ARC 800
Power Unit
93-16-0702A

Operating Manual
Dear customer,

Thank you very much for purchasing a power unit from HBS Bolzenschweiss-Systeme.

We from HBS wish you always successful working with this stud welding unit.

We ask you to observe the following points:

- Store the operating manual in a way that it can always be accessed by the operator.
- Let the operator sign before starting up that he has read and completely understood the operating manual.
- This operating manual applies only to this stud welding unit.
- Protect the stud welding unit from unauthorized use.
- The stud welding unit must only be operated by trained personnel.
- Let an electrician check whether the wall sockets where you want to connect the related stud welding unit, are properly fused and grounded.
- Inform our customer service in case of malfunction.
- In case of accident, inform a physician and the responsible official body.

THREAT TO LIFE!
Persons fitted with a pace maker must not operate the stud welding machine.

MAGNETIC FIELDS!
During stud welding, strong electro-magnetic fields are generated. Do not weld in the vicinity of the electrical equipment which could be affected.

Safety instructions are a delicate subject. Anybody who handles a stud welding unit, whether it is the welding gun or the power unit, should be familiar with them, because improper use of stud welding units can be dangerous to life.

For your own sake you should know the safety instructions for operating your HBS stud welding units inside out.

In addition to the protection of your health and the capital value of the enterprise, the safety instructions are intended to clarify any responsibilities, which arise from ownership and operation of the equipment.

This chapter of the operating manual offers you clear and easy to understand information for the safe operation of your HBS stud welding unit.
Your power unit may differ in some details from the captions in this manual. This has no effect on the operation of the welding machine.

Should you have questions about this manual or in case you want to order some more copies, please provide the order number listed in the foot line.

Important reminder:
Data and information herein were collected with greatest care. Although we did our very best to correctly update any information up to the time of delivery, there is no guarantee in respect of errors.

If you should detect errors or mistakes right in this manual, please contact us:

HBS Bolzenschweiss-Systeme GmbH & Co. KG
Felix-Wankel-Strasse 18
85221 Dachau / Germany

A feedback blank is provided in the appendix.
Table of Contents

1 General .................................................................................................................. 9
  1.1 Guide to this Operating Manual ........................................................................ 10
  1.2 Safety Symbols ............................................................................................... 11
  1.3 General Safety Instructions .............................................................................. 12
  1.4 Intended Use .................................................................................................... 12
  1.5 Transportation, Packaging, Storage ............................................................... 13
  1.6 Accompanying Documents .............................................................................. 13
  1.7 Markings ......................................................................................................... 14

2 Delivery .............................................................................................................. 15

3 Starting-up .......................................................................................................... 16
  3.1 Requirements of Workplace ............................................................................ 16
  3.2 Connecting the Power Unit to the Primary Power Supply ............................ 17
  3.3 Connecting the Welding Gun to the Power Unit ............................................ 18
  3.4 Ground Connection ....................................................................................... 19
  3.5 Shielding Gas Connection .............................................................................. 20
  3.6 Change Working Place ................................................................................... 20

4 Function ............................................................................................................. 21
  4.1 Components of the Power Unit ..................................................................... 21
  4.1.1 Power Unit .................................................................................................. 21
  4.1.2 Control Unit ............................................................................................... 21
  4.2 Keyboard and Display ................................................................................... 22

5 Stud Welding Procedure ..................................................................................... 23
  5.1 Safety Instructions .......................................................................................... 23
  5.2 Functional Principle of Stud Welding ............................................................ 26
    5.2.1 Drawn-Arc stud Welding with Ceramic Ferrule ......................................... 28
    5.2.2 Drawn-Arc Stud Welding with Shielding Gas .......................................... 28
    5.2.3 Short-Cycle Drawn-Arc Stud Welding with Shielding Gas ..................... 29
    5.2.4 Drawn-Arc Capacitor-Discharge Stud Welding ....................................... 30
  5.3 Welding Preparation ....................................................................................... 30
  5.4 High-strength Welds ..................................................................................... 30
<table>
<thead>
<tr>
<th>Section</th>
<th>Page</th>
</tr>
</thead>
<tbody>
<tr>
<td>Glossary</td>
<td>65</td>
</tr>
<tr>
<td>Regulations and Standards</td>
<td>66</td>
</tr>
<tr>
<td>Further Instructions</td>
<td>68</td>
</tr>
<tr>
<td>Guarantee Clauses</td>
<td>69</td>
</tr>
<tr>
<td>Confirmation</td>
<td>70</td>
</tr>
<tr>
<td>Feedback</td>
<td>71</td>
</tr>
<tr>
<td>Service &amp; Support</td>
<td>72</td>
</tr>
<tr>
<td>Index</td>
<td>73</td>
</tr>
</tbody>
</table>
1 General

Persons addressed by this operating manual
This operating manual is written for operators, personnel of the end user, and authorized service technicians. It provides you with all necessary information to operate the power unit.

Required user qualification
The power unit must only be operated by qualified personnel.
◆ Let the power unit only be operated by persons who
  – are qualified through a suitable training according to the current standards (see appendix),
  – are properly instructed,
  – are physically and intellectually suitable,
  – can be expected to reliably fulfill the requested job.

What else must the owner observe?
◆ Make sure that this operating manual is always in reach of the stud welding unit.
◆ Read the entire manual before operating the power unit.
◆ Strictly observe the safety instructions.
◆ Before starting up the power unit, let the operator sign the confirmation that he/she has read and fully understood the operating manual (see appendix).
◆ Do not commence stud welding until you have understood all operating processes.
◆ Contact us if there are any doubts on certain operating procedures.
◆ Protect the power unit against unauthorized use.
◆ Inform our service in case of malfunction.

Based on this operating manual, a company specific work order, as well as a company specific maintenance instruction must be drawn up. The company specific work order must consider the special user conditions in your company.

Make sure that operators of the welder are provided with and wear personal protective equipment, e.g. protective goggles, gloves, shoes, ear protection etc.

Owners and operators make sure that the power unit is only used as directed.
◆ During any activity such as transportation, set-up, (re-)assembly, production, maintenance etc. observe the information given in this operating manual.
1.1 Guide to this Operating Manual

This operating manual provides you with the following information

"Delivery" in Chapter 2
"Starting-up" in Chapter 3
"Functional Principle" in Chapter 4
"Stud Welding Process" in Chapter 5
"Switching off the Power Unit" in Chapter 6
"Care and Maintenance" in Chapter 7
Technical Data and much more in Appendix

THREAT TO LIFE and risk of serious health and material damage in case of improper use of the power unit. Observe all notes in this operating manual.

Note for qualified operators (see chapter 1).

All instructions contained in this manual must also be observed by qualified operators.

The welding process and the sequence of procedures to carry out a weld are described in chapter 5.
1.2 Safety Symbols

Symbols and markings used in this operating manual mean:

- **STOP**
  Threat to life or risk of personal injury

- **Danger**
  Risk of material damage

- **Ban for persons fitted with a pace maker**

- **Warning of dangerous electrical voltage**

- **Warning of electromagnetic fields**

- **Wear protective clothes**

- **Wear protective goggles**

- **Wear ear protection**

- **Prompt**

- **List**

Additional tips for operation and service safety
1.3 General Safety Instructions

Improper operation of the power unit is LIFE-THREATENING!

Threat to life
- by electric shock and arc
- by toxic vapors and airborne particles
- by red-hot metal spatters (fire risk)
- by blow-up of explosive gases and materials
- by strong magnetic fields for persons fitted with a pace maker

In addition, through improper use damage to the stud welding unit and to material can be caused. For details, see chapters 1, 3 and 5.

1.4 Intended Use

Warning: Unauthorized interference with the stud welding unit as well as unauthorized alteration of the stud welding unit are prohibited and result in complete cancellation of any guarantee and liability claims against HBS.

Operation of the power unit is only allowed with HBS welding guns, this clause is also part of "use as directed".

The power unit is intended to weld welding elements according to actual standards (see chapter 5 and appendix). Any other use is regarded as not used as directed. The manufacturer is not liable for damages resulting from the stud welding unit not used as directed. Any risk is carried by the user.

The power unit is designed according to specific standards and accident prevention regulations. Basics are European Union guidelines and in Germany valid standards. Please note that in your country additional standards and safety conditions (especially rules for accident prevention) may differ from the standards mentioned in this operating manual. The power unit was manufactured to the latest developments in technology and is regarded as safe to operate (place of operation see section 8.1).

The welding guns A 12, A 16, AI 06 and CA 08 can be connected to the HBS power unit ARC 800. For details please contact the HBS customer service (address see page ii).

◆ Check in any case the operating manual of the HBS welding gun whether this power unit can be used.

Observing the operating manual of the used welding gun is also part of the "use as directed".
1.5 Transportation, Packaging, Storage

HBS delivers products in a specific transport package.

- Save the undamaged packing. Ship and transport the device only in its original packing.

Right before delivery, the power unit is once again checked for proper functioning and a control mark is attached. When receiving the delivery, check everything for damages and completeness. If damages occurred during transportation or components are missing, inform the manufacturer or the haulier immediately (see page ii).

Proper functioning of the power unit can only be checked before starting-up by visual inspection (visible damage).

The following items are to be observed if the power unit is not to be put into operation immediately after delivery.

- The power unit must be stored in a secure place
- The power unit must be protected against humidity, dust, metallic dirt.
  - Storage temperature: -5 °C to +50 °C
  - Relative humidity: 0% to 50% at +40 °C
    0% to 90% at +20 °C

- If you resell the power unit, please provide us with the name and postal address of the new owner so that we can advise them of any changes to the operating manual.

1.6 Accompanying Documents

In addition to this operating manual, you must observe the operating manual of the welding gun as well as applicable accident prevention and safety instructions.
1.7 Markings

There are various markings and safety symbols attached to your power unit (see section 8.1).

◆ Make sure that all markings remain clearly visible.

Type plate
The type plate contains the following data:
Manufacturer
Type
Order No./Serial No.
Primary voltage
Fuse
Power consumption
Cooling class
Protection class
Date

Safety symbols

Replace illegible or damaged markings

Before opening machine disconnect mains

Observe operating manual

Warning of dangerous electrical voltage

◆ Secure the following safety symbols in the area of welding place:
2 Delivery

The basic equipment of your power unit contains the following components:

<table>
<thead>
<tr>
<th>No. of pieces</th>
<th>Part</th>
<th>Type</th>
<th>Order No.</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Power unit</td>
<td>ARC 800</td>
<td>93-16-0702A</td>
</tr>
<tr>
<td>1</td>
<td>Operating manual</td>
<td>ARC 800</td>
<td>BA 93-16-0702A</td>
</tr>
</tbody>
</table>
3 Starting-up

In this chapter you learn what to observe during setting-up and starting-up of the power unit.

3.1 Requirements of Workplace

Vapors and airborne particles may occur during stud welding operations. Especially with surface treated materials, toxic vapors may be produced.

- Ensure that a fume extraction is available and that the room is adequately ventilated according to accident prevention regulations.
- If possible, do not weld in rooms which are lower than 3 meters.
- Special regulations apply for confined rooms, according to accident prevention regulations of the official bodies (see appendix).
- Weld only in adequate distance from combustible articles or liquids.
- Before you start welding, remove any combustible articles or liquids in vicinity of the workplace.
- Make sure that a fire extinguisher is within reach.
- Never weld in rooms exposed to risk of explosion.
- Do not set-up the product in the vicinity of any apparatus or equipment which is sensitive to welding spatters.
- Do not set-up the product in the vicinity of any apparatus or equipment which is sensitive to magnetic fields.
- Set-up the power unit:
  - on a stable, clean, and level surface
  - so that no-one is influenced or injured by welding spatters
  - so that all cables and primary lines are protected from being damaged
  - so that nobody will trip or fall over the cables or connection lines.
- Ensure that air is able to circulate freely through the housing.

If heat is built-up inside the housing caused by bad air circulation, the stud welding unit will be seriously damaged.
Secure the following safety symbols in the area of welding place:

**THREAT TO LIFE to persons fitted with a pace maker**

Strong electro-magnetic fields occur in the vicinity of the stud welding unit during welding. Such fields may affect the proper function of a pace maker. Thus persons equipped with a pace maker must not operate the stud welding unit and must not stay in its vicinity during welding.

During the actual welding process, you must expect red-hot welding spatters, possibly liquid spatters, a flash, and a loud bang > 90 dB (A). Alert any colleagues who are occupied in the vicinity of the welder. Wear your personal protective equipment according to actual standards (see appendix).

### 3.2 Connecting the Power Unit to the Primary Power Supply

- Compare the primary voltage specified on the type plate with the voltage provided by your primary power supply. The type plate is located on the backside of the power unit.

**Danger**

Never connect the welder to a power supply with a voltage different from the voltage indicated on the type plate.

- Check the current consumption specified on the type plate with the fuse rating of your primary power supply.
- Have an electrician check whether the outlet to which you want to connect the power unit is correctly grounded.
- Switch off the power unit.
- Insert the primary plug into the checked outlet.
3.3 Connecting the Welding Gun to the Power Unit

Switch off the power unit. In this way, you avoid any risk of electrical shock.

◆ Plug the welding cable of the welding gun into the socket of the power unit.
◆ Press-in the plug and twist firmly clockwise.

The connection is not secured against working itself loose! Check the plug connections regularly to ensure that they are properly locked. In case of loose connection, heat may build up in the plug and may destroy the entire plug connection.

◆ Plug the control cable in the connector of the power unit.

◆ Twist the retaining nut of the control cable connector clockwise to secure the connection.

The welding gun cables must not be coiled during welding. Coiled cables work as a coil and may negatively affect the welding result. Before welding, lay out the cables lengthwise.

◆ Fix the cables. Strong magnetic fields occur during welding which may cause a movement of the cables. This may cause a slackness of the connections.
3.4 Ground Connection

◆ Plug the ground cable in the connector of the power unit.

◆ Press in the plug and twist firmly clockwise.

The connection is not secured against working itself loose! Check the plug connections regularly to ensure that they are properly locked. In case of loose connection, heat may build up in the plug and may destroy the entire plug connection.

◆ Remove any rust, paint, or contaminants from the workpiece in the areas where you intend to connect the ground cables.

◆ Connect the ground clamps to the workpiece as securely as possible.

Take care to ensure good contact and symmetrical connection. The welding location must lie directly between the two ground clamps.
3.5 Shielding Gas Connection

Observe the standards (see appendix) when handling the shielding gas bottles.

Connect the shielding gas bottle as follows:

- Connect the gas hose of the shielding gas bottle to the gas inlet of the power unit.
- Connect the gas hose of the welding gun to the gas outlet.
- Set the flow meter of the shielding gas bottle to 8 - 16 liters/min.

Minimum flow rate for stud welding with shielded gas is 8 l/min.

A gas mixture of 82% Argon (Ar) and 18% carbon dioxide (CO₂) is mainly used for stud welding.

3.6 Change Working Place

Switch off the power unit. In this way, you avoid any risk of electrical shock.

- When you move your workplace, disconnect the welding gun and the ground cables from the power unit. Proceed in reversed sequence as described in sections 3.2, 3.3, 3.4 and 3.5.
- After changing the workplace, check the welding gun and the ground cables for possible damage or missing components.
4 Function

In this chapter you learn more about the design of the power unit and how to use the various setting options.

4.1 Components of the Power Unit

4.1.1 Power Unit

The power unit consists of the main assemblies

1 - Solid-State-Relais  
2 - Transformer  
3 - Rectifier  
4 - Control unit

Mains alternating current is transformed in the transformer (2) and converted in the rectifier (3).

4.1.2 Control Unit

The control unit synchronizes the mechanical sequence (lifting the welding element) with the electronic control (ignition of pilot arc, ignition of main arc, sequence of welding time). The welding time is stepless adjustable.
4 Function

4.2 Keyboard and Display

Stand-by display green = Ready for welding
Stand-by display red = Locked

How to use displays and keys is described in section 5.6.
5 Stud Welding Procedure

This chapter contains the basics of stud welding, how you must actually proceed, and what must be observed. You learn to select correct welding parameters and which welding elements can be used.

5.1 Safety Instructions

Improper operation of the power unit is LIFE-THREATENING!

Threat to life
- by electric shock and arc
- by toxic vapors and airborne particles
- by red-hot metal spatters (fire risk)
- by blow-up of explosive gases and materials
- during welding of hollow parts
- by strong magnetic fields to persons fitted with a pace maker

Threat to life by electrical shock and arc

During the actual stud welding process, do not touch the welding elements, chuck, or retaining nut nor any electrically conductive parts in their vicinity. These are all electrically life.
Step onto an insulating mat, if you have to weld under the following conditions:
- in confined rooms with electrically conductive walls
- under confined conditions between or on electrically conductive parts
- with restricted freedom of movement on electrically conductive parts
- in wet or hot areas

When operating the stud welding unit, you must not wear any metallic jewellery incl. wrist watches, especially on hands. Remove any electrically conductive or electro-magnetically sensitive parts from your body before you start welding. In this way, you avoid the risk of damage by electric shock or influence of electromagnetic fields.
5 Stud Welding Procedure

5.1 Safety Instructions

THREAT TO LIFE by toxic vapors and airborne particles
Toxic vapors and airborne particles may occur during stud welding operations, especially with surface treated materials.
Ensure that a fume extraction is available that the room is adequately ventilated according to accident prevention regulations.
If possible, do not weld in rooms which are lower than 3 meters.
Special regulations apply for confined rooms according to accident prevention regulations of the official bodies of your country (see appendix).

THREAT TO LIFE by red-hot metal spatters (fire risk)
Make sure that a fire extinguisher is within reach.
Do not wear clothes, which are contaminated with combustible materials like oil, grease, kerosene etc. during welding.
Always wear your personal protective equipment such as:
– protective gloves to current standards (see appendix),
– safety goggles with a window providing protection class 2 to current standards (see appendix),
– non-combustible clothes
– ear protection to current standards (see appendix),
– a protective apron over your clothes,
– a protective headgear when welding overhead.
Before starting to weld, remove all combustible articles and liquids in vicinity of the workplace.
Weld only in sufficient distance from combustible articles or liquids. Choose a safety distance where there is no risk to injury from welding spatters!

THREAT TO LIFE by blow-up of explosive gases and materials
Never weld in rooms exposed to danger by explosion.
Special know-how is required when welding hollow parts which
– are combustible or support combustion,
– can emit toxic gases, vapors, or airborne particles,
– can explode.
Never execute such operations, if you do not have such special know-how.

Observe the regulations for accident prevention and standards which apply to the use of your stud welding unit (see appendix). The official Professional Association of your country will provide you with further information. Please note that in your country additional standards and safety conditions (especially rules for accident prevention) may differ from the standards mentioned in this operating manual.
5 Stud Welding Procedure

5.1 Safety Instructions

THREAT TO LIFE to persons fitted with a pace maker

Strong electro-magnetic fields occur in the vicinity of the stud welding unit during welding. Such fields may affect the proper function of a pace maker. Thus persons equipped with a pace maker must not operate the stud welding unit and must not stay in its vicinity during welding.

During the actual welding process, you must expect red-hot welding spatters, possibly liquid spatters, a flash, and a loud bang > 90 dB (A). Alert any colleagues who are occupied in the vicinity of the welder. Wear your personal protective equipment according to actual standards (see appendix).

MAGNETIC FIELDS!
During stud welding, strong magnetic fields are present. Do not weld in the vicinity of electrical systems and machines which could be affected.

Warning: Unauthorized interference with the stud welding unit as well as unauthorized alteration of the stud welding unit are prohibited and result in complete cancellation of any guarantee and liability claims against HBS.

♦ In case of any accidents whatsoever, advise a physician, your supervisor, and the official bodies immediately.
5.2 Functional Principle of Stud Welding

The face of a stud-shaped welding element and the opposite surface of the workpiece are molten by an arc. Stud welding is suitable for the welding of joining elements across the entire cross-section, mainly using pin-shaped metallic welding elements with metallic workpieces.

The various processes of arc stud welding are distinguished by:

- The method of weld pool protection (shielding gas - SG, ceramic ferrule - CF or no protection - NP)
- The length of welding time (standard ARC or short-cycle drawn-arc stud welding - SC)
- The energy source (welding rectifier supplied by mains, inverter, capacitor battery)

Variations for drawn-arc ignition are described in current standards and regulations (see appendix).

Drawn-Arc Stud Welding

The HBS stud welding unit operates by process of ‘arc stud welding with drawn-arc ignition’ according to the current standards (see appendix). The standards assign this method of joining pin-shaped elements with plane workpieces to the so called ‘Arc Pressure Welding’ (code BH).

Joining is carried out in plastic or liquefied condition of the welding zone. The process can be carried out mechanically or automatically, depending on the used welding guns/welding heads.

Generally, the positive pole of the power unit is connected to the workpiece. The welding element is manually or automatically inserted into the chuck of the welding gun or of the welding head. Then it is placed onto the workpiece - possibly equipped with a ceramic ferrule (see position 1). When the button of the welding gun is triggered, the automated welding process starts, which works as follows:

Pre-flow of shielding gas depending on set pre-flow time (only with shielding gas for weld pool protection).
At the beginning of the welding process, the welding element (stud) in the welding gun is lifted clear off the workpiece by a lifting device (solenoid). An initial switched current triggers a pilot arc of a low current power (see position 2). Then the main arc ignites between the face area of the welding element and the workpiece.

The main arc burns at the set current during the welding time preselected at the power unit. The selected welding energy must match the requirements of the selected welding element. The energy of the arc melts the face of the welding element and the workpiece (see position 3).

At the end of the preset welding time, the stud is mechanically moved to the workpiece. On plunging into the weld pool, the two weld zones join and solidify. The contact of stud and workpiece extinguishes the arc in a short-circuit and the main current is switched off.

The weld zone solidifies and cools down. The welding element is now welded to the workpiece over its entire cross-section of the welding element (see position 4). As soon as the weld metal is cooled down, the welding gun can be carefully withdrawn from the welding element. When using shielding gas, the shielding gas flow is switched off with the withdrawal of the welding gun. If a ceramic ferrule is used, it can be removed by light hammer blows.

The welding range of drawn-arc stud welding is about 3 to 25 mm diameter when using mild steel/stainless steel. Welding elements with rectangular cross-section should not exceed a ratio length : width of about 5 : 1. All technical information and adjustment values are based on the use of welding elements which correspond with current standards (see appendix).

### Variations on Drawn-Arc Stud Welding

<table>
<thead>
<tr>
<th>Item</th>
<th>Drawn-arc stud welding with ceramic ferrule/ring</th>
<th>Drawn-arc stud welding with shielding gas</th>
<th>Short-cycle stud welding with shielding gas</th>
<th>Capacitor-discharge stud welding with drawn-arc</th>
</tr>
</thead>
<tbody>
<tr>
<td>Diameter</td>
<td>d (metric mm (imperial))</td>
<td>3 - 25 (5/32 or 12 gage to 1&quot;)</td>
<td>3 - 12 (1/8 or 12 gage to 1/2&quot;) (5/8&quot;)</td>
<td>2 - 14 (gage to 5/16&quot;)</td>
</tr>
<tr>
<td>Max. current [A]</td>
<td>3000</td>
<td>2500</td>
<td>1500</td>
<td>6000</td>
</tr>
<tr>
<td>Welding time (ms)</td>
<td>80 - 2000</td>
<td>80 - 2000</td>
<td>80 - 100</td>
<td>30 - 10</td>
</tr>
<tr>
<td>Energy source</td>
<td>Welding rectifier</td>
<td>Welding transformer</td>
<td>Welding rectifier</td>
<td>Welding rectifier</td>
</tr>
<tr>
<td>Weld pool protection</td>
<td>Ceramic ferrule CF</td>
<td>No protection NP</td>
<td>No protection NP</td>
<td>No protection NP</td>
</tr>
<tr>
<td>Material welding element</td>
<td>S 235 CrNi steel</td>
<td>S 235 CrNi steel</td>
<td>S 235 CrNi steel</td>
<td>S 235 CrNi steel</td>
</tr>
<tr>
<td>Workpiece surface</td>
<td>Metallic bright (rolling skin, rust film)</td>
<td>Metallic bright (rolling skin, rust film)</td>
<td>Metallic bright, galvanized, light oiled</td>
<td>Metallic bright, galvanized, light oiled</td>
</tr>
<tr>
<td>Min. thickness of workpiece</td>
<td>3 - d</td>
<td>1/2 d min. 1 mm (0,04&quot;)</td>
<td>1/2 d min. 0,6 mm (0,02&quot;)</td>
<td>1/10 d min. 0,6 mm (0,02&quot;)</td>
</tr>
</tbody>
</table>

### Adjustable parameters

- **Welding current**
  - \( I = 80 \text{ A} \) up to \( 16 \text{ mm (0,6")} \)
  - \( I = 80 \text{ A} \) up to \( 16 \text{ mm (0,6")} \)
  - \( I = 100 \text{ A} \) up to \( 12 \text{ mm (0,47")} \)
  - \( I = 100 \text{ A} \) up to \( 12 \text{ mm (0,47")} \)

- **Welding time**
  - \( t_{\text{ms}} = 20 \text{ x d} \) up to \( 12 \text{ mm (0,47")} \)
  - \( t_{\text{ms}} = 20 \text{ x d} \) up to \( 12 \text{ mm (0,47")} \)
  - \( t_{\text{ms}} = 20 \text{ x d} \) up to \( 12 \text{ mm (0,47")} \)
  - \( t_{\text{ms}} = 20 \text{ x d} \) up to \( 12 \text{ mm (0,47")} \)

- **Springs**
  - Lift (arc length)
  - Lift (arc length)
  - Lift (arc length)
  - Lift (spring pressure (plunging speed))

- **Plunging depth**
  - Plunging depth
  - Plunging depth
  - Plunging depth
  - Plunging depth
5.2.1 Drawn-Arc stud Welding with Ceramic Ferrule

Drawn-arc stud welding with ceramic ferrule is used with welding elements of 3 to 25 mm diameter (preferably above 12 mm diameter) and with welding times of 50 to 2000 ms. It is generally suitable for all welding positions. When stud welding with ceramic ferrule, the welding position is PA (vertical). The major part of all applications applies to this procedure.

The ceramic ferrule (CF)
- prevents atmosphere from getting to the weld pool by a formation of metal vapor in the arc chamber
- stabilizes and concentrates the arc, thus decreasing the arc blow effect
- forms the melt under pressure to a weld collar and supports the weld pool on a vertical wall and overhead
- protects the welder from arc radiation and welding spatters

Normally, the ceramic ferrule is used for only one weld and is removed after solidification of the weld pool.

Standard welding elements and ceramic ferrules are described in several standards (see appendix). When using concrete anchors or shear connectors the front area can be plane constructed with a small pressed-in aluminum ball.

Studs with cone-shaped front area and aluminum ball are preferably used with ceramic ferrule.

5.2.2 Drawn-Arc Stud Welding with Shielding Gas

Drawn-arc stud welding with shielding gas is used with welding elements for a diameter range of 3 to 12 (16) mm and with welding times from 50 to 2000 ms. Principally, it is suitable for all welding positions, however, it is preferably used in vertical position PA. With stud welding with shielding gas, the weld area is protected by shielding gas. The shielding gas, which is fed from outside through a gas control and an additional device, displaces the ambient atmosphere from the welding area and reduces considerably pore formation.

With steel and CrNi steel, the gas mixture 82% Ar and 18% CO₂ (DIN EN ISO 14175 – M21) is mainly used.

With aluminum, pure argon Ar 99,99 (DIN EN ISO 14175 – I1) or Ar-He mixtures (DIN EN ISO 14175 – I3) are used.
The shielding gas influences
– the arc and the melting behavior of welding element and workpiece,
– the development of the weld collar and the penetration shape via the surface tension.

With stud welding with shielding gas, the shape of the weld collar is not reproducible, as the shielding gas has no forming effects on the melt—different from a ceramic ferrule. And so an additional ceramic ferrule may be used in special cases.

The standard welding elements and ceramic ferrules for drawn-arc stud welding are described in several standards (see appendix). Welding elements with cone-shaped front area and without an aluminum ball are preferably used.

Studs with cone-shaped front area preferably used under shielding gas.

With shielding gas, you should only weld in position PA (vertical) because due to gravity, the shielding gas cannot prevent flow of the molten metal.

5.2.3 Short-Cycle Drawn-Arc Stud Welding with Shielding Gas

Short-cycle drawn-arc welding with shielding gas is used for welding elements within a diameter range of 3 to 12 mm (nominal diameter without flange) and welding times between 5 and 100 ms.

Due to the short welding times, the energy input and the weld pool are so small that also welding elements up to 12 mm diameter can be welded on thin workpieces.

Normally, welding elements with flange (according to current standards, see appendix) are used, which forms a larger welding area compared with the shaft diameter. In this way, higher tensional forces than in the stud shaft can be transmitted in spite of some pores in the weld zone. To minimize pore formation, the use of shielding gas for stud diameters upwards of 8 mm is recommended.
5.2.4 **Drawn-Arc Capacitor-Discharge Stud Welding**

With drawn-arc capacitor-discharge stud welding, the welding energy is taken from a capacitor. As a result, welding currents are very high and welding times (< 10 ms) very short. Normally, a weld pool protection is not required. The process is mainly used for welding elements in a diameter range of up to 8 mm.

5.3 **Welding Preparation**

- Read the safety instructions in chapters 1, 3 and 5.
- Observe the workplace requirements (chapter 3, "Starting-up").
- Check all cables and connections for proper condition.
- Replace immediately defective cables and cable connections to avoid electrical shocks.
- Check the chuck for proper seat (see operating manual of according welding gun).
- Before welding, make sure that the bellows are checked for damage and proper seat.

5.4 **High-strength Welds**

- The following must be removed both from the weld zone and the ground clamp connection areas:
  - paint, oil and any other impurities,
  - rust,
  - non-conductive coatings from surface treated workpieces.
- Weld to smooth and flat surfaces only.

  **For welding to pipes or punched plates consult our responsible application manager (address of customer service see page ii).**

5.5 **Determination of Welding Parameters**

The adjustment of welding parameters on the power unit (e.g. welding time) or on the welding gun (e.g. lift) depends amongst others on

- material of the welding element
- diameter of the welding element
- material of the workpiece

The guidelines should be verified by test welding on the actual material and be changed if necessary. For an assessment of welding results, see sections 5.8 and 5.9.
Determination of welding time

Data given in the following table are only guidelines. They must be verified by trial welds on the actual material according to actual standards and DVS guidelines (see appendix). Before you use another lot of welding elements, carry out some trial welds to verify the parameter setting.

### Setting of power unit

<table>
<thead>
<tr>
<th>Designation</th>
<th>Eff. diameter (mm/inches)</th>
<th>Welding time in ms</th>
</tr>
</thead>
<tbody>
<tr>
<td>M3</td>
<td>1/8&quot; not normed</td>
<td></td>
</tr>
<tr>
<td>M4</td>
<td>5/32&quot; not normed</td>
<td></td>
</tr>
<tr>
<td>M5</td>
<td>3/16&quot; not normed</td>
<td></td>
</tr>
<tr>
<td>M6</td>
<td>1/4&quot; 4.7/0.19</td>
<td>45</td>
</tr>
<tr>
<td>M8</td>
<td>5/16&quot; 6.2/0.24</td>
<td>80</td>
</tr>
<tr>
<td>M10</td>
<td>3/8&quot; 7.9/0.31</td>
<td>130</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Designation</th>
<th>Eff. diameter (mm/inches)</th>
<th>Welding time in ms</th>
</tr>
</thead>
<tbody>
<tr>
<td>M3</td>
<td>1/8&quot; not normed</td>
<td></td>
</tr>
<tr>
<td>M4</td>
<td>5/32&quot; not normed</td>
<td></td>
</tr>
<tr>
<td>M5</td>
<td>3/16&quot; not normed</td>
<td></td>
</tr>
<tr>
<td>M6</td>
<td>1/4&quot; 5.4/0.21</td>
<td>60</td>
</tr>
<tr>
<td>M8</td>
<td>5/16&quot; 7.18/0.28</td>
<td>100</td>
</tr>
<tr>
<td>M10</td>
<td>3/8&quot; 9.0/0.35</td>
<td>160</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Designation</th>
<th>Eff. diameter (mm/inches)</th>
<th>Welding time in ms</th>
</tr>
</thead>
<tbody>
<tr>
<td>PD (MD)</td>
<td>1/8&quot; not normed</td>
<td></td>
</tr>
<tr>
<td>PS (FD)</td>
<td>5/32&quot;</td>
<td></td>
</tr>
<tr>
<td>RD</td>
<td>3/16&quot; not normed</td>
<td></td>
</tr>
<tr>
<td>UD / Pins</td>
<td>1/4&quot;</td>
<td>45</td>
</tr>
<tr>
<td>Eff. diameter (mm/inches)</td>
<td></td>
<td>Welding time in ms</td>
</tr>
<tr>
<td>M3</td>
<td>1/8&quot; not normed</td>
<td></td>
</tr>
<tr>
<td>M4</td>
<td>5/32&quot;</td>
<td></td>
</tr>
<tr>
<td>M5</td>
<td>3/16&quot; not normed</td>
<td></td>
</tr>
<tr>
<td>M6</td>
<td>1/4&quot;</td>
<td>7</td>
</tr>
<tr>
<td>M8</td>
<td>5/16&quot;</td>
<td>9</td>
</tr>
<tr>
<td>M10</td>
<td>3/8&quot;</td>
<td>11</td>
</tr>
</tbody>
</table>

### Setting of welding gun

<table>
<thead>
<tr>
<th>Eff. diameter (metric/mm)</th>
<th>Plunging depth</th>
<th>Lift</th>
<th>Plunging depth</th>
<th>Lift</th>
</tr>
</thead>
<tbody>
<tr>
<td>3 #4 or 12 gage</td>
<td>1.0</td>
<td>1.0</td>
<td>2.5</td>
<td>1.5</td>
</tr>
<tr>
<td>4 #8</td>
<td>1.0</td>
<td>1.0</td>
<td>2.5</td>
<td>1.5</td>
</tr>
<tr>
<td>5 #10 or 3/16&quot;</td>
<td>1.0</td>
<td>1.0</td>
<td>2.5</td>
<td>1.5</td>
</tr>
<tr>
<td>6 1/4&quot;</td>
<td>1.0</td>
<td>1.0</td>
<td>2.5</td>
<td>1.5</td>
</tr>
<tr>
<td>8 5/16&quot;</td>
<td>1.0</td>
<td>1.0</td>
<td>2.5</td>
<td>2.0</td>
</tr>
<tr>
<td>10 7/16&quot;</td>
<td>1.5</td>
<td>1.5</td>
<td>2.5</td>
<td>2.0</td>
</tr>
<tr>
<td>12 1/2&quot;</td>
<td>1.5</td>
<td>1.5</td>
<td>3.0</td>
<td>2.0</td>
</tr>
</tbody>
</table>

Further notes on
- welding elements
- prestress at installation (tie load) and torque
- material combinations
see appendix and operating manual of the according welding gun.
5.6 Switching on the Power Unit

Improper operation of the stud welding unit is **LIFE-THREATENING**!
First read the safety instructions in chapters 1, 3 and 5.

- Insert the primary plug of the power unit into an appropriate socket.
- Switch on the power unit with the mains switch.

The digital display shows the adjusted charging voltage.

![Mains switch diagram](image)

The digital display shows the adjusted welding time.

![Display with indicators](image)

There is a luminous indication (LED) to the left of the display:

- **Green** – on, power unit is ready for welding
- **Red** – on, power unit is locked
  - after welding, until there is electrical contact with the workpiece
  - if the power unit is overheated (the display shows 8 ... 2).
  After a short cooling period, the work can continue.

- **Green** – lights if the solenoid of the welding gun is controlled
- **Green** – lights if the welding gun button is triggered
- **Green** – lights if there is electrical contact between welding element and workpiece.
5.6.1 Adjusting the Welding Time

- Refer to the table in section 5.5 for the required welding time matching your welding job.
- Set the welding time (digital display) with the arrow keys (↑ higher – ↓ lower) on the display.

5.6.2 Adjusting the Gas Pre-Flow Time

If working with shielding gas, you have to set the gas pre-flow time. Adjust at the display, how long the shielding gas should flow before the welding process starts. The gas flows automatically until the welding gun is removed from the joined welding element.

- Adjust the flow meter at the gas bottle to 8 to 16 liters/min.
- Press simultaneously the two arrow keys at the power unit (↑, ↓) for about one second.
- The display shows 1 ... 00.
- Now set the gas pre-flow time with the two arrow keys (↑ longer – ↓ shorter).
- 01 corresponds to 100 ms, 10 to 1 s (adjustment range 0 to 2 s)
- You return to the display of welding time by another simultaneous press on the two arrow keys (↑, ↓) for about one second.

If you are working without shielding gas, set the gas pre-flow time 1 ... 00. The gas valve remains closed during welding.

5.7 Welding Procedure

Improper operation of the stud welding unit is LIFE-THREATENING! The stud welding unit must only be operated by qualified personnel (see chapter 1). Observe the safety instructions in chapters 1, 3 and 5.

- Prepare the stud welding unit, the ground connection, and the workpiece according to the instructions given in the operating manual.

Chapter 5 contains guideline for welding parameters. The data given are only guidelines. They must be verified by trial welds on the actual workpiece according to actual standards and DVS regulations (see appendix).
During the actual welding process, you must expect red-hot welding spatters, possibly liquid spatters, a flash, and a loud bang may occur > 90dB (A). Inform any colleagues who are occupied in the vicinity of the welder about the bang. Wear always your personal protective equipment according to actual standards (see appendix).

- Insert the welding element into the chuck.

As soon as the power unit is ready for the welding process,

- place the welding gun vertically against the workpiece,
- push the welding gun firmly with both hands onto the workpiece until the welding gun support (distance device) is evenly seated on the workpiece,
- hold the welding gun firmly, still, and straight,
- take care that you do not touch any metallic part of the welding gun,
- press the trigger button of the welding gun.

This initiates the welding process.

The welding process can only be initiated, if the current circuit is closed, i.e. the welding element is in electrical contact with the base material.

After the welding process has been completed, withdraw the welding gun straight back from the welding element. If you remove the welding gun at an angle, the chuck will be stretched, this reduces its life expectancy.

You can now insert a new welding element in the chuck and repeat the welding process as described above.

5.8 Checking the Quality of the Weld

You can check the quality of the weld by means of a visual inspection and a bending test.

See also actual standards in the appendix “Arc stud welding of metallic materials”, in section irregularities and corrective actions.
5.8.1 Visual Inspection

A visual inspection must be carried out with each welding element. Shape, size, evenness, and color of the weld collar are assessed during a visual inspection. The length of a welded element should be 2 - 3 mm shorter than before welding.

<table>
<thead>
<tr>
<th>Condition</th>
<th>Possible cause</th>
<th>Corrective actions</th>
</tr>
</thead>
<tbody>
<tr>
<td>Weld collar evenly, shiny, and complete</td>
<td>Correct parameters</td>
<td>None</td>
</tr>
<tr>
<td>Length of welding element within tolerance</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Contraction of weld collar</td>
<td>Plunging depth or lift too low</td>
<td>Increase plunging depth, check lift and centering of the ceramic ring</td>
</tr>
<tr>
<td>Welding element too long</td>
<td>Welding energy too high</td>
<td>Decrease current and/or time</td>
</tr>
<tr>
<td></td>
<td>Ceramic ring not centered correctly</td>
<td>Check centering</td>
</tr>
<tr>
<td>Weakly developed, uneven weld collar with flat surface</td>
<td>Welding energy too low</td>
<td>Increase current and/or time</td>
</tr>
<tr>
<td>Welding element too long</td>
<td>Ceramic ring is humid</td>
<td>Rebake ceramic rings in a furnace</td>
</tr>
<tr>
<td>Single-sided weld collar</td>
<td>Arc blow effect</td>
<td>See arc blow effect</td>
</tr>
<tr>
<td>Undercut</td>
<td>Ceramic ring not centered correctly</td>
<td>Check centering</td>
</tr>
<tr>
<td>Weld collar low, shiny surface with many spatters</td>
<td>Welding energy too high</td>
<td>Decrease current and/or time</td>
</tr>
<tr>
<td>Welding element too short</td>
<td>Plunging speed too high</td>
<td>Adjust plunging depth and/or damping factor</td>
</tr>
</tbody>
</table>

5.8.2 Bending Test

You can purchase from HBS a bending device with inserts for various diameters of the welding elements.
The bending test serves as an easy work sample and as a check for the selected welding parameters.

- Bend the welding element with the bending device once by 60°.
  Carry out the test in different directions.

The bending test is passed if a crack or a fracture of the welded zone does not occur.

- Please note the instructions on fault recognition and corrective actions in chapter 5.

You don’t need to test all studs. It is sufficient to carry out stud tests at random.

If the strength of the joint is inadequate, then:

- check the setting of the stud welding unit
- check whether the surface of welding element and base material are clean and electrically conductive (must be free from scale, oil, paint, oxide layers)
- grind off hardened workpiece surfaces (e.g. roll hardening).
- Check the piston of the welding gun for ease of movement.

<table>
<thead>
<tr>
<th>Bending Test</th>
</tr>
</thead>
<tbody>
<tr>
<td>Type of fracture</td>
</tr>
<tr>
<td>Base material buckling</td>
</tr>
<tr>
<td>Fracture in welding element above weld collar</td>
</tr>
<tr>
<td>Fracture in the weld metal Many pores</td>
</tr>
<tr>
<td></td>
</tr>
<tr>
<td></td>
</tr>
<tr>
<td>Fracture in the weld metal Shiny fracture surface</td>
</tr>
</tbody>
</table>
5.8.3 Arc Blow Effect

A so called arc blow effect can occur with unproportionally distributed ground connections in relation to the base material mass, varying material distribution, or welding at the edge of a workpiece. This is an undesired deflection of the arc. It causes a single-sided melting of the stud material, increased pore formation, and undercuts in the welding area.

The arc blow effect is proportional to the current and can be influenced by symmetric installation of the ground clamps, by fitting of compensation masses, or by rotating the welding gun around its vertical axis (applies for welding guns with external welding cable).

Arc blow effects and some corrective actions
(according to standards, see appendix)

<table>
<thead>
<tr>
<th>Cause</th>
<th>Corrective action</th>
</tr>
</thead>
<tbody>
<tr>
<td><img src="image1.png" alt="Diagram 1" /></td>
<td><img src="image2.png" alt="Diagram 2" /></td>
</tr>
<tr>
<td><img src="image3.png" alt="Diagram 3" /></td>
<td><img src="image4.png" alt="Diagram 4" /></td>
</tr>
<tr>
<td><img src="image5.png" alt="Diagram 5" /></td>
<td><img src="image6.png" alt="Diagram 6" /></td>
</tr>
</tbody>
</table>
### 5.9 Malfunctions and Corrective Actions

<table>
<thead>
<tr>
<th>Malfunction</th>
<th>Possible cause</th>
<th>Fault finding</th>
<th>Corrective action</th>
<th>Carried out by</th>
</tr>
</thead>
<tbody>
<tr>
<td>Primary switch does not rest in position 1</td>
<td>Primary switch defective</td>
<td>Check primary switch *)</td>
<td>Replace primary switch *)</td>
<td>Qualified personnel</td>
</tr>
<tr>
<td></td>
<td>Fuse F4 1 AF for primary switch defective</td>
<td>Check voltage supply of primary switch *)</td>
<td>Replace fuse F4 1 AF *)</td>
<td>Qualified personnel</td>
</tr>
<tr>
<td></td>
<td>Primary cable defective</td>
<td>Check primary cable for breaks *)</td>
<td>Replace primary cable *)</td>
<td>Qualified personnel</td>
</tr>
<tr>
<td>No LED display at the front</td>
<td>Fuse F5 1 AF defective</td>
<td>Check fuse F5 1 AF *)</td>
<td>Replace fuse F5 1 AF *)</td>
<td>Qualified personnel</td>
</tr>
<tr>
<td>No K-display</td>
<td>No ground connection</td>
<td>Check ground connection on workpiece</td>
<td>Tighten ground connection properly</td>
<td>Qualified personnel</td>
</tr>
<tr>
<td></td>
<td>Welding gun not connected</td>
<td>Check welding gun connection</td>
<td>Connect welding gun properly</td>
<td>Instructed personnel</td>
</tr>
<tr>
<td></td>
<td>Transition resistance (between stud and workpiece) too high</td>
<td>Check material surface</td>
<td>Clean or grind material surface</td>
<td>Instructed personnel</td>
</tr>
<tr>
<td></td>
<td>Ground cable broken</td>
<td>Check ground cable *)</td>
<td>Replace ground cable *)</td>
<td>Qualified personnel</td>
</tr>
<tr>
<td></td>
<td>Welding gun cable broken</td>
<td>Check welding gun cable *)</td>
<td>Replace welding gun cable *)</td>
<td>Qualified personnel</td>
</tr>
<tr>
<td>No display</td>
<td>Defective connecting line of welding gun</td>
<td>Check function of connecting line *)</td>
<td>Replace connecting line *)</td>
<td>Qualified personnel</td>
</tr>
<tr>
<td></td>
<td>Welding gun trigger button defective</td>
<td>Check control cable for electrical flow with triggered start button *)</td>
<td>Replace welding gun trigger button *)</td>
<td>Qualified personnel</td>
</tr>
<tr>
<td></td>
<td>Control cable broken</td>
<td>Check control cable for electrical flow *)</td>
<td>Replace control cable *)</td>
<td>Qualified personnel</td>
</tr>
<tr>
<td>Continuously red display: Display 8...2</td>
<td>Welding sequence too fast</td>
<td>Power unit resets automatically</td>
<td>Let switched on power unit cool down, power unit resets automatically</td>
<td>Instructed personnel</td>
</tr>
<tr>
<td>Welding gun does not lift, in spite of</td>
<td>No lift adjusted</td>
<td>Check settings of welding gun</td>
<td>Modify set parameters</td>
<td>Instructed personnel</td>
</tr>
<tr>
<td></td>
<td>Short circuit of solenoid circuit of the welding gun</td>
<td>Check resistance value of control cable (18 Ω to 22 Ω) between Pin 1 and Pin 2 *)</td>
<td>Replace control cable plug, control cable, solenoid *)</td>
<td>Qualified personnel</td>
</tr>
<tr>
<td></td>
<td>Solenoid defective</td>
<td>Check solenoid (18 Ω to 22 Ω) *)</td>
<td>Replace solenoid *)</td>
<td>Qualified personnel</td>
</tr>
<tr>
<td></td>
<td>Fuse F3 4 AF defective</td>
<td>Check fuse F3 4 AF *)</td>
<td>Replace fuse F3 4 AF *)</td>
<td>Qualified personnel</td>
</tr>
<tr>
<td>Lifting impossible</td>
<td>Solenoid circuit interrupted</td>
<td>Check resistance value at control cable plug (18 Ω to 22 Ω) between Pin 1 and Pin 2 *)</td>
<td>Replace solenoid or control line *)</td>
<td>Qualified personnel</td>
</tr>
<tr>
<td>No shielding gas</td>
<td>Shielding gas not connected</td>
<td>Check shielding gas connection</td>
<td>Connect shielding gas</td>
<td>Instructed personnel</td>
</tr>
<tr>
<td></td>
<td>Shielding gas control not enabled</td>
<td>Check gas control for activity</td>
<td>Switch on shielding gas control</td>
<td>Instructed personnel</td>
</tr>
<tr>
<td></td>
<td>Shielding gas valve defective</td>
<td>Check shielding gas valve *)</td>
<td>Replace shielding gas valve *)</td>
<td>Qualified personnel</td>
</tr>
</tbody>
</table>

Actions marked with *) must only be carried out by qualified electricians!

If none of the actions is successful, please contact our service department.
5.10 Welding Elements

The stud welding unit must be suitable for welding the welding elements to be used. Observe the instructions in the operating manuals.

Welding elements are mainly manufactured with the cold formed process. We recommend the following standard welding elements (see appendix).

Use only welding elements of the same lot. Take particular care not to mix-up different lots. Slightest variations in geometry of the welding elements, especially of the ignition tip, require modified settings of the welding process.

<table>
<thead>
<tr>
<th>Threaded stud RD (MR)</th>
<th>Diameter</th>
<th>Length</th>
<th>Ceramic</th>
<th>Shielding gas *</th>
<th>Chuck</th>
</tr>
</thead>
<tbody>
<tr>
<td>M6</td>
<td>15-40 mm</td>
<td>83-50-006</td>
<td>83-51-006</td>
<td></td>
<td></td>
</tr>
<tr>
<td>M8</td>
<td>15-50 mm</td>
<td>83-50-008</td>
<td>83-51-008</td>
<td></td>
<td></td>
</tr>
<tr>
<td>M10</td>
<td>20-55 mm</td>
<td>83-50-010</td>
<td>83-51-010</td>
<td></td>
<td></td>
</tr>
<tr>
<td>M12</td>
<td>25-60 mm</td>
<td>83-50-012</td>
<td>83-51-012</td>
<td></td>
<td></td>
</tr>
<tr>
<td>M16</td>
<td>30-65 mm</td>
<td>83-50-016</td>
<td>83-51-016</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Materials: S235 / St37.3k (4.8) / 1.4301, 1.4303

<table>
<thead>
<tr>
<th>Threaded stud DD (MD)</th>
<th>Diameter</th>
<th>Length</th>
<th>Ceramic</th>
<th>Shielding gas *</th>
<th>Chuck</th>
</tr>
</thead>
<tbody>
<tr>
<td>M6</td>
<td>15-30 mm</td>
<td>83-50-006</td>
<td>83-51-006</td>
<td></td>
<td></td>
</tr>
<tr>
<td>M8</td>
<td>15-50 mm</td>
<td>83-50-008</td>
<td>83-51-008</td>
<td></td>
<td></td>
</tr>
<tr>
<td>M10</td>
<td>20-55 mm</td>
<td>83-50-010</td>
<td>83-51-010</td>
<td></td>
<td></td>
</tr>
<tr>
<td>M12</td>
<td>25-60 mm</td>
<td>83-50-012</td>
<td>83-51-012</td>
<td></td>
<td></td>
</tr>
<tr>
<td>M16</td>
<td>30-65 mm</td>
<td>83-50-016</td>
<td>---</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Materials: S235 / St37.3k (4.8) / 1.4301, 1.4303

<table>
<thead>
<tr>
<th>Threaded stud PD (MP)</th>
<th>Diameter</th>
<th>Length</th>
<th>Ceramic</th>
<th>Shielding gas *</th>
<th>Chuck</th>
</tr>
</thead>
<tbody>
<tr>
<td>M6</td>
<td>15-40 mm</td>
<td>83-50-006</td>
<td>83-51-006</td>
<td></td>
<td></td>
</tr>
<tr>
<td>M8</td>
<td>20-50 mm</td>
<td>83-50-008</td>
<td>83-51-008</td>
<td></td>
<td></td>
</tr>
<tr>
<td>M10</td>
<td>20-160 mm</td>
<td>83-50-010</td>
<td>83-51-010</td>
<td></td>
<td></td>
</tr>
<tr>
<td>M12</td>
<td>25-160 mm</td>
<td>83-50-012</td>
<td>83-51-012</td>
<td></td>
<td></td>
</tr>
<tr>
<td>M16</td>
<td>30-160 mm</td>
<td>83-50-016</td>
<td>---</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Materials: S235 / St37.3k (4.8) / 1.4301, 1.4303

* Please use only welding elements without aluminum ball.
5 Stud Welding Procedure

5.10 Welding Elements

<table>
<thead>
<tr>
<th>Pin UD (S)</th>
<th>Diameter</th>
<th>Length</th>
<th>Chuck Ceramic</th>
<th>Shielding gas *)</th>
</tr>
</thead>
<tbody>
<tr>
<td>6</td>
<td>20-50 mm</td>
<td>83-50-006</td>
<td>83-51-006</td>
<td></td>
</tr>
<tr>
<td>8</td>
<td>20-50 mm</td>
<td>83-50-008</td>
<td>83-51-008</td>
<td></td>
</tr>
<tr>
<td>10</td>
<td>20-80 mm</td>
<td>83-50-010</td>
<td>83-51-010</td>
<td></td>
</tr>
<tr>
<td>12</td>
<td>20-80 mm</td>
<td>83-50-012</td>
<td>83-51-012</td>
<td></td>
</tr>
<tr>
<td>16</td>
<td>25-80 mm</td>
<td>83-50-016</td>
<td>---</td>
<td></td>
</tr>
</tbody>
</table>

Materials: S235 / St37.3k (4.8) / 1.4301, 1.4303

<table>
<thead>
<tr>
<th>Pin with internal thread MI (ID)</th>
<th>Diameter</th>
<th>Length</th>
<th>Chuck Ceramic</th>
<th>Shielding gas *)</th>
</tr>
</thead>
<tbody>
<tr>
<td>M10</td>
<td>20-50 mm</td>
<td>83-50-010</td>
<td>83-51-010</td>
<td></td>
</tr>
<tr>
<td>M12</td>
<td>20-50 mm</td>
<td>83-50-012</td>
<td>83-51-012</td>
<td></td>
</tr>
<tr>
<td>M16</td>
<td>20-50 mm</td>
<td>83-50-016</td>
<td>---</td>
<td></td>
</tr>
</tbody>
</table>

Materials: S235 / St37.3k (4.8) / 1.4301, 1.4303

<table>
<thead>
<tr>
<th>Head stud SD</th>
<th>Diameter</th>
<th>Length</th>
<th>Chuck ceramic</th>
</tr>
</thead>
<tbody>
<tr>
<td>1/4&quot; (6)</td>
<td>50-100 mm</td>
<td>83-53-006</td>
<td></td>
</tr>
<tr>
<td>3/8&quot; (10)</td>
<td>50-175 mm</td>
<td>83-53-010</td>
<td></td>
</tr>
<tr>
<td>1/2&quot; (13)</td>
<td>50-175 mm</td>
<td>83-53-012</td>
<td></td>
</tr>
<tr>
<td>5/8&quot; (16)</td>
<td>50-175 mm</td>
<td>83-53-019</td>
<td></td>
</tr>
<tr>
<td>3/4&quot; (19)</td>
<td>50-175 mm</td>
<td>83-53-019</td>
<td></td>
</tr>
<tr>
<td>7/8&quot; (22)</td>
<td>75-200 mm</td>
<td>83-53-022</td>
<td></td>
</tr>
</tbody>
</table>

Materials: S235 / St37.3k (4.8) / 1.4301, 1.4303

<table>
<thead>
<tr>
<th>Ceramic ferrule RF for threaded stud RD</th>
<th>Diameter</th>
<th>Ceramic ferrule support</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>6</td>
<td>80-31-095</td>
</tr>
<tr>
<td></td>
<td>8</td>
<td>80-31-120</td>
</tr>
<tr>
<td></td>
<td>10</td>
<td>80-31-150</td>
</tr>
<tr>
<td></td>
<td>12</td>
<td>80-31-170</td>
</tr>
<tr>
<td></td>
<td>16</td>
<td>80-31-205</td>
</tr>
</tbody>
</table>

Materials: S235 / St37.3k (4.8) / 1.4301, 1.4303

* Please use only HBS welding elements without aluminum ball.
### 5 Stud Welding Procedure

#### 5.10 Welding Elements

- **Ceramic ferrule PF for threaded stud PD**
  - Diameter | Ceramic ferrule support |
  - 6        | 80-31-095           |
  - 8        | 80-31-120           |
  - 10       | 80-31-150           |
  - 12       | 80-31-205           |
  - 16       | 80-30-116           |

- **Ceramic ferrule UF for pins UD, MI**

\[
\begin{align*}
\text{Diameter} & \quad \text{Ceramic ferrule support} \\
6 & \quad 80-31-095 \\
8 & \quad 80-31-120 \\
10 & \quad 80-31-150 \\
12 & \quad 80-31-205 \\
16 & \quad 80-30-116 \\
\end{align*}
\]

- **Ceramic ferrule UF for head stud SD**
  - Diameter | Ceramic ferrule support |
  - 1/4"     | 80-30-206           |
  - 3/8"     | 80-30-210           |
  - 1/2"     | 80-30-213           |
  - 5/8"     | 80-30-219           |
  - 3/4"     | 80-30-219           |
  - 7/8"     | 80-30-222           |

- **Threaded stud FD with flange**
  - Diameter | Length | Chuck |
  - M3       | on request | 82-50-003 |
  - M4       | on request | 82-50-004 |
  - M5       | on request | 82-50-005 |
  - M6       | on request | 82-50-006 |
  - M8       | on request | 82-50-008 |

- **X-mas tree stud**
  - Diameter | Length | Chuck |
  - 5        | on request | 82-50-005 |
  - 6        | on request | 82-50-006 |

We look forward to consult you with view to special welding elements and other special materials.

HBS Bolzenschweiss-Systeme GmbH & Co. KG
Felix-Wankel-Strasse 18
85221 Dachau / Germany
Phone +49 (0) 8131 511-0
Fax +49 (0) 8131 511-100
E-mail post@hbs-info.com
6 Switching off the Power Unit

This chapter describes what you should observe when you switch off the power unit temporarily or completely.

6.1 Temporary Switching off

◆ Switch off the power unit.
◆ Unplug the control cable and the welding cable from the power unit.
◆ Protect the power unit against ingress of fluids and foreign bodies.

6.2 Disposal

If you shut down the installation, you can return the complete power unit to HBS (for address see page ii).

We will take care of environmentally correct material separation and disposal.
7 Care and Maintenance

7.1 Safety Instructions

Stop ! Let maintenance and repair operations be carried out only by qualified personnel or by your competent service technician.

- Before starting any repair or maintenance operation, always switch the power unit off and disconnect the primary plug.
- Do not wear a wrist watch or any electrically conductive jewellery.

7.2 Regular Maintenance Operations

Stop ! Clean the inner components of the power unit periodically of dust. Use a dry washcloth or a brush. To open the power unit, proceed as described in sections 7.1, 7.3 and 7.4.

- Clean the surface of the power unit with a humid washcloth and a detergent.

Hand ! Do not use any solvent containing cleaning agents. Solvent containing cleaning agents may damage the surface of the power unit.

7.3 Tools to be Used

- Cross-slotted screwdriver, size 2
7.4 Open the Power Unit

Open the power unit only if you are sufficiently qualified in repairing electrical equipment.

- Remove the 10 screws of the casing (5 at each side).
- Carefully remove the cover and disconnect the ground cable on the inside of the cover.
- Now pull off the cover.

Re-assemble the power unit in reverse sequence.

Make sure that no cables are jammed or sheared during assembly.
### 8 Appendix

In the appendix, there is information of interest regarding technical data, spare part lists, accessories, standards, etc.

#### 8.1 Technical Data

**Power Unit ARC 800**

*for ARC stud welding according to current standards*

<table>
<thead>
<tr>
<th>Specification</th>
<th>Details</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Welding range</strong></td>
<td>#4 to 1/2&quot;, dia. 14 ga to 3/8&quot; (M3 to MR12, dia. 2 to 10 mm)</td>
</tr>
<tr>
<td><strong>Welding material</strong></td>
<td>Mild steel, stainless steel</td>
</tr>
<tr>
<td><strong>Welding rate</strong></td>
<td>7 to 17 studs/min (depending on application and stud dia.)</td>
</tr>
<tr>
<td><strong>Welding current</strong></td>
<td>800 A</td>
</tr>
<tr>
<td><strong>Welding time</strong></td>
<td>5 to 1,000 msec</td>
</tr>
<tr>
<td><strong>Primary power</strong></td>
<td>230/460 V, 3 phases, 50/60 Hz, 50/35 AT (alternative input voltages available)</td>
</tr>
<tr>
<td><strong>Power source</strong></td>
<td>Transformer/Rectifier</td>
</tr>
<tr>
<td><strong>Cooling type</strong></td>
<td>F (temperatur controlled cooling fan)</td>
</tr>
<tr>
<td><strong>Insulation class</strong></td>
<td>IP 23 (also permits operation outdoors)</td>
</tr>
<tr>
<td><strong>Operational and storage conditions</strong></td>
<td>According to current standards</td>
</tr>
<tr>
<td><strong>Dimensions L x W x H</strong></td>
<td>18.50&quot; x 9.06&quot; x 8.66&quot; (470 x 230 x 220 mm) without handle</td>
</tr>
<tr>
<td><strong>Weight</strong></td>
<td>81.57 lbs (37 kg)</td>
</tr>
</tbody>
</table>
# 8.2 Spare Parts

**Spare part list power unit type ARC 800 (93-16-0702A)**

When ordering spare parts, please indicate order number and type of power unit.

<table>
<thead>
<tr>
<th>Pos.</th>
<th>Quantity</th>
<th>Order No.</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>2</td>
<td>11</td>
<td>80-90-184</td>
<td>Tooth lock washer A4</td>
</tr>
<tr>
<td>5</td>
<td>1</td>
<td>88-11-575</td>
<td>Bottom unit complete</td>
</tr>
<tr>
<td>7</td>
<td>1</td>
<td>88-10-546</td>
<td>Cover plate</td>
</tr>
<tr>
<td>8</td>
<td>11</td>
<td>80-90-158</td>
<td>Screw M4 x 6 black</td>
</tr>
<tr>
<td>10</td>
<td>1</td>
<td>88-11-259A</td>
<td>Rear wall complete</td>
</tr>
<tr>
<td>11</td>
<td>2</td>
<td>80-90-149</td>
<td>Screw M8 x 20</td>
</tr>
<tr>
<td>12</td>
<td>2</td>
<td>80-90-150</td>
<td>Washer 8 mm</td>
</tr>
<tr>
<td>13</td>
<td>2</td>
<td>80-90-167</td>
<td>Cupal washer M8</td>
</tr>
<tr>
<td>14</td>
<td>2</td>
<td>80-10-249</td>
<td>Flat connection</td>
</tr>
<tr>
<td>15</td>
<td>1</td>
<td>88-11-576</td>
<td>Support unit complete</td>
</tr>
<tr>
<td>16</td>
<td>2</td>
<td>80-90-140</td>
<td>Spring washer 8 mm</td>
</tr>
<tr>
<td>17</td>
<td>2</td>
<td>80-90-141</td>
<td>Nut M8</td>
</tr>
<tr>
<td>20</td>
<td>1</td>
<td>88-11-268A</td>
<td>Front plate complete</td>
</tr>
<tr>
<td>21</td>
<td>1</td>
<td>80-10-159</td>
<td>Cap</td>
</tr>
<tr>
<td>22</td>
<td>2</td>
<td>80-10-115</td>
<td>Cap</td>
</tr>
<tr>
<td>25</td>
<td>1</td>
<td>80-10-857</td>
<td>Handle A=300</td>
</tr>
<tr>
<td>26</td>
<td>2</td>
<td>80-90-199</td>
<td>Screw M5 x 12</td>
</tr>
<tr>
<td>27</td>
<td>2</td>
<td>80-90-202</td>
<td>Washer 5 mm</td>
</tr>
<tr>
<td>28</td>
<td>2</td>
<td>80-90-128</td>
<td>Spring washer 5 mm</td>
</tr>
<tr>
<td>29</td>
<td>2</td>
<td>80-90-225</td>
<td>Head nut M5</td>
</tr>
<tr>
<td>30</td>
<td>1</td>
<td>88-11-272</td>
<td>Cover</td>
</tr>
<tr>
<td>31</td>
<td>10</td>
<td>80-90-280</td>
<td>Screw M4 x 10 black</td>
</tr>
<tr>
<td>32</td>
<td>3</td>
<td>80-90-296</td>
<td>Screw M6 x 12</td>
</tr>
<tr>
<td>33</td>
<td>3</td>
<td>80-90-147</td>
<td>Spring washer 6 mm</td>
</tr>
<tr>
<td>35</td>
<td>1</td>
<td>80-11-626</td>
<td>Label mat black</td>
</tr>
<tr>
<td>40</td>
<td>1</td>
<td>80-11-624</td>
<td>Label mat white</td>
</tr>
<tr>
<td>65</td>
<td>1</td>
<td>80-11-359</td>
<td>Conductor mark ground cable</td>
</tr>
<tr>
<td>85</td>
<td>1</td>
<td>93-50-020</td>
<td>Shielding gas module</td>
</tr>
<tr>
<td>1</td>
<td></td>
<td>80-70-291C</td>
<td>Cable harness</td>
</tr>
</tbody>
</table>
Power unit ARC 800 (93-16-0702A)
### Spare part list front plate complete ARC 800 (88-11-268A)

<table>
<thead>
<tr>
<th>Pos.</th>
<th>Quantity</th>
<th>Order No.</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>5</td>
<td>1</td>
<td>88-11-269</td>
<td>Front plate</td>
</tr>
<tr>
<td>10</td>
<td>1</td>
<td>88-11-270</td>
<td>Board support</td>
</tr>
<tr>
<td>11</td>
<td>2</td>
<td>80-90-121</td>
<td>Spring washer 4 mm</td>
</tr>
<tr>
<td>12</td>
<td>6</td>
<td>80-90-153</td>
<td>Nut M4</td>
</tr>
<tr>
<td>25</td>
<td>2</td>
<td>80-50-035</td>
<td>Mounting sleeve</td>
</tr>
<tr>
<td>29</td>
<td>2</td>
<td>80-90-137</td>
<td>Screw M3 x 8</td>
</tr>
<tr>
<td>30</td>
<td>1</td>
<td>80-30-195</td>
<td>Control cable sleeve</td>
</tr>
<tr>
<td>34</td>
<td>4</td>
<td>80-90-179</td>
<td>Screw M4 x 12</td>
</tr>
<tr>
<td>35</td>
<td>1</td>
<td>80-50-480</td>
<td>Primary switch</td>
</tr>
<tr>
<td>40</td>
<td>2</td>
<td>88-11-283</td>
<td>Distance sleeve 6,5 x 9</td>
</tr>
<tr>
<td>45</td>
<td>1</td>
<td>80-80-497</td>
<td>P.C. board ARC processor</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>(Observe program version!)</td>
</tr>
<tr>
<td>50</td>
<td>2</td>
<td>80-11-023</td>
<td>Distance stud</td>
</tr>
<tr>
<td>55</td>
<td>1</td>
<td>80-80-490</td>
<td>P.C. board ARC supply</td>
</tr>
<tr>
<td>60</td>
<td>2</td>
<td>80-10-149</td>
<td>Distance stud</td>
</tr>
<tr>
<td>65</td>
<td>1</td>
<td>88-10-930A</td>
<td>Front film</td>
</tr>
<tr>
<td>67</td>
<td>4</td>
<td>80-10-576</td>
<td>Flat connection</td>
</tr>
<tr>
<td>68</td>
<td>2</td>
<td>80-56-215</td>
<td>Capacitor</td>
</tr>
<tr>
<td>70</td>
<td>1</td>
<td>80-70-278</td>
<td>Connection cable</td>
</tr>
<tr>
<td>75</td>
<td>1</td>
<td>80-70-279</td>
<td>Connection cable</td>
</tr>
<tr>
<td>80</td>
<td>2</td>
<td>80-11-111</td>
<td>Cage nut M4</td>
</tr>
<tr>
<td>85</td>
<td>1</td>
<td>80-11-754</td>
<td>HBS-Logo small</td>
</tr>
<tr>
<td>90</td>
<td>1</td>
<td>80-11-359</td>
<td>Conductor mark ground cable</td>
</tr>
</tbody>
</table>

* see sticker “Controller”
Front plate complete ARC 800 (88-11-268A)
### Spare part list support unit complete ARC 800 (88-11-576)

<table>
<thead>
<tr>
<th>Pos.</th>
<th>Quantity</th>
<th>Order No.</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>2</td>
<td>3</td>
<td>80-90-320</td>
<td>Screw M6 x 20</td>
</tr>
<tr>
<td>3</td>
<td>3</td>
<td>80-90-197</td>
<td>Tooth lock washer A6</td>
</tr>
<tr>
<td>4</td>
<td>6</td>
<td>80-90-146</td>
<td>Nut M6</td>
</tr>
<tr>
<td>5</td>
<td>1</td>
<td>88-12-833</td>
<td>Angled support plate</td>
</tr>
<tr>
<td>6</td>
<td>6</td>
<td>80-90-198</td>
<td>Washer 6 mm</td>
</tr>
<tr>
<td>7</td>
<td>7</td>
<td>80-90-147</td>
<td>Spring washer 6 mm</td>
</tr>
<tr>
<td>8</td>
<td>2</td>
<td>80-11-670</td>
<td>Cable mounting</td>
</tr>
<tr>
<td>9</td>
<td>1</td>
<td>80-11-669</td>
<td>Wire protecting sleeve</td>
</tr>
<tr>
<td>10</td>
<td>1</td>
<td>88-11-266</td>
<td>Angle plate</td>
</tr>
<tr>
<td>12</td>
<td>10</td>
<td>80-90-121</td>
<td>Spring washer 4 mm</td>
</tr>
<tr>
<td>13</td>
<td>6</td>
<td>80-90-164</td>
<td>Washer 4 mm</td>
</tr>
<tr>
<td>25</td>
<td>1</td>
<td>80-30-262</td>
<td>Clamping jaw complete</td>
</tr>
<tr>
<td>35</td>
<td>2</td>
<td>80-10-785</td>
<td>Adhesive clip</td>
</tr>
<tr>
<td>40</td>
<td>1</td>
<td>80-11-643</td>
<td>Cable mounting pluggable</td>
</tr>
<tr>
<td>45</td>
<td>1</td>
<td>80-50-927</td>
<td>Mains interference filter</td>
</tr>
<tr>
<td>46</td>
<td>14</td>
<td>80-90-191</td>
<td>Screw M4 x 8</td>
</tr>
<tr>
<td>49</td>
<td>6</td>
<td>80-90-147</td>
<td>Spring washer 6 mm</td>
</tr>
<tr>
<td>50</td>
<td>1</td>
<td>88-11-263</td>
<td>Mounting plate</td>
</tr>
<tr>
<td>51</td>
<td>6</td>
<td>80-90-163</td>
<td>Screw M6 x 16</td>
</tr>
<tr>
<td>52</td>
<td>6</td>
<td>80-90-128</td>
<td>Spring washer 5 mm</td>
</tr>
<tr>
<td>53</td>
<td>6</td>
<td>80-90-198</td>
<td>Washer 6 mm</td>
</tr>
<tr>
<td>54</td>
<td>6</td>
<td>80-90-239</td>
<td>Cupal washer M6</td>
</tr>
<tr>
<td>55</td>
<td>3</td>
<td>80-55-331</td>
<td>Diodes-Diodes module</td>
</tr>
<tr>
<td>57</td>
<td>2</td>
<td>80-11-121</td>
<td>Flat connection</td>
</tr>
<tr>
<td>58</td>
<td>6</td>
<td>80-90-163</td>
<td>Screw M6 x 16</td>
</tr>
<tr>
<td>60</td>
<td>1</td>
<td>88-11-425</td>
<td>Conductor rail plus</td>
</tr>
<tr>
<td>62</td>
<td>4</td>
<td>80-90-203</td>
<td>Screw M6 x 12</td>
</tr>
<tr>
<td>63</td>
<td>2</td>
<td>80-11-642</td>
<td>Distance stud M6</td>
</tr>
<tr>
<td>65</td>
<td>1</td>
<td>88-11-424</td>
<td>Conductor rail minus</td>
</tr>
<tr>
<td>70</td>
<td>1</td>
<td>80-40-384</td>
<td>Clamping plate</td>
</tr>
<tr>
<td>75</td>
<td>1</td>
<td>80-40-383</td>
<td>Cupal plate</td>
</tr>
<tr>
<td>80</td>
<td>1</td>
<td>80-55-076</td>
<td>Thyristor</td>
</tr>
<tr>
<td>84</td>
<td>4</td>
<td>80-90-168</td>
<td>Screw M5 x 35</td>
</tr>
<tr>
<td>85</td>
<td>1</td>
<td>80-10-177</td>
<td>Clamping device</td>
</tr>
<tr>
<td>90</td>
<td>1</td>
<td>80-56-041</td>
<td>Capacitor</td>
</tr>
<tr>
<td>Part No.</td>
<td>Qty</td>
<td>Description</td>
<td></td>
</tr>
<tr>
<td>---------</td>
<td>-----</td>
<td>--------------------------------------</td>
<td></td>
</tr>
<tr>
<td>80-57-332</td>
<td>1</td>
<td>Resistor L</td>
<td></td>
</tr>
<tr>
<td>80-90-202</td>
<td>2</td>
<td>Washer 5 mm</td>
<td></td>
</tr>
<tr>
<td>80-90-127</td>
<td>2</td>
<td>Screw M5 x 8</td>
<td></td>
</tr>
<tr>
<td>88-11-559</td>
<td>1</td>
<td>Transformer 230/460 V</td>
<td></td>
</tr>
<tr>
<td>80-80-491C</td>
<td>1</td>
<td>P.C. board ARC transformer</td>
<td></td>
</tr>
<tr>
<td>80-55-021</td>
<td>2</td>
<td>Solid State Relay</td>
<td></td>
</tr>
<tr>
<td>80-55-116</td>
<td>2</td>
<td>Varistor</td>
<td></td>
</tr>
<tr>
<td>80-70-345</td>
<td>1</td>
<td>Varistor</td>
<td></td>
</tr>
<tr>
<td>80-11-359</td>
<td>3</td>
<td>Conductor mark ground cable</td>
<td></td>
</tr>
</tbody>
</table>

8 Appendix

8.2 Spare Parts
### Spare part list rear wall complete ARC 800 (88-11-259A)

<table>
<thead>
<tr>
<th>Pos.</th>
<th>Quantity</th>
<th>Order No.</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>5</td>
<td>1</td>
<td>88-16-456</td>
<td>Rear wall</td>
</tr>
<tr>
<td>10</td>
<td>1</td>
<td>80-10-0960</td>
<td>Screwed cable connection</td>
</tr>
<tr>
<td>15</td>
<td>1</td>
<td>80-11-567</td>
<td>Lock nut</td>
</tr>
<tr>
<td>30</td>
<td>1</td>
<td>80-50-049</td>
<td>Fan</td>
</tr>
<tr>
<td>31</td>
<td>4</td>
<td>80-90-108</td>
<td>Screw M4 x 12</td>
</tr>
<tr>
<td>32</td>
<td>4</td>
<td>80-90-121</td>
<td>Spring washer 4 mm</td>
</tr>
<tr>
<td>33</td>
<td>1</td>
<td>80-90-184</td>
<td>Tooth lock washer A4</td>
</tr>
<tr>
<td>35</td>
<td>1</td>
<td>80-11-359</td>
<td>Conductor mark ground cable</td>
</tr>
</tbody>
</table>
Rear wall complete ARC 800 (88-11-259A)
### Spare part list bottom unit complete ARC 800 (88-11-575)

<table>
<thead>
<tr>
<th>Pos.</th>
<th>Quantity</th>
<th>Order No.</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>3</td>
<td>6</td>
<td>80-11-437</td>
<td>Cage nut M4</td>
</tr>
<tr>
<td>5</td>
<td>1</td>
<td>88-11-256</td>
<td>Bottom plate</td>
</tr>
<tr>
<td>10</td>
<td>4</td>
<td>80-10-203</td>
<td>Casing feet</td>
</tr>
<tr>
<td>11</td>
<td>4</td>
<td>80-90-173</td>
<td>Screw M4 x 10</td>
</tr>
<tr>
<td>12</td>
<td>4</td>
<td>80-90-164</td>
<td>Washer 4 mm</td>
</tr>
<tr>
<td>15</td>
<td>1</td>
<td>88-11-258</td>
<td>Resistor support</td>
</tr>
<tr>
<td>16</td>
<td>2</td>
<td>80-90-152</td>
<td>Screw M5 x 10</td>
</tr>
<tr>
<td>17</td>
<td>2</td>
<td>80-90-128</td>
<td>Spring washer 5 mm</td>
</tr>
<tr>
<td>18</td>
<td>2</td>
<td>80-90-202</td>
<td>Washer 5 mm</td>
</tr>
<tr>
<td>20</td>
<td>1</td>
<td>80-57-041</td>
<td>Resistor</td>
</tr>
<tr>
<td>25</td>
<td>1</td>
<td>88-11-577</td>
<td>Transformer</td>
</tr>
<tr>
<td>26</td>
<td>4</td>
<td>80-90-296</td>
<td>Screw M6 x 12</td>
</tr>
<tr>
<td>27</td>
<td>4</td>
<td>80-90-147</td>
<td>Spring washer 6 mm</td>
</tr>
<tr>
<td>28</td>
<td>4</td>
<td>80-90-198</td>
<td>Washer 6 mm</td>
</tr>
<tr>
<td>30</td>
<td>1</td>
<td>88-11-257</td>
<td>U-plate</td>
</tr>
<tr>
<td>31</td>
<td>4</td>
<td>80-90-110</td>
<td>Screw M4 x 8</td>
</tr>
<tr>
<td>32</td>
<td>4</td>
<td>80-90-121</td>
<td>Spring washer 4 mm</td>
</tr>
<tr>
<td>50</td>
<td>1</td>
<td>80-11-359</td>
<td>Conductor mark ground cable</td>
</tr>
</tbody>
</table>
Bottom unit complete ARC 800 (88-11-575)
### Spare part list shielding gas module ARC 800 (93-50-020)

<table>
<thead>
<tr>
<th>Pos.</th>
<th>Quantity</th>
<th>Order No.</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>100</td>
<td>1</td>
<td>80-10-145</td>
<td>Connector female</td>
</tr>
<tr>
<td>110</td>
<td>1</td>
<td>80-10-024</td>
<td>Nipple</td>
</tr>
<tr>
<td>115</td>
<td>1</td>
<td>80-10-139</td>
<td>Connector male</td>
</tr>
<tr>
<td>120</td>
<td>1</td>
<td>80-10-146A</td>
<td>Solenoid valve</td>
</tr>
<tr>
<td>122</td>
<td>2</td>
<td>88-11-839</td>
<td>Connection cable</td>
</tr>
<tr>
<td>125</td>
<td>1</td>
<td>80-10-143</td>
<td>Connector female</td>
</tr>
<tr>
<td>140</td>
<td>0.26 m</td>
<td>80-10-182</td>
<td>Plastic hose</td>
</tr>
</tbody>
</table>
Shielding gas module ARC 800 (93-50-020)
Changing the electronic board

Changing the electronic board may only be carried out by sufficiently qualified personnel or by your service technician.

Before starting any repair or maintenance operation, always switch the power unit off and disconnect the primary plug.
Do not wear a wrist watch or any electrically conductive jewellery.

To change the electronic board, proceed as described in section 7.1 (Safety Instructions), 7.3 (Tools to be Used) and 7.4 (Open the Power Unit).

Replacement of the electronic board 80-80-490

◆ Loosen the plugs X1, X2, X3, X4, and SV2.
◆ Remove the two spacers.

◆ Replace the electronic board. For re-assembly, proceed in reversed sequence.

**Replacement of the electronic board 80-80-497**

◆ See changing the electronic board 80-80-490. In addition, you must remove the two spacers.

◆ Replace the electronic board 80-80-497.

**Please observe the program version!**
Main board (80-80-497)

Please observe the program version!
Setting the stud welding unit to various primary voltages

Using a power unit set to an incorrect primary voltage will damage the power unit.
Transformer board (80-80-491C)

Setting the stud welding unit to the correct primary voltage:
Insert jumper (see center of picture) to the corresponding phase
(230 V, 420 V, 460 V or 575 V)

Using a power unit set to an incorrect primary voltage will
damage the power unit.
8.3 Electrical Circuit Diagram
8.4 Environmentally Admissible Disposal

- After repair of the power unit, dispose replaced parts in an environmentally admissible way.

Used materials:
- Steel
- Nonferrous metals (brass, copper)
- Plastics
- Aluminum
Glossary

Arc: Electrical discharge at its own between two electrodes under sufficiently high current. Whitish light is emitted. The arc generates very high temperatures.

Automatic welding head: Device to weld welding elements

Capacitor: A component which serves as storage of electrical charge

Power unit: Device to provide electrical energy for stud welding

Rectifier: Electric component transforming alternating current into direct current

Stud feeder: Device for the automatic stud feeding of welding elements

Stud welding unit: Power unit inclusive welding gun

Thyristor: Electronic component, contactless switch, which will let the current only pass through if a control pulse is given to the gate (additional electrode)

Welding element: A component, like a stud, bolt, pin, which is welded to the work piece

Welding gun: Device to weld welding elements

Welding parameters: Various settings on the gun as well as on the power unit. For example: duration and strength of current during welding process, charging voltage, spring force of the welding gun.

Work piece: A component, like a sheet, tube, etc. to which the welding element is fastened
The regulations and standards are recommendations and don’t purport to be completely.

<table>
<thead>
<tr>
<th>Standards, regulations</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Stud welding (fundamentals)</strong></td>
<td></td>
</tr>
<tr>
<td>DIN EN ISO 13918</td>
<td>Welding - Studs and ceramic ferrules for arc stud welding</td>
</tr>
<tr>
<td>DIN EN ISO 14555</td>
<td>Welding - Arc stud welding of metallic materials</td>
</tr>
<tr>
<td>DIN EN 1418</td>
<td>Welding personnel - Approval testing of welding operators for fusion welding and resistance weld setters for fully mechanized and automatic welding of metallic materials</td>
</tr>
<tr>
<td>DVS 0901</td>
<td>Stud welding method for metals - Survey</td>
</tr>
<tr>
<td>DVS 0902</td>
<td>Arc stud welding</td>
</tr>
<tr>
<td>DVS 0903</td>
<td>Capacitor discharge welding with tip ignition</td>
</tr>
<tr>
<td>DVS 0904</td>
<td>Tips - Arc stud welding</td>
</tr>
<tr>
<td>DVS 2927</td>
<td>Resistor projection welding and Arc welding of one-sided thick plastics coated thin metal sheets</td>
</tr>
<tr>
<td><strong>Stud welding (general)</strong></td>
<td></td>
</tr>
<tr>
<td>DIN EN ISO 4063</td>
<td>Welding and allied processes - Nomenclature of processes and reference numbers</td>
</tr>
<tr>
<td>DIN ISO 857-1</td>
<td>Welding and allied processes - Vocabulary - Part 1: Metal welding processes</td>
</tr>
<tr>
<td>DIN EN ISO 14175</td>
<td>Welding consumables - Shielding gases for fusion welding and allied processes</td>
</tr>
<tr>
<td>DIN EN 764-1</td>
<td>Pressure equipment - Part 1: Terminology - Pressure, temperature, volume, nominal width</td>
</tr>
<tr>
<td>DIN EN 6947</td>
<td>Welds - Working positions - Definitions of angles of slope and rotation</td>
</tr>
<tr>
<td>DIN 1910</td>
<td>Welding</td>
</tr>
</tbody>
</table>
### Regulations and Standards

#### Machine safety
- **73/23/EWG**: Electrical equipment designed for use within certain voltage limits
- **2004/108/EG**: EMC-Guidelines
- **98/37/EG**: Machine guidelines
- **DIN EN 60204-1**: Safety of machinery - Electrical equipment of machines - Part 1: General requirements
- **DIN EN 60529**: Degrees of protection provided by enclosures (IP code)
- **DIN EN 60974-1**: Arc welding equipment - Part 1: Welding power sources
- **DIN EN 60974-10**: Electromagnetic compatibility (EMC); Arc welding equipment - Part 10: Requirements

#### Personal safety and accident prevention
- **DIN EN ISO 20345**: Personal protective equipment: Safety footwear
- **DIN EN 12477**: Protective gloves for welders
- **DIN EN 166**: Personal eye-protection - Specifications
- **DIN EN 352-1**: Hearing protectors - General requirements - Part 1: Ear-muffs
- **BGV A1**: Safety rules „Principles of prevention”
- **BGV A3**: Accident prevention regulation „Electrical equipment and operating material”
- **BGV B3**: Safety rules “Noise”
- **BGV B11**: Safety rules “EMC”
- **BGV D1**: Safety rules - welding, cutting and similar processes

**Please note that in your country additional standards and safety conditions (especially rules for accident prevention) may differ from the standards mentioned in this operating manual.**
Further Instructions

Welding elements, abbreviations, materials, standards, mechanical properties to actual standards

<table>
<thead>
<tr>
<th>Stud types</th>
<th>Abbreviations for studs (ceramic ferrules)</th>
<th>Material</th>
<th>Norm</th>
<th>Mechanical characteristics</th>
</tr>
</thead>
<tbody>
<tr>
<td>Threaded stud</td>
<td>PD (PF)</td>
<td>Mild steel (4.81)</td>
<td>ISO 888-1</td>
<td>see ISO 888-1</td>
</tr>
<tr>
<td>Threaded stud with reduced shell</td>
<td>RD (RF)</td>
<td>1.4301/03 (A2-50)</td>
<td>EN ISO 3505-1</td>
<td>see ISO 3505-1</td>
</tr>
<tr>
<td>Pin with internal thread</td>
<td>ID (UF)</td>
<td>1.4301/03 (A2-50)</td>
<td>ISO/TR 15608</td>
<td>see ISO 3505-1</td>
</tr>
<tr>
<td>Head stud</td>
<td>SD (UF)</td>
<td>1.4301/03 (A2-50)</td>
<td>EN 10088-1</td>
<td>see ISO 888-1</td>
</tr>
<tr>
<td>Threaded stud with flange</td>
<td>PS</td>
<td>Mild steel (4.81)</td>
<td>ISO 898-1</td>
<td>see ISO 888-1</td>
</tr>
<tr>
<td>Pin with flange</td>
<td>US</td>
<td>1.4301/03 (A2-50)</td>
<td>EN ISO 3506-1</td>
<td>see ISO 3505-1</td>
</tr>
</tbody>
</table>

Further materials on request

Prestress at installation (tie load) and torque

<table>
<thead>
<tr>
<th>Threaded stud</th>
<th>Steel (4.81)</th>
<th>1.4301/03 (A2-50)</th>
<th>AlMg3 (F23)</th>
<th>CuZn37 (Me63)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>μ = 0,18</td>
<td>μ = 0,18</td>
<td>μ = 0,18</td>
<td>μ = 0,18</td>
</tr>
<tr>
<td></td>
<td>Rp0,2 = 340 N/mm²</td>
<td>Rp0,2 = 210 N/mm²</td>
<td>Rp0,2 = 170 N/mm²</td>
<td>Rp0,2 = 250 N/mm²</td>
</tr>
<tr>
<td>Prestress at installation (kN)</td>
<td>Torque (Nm)</td>
<td>Prestress at installation (kN)</td>
<td>Torque (Nm)</td>
<td>Prestress at installation (kN)</td>
</tr>
<tr>
<td>M6</td>
<td>4,3</td>
<td>6,1</td>
<td>2,7</td>
<td>3,8</td>
</tr>
<tr>
<td>M8</td>
<td>8,0</td>
<td>15,0</td>
<td>4,9</td>
<td>9,5</td>
</tr>
<tr>
<td>M10</td>
<td>13,0</td>
<td>30,0</td>
<td>7,8</td>
<td>19,0</td>
</tr>
<tr>
<td>M12</td>
<td>19,0</td>
<td>53,0</td>
<td>12,0</td>
<td>33,0</td>
</tr>
<tr>
<td>M16</td>
<td>35,0</td>
<td>135,0</td>
<td>22,0</td>
<td>82,0</td>
</tr>
</tbody>
</table>

Values correspond with actual standards

Prestress at installation and torque

<table>
<thead>
<tr>
<th>Stud types</th>
<th>Abbreviations for studs (ceramic ferrules)</th>
<th>Material</th>
<th>Norm</th>
<th>Mechanical characteristics</th>
</tr>
</thead>
<tbody>
<tr>
<td>Drawn arc welding with ceramic ferrule (CF) or shielding gas (SG)</td>
<td>Drawn arc welding with ceramic ferrule (CF) or shielding gas (SG)</td>
<td>Drawn arc welding with ceramic ferrule (CF) or shielding gas (SG)</td>
<td>Drawn arc welding with ceramic ferrule (CF) or shielding gas (SG)</td>
<td>Drawn arc welding with ceramic ferrule (CF) or shielding gas (SG)</td>
</tr>
<tr>
<td>Threaded stud</td>
<td>PD (PF)</td>
<td>Mild steel (4.81)</td>
<td>ISO 888-1</td>
<td>see ISO 888-1</td>
</tr>
<tr>
<td>Threaded stud with reduced shell</td>
<td>RD (RF)</td>
<td>1.4301/03 (A2-50)</td>
<td>EN ISO 3505-1</td>
<td>see ISO 3505-1</td>
</tr>
<tr>
<td>Pin with internal thread</td>
<td>ID (UF)</td>
<td>1.4301/03 (A2-50)</td>
<td>ISO/TR 15608</td>
<td>see ISO 3505-1</td>
</tr>
<tr>
<td>Head stud</td>
<td>SD (UF)</td>
<td>1.4301/03 (A2-50)</td>
<td>EN 10088-1</td>
<td>see ISO 888-1</td>
</tr>
<tr>
<td>Threaded stud with flange</td>
<td>PS</td>
<td>Mild steel (4.81)</td>
<td>ISO 898-1</td>
<td>see ISO 888-1</td>
</tr>
<tr>
<td>Pin with flange</td>
<td>US</td>
<td>1.4301/03 (A2-50)</td>
<td>EN ISO 3506-1</td>
<td>see ISO 3505-1</td>
</tr>
</tbody>
</table>

Further materials on request

Material combinations

Values correspond with actual standards

Material combinations

<table>
<thead>
<tr>
<th>Stud material</th>
<th>Base material</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>ISO/TR 15608</td>
</tr>
<tr>
<td></td>
<td>Groups 1 and 2</td>
</tr>
<tr>
<td>Steel (S235) 4.81/16Mb3</td>
<td>a</td>
</tr>
<tr>
<td>1.4301/03, 1.4401/04, 1.4541,1.4571</td>
<td>b/a</td>
</tr>
<tr>
<td>EN AW-5754/EN AW-5754</td>
<td>--</td>
</tr>
<tr>
<td>EN AW-5754/EN AW-5754</td>
<td>--</td>
</tr>
<tr>
<td>EN AW-5754/EN AW-5754</td>
<td>--</td>
</tr>
</tbody>
</table>

Exemplification of welding suitability

-- non weldable
a well suited for any application, e.g. power transmission
b suitable, limitations with power transmission

Weldability tests of other material combinations upon request.
Guarantee Clauses

Please refer to the current “General Terms and Conditions” for the guarantee clauses.

We are not liable for malfunctions which are caused by

– normal wear,
– improper use,
– non-observing the operating manual,
– transport damages.

Any guarantee claim will be cancelled if repair operations are carried out by unauthorized persons.

⚠️ Warning: Unauthorized interference with the stud welding unit as well as unauthorized alteration of the stud welding unit are prohibited and result in complete cancellation of any guarantee and liability claims against HBS.

Please fill in the serial number:

Serial number automatic welding head: .................................................
Serial number power unit: .................................................
Serial number welding gun: .................................................
Serial number stud feeder: .................................................

Please indicate the serial numbers in case of enquiries or when ordering spare parts.
Confirmation

Herewith I confirm that I have read and understand the present operating manual completely.

Date  Name

________________  ______________________________

________________  ______________________________

________________  ______________________________

________________  ______________________________

________________  ______________________________

________________  ______________________________

________________  ______________________________

________________  ______________________________

________________  ______________________________

________________  ______________________________

________________  ______________________________

________________  ______________________________

________________  ______________________________

________________  ______________________________

________________  ______________________________

________________  ______________________________

________________  ______________________________

________________  ______________________________

________________  ______________________________
Feedback

HBS Bolzenschweiss-Systeme
GmbH & Co. KG
Felix-Wankel-Strasse 18
85221 Dachau / Germany
Postfach 13 46
85203 Dachau / Germany

Product description
Serial number

My opinion/criticism/complaints/indication of malfunction:

________________________________________________________________________

________________________________________________________________________

________________________________________________________________________

________________________________________________________________________

________________________________________________________________________

________________________________________________________________________

________________________________________________________________________

Date and signature

__________________________________________
Service & Support

With the sending please attach a copy of the filled out form together with the repair number given by HBS. Repairs without repair number will not be handled.

Repair number
(given by HBS)

Company:
Name / Surname:
Street:
City, State and ZIP:
Country:
Phone & Fax:
E-mail address:
Unit / gun type of model:
Serial number:
Date of purchase:
Purchased at distributor:

Further descriptions of default:

Service & support may be done up to the value of EUR ________ without tender:

Could you find any damage / burning mark:
on the cables:
on chucks:
Are all plug and screw connections fastened tight *:
Are there any burning marks on plug or screw connections:
Are there any other visual damages (e.g. cracks, dents):
Have you checked the fuses:

Default on the display of the power unit:

<table>
<thead>
<tr>
<th>ARC</th>
<th>CD</th>
</tr>
</thead>
<tbody>
<tr>
<td>![image]</td>
<td>![image]</td>
</tr>
<tr>
<td>![image]</td>
<td>![image]</td>
</tr>
<tr>
<td>![image]</td>
<td>![image]</td>
</tr>
</tbody>
</table>

Which LEDs are burning (please mark with a cross)?

Please e-mail or fax this form to post@hbs-info.de or fax: ++49 - 81 31 - 5 11 - 1 00.
In case a repair is necessary you get the required repair number!

* See also according operating manual, chapter „Starting-up”
** Doesn’t light when using a contact welding gun
# Index

| A | accident prevention ........................................ 12, 24 |
| B | anger .................................................................... 17, 25, 34 |
| C | capacitor .......................................................... 65 |
| D | defective cables ..................................................... 30 |
| E | ear protection ..................................................... 9, 24 |
| F | fault recognition ................................................... 36 |
| G | gas pre-flow time .................................................... 33 |
| H | headgear, protective .................................................. 24 |
| I | intended use ............................................................. 12 |
| K | keyboard .................................................................. 22 |

## Accident Prevention
- Prevention regulations .................................................. 16
- Accidents ................................................................. 25
- Accompanying documents .............................................. 13
- Airborne particles ........................................................ 16
- Arc ........................................................................ 65
- Arc blow effect ......................................................... 37
- Arrow keys ............................................................ 33
- Articles, combustible ................................................... 16
- Automatic welding head ............................................ 65

## Bending Test
- Bang ................................................................. 17, 25, 34
- Bending device with inserts ........................................ 35
- Bending test .......................................................... 35
- Blow-up ................................................................... 24

## Capacitor
- Care and maintenance ............................................... 10
- Ceramic ferrule/ring .................................................. 28
- Cold formed process .................................................. 39
- Company specific maintenance instruction .................... 9
- Company specific work order ....................................... 9
- Components of the power unit .................................... 21
- Confirmation .......................................................... 70
- Confirmation, operator sign ....................................... 9
- Control cable connector ............................................ 18
- Cooling fan .................................................................. 45
- Corrective actions ..................................................... 36
- Cover ........................................................................ 44
- Cross-slotted screwdriver ......................................... 43

## Defective Cables
- Delivery ............................................................... 10, 15
- Display ................................................................. 22
- Disposal ................................................................. 42
- Disposal, environmentally admissible ......................... 64
- Distance device ....................................................... 34
- Drawn-arc stud welding, variations ............................. 27
- DVS regulations ....................................................... 33

## Electrical Circuit Diagram
- Ear protection ......................................................... 9, 24
- Electrical shock, risk of ............................................. 18
- Electrical voltage ..................................................... 11, 14
- Electromagnetic fields ............................................... 11
- Electronic board ....................................................... 58
- Entire plug connection, destroying ............................. 18

## Electrical Shock
- Electrical shock, risk of .......................................... 18

## Electrical Voltage
- Electrical voltage .................................................... 11, 14

## Electromagnetic Fields
- Electromagnetic fields ............................................. 11

## Entire Plug Connection
- Entire plug connection, destroying ........................... 18

## Fume Extraction
- Fume extraction ....................................................... 24

## Function
- Function ............................................................... 21

## Further Instructions
- Further instructions ............................................... 68
- Fuse rating ............................................................ 17

## General
- General ................................................................. 9
- General safety instructions ......................................... 12

## Glossary
- Glossary .............................................................. 65

## Gloves
- Gloves ................................................................. 9

## Ground Cable
- Ground cable ........................................................ 19
- Ground clamps ....................................................... 19
- Ground connection ............................................... 19, 44
- Guarantee claims ..................................................... 12, 25
- Guarantee clauses ................................................... 69

## Guarantee Claims
- Guarantee claims ..................................................... 12, 25

## Guarantee Clauses
- Guarantee clauses ................................................... 69

## Headgear
- Headgear, protective ............................................... 24

## Heat Built-Up
- Heat built-up ........................................................ 16

## High-Strength Welds
- High-strength welds ................................................. 30

## Hollow Parts
- Hollow parts, welding on ...................................... 24

## Intended Use
- Intended use ........................................................... 12

## Keyboard
- Keyboard .............................................................. 22

## Fume Extraction
- Fume extraction ....................................................... 24
Index

L
liability, any ................................ 12, 25, 69
liquid spatters .................................. 34
liquids, combustible ............................. 16
locked ................................................. 22
lot ........................................................ 39

M
magnetic fields .................................. 16, 25
mains switch ....................................... 32
maintenance ................................... 9, 43
maintenance instruction ........................ 9
maintenance instruction  
for your company ........................... 9
malfunction ............................................ 9
malfunctions and corrective actions ..... 38
markings ............................................. 14
material combinations .....................31, 68
material of the welding element ........... 30
material of the workpiece ..................... 30
material separation, 
environmentally correct .......... 42
metal spatters ..................................... 24
minimum flow rate ............................... 20

N
non-combustible clothes ...................... 24

O
operating manual ............................ 9, 15
operating manual, storage of ............... 9
operation, improper ......................... 33
operators ............................................... 9
order number ....................................... 46
ordering spare parts ......................... 69

P
pace maker ........................................ 11, 17, 25
personal injury ...................................... 11
personnel, properly instructed, qualified ... 9
personnel, qualified .............................. 9
pipes, welding to .................................. 30
place of operation ............................... 12
power unit ......................................... 21, 65
prestress at installation .....................31, 68
primary power supply ....................... 17
program version ...................... 48, 59, 60
protective apron .................................. 24
protective equipment ........................... 17, 25
protective equipment, personal ............. 9
protective gloves .................................. 24
protective goggles ............................... 9
punched plates ................................. 30
punched plates, welding to ................. 30

R
ready for welding ................................ 22
rectifier ..........................................21, 65
recycling ............................................ 64
regulations ........................................... 66
repair .................................................. 64
requirements of workplace .................. 16
risk of material damage ..................... 11
room adequately ventilated ............16, 24
rooms exposed to risk of explosion .... 16

S
safety goggles ..................................... 24
safety instructions .................... 9, 23, 43
safety symbols ..................................... 11
serial number ...................................... 43
service ................................................ 9
service & support .................................. 72
service technician ............................. 9
set-up .................................................. 9
shielding gas connection .................... 20
shielding gas module ......................... 56
shoes .................................................... 9
solid-state-relais .................................. 21
spare parts, ordering of .................46, 69
special welding elements .................. 41
standards ............................................ 66
standards, actual ............................... 12, 33
starting-up ......................................... 10, 16
stud feeder ......................................... 65
stud welding, functional principle ......... 26
stud welding procedure ..................... 23
stud welding process ......................... 10
stud welding unit ................................. 65
surface of welding element ................ 36
surface, workpiece ............................. 36
switching off, temporary ................. 42
switching off the power unit ..........10, 42
T

technical data ................................. 10, 45
test welding ..................................... 30
threat to life .................................... 10
thyristor ......................................... 65
torque ........................................... 31, 68
training according to current standards .... 9
transformer ........................................ 21
transformer board .................... 61
transportation ................................... 9
transportation, packaging, storage ...... 13
type plate ...................................... 14, 17

U

unauthorized use ................................. 9

V

vapors, toxic ...................................... 16
visual inspection ................................. 35

W

weld, checking the quality of the .......... 34
welding elements ......................... 12, 31, 39, 65
welding elements, lot of ................. 31
welding gun .................................... 12, 65
welding gun cables ............................. 18
welding gun support (distance device) ... 34
welding parameters ......................... 33, 65
welding parameters, determination ...... 30
welding preparation ......................... 30
welding procedure ............................. 33
welding process ................................ 10
welding spatters ................................. 34
work piece ...................................... 65
working place, change of ................. 20