



ONURFIX®

IT 2002

Power Unit

93-66-2201



Operating Manual

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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.

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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:



Threat to life or risk of personal injury



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



Additional tips for operation and service safety



Prompt



List

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



Danger

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 16, A 22 and A 25 can be connected to the HBS power unit IT 2002. 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.

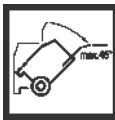
- ◆ Save the undamaged packing. Ship and transport the device only in its original packing.

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



During transport and set-up of the machine, safety against tilting is only guaranteed up to an angle of 45°.



A lift unit with a hook can be used for lifting and transporting the power unit.

Lifting the power unit using the handle is not permitted.

- ◆ 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

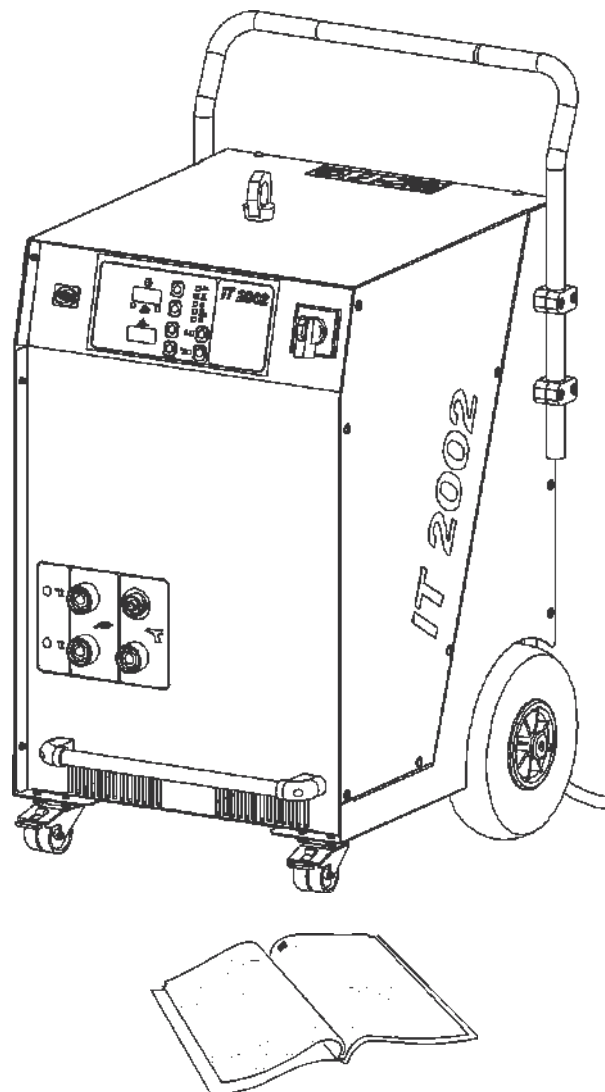
- ◆ Secure the following safety symbols in the area of welding place:



2 Delivery

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

| No. of pieces | Part | Type | Order No. |
|---------------|------------------|---------|---------------|
| 1 | Power unit | IT 2002 | 93-66-2201 |
| 1 | Operating Manual | IT 2002 | BA 93-66-2201 |



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.



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

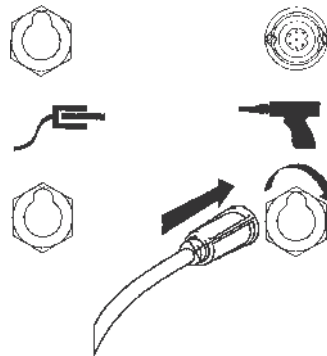
- ◆ Check the current consumption specified on the type plate with the fuse rating of your primary power supply.
- ◆ Have an electrician check whether the outlet to which you want to connect the power unit is correctly grounded.
- ◆ Switch off the power unit.
- ◆ Insert the primary plug into the checked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

3.3 Connecting the Welding Gun to the Power Unit



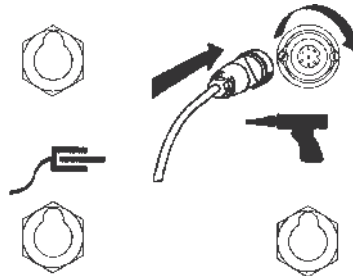
Switch off the power unit. In this way, you avoid any risk of electrical shock.

- ◆ 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.

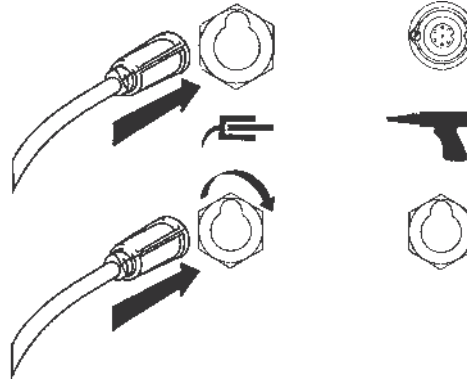


The welding gun cables must not be coiled during welding. Coiled cables work as a coil and may negatively affect the welding result. Before welding, lay out the cables lengthwise.

- ◆ 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.

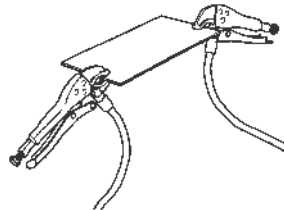


- ◆ Press in the plug and twist firmly clockwise.



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 Change Working Place



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

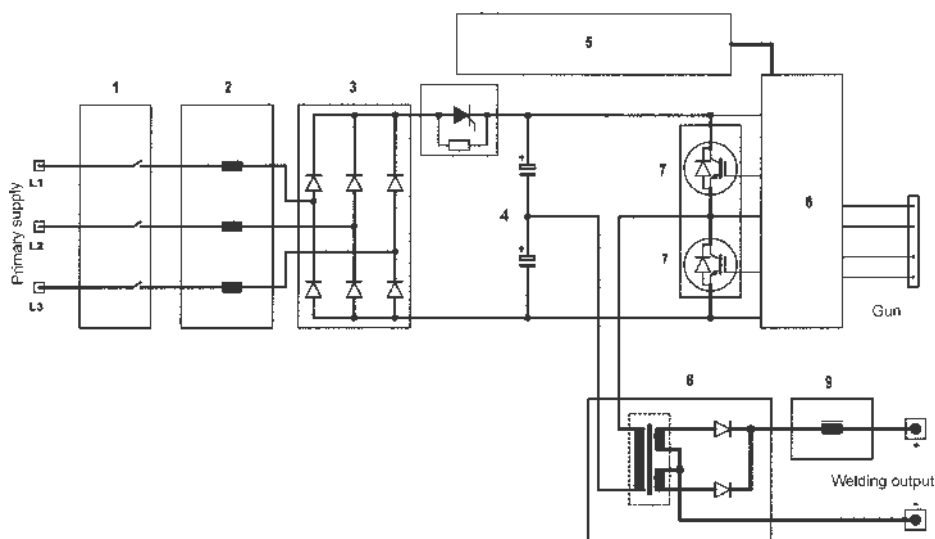
- ◆ When you move your workplace, disconnect the welding gun and the ground cables from the power unit. Proceed in reversed sequence as described in sections 3.2, 3.3 and 3.4.
- ◆ After changing the workplace, check the welding gun and the ground cables for possible damage or missing components.

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 - Mains switch | 6 - Control unit |
| 2 - EMC-filter | 7 - IGBT switch |
| 3 - Bridge rectifier | 8 - Middle-frequency transformer with diodes |
| 4 - Electrolytic capacitors | 9 - Welding current stabilizer |
| 5 - Control unit | |

After passing the mains switch (1) and the EMC-filter (2), the mains alternating current is converted in the bridge rectifier (3).

The rectified voltage is smoothed by the electrolytic capacitors (4) and transferred to the IGBT switches (7). These switches convert the direct current into a high-frequency alternating current of 30 kHz.

The energy is transferred via the middle-frequency transformer with diodes (8) and rectified.

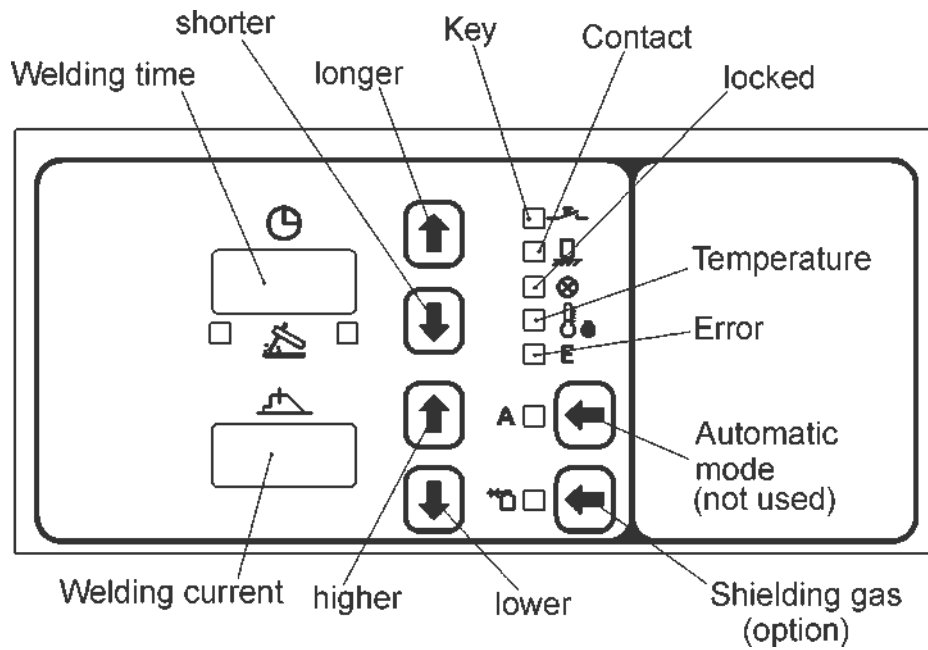
The stabilizer (9) smoothes the current and passes it on to the welding sleeves.

Control of the IGBT switches (7) is carried out by the control unit (6).

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.

4.2 Keyboard and Display



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.



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.

**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.

**Danger**

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)

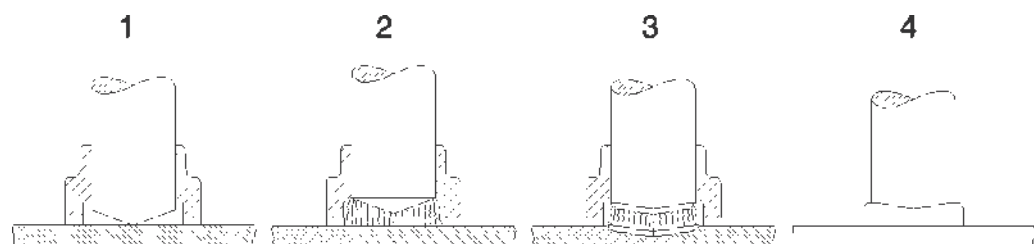
Variations for drawn-arc ignition are described in current standards and regulations (see appendix).

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).

Variants of drawn-arc stud welding

| Item | Drawn-arc stud welding with ceramic ferrule/ring | Drawn-arc stud welding with shielding gas | Short-cycle stud welding with shielding gas | Capacitor-discharge stud welding with drawn-arc |
|---|--|--|---|---|
| Diameter welding element d [metric mm (imperial)] | 3 - 25 (#4 or 12 gage to 1") | 3 - 12 (16) (#4 or 12 gage to 1/2" (5/8")) | 3 - 12 (#4 or 12 gage to 1/2") | 2 - 8 (14 gage to 5/16") |
| Max. current I [A] | 3000 | 2500 | 1500 | 5000 |
| Welding time t [ms] | 30 - 2000 | 50 - 2000 | 5 - 100 | 3 - 10 |
| Energy source | Welding rectifier Welding transformer | Welding rectifier Welding transformer | Welding rectifier | Capacitor |
| Weld pool protection | Ceramic ferrule CF | Shielding gas SG | Shielding gas SG No protection NP | No protection NP |
| Material welding element | S 235 CrNi steel Aluminum (up to 12 mm/0,47") | S 235 CrNi steel Aluminum (up to 12 mm/0,47") | S 235 CrNi steel Brass (with shielding gas) | S 235 CrNi steel Aluminum, brass, copper |
| Workpiece surface | Metallic bright (rolling skin, rust film) | Metallic bright (rolling skin, rust film) | Metallic bright, galvanized, light oiled | Metallic bright, galvanized, light oiled |
| Min. thickness of workpiece | 1/4 d min. 1 mm (0,04") | 1/8 d min. 1 mm (0,04") | 1/8 d min. 0,6 mm (0,02") | 1/10 d min. 0,6 mm (0,02") |
| Adjustable parameters | Welding current I [A] = 80 x d (up to 16 mm/0,63") | Welding current I [A] = 80 x d (up to 16 mm/0,63") | Welding current I [A] = 100 x d (up to 12 mm/0,47") | Charging voltage |
| | Welding time t [ms] = 20 x d (up to 12 mm/0,47") | Welding time t [ms] = 20 x d (up to 12 mm/0,47") | Welding time | Ignition point / lift |
| | Lift (arc length) | Lift (arc length) | Lift (arc length) | Spring pressure (plunging speed) |
| | 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.

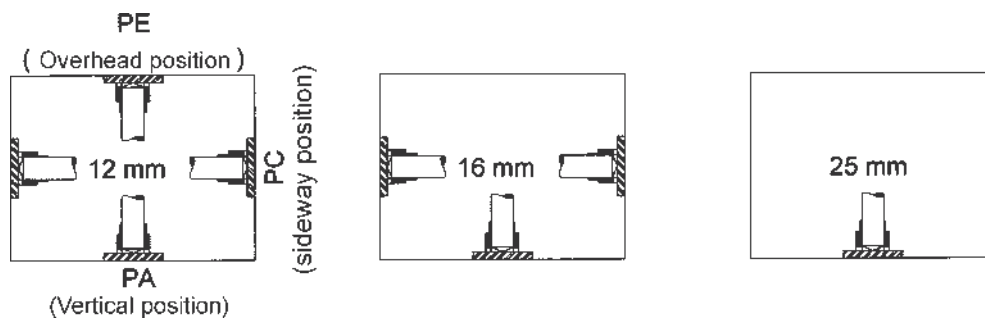
With stud welding with shielding gas, the shape of the weld collar is not reproducible, as the shielding gas has no forming effects on the melt – different from a ceramic ferrule. And so an additional ceramic ferrule may be used in special cases.

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 with 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. Before you use another lot of welding elements, carry out some trial welds to verify the parameter setting.

Setting of power unit *)

| Welding position down | | | | | | | Welding position overhead | | | | Welding position to vertical surface | | | |
|-----------------------|-------|-----------------|-----------------|--------------|------|----------------|---------------------------|--------------|------|----------------|--------------------------------------|--------------|------|----------------|
| Stud diameter | | Surface | Welding current | Welding time | Lift | Plunging depth | Welding current | Welding time | Lift | Plunging depth | Welding current | Welding time | Lift | Plunging depth |
| mm | inch | cm ² | A | sec | mm | mm | A | sec | mm | mm | A | sec | mm | mm |
| 6,4 | 0,25 | 0,3168 | 450 | 0,1 | 1,6 | 3,2 | 450 | 0,17 | 1,6 | 3,2 | 450 | 0,17 | 1,6 | 3,2 |
| 7,9 | 0,312 | 0,4948 | 500 | 0,25 | 1,6 | 3,2 | 500 | 0,25 | 1,6 | 3,2 | 500 | 0,25 | 1,6 | 3,2 |
| 9,5 | 0,375 | 0,7129 | 550 | 0,33 | 1,6 | 3,2 | 550 | 0,36 | 1,6 | 3,2 | 600 | 0,33 | 1,6 | 3,2 |
| 11,1 | 0,437 | 0,9697 | 675 | 0,42 | 1,6 | 3,2 | 675 | 0,42 | 1,6 | 3,2 | 750 | 0,33 | 1,6 | 3,2 |
| 12,7 | 0,500 | 1,2671 | 800 | 0,55 | 1,6 | 3,2 | 800 | 0,55 | 1,6 | 3,2 | 875 | 0,46 | 1,6 | 3,2 |
| 15,9 | 0,625 | 1,9794 | 1200 | 0,67 | 2,4 | 4,7 | 1200 | 0,67 | 1,6 | 4,7 | 1275 | 0,6 | 1,6 | 4,7 |
| 19,1 | 0,750 | 2,8503 | 1500 | 0,84 | 2,4 | 4,7 | 1500 | 0,84 | 1,6 | 4,7 | not recommended | | | |
| 22,2 | 0,875 | 3,8793 | 1700 | 1 | 3,2 | 6,4 | 1700 | 1,00 | 1,6 | 6,4 | not recommended | | | |
| 25,4 | 1,000 | 5,0671 | 1900 | 1,4 | 3,2 | 6,4 | 2050 | 1,20 | 1,6 | 6,4 | not recommended | | | |

*) When welding with shielding gas, a 10% longer time is normally selected.

When welding alloyed steel, a 10% lower current is normally selected.

The given values apply to weldings in the welding position PA. The welding time shall be reduced for welding in the welding position PC.

In the case of short cycle stud welding, the welding time is less than 100 ms. It depends not only on the stud diameter, but also on the available current intensity ($I[A] = \min. 100 \times \varnothing (mm)$).

The welding time should be as short as possible in the case of welding without weld pool protection.

Welding energy is only selected by welding time.



Further notes on

- welding elements
- prestress at installation (tie load) and torque
- material combinations

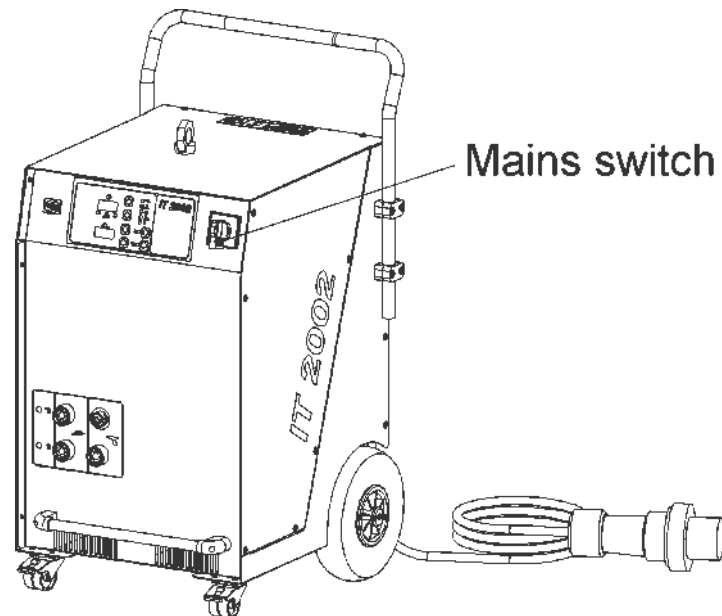
see appendix and operating manual of the according welding gun.

5.6 Switching on the Power Unit

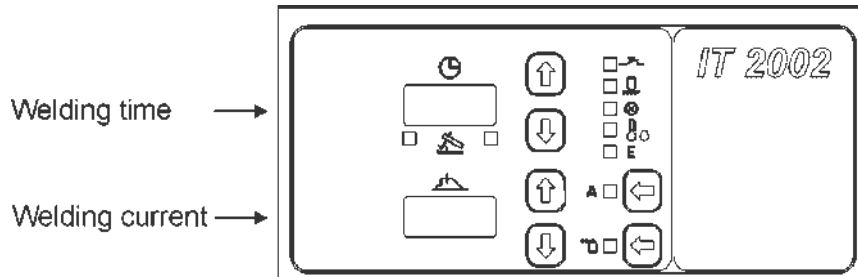


**Improper operation of the stud welding unit is
LIFE-THREATENING!
First read the safety instructions in chapters 1, 3 and 5.**










- ◆ 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 welding time and welding current.




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

-  Yellow – lights if the welding gun button is triggered
-  Yellow – lights if there is electrical contact between welding element and workpiece
-  Red – on, power unit is locked
 - after welding, until there is electrical contact with the workpiece
-  Green – on, power unit is ready for welding
-  Red – on, power unit is locked
 - if the power unit is overheated (displays show 8888 and LED  lights).
 - After a short cooling period, the work can continue.
-  Red – on, power unit is locked
 - if the power unit is overheated
 - if there is a malfunction of the power unit
-  Green – lights, automatic mode is switched on (option)
-  Green – lights, shielding gas is switched on (option)

5.6.1 Adjusting the Welding Time

- ◆ Set the welding time (digital display ) with the arrow keys (longer – shorter) on the display.

5.6.2 Adjusting the Welding Current

- ◆ Set the welding current (digital display ) with the two arrow keys (higher – lower) on the display.

5.6.3 Library Mode

In the library mode, you can call up and modify charging voltages, depending on stud diameter (UD/pins).

- ◆ Simultaneously press both arrow keys of welding time (shorter longer) for about one second. The display welding time shows 1'4 (1'4 means the set welding current and welding time for stud diameter of 1/4").
- ◆ You can pre-select the stud diameter (1/4" to 1") with both arrow keys (shorter longer). After about 3 seconds the display (🕒) jumps onto the pre-selected welding time and the display (🔌) onto the pre-selected welding current.
- ◆ In addition, you can modify the welding time and welding current individually by pressing the arrow keys (as described above).

5.6.4 Conversion Current Curve

It is possible to adjust the current curve for a special welding method. There is a difference between drawn-arc stud welding with ceramic ferrule or with shielding gas.

Drawn-arc stud welding with ceramic ferrule

Simultaneously press both arrow keys (welding current higher lower) for about one second. The display welding current shows the current scale with dots.

1.9.4.0.

Drawn-arc stud welding with shielding gas

Simultaneously press both arrow keys (welding current higher lower) for about one second. The display welding current shows the current scale without dots.

194 0

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.




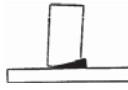



See also actual standards in the appendix “Arc stud welding of metallic materials“, in section irregularities and corrective actions.

5.8.1 Visual Inspection

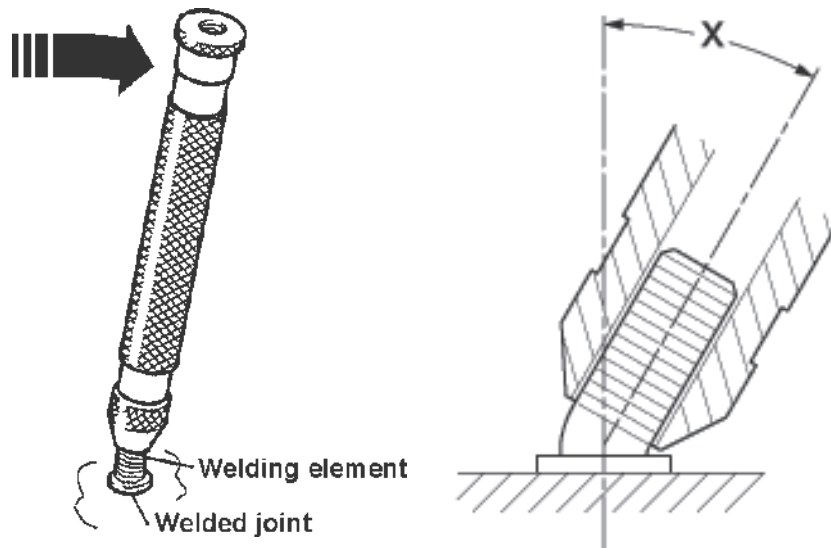
A visual inspection must be carried out with each welding element.

Shape, size, evenness, and color of the weld collar are assessed during a visual inspection. The length of a welded element should be 2 to 3 mm shorter than before welding.

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

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. The welded joint is stressed by bending in a non-defined way.

- ◆ 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.



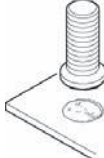
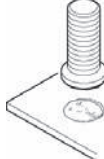
- ◆ Please note the instructions on fault recognition and corrective actions in chapter 5.



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.

| Bending Test | | |
|---|---|--|
| Type of fracture | Possible cause | Corrective actions |
| Base material buckling  | - Correct parameters | - none |
| Fracture in welding element above weld collar  | - Correct parameters | - none |
| Fracture in the weld metal Many pores  | - Welding energy too low - Plunging speed too low - Unsuitable stud/base material combination | - Increase welding energy - Increase plunging speed - Replace welding element or workpiece |
| Fracture in the weld metal Shiny fracture surface  | - Welding time too short | - Increase welding time |

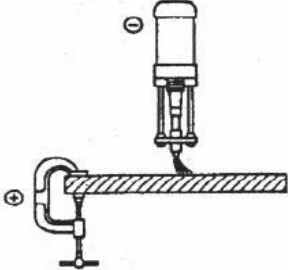
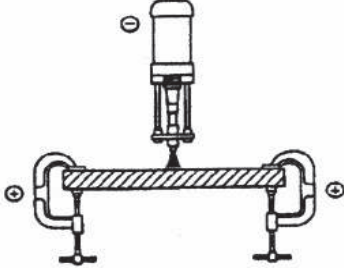
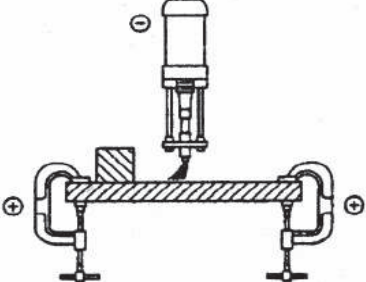
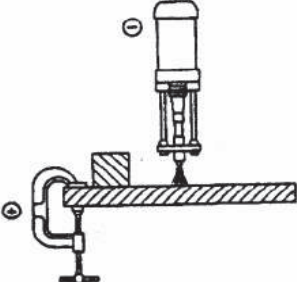
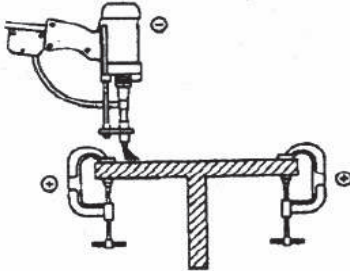
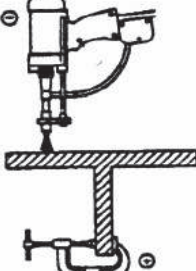
5.8.3 Arc Blow Effect

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)

| Cause | Corrective action |
|---|--|
|  |  |
|  |  |
|  |  |

5.9 Malfunctions and Corrective Actions

| Malfunction | Possible cause | Fault finding | Corrective action | Carried out by |
|--|---|--|---|--|
| Primary switch does not rest in position 1 | Primary switch defective | Check primary switch *) | Replace primary switch *) | Qualified personnel |
| | Fuse F4 1 AF for primary switch defective | Check voltage supply of primary switch *) | Replace fuse F4 1 AF *) | Qualified personnel |
| | Primary cable defective | Check primary cable for breaks *) | Replace primary cable *) | Qualified personnel |
| No LED display at the front | Fuse F5 1 AF defective | Check fuse F5 1 AF *) | Replace fuse F5 1 AF *) | Qualified personnel |
| No  display | No ground connection | Check ground connection on workpiece | Tighten ground connection properly | Qualified personnel |
| | Welding gun not connected | Check welding gun connection | Connect welding gun properly | Instructed personnel |
| | Transition resistance (between stud and workpiece) too high | Check material surface | Clean or grind material surface | Instructed personnel |
| | Ground cable broken | Check ground cable *) | Replace ground cable *) | Qualified personnel |
| | Welding gun cable broken | Check welding gun cable *) | Replace welding gun cable *) | Qualified personnel |
| No  display | Defective connecting line of welding gun | Check function of connecting line *) | Replace connecting line *) | Qualified personnel |
| | Welding gun trigger button defective | Check control cable for electrical flow with triggered start button *) | Replace welding gun trigger button *) | Qualified personnel |
| | Control cable broken | Check control cable for electrical flow *) | Replace control cable *) | Qualified personnel |
| Continuously red display: Display 8888  | Welding sequence too fast | Power unit resets automatically | Let switched on power unit cool down, power unit resets automatically | Instructed personnel |
| Welding gun does not lift, in spite of  and  | No lift adjusted | Check settings of welding gun | Modify set parameters | Instructed personnel |
| | Short circuit of solenoid circuit of the welding gun | Check resistance value of control cable (18 Ω to 22 Ω) between Pin 1 and Pin 2 *) | Replace control cable plug, control cable, solenoid *) | Qualified personnel |
| | Solenoid defective Fuse F3 4 AF defective | Check solenoid (18 Ω to 22 Ω *) Check fuse F3 4 AF *) | Replace solenoid *) Replace fuse F3 4 AF *) | Qualified personnel Qualified personnel |
| Lifting impossible | Solenoid circuit interrupted | Check resistance value at control cable plug (18 Ω to 22 Ω) between Pin 1 and Pin 2 *) | Replace solenoid or control line *) | Qualified personnel |
| No shielding gas | Shielding gas not connected | Check shielding gas connection | Connect shielding gas | Instructed personnel |
| | Shielding gas control not enabled | Check shielding gas control for activity | Switch on shielding gas control | Instructed personnel |
| | Shielding gas valve defective | Check shielding gas valve *) | Replace shielding gas valve *) | Qualified personnel |



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



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

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



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



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.



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

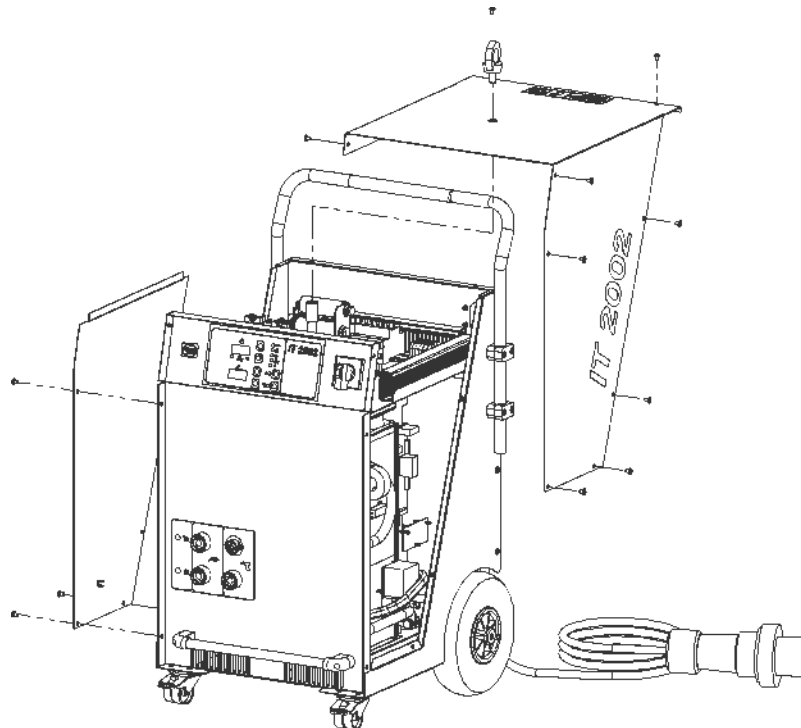
- Allen key, size 4

7.4 Open the Power Unit



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

- ◆ Remove the 9 screws of the cover and remove the crane hook.
- ◆ Remove the 5 screws of the side plate and remove the ground conductor from the inside of the side plate.
- ◆ Lift carefully the casing cover and remove the ground conductor from the inside of the cover.
- ◆ Now pull off the cover from the power unit.



- ◆ 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 IT 2002 for ARC stud welding according to current standards

| | |
|------------------------------------|---|
| Welding range | #4 to 1", dia. 14 ga to 1" (M3 to M24, dia. 2 to 25 mm) |
| Welding material | Mild steel, stainless steel, aluminum |
| Welding rate | Dia. 7/8" = 7 studs/min (dia. 22 mm = 7 studs/min) |
| Welding current | 2,000 A (max.) |
| Current adjustment range | 300 to 2,000 A (stepless) |
| Welding time | 5 to 1,500 msec (stepless) |
| Primary power | 480/460 V, 3 phases, 50/60 Hz, 63 AT (alternative input voltages available) |
| Connected load | 100 kVA (with 400 V mains), 80 kW |
| Cooling type | F (temperature controlled cooling fan) |
| Protection class | IP 23 (also permits operation outdoors) |
| Operational and storage conditions | According to current standards |
| Dimension L x W x H | 23.6" x 19.7" x 32.7" (600 x 500 x 830 mm) without handle |
| Weight | 209.4 lbs (95 kg) |

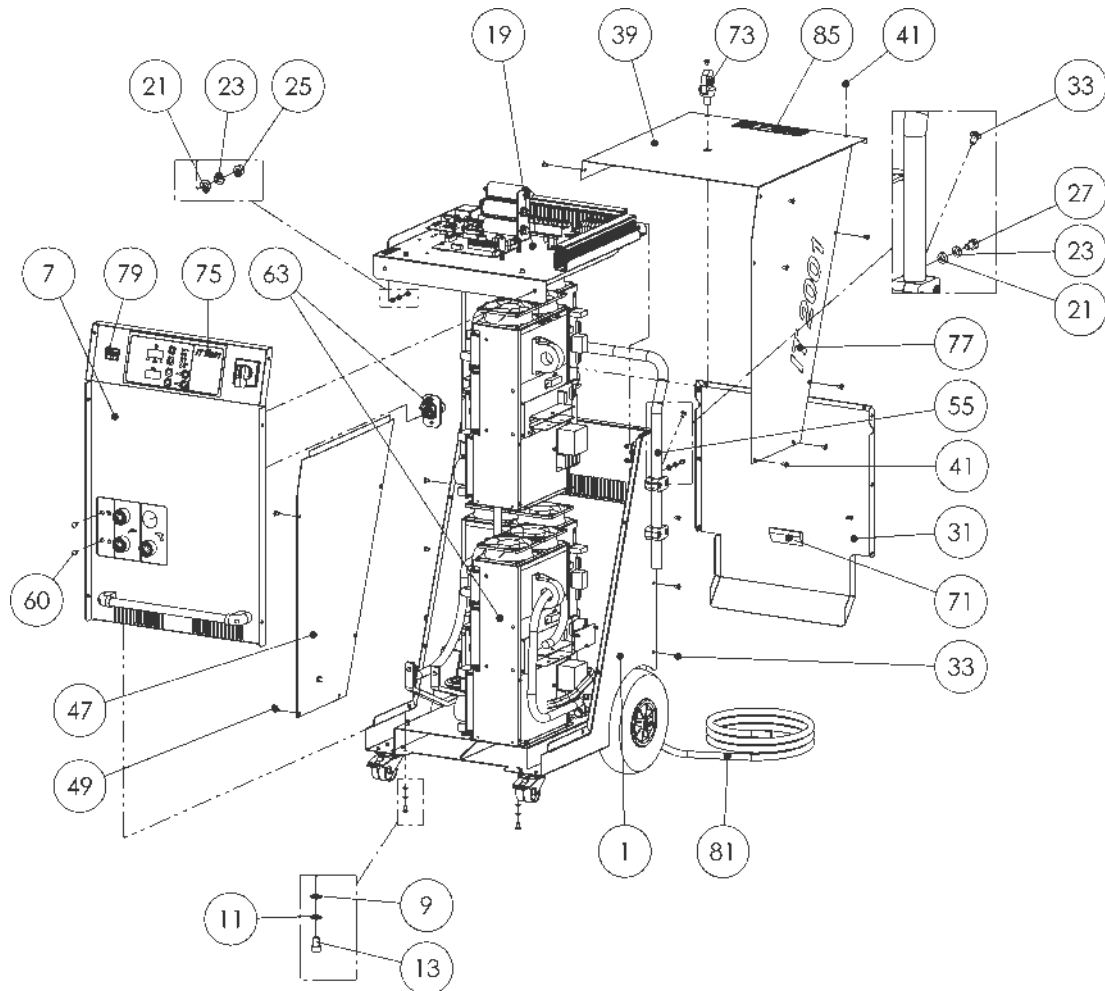
8.2 Spare Parts

Spare part list power unit type IT 2002 (93-66-2201)

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

| Pos. | Quantity | Order No. | Description |
|------|----------|--------------|-------------------------------|
| 1 | 1 | 88-16-268 | Basic assembly complete |
| 7 | 1 | 88-16-269023 | Front assembly complete |
| 9 | 2 | 80-90-198 | Washer 6 mm |
| 11 | 2 | 80-90-147 | Spring washer 6 mm |
| 13 | 2 | 80-90-114 | Screw M6 x 10 |
| 19 | 1 | 88-16-270 | Installation support complete |
| 21 | 4 | 80-90-198 | Washer 6 mm |
| 23 | 4 | 80-90-147 | Spring washer 6 mm |
| 25 | 2 | 80-90-146 | Nut M6 |
| 27 | 2 | 80-90-296 | Screw M6 x 12 |
| 31 | 1 | 88-16-254 | Rear wall complete |
| 33 | 8 | 80-90-446 | Screw M6 x 10 |
| 39 | 1 | 88-16-256 | Cover complete |
| 41 | 9 | 80-90-446 | Screw M6 x 10 |
| 47 | 1 | 88-16-258 | Side panel complete |
| 49 | 5 | 80-90-446 | Screw M6 x 10 |
| 55 | 1 | 88-16-260 | Handle complete |
| 60 | 2 | 80-10-159 | Cap |
| 63 | 1 | 88-17-930 | Country module USA complete |
| 71 | 1 | 80-11-573 | Recessed grip P2 |
| 73 | 1 | 80-10-0949 | Ring screw turnable |
| 75 | 1 | 80-10-1142 | Label mat white |
| 77 | 1 | 80-10-1141 | Label mat black |
| 79 | 1 | 80-11-754 | HBS Logo small 37 x 28 |
| 81 | 5 m | 80-50-406 | Mains cable |
| 85 | 1 | 88-12-889 | Safety label |

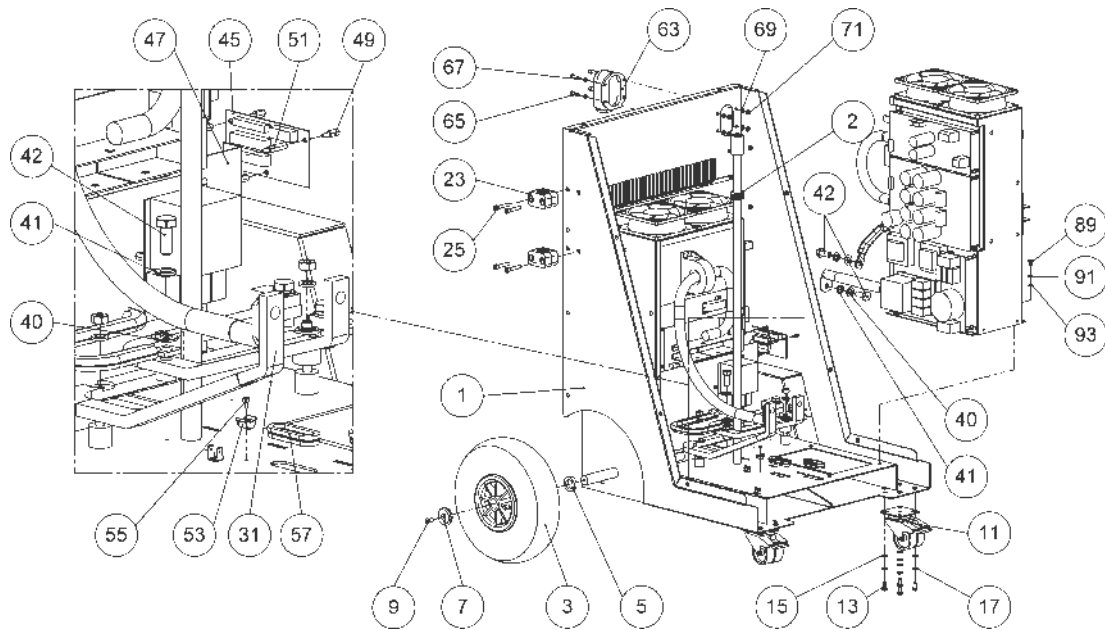
Power unit type IT 2002 (93-66-2201)



Basic set-up complete IT 2002 (88-16-268)

| Pos. | Quantity | OrderNo. | Description |
|------|----------|-------------|--------------------------------------|
| 1 | 1 | 88-16-194 | Support complete |
| 2 | 2 | 80-10-1020 | O-ring, 16,00 x 6,00 |
| 3 | 2 | 80-11-806 | Air wheel Ø = 260 mm |
| 5 | 2 | 88-12-233 | Distance washer internal |
| 7 | 2 | 88-12-234 | Washer |
| 9 | 2 | 80-90-370 | Screw M6 x 16 |
| 11 | 2 | 80-11-916 | Guide roll |
| 13 | 8 | 80-90-203 | Screw M6 x 12 |
| 15 | 8 | 80-90-198 | Washer 6 mm |
| 17 | 8 | 80-90-147 | Spring washer 6 mm |
| 23 | 4 | 80-10-0951 | Cable clip PA-32 |
| 25 | 8 | 80-90-134 | Screw M6 x 35 |
| 31 | 1 | 88-16-246 | Conductor rail complete |
| 40 | 3 | 80-90-217 | Washer 10 mm |
| 41 | 3 | 80-90-295 | Spring washer 10 mm |
| 42 | 3 | 80-90-294 | Screw M10 x 25 |
| 45 | 1 | 80-50-04382 | Synchronizing component |
| 47 | 1 | 88-16-266 | Support for P.C. board |
| 49 | 3 | 80-10-280 | Distance stud |
| 51 | 3 | 80-10-372 | Distance stud |
| 53 | 9 | 80-10-946 | Fastening element |
| 55 | 9 | 80-90-189 | Screw M3 x 6 |
| 57 | 4 | 80-10-0620 | Slotted hole sleeve 50 x 16 mm black |
| 63 | 1 | 80-10-0952 | Screwed cable connection |
| 65 | 4 | 80-90-199 | Screw M5 x 12 |
| 67 | 4 | 80-90-128 | Spring washer 5 mm |
| 69 | 4 | 80-90-202 | Washer 5 mm |
| 71 | 4 | 80-90-188 | Nut M5 |
| 89 | 4 | 80-90-152 | Screw M5 x 10 |
| 91 | 4 | 80-90-202 | Washer 5 mm |
| 93 | 4 | 80-90-128 | Spring washer 5 mm |

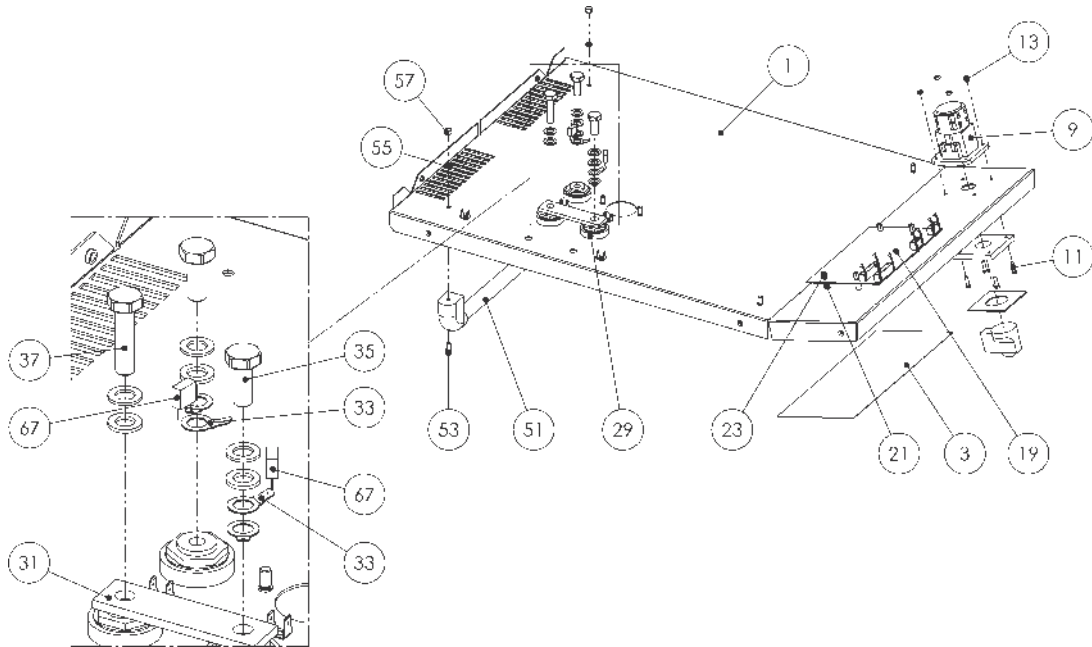
Basic set-up complete IT 2002 (88-16-268)



Front assembly complete IT 2002 (88-16-269023)

| Pos. | Quantity | OrderNo. | Description |
|------|----------|--------------|-------------------------------|
| 1 | 1 | 88-16-464 | Front wall printed |
| 3 | 1 | 88-13-164 | Front film |
| 9 | 1 | 80-50-0071 | Mains switch |
| 11 | 4 | 80-90-378 | Screw M4 x 14 |
| 13 | 4 | 80-90-153 | Nut M4 |
| 19 | 1 | 80-80-558023 | Electronic board IT processor |
| 21 | 4 | 88-11-784 | Distance sleeve |
| 23 | 4 | 80-11-415 | Distance stud |
| 29 | 3 | 80-50-035 | Mounting sleeve |
| 31 | 1 | 88-16-865 | Ground connector |
| 33 | 4 | 80-10-576 | Flat connection |
| 35 | 2 | 80-90-294 | Screw M10 x 25 |
| 37 | 1 | 80-90-223 | Screw M10 x 30 |
| 51 | 1 | 80-11-094 | Handle A=390 |
| 53 | 2 | 80-90-166 | Screw M5 x 10 |
| 55 | 2 | 80-90-202 | Washer 5 mm |
| 57 | 2 | 80-90-225 | Cap nut M5 |
| 67 | 2 | 80-56-215 | Capacitor noise suppression |

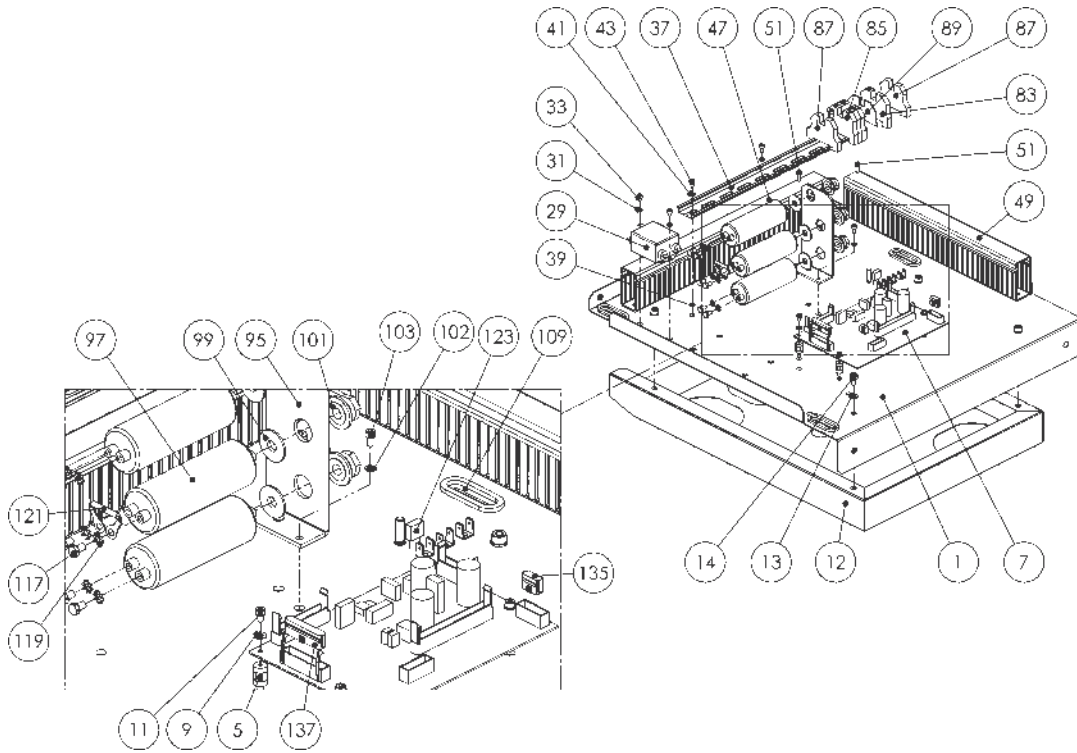
Front assembly complete IT 2002 (88-16-269023)



Installation support complete IT 2002 (88-16-270)

| Pos. | Quantity | OrderNo. | Description |
|------|----------|------------|--------------------------------|
| 1 | 1 | 88-16-252 | Installation support complete |
| 5 | 4 | 80-11-499 | Distance stud M4 |
| 7 | 1 | 80-80-557 | P.C. board IT-supply |
| 9 | 4 | 80-90-164 | Washer 4mm |
| 11 | 4 | 80-90-195 | Screw M4 x 6 |
| 12 | 1 | 88-16-333 | Cooling channel complete |
| 13 | 5 | 80-90-198 | Washer 6 mm |
| 14 | 5 | 80-90-114 | Screw M6 x 10 |
| 29 | 1 | 80-50-927 | Mains interference filter |
| 31 | 2 | 80-90-121 | Spring washer 4 mm |
| 33 | 4 | 80-90-195 | Screw M4 x 6 |
| 37 | 0.32 m | 80-10-610 | Mounting rail punched |
| 39 | 3 | 80-90-184 | Tooth lock washer 4 mm |
| 41 | 3 | 80-90-164 | Washer 4 mm |
| 43 | 3 | 80-90-110 | Screw M4 x 8 |
| 47 | 1.0 m | 88-16-455 | Cable channel 31 x 63 x 385 |
| 49 | 1.0 m | 88-16-454 | Cable channel 31 x 63 x 345 |
| 51 | 6 | 80-90-289 | Screw M4 x 12 |
| 83 | 1 | 80-50-573 | Ground conductor clamp |
| 85 | 3 | 80-50-424 | Clamp WDU |
| 87 | 2 | 80-50-413 | End fitting WEW |
| 89 | 1 | 80-50-415 | Distance plate |
| 95 | 1 | 88-16-267 | Support capacitor |
| 97 | 3 | 80-56-041 | Capacitor |
| 99 | 3 | 80-90-435 | Washer 8 mm |
| 101 | 3 | 80-90-437 | Cap nut plastic |
| 102 | 2 | 80-90-121 | Spring washer 4 mm |
| 103 | 2 | 80-90-110 | Screw M4 x 8 |
| 109 | 4 | 80-10-0620 | Slotted hole sleeve 50 x 16 mm |
| 117 | 6 | 80-90-127 | Screw M5 x 8 |
| 119 | 6 | 80-90-177 | Tooth lock washer A5 |
| 121 | 1 | 80-57-332 | Resistor L |
| 123 | 1 | 80-56-215 | Capacitor noise suppression |
| 127 | 2 | 80-50-652 | Plug print clamp |
| 129 | 1 | 80-50-693 | Plug print clamp |

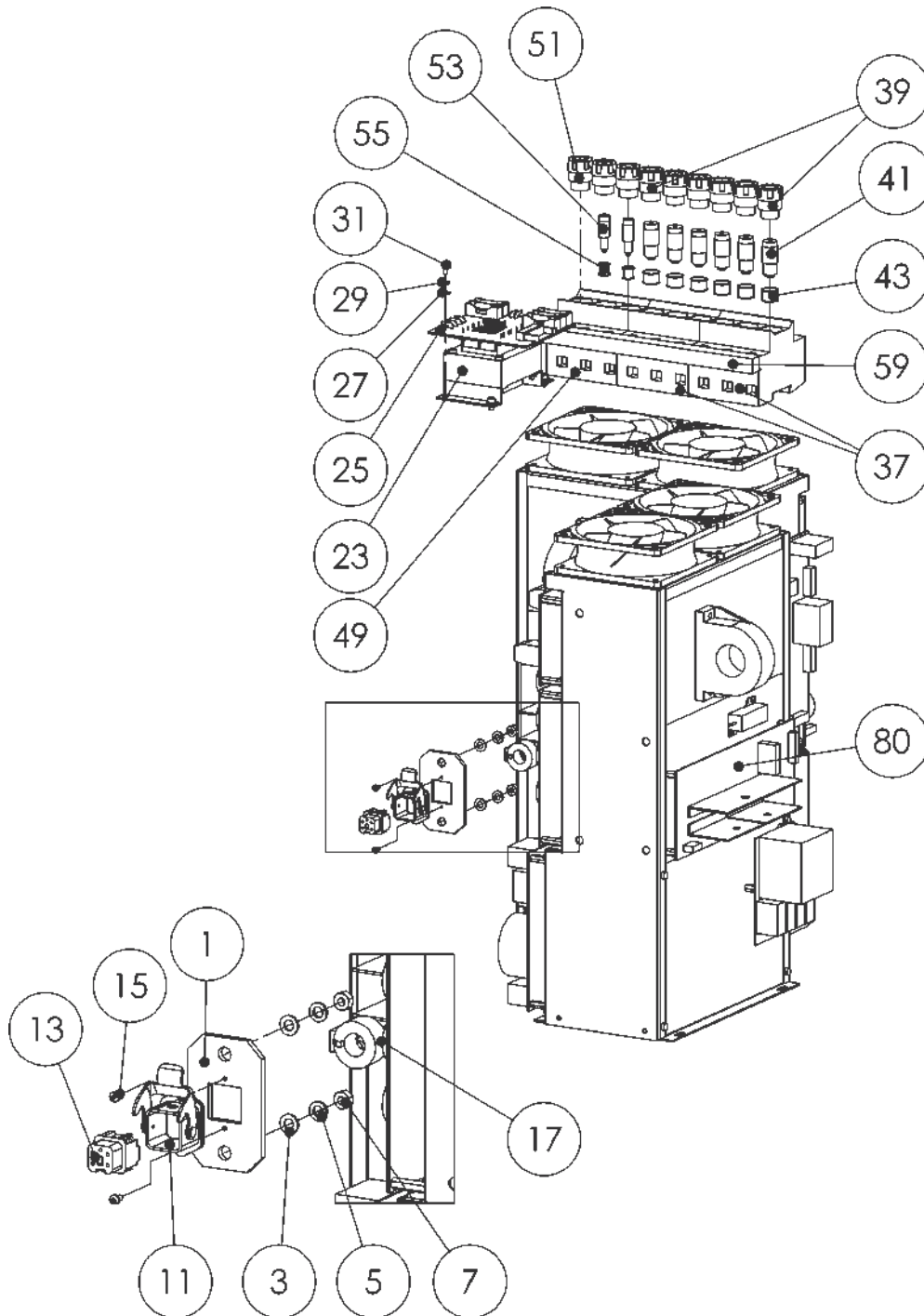
| | | | |
|-----|---|------------|---------------------|
| 131 | 1 | 80-50-640 | Plug |
| 135 | 2 | 80-50-1441 | Pole connector 14 P |
| 137 | 4 | 80-50-2641 | Pole connector 26 P |



Country module USA complete IT 2002 (88-17-930)

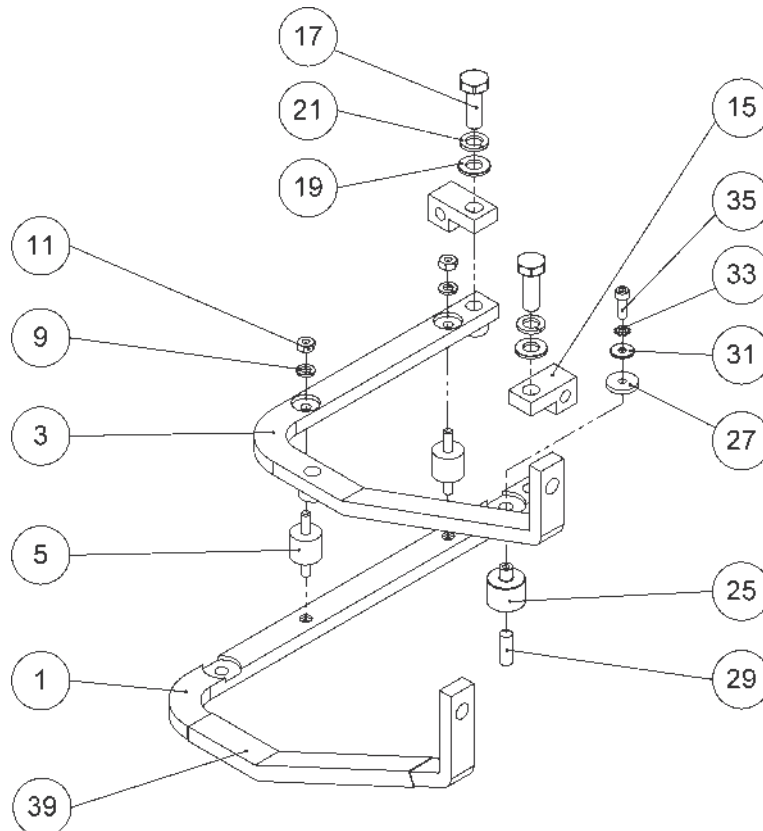
| Pos. | Quantity | OrderNo. | Description |
|------|----------|------------|-------------------------------------|
| 1 | 1 | 88-16-841 | Gunconnection |
| 3 | 2 | 80-90-198 | Washer 6 mm |
| 5 | 2 | 80-90-147 | Spring washer 6 mm |
| 7 | 2 | 80-90-146 | Nut M6 |
| 11 | 1 | 80-50-0709 | External mounting housing |
| 13 | 1 | 80-50-0710 | Control cablesleeve |
| 15 | 2 | 80-90-249 | Screw M3 x 6 |
| 17 | 1 | 80-10-0173 | Clip-on ferrite |
| 23 | 1 | 88-16-332 | Transformer 480V |
| 25 | 1 | 80-80-597 | P.C. board ARC transformer |
| 27 | 4 | 80-90-164 | Washer 4 mm |
| 29 | 4 | 80-90-121 | Spring washer 4 mm |
| 31 | 4 | 80-90-110 | Screw M4 x 8 |
| 37 | 2 | 80-50-0301 | Neozed fuse-base, Gr. D02 |
| 39 | 6 | 80-50-0493 | Neozed screw cap D02 |
| 41 | 6 | 80-50-0458 | Neozed fuse 35 A/400 V, Gr. D02 |
| 43 | 6 | 80-50-0490 | Neozed Screw-in pad socket D02/35 A |
| 49 | 1 | 80-50-0598 | Neozed fuse-base, Gr. D01 |
| 51 | 3 | 80-50-0492 | Neozed screw cap D01 |
| 53 | 2 | 80-50-0297 | Neozed fuse 4 A/400 V, Gr. D01 |
| 55 | 2 | 80-50-0491 | Neozed Screw-in pad socket D01/4 A |
| 59 | 1 | 80-50-0489 | Neozed bus bar |
| 80 | 2 | 80-70-429 | Power element |

Country module USA complete IT 2002 (88-17-930)

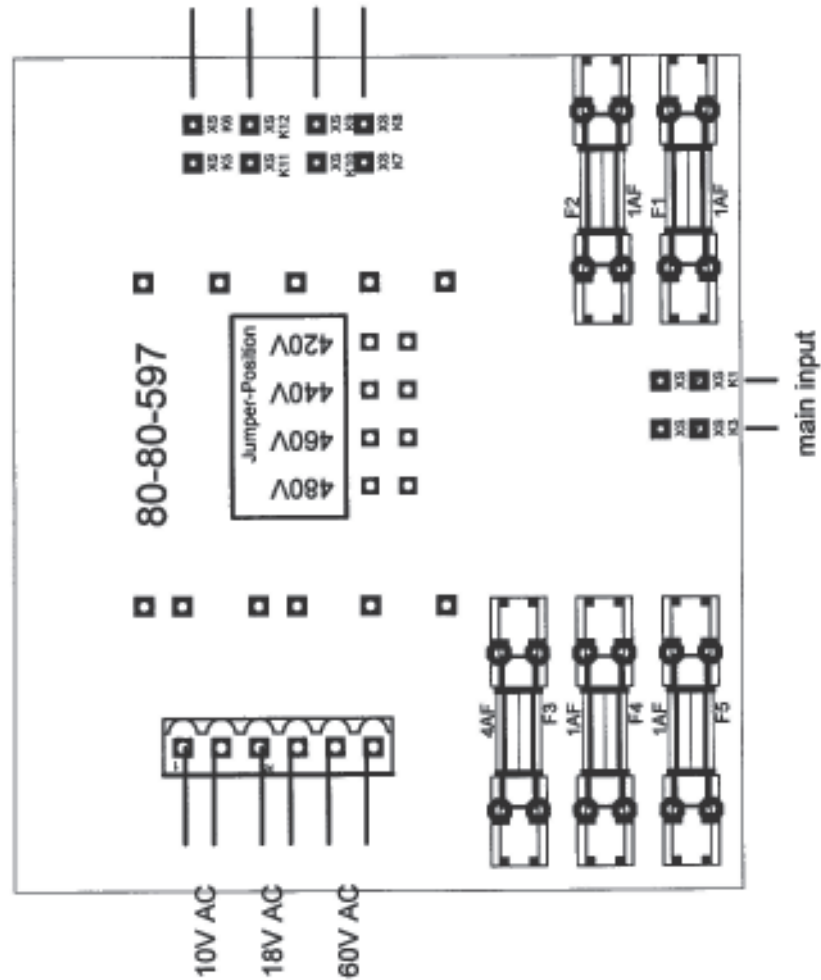


Conductor Rail complete IT 2002 (88-16-246)

| Pos. | Quantity | OrderNo. | Description |
|------|----------|-----------|----------------------------------|
| 1 | 1 | 88-16-467 | Ground conductor rail KP |
| 3 | 1 | 88-16-468 | Negative conductor rail KP |
| 5 | 2 | 80-11-674 | Distance stud M6 |
| 9 | 2 | 80-90-147 | Spring washer 6 mm |
| 11 | 2 | 80-90-146 | Nut M6 |
| 15 | 2 | 88-16-747 | Contact block |
| 17 | 2 | 80-90-458 | Screw M10 x 35 |
| 19 | 2 | 80-90-217 | Washer 10 mm |
| 21 | 2 | 80-90-295 | Spring washer 10 mm |
| 25 | 1 | 88-17-191 | Support conductor rail |
| 27 | 1 | 88-17-192 | Insulating washer conductor rail |
| 29 | 1 | 80-90-447 | Screw M8 x 25 |
| 31 | 1 | 80-90-185 | Washer 5 mm |
| 33 | 1 | 80-90-177 | Tooth lock washer A5 |
| 35 | 1 | 80-90-145 | Screw M5 x 16 |
| 39 | 0.22 m | 88-17-193 | Thermo-shrinkable tubing |

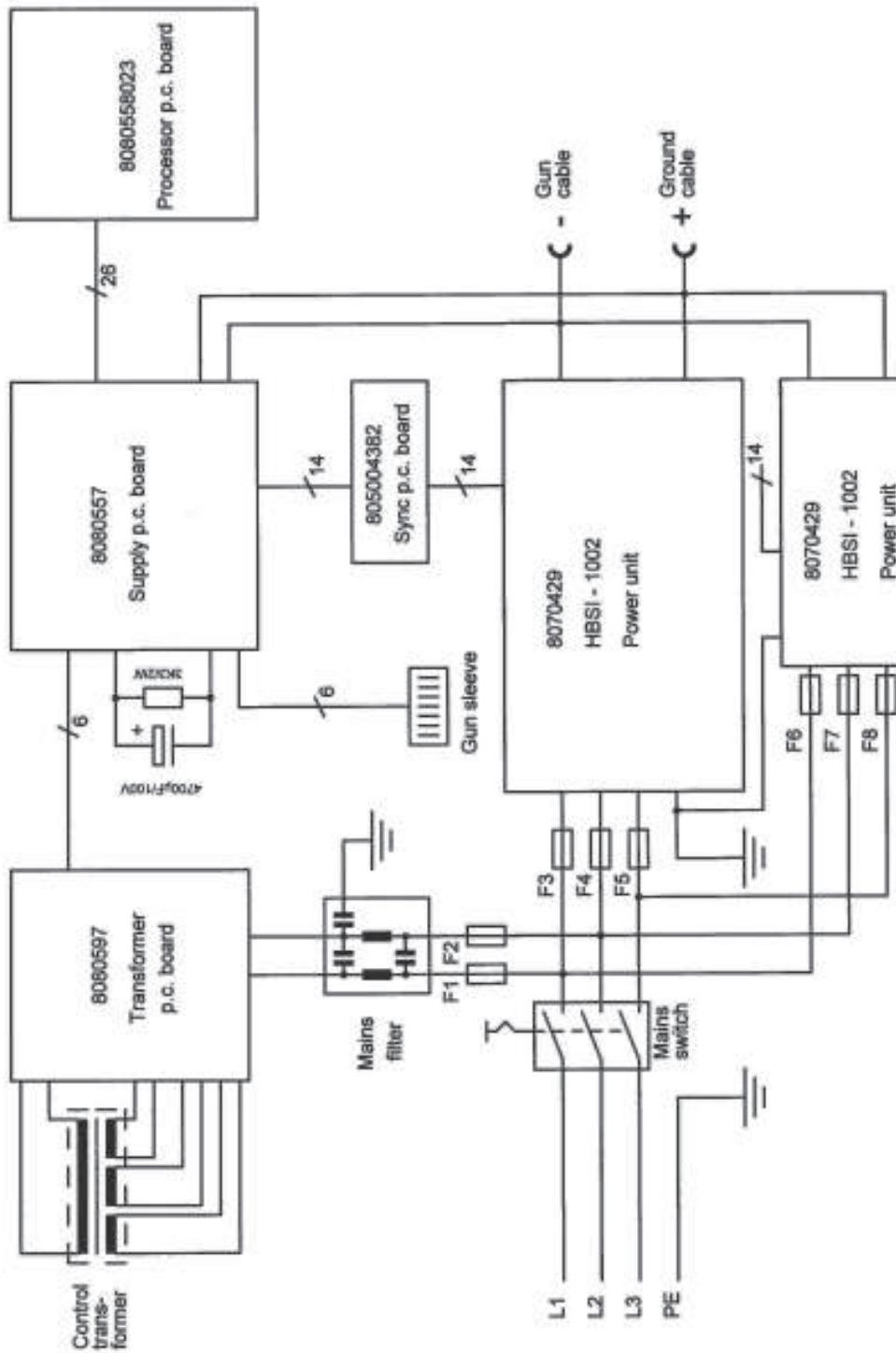


Setting the stud welding unit to the correct primary voltage:
 Insert jumper (see center of picture) to the corresponding phase
 (420 V, 440 V, 460 V or 480 V)



Using a power unit set to an incorrect primary voltage will damage the power unit.

8.3 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 |

Regulations and Standards

The regulations and standards are recommendations and don't purport to be completely.

| Standards, regulations | Description |
|------------------------------------|---|
| <u>Stud welding (fundamentals)</u> | |
| DIN EN ISO 13918 | Welding - Studs and ceramic ferrules for arc stud welding |
| DIN EN ISO 14555 | Welding - Arc stud welding of metallic materials |
| DIN EN 1418 | Welding personnel - Approval testing of welding operators for fusion welding and resistance weld setters for fully mechanized and automatic welding of metallic materials |
| DVS 0901 | Stud welding method for metals - General |
| DVS 0902 | Drawn-arc stud welding |
| DVS 0903 | Capacitor-discharge stud welding with tip ignition |
| DVS 0904 | Instructions for practice - Arc stud welding |
| DVS 2927 | Resistor projection welding and Arc welding of one-sided thick plastics coated thin metal sheets |
| <u>Stud welding (general)</u> | |
| DIN EN ISO 4063 | Welding and allied processes - Nomenclature of processes and reference numbers |
| DIN ISO 857-1 | Welding and allied processes - Vocabulary - Part 1: Metal welding processes |
| DIN EN ISO 14175 | Welding consumables - Gases and gas mixtures for fusion welding and allied processes |
| DIN EN 764-1 | Pressure equipment - Part 1: Terminology - Pressure, temperature, volume, nominal size |
| DIN EN ISO 6947 | Welds - Working positions - Definitions of angles of slope and rotation |

Machine safety

| | |
|-----------------|---|
| 2006/95/EC | Electrical equipment designed for use within certain voltage limits |
| 2004/108/EC | EMC-Guidelines |
| 98/37/EC | Machine guideline (valid until 28.12.2009) |
| 2006/42/EC | Machine guideline (valid from 29.12.2009) |
| 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 | Arc welding equipment - Part 10: Electromagnetic compatibility (EMC) 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 | Accident-prevention regulation „Principles of prevention“ |
| BGV A3 | Accident-prevention regulation „Electrical equipment and operating material“ |
| BGV A8 | Accident-prevention regulation „Health and safety signs at work“ |
| 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

| Stud types | | Abbreviations for studs (ceramic ferrules) | Material | Norm | Mechanical characteristics | |
|----------------------------------|---|--|---------------------------------|---|---|----------------|
| Stud welding with drawn arc (DS) | Drawn arc welding with ceramic ferrule (CF) or shielding gas (SG) | Threaded stud | Mild steel (4.8 ¹⁾) | ISO 898-1 | see ISO 898-1 | |
| | | Threaded stud with reduced shaft | | | | PD (PF) |
| | | Pin | RD (RF) | 1.4301/03 (A2-50) | EN ISO 3506-1 | see ISO 3506-1 |
| | | Pin with internal thread | UD (UF) | | | |
| | Head stud | SD (UF) | Mild steel (S235J2G3 + C450) | ISO/TR 15608 | R _m ≥ 400 N/mm ² ReH ≥ 235 N/mm ² A5 ≥ 15% | |
| | | 1.4301/03 (A2-50) | EN 10088-1 | R _m ≥ 500 - 780 N/mm ² Rp0,2 ≥ 350 N/mm ² A5 ≥ 25% | | |
| | Short cycle welding with drawn arc | Threaded stud with flange | FS | Mild steel (4.8 ¹⁾) copper plated | ISO 898-1 | see ISO 898-1 |
| | | Pin with flange | US | | | |
| | | Pin with internal thread and flange | IS | 1.4301/03 (A2-50) | EN ISO 3506-1 | see ISO 3506-1 |

Further materials on request

¹⁾ weldable

Prestress at installation (tie load) and torque

| Threaded stud | Steel (4.8 ¹⁾) μ = 0,18 R _{p0,2} = 340 N/mm ² | | 1.4301/03 (A2-50) μ = 0,18 R _{p0,2} = 210 N/mm ² | | AlMg3 (F23) μ = 0,18 R _{p0,2} = 170 N/mm ² | | CuZn37 (M63) μ = 0,18 R _{p0,2} = 250 N/mm ² | |
|---------------|---|-------------|--|-------------|--|-------------|---|-------------|
| | Prestress at installation (kN) | Torque (Nm) | Prestress at installation (kN) | Torque (Nm) | Prestress at installation (kN) | Torque (Nm) | Prestress at installation (kN) | Torque (Nm) |
| M6 | 4,3 | 6,1 | 2,7 | 3,8 | 2,2 | 3,1 | 3,2 | 4,5 |
| M8 | 8,0 | 15,0 | 4,9 | 9,5 | 4,0 | 7,5 | 6,0 | 11,0 |
| M10 | 13,0 | 30,0 | 7,8 | 19,0 | | | | |
| M12 | 19,0 | 53,0 | 12,0 | 33,0 | | | | |
| M16 | 35,0 | 135,0 | 22,0 | 82,0 | | | | |

Values correspond with actual standards

¹⁾ weldable

All given values are leads for minimum tensile strength and minimum torque of a weld without permanent deformation of parts to be joined. Parts to be joined must have sufficient wall thickness. Values apply for cold rolled threaded studs with standard thread without surface protection and without thread lubrication. Throughout the entire stud length, at least the stressed cross section must be present. Values apply for indicated yield strengths.

Material combinations

according to the actual standards (select stud material in a way that material of the same kind is welded).

| Stud material | Base material | | | |
|--|-------------------------------|---------------------------------|------------------------------|-------------------------------|
| | ISO/TR 15608 Groups 1 and 2.1 | ISO/TR 15608 Groups 2.2, 3 to 6 | ISO/TR 15608 Groups 8 and 10 | ISO/TR 15608 Groups 21 and 22 |
| Steel (S235) 4.8 ¹⁾ 16Mo3 | a | b | b | -- |
| 1.4301/03, 1.4401/04, 1.4541, 1.4571 | b/a | b | a | -- |
| EN AW-AlMg3/EN AW-5754 EN AW-AlMg5/EN AW-5019 | -- | -- | -- | b |

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.

¹⁾ weldable

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.



Danger

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 stud feeder:

Serial number welding gun:

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

Sender:

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: Yes No

Could you find any damage / burning mark:
on the cables: Yes No

on chucks: Yes No

Are all plug and screw connections fastened tight *: Yes No

Are there any burning marks on plug or screw connections: Yes No

Are there any other visual damages (e.g. cracks, dents): Yes No

Have you checked the fuses: Yes No

Default on the display of the power unit:

| ARC | | | | | CD | | | | | | |
|-----|--|--|--|--|----|--|--|--|--|--|--|
| | | | | | | | | | | | |
| | | | | | | | | | | | |

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

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