User Manual

AluRepair+

VAS 852 001

ASE 852 001 00 000

Operating Instructions VAS 852 001 | CMA-210 | Version: 2016/05

Original operating instructions

Please retain instructions for future use.

Dear Customer,

Many thanks for purchasing our CMA-210 multi-functional welding unit (hereinafter referred to as WU). At Carbon, we are convinced that you have chosen a device that will fulfill your future needs and wish you every success in the work you carry out with this device.

Our aim is to ensure the high quality of our products by continuously developing the construction and features of our products and the accessories available for them. As a result of this, the product you have purchased may differ in certain respects from those presented in these operating instructions. For that reason, no entitlements may be directed from the details, illustrations and descriptions contained herein.

The data and information contained in this User Manual have been compiled with the greatest possible care. We have done all that we can to ensure that the information contained in this manual was accurate and up to date at the time of dispatch. Nevertheless, we are unable to guarantee that this information is absolutely error-free.

If, after looking through this manual, you should identify any errors or items that are unclear, please let us know.

Please also let us know if you have ideas or complaints about our product. We will be grateful for your feedback.

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Table of Contents

1. Aluminum – the material

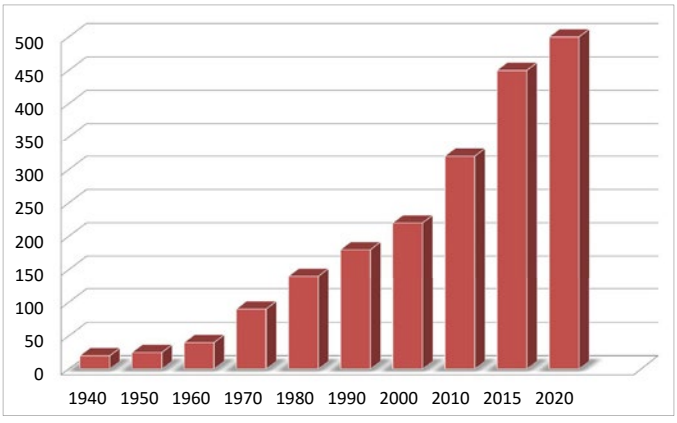
Aluminum (from the Latin alumen = alum) is a chemical element of the periodic system with an atomic number of 13. The chemical symbol for the element aluminum is Al. Aluminum belongs to the boron group (formerly also known as the "earth metals" group).

A light metal, aluminum is silver-gray in appearance, due to the thin oxide layer that quickly forms in air. That oxide layer makes aluminum very resistant to corrosion. Aluminum is a very soft metal, is tensile and can be rolled out to form a thin foil. Aluminum is the third most frequently encountered chemical element in the earth's crust and it only occurs in the form of chemical compounds. It is also a good electrical conductor.

1.1. History

Compared to other metals, aluminum was only discovered relatively recently. Sir Humphry Davy was the first person to discover and name aluminum, back in 1808. Friedrich Wöhler successfully produced aluminum in 1827, starting from an impure form of the element that Hans Christian Oersted had produced two years before. At that time, the price of aluminum was higher than that of gold.

The Wöhler process was refined and improved by Henri Sainte-Claire in 1846 and published in a book in 1859. As a result, the price of aluminum fell by 90 percent over the course of a ten-year period. In 1886, the aluminum production process that carries their name was developed independently of one another by Charles Martin Hall and Paul Héroult: the Hall-Héroult process. The process used in the production of aluminum follows the same principle to this day. In 1889, the process was further improved by Karl Josef Bayer.



Aluminum production since 1940

1.2. Occurrence

Aluminum is frequently encountered in nature in the form of aluminum silicate. Aluminum oxide (Al2O3) occurs only rarely and is known as a precious and semi-precious stone. Depending on the impurities they contain, these are known as emeralds, rubies or sapphires. A form of aluminum that is encountered much more frequently is bauxite.

1.3. Extraction

According to the Oersted process (1825), aluminum is produced from aluminum chloride and potassium amalgam, in which potassium serves as a reducing agent. The technical production of aluminum takes place by means of fused-salt electrolysis (the cryolite-alumina process or Bayer process). This process requires a very large quantity of energy, amounting to approximately 13-16 kWh/kg. Every year, around 36 million tons of aluminum are extracted.

The properties of aluminum

Density	2.7 g/cm^3
Magnetism	Fixed (paramagnetic)
Crystalline structure	Cubic, surface-centered
Density (Mohs hardness)	2700 kg/m3 (2.75)
Melting point	660.32°C
Boiling point	2519 °C
Molar volume	$10.00 \cdot 10^{-6}$ m^3/mol
Vaporization heat	293.4 kJ/mol
Melting heat	10.79 kJ/mol
Specific heat capacity	900 J/(kg · K)
Electrical conductivity	37.7 · 106 S/m
Thermal conductivity	237 W/(m · K)

As a result of its very low density, aluminum is the ideal material whenever a mass needs to be transported, so it is hardly surprising that many of its applications are found in the packaging industry and in the aeronautics and aerospace sectors. For the same reason, aluminum is additionally being used to an increasing degree in vehicle construction. In alloys with magnesium, silicon and other metals, extrusion molding profiles can be used to create aluminum products whose strength are not far removed from that of steel. For that reason, the aluminum is very much in demand as a means of achieving a more lightweight construction. That is why it is the material of choice in airplane construction and space technology. In household applications, aluminum is commonly used in the form of drinks cans and aluminum foil, and is sometimes used to make cooking pots. Environmental associations have criticized the use of aluminum, due to the large quantity of resources consumed during its production. In non-phlegmatized powder form (with a particle size of < 500 µm), its large surface area makes it highly reactive. For example, aluminum will react with water and will form aluminum oxide. Hydrogen is emitted during the reaction. As a component, aluminum is also indispensable in the thermit reaction, which is exothermic (up to 2500°C). Important: When in contact with air, non-phlegmatized aluminum dust will self-ignite in an explosive form and so it carries the hazard symbol [F+].

When aluminum is in contact with water and oxygen, an oxide film forms on its surface that effectively protects the metal from corrosion. Aluminum is frequently protected by applying an oxide layer, in a process known as eloxation.

1.4. Processing of aluminum

Aluminum is frequently processed using a casting process (aluminum casing), in the form of continuous casting, pressure casting, extrusion casting or spray compacting. For example, aluminum can be: melted, machined, rolled, deep-drawn, folded, forged, cut, beaten out and polished. Aluminum is a relatively soft metal and is easily formed. It can be rolled to a thickness of 0.004 mm, for applications including aluminum foil. Its elasticity is also greater than the elasticity of steel.

1.5. Aluminum alloys

The low mechanical strength of pure aluminum is improved by creating aluminum alloys; it is also possible to reduce the specific electrical resistance when compared to that of pure aluminum. In addition to improving its mechanical properties, converting aluminum into aluminum alloys also improves its corrosion resistance and resistance to sea water. Many types of aluminum alloy can also be hardened. This can be achieved by annealing the aluminum at around 500 degrees Celsius, quenching it and then aging it for several hours at a temperature of 150 degrees Celsius.

The various applications of aluminum alloys include:

- Wrought alloys: Sheets, bars, profiles, pipes and pressed components
- Cast alloys: sand-cast alloys, die-cast alloys and lost-wax alloys

1.5.1 Aluminum wrought alloys

The hardness of aluminum can be increased with the addition of Cu or Zn, but the ductility of the resulting alloy is low.

There are three forms of wrought alloys:

- Aluminum-magnesium-silicon alloy
- Aluminum-copper-magnesium alloy
- Aluminum-magnesium alloy

Properties

- Good machinability
- High strength
- Highly polishable
- Corrosion resistant, especially corrosion caused by sea water.

Application

- For lightweight components subjected to a heavy load
- Aircraft components, vehicle equipment, containers
- Sheets, pipes and profiles in vehicles, aircraft, ships and heating systems
- Live tracks, energy lines

1.5.2 Aluminum cast alloys

Cast alloys can be identified by the letter "C" before the list of components.

Properties

- Corrosion resistant
- Weldable
- Highly wear-resistant
- Easily machined

Application

- Cast components such as motor housings, pumps and drive systems subjected to oscillation loads
- Devices and machines for the household and the food industry

1.6. Composition of Al alloys

Metal alloys	Name	Wrought or cast alloy	Proportions	Application
Al-Cu-Ti-Mg	Alufont	C	Cu: 4.3-4.9% Mg: 0.2-0.3% Ti: 0.1-0.2%	Equipment building Shipbuilding
Al-Si	Silafont	C	Si: 9-13%	Vehicle construction
Al-Mg-Zn-Cu	Perudur	W	Zn: 3.5-6% Mg: 2.7-2.5% Cu: 1.5-1.8%	Vehicle construction Bridge construction High-rise buildings
Al-Mg-Zn	Unidus	W	Zn 3.5-5% Mg: 0.8-1.6%	Vehicle construction Bridge construction High-rise buildings
Al-Cu	Decoltal	W	Cu: 5-6%	Machined components
Al-Cu-Mg	Avional	W	Cu: 2-5% Mg up to 0.7%	Aircraft construction
Al-Si-Mg	Grinatal Extrudal Anticorodal	W C, W	Si: 0.5-5% Mg up to 0.7%	Aircraft construction Vehicle construction
Al-Mn-Mg	Peralurnan	C, W	Mg: 0.6-1.8% Mn up to 0.4%	Equipment building
Al-Mn	Aluman	C, W	Mn: 1-1.4%	Equipment building, sheet metal

1.7. Aluminum in vehicle construction

The proportion of aluminum in a motor vehicle in 1990: Approx. 55 kg
The proportion of aluminum in a motor vehicle in 2002: Approx. 100 kg
The proportion of aluminum in a motor vehicle in 2015: Approx. 160 kg

In the case of a vehicle weighting around 1500 kg in total, this is equivalent to an increase of 300% in 25 years.

1.7.1 The use of aluminum in vehicle bodywork

Engine hoods, tailgates, doors, bumpers and all-aluminum bodywork.

1.7.2 Reasons why aluminum is used in automobiles

- It is simple to process: For example, aluminum can be: melted, machined, rolled, deep-drawn, folded, forged, cut, beaten out and polished.
- It reduces fuel consumption and emissions, due to the weight-saving it generates.
- It improves passive safety in the event of a collision: Compared to steel components, the impact resistance of aluminum is 2.5 times greater.
- Recycling/disposal: Aluminum is more easily recycled than steel. Both with regard to energy consumption and from a commercial point of view, recycling aluminum is the most beneficial when compared to other metals. Remelting aluminum consumes only 5% of the energy required in order to extract aluminum from ore. Due to the large quantity of material available for recycling, secondary aluminum is therefore relatively cheap to produce in this day and age.

1.8. The different jointing methods used during production

A large number of jointing processes can be used to join aluminum components together in an effective way. Depending on the load that will be placed on the joint, a various jointing processes are used.

- Removable joints using self-tapping or conventional screws.
- Non-removable joints are often glued, such as those on the outer surfaces of doors and engine hoods.
- Welding using laser MIG hybrid welding, consisting of a combination of the conventional laser welding and the arc welding process or other welding processes.
- Clinching and riveting using punched rivets, such as that found in door boxes.

2. The principles of aluminum repair

2.1. The risks of working with aluminum

2.1.1 Corrosion

If aluminum comes into contact with steel, this can give rise to what is known as contact corrosion.

2.1.2 Tendency to explode

If aluminum particles come into contact with the particles of other metals, especially steel, in a moist environment, smoldering fires or even explosions may result. This hazard applies especially in production plants.

2.1.3 Deformation

Aluminum is much easier to deform than materials such as steel. This is something that must be taken into account, especially when stretching or cold-processing aluminum. What is more, aluminum is more susceptible to indentation and has a tendency to shear.

2.2. The workshop as a work location

When carrying out work on aluminum components, only certain types of equipment, tools and certain specific products may be used.

In order to work aluminum, a designated workplace is required, along with the specific tools and materials required that need to be kept there under protected conditions.

Explosion prevention:
Steel particles must be extracted separately from aluminum particles, which means that a separate extraction system is required for each.

Festo aluminum sanding device, with extractor

2.3. Instructions for aluminum repairs

Depending on the type of aluminum alloy used for doors, hoods and covers and the type of the damage, a variety of repair methods may be used. If the folded joints, the bumper reinforcements or the door box reinforcements etc. have been severely deformed, the entire bodywork component must be replaced. In cases involving large cracks in the material, a repair is definitely not recommended.

2.4. Minor dents: Beating out without painting

When beating out, without repainting, the working method makes use of special panel-beaters, which are used in a manner similar to the one employed when panel-beating vehicle bodywork made from steel. This process is only suitable when restoring minor dents caused by hail or chestnuts or caused during parking. In addition to requiring special tools and accessories, panel beating is an activity that requires training, sensitivity of touch and a great deal of experience and skill.

2.5. Major deformations: Hot repairs

During the production process, aluminum components are processed, deep drawn while cold and then exposed to a variety of heat treatments. When restoring the external bodywork panels made from aluminum, it is necessary for the panels to be heated up during the repair.

At a temperature of 140°C, the aluminum molecules begin to oscillate. From that temperature upwards, the panels become soft and can therefore be worked. In the case of collision damage involving significant stretching of the metal requires an even higher degree of heating is required.

The annealing temperature of aluminum and its alloys lies between 300°C and 450°C. In order to reach this temperature quickly and in a targeted way, it is necessary to make use of an acetylene welding torch.

Hot air fans or propane gas burners are not suitable!

Red-hot aluminum does not change color! It is not possible to see with the naked eye when aluminum has reached its annealing temperature. It is therefore extremely important to use equipment that includes a temperature control system.

This can be achieved using a calibrated temperature indicating stick (400°C to 450°C, depending on the type of alloy being used), however it is also possible to use curd soap. Curd soap discolors, becoming brown once reaching a temperature of 400°C.

The melting point of aluminum is 660°C!

Once the material is heated up to a higher temperature than this, holes will begin to form in the metal. Repairing holes in the outer skin of aluminum bodywork is very time-consuming and very difficult. That is why it is extremely important not to apply too much heat to the material.

2.6. Procedure

2.6.1 Pre-pulling of deformed areas using the Miracle Glue technique

A large part of the deformation can be aligned in a short time using Miracle Glue technique.

2.6.2 Smooth sanding of the damaged area

In order to attach the pulling bits and to ensure optimum temperature control, the paint must be removed from the damaged area using a suitable abrasive. It is important to make sure that only the layers of paint are removed, not the material itself. As little material should be removed as possible, in order to avoid any unnecessary reduction in material strength. Sanding must not introduce any carbon into the material.

The images show restoration work carried out on an aluminum side-panel. The depth of the damage was 30 mm and the door aperture had also become compressed. Using the Glue technique, it is possible to carry out an approximate alignment of the deformed area before the actual AluRepair restoration takes place. This saves time. The glue pads are attached using a hot glue. Pulling is then carried out place using the Miracle system components.

2.6.3 Welding on of the aluminum bits

The Miracle aluminum bits are welded to the bare metal using the special welding gun. Depending on the aluminum alloy used to make the bodywork and the type of damage that has occurred, a variety of bits may be used.

2.6.4 Applying the Miracle pulling components

Depending on the deformation and type of damage, a variety of Miracle pulling components may be used, often at the same time. When working with the strong puller and line puller, a pulling bar of sufficient length is first placed through the eyes of the bits that have been welded to the metal. After that, the puller is attached and lightly pre-tensioned. When using the Easy Puller, the pulling hook is inserted into the eyes of the 1-3 bits that have been welded on and are then pre-tensioned.

Important: Tension may only be applied to the aluminum bits when carrying out controlled pulling. Impact tools such as a flying hammer, drawing and impact hammers and polishers etc. may not be used.

2.6.5 Heating of the damaged area using an acetylene welding burner

The entire damaged area that needs to be pulled must be heated. While this is taking place, it is necessary for the temperature of the entire surface to be monitored. For that purpose, it is preferable to use an infra-red temperature gage that enables the temperature to be measured precisely. In order to ensure that the temperature is determined precisely, the device must be set correctly, according to the properties and reflection of the surface concerned. In this regard, please pay attention to the operating instructions of the TP4 pyrometer.

In order to enable the damaged area to be heated in a precise way, the acetylene welding burner must be set to the correct temperature. The correct type of jet must also be used. The quantity of gas must be approximately 100 l/min.

Direct the flame vertically onto the surface and the bright cone of the flame will arise from the panel.

As soon as the temperature control is triggered, remove the burner and start processing the sheet metal immediately; aluminum cools quickly.

TP4 pyrometer / Infrared temperature gage

2.6.6 Pulling out and manipulation of damaged area

Once the correct temperature has been reached, the pulling components are used in a gentle and controlled way, in order to pull out the dent. It is important to make sure that the technician does not pull too hard, so as to avoid overpulling the material. For that reason, always use the pulling components that form part of the Miracle system, such as the Line Puller, Lever Puller, Strong Puller and Easy Puller. The components of the Miracle system complement one another and can be used in combination, in order to achieve the optimum distribution of the pulling forces used to repair the damage.

2.6.7 Releasing tensions within the material using a plastic hammer

Tapping within the damaged area using special aluminum alignment hammers causes any residual tensions within the material to be released.

Important: The hammers used may only be used for repairs to aluminum, as any metal particles introduced will inevitably lead to corrosion in the damaged area.

2.6.8 Removing the aluminum bits

Using the CMA-155 bit cutter, the welded-on aluminum bits are cut off very short.

3. Important safety instructions

The target group of this manual are specialist technicians, who, as a result of their specialist training, their expertise and experience and their knowledge of the applicable rules are able to evaluate the tasks assigned to them and identify any potential hazards.

Hazard caused by incorrect application

◆ Only use the welding unit for the purpose described in this manual.

Otherwise, you will be putting yourself in danger, or will damage the welding unit itself.

You will also put yourself and other people in danger, if you operate the welding unit incorrectly or if you fail to observe the safety instructions or warnings. Severe injury or considerable material damage may result.

Unauthorized operators are at risk

◆ Only make use of the welding unit, if

- you have received the relevant training, have been briefed and are authorized to do so and
- you are aware of the contents of this manual and have understood it in full.

◆ Never use the welding unit

- if you are under the influence
- of drugs, alcohol or
- medication.

Danger caused by unauthorized alterations

◆ Never make any changes to the welding unit or any of its constituent parts, without obtaining a Certificate of Compliance from the manufacturer.

If you fail to adhere to this rule, you will be putting yourself in danger. Severe injury or considerable material damage may result.

Risk of death for persons fitted with a pacemaker

- Never operate the welding unit if you have been fitted with a pacemaker.
- If fitted with a pacemaker, never remain in the vicinity of the welding unit while welding is being carried out.
- Never operate the welding unit, if persons fitted with a pacemaker are in the vicinity of the unit.

The reason for this is that while welding is in progress, strong electromagnetic fields will occur in the vicinity of the welding unit. Electromagnetic fields of that type may cause pacemakers to malfunction.

Danger caused by vapors and aerosols

- Activate the welding fumes extractor in the workplace.
- Ensure adequate ventilation.
- Never carry out welding in rooms less than 3 meters in height.
- Always follow your work instructions and the relevant accident prevention rules.

That way, you will avoid damaging your own and others' health as a result of vapors and aerosols.

Danger caused by red-hot splashes of metal (risk of fire)

While welding, you must expect to be exposed to red-hot splashes of metal and fluids, an arc of light and a loud bang > 90 dB (A).

- Before commencing work, inform staff working in the immediate vicinity of the work to be undertaken.
- Ensure that a fire extinguisher that fulfills the requirements is available in the workplace.

- While welding, do not wear work clothing that has been contaminated with substances such as oil, grease, petroleum etc.
- Wear approved personal protective equipment, such as:
  - Protective gloves that fulfill the current standard
  - Protective eyewear with lenses compliant with protection level 2 that fulfill the current standard
  - Non-flammable clothing
  - Capsule hearing protection in accordance with the current standard
  - A protective apron over your clothing
  - Protective headgear if welding above your head
  - Safety shoes
- Before commencing welding, remove all flammable objects and fluids from the vicinity of the workplace.
- Welding must be carried out at a sufficient distance from flammable materials or fluids. The safety distance between the welding location and any such materials or fluids must be sufficiently large to prevent any hazards caused by weld splashes.

Protecting the stud welding system

- Take precautions to prevent foreign bodies or fluids from any grinding or abrasion work in the vicinity of the work location from penetrating the welding unit.

This will extend the service life of your welding unit.

4. Symbols and definitions used

The symbols used in this manual have the following meanings:

Hazard

Warns of hazards that may **cause injury to people** or may **cause considerable material damage.**

Important

Operational faults may occur, if you fail to observe these **instructions.**

The unit must not be operated by persons fitted with a pacemaker

Hazard

Warns you of **electrical** hazards

Hazard

Warns you of **electromagnetic** fields that may occur during welding

These symbols instruct you to wear your **personal protective equipment when handling the welding** unit.

This symbol instructs you to wear **hearing protection**.
A bang measuring > 90 dB (A) may occur during welding.

Tip

Notification regarding **useful information** about the handling of the welding unit

Cross-references in this handbook are marked with this symbol or appear in ***italics***

Risk of fire

Before commencing work, ensure that a suitable fire extinguisher is available nearby.

◆ **Instruction to take action**

– **Enumeration**

Glossary

Welding Unit:	Power unit, including welding gun
Rectifier:	An electrical component that changes alternating current into direct current
Condenser:	A component that stores electrical energy
Power unit:	A device that provides the electrical energy for welding to take place
Light arc:	An autonomous discharge of gas between two electrodes, if sufficient current is present. A white light is emitted. The arc of light can be used to generate very high temperatures.
Welding element:	A component, such as the stud or road being welded to the workpiece.
Welding parameters:	Mechanical and electrical settings on the welding gun and on the power unit (such as resilience or charge voltage)
Welding gun:	A device used to weld two elements together.
Thyristor:	An electronic component for the contactless switching of high currents: switching is carried out via the control input
Workpiece:	Components such as sheet metals or pipes, onto which welding elements are to be attached.

5. Scope of supply

The **standard equipment** of your power unit consists of the following components:

Number of items	Component	Type	Item no.
1	Power unit		CMA-210
1	User Manual		

- Upon receipt, check that the delivery is complete and has not sustained any visible damage.
- Inform the delivery company or sales representative immediately of any damage that has occurred during transportation, or of any missing components (the address can be found on page 2).

6. Accessories

The accessories supplied can be determined by referring to our product description.

7. Technical data

CMA-210 Power Unit
for arc ignition welding compliant with the current standard

Gas/Automatic/Process-automatic	Series/---/---
Welding area	Studs Ø 4 - 10 mm or pulling bits
Welding material	Studs: Stahl (non-alloy and alloy), aluminum Pulling bits: Aluminum in various strengths, geometries and alloys
Welding current	1000 A
Permitted current range	100 - 1000 A
Welding time	5 - 1000 msec (continuous)
Connection	400 V, 3 phases, 50/60 Hz, 35 AT
Mains plug	32 A (for a 400-volt network)
Connected load	50 kVA (for a 400-volt network)
Type of cooling	F (thermally controlled ventilator)
Protection type	IP 23 (use in the open air also permitted)
Ambient air temperature range	0°C to 40°C
Dimensions L x W x H	660 x 280 x 340 mm (not including handle)
Weight	29 kg

8. Appropriate use

Our welding units are constructed and designed exclusively for professional use. Any non-professional use is expressly forbidden, as a non-professional operator may have an insufficient knowledge of applied welding technology and of the applicable standards.

The power unit is exclusively intended for the welding of standard welding elements. Any other use will give rise to a reduction in the required strength of the welded joint.

The following items may be connected to the power unit:

– The A 12 welding gun, for arc-ignition welding

Appropriate use also includes following the instructions in the User Manual for the welding gun used, in addition to adhering to the intervals and conditions for the inspection and maintenance of the power unit and the components used.

In all cases, you should check in the User Manual whether it is allowed to be used in combination with this power unit.

The welding unit must be suitable for welding the elements concerned.

Welding elements produced using the cold-heading process have a flange and a firing tip. During welding, the flange prevents the arc from jumping across onto the cylindrical part of the welding element, while also increasing the size of the welding surface.

◆ **For details of the welding elements that can be used, please consult the User Manual.**

9. Guarantee

The scope of the guarantee can be found in the current version of the "General Terms and Conditions of Business".

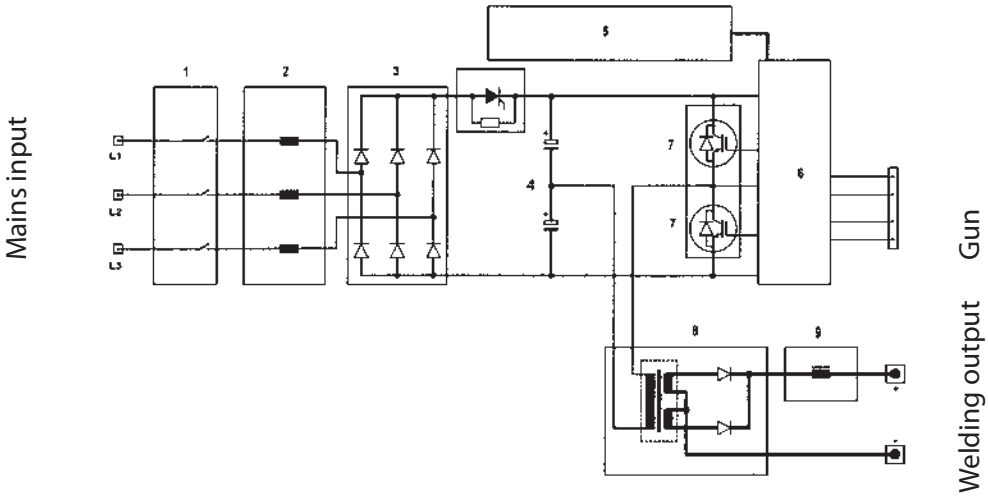
The guarantee does not cover any faults that arise due to

– ordinary wear and tear
– improper handling
– failure to follow the instructions in the User Manual
– failure to adhere to the safety rules
– inappropriate use, or
– damage during transportation

Entitlements under the guarantee shall cease to apply, if any alterations, changes, servicing or repairs are carried out by unauthorized persons. We wish to state expressly that the only spare parts, accessory devices or components that may be used are those that have been approved by us. The same shall accordingly apply to structural components installed by our suppliers.

10. The construction of the power unit

10.1. Main structural components



1 Main switch
2 EMV filters
3 Bridge rectifier
4 Electrolytic condensers
5 Control unit
6 Regulation and control unit
7 IGBT switch
8 Medium-frequency transformer with diodes
9 Welding current choke

The mains current is rectified downstream of the **main switch (1)** and the **EMV filter (2)** in the **bridge rectifier (3)**.

The rectified current is smoothed out in the **electrolytic condensers (4)** and passed to the **IGBT switches (7)**. These switches convert the direct current into a high-frequency 30 kHz alternating current.

The energy is transferred via the medium-frequency transformer using **diodes (8)** and rectified.

The **choke (9)** smooths out the current and transfers it to the weld bushings.

The **IGBT switches (7)** are controlled within the **regulation and control unit (6)**.

The **control unit (5)** coordinates the mechanical process (the lifting off of the welding element) with the electronic control system (activation of the start-up current, activation of the main current, ending of welding time).

The welding time and welding current are infinitely adjustable.

Welding with protection gas

During the welding process, the welding unit automatically regulates the amount of time during which the gas must continue to flow through the device.

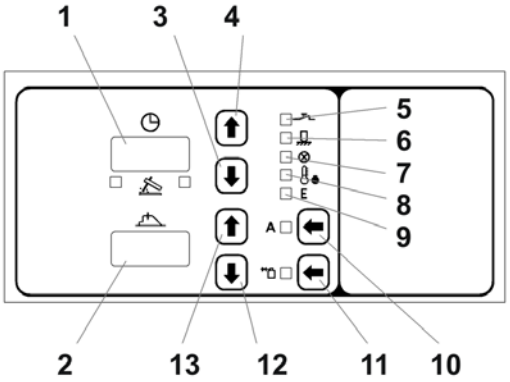
Rating plate

The rating plate can be found on the reverse side of the power unit.

The following details are displayed on the rating plate:

- Manufacturer
- Type
- Order number/serial number
- Supply voltage
- Power fuse
- Power uptake
- Type of cooling
- Protection type
- Date

10.2. Keyboard and display



1 Welding time
2 Welding current
3 shorter
4 longer
5 key
6 Contact
7 Blocked
8 Temperature
9 Error
10 Automation (not used)
11 Protection gas
12 less
13 more

The condition of the welding unit is verified when the device is switched on.

Once the self-test has been completed, the most recently selected **welding time (1)** and **welding current (2)** will be displayed.

To the right of displays (1) and (2) is located an LED that has the following meanings:

	Yellow	lights up when activating the key on the welding gun
	Yellow	lights up when electrical contact takes place between the welding element and the workpiece
	Red	The power unit is blocked – After welding, as long as electrical contact has been made with the workpiece
	Green	The power unit is ready for welding.
	Red	The power unit is blocked – If the power unit has been thermally overloaded. (The numbers 8888 will appear in the displays and the LED E will light up). Work may be resumed after a short period, once the device has cooled down.
E	Red	The power unit is blocked – If the power unit has been thermally overloaded – if there is a fault in the power section
A		If lit, automatic system has been activated
		If lit, protection gas has been activated

11. Welding process

The power unit must only be used for arc ignition stud welding and for the welding on of aluminum bits.

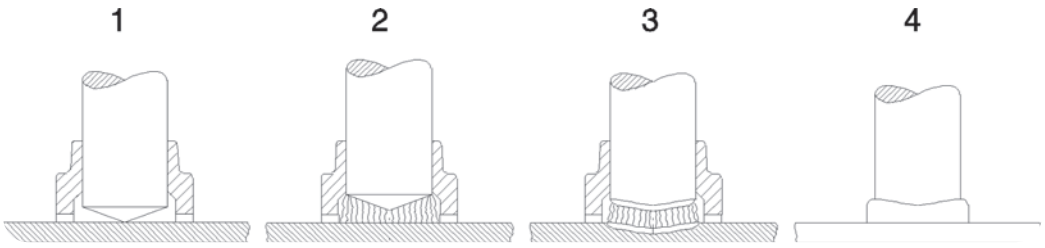
The front surface of a stud-type welding element/bit and the opposing surface of the workpiece are melted off by means of an arc of light and then jointed. The process is suitable for welding entire surfaces of connecting elements, mainly for pin-shaped metallic components and bits onto metallic workpieces..

11.1. Arc-ignition stud welding

The welding unit from Carbon uses the process known as "arc-ignition stud welding" and complies with the current standard. The standard assigns this process, which involves the joining of pin-shaped components and bits with flat-surfaced workpieces to the category of arc pressure welding (code: BH).

Jointing occurs while the welding zone is in a plastic or liquid state. The process can be carried out mechanically or automatically using welding guns.

Generally speaking, the positive pole (earth) of the power unit is connected to the workpiece. The welding element is manually inserted into the stud holder of the welding gun and applied to the workpiece (see picture, **item 1**). When activating the welding gun key, the welding process will begin automatically, as follows:



– At the start of the welding process, the welding element (the stud) in the welding gun is raised using a lifting mechanism (lifting magnet). The activated start-up current is then used to generate a pilot light arc (see image, **item 2**). After that, the main light arc is created between the surface of the welding element and the workpiece.
– The main arc will burn at the welding current that was set and for the welding time pre-selected on the power unit. The welding energy selected must be in keeping with the welding element selected. Due to the effects of the arc, the surface of the welding element and the workpiece are melted together (see image, **item 3**).
– One the set welding time has elapsed, the welding element will be mechanically moved towards the workpiece. When inserted into the molten metal, both melt areas will be united and will set hard. Once the welding element and workpiece come into contact with one another, the arc will be extinguished as a result of the short circuit and the main current will be turned off.
– The melt area will go hard and cool off. The welding element has been fully welded to the workpiece (see image, **item 4**). Once the welded workpiece has cooled, the welding gun can be carefully pulled away from the welding element. If protection gas is being used, the protection gas will cease to flow when the welding gun is removed.

Arc ignition stud welding with protection gas

Stud welding with protection gas is used welding elements with a diameter of between 4 and 10 mm (nominal diameter, not including the flange). The welding times used will be from 50 to 1000 ms. As a result of the short welding times, the amount of heat generated in the melt area is so small, the even welding elements of up to 10 mm in diameter can be welded onto thin work pieces. Arc ignition stud welding with protection gas is therefore suitable for all positions that require welding. During arc ignition stud welding with protection gas, the welding area is protected by an externally applied protection gas. The protection gas, which is applied by means of a gas control system and an additional device displaces the atmosphere within the welding area, thereby considerably reducing the formation of pores. Welding is predominantly carried out in the PA position (flat position).

	Recommendation according to	Recommended by Carbon
Stahl (non-alloy and alloy)	DIN EN ISO 14175-M21: (82% Ar / 18% CO_2)	(90% Ar / 10% CO_2 *) (92% Ar / 8% CO_2 *)
Al and Al-alloys		Ar 84,985 V% / He 15,000 V% / N2 0,015 V%

*) As a result of the increased proportion of CO_2, the surface tension of the weld pool is reduced. This may give rise to an increase in metal splashes.

The protection gas affects

- The arc and alters the melting behavior of the welding element and the workpiece.
- The change in surface tension also affects the formation of the weld bead and the penetration shape.

The shape of the weld bead cannot be reproduced using stud welding with protection gas, as protection gas does not have any effect on the shape of the melt. Generally speaking, welding elements with a compressed flange (in accordance with the current standards) are used. Compared to the shaft diameter, this forms an enlarged welding surface. Despite the presence of pores in the weld area, higher tensile forces can be transferred than are possible in the stud shaft.

The standard welding studs for arc stud welding are described in the standard. Welding elements with a conical front surface and without aluminum spheres are preferred.

When protection gas is being used, welding should only take place in PA position (flat position) as the protection gas is unable to prevent the melt from flowing due to the forces of gravity.

12. Preparing the workspace and welding process

Danger caused by vapors and aerosols

- Activate the welding fumes extractor in the workplace.
- Ensure adequate ventilation.
- Never carry out welding in rooms less than 3 meters in height.
- What is more, you must always follow your work instructions and the relevant accident prevention rules.

That way, you will avoid damaging your own and others' health as a result of vapors and aerosols.

Risk of fire or explosion

- Remove all flammable objects and fluids from your working area.
- Make sure that no explosive substances are in the vicinity of the working area.
- Ensure that a fire extinguisher that fulfills the requirements is available in the workplace.

Risk of tripping or falling

- Cables and connecting wires should be laid in such a way that they are protected from damage and
- that neither you or any third-party are likely to trip or fall over them.

Warning of weld splashes

- Make sure that in the working area of the immediate vicinity, no objects are present that may be sensitive to weld splashes. If needed, any such objects may need to be removed.

Warning of electromagnetic fields

- Make sure that in the working area of the immediate vicinity, no objects are present that may be sensitive to magnetic fields.
- If needed, any such objects may need to be removed.

Risk of death

- Make sure that air is able to circulate freely inside the power unit housing.
- Always stand the power unit on a stable, level and clean surface.
- Check the condition of all cables and cable connections.
- Any defective cables or cable connections must be repaired or replaced by a trained technician.

12.1. Surface preparation

- Remove

– paint, oil and other contaminants

– rust

– non-conductive covering layers (in the case of working materials with a treated surface)

from the surface to be welded and from the attachment points of the earth clips.

In this way, you will be able to ensure that the welded joints are as strong as possible.

- **Only weld the welding element onto a smooth surface.**

12.2. Checking the welding gun

◆ Check, whether the welding gun you intend to use is capable of being used with this particular power unit.

Only the following welding guns may be connected to the power unit:

– The A 12 welding gun for stud and bit arc-ignition welding

◆ Check that the stud or bit holder is correctly located on your welding gun.

◆ Check whether the resilience and lift settings applied match the ones listed in the welding parameters table in the instruction manual.

◆ **For details, please consult section 14.4 of this User Manual.**

13. Connection

◆ **First prepare your workspace.**

◆ In this regard, read and observe the stipulations in *item 12 "Preparing the workspace and welding process"*.

Risk caused by electrical current

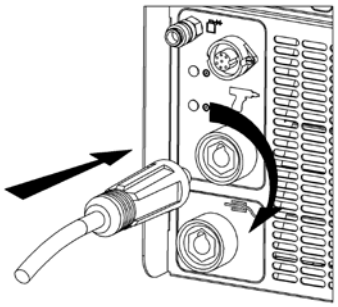
◆ While connecting the cables, make sure that the power unit is switched off.

That way, you will prevent yourself from accidentally activating the welding process.

◆ **Make sure that the cables are firmly connected.**

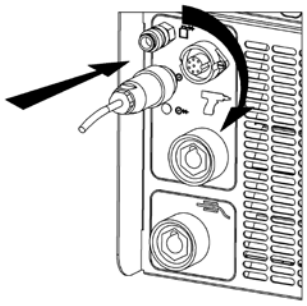
During the welding process, strong magnetic fields are created that cause the cables to be agitated. This may cause the cables to come away from their sockets.

13.1. Connecting the welding gun to the power unit



Connecting the welding current cable

- Only insert the welding current cable into the relevant socket on the power unit at this point in time.
- Push on the plug and turn it firmly to the right.



Connecting the control cable

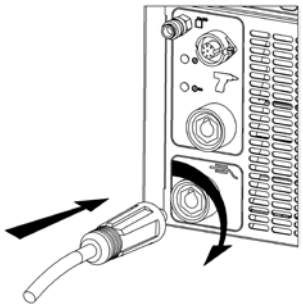
- Insert the control cable into the relevant socket on the power unit.
- Turn the control cable union nut to the right.

The only type of connections that cause damage are connections that are loosely inserted.

- That is why it is important to check that a plug connection is firmly inserted at all times.

That way, you will prevent poor contact and prevent the plug connection from getting hot.

13.2. Earth connection



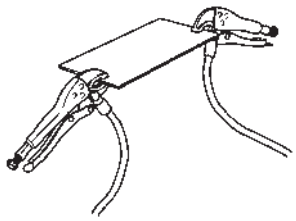
Connect earth cable

- Insert the earth cable into the relevant socket on the power unit.
- Push on the plug and turn it firmly to the right.

The only type of connections that cause damage are connections that are loosely inserted.

- That is why it is important to check that a plug connection is firmly inserted at all times.

That way, you will prevent poor contact and prevent the plug connection from getting hot.

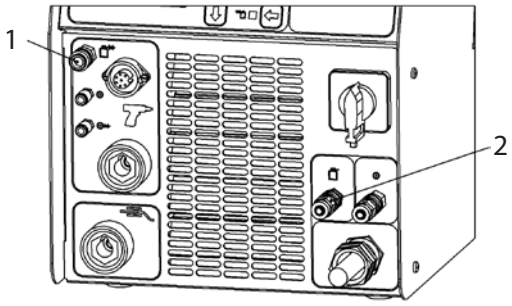


Attach earth clips

- Remove any rust, paint or contaminants at the points on the workpiece where you wish to apply the earth clips.
- Apply the earth clips to the workpiece with as much tension as possible.
- Make sure that effective contact is made and the connection is symmetrical.

The welding location should be located half-way between the two earth clips.

13.3. Connecting the protection gas



1 - Gas outlet

2 - Gas inlet of protection gas canister

- ◆ Insert the gas hose of the protection gas supply system to the gas inlet of the power unit.
- ◆ Place the welding gun gas hose onto the gas outlet.
- ◆ Set the flow meter on the protection gas supply system to 10-16 liters/min.

☞ **The minimum flow rate for stud welding with protection gas is 10 liters/min. (The flow rate is measured with the valve open and gas flowing out)**

During stud welding, a blend of protection gas defined under the DIN EN ISO 14175 is used.

- ◆ For details, please read the instructions in section 11.1.

13.4. Connecting the power unit to the electricity supply

Risk caused by electrical current and voltage

- Have an electrician check whether the socket to which you wish to connect the power unit has the required type of earth.
- Only connect the power unit to a mains network with the same mains voltage as the one that can be found on the rating plate.
- Compare the power uptake displayed on the rating plate with the fuse of your mains network.
- Check whether the power unit is switched off.
- First insert the plug into the socket provided.

14. Welding

- **First connect the power unit.**
- In this regard, read and observe the stipulations in *item 13 "Connection"*.

Risk of death for persons fitted with a pacemaker

- Never operate the welding unit if you have been fitted with a pacemaker.
- If fitted with a pacemaker, never remain in the vicinity of the welding unit while welding is being carried out.
- Never operate the welding unit, if persons fitted with a pacemaker are in the vicinity of the unit.

The reason for this is that while welding is in progress, strong electromagnetic fields will occur in the vicinity of the welding unit. Electromagnetic fields of that type may cause pacemakers to malfunction.

14.1. Activating the power unit

1 Mains switch

- Only activate the power unit at this point in time, using the **mains switch (1)**.

14.2. Establishing the welding time and welding current

Establishing the welding time and welding current on the power unit using the arrow buttons partly depends on

- the welding gun that is used
- the material from which the welding element is made
- the diameter of the welding element
- the material from which the workpiece is made

◆ Use the table alongside to determine the values you need to set on the power unit to determine the welding time and welding current.

Stud		Compo-nent	Electricity source		Gun/head			Remark
Dimensions	Working material	Working material	$I_{welding}$ [A]	$t_{welding}$ [ms]	Projection P [mm]	Lift L [mm]	Resilience scale	
Ø 4.0 mm	Steel	Steel	400	20 ms	2.0	1.0	6	polarity reversed
Ø 5.0 mm	Steel	Steel	550	20 ms	2.0	1.0	6	polarity reversed
Ø 6.0 mm	Steel	Steel	800	20 ms	2.0	1.0	6	polarity reversed
Ø 8.0 mm	Steel	Steel	1000	30 ms	2.0	1.0	6	polarity reversed
Ø 10.0 mm	Steel	Steel	1000	60 ms	2.0	1.0	6	polarity reversed

Aluminum bits		Compo-nent	Electricity source				Gun/head	
Strength	Working material	Working material	$I_{welding}$ [A]	$t_{welding}$ [ms]	Gas time [s]	V_{Gas} [l/min]	Lift L [mm]	Resilience scale
1.0 mm	Alu	Alu	130	5 ms	1.0	10	1.0	6
1.5 mm	Alu	Alu	200	5 ms	1.0	10	1.0	6
2.0 mm	Alu	Alu	240	5 ms	1.0	10	1.0	6

Stud		Compo-nent	Electricity source				Gun/head			Remark
Dimen-sions	Working material	Working material	$I_{welding}$ [A]	$t_{welding}$ [ms]	Gas time [s]	V_{Gas} [l/min]	Projection P [mm]	Lift L [mm]	Resil-ience scale	
Ø 4.0 mm	Alu	Alu	400	5 ms	1.0	10	2.0	1.0	6	polarity reversed
Ø 5.0 mm	Alu	Alu	500	5 ms	1.0	10	2.0	1.0	6	polarity reversed
Ø 6.0 mm	Alu	Alu	600	5 ms	1.0	10	2.0	1.0	6	polarity reversed
Ø 8.0 mm	Alu	Alu	1000	25 ms	2.0	10	2.0	1.0	6	polarity reversed
Ø 8.0 mm	Steel	Usibor	1000	100 ms	2.0	10	2.0	1.0	6	polarity reversed
Ø 4.0 mm	Stainless steel	Stainless steel	600	18 ms	1.0	10	2.0	1.0	6	polarity reversed
Ø 5.0 mm	Stainless steel	Stainless steel	600	30 ms	1.0	10	2.0	1.0	6	polarity reversed

Grounding bolts		Compo-nent	Electricity source				Gun/head			Remark
Dimen-sions	Working material	Working material	$I_{welding}$ [A]	$t_{welding}$ [ms]	Gas time [s]	V_{Gas} [l/min]	Projection P [mm]	Lift L [mm]	Resil-ience scale	
M8	Alu	Alu	1000	25 ms	2.0	10	2.0	1.4	6	polarity reversed
M10	Alu	Alu	1000	60 ms	2.0	10	2.0	1.4	6	polarity reversed

☞ **The details given in this table are guideline values and must be verified by carrying out a test welding on the original material with the same properties as the original workpiece.**

14.3. Available settings

Setting the welding parameters

Setting the welding time

- **First determine the required welding time**
- In this regard, read and observe the stipulations in *item 14.2 "Determining the welding current and welding time"*.

- First set the required welding time (digital display ◷) using the arrow keys.

Setting the welding current

- **First determine the required welding current.**
- In this regard, read and observe the stipulations in *item 14.2 "Determining the welding current and welding time"*.

- First set the required welding current (digital display ⏜) using the arrow keys.

Setting the gas pre-flow time

If you are using protection gas, you need to set the gas pre-flow time. You can use the display to set how long the protection gas should flow before the welding process begins. The gas will continue to flow for as long as the gun is in contact with the working material.

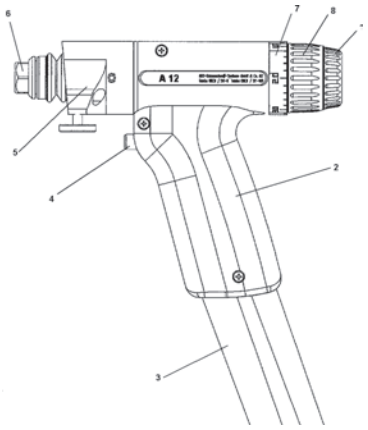
- On the gas flow regulator of the gas canister, set the gas quantity to 10 - 16 liters per minute (at least 10 liters per minute).
- Press the protection gas key and the Protection Gas LED will light up.
- In the welding time display (◷), the gas pre-flow time will be shown.
- You can use both arrow keys ([↑] longer – [↓] shorter) to set the gas pre-flow time. 01 corresponds to 100 ms, 10 corresponds to 1 s – the range that can be set is from 0 to 2 s.

After about 2 s, the welding time display (◷) will automatically switch to the welding time most recently set.

If you are working without protection gas, set the gas pre-flow time to 1 ... 00.
The gas valve will therefore remain closed during the welding process.

15. A12 welding gun

In this section, you will find out how the welding gun is constructed and how you can make use of the various settings available.



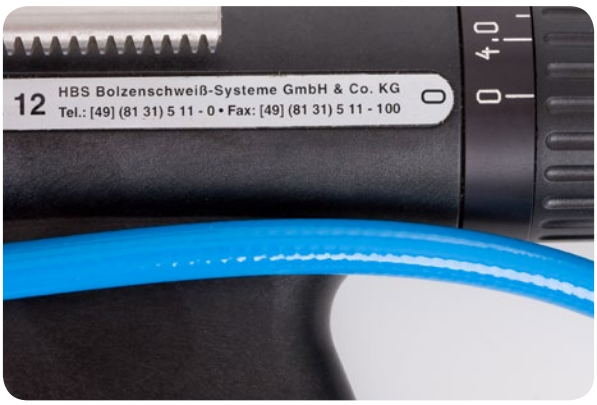
The basic body of the welding gun consists of a stable, two-part plastic housing (2).

The control cable and the welding current cable (3) are led through the handle of the welding gun. On the front side of the welding gun are the welding iron and the union nut (6) that serve to accommodate and attach the bit holder or the manual stud holder. At the front end of the welding gun can be found the foot ring stand (5). Behind this is the adjustment for the lift setting (8), the turnable scale ring (7) and the resilience setting (1). At the front of the welding gun handle is the welding gun key (4) which triggers the welding process.

The serial number is embossed into the welding gun handle.

15.1. Setting the lift height

The scale ring for the lift is not fixed and can be moved. When the device is in the correct basic setting, the "0" value will be aligned with the middle of the rating plate sticker. Before commencing work, please check that the scale ring is in the correct position.



Pull the settings wheel backwards out of its locked position. Now you can set the settings wheel to the required lift by turning it counter-clockwise in steps of 0.2 mm. (The empty range between 0 and 0.2 is used for the mechanical compensation of the lift ring construction). Now move the settings wheel forwards again and return it to the locked position. The lift settings range from 0 to 4 mm.

Lift for the welding on of aluminum bits

A value of 1.0 is normally recommended for welding on bits.

15.2. Setting the resilience / adjusting the resilience scale

Turn the settings wheel to the selected reference value in order to determine the effective initial resilience.

You are able to change the resilience on an individual basis, according to your welding task.

Turning the settings wheel clockwise reduces the initial resilience of the welding iron.

Turning the settings wheel counter-clockwise increases the initial resilience of the welding iron. The reference point for resilience is the white line on the scale ring.

Important!

The maximum number of turns of the settings wheel is one (1) turn. The application of force in cases where the wheel resists movement may cause the mechanical failure of individual components.

When welding on aluminum bits, the resilience should be set to a value of 6. In the case of stud welding, guideline values and the welding parameters, such as the welding current and welding time that need to be set can be found in section 14.3.

16. Aluminum bits technology

Using the AluRepair system, aluminum bits can be welded on quickly and with a high degree of processing certainty. If the system is operated correctly, an excellent surface weld with high tensile strength will be obtained.

16.1. Bit and stud welding with arc ignition

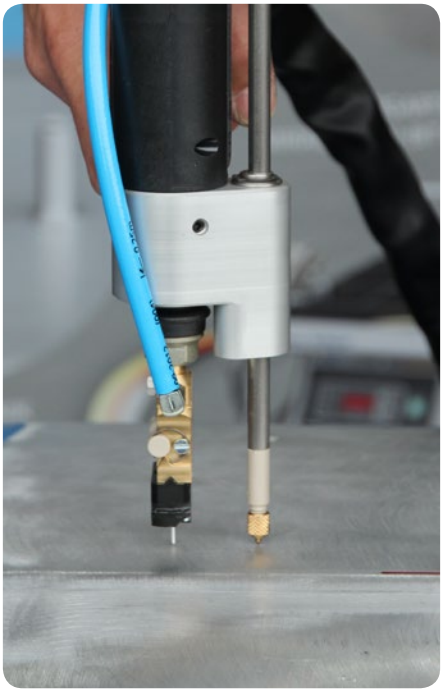
Using the CMA-210 AluRepair system, Miracle aluminum bits, aluminum studs and metallic studs of different diameters can be welded on. What follows below is an explanation of the technology that is used - art-ignition stud welding.

The front surface of a bit or a stud-type element and the opposing surface of the workpiece are melted off using an arc of light and then jointed.

The process is suitable for welding entire surfaces of connecting elements, mainly for pin-shaped metallic components onto metallic workpieces.

Arc-ignition welding

The CMA-210 stud welding unit utilizes the process of light "arc-ignition stud welding" in accordance with the current standard (see Annex). The standard assigns this process, which involves the joining of pin-shaped components with flat-surfaced workpieces to the category of arc pressure welding.



Jointing occurs while the welding zone is in a plastic or liquid state. The process can be carried out mechanically using the bit welding gun or the stud welding attachment.

Generally speaking, the positive pole (earth) of the power unit is connected to the workpiece. The welding element is manually inserted into the stud holder of the welding gun or welding head manually or automatically and applied to the workpiece (see picture, item 1).

When activating the welding gun key, the welding process will begin automatically, as follows:

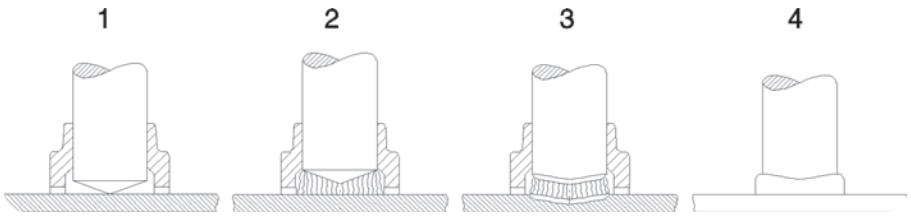
– The protection gas is set to pre-flow in accordance with the pre-flow time set (only when protection gas is being used to protect the weld pool)

– At the start of the welding process, the welding element (the stud) in the welding gun is raised using a lifting mechanism (lifting magnet). The activated start-up current is then used to generate a pilot light arc (see image, **item 2**). After that, the main light arc is created between the surface of the welding element and the workpiece.

– The main arc will burn at the welding current that was set and for the welding time pre-selected on the power unit. The welding energy selected must be in keeping with the welding element selected. Due to the effects of the arc, the surface of the welding element and the workpiece are melted together (see image, **item 3**).

– One the set welding time has elapsed, the welding element will be mechanically moved towards the workpiece. When inserted into the molten metal, both melt areas will be united and will set hard. Once the welding element and workpiece come into contact with one another, the arc will be extinguished as a result of the short circuit and the main current will be turned off.

– The melt area will go hard and cool off. The welding element has been fully welded to the workpiece (see image, **item 4**). Once the welded workpiece has cooled, the welding gun can be carefully pulled away from the welding element.



16.2. Arc ignition stud welding with protection gas

Stud welding with protection gas is used welding elements with a diameter of between 4 and 10 mm (nominal diameter, not including the flange). The welding times used will be from 5 to 100 ms.

As a result of the short welding times, the amount of heat generated in the melt area is so small, the even welding elements of up to 10 mm in diameter can be welded onto thin work pieces. Generally speaking, welding elements with a compressed flange are used. Compared to the shaft diameter, this forms an enlarged welding surface. Despite the presence of pores in the weld area, higher tensile forces can be transferred than are possible in the stud shaft.

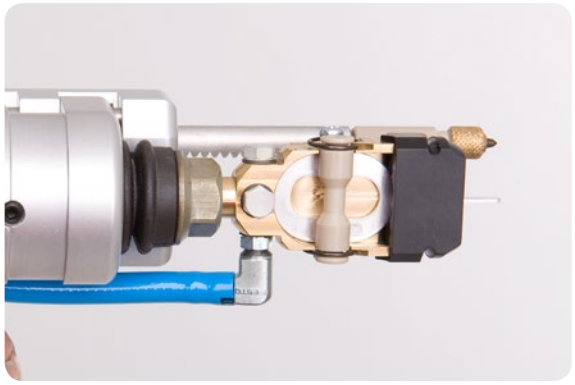
17. Welding on of aluminum bits

17.1. Converting the welding gun in order to weld aluminum bits

- Deploy the stand, align it and secure it using the three Inbus screws.
- Slide the bit holder into the welding gun and tighten the nut (not too tightly)
- Connect the protection gas pipe.
- Insert a bit into the bit-holder - the end with the pulling eye is inserted first
- Set the stand (as described in 17.3).

17.2. Inserting the bits

Insert a bit into the bit-holder. The end with the pulling eye must be at the back. The bit needs to be inserted until it engages. The holder can be used for all types of bit of between 1.0 mm and 2.0 mm.



17.3. Setting the welding gun stand

1. Opening

Turn the handle of the stand clockwise in order to open the stand.

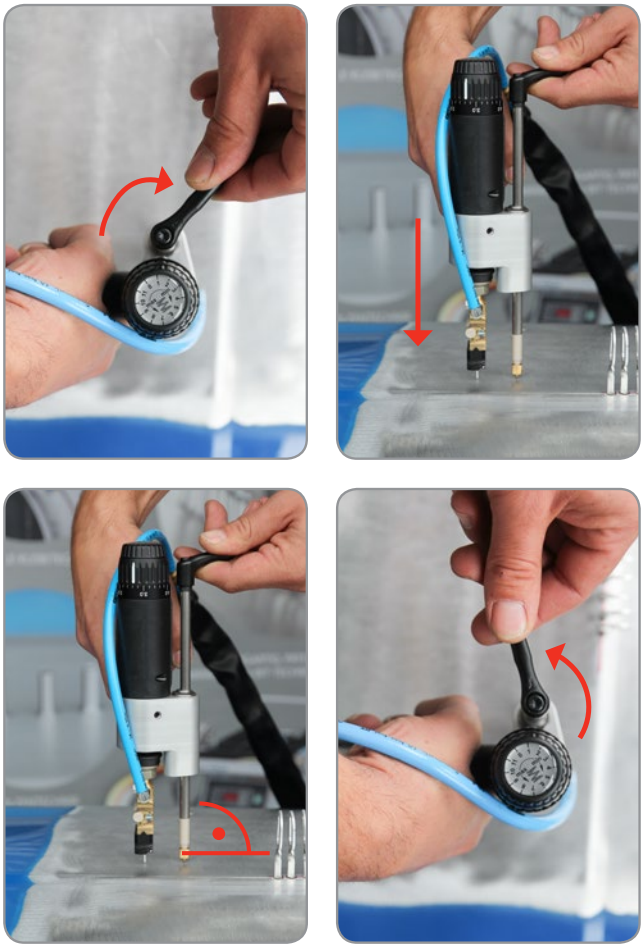
2. Setting the height

Stand the gun vertically on the sheet metal and set the stand in such a way that its tip touches the upper surface. It is important to make sure that the stand is only placed on top and not pressed into place.

3. Tightening

Lock the stand by turning the handle counter-clockwise.

The insertion measurement of 2 mm is ensured by means of the limit stop.



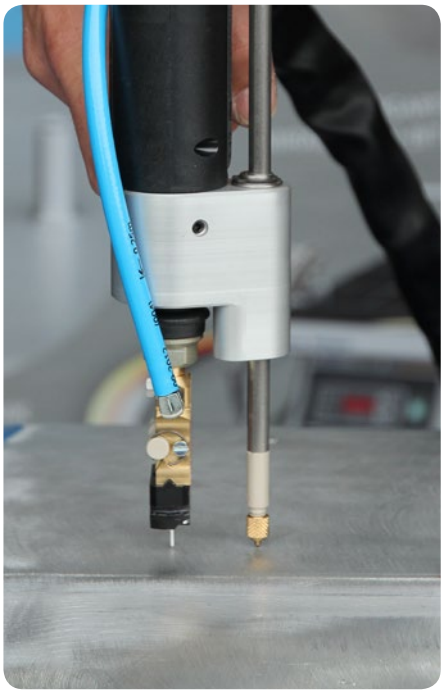
17.4. Flushing the protection gas pipe

Before the first welding operation, briefly activate the trigger on the welding gun. The protection gas will start to flow. This will ensure that sufficient protection gas will be in the supply pipe when the first item is welded. If you have been working for a long time and take a break from your work, you could repeat this action before resuming work again.

17.5. Attaching the gun

Place the welding gun vertically onto the workpiece and press the gun so firmly against the workpiece that sufficient pre-tension is achieved.

- Hold the welding gun firmly, calmly and straight.
- Make sure that no metallic components are touching the welding gun.
- During welding, the blue gas hose must be left free and must not be enclosed in your hand, as the lift may otherwise be affected.



17.6. Commencing the welding process

- Then press the key on the welding gun.
- The welding process will be activated.
- Once the gas pre-flow time has elapsed, welding will take place.

The welding process can only be set in motion, if the welding circuit has been completed, in other words, if the welding element has made electrical contact with the workpiece.

- The gas will continue to flow until you interrupt the contact with the workpiece.
- Pull the welding gun vertically upwards to remove it from the bit that has been welded on.

You can then insert a new bit into the holder and repeat the welding process.

17.7. Miracle aluminum bits

The Miracle aluminum bits are welded to the bare metal using the special welding gun. Depending on the aluminum alloy used to make the bodywork and the type of damage that has occurred, a variety of bits may be used.

17.8. Material and construction

The Miracle aluminum bits are available in 14 different versions:

Item no.	Description	Material	Strength	Version	Numbering	No. in pack
CMA-130-s	Aluminum bits	AlSi	1 mm	straight	1/1.0	50 units
CMA-130-r	Aluminum bits	AlSi	1 mm	turned	1/1.0	50 units
CMA-131-s	Aluminum bits	AlSi	1.5 mm	straight	1/1.5	50 units
CMA-131-r	Aluminum bits	AlSi	1.5 mm	turned	1/1.5	50 units
CMA-132-s	Aluminum bits	AlMg3	1 mm	straight	2/1.0	50 units
CMA-132-r	Aluminum bits	AlMg3	1 mm	turned	2/1.0	50 units
CMA-133-s	Aluminum bits	AlMg3	1.5 mm	straight	2,1.5	50 units
CMA-133-r	Aluminum bits	AlMg3	1.5 mm	turned	2,1.5	50 units
CMA-134-s	Aluminum bits	Al 99.5	1 mm	straight	3/1.0	50 units
CMA-134-r	Aluminum bits	Al 99.5	1 mm	turned	3/1.0	50 units
CMA-135-s	Aluminum bits	Al 99.5	1.5 mm	straight	3/1.5	50 units
CMA-135-r	Aluminum bits	Al 99.5	1.5 mm	turned	3/1.5	50 units
CMA-136-s	Aluminum bits	Al 99.5	2.0 mm	straight	3/2.0	50 units
CMA-136-r	Aluminum bits	Al 99.5	2.0 mm	turned	3/2.0	50 units

Straight bits

The standard version for normal working

Turned bits

Pulling at the edges and increased stability as a result of improved longitudinal pulling. Optimum distribution of forces along the pulling edge by reducing lateral forces.

17.9. Removal/separation of aluminum bits

Using the special CMA-155 bit cutter, the welded-on aluminum bits are cut off very short. The benefit of this is that very little sanding work is required and no material will be removed unnecessarily. Once the bits have been removed and assuming no further pulling is required, preparations for painting can begin.

17.10. Labeling

The bits are embossed with two numbers.

The first number denotes the material - 1 stands for AlSi, 2 for AlMg3 and 3 for pure aluminum Al 99.5. The second number denotes the strength of the material. Bits with a strength of 2.0 mm are capable of withstanding higher tensile forces and are used on items such as sills.

The material to be selected will be determined in accordance with the material of which the panels being aligned are constructed. Generally speaking, it is advisable to begin with Al 99.5% (no. 3). If the weld proves to be unsatisfactory, please try selecting a different material. AlMg3-Bits are suitable for higher tensile forces.

18. Stud welding using the CMA-210

The CMA-210 is not only capable of welding aluminum bits, but also studs and threaded bolts made from steel or aluminum.

A typical application for stud welding when repairing aluminum panels is for the welding on of threaded bolts for the removal of blind screws or threaded bolts that have sheared off.

18.1. Set of accessories for stud welding

Supplied with your welding unit is a set of accessories for stud welding.
The set consists of a gas jet holder with protection gas pipe - the protection gas pipe L = 42, 48, 58 mm and the stud holder 4 / 5 / 6 / 8 and 10 mm.

Stud holders	Item no.
10 mm	CMA-176
8 mm	CMA-175
6 mm	CMA-172
5 mm	CMA-171
4 mm	CMA-170

Protection gas pipes	Item no.
L = 42 mm for 4 / 5 / 6 mm	CMA-177
L = 48 mm for 8 mm	CMA-175-1
L = 58 mm for 10 mm	CMA-176-1

18.2. Converting the welding gun for stud welding

– Attach the gas jet holder and secure it using the three Inbus screws.
– Connect the protection gas pipe.
– Insert the required stud into the stud holder and set the engagement screw so that the stud to be welded has a thread overlap of 2 mm to the stud holder.
– Slide the stud holder, with the stud inserted, into the welding gun and tighten the nut (not too tightly).
– Screw on the gas jet.
– Make sure that the stud has an overlap of 2 mm to the gas jet - only that way will the correct pre-tension for the specified lift be guaranteed.

19. Welding on of bolts

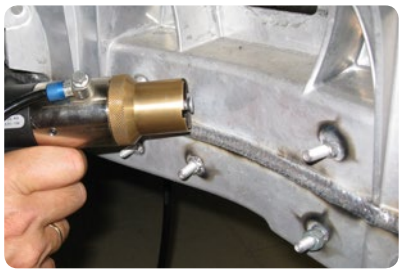
- Place the stud inside the holder.
- Place the gun vertically on top of the workpiece.
- Firmly press the welding gun against the workpiece with both hands, until the welding gun attachment (spacer device) is sitting evenly on top of the workpiece.
- Hold the welding gun firmly, calmly and straight.
- Make sure that no metallic components are touching the welding gun.
- Then press the key on the welding gun.
- Activate the trigger on the welding gun.

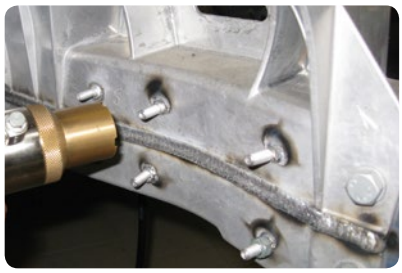
The welding process will be activated.

The welding process can only be set in motion, if the welding circuit has been completed, in other words, if the welding element has made electrical contact with the workpiece.

Once welding is complete, pull the welding gun vertically up from the welding element. If you pull the welding gun away at an angle, you will stretch the stud holder, thereby reducing its service life.

You can then insert a new welding element into the stud holder and repeat the welding process as described.





19.1. Converting the welding gun for the welding of tension bolts

- Attach the gas jet holder and secure it using the three Inbus screws.
- Connect the protection gas pipe.
- Slide the stud holder into the welding gun and tighten the nut (not too tightly).
- Screw on the gas jet. The correct overlap of the stud will have been achieved if you have fully inserted the stud holder and have screwed on the gas jet until it engages.
- For this application only use the AS 852001/1 bzw. VAS 852001/2 stainless steel studs produced by our company.

19.2. Long stud holder and long protection gas pipe

CMA-178 Stud holder, long, 4 mm

CMA-179 Stud holder, long, 5 mm

CMA-178-1 Protection gas pipe, long, 110 mm

(for the CMA-178 and CMA-179 long stud holder)

19.3. Changing the polarity of the welding gun

When welding on steel studs, the main current should flow through the welding element and not through the workpiece, which is the case when welding on aluminum bits. For that reason, the polarity must be changed when welding on steel studs, as shown.

For stud welding, apply BOTH earth cables to the workpiece, so as to obtain a more effective earthing and to preclude any problems during welding, as a result of any blowing effect.

19.4. Carrying out the welding process

- **First set the required welding time**
- In this regard, read and observe the stipulations in *item 14.4 "Setting the welding time"*.

- **First set the required welding current.**
- In this regard, read and observe the stipulations in *item 14.4 "Setting the welding current"*.

Risk of electric shock and hazard posed by the light arc

- During the welding process never touch the welding elements, the stud holder, the union nut or any electrically conductive parts in the vicinity of these.

All of those components will be electrically live.

- During the welding process, never wear metallic items of jewelry, or a wristwatch.

That way, you will avoid injuries and damage caused by electrical current or electromagnetic fields.

Risk of electric shock and hazard posed by the light arc

- Stand on an insulated surface if welding under any of the following conditions:

– In confined spaces constructed from electrically conductive walls

– In restrictive situations between or against electrically conductive components

– In areas allowing only limited movement on electrically conductive components

– In damp, wet or warm spaces

Risk of explosion caused by explosive substances and gases

- Never weld in spaces, in which a risk of explosion exists.
- Never weld onto hollow bodies that contain, or have contained, substances that
  - are flammable or promote combustion
  - may emit gases, vapors or suspended matter that are harmful to health
  - may cause explosions.

Any such tasks may only be carried out by a specialist, trained technician.

- Never carry out work of this type if you have not received suitable specialist training.

Risk of fire or burns due to red-hot welding splashes

- Wear your personal protection equipment and
- your protective eyewear with a category 2 protective lens.
- Wear protective headgear if welding above your head.
- Before commencing welding, remove all flammable objects and fluids from the vicinity of the workplace.
- Ensure that a fire extinguisher that fulfills the requirements is available in the workplace.
- Always follow your work instructions and the relevant accident prevention rules.

Red-hot splashes of weld and fluids occur during the welding process.

Hazard due to noise

- While welding, you should wear hearing protectors.
- Always follow your work instructions and the relevant accident prevention rules.
- Before commencing work, inform staff working in the immediate vicinity of the work to be undertaken.

A bang measuring > 90 dB (A) may occur during welding.

- Ensure that the welding gun was prepared in accordance with the User Manual.

- Check whether a welding element has been inserted into the welding gun.
- If necessary, insert the welding element yourself.
- Place the welding gun vertically onto the workpiece, as soon as the power unit is ready for welding.
- Firmly press the welding gun against the workpiece with both hands, until the welding gun attachment (spacer device) is sitting evenly on top of the workpiece.
- Hold the welding gun firmly, calmly and straight.
- Make sure that no metallic components are touching the welding gun.
- Now press the key on the welding gun.

  The welding process will be activated.

- **Once welding is complete, always pull the welding gun vertically up from the welding element**.

If you pull the welding gun away at an angle, you will stretch the stud holder, thereby reducing its service life.

Risk of burns

During the welding process, the head of the welding gun will become extremely hot. The same thing applies to the element being welded on, as well as to the workpiece itself.

- Wear your personal protection equipment.

☞

- **On each occasion, use only welding elements from a single batch.**
- Strictly ensure that different batches are not mixed.
- After changing batches, carry out further test welding.

The smallest changes of geometry, especially at the tip of the welding elements, will require different settings to be specified for the welding process.

☞

- Check the quality of the welded joint immediately, before inserting a new welding element and repeating the welding process.
- To that end, proceed in accordance with *item 18 below*.

20. Testing the quality of the welded joint

You can determine the quality of the welded joint by means of:

– status displays and messages appearing on the display of the welding unit
– A visual check
– A torque test
– Macrosection and hardness test and
– tensile test

The number of and/or the method used when carrying out tests, in addition to the acceptance criteria, can be derived from the current standard governing the quality requirements.

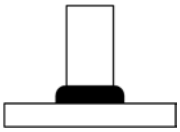
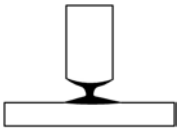
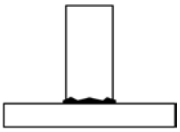
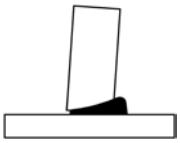
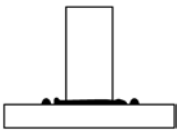
20.1. Quality testing - stud welding with arc ignition

20.1.1 Carrying out a visual check

The criteria are:

– The viability of the thread
– The evenness of the welding bead
– Splashes and
– Porosity

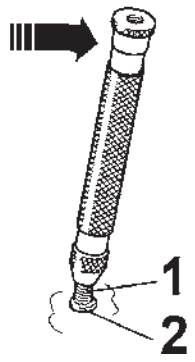
- Carry out the visual check on all welded elements.

A visual check			
Suitability		Possible cause	Corrective measures
	The welding bead is even, shiny and sealed. The length of the welding element is within tolerance after welding.	The settings are correct.	None
	Contraction at the weld Welding element too long	Insertion measurement or lift too short Welding energy too high Ceramic ring not centered Damping effect too strong	Increase insertion measurement; check the lift and the centering of the ceramic ring Reduce current and/or time Check centering Reduce damping effect
	Weakly formed, uneven welding bead with a matte surface Welding element too long	Welding energy too low Ceramic ring is damp Lift is too low	Increase current and/or time Dry ceramic rings in oven Increase lift
	Welding bead is one-sided Undercutting	Blowing effect Ceramic ring not centered	See "Blowing effect" Check centering
	Welding bead low, surface glowing with pronounced spatters Welding element too short	Welding energy too high Insertion speed too high	Reduce current and/or time Adjust insertion measurement and/or damping

20.1.2 Carrying out a bending test

A bending device with inserts for welding elements of various diameters is available for purchase.

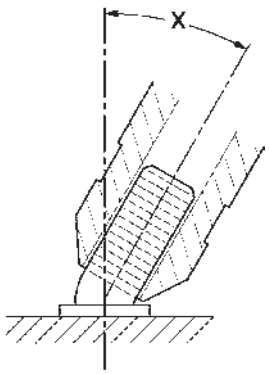
The bending test serves as a simple working test and as an approximate means of testing the welding parameters selected. The welded joint is therefore subjected to an undefined bending load.



1 - Welding element

2 - Welded joint

◆ Attach the bending device onto the **welding element (1)** and



◆ Bend the **welding element (1)** once to an angle of 60° in any direction.

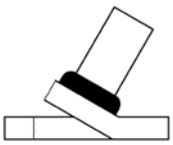
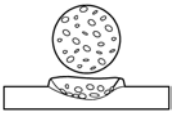
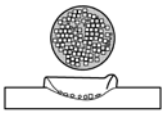
The bending test will have been completed successfully, if no cracks or breaks can be observed inside the welding area.

☞ ◆ **Faulty welding beads should be checked as a matter of priority.**

◆ **Bend** the welding element therefore into the opposite direction to the fault that has been detected.

☞ ◆ It is not necessary to test all welding elements.

It is sufficient if you carry out spot checks on a number of welding elements during the course of routine testing.

Bend testing/fracture testing			
Nature of fracture		Possible cause	Corrective measures
	Detachment of basic material	Correct settings	None
	Fracture above the weld bead following sufficient deformation	Correct settings	None
	Fracture in the weld Large quantity of pores	Welding energy too low Contaminated surface Working material not suitable for stud welding	Increase current and/or time Clean Select a suitable working material
	Fracture in the weld area Surface of break is shiny.	Welding time too short	Extend welding time

If the strength of the welded joint is insufficient:

- ◆ Check the settings in the welding unit.
- ◆ Check whether the surfaces of the welding elements and the workpiece are clean and electrically conductive.

These must be free of scale, oil, paint and oxide deposits.

- ◆ Sand the hardened surfaces of the workpiece (e. g. hardened finish).
- ◆ Check whether the welding iron in the welding gun will move freely.

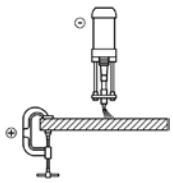
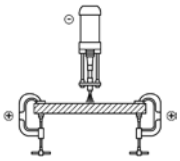
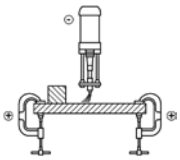
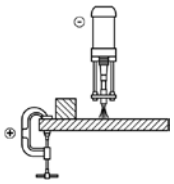
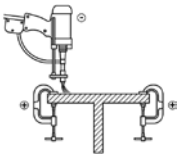
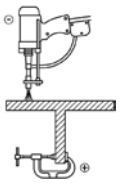
20.2. Optimizing the welding parameters

- ◆ First, check the settings in the welding gun - see item 14.3
- ◆ Then check the welding time and welding current settings, see table 14.4.

20.3. Blowing effect and remedies

A blowing effect can sometimes occur if the earth connection is asymmetrical, if the distribution of materials is different or when welding at the edge of a workpiece. This is caused by an undesirable diversion of the light arc. This results in the melting of the stud material on one side, an increase in pore-formation and undercuttings in the welding area.

The blowing effect is proportional to the strength of the current and can be compensated for by ensuring that the earth clips are attached symmetrically, by connecting compensatory earths or (in the case of welding guns with an external welding cable) by turning the welding gun around the vertical axis.

Blowing effect	
Cause	Remedy
	
	
	

21. Fault detection and rectification

Danger due to insufficiently qualified operating personnel

- Only carry out the tasks described here on your power unit or stud welding gun.
- Repairs may only be carried out by qualified personnel.
- For further information, please contact your specialist dealer or your maintenance department.

Faults	Possible cause	Fault tracing	Rectifying faults	Implementation
Mains switch does not remain in position 1	Mains switch is faulty	Check mains switch*)	Replace mains switch*)	Specialist trained personnel
	Mains switch fuse F4 1 AF faulty	Check power supply to mains switch*)	Replace fuse F4 1 AF*)	Specialist trained personnel
	Mains cable faulty	Check mains cable for breaks*)	Replace mains cable*)	Specialist trained personnel
No LED display on the front panel	Fuse F5 1 AF faulty	Check fuse F5 1 AF*)	Replace fuse F5 1 AF*)	Specialist trained personnel
No display	No earth connection	Check workpiece earth connection	Attach earth connection correctly	Instructed personnel
	Gun not connected	Check gun connection	Connect gun correctly	Instructed personnel
	Transfer resistor (between stud and workpiece) too high	Check workpiece surface	Clean and sand workpiece surface	Instructed personnel
	Break in earth cable	Check earth cable*)	Replace earth cable*)	Specialist trained personnel
	Break in welding gun cable	Check welding gun cable*)	Replace welding gun cable*)	Specialist trained personnel
No display	Fault in welding gun connection line	Check whether connection line is working correctly*)	Replace connection line*)	Specialist trained personnel
	Welding gun start button faulty	Press start button and test control cable for continuity*)	Replace welding gun start button*)	Specialist trained personnel
	Cable break in control line	Test control cable for continuity*)	Replace control cable*)	Specialist trained personnel

Faults	Possible cause	Fault tracing	Rectifying faults	Implementation
Staying on red Display: 8888	Welding sequence too high	Power unit resets itself	Allow switched on power unit to cool down	Instructed personnel
Gun will not lift up despite and	No lift has been set	Check the welding gun settings	Change parameters set	Instructed personnel
	Short-circuit in the magnetic circuit of the welding gun	Measure resistance value at pin 1 and pin 2 on the control cable plug (18 Ω to 22 Ω)*)	Replace control cable plug, control cable and arc magnet*)	Specialist trained personnel
	Arc magnet faulty	Measure arc magnet (18 Ω to 22 Ω)*)	Replace arc magnet*)	Specialist trained personnel
	Fuse F3 4 AF faulty	Check fuse F3 4 AF*)	Replace fuse F3 4 AF*)	Specialist trained personnel
Air shot not possible	Break in magnetic circuit	Measure resistance value at pin 1 and pin 2 on the control cable plug (18 Ω to 22 Ω)*)	Replace arc magnet or control line*)	Specialist trained personnel
No protection gas	Protection gas not connected	Check protection gas connection	Connecting the protection gas	Instructed personnel
	Protection gas control not activated	Test protection gas control is activated	Activate protection gas control	Instructed personnel
	Protection gas valve faulty	Test protection gas valve*)	Replace protection gas valve*)	Specialist trained personnel

Tasks labeled *) may only be carried out by specialist electricians!

- Please contact our service department, if none of the measures named above proves successful.
- When sending in the power unit, please use our repair form at http://www.carbon.ag/unternehmen/service-reparaturen/.

22. Decommissioning

- Switch off the power unit.
- Pull out the mains plug.
- Disconnect the control cable and welding cable from the power unit.
- Protect the power unit and its components against penetration by liquids or foreign bodies.

23. Care and maintenance

Risk caused by electrical current and voltage

- Always switch off the power unit before any care is carried out.
- Pull out the mains plug.

Danger due to insufficiently qualified operating personnel

- Only carry out the tasks described here on your power unit.
- Repairs may only be carried out by qualified personnel.
- For further information, please contact your specialist dealer or your maintenance department.

23.1. Cleaning

- Clean the surface of the power unit if needed, using a slightly damp cloth.
- Add some household washing-up liquid to the cleaning water.

- **Do not use solvents for cleaning purposes**

Solvents may damage the surface of your power unit.

The interior of the power unit must be cleaned at least once every three months.

- For further information, please contact your specialist dealer or your maintenance department.

23.2. Checking and testing

- **Check the condition of the mains cable**
- If any damage is found, please inform your specialist dealer or maintenance department.

- Before each use, check whether the displays on the power unit are still legible.
- Clean the display and keyboard whenever they become dirty.

- Replace any labels that have been removed or damaged:

Pull out the plug before opening the device

Follow the instructions in the User Manual

Warns of hazardous electrical current

24. Storage

- ◆ When not being used, store the power unit in a secure and dust-free location.
- ◆ Protect the power unit from moisture and contamination from metals.

- ◆ Only store the power unit in the ambient conditions described below.

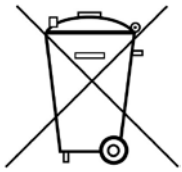
Storage temperature:

-5°C to +50°C

Relative air humidity:

0% - 50% at +40°C
0% - 90% at +20°C

25. Disposal



- ◆ Only dispose of your power unit using the manufacturer's scheme or by using a specialist disposal company.
- ◆ Never dispose of your power unit in the household waste collection.

26. EC Declaration of Conformity

EG-Konformitätserklärung

EG-Konformitätserklärung

gemäß Richtlinie 2006/42/EG, Anhang II 1 A
(Original EG-Konformitätserklärung)

Hiermit erklärt der Hersteller

CARBON GmbH
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DEUTSCHLAND
Tel. +49 7465 466
Fax +49 7465 2217

dass folgendes Produkt

Maschinenangaben: Leistungseinheit
Typ: CMA-210
Serien-Nr: 161XXXX
Baujahr: 2016

gemeinsam mit CARBON-Komponenten als Gesamtsystem

allen einschlägigen Bestimmungen der o. g. Richtlinie entspricht, einschließlich deren zum Zeitpunkt dieser Erklärung gültiger Änderungen.

Das Produkt entspricht folgenden weiteren EU-Richtlinien, einschließlich deren zum Zeitpunkt dieser Erklärung gültiger Änderungen:

Niederspannungsrichtlinie 2014/35/EU
„Elektromagnetische Verträglichkeit" 2014/30/EU
„Beschränkung der Verwendung gefährlicher Stoffe in Elektro- und Elektronikgeräten" 2011/65/EU

Folgende harmonisierten Normen (oder Teile daraus) wurden angewendet:

DIN EN 60974-1	Lichtbogenschweißeinrichtungen - Teil 1: Schweißstromquellen
DIN EN 60974-10	Lichtbogenschweißeinrichtungen - Teil 10: Anforderungen an die elektromagnetische Verträglichkeit (EMV)
DIN EN 60204-1	Sicherheit von Maschinen - Elektrische Ausrüstung von Maschinen - Teil 1: Allgemeine Anforderungen

Folgende nationale Normen und sonstige Spezifikationen (oder Teile daraus) wurden angewendet:

VDE 0544-1

Person, die in der Gemeinschaft ansässig und bevollmächtigt ist, die technischen Unterlagen zusammenzustellen:

Name: Edeltraud Holle Anschrift: siehe Hersteller

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Eigeltingen-Heudorf, 01.03.2016
Ausstellungsort, Datum

Edeltraud Holle (Geschäftsführer CARBON)

27. Notes

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