanges. Their purpose is to electrically connect two mechanically joined track sections.

To Web.

We recommend welding to the middle of the web to avoid damaging the rail.

To Foot.

The easiest and most convenient connection to make. In this case, we can use either a graphite mold or a single-use sand mold. This last option is the most recommendable because it is an indirect welding that does not affect the steel of the rail.

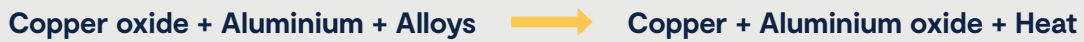
KLK-weld Procedure

The KLK-weld aluminothermic welding procedure is an exothermic reaction that occurs when aluminium reduces copper oxide.

Our working principle is:

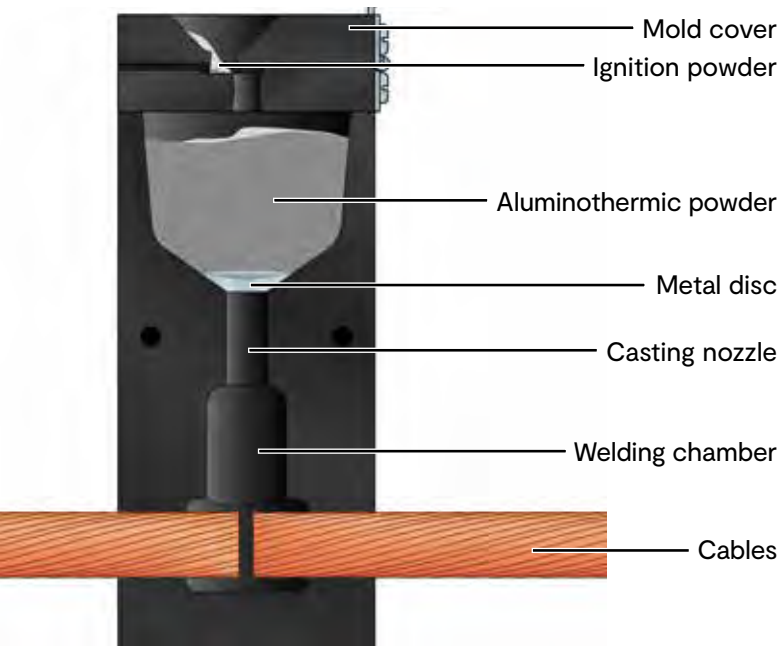


Which translates to:



Molds

The reaction takes place inside a graphite mold, which has a life span of at least 70 welds, or sand, for single use (ELPA kit).



Cartridges

The heat from the exothermic reaction is sufficient to melt the metals in the crucible, without the need for any other external energy source.

The shutter disc has a triple function:

1. Retain the dust before ignition.
2. Allow a homogeneous chemical reaction before casting.
3. Ensure separation between the slag (aluminium oxide) and the higher density melting metal (copper).

The temperature reached (over 2,500°C) is higher than the melting point of metals such as copper, steel, brass, bronze.

The parts to be welded, are first placed in the welding chamber and then melted by the heat contributed by the liquefied metal.

This produces a mechanical and electrical connection made of an alloy of the different metals melted together.

The intra-molecular structure gives this bond several advantages:

1. Not damaged by corrosion.
2. Electrical characteristics better than other types of mechanical connections.
3. Optimal mechanical characteristics.
4. No dielectric influence due to different types of metals.



Cartridge type	C-15	C-25	C-32	C-45	C-65	C-90	C-115	C-150	C-200	C-250
Colour	Light grey	Dark grey	Violet	White	Yellow	Orange	Red	Brown	Blue	Green
Units per box	20	20	20	20	10	10	10	10	10	10

KLK-weld Equipment

The KLK-weld equipment is light and portable, and does not require any external power source, making it suitable for field use. Non-specialist personnel can achieve optimal electrical connections and high mechanical quality in a very short time.



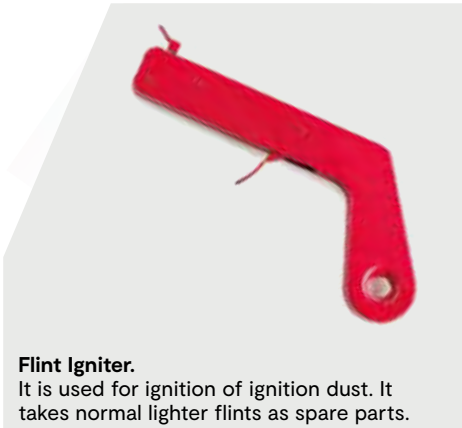
Mold.
The molds are machined from a block of refractory material (graphite).



Card Cloth Brush.
Used for the correct cleaning of cables to be used.



Mold Brush.
For cleaning the inside of the mold after each weld.



Flint Igniter.
It is used for ignition of ignition dust. It takes normal lighter flints as spare parts.



RR Scraper.
Its shape is specially designed for cleaning the RR-type mold loading hopper.



R Scraper.
Its shape is specially designed for cleaning the mold loading hopper. Types: R-45, R-90, R-150, R-750.



Sealing Paste.
Beads of refractory paste prevent leakage of molten copper between the walls of the mold and the conductors to be welded.



Remote Igniter.
System used to ignite the load safely and cleanly.



Long Consumable.
To carry out the ignition with the remote igniter.

Handle Clamps

The handle clamps for cable/rail welding are designed to fix the mold to the rail as required in each particular case. The fixing mechanism is adjustable to properly fit each rail type. The molds are replaced easily and quickly.

To avoid loss of molten metal, we recommend apply sealing paste.



TRA-D/SDRR, TRA/V-16 Handle Clamp.



SMRTC/MS Handle Clamp.



TRA-C/SLT, TRA/V-17 Handle Clamp.



TSC-80 Handle Clamp.



TRA-P/SLP-SEI Handle Clamp.



TRA-A/SMRLC Handle Clamp.

Connection Types

ELPA**MRR
(CRA-CRR)****CRA-TA****MLT
(CRA-TC)****CRA-TP****MRLA
(CRA-TH)****CRA-PH****BRA-V****SEI****SEI/PR****MRLC****MRTC**

ELPA welding procedure

Procedure for welding electrical connections between copper cable and rail foot

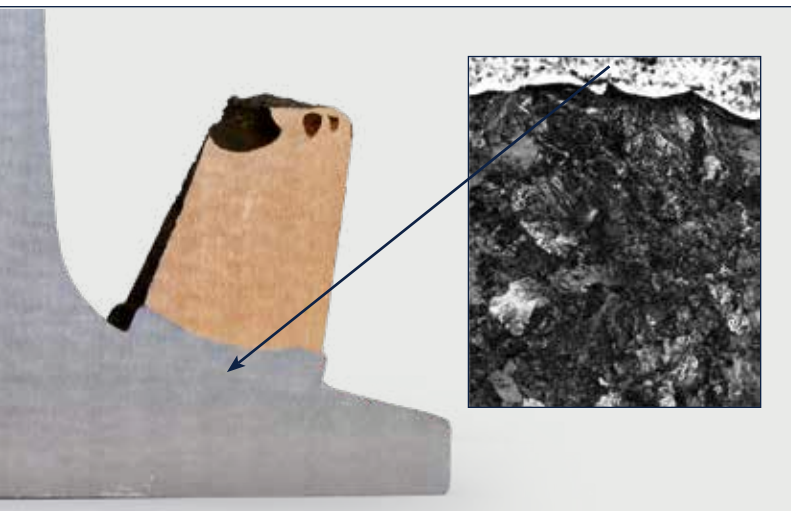


The **ELPA KLK-weld** procedure is the best solution for making the electrical connection between the copper cable to the rail foot, as the resulting weld has a low electrical resistivity and a high mechanical strength in the connection. This procedure does not change the rail structure, as the temperature never exceeds 600 °C.





The electrical resistance of the connection is less than $10^{-5} \Omega$, and the mechanical shear resistance at the plate/rail joint is greater than 50 kN.



Unlike other welding procedures, the **ELPA KLK-weld** procedure does not affect the rail steel. A micrographic study of the braze weld of the plate to the rail shows that the steel structure in the rail remains unchanged, totally pearlitic and with no cracks.

The **ELPA KLK-weld** procedure combines aluminothermic welding and capillary tin-silver welding processes in which the latter takes advantage of the heat produced in the former. A ferritic steel plate is placed between the copper cable and the foot of the rail so the thermal shock of the aluminothermic molten metal is absorbed by it, and the copper cable is welded to the plate. Since the plate incorporates, on the side in contact with the rail, a tin-silver alloy, the final joint of the plate to the rail is made as a result of the combination of the heat that melts this alloy and the force of a spring that pushes the plate against the rail during the solidification process.



The spring clip acts as a system for fastening the mold to the rail runner. This system is suitable for most rail profiles.

The **ELPA KLK-weld** kit includes:

- a. Ceramic mold with a steel plate, sleeve for cable entrance, metal disc to seal the crucible draining hole, mold lid and spring clip.
- b. Cartridge containing the welding and the ignition powder.
- c. Flux portion.
- d. User guide.



The **ELPA KLK-weld** kits are manufactured for cable cross-sections ranging from 10 mm² to 240 mm² and can be used with most rail profiles: AREA, BS, UIC, U, S, RN, etc. The following are examples of possible kits:

Name	Application (*)	S.N.C.F
ELPA 10 Kit	Copper cable, 10 mm ² (Ø4.05 mm)	
ELPA 35 Kit	Copper cable, 35 mm ² (Ø7.6 mm)	0.393.1209.5
ELPA 50 Kit	Copper cable, 50 mm ² (Ø9.2 mm)	
ELPA 70 Kit	Copper cable, 70 mm ² (Ø10.9 mm)	0.393.1210.3
ELPA 95 Kit	Copper cable, 95 mm ² (Ø12.6 mm)	0.393.1211.1
ELPA 120 Kit	Copper cable, 120 mm ² (Ø14.3 mm)	
ELPA 150 Kit	Copper cable, 150 mm ² (Ø15.6 mm)	
ELPA 185 Kit	Copper cable, 185 mm ² (Ø17.6 mm)	0.393.1212.9
ELPA 240 R Kit	Copper cable, 240 mm ² (Ø20.0 mm)	
ELPA 240 Kit	Copper cable, 240 mm ² (Ø23.0 mm)	
ELPA 12 Kit	Bolt Ø12 mm (**)	

(*) Ask us about other cross-sections/diameters.

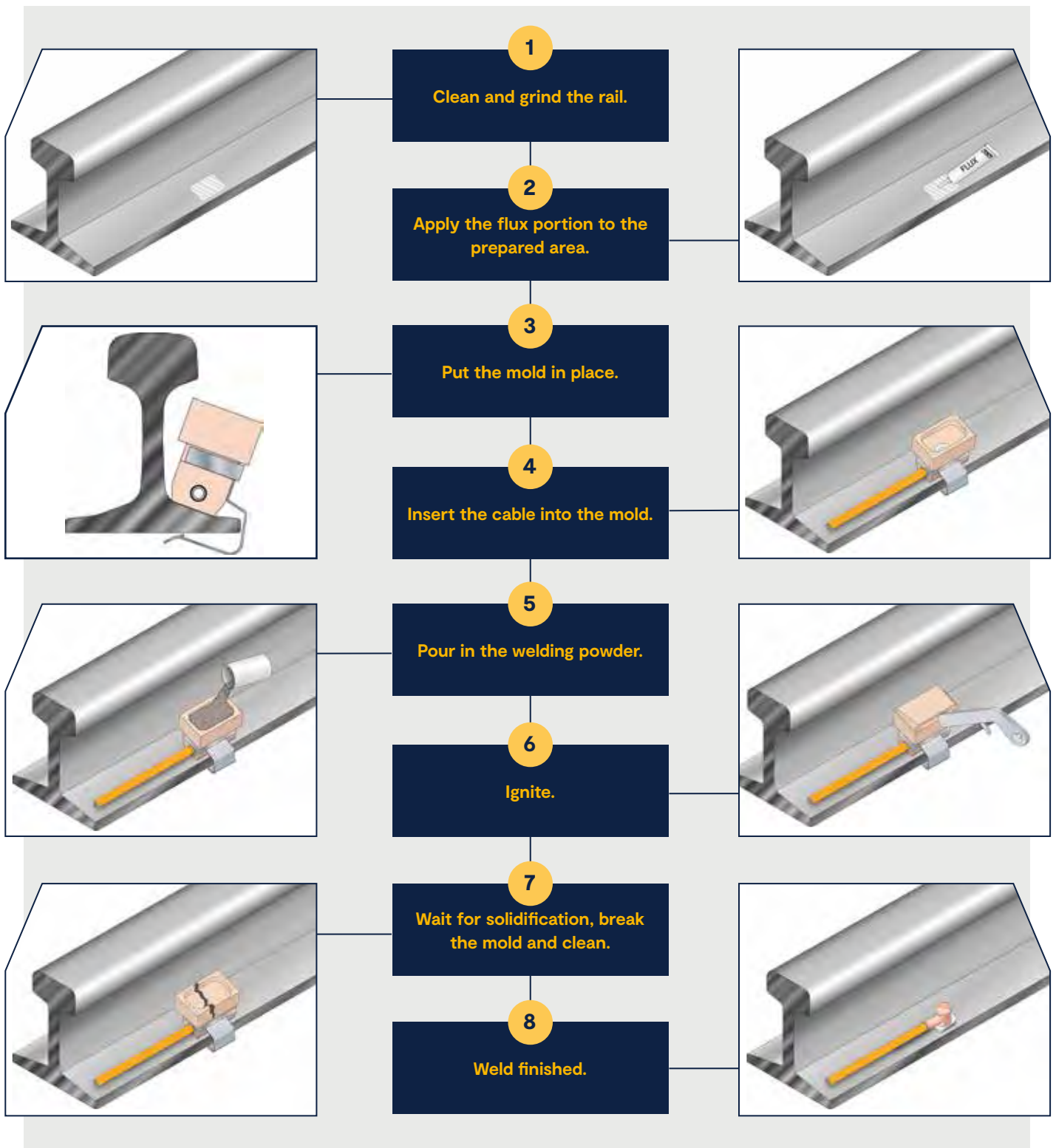
(**) The bolt can be welded to aluminium wire, or be part of a bimetallic CuAl terminal.

The **LsVIP KLK-weld** ignition procedure can be used, which prevents smoke and other emissions from the mold and allows remote ignition. This requires the following elements:

- a. ELPA LsVIP cover.
- b. Remote ignition device.
- c. Fuses (one per ignition).



Easy and quick to use.



ELPA 12 procedure

The ELPA 12 procedure is used to make the electrical connection between the aluminium cable to the rail foot.

It is done with an aluminium-copper bimetallic terminal. The two metals are joined using a friction welding process. The inside of the aluminium body has neutral grease to prevent oxidation.

The copper bolt of the bimetal terminal is welded to the Elpa 12, so that on site all you need to do is put the aluminium cable at the end and weld the Elpa 12 to the rail foot in the usual way.



LsVIP ignition procedure

The **LsVIP KLK-weld** ignition procedure is best from the safety and cleanliness point of view.

This procedure uses a special cover that has the following advantages:

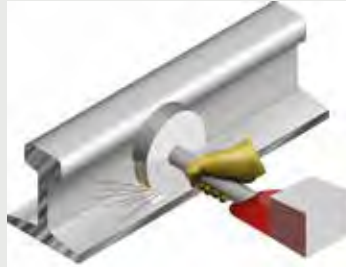
- Its lid completely closes the mold crucible, to prevent spattering from the aluminothermic reaction.
- It minimizes smoke emissions.
- It can be used either with the standard flint igniter or with the KLK-weld Remote Ignition Device.
- It enables the charge to be ignited at a certain distance from the mold.



KLK-weld procedure



1. Remove the insulation from the cable on a length of 15 cm. Clean any dust and rust from the weld surface using the card cloth brush.



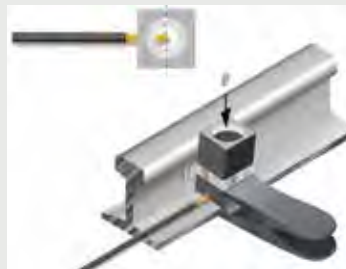
2. Grind the weld area to remove any rust completely. The quality of the weld depends on the cleanliness of the area, so clean it very carefully.



3. Before the first weld, preheat the mold for at least 5 minutes to drive off any moisture, to avoid pores in the weld.



4. Close the handle clamp and lock it. Use sealing paste between the cable and the mold to prevent molten metal leakage.



5. Check that the end of the cable is under the centre of the tap hole. Place the metal disc on the bottom of the hopper. Place the conical side downwards.



6. Open the coloured cartridge cover and empty the welding powder into the mold hopper.



7. Close the mold cover. Place the pistol sideways on the ignition powder or the remote ignition device and fire it to ignite.



8. Wait one minute before opening the mold handle clamp. Open it completely, to remove the welded connection. Take special care during this operation to avoid damaging the mold.



9. Remove slag from the crucible and tap hole with the mold scraper. Remove dust from the weld cavity, tap hole, crucible and mold cover with the mold brush.

Standards-Compliant Cable / Rail welding



Each Railway Administration has its own standardised connections to the rail for ensuring traction return current continuity.

Aluminothermic welding is the most suitable for welding these connections to the rail. Spanish Railways (Renfe) has standardised, in accordance with its Technical Specification E.T. 03.364.005.3, the following cable to rail connections:

Type V-16 Connection



Connection 50 mm ²		Mold type	Cartridge	Handle clamp
V-16	Length: 225 mm	CRA-CRR V-16	C-45R	TRA/V-16

Type V-17 Connection



Connection 139 mm ²		Mold type	Cartridge	Handle clamp
V-17	Lengths: 700, 2.400 and 2.800 mm	CRA-TC V-17	C-90R	TRA/V-17

Connection Types.

Flange connections on Rail Head CRA-CRR (MRR)



Cross-section (mm ²)	Mold type	Cartridge	Handle clamp	Scraper
35	MRR 35	C-32 R	SDRR	RR
50	MRR 50	C-45 R	SDRR	RR
70	MRR 70	C-65 R	SDRR	RR
95	MRR 95	C-65 R	SDRR	RR
120	MRR 120	C-115 R	SDRR	RR
150	MRR 150	C-150 R	SDRR	RR

Add to the mold reference: (D) For Right hand mold. (L) For Left hand mold.
 You must know the type or profile of the rail to be able to fit the mold properly.

Connecting flanges



Connection 50 mm ²	
RR-50	Length: 185 mm



Connection 95 mm ²	
RR-95	Length: 175 mm
RR-95-R	Length: 285 mm
RR-95-L	Length: 405 mm



Connection 120 mm ²	
RR-120	Length: 175 mm

S.N.C.F. codes for the MRR connection.

Reference	S.N.C.F.	
MRR-50G	7.393.4923.1	0.002.4923
SDRR-50	7.393.4939.7	0.110.4939
C-45R	7.393.4950.4	0.005.0005
MRR-95G	7.393.4921.5	0.002.4921
SDRR-95	7.393.4935.5	0.110.4935
C-65R	7.393.5842.2	0.005.0006
RR-95L	7.952.0691	0.010.0311
MRR-120G		0.002.4016
SRR-120		0.110.4016

Reference	S.N.C.F.	
MRR-50D	7.393.4924.9	0.002.4924
SRR-50		0.110.4013
RR-50	7.952.0694	0.010.0300
MRR-95D	7.393.4922.3	0.002.4922
SRR-95	7.393.4936.3	0.110.4936
RR-95	7.952.0690	0.010.0310
RR-95R		0.010.0315
MRR-120D		0.002.4116
C-115		1.005.0008

Tap cable to rail head MLT (CRA-TC)



Cros-section (mm ²)	Mold type	Cartridge	Handle clamp	Sleeve	Die	Scraper
35	MLT-35	C-65 R	SLT-75	E-35	ME-75+MPO	R-45
75	MLT-75	C-65 R	SLT-75	E-75	ME-75+MPO	R-45
185	MLT-185	C-90 R	SLT-185	E-185	ME-185+MPO	R-90
35	CRA-TC 35	C-45	TRA-C			
50	CRA-TC 50	C-65	TRA-C			
70	CRA-TC 70	C-65	TRA-C			
95	CRA-TC 95	C-90	TRA-C			
120	CRA-TC 120	C-115	TRA-C			

You must know the type or profile of the rail to be able to fit the mold properly.
Use sealing paste.

S.N.C.F. codes for the MLT connection.

Reference	S.N.C.F.	
MLT-75	7.393.4932	0.002.4932
C-65R	7.393.5842.2	0.005.0006
SLT-75	7.393.4940	0.110.4940
ME-75	7.393.6192	0.010.6192
MPO	7.393.6190	0.010.6190
E-75	7.952.0695	0.010.0695
E-35	7.952.0742	0.010.0742

Reference	S.N.C.F.	
MLT-185	7.393.4930	0.002.4930
C-90R	7.393.4951	0.005.0007
SLT-185	7.393.4936	0.110.4936
ME-185	7.393.4962	0.010.4962
MPO	7.393.6190	0.010.6190
E-185	7.952.0693	0.010.0693

Tap cable to rail web MRLA (CRA-TA)



Cros-section (mm ²)	Mold type	Cartridge	Handle clamp	Scraper
35	MRLA 35	C-45	TRA-A	R-45
50	MRLA 50	C-65	TRA-A	R-45
70	MRLA 70	C-90	TRA-A	R-90
95	MRLA 95	C-90	TRA-A	R-90
120	MRLA 120	C-115	TRA-A	R-90
150	MRLA 150	C-150	TRA-A	R-15

Add to the mold reference: (D) For Right hand mold. (I) For Left hand mold.

You must know the type or profile of the rail to be able to fit the mold properly. Use sealing paste.

Tap cable to foot CRA-TP



Cross-section (mm ²)	Mold type	Cartridge	Handle clamp	Scraper
35	CRA-TP 35	C-45	TRA-P	R-45
50	CRA-TP 50	C-65	TRA-P	R-45
70	CRA-TP 70	C-65	TRA-P	R-45
95	CRA-TP 95	C-90	TRA-P	R-90
120	CRA-TP 120	C-115	TRA-P	R-90
150	CRA-TP 150	C-115	TRA-P	R-90

Add to the mold reference: (D) For Right hand mold. (l) For Left hand mold.

You must know the type or profile of the rail to be able to fit the mold properly.

Use sealing paste.

Tap cable to rail web-foot fillet CRA-TH



Cross-section (mm ²)	Mold type	Cartridge	Handle clamp	Scraper
35	CRA-TH 35	C-65	TSC-80	R-45
50	CRA-TH 50	C-65	TSC-80	R-45
70	CRA-TH 70	C-90	TSC-80	R-90
95	CRA-TH 95	C-115	TSC-80	R-90
120	CRA-TH 120	C-150	TSC-80	R-150
150	CRA-TH 150	C-150	TSC-80	R-150

Add to the mold reference: (D) For Right hand mold. (l) For Left hand mold.

You must know the type or profile of the rail to be able to fit the mold properly.

Use sealing paste.

Tap cable to rail web-foot fillet CRA-PH



Cross-section (mm ²)	Mold type	Cartridge	Handle clamp	Scraper
35	CRA-PH 35	C-90	TSC-80	R-90
50	CRA-PH 50	C-90	TSC-80	R-90
70	CRA-PH 70	C-115	TSC-80	R-90
95	CRA-PH 95	C-150	TSC-80	R-150
120	CRA-PH 120	C-200	TSC-80	R-150
150	CRA-PH 150	C-200	TSC-80	R-150

You must know the type or profile of the rail to be able to fit the mold properly.
Use sealing paste.

Threaded studs to rail web BRA-V



Thread	Mold type	Cartridge	Handle clamp	Scraper
M 10	BRA-V-M10	C-65	TSC-80	R-45
M 12	BRA-V-M12	C-90	TSC-80	R-90
M 16	BRA-V-M16	C-115	TSC-80	R-90

You must know the type or profile of the rail to be able to fit the mold properly.

Cable to grooved rail SEI



Cross-section (mm ²)	Mold type	Cartridge	Handle clamp	Scraper
10	SEI-10	C-45	SLP-SEI	RR
16	SEI-16	C-45	SLP-SEI	RR
25	SEI-25	C-45	SLP-SEI	RR
35	SEI-35	C-45	SLP-SEI	RR
50	SEI-50	C-45	SLP-SEI	RR
70	SEI-70	C-65	SLP-SEI	RR
95	SEI-95	C-90	SLP-SEI-240	RR
120	SEI-120	C-115	SLP-SEI-240	RR
150	SEI-150	C-115	SLP-SEI-240	RR
185	SEI-185	C-150	SLP-SEI-240	RR
240	SEI-240	C-200	SLP-SEI-240	RR

Add to the mold reference: (D) For Right hand mold. (l) For Left hand mold.

You must know the type or profile of the rail to be able to fit the mold properly.

Use sealing paste.

Cable to rail web-foot fillet SEI/PR



Cross-section (mm ²)	Mold type	Cartridge	Handle clamp	Scraper
10	SEI-10/PR	C-45	SLP-SEI	RR
16	SEI-16/PR	C-45	SLP-SEI	RR
25	SEI-25/PR	C-45	SLP-SEI	RR
35	SEI-35/PR	C-45	SLP-SEI	RR
50	SEI-50/PR	C-45	SLP-SEI	RR
70	SEI-70/PR	C-65	SLP-SEI	RR
95	SEI-95/PR	C-90	SLP-SEI-240	RR
120	SEI-120/PR	C-115	SLP-SEI-240	RR
150	SEI-150/PR	C-115	SLP-SEI-240	RR
185	SEI-185/PR	C-150	SLP-SEI-240	RR
240	SEI-240/PR	C-200	SLP-SEI-240	RR

Add to the mold reference: (D) For Right hand mold. (I) For Left hand mold.

You must know the type or profile of the rail to be able to fit the mold properly.

Use sealing paste.

Cable to L-track MRLC



Cross-section (mm ²)	Mold type			Cartridge	Handle clamp	Scraper
	→	←	↓			
35	MRLC-35X8I	MRLC-35X8D	MRLC-35X8V	C-115	SMRLC-G SMRLC-D SMRLC-V	R-45
50	MRLC-50X8I	MRLC-50X8D	MRLC-50X8V	C-115		R-45

Es imprescindible conocer el tipo o perfil del carril para una perfecta adaptación del molde.

Cable to T-rail MRTC

T-rail clip welding (maximum clip capacity 240 mm²).
Ask us about other cable cross-sections and sizes.



MM	Mold type	Cartridge	Handle clamp	Scraper
35x8	MRTC-35x8	C-115	SMRTC	R-45
50x8	MRTC-50x8	C-150	SMRTC	R-45

Add to the mold reference: (D) For Right hand mold. (L) For Left hand mold.

Welding clip for L- or T-rail

Cast brass clip with zinc-coated
U-bolt or bronze variant.



Reference	Cross-section (mm ²)
2BC312	25-150

For other dimensions, please ask us.



Committed to service

PANDROL

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