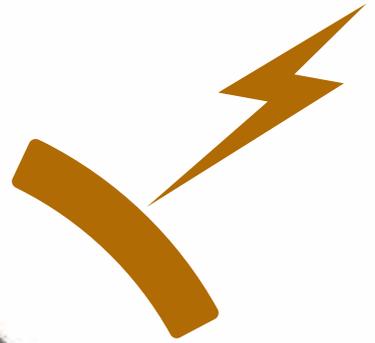




APLICACIONES TECNOLÓGICAS

EXOTHERMIC WELDING



APLIWELD®



 **APLICACIONES
TECNOLÓGICAS**

EXOTHERMIC WELDING: APLIWELD®

The Apliweld® product developed by Aplicaciones Tecnológicas S.A comprises all the necessary equipment and technical support for aluminothermic copper weldings.



Earthing



Referrals and connections between cables and rods



Technological advances in welding technology developed applications have resulted in improved exothermic grounding rail systems.

The Apliweld® welding is based on the reduction of copper oxide by metallic aluminium through an exothermic reaction

The reaction reaches temperatures over 1000°C thus achieving the fusion of the materials to be welded. The conductors are joined by the resulting product of the main reaction when it gets to the solid state. This reaction-fusion-solidification process takes just a few seconds.

The product is called Apliweld aluminothermic welding due to the chemical reaction but it is also known as exothermic welding because of its difference with other soldering processes, which are usually endothermic.

The reaction is produced by a starting reactant that provides enough energy to activate the welding reaction, which occurs quick and safely inside a graphite mould. The mould is specifically designed for each union, depending on the elements to be welded and the required joint type.

There are many advantages of using exothermic welding. The most important one being that the process produces not just a mechanical but a molecular joint between the conductors.

- Apliweld®** has a superior electrical conductivity than the conductors themselves.
- Apliweld®** does not corrode oxide or degrade with time and is resistant to galvanic coupling.
- Apliweld®** is able to withstand repeated electrical discharges.
- Apliweld®** never increases its resistance.
- Apliweld®** has higher mechanical and squeezing resistance than the conductors themselves.
- Apliweld®** offers a permanent welding and a low resistance connection, essential for achieving longwearing and trustworthy results in earthings.
- Apliweld®** guarantees the most common connections not only between copper cables but also for welding tapes and metallic pieces made of brass, stainless steel, copper coated steel earth rods...

APLIWELD® PRODUCTS: MOULD + POWDER + ACCESSORIES

SPECIFIC GRAPHITE MOULDS

The graphite mould is a block of this material that is used as the reaction recipient. Depending on the type of union and the conductors to be welded a different mould is required, although each mould can make 80 to 100 connections. A summary of the most common connections is given on page 284 of this catalogue and all references are available in our website www.at3w.com



MULTIPLE-MOULD

This system allows the welding of the most common connections for cables up to 95 mm², earth rods up to 19mm diameter and tapes up to 30x2mm using the same graphite pieces.



WELDING COMPOUND

The welding compound is the solid mixture that produces when reacting the material melting the conductors to be welded. Apliweld® supplies the material needed to make 10 connections on each material box. Each box includes:

- 10 packages of welding compound.
- 10 packages of starting powder.
- 10 Metallic disks.

E0090 or E0115 welding packages cover the whole range of recommended connections with multiple mould system.

Each graphite mould requires a specific amount of welding compound to perform the connection correctly. There are 8 different packages: E0032 E0045 E0065 E0090 E0115 E0150 E0200 E0250

The adequate type of welding mixture can easily be calculated in our website www.at3w.com



Apart from the welding powder, 2 to 5 cavity sealers are required to make a welding. Both are one-use compounds.

ACCESSORIES

The main elements described before are complemented with the corresponding clamps for each connection, the igniting and cleaning tools as well as other elements that will be necessary in some other specific cases for certain the welding or use conditions.

All pieces required to make 20 to 30 weldings with a multiple mould are included in a practical case.



PRODUCTS AND CODES APLIWELD®

Codes for multiple mould.

Codes for specific moulds.

Reference	Description
E0032	10 welding mixtures of 32 grams + 10 starting powder + 10 metallic disks
E0045	10 welding mixtures of 45 grams + 10 starting powder + 10 metallic disks
E0065	10 welding mixtures of 65 grams + 10 starting powder + 10 metallic disks
E0090	10 welding mixtures of 90 grams + 10 starting powder + 10 metallic disks
E0115	10 welding mixtures of 115 grams + 10 starting powder + 10 metallic disks
E0150	10 welding mixtures of 150 grams + 10 starting powder + 10 metallic disks
E0200	10 welding mixtures of 200 grams + 10 starting powder + 10 metallic disks
E0250	10 welding mixtures of 250 grams + 10 starting powder + 10 metallic disks
50N	Universal Handle Clamp for the 90% of connections
51N	Vertical surfaces and pipes handle clamp
52N	Rail base Handle Clamp
53SN	Multiple mould handle clamp
54N	Rail head and web handle clamp
58N	Horizontal surface clamp accessory
59N	Holding cable clamp
60N	Flint Igniters
61N	Conductors cleaning brush
62N	Vertical moulds cleaning brush
63N	Slag Scraper
64N	Welding cavity clearing brush
65N	Sealer compound (0,45Kg)
66N	Sealer compound (0,9Kg)
67N	Double brush for conductor cleaning

Reference	Description
68N	Basic tool kit
69N	67N Double brush renewals
70N	Flint igniter renewals 10u.
71N	Sealer compound (2,25 Kg.)
72N	Cable adapter sleeve (25 units)
72NC35	Cable adapter sleeve 35 mm ² (25 units)
72NC50	Cable adapter sleeve 50 mm ² (25 units)
72NC70	Cable adapter sleeve 70 mm ² (25 units)
73N	Safety gloves
74N	Flint ignitor extension
75N	Fire torch
76N	Butane gas clynder 0,4L
77N	Safety goggles
79N	Earth rod to earth rod clamp
80N	Tool box
81N	Ceramic tray
82N	Vertical stand pliers
83N	Ceramic sheet
84N	Mini-blowtorch
85N	Mini-blowtorch renewals
89N	Cavity sealer
6089N	60 cavity sealers bag
TMS	Multiple mould crucible
CHMS	MMS horizontal lower piece
CVMS T14	MMS vertical lower piece for 14.3mm e.rod
CVMS T16	MMS vertical lower piece for 15.9mm e.rod
CVMS TX	MMS vertical lower piece for Xmm e.rod X= required diameter.

PROCESS TO OBTAIN AN APLIWELD® WELDING

INSTRUCTIONS FOR USE

The material to be welded (cable, rod, tape...) must be clean and dry using the brush included in the set of accessories. Then the oxide layer and superficial impurity is eliminated.

Given that the graphite mould also absorbs moisture, this should be removed by preheating with a gas welding torch to avoid a porous welding. After the first welding is done, it is not necessary to re-heat the mould if the next welding is done within 15 minutes as it conserves the previously generated heat.



Place the conductors in the mould and close the handle clamps to avoid material leakages during the reaction.



Obstruct the tap hole with the metallic disk.



Empty the contents of the welding mixture package.



Empty 50% of the starting powder on the side of the mould as a fuse, scattering the rest into the welding mixture. Close the mould lid.



Ignite the starting powder extended on the side of the mould using the flint igniters.



Once started, the reaction will take 3-4 seconds during which it is recommended to stand back the mould.



Once open, clean the slag stick to the mould with the relevant clearing brush. Then the mould will be ready to be used again without having to reheat it with a gas welding torch, as explained before.

SPECIFIC MOULD



Place the correct inferior piece and first cavity sealer.



Put the correspondent conductors to be joined, and then another cavity sealer.



Close the mould cover. Following steps including ignition and clean up jobs are similar to the case of specific moulds.



Carefully remove the cavity sealer to check the result. Be aware: the system is at an extremely high temperature.

MULTIPLE MOULD

MULTIPLE MOULD

The Apliweld® multiple mould is a system to make the most common welding with the same graphite pieces, reducing expenses, materials and the delivery time.

Joints between cables up to 95mm², re-bar up to 12mm of diameter, earth rods up to 19mm and cooper tape up to 30mm de width are allowed.

The multiple mould parts should be purchased separately or in a suitcase. The references and the components vary only in part for rod, which diameter has to be specified:



INSTRUCTIONS

There are two lower parts machined on both faces so that just changing the lower part or turning it around will get to make all possible weldings.



MULTIPLE MOULD PIECES



AT-53SN
Standard multiple clamp.
Piece to make all the possible weldings with capacity of 250 joints.



TMS
Standard multiple crucible.
Graphite piece to fix every union. Able to withstand more than 100 weldings.



AT-68N Basic tools set.
Tool set (Fire igniters, brush, sealing paste, etc.) necessary for a correct use of the product.



AT-82N Vertical stand pliers.
Specific clamp to joint to vertical pieces simplifying the preparation process.

BASES AND ACCESSORIES



CVMS TX Lower piece.
Graphite block joints between cables up to 95mm² section to earth rods with a diameter "X" to be determined by the user.



CHMS Lower piece.
Either for Cross or T connection between cables and/or tapes.



6069N Cavity sealers.
Isolating ceramic blanket made to provide chamber in the system. Each 6069N includes 60 pieces.



E0090-E0115:
All the multiple mould connections can be done using these two welding packages.

MULTIPLE MOULD

The easiest way of working with the multiple moulds is acquiring the described case that includes all the accessories and then request the needed welding mixture and sealers depending on the work to be done.



MM-C95-P-T "X" (x is the code for the rod T14, T16, T17...)

Units		Units	
1	MCS Multiple crucible Standard	1	68N Basic tool kit
1	CHMS Inferior piece for horizontal Conductors	1	82N Vertical stand pliers
1	CVMS T "X" Inferior Piece for rod in T	2	6089 Cavity sealer (60uds)
1	53SN Standard multiple clamp	1	80N Tool box

REFERENCES: MOULDS AND CHARGES FOR THE MOST COMMON CONNECTIONS

Conductor 1	Conductor 2	Union type	WP	Sealer	
Cable Up to 70mm ²	Cable Up to 70 mm ²	T Horizontal	90	2	A
Cable 95 mm ²	Cable Up to 95 mm ²	T Horizontal	115	3	
Cable Up to 50 mm ²	Cable Up to 50 mm ²	Cross	90	3	B
Cable 70 mm ²	Cable Up to 70 mm ²	Cross	115	4	
Cable 95 mm ²	Cable Up to 95 mm ²	Cross	115	5	C
Cable Up to 70 mm ²	Rod Any	T vertical	90	2	
Cable 95 mm ²	Rod Any	T vertical	115	3	D
Tape Any	Tape Any	T or Cross	90	2	
Tape Any	Rod Any	T	90	2	E

Besides straight connections are possible using E0090 for the whole range of conductors except 95mm² which requires E0115.

Make C70= V10 and C95=V12 for re-bar connections.

For tape to cable splices, tape = cable upon 50mm².

Use E0115 for cable/cable parallel connection. Not recommended for cables bigger than 50mm².

Example:

In an earthing work, 30 cross shaped, cable to cable connections are required for 50mm² conductor. Besides this cable will be connected to a 10mm re-bar (**10 weldings**). There are 10 derivation weldings to carry out with 35mm² to 50mm². Finally, 30 earthings with 50mm² cable to Ø14.3mm ground rod on T shapel.

Total = **80 weldings**.

The selection of references will result as follows:

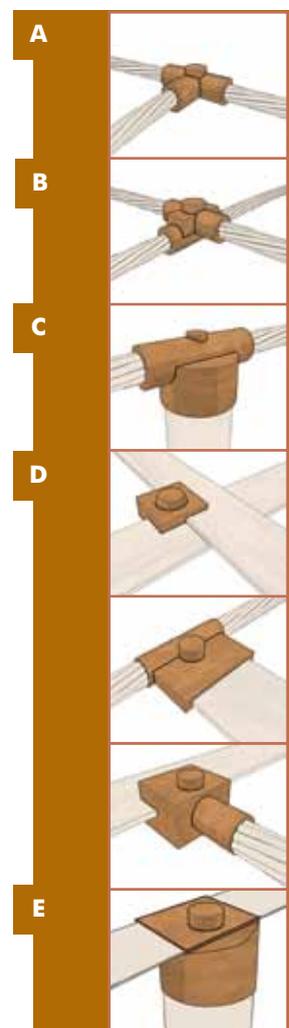
1. MM-P-T14

1. E0115v10

7. E0090v10

2. 6069N (Box includes 2 6069N)

If any piece of the box becomes worn, request for a new one. Pieces are also sold separately.

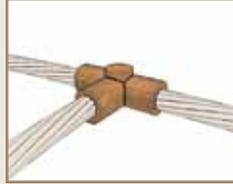


REFERENCES: MOULDS AND CHARGES FOR THE MOST COMMON CONNECTIONS

Every reference and their corresponding welding powder can be consulted in www.at3w.com. In this section, all the conductors and their most common connections are summarized:

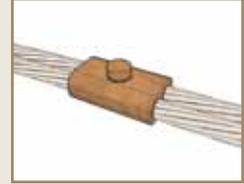
Cable Moulds / T cable (H Mould)

C35/T14/64 - C35/T16/64	E0065
C50/T14/64 - C50/T16/64	E0090
C70/T14/64 - C70/T16/64	E0090
C95/T14/64 - C95/T16/64	E0115
C120/T14/64 - C120/T16/64	E0115
C150/T14/64 - C150/T16/64	E0150



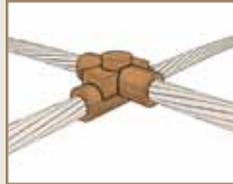
Cable Moulds / parallel cable (H mould)

C35/C35/15	E0065
C50/C50/15	E0090
C70/C70/15	E0090
C95/C95/15	E0115
C120/C120/15	E0150
C150/C150/15	E0200



Cable Moulds / Cable in X (HA Mould)

C35/C35/16	E0115
C50/C50/16	E0150
C70/C70/16	E0200
C95/C95/16	E0250
C120/C120/16	E0250
C150/C150/16	2xE0150



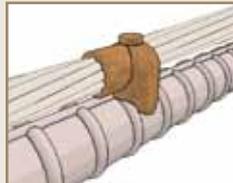
Cable Moulds / Metallic surface (O Mould)

C35/M/49	E0032
C50/M/49	E0045
C70/M/49	E0045
C95/M/49	E0065
C120/M/49	E0065
C150/M/49	E0090



Cable Moulds / Parallel lightning rod (V Mould)

C35/V20/57	E0065
C50/V20/57	E0090
C70/V20/57	E0090
C95/V20/57	E0090
C120/V20/57	E0115
C150/V20/57	E0115



Cable Moulds/rod in T (V Mould)

C35/T14/64 - C35/T16/64	E0065
C50/T14/64 - C50/T16/64	E0090
C70/T14/64 - C70/T16/64	E0090
C95/T14/64 - C95/T16/64	E0115
C120/T14/64 - C120/T16/64	E0115
C150/T14/64 - C150/T16/64	E0150



MOST COMMON CONDUCTORS

Cable section	Code
35mm ²	C35
50mm ²	C50
70mm ²	C70
95mm ²	C95
120mm ²	C120
150mm ²	C150

Re-bar diameter	Code
14,3mm	T14
15,9mm	T16

Re-bar diameter	Code
20mm	V20

Dimension	Code
30x2mm	P302

Code	Mould	Joint	Mixture
P302/P302/21	H		E0090
P302/P302/23	H		E0090
P302/P302/29	V		E0115
P302/C50/31	H		E0090
P302/T14/64	V		E0115
P302/T16/64	V		E0150

REFERENCE SELECTION PROCESS: ACCESSORIES FOR EACH TYPE MOULD

90% of our references can be made using exclusively these products:

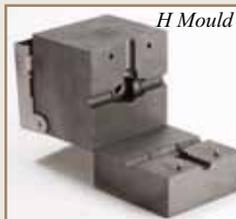
V, H, HA and VA Moulds



50N



V Mould

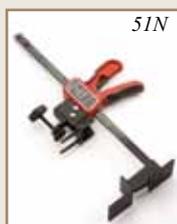


H Mould



68N

O Mould



51N



O Mould

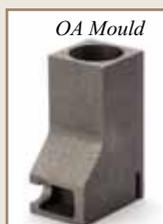


68N

OA Mould



54N



OA Mould



68N

ADVISABLE ACCESSORIES AND EXCEPTIONS

The rest of the references are required depending on each working conditions. There are some to carry out the process conveniently for a particular case and spare parts. They will be included depending on each particular case.



77N For all cases.



59N Recommended for all connections with pass-through cable.



65N Necessary in every rebar union.

58N, 79N and 52N are recommended clamps, respectively, for joints to a metallic horizontal piece, joints vertical rod to rod and joints to rail base.

ANNEX: ACCEPTABLE WELDINGS AND INSPECTION

ACCEPTABLE WELDING

SPECIFIC MOULD



Unacceptable welding



Acceptable welding



Optimum welding

To achieve a welding which complies with the minimum conditions, the mould should be clean, with all the cavities clearly defined to hold the conductors, but also the metallic disk closing the tap hole.

For a valid welding, the following conditions should be accomplished:

- An acceptable welding covers at least the thickness that conductor had before welding it, otherwise reject the result.
- The result doesn't show deep porosity on the welding surface. (Pinholes not deeper than 1mm.
- Final welding has not slag on it (no more than 20%) after a convenient cleaning.
- The colour of the welding should vary from golden to bronze once cleaned.

A perfect welding shows solid appearance turning from gold to bronze. It also covers the whole surface of the conductor with the welding cavity and with the least imperfections on it.

A welding can be unacceptable for different reasons ranging from the inadequate use of the welding mixture packaging to faults in the structure of the mould.

MULTIPLE MOULD



Unacceptable welding



Acceptable welding



Optimum welding

INSPECTION OF THE WELDING

SPECIFIC MOULD



Fault 1



Fault 2



Fault 3



Fault 4

The welding may be unacceptable. This can be determined by a visual inspection:

1. - **The welding shows pinholes on the surface:** This is due to moisture in the mould. The best solution is to heat the mould or to make a previous welding using scrap conductors. It is also probable that porosity is due to the conductors which are wet, dirty, oily or with organic contaminants on it. In the same way, it is necessary to wipe and heat them.
2. - **There is too much slag in the welding connection:** The welding powder drops through the retaining disk before the ignition or not enough weld metal was used.
3. - **The welding mixture doesn't completely cover the volume of the conductors:** Material leakages may

occur due to a worn mould or remaining humidity. It could also be due to inadequate packaging or an incorrect positioning of the conductors in the mould. Occasionally, conductors may separate when melted making the volume to be filled by the molten metal bigger. In this case, it is not enough material to fill the welding cavity.

4. - **The molten leaks out of the welding cavity during the reaction or when checking the result that part of the welding has exceeded the limits of the cavity.** This happens when the mould isn't well-closed or because it is already worn-out. It can be possible that conductors are too small for a determined mould. In these cases, the best solution is to get a new mould although the Sealer compound or the cable adaptors may solve the problem for a few connections.

MULTIPLE MOULD



Fault 1



Fault 2



Fault 3



Fault 4

