WELDING TECHNOLOGIES

Aluminium Welding

Quality Without Compromise

Aluminium Welding

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As a world leader in welding equipment and welding systems for the automotive industry for more than half a century, ARO is a name which has become synonymous with resistance welding. Clients choose ARO for its proven superiority in state-of-the-art technology, reliability and quality without compromise.

Based in Montval-sur-Loir near Le Mans in France, ARO has a worldwide presence, with branches and production sites in Europe, Asia and North, Central and South America delivering a complete range of services to international customers.

Aluminium: unique advantages

As a metal, aluminium's unique properties and qualities (including its light weight, mechanical strength, resistance to corrosion, conductivity and recyclability) have helped create an unprecedented boom in the aluminium industry. After iron, aluminium is currently the world's most used metal.

ARO headquarters Montval-sur-Loir, France.

As an alloy, or in its pure form, aluminium can be found in the transport sector, the packaging and building industry, the electrical engineering industry as well as in many of the world's consumer goods.

Increasingly rigorous environmental requirements with demanding weight and recycling standards are making aluminium an attractive option for many branches of industry, but compared to steel, there are still significant assembly and cost issues to overcome. ARO has developed new technologies to bring unprecedented levels of cost-efficiency for aluminium resistance welding.

Leading the way in aluminium resistance welding

The basic principle of resistance welding is the assembly of two metal parts through fusion under force. This process offers considerable user advantages.

Advantages of resistance welding:

- **Cost efficiency**
  - Requires only limited investment: flexible and capable welding equipment
  - Eliminates the need for additional material: no gas, no mounting parts (rivets, screws, bolts) which add cost and require significant storage and handling
- **Performance**
  - Fast execution: no prior operation required (primary drilling, assembly components distribution, etc)
  - Multiple sheet thickness assembling and stacking
  - Substantial resistance to mechanical stress
- **Quality**
  - Aesthetics of finished product
  - Little alteration over time
  - Repeatability
- **Polyvalence**
  - Spot, seam and projection welding address the majority of all assembly issues
- **Environmental Protection**
  - Non-polluting (no smoke emissions or solvents)
  - Easier recycling of aluminium parts (no addition of other materials during assembly process)
  - No additional weight (no rivets or hardfacing)

Whilst all of these advantages have made resistance welding a very widely used process, particularly in the automotive industry, it has up until now, been difficult to use for welding aluminium. Now, with ARO's technology and know-how, aluminium sheet assembly is an extremely viable option.

Spot Welding.

Quality, performance and cost-efficiency in aluminium and aluminium alloy assembly

ARO Technologies

A range of high power DC transformers for stationary and robotic applications

New resistance welding technologies developed by ARO allow for application of the resistance welding principles most suited to the specific physical and chemical features of aluminium.

Low electrical resistance

Strong thermal conductivity

High coefficient of thermal expansion

Presence of aluminium oxide on surface

→

High welding currents

Short welding times

Elevated and precise force

Force control

Force profiles

Current/force synchronisation

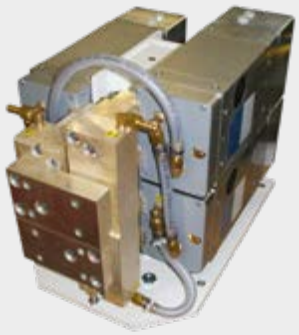
Traceability of results

Electrode cleaning

High welding currents/short welding times

ARO has developed a range of high power, medium-frequency transformers that are capable of achieving welding currents of up to 100kA for stationary applications and up to 80kA for robotic applications.

These transformers are controlled by a range of MF welding cabinets supplying welding currents between 5kA and 100kA.



MFDC transformer
465 KVA – 100kA.

MFDC transformer
360 KVA – 80kA.

Welding cabinet from 5kA...

... to 100kA.

iBox: real-time force control

Elevated and precise force values

Only servo-actuators with integrated force sensors can produce force values of up to 2000 daN with the precision and speed required for high quality resistance welding.

Force regulation

To ensure a reliable and robust weld process, the force applied to the electrodes must be perfectly controlled. The iBox welding control cabinet provides the ideal solution for this, allowing precise force control on the electrodes in real time.

Force profiles

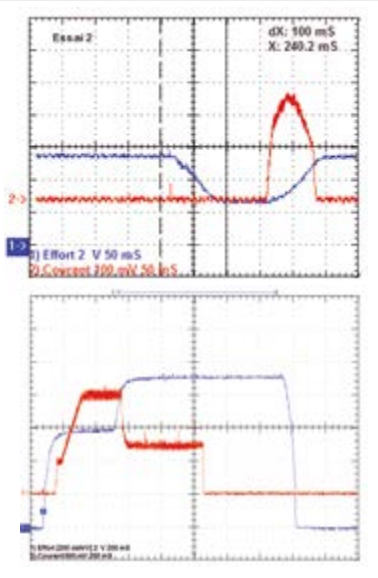
One of the key, innovative advantages of the iBox is complete force profile management with servo-actuators. The reversibility of the process means that it is possible to increase or decrease the force, for each welding phase.

Advantage: Welding Quality

- **Welding spot repeatability: force control guarantees constant force values on the electrodes, for each weld**
- **Checking of spot indentation and expansion**
- **Reduced risk of material projection: force control limits compression of the melted nugget during the welding cycle**
- **Improved electrode dressing: force control provides for a more accurate dressing to restore the original properties of the electrode's active surface**

Advantage: Welding Quality

- **Force step management results in reduction or even suppression of cracks and porosities that may occur in the welding nugget**



iBox welding controller.

Sophisticated force profiles to set exact parameters for each industrial application

Conclusive results

iBox creates a large number of sophisticated force profiles to guide in the selection of welding parameters for each industrial application.

Macrographic sections of the welding spots:

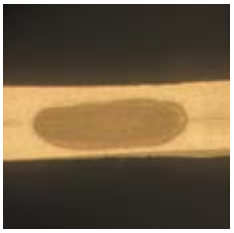
WITHOUT FORCE PROFILE (-)

ALUMINIUM 2024 T3 : 1+1
Cracks

WITH FORCE PROFILE (+)

ALUMINIUM 2024 T3 : 0.5+1
Good nugget

ALUMINIUM 5086 : 0.6+0.6
Porosities



ALUMINIUM 5086 : 0.6+0.6
Good nugget

Cleaning electrodes

In the welding process, built-up deposits of aluminium oxide can contaminate the electrodes, so to ensure consistent weld quality, the electrodes' copper alloy contact surfaces must be cleaned on a regular basis. ARO provides dressing devices to prolong electrode life and reduce the need to buy costly parts.

Before dressing.

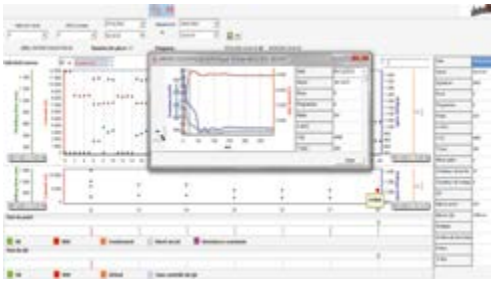
After dressing.

Current/force synchronisation

iBox ensures centralization of all the welding parameters, allowing a perfect synchronisation of welding force with the welding current which interacts with the servo-actuator and the force sensor. This feature is crucial for both restraining the strong thermal expansion of aluminium during welding and also ensuring the formation of a homogeneous nugget.

Traceability of results

ARO offers monitoring software programs that ensure optimum traceability of all welding data.



Advantage: Quality Assurance

- **Recording and saving of all events that occur on the resistance welding installations (welding results, faults, etc)**
- **Auditing of the welding parameters in real time**
- **Generation of statistical tracking tools (reports, charts, etc)**

ARO Solutions

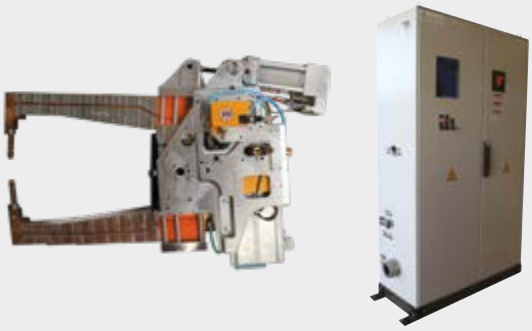
ARO makes its welding laboratories in France and the USA available for a broad variety of testing (peel test, macrographic section, radiogram, etc). At the outset of each project, ARO's welding engineers carry out a full analysis to determine an exact solution.

ARO provides a range of powerful, reliable welding products to deliver the ideal solution for any aluminium and aluminium alloy assembly requirement, whether that be a robotic, manual or stationary process.

Robotic aluminium welding using more cost-effective, conventional robots

Robotic process

Robot gun & welding cabinet
Recent generations of ARO electrical guns for robotic welding of aluminium have a performance/weight ratio to allow them to be used with more conventional robots which are less costly than heavy-load robots.



Stationary process

Stationary machine & welding cabinet
ARO stationary solutions with servo-actuator cover a large number of aluminium welding applications. ARO also designs welding tools and provides accessories to optimize installations.

Manual process

Manual guns & welding cabinet
For prototype applications or small series, ARO offers a range of high capacity manual aluminium welding guns. Robust and flexible, these units are capable of welding a wide variety of workpieces.

Resistance welding is currently proving to be the optimum assembly process in terms of output quality and cost. For aluminium, long considered a difficult material, ARO has developed state-of-the-art technologies that successfully address assembly and cost issues while bringing new levels of viability and efficiency to aluminium resistance welding.

WELDING TECHNOLOGIES

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