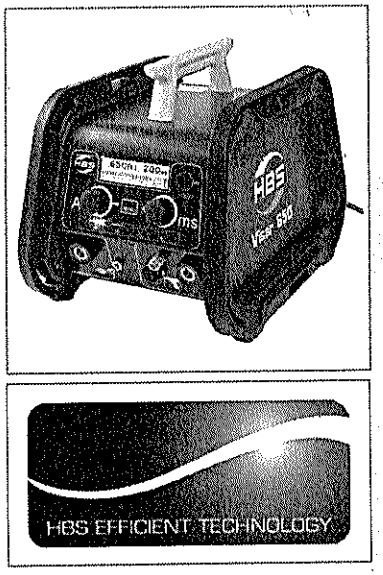
# Visar 650

Stud Welding Unit
Shielding Gas Version
93-66-0652







# Operating Manual

2021

After-sales service for Germany:

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Visar 650 Operating Manual Issue 2021-01 Order No. US-BA 93-66-0652

Translation of the Original Operating Manual

Please keep the manual in a safe place for future reference.

Dear Customer,

Many thanks for buying a stud welding machine from HBS Bolzenschweiss-Systeme.

We at HBS wish you success at all times when working with this stud welding machine.

The high level of quality of our products is guaranteed by ongoing further development in the design, equipment and accessories. This may result in differences between the present operating manual and your product. No claims can therefore be derived from the data, illustrations and descriptions.

We have compiled the data and information in this reference work with the greatest care, and have made every effort to ensure that the information contained in this manual was correct and up-to-date at the time of delivery. We can nevertheless give no guarantee for an absolutely error-free document.

Should you discover any errors or unclear points when reading this operating manual, please do not hesitate to contact us.

We would also be grateful for any feedback should you have any suggestions or complaints to make about our product.

HBS Bolzenschweiss-Systeme GmbH & Co. KG

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85221 Dachau

GERMANY

# Table of Contents

# 1 Important Safety Precautions

The target group for this manual are qualified personnel who in view of their technical training, know-how and experience and knowledge of applicable regulations are able to assess the work assigned to them and recognise potential hazards.

**Danger from incorrect use**

- Use the stud welding machine only for the purpose described in this manual.

Otherwise you may endanger yourself or damage the stud welding machine.

You endanger yourself and others if you operate the stud welding machine incorrectly or fail to observe the safety precautions and warnings. This can lead to serious injury or extensive material damage.

**Danger for unauthorised operating personnel**

- Work with the stud welding machine only when
  - You are appropriately trained, instructed and authorised to do so, and
  - You have read and completely understood this operating manual.
- Never work with the stud welding machine when you are under the influence of
  - Alcohol,
  - Drugs or
  - Medication.

**Danger from unauthorised modifications**

- Never modify the stud welding machine or parts thereof without obtaining a clearance certificate from the manufacturer.

You will otherwise endanger yourself. This can lead to serious injury or extensive material damage.

**Life-threatening danger for wearers of active implanted cardiac devices**

**Danger for workers at particular risk within the meaning of the EMF directive**

Persons at particular risk within the meaning of the EMF directive are:

- Workers with active implanted medical devices
- Workers with passive implanted medical devices that contain metal
- Workers with medical devices worn on the body
- Pregnant workers.

◆ Never operate the stud welding machine if you are among the group of workers at particular risk within the meaning of the EMF directive.

◆ In this case, never remain in the vicinity of the stud welding machine during welding.

◆ Never operate the stud welding machine if persons are located nearby who are among the group of workers at particular risk within the meaning of the EMF directive.

Strong electromagnetic fields are produced in the vicinity of the stud welding machine during welding. These fields can adversely affect the function of medical devices as well as the course of a pregnancy.

**Danger from fumes and airborne particulates**

◆ Switch on the welding fume extractor at the place of work.

◆ Ensure that the room is well ventilated.

◆ Never weld in rooms with a ceiling height of less than 3 m.

◆ Observe furthermore your working instructions and the accident prevention regulations.

This will help to avoid health damage due to fumes and airborne particulates.

**Danger from glowing metal spatter (fire hazard)**

Glowing hot weld spatter and liquid splashes, flashes of light and a loud bang > 90 dB (A) must be anticipated during stud welding.

- Inform colleagues working in the immediate vicinity accordingly before starting work.
- Ensure that an approved fire extinguisher is available at the workplace.
- Do not weld when wearing working clothes soiled with flammable substances such as oil, grease, petroleum, etc.
- Wear your proper protective clothing, such as:
  - Protective gloves in accordance with the relevant standard,
  - Non-flammable clothing,
  - A protective apron over your clothing,
  - Full-ear hearing protection in accordance with the relevant standard,
  - A safety helmet when welding above your head,
  - Safety shoes,
  - Safety goggles with sight glass of protection level 2 in compliance with the applicable standards and do not look directly into the electric arc.
- Remove all flammable materials and liquids from the vicinity of the work area before starting welding.
- Weld at a safe distance from flammable materials or liquids. Select a safety distance large enough to ensure that no danger can arise from weld spatter.


**Protection of the stud welding unit**

- Protect the stud welding machine against the ingress of foreign matter and liquids caused by cutting or grinding work in the vicinity of your work area.

This will help to prolong the service life of your stud welding machine.

**Safety notices in accordance with EMF directive 2013/35/EU**

Currents flowing through electrical conductors during stud welding cause electric and magnetic fields that can occur, in particular, near the hand-held welding guns, the welding arrangement (e.g., welding cables) and the welding power sources.

Due to the high currents, high EMF exposures may occur.

**Danger for workers at particular risk within the meaning of the EMF directive**

Persons at particular risk within the meaning of the EMF directive are:

- Workers with active implanted medical devices
- Workers with passive implanted medical devices that contain metal
- Workers with medical devices worn on the body
- Pregnant workers.

Strong electromagnetic fields are produced in the vicinity of the stud welding machine during welding.

To reduce the danger posed by electromagnetic fields, we recommend, among other things, the following rules of conduct:

- Lay all cables as close together as possible.

For proper bundling and safeguarding of the cables, HBS offers protective tubes in various sizes.

- Do not position yourself between the welding cables.
- Only lay the cables to one side and position them as far as possible from the operating personnel.
- Do not loop the cables over your body, especially not at head level.
- Completely unwind the welding cables.
- Use the shortest possible welding cables.
- Place portable welding power sources as far away as possible while welding.
- If possible, do not operate welding power sources in the immediate vicinity of other persons, do not sit directly next to the welding power source while working and do not lean against it.
- In addition to these safety notices, also observe your work instructions and accident prevention regulations.

# 2 Symbols and Terms Used

The symbols used in this operating manual have the following meanings:

**Danger**

**Warns you of hazards** that can lead to **injury of persons** or to **considerable material damage.**


**Caution**

**Problems** in operating **may occur** if this information **is not observed.**

**No access for people with active implanted cardiac devices**

**No access for persons with implants made of metal**

**No access for pregnant women**

**Danger**

Warns you of **electrical** hazards

**Danger**

Warns you of **electromagnetic fields** that can be generated during welding

These symbols prompt you to wear **personal protective clothing when working with the stud welding unit.**

This symbol prompts you to wear **ear protection. A loud bang > 90 dB (A) can occur during the welding process.**

**Tip**

**Cross-reference** to **useful information** on the use of the stud welding machine

**Cross-references in this operating manual are marked with this symbol** or ***are printed in italics***

**Fire hazard**

Have a suitable fire extinguisher for the working area ready before starting work.

◆ **Work instruction**

– **List**

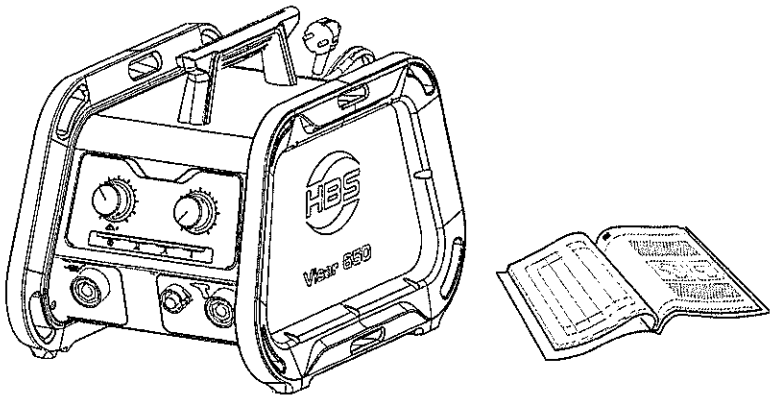
### Glossary

| | |
|---|---|
| Automatic welding head: | Device for welding of welding elements |
| Capacitor: | Component for storage of electrical energy. |
| Electric arc: | Autonomous gas discharge between two electrodes when the current is high enough. A whitish light is emitted in the process. The electric arc allows very high temperatures to be generated. |
| Rectifier: | Electrical component that converts alternating voltage into direct voltage |
| Stud feeder: | Device for automatic feeding of welding elements |
| Stud welding gun: | Device for welding of welding elements |
| Stud welding system: | Stud welding unit including stud welding gun or welding head |
| Stud welding unit: | Device for provision of the electrical energy for stud welding |
| Thyristor: | Electronic component for contact-free switching of high currents; switching takes place via the control input |
| Welding element: | Component such as stud or pin that is welded to the workpiece |
| Welding parameters: | Mechanical and electrical settings at the stud welding gun or welding head and at the stud welding unit (e.g. spring force, charging voltage) |
| Workpiece: | Components such as sheet metal or tubes to which the welding elements are to be fastened |

# 3 Scope of Supply

The **basic configuration** of your stud welding unit contains the following parts:

| No. of pieces | Part | Type | Order No. |
|---|---|---|---|
| 1 | Stud welding unit | Visar 650 Gas | 93-66-0652 |
| 1 | Operating manual | Visar 650 Gas | US-BA 93-66-0652 |



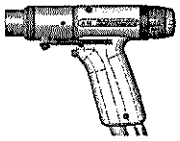
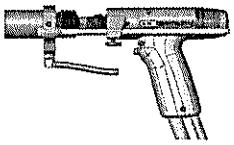
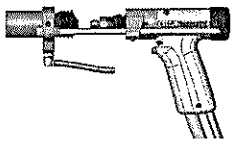

- Inspect the shipment for visible damage and completeness immediately on receipt.
- Report any transport damage or missing components immediately to the delivering shipping agent or the dealer (address, see page 2).

# 4 Accessories

The following **accessories** are available:

| | No. of pieces | Part | Type | Order No. |
|---|---|---|---|---|
|  | 1 | Ground cable | 5 m, 25 mm² | 93-40-020 |
|  | 1 | Toolbag | | 88-24-466 |

The following **stud welding guns** are recommended for **Visar 650 gas version:**

| | | | |
|---|---|---|---|
| **Welding range *)** | M3 - M6, Ø 2 - 6 mm | ARC: Ø 6 - 8 mm M6 - M10 (Type RD), SC: Ø 6 mm / M6 | |
| **Stud length** | 10 - 40 mm | 10 - 120 mm | |
| | **A 12** | **A 12** | **A 12-FL** |
| |  |  |  |
| | • Small gun with easy set-up for SC welding<br>• Length compensation (stable welding results) | | • Simple set-up of the gun without length compensation |
| **Welding elements** |  |  |  |
| **Welding process** | ARC (Gas) | | |
| **Stud type** | SC threaded studs with flange (PS), pins with flange (US), pins with internal thread and flange (IS) | ARC threaded studs (PD/RD/DD), pins (UD), pins with internal thread (ID) | |
| **Length compensation** | 3 mm automatic | | -- |
| **Lift** | Adjustment range 3 mm, lockable | | Fixed 6 mm |
| **Spring force** | Adjustable, arresting | | Fixed |
| **Welding cable** | 4.8 m, 35 mm², SK 50 | | 5 m, 35 mm², SK 50 |
| | **Order No.**<br>**93-20-277**<br>(welding gun A 12 incl. shielding gas shroud PSS-1/SC) | **Order No.**<br>**93-20-274**<br>(welding gun A 12 incl. shielding gas leg assembly PSS-2) | **Order No.**<br>**93-20-260**<br>(welding gun excluding leg assembly)<br><br>**93-40-021**<br>(shielding gas leg assembly PSS-2)<br>not included in delivery |

*) recommended welding range Visar 650 gas version / welding gun with this equipment

# 5 Technical Data

**Stud welding unit Visar 650 (Shielding gas version)**
for ARC stud welding according to current standards

| | | |
|---|---|---|
| Welding range | ARC: | #4 - 7/16" (type RD), Ø 14 ga - 5/16" |
| | SC: | (M3 - M10 (type RD), Ø 2 - 8 mm) |
| | | #4 - 1/4", Ø 14 ga - 1/4" |
| | | (M3 - M6, Ø 2 - 6 mm) |
| Welding material | Mild steel, stainless steel, Aluminium *) | |

*) Welding element is not standardized according to DIN EN ISO 13918, but manufactured by the manufacturer's discretion. The welding parameters should be determined by test weldings.

| Welding rate | 25 °C | 100 % | 50 % | 35 % |
|---|---|---|---|---|
| | F [studs/min] | 8 | 14 | 18 |
| | t [ms] | 160 | 160 | 160 |
| | $I_2$ [A] | 650 | 650 | 650 |
| | $U_2$ [V] | 30 | 30 | 30 |

| | |
|---|---|
| Welding current | 650 A (max.) |
| Current adjustment range | 100 to 650 A |
| Welding time | 5 to 200 ms (stepless) |
| Primary power | 100 to 240 V, 1 phase, 50/60 Hz, 16 AT |
| Primary plug | 16 A 2-pin grounded safety plug (plug type F CEE 7/4) |
| Connected load | 6 kVA |
| Connected load external power generator | ≥ 3 kVA |
| Cooling type | F (temperature controlled cooling fan) |
| IP Code | IP 44 (also permits operation outdoors) |
| Ambient temperature limits | 32 °F to 104 °F (0 °C to 40 °C) |
| Dimension L x W x H | 18.66" x 13.27" x 13.82" (474 x 337 x 351 mm) with handle |
| Weight | 39.68 lbs (18 kg) |

# 6 Intended Use

Our stud welding units are designed and built exclusively for industrial use. Non-industrial use is expressly forbidden due to the lack of know-how about the welding technology employed and the applicable standards.

The stud welding unit is intended exclusively for stud welding of standardised welding elements. Any other use will result in the desired strength of the welded joint being reduced.

This stud welding unit can only be used with the HBS stud welding guns A 12 and A 12-FL.

The intended use also implies observance of the stud welding gun operating manual and compliance with the intervals and conditions for inspection and maintenance of the stud welding unit and the components employed.

- Always check the operating manual of your stud welding gun whether it may be used with this stud welding unit.

The stud welding unit must be suitable for welding the welding elements in use.

Welding elements manufactured with the cold formed process have a flange and an ignition tip. During welding, the flange prevents the arc getting to the cylindric part of the welding element and increases simultaneously the welding area.

- **Please refer to the operating manual of your stud welding gun for detailed information on which welding elements may be used.**

# 7 Warranty

Please refer to the latest "General Terms and Conditions" for the scope of the warranty.

The warranty does not cover faults caused by e.g.

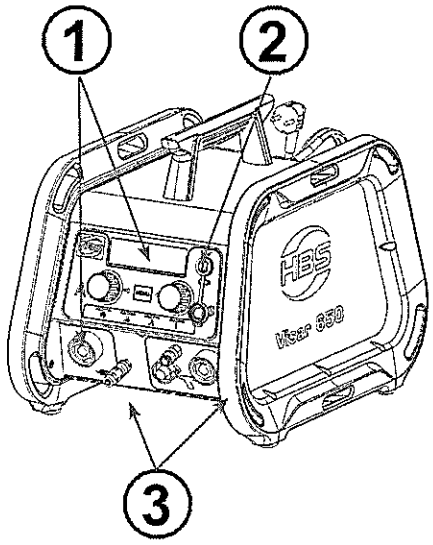
- Normal wear,
- Improper handling,
- Failure to observe the operating manual,
- Failure to observe the safety precautions,
- Use for other than the intended purpose, or
- Transport damage.

Warranty entitlement shall no longer be valid if modifications, changes or service and repair work is carried out by unauthorised persons or without the knowledge of the manufacturer. Invalidation of warranty entitlement shall also render the declaration of conformity invalid. The CE marking shall be declared invalid by the manufacturer.

We expressly point out that only spare parts and accessories or components approved by us may be used. The same applies likewise to installed units from our sub-suppliers.

# 8 Components of the Stud Welding Unit

The Visar 650 is ideal for use on construction sites:

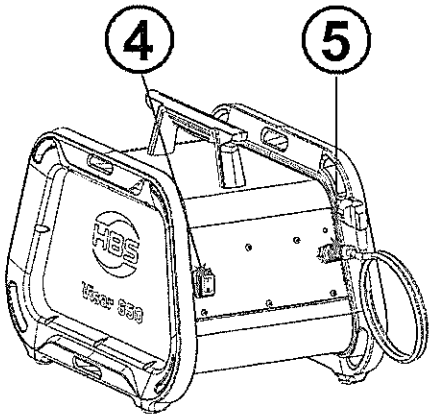



① **Operator panel with display:**
- Recessed to protect against damage

**Connection sockets** (welding-current, control and ground cable, shielding gas)
- Recessed and mounted at an angle

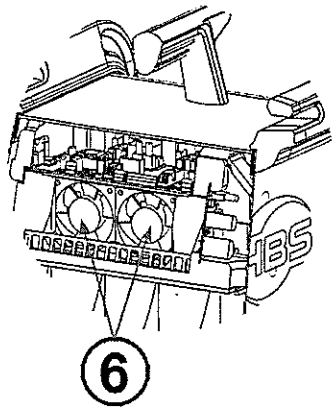
② **USB connection**
- For easily saving and opening programs as well as for software updates

③ **Circumferential side frame** (bumper) made of PP foam **for large ground clearance**;
- Good stability on rough ground
- Protection against dirt and water



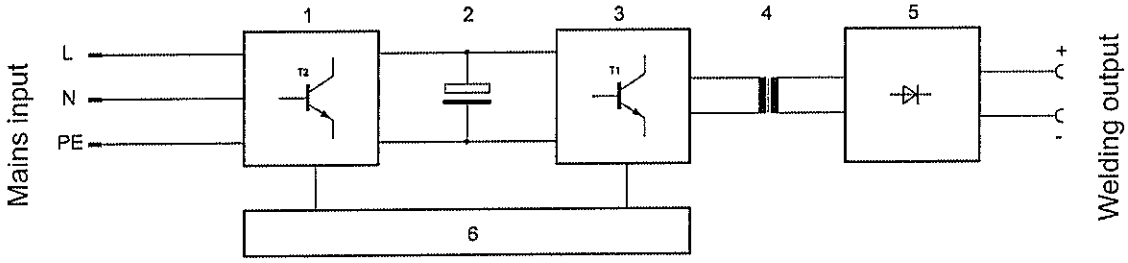

④ **Back:**
- Mains switch

⑤ – Mains cable




⑥ **Internal fans:**
- Protection against internal soiling

## 8.1 Main Assemblies




1 - PFC mains input

2 - Electrolytic capacitors

3 - IGBT switch

4 - Medium frequency transformer

5 - Rectifier

6 - Control unit

The mains voltage is rectified by the master switch and the EMV filter in the **PFC unit (1)**.

The rectified voltage is smoothed by the **electrolytic capacitors (2)** and led to the **IGBT switches (3)**. These switches turn the direct voltage into a high-frequency alternating voltage of 30 kHz.

The energy is transferred via the **medium frequency transformer (4)** with **diodes (5)** and rectified. The smoothed current is led to the weld bushes.

The **IGBT switch (3)** is controlled in the **control unit (6)**. The control unit also coordinates the mechanical process (withdrawing of the welding elements) with the electronic control system (triggering the pre current, triggering the main current, welding time process). The welding time and welding current are fully adjustable.

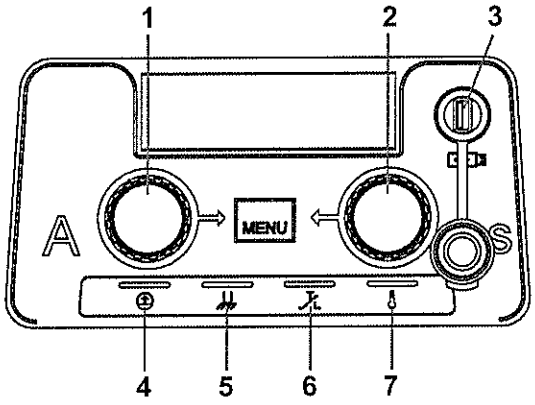
The type plate is located on the backside of the stud welding unit.

**Type plate**

The type plate contains the following information:

- Manufacturer
- Type
- Order No./Serial No.
- Primary voltage
- Fuse
- Power consumption
- Cooling class
- IP code
- Date

## 8.2 Operation Panel and Display




1 - Welding current (push/rotary button)

2 - Welding time (push/rotary button)

3 - USB connection with protection cap

4 - Ready (LED)

5 - Contact (LED)

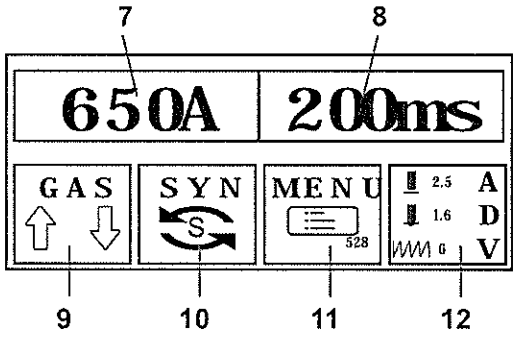
6 - Trigger (LED)

7 - Temperature (LED)

The lower section of the keypad contains a light-emitting diode (LED) with the following meanings:

| | | | |
|---|---|---|---|
| | Yellow | Flashes quickly | After switching on the stud welding unit:<br>The capacitors are charged. The stud welding unit runs a self-test. |
| | | Flashes slowly | After the self-test, the stud welding unit changes to sleep mode.<br>Sleep mode is ended when the welding-gun button is triggered or the welding gun makes contact with the workpiece. The stud welding unit now switches to "Ready". |
| | | Lights up | When the stud welding unit is ready for welding.<br>After about 3 minutes, the stud welding unit switches to sleep mode. |
| | | Flashes slowly | After switching off the stud welding unit:<br>The capacitors are discharged. |
| | Yellow | Lights up | When electrical contact exists between the welding element and the workpiece |
| | Yellow | Lights up | When the welding gun button is triggered. |
| | Yellow | Lights up | The stud welding unit is locked in the event of<br>– if the stud welding unit is overheated. After a short cooling period, the work can be continued. |

**Display:**




7 - Set welding current

8 - Set welding time

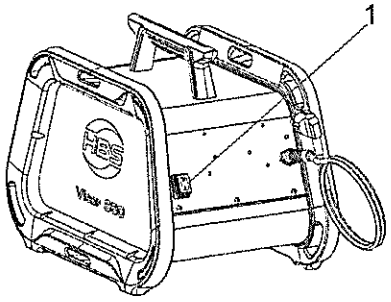
9 - Gas: On/Off (gas pre-flow time/gas post-flow time)

10 - SYN: Stud welding mode synergy

11 - MENU: Program and system management

12 - ADV: Adjusting existing programs to customer specific conditions

## 8.3 Mains switch




1 - Mains switch

The switch for mains mode is located on the rear of the stud welding unit.

## 8.4 Process control

This stud welding machine includes the "real-time process control" function.

Real-time process control (CP) serves to monitor the quality of a product during ongoing production and thereby ensure that the quality specifications are maintained. During the current welding process, it detects key physical measured variables that characterise the production quality or characteristics that are derived from those variables and evaluates them.

This real-time process control couples the quality assessment directly to the welding process so that a response can be made to the quality result during or immediately following the welding process. Deviations from set tolerances are signalled immediately after welding; corrective measures can be initiated.

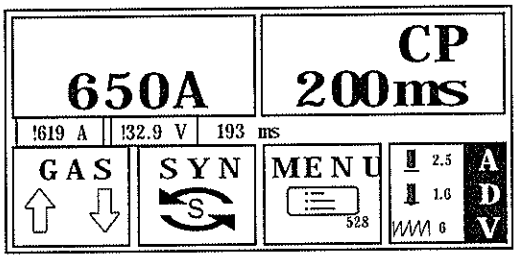
Different measured variables can be stored for various welding tasks. Thus, it is possible to perform an individual process assessment for each welding task (stud dimension/welding position/material/etc.).

The set values are determined through reference welds.

The actual and set values are compared with one another during daily welding work. If the actual values are within the specified tolerance range of the set values, the current welded joint is accepted as OK; otherwise, it is rejected as NOK.

Rejection is indicated on the stud welding machine at the end of the corresponding welding process as follows:

1. Indicator on the display:




2. Process interruption:

The device is locked after a deviation occurs. After pressing the gun button for a longer period of time (> 2 seconds), the stud welding machine is again ready for welding.

To melt stud and metal sheet, electric work W = I x t x U produced in the electric arc is used. This yields the following characteristic physical monitoring variables for process control:

- Welding current curve vs. welding time
- (Welding) voltage curve vs. welding time
- Transient voltages (drop short-circuits or voltage peaks)
- Electric resistance in the welding circuit (resistance of the circuit)

Acoustic signals:
The noise from the electric arc provides the stud welder with information on the process stability and possible drop short-circuits. In the ideal case, it is uniform and without interruptions.

There is no blanket answer to the question as to which measured variables should be used for process control. The measured variables should reflect the process behaviour and thereby allow conclusions to be drawn on the weld seam quality that is to be expected.

With drawn arc stud welding, deviations of a parameter with respect to the reference welds often have only minor impacts on the quality of the weld. The combined interference effect of multiple welding conditions may, however, have a significant impact.

With drawn arc stud welding (ARC), the evaluation of the voltage curve is especially decisive.

Short cycle drawn arc stud welding (short-cycle/SC):
Here, a change to just one parameter can affect the quality of the weld. Experience gained from use in series production is necessary for process assessment with respect to the specific boundary conditions when using process control.

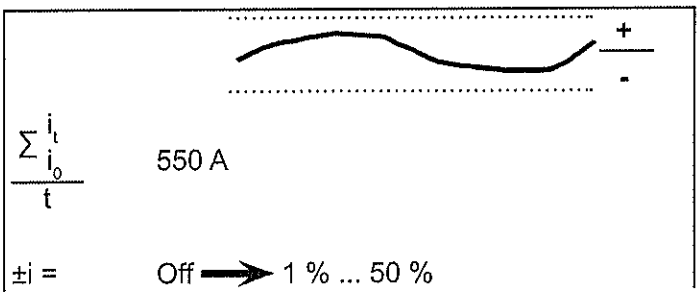
**Welding current curve vs. welding time**

The welding current curve vs. time provides important information on the individual process sections during the stud welding process.

- Pre current: electric arc ignition and stabilisation
- Main current/welding current: electric arc burning and energy input
- Insertion current: short circuit and end of process

The welding current determines the temperature and the "fluidity" of the weld pool. To avoid the susceptibility to pore formation, the current must not be less than a minimum current value for a given diameter.

During each welding process, physical influences (workpiece soiling, tolerance deviations with welding elements and similar) may cause the welding current to fluctuate. With the definition of welding current tolerances, limit values for quality criteria can be defined. During normal workflow, the current value of the welding current is then compared with the reference value.




Welding current tolerance

To more easily set the start parameters, a recommended value of ±10% can be defined.

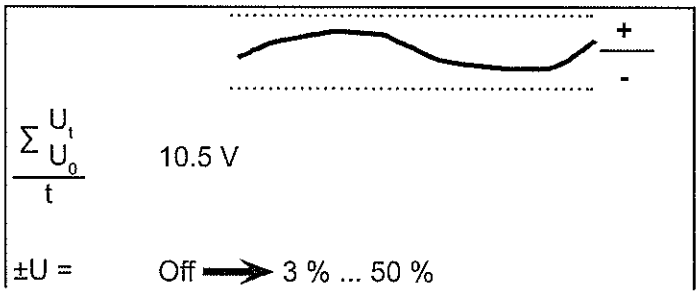
**Voltage curve vs. welding time**

The electric arc voltage changes during the welding process as, e.g., a function of

- Welding current
- Lift
- Surface condition of the component surface
- Geometry of the stud tip
- Weld pool protection (shielding gas or ceramic ferrule)

The voltage curve vs. time provides important information on the individual process sections during the stud welding process – from electric arc burning to insertion – as well as on the electric arc length. With the definition of voltage tolerances, limit values for quality criteria can also be defined here.

During drawn arc stud welding, the voltage curve is fairly constant. For example, when using ceramic ferrules, the voltage is approximately 30 V; when using shielding gas (M21 – DIN EN ISO 14175), it is approximately 3 V (10%) less.
Damp ceramic ferrules or heavily oiled surfaces negatively impact welding execution. This influence is recognisable by a significantly higher voltage level (+5 V) with respect to reference values.

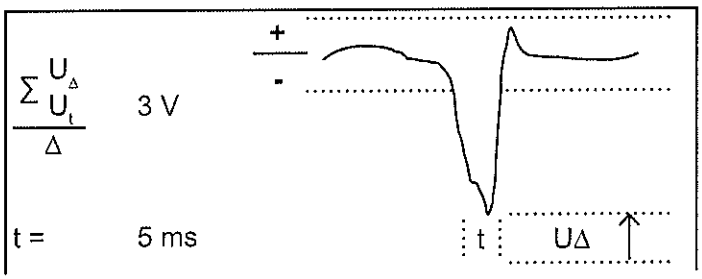



◆ You have the option of entering a fixed voltage value manually. This should be determined in advance through reference welds.

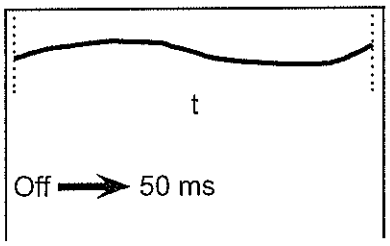
### Drop short-circuits or voltage peaks

With regard to the welding capacity, the entire voltage curve can be viewed as a combined variable vs. time. When welding while experiencing (drop) short-circuit formation, these short circuits appear as characteristic drops in the curve.

For process monitoring, it is therefore helpful to observe and evaluate the voltage separately in the process phases.



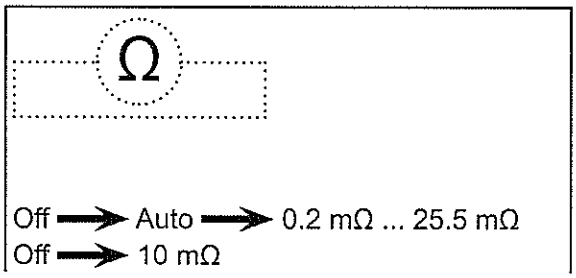

### Defining the tolerance time



### Electric resistance of the circuit

During the welding process, welding gun, welding and ground cable, workpiece and welding element form a closed welding circuit with a defined electric resistance. This resistance is affected by external mechanical influences of the used components (loose ground connections, scorched chucks, cable breakage, condition of the component surface and similar). This can result in a gradual change of the quality results.

By determining the resistance in the welding circuit and by defining limit values (tolerances), condition monitoring is integrated in the process control to detect and report problems in good time.




| | |
|---|---|
| Resistance of the circuit | Off → Auto → 0.2 mΩ ... 25.5 mΩ |
| Resistance tolerance | Off → 10 mΩ |

To more easily set the properties, the system defines a reference value with the "Auto" setting automatically.

Process control is divided into two phases:

- Learning and validation phase → Reference welds
- Application phase → Series operation

**Learning phase: reference welds**

The welding process is observed with measurements in a "learning phase" using a defined number of reference welds ("monitored learning").

To more easily define the set values and tolerances, the respective physical measured variable can be set to "AUTO".

These measured variables are stored during subsequent welding. A set range with defined tolerances is thereby determined for process control.

☞ **Only the OK welds are used** for reference values.

☞
- ◆ Perform your reference welds in such a way that they reflect your welding task.
- ◆ For various welding tasks, perform separate reference welds for each task and store them accordingly.

**Application phase: series operation**

◆ Call up the corresponding reference values.

The welding process can now be started.

In series operation, the current actual values are compared with the set values in real time and classified as OK or NOK.

In the event of NOK welds, an intervention in the production process occurs.

The welding results can be recorded for subsequent evaluations.

## 8.5 Special commands via USB interface

Each stud welding machine of the VISAR series with process control function has its own identification designation.

This designation can be read out together with the generated number of welds, the actual values of the welding parameters as well as the result of the quality assessment via the USB interface and archived.

For process optimisation and traceability, we recommend documenting the welding position, the material quality and the surface characteristics, the component dimensions and the welding parameters set on the gun for each individual connection.

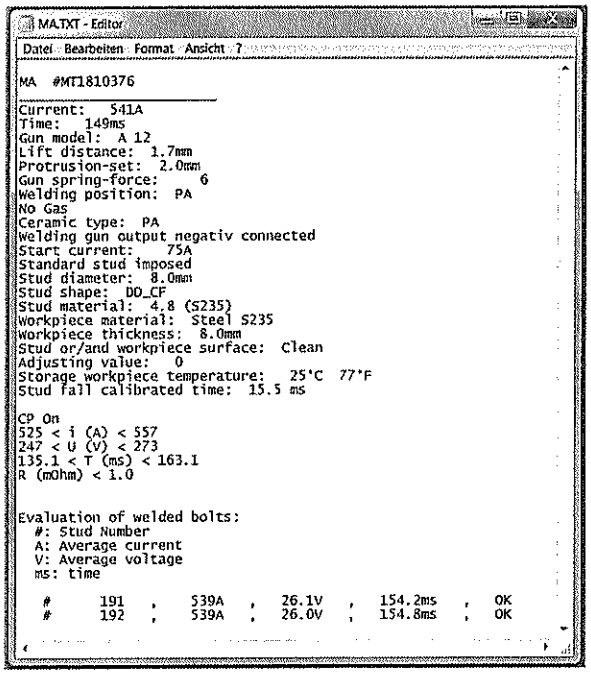
By default, the oscillogram of the last weld is stored. The weld oscillogram and the average values of the last weld can be transferred to a USB memory device via the USB interface for analyses or documentation purposes. Visualisable information about the welding process can thereby be made available for improving the process quality or for documentation purposes.

All command functions described in the following are **not** included in the scope of supply by default and must be requested separately from HBS.

### 8.5.1 Documentation

(DOCUMENT.0LQ – can be activated via USB command)

With process control switched on and the "Documentation" USB command activated via a USB memory device, all settings of the device are collected in a file that bears the same name as the job that is currently being used. Average values for current, voltage and welding time are thereby recorded for the respective current, absolute number of welds.

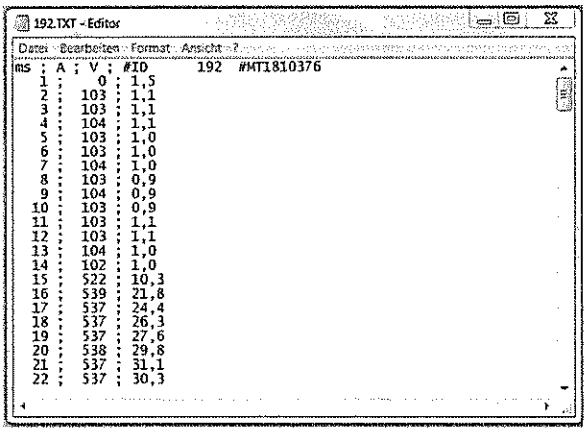



This function is only active with a previously opened job.
Recording is ended as soon as the USB memory device is removed or the device is switched off.

### 8.5.2 Oscillogram

(DAT_LOG.0LQ – can be activated via USB command)

With process control switched on and the "Oscillogram" USB command activated via a USB memory device, all settings of the device are collected in a file that bears the same name as the current absolute number of welds. This file contains the current and voltage values over the time axis that an oscillogram can generate. The oscillogram data can be visualised either via Excel import or visualisation software provided by HBS.




This command is only valid for the last weld and must be called up again for each new recording.

### 8.5.3 Special command "Lock device"

(LOCK_UN.0LQ – can be activated via USB command)

With this command, the device can be locked to prevent changes from being made to the settings of an opened job. The command for locking the device is called via the USB interface.

Calling the command again cancels the lock.

# 9 Welding Process

Stud welding with a drawn arc process is divided into drawn-arc stud welding with ceramic ferrule and drawn-arc stud welding with shielding gas. This stud welding unit must be used exclusively for stud welding with drawn arc.

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:

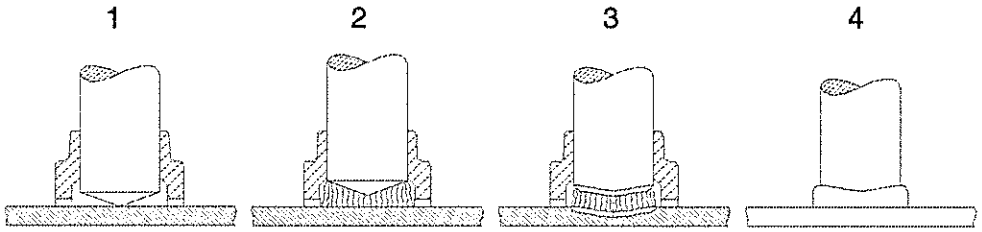
- The method of weld pool protection (shielding gas - SG, ceramic ferrule - CF or no protection - NP)
- The length of welding time (standard ARC or short-cycle drawn-arc stud welding - SC)
- The energy source (welding rectifier supplied by mains, inverter, capacitor battery).

## 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. The standards assign this method of joining pin-shaped elements with plane workpieces to the so called 'Arc Pressure Welding'.

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 stud welding 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 figure, **position 1**). When the button of the welding gun is triggered, the automated welding process starts, which works as follows:




- 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 figure, **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 stud welding 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 figure, **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 figure, **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.

## Variants of drawn-arc stud welding

| Item | Drawn arc stud welding with ceramic ferrule | Drawn arc stud welding with shielding gas | Short-cycle drawn arc stud welding with shielding gas |
|---|---|---|---|
| Diameter welding element d metric in mm (imperial) | 3 - 25 (#4 or 12 gage to 1") | 3 - 12 (16) (#4 or 12 gage to 1/2" (5/8")), by using aluminium up to 12 mm/ 1/2") | 3 - 12 (#4 or 12 gage to 1/2"), by using brass and aluminium with shielding gas |
| Max. current I in A | 3000 | 3000 | 2000 |
| Welding time t in ms | 100 - 2000 | 100 - 2000 | 10 - 100 |
| Energy source | Welding rectifier, inverter | Welding rectifier, inverter | Welding rectifier, inverter |
| Weld pool protection | Ceramic ferrule CF | Shielding gas SG | Shielding gas SG or no protection NP |
| Material welding element (suitable for welding) | Mild steel, stainless steel | Mild steel, stainless steel, aluminium (up to 12 mm) | Mild steel, stainless steel, brass and aluminium with shielding gas |
| Workpiece surface | Metallic bright (rolling skin, rust film, welding primer) | Metallic bright (rolling skin, rust film, welding primer) | Metallic bright, galvanised (< 40 µm), slightly oiled |
| Min. thickness of workpiece | 1/4 d<br>min. 1 mm | 1/8 d<br>min. 1 mm | 1/10 d<br>approx. 0.7 mm |
| Adjustable parameters | Welding current<br>I in A = 80 x d<br>(up to 16 mm) | Welding current<br>I in A = 80 x d<br>(up to 16 mm) | Welding current<br>I in A = 100 x d<br>(up to 12 mm) |
| | Welding time<br>t in ms = 20 x d<br>(up to 12 mm) | Welding time<br>t in ms = 20 x d<br>(up to 12 mm) | Welding time |
| | Lift<br>(arc length) | Lift<br>(arc length) | Lift<br>(arc length) |
| | Protrusion, immersion speed (plunge damper from 14 mm diameter) | Protrusion, immersion speed (plunge damper from 14 mm diameter) | Protrusion, immersion speed |

### Drawn-Arc Stud Welding with Ceramic Ferrule

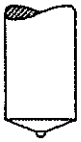
Drawn-arc stud welding with ceramic ferrule is used with welding elements of 3 to 25 mm diameter (preferably above 12 mm diameter) and with welding times of about 100 to 2000 ms. It is generally suitable for all welding positions. When stud welding with ceramic ferrule, the welding position is PA (flat position). 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 EN ISO 13918. When using concrete anchors or shear connectors the front area can be plane constructed with a small pressed-in aluminium ball.



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

### 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 100 to 2000 ms. Principally, it is suitable for all welding positions, however, it is preferably used in flat 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.

| | Recommendation according | Recommendation according HBS |
|---|---|---|
| Mild steel / stainless steel | DIN EN ISO 14175-M21: | 90 % Ar / 10 % $CO_2$ *) |
| | (82 % Ar / 18 % $CO_2$) | 92 % Ar / 8 % $CO_2$ *) |
| Aluminium and aluminium alloys | DIN EN ISO 14175-I1 | 85 % Ar / 15 % He |
| | DIN EN ISO 14175-I3 | 70 % Ar / 30 % He **) |

*) As a result of the higher amount of $CO_2$ the surface tension of the weld pool is reduced, which may lead to increased spatter formation.

**) For larger plate thicknesses the helium content may be increased.

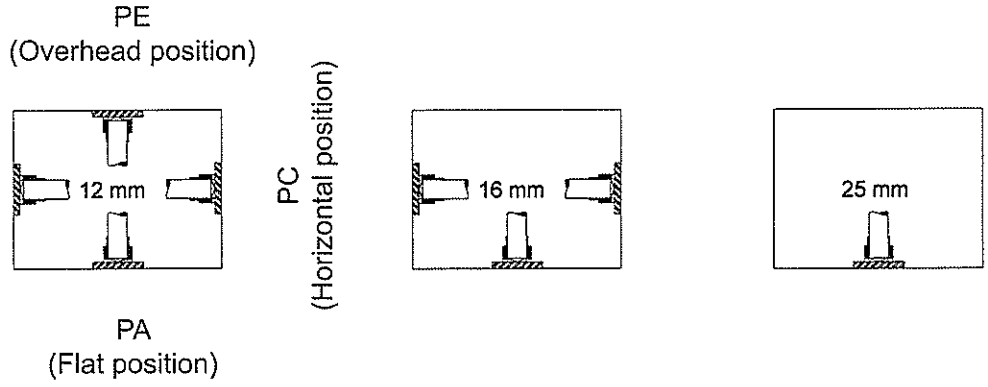
The shielding gas influences

- 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 for drawn-arc stud welding with shielding gas are described in EN ISO 13918. Welding elements with cone-shaped front area and without an aluminum ball are preferably used.

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




**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 10 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) 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.

# 10 Preparing Workplace and Welding Process

**Danger from fumes and airborne particulates**

- Switch on the welding fume extractor at the workplace.
- Ensure that the room is well ventilated.
- Never weld in rooms with a ceiling height of less than 3 m.
- Observe furthermore your working instructions and the accident prevention regulations.

This will help to avoid health damage due to fumes and airborne particulates.

**Danger from fire and explosion**

- Remove all inflammable materials and liquids from your working area.
- Ensure that there are no explosive materials in your working area.
- Ensure that an approved fire extinguisher is available at the workplace.

**Danger from tripping and falling**

- Lay cables and connecting leads in such a way that they are protected against damage and
- that you or third parties cannot trip over them or fall.


**Warning of weld spatter**

- Ensure that there is no equipment or apparatus in the working area that could be damaged by weld spatter.
- Remove if necessary.

**Warning of electromagnetic fields**

- Ensure that there is no equipment or apparatus in the working area that could be damaged by magnetic fields.
- Remove if necessary.


**Danger!**

- Ensure that there is a free circulation of air through the housing of the stud welding unit.
- Always place the stud welding unit on a stable, level and clean surface.
- Check the condition of all cables and cable connections.
- Have defective cables or their connections immediately repaired or replaced by a qualified electrician.

## 10.1 Preparing Surfaces

- Remove

– Paint, oil and other impurities,

– Rust,

– Non-conductive coatings (of surface-coated materials)

from the welding surface and the contact points of the ground clamps.

This ensures a high strength of the welded joints.

- **Weld the welding element only to a flat surface.**
- Ask your application consultant at HBS about welded joints on tubes and riffle plates (*see page 2*).

## 10.2 Checking the Stud Welding Gun

- Always check the operating manual of your stud welding gun to see whether it may be used with this stud welding unit.

This stud welding unit can only be used with the HBS stud welding guns A 12 and A 12-FL.

- Check the chuck of your stud welding gun for proper fit and ensure it is tightened.
- Check the bellows of your stud welding gun for damage.
- Check if spring force and lift are set according to the welding parameter table in the operating manual of the stud welding gun.

- **Refer here to the operating manual of your stud welding gun.**

# 11 Connection

◆ **First prepare your workplace.**

◆ Read and observe here *point 10 "Preparing Workplace and Welding Process".*

**Electric shock hazard**

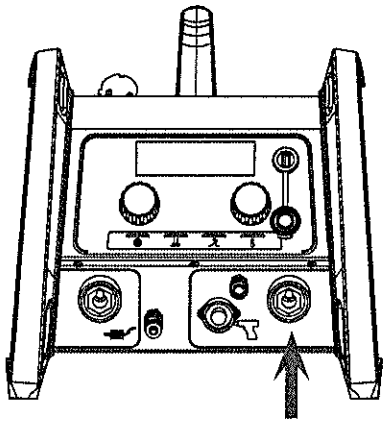
◆ Leave the stud welding unit switched off during connection of the connecting leads.

In this way you can avoid any unintentional starting of the welding process.

◆ **Secure the cables.**

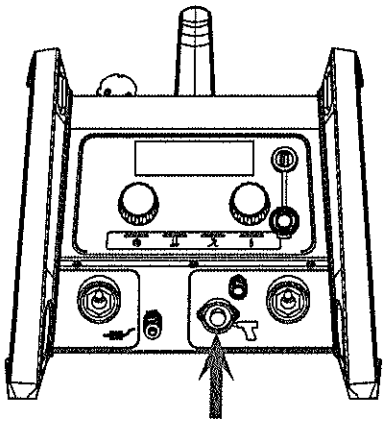
Strong magnetic fields are generated during the welding process that can lead to whipping of the cables. This can cause the cables to come out of the plug sockets.

## 11.1 Connecting the Stud Welding Gun to the Stud Welding Unit



**Connect the welding current cable**

- Only now plug the welding current cable into the corresponding socket of the stud welding unit.
- Press in the plug and turn it firmly clockwise (to the right).



**Connect the control cable**

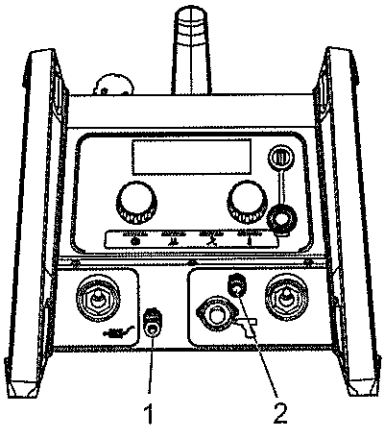
- Plug the control cable into the corresponding socket of the stud welding unit.
- Twist the retaining nut of the control cable connector clockwise.

**Only loosely made connections will result in damage to the plug connectors.**

- Therefore always check that the plug connector is firmly inserted.

This prevents a poor contact and hence overheating of the plug connectors.

## 11.2 Connecting the Shielding Gas




1 - Gas inlet (e.g. shielding gas bottle)

2 - Gas outlet

- Connect the gas hose of the shielding gas bottle to the gas inlet of the stud welding 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.**

For stud welding a shielding gas mixture according DIN EN ISO 14175 is used.

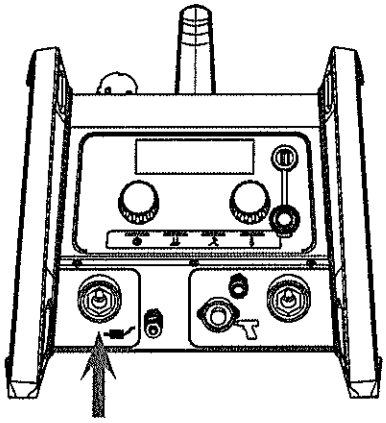
- Please refer to *chapter 9* for more detailed information.

- **You must not put the air hose into the gas valve of the stud welding unit!**

  The valve would be destroyed.

**If the conduits are wrongly connected, feeding and welding malfunctions will occur.**

## 11.3 Connecting the Ground Cable



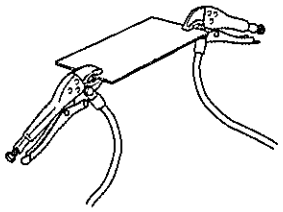
**Connect the ground cable**

- Plug the ground cable into the corresponding socket of the stud welding unit.
- Press in the plug and turn it firmly clockwise (to the right).

**Only loosely made connections will result in damage to the plug connectors.**

- Therefore always check that the plug connector is firmly inserted.

This prevents a poor contact and hence overheating of the plug connectors.

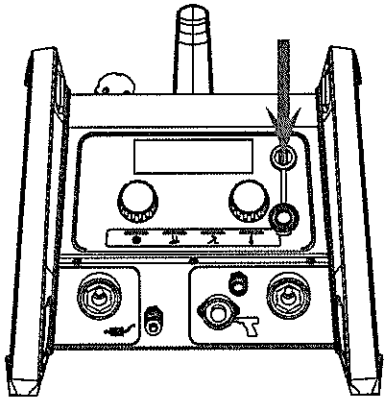


**Connect the ground clamps**

- Remove rust, paint and dirt from the points on the workpiece to which you wish to connect the ground clamps.
- Attach the ground clamps to the workpiece as tightly as possible.
- Pay attention to a good contact and symmetrical connection.

**The welding point should be in the middle between the two ground clamps.**

## 11.4 Connecting a USB Stick



**Connect a USB Stick**

Via the USB port, existing welding programs can be called up and new welding programs can bei stored.

The USB port is protected with a protective cap against dirt and damage.

## 11.5 Connecting the Stud Welding Unit to the Mains Supply

**Electric shock hazard**

- Have an electrician check whether the plug socket to which you intended to connect the stud welding unit is correctly earthed.
- Connect the stud welding unit only to a mains supply with the same mains voltage as that indicated on the type plate.
- Compare the current consumption indicated on the type plate with the fuse of your mains power supply.
- Check that the stud welding unit is switched off.
- Only now insert the plug into the plug socket.

# 12 Welding

- **First connect up the stud welding unit.**
- Read and observe here *point 11 „Connection".*

**Life-threatening danger for wearers of active implanted cardiac devices**

**Danger for workers at particular risk within the meaning of the EMF directive**

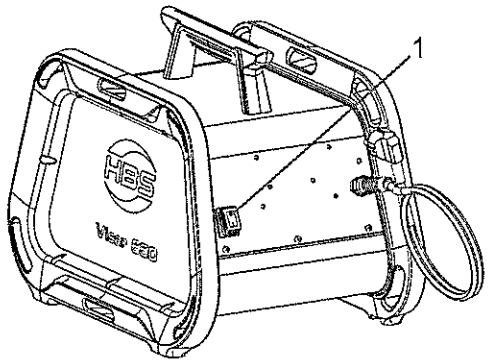
Persons at particular risk within the meaning of the EMF directive are:

- Workers with active implanted medical devices
- Workers with passive implanted medical devices that contain metal
- Workers with medical devices worn on the body
- Pregnant workers.

- Never operate the stud welding machine if you are among the group of workers at particular risk within the meaning of the EMF directive.
- In this case, never remain in the vicinity of the stud welding machine during welding.
- Never operate the stud welding machine if persons are located nearby who are among the group of workers at particular risk within the meaning of the EMF directive.

Strong electromagnetic fields are produced in the vicinity of the stud welding machine during welding. These fields can adversely affect the function of medical devices as well as the course of a pregnancy.

## 12.1 Switching on the Stud Welding Unit




1 - Mains switch

◆ Only now switch on the stud welding unit at the **mains switch (1)**.

| | | | |
|---|---|---|---|
| | Yellow | Flashes quickly | After switching on the stud welding unit:<br>The capacitors are charged. The stud welding unit runs a self-test. |
| | | Flashes slowly | After the self-test, the stud welding unit changes to sleep mode. Sleep mode is ended when the welding-gun button is triggered or the welding gun makes contact with the workpiece. The stud welding unit now switches to "Ready". |
| | | Lights up | When the stud welding unit is ready for welding.<br>After about 3 minutes, the stud welding unit switches to sleep mode. |

◆ When **switching on** the stud welding unit, do not set the **welding gun on the workpiece.**

The stud welding unit will otherwise not switch to "Ready".

## 12.2 Determining Welding Current and Welding Time

Determination of welding time and welding current at the stud welding unit depends i.a. on

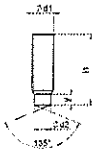
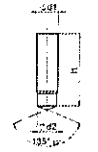
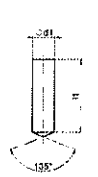
- the diameter of the welding element,
- the material of the welding element,
- the material of the workpiece,
- the used weld pool protection (ceramic ferrule, shielding gas, no protection).

◆ Determine welding time and welding current to be set at the stud welding unit using the following tables.

**The figures in these table are indicative values and must be checked by means of a test welding on the original material with the same properties as the original workpiece.**

### Determining welding current and welding time for welding gun A 12 and A 12-FL

for drawn arc stud welding with ceramic ferrule

| Welding elements<br>Material:<br>4.8 (suitable for welding) | | Diameter of welding elements<br>metric<br>Stud diameter in mm | <br><br>eff. diameter in mm | <br>imperial (US)<br>Stud diameter in inches | <br><br>eff. diameter in inches | Welding current [1)2)]<br>Visar 650<br>I in A | Welding time [1)2)]<br>Visar 650<br>t in ms |
|---|---|---|---|---|---|---|---|
| Material of workpiece: Mild steel (suitable for welding) | | | | | | | |
|  | | $Ø d_1$ | $Ø d_2$ | $Ø d_1$ | $Ø d_2$ | | |
| | RD [3)] | M6 | 4.7 | 1/4 | 0.185 | 300 | 150 |
| | RD [3)] | M8 | 6.2 | 5/16 | 0.244 | 450 | 170 |
| | RD [3)] | M10 | 7.9 | 3/8 | 0.311 | 630 | 200 |
|  | | $Ø d_1$ | $Ø d_2$ | $Ø d_1$ | $Ø d_2$ | | |
| | PD/MD (DD) [3)] | M6 | 5.35 | 1/4 | 0.211 | 450 | 100 |
| | PD/MD (DD) [3)] | M8 | 7.19 | 5/16 | 0.283 | 560 | 200 |
|  | | $Ø d_1$ | | $Ø d_1$ | | | |
| | UD / Pins [3)] | 3 | | #4 /12 gage | | --- | --- |
| | UD / Pins [3)] | 4 | | #8 | | --- | --- |
| | UD / Pins [3)] | 5 | | #10 / 3/16 | | --- | --- |
| | UD / Pins [3)] | 6 | | 1/4 | | 450 | 180 |
| | UD / Pins [3)] | 8 | | 5/16 | | 630 | 200 |

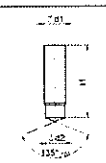
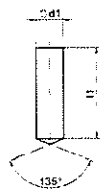
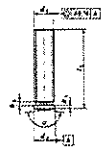
1) to be checked by test weldings

2) Information and recommendations on this can be found in **DIN EN ISO 14555.**

3) Information and recommendations on this can be found in **DIN EN ISO 13918.**

## Determining welding current and welding time for welding gun A 12 and A 12-FL

for drawn arc stud welding with shielding gas [4]

| Welding elements<br>Material:<br>4.8 (suitable for welding) | | Diameter of welding elements<br>metric | | imperial (US) | | Welding current [1][2]<br>Visar 650<br>I in A | Welding time [1][2]<br>Visar 650<br>t in ms |
|---|---|---|---|---|---|---|---|
| | | Stud diameter in mm | eff. diameter in mm | Stud diameter in inches | eff. diameter in inches | | |
| Material of workpiece: Mild steel (suitable for welding) | | | | | | | |
|  | | Ø $d_1$ | Ø $d_2$ | Ø $d_1$ | Ø $d_2$ | | |
| | RD [3] | M6 | 4.7 | 1/4 | 0.185 | 400 | 125 |
| | RD [3] | M8 | 6.2 | 5/16 | 0.244 | 600 | 120 |
| | RD [3] | M10 | 7.9 | 3/8 | 0.311 | 650 | 200 |
|  | | Ø $d_1$ | Ø $d_2$ | Ø $d_1$ | Ø $d_2$ | | |
| | PD/MD (DD) [3] | M6 | 5.35 | 1/4 | 0.211 | 490 | 100 |
| | PD/MD (DD) [3] | M8 | 7.19 | 5/16 | 0.283 | 620 | 180 |
|  | | Ø $d_1$ | | Ø $d_1$ | | | |
| | UD / Pins [3] | 3 | | #4 /12 gage | | 250 | 60 |
| | UD / Pins [3] | 4 | | #8 | | 320 | 90 |
| | UD / Pins [3] | 5 | | #10 / 3/16 | | 425 | 150 |
| | UD / Pins [3] | 6 | | 1/4 | | 600 | 120 |
| | UD / Pins [3] | 8 | | 5/16 | | 650 | 200 |
|  | | Ø $d_1$ | Ø $d_2$ | Ø $d_1$ | Ø $d_2$ | | |
| | PS (US, IS) [5] | M3 | 4 | 1/8 | 0.157 | 400 | 20 |
| | PS (US, IS) [5] | M4 | 5 | 5/32 | 0.197 | 500 | 25 |
| | PS (US, IS) [5] | M5 | 6 | 3/16 | 0.236 | 600 | 30 |

1) to be checked by test weldings

2) Information and recommendations on this can be found in **DIN EN ISO 14555.**

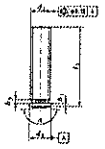
3) Information and recommendations on this can be found in **DIN EN ISO 13918.**

4) Shielding gas: 82 % Ar / 18 % $CO_2$

5) Information and recommendations on this can be found in **DIN EN ISO DVS 0902.**

## Determining welding current and welding time for welding gun A 12 and A 12-FL

for drawn arc stud welding without weld pool protection

| Welding elements<br>Material:<br>4.8 (suitable for welding) | | Diameter of welding elements | | | | Welding current [1)2)]<br>Visar 650<br>I in A | Welding time [1)2)]<br>Visar 650<br>t in ms |
|---|---|---|---|---|---|---|---|
| | | metric | | imperial (US) | | | |
| | | Stud diameter in mm | eff. diameter in mm | Stud diameter in inches | eff. diameter in inches | | |
| Material of workpiece: Mild steel (suitable for welding) | | | | | | | |
|  | | Ø $d_1$ | Ø $d_2$ | Ø $d_1$ | Ø $d_2$ | | |
| | PS (US, IS) [5)] | M3 | 4 | 1/8 | 0.157 | 400 | 10 |
| | PS (US, IS) [5)] | M4 | 5 | 5/32 | 0.197 | 600 | 15 |
| | PS (US, IS) [5)] | M5 | 6 | 3/16 | 0.236 | 600 | 25 |

1) to be checked by test weldings

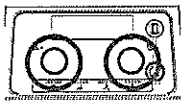
2) Information and recommendations on this can be found in **DIN EN ISO 14555**.

5) Information and recommendations on this can be found in **DVS 0902**.

## 12.3 Setting Welding Parameters

### Setting options

◆ You have the following options for setting the necessary welding parameters:



**Basic settings**

**Adjustable welding parameters:**

– Welding current (Ⓐ) and welding time (ms) using the two push/rotary buttons.

**GAS** **Shielding gas**

– Shielding gas selection or deselection via the "**GAS**" option in the manu navigation,
– Setting of the gas pre-flow and post-flow time in the menu navigation.

**SYN** **Synergic stud welding mode**

Selectable options: "Simple" mode and "Professional" mode

**Adjustable welding parameters in "Simple" mode:**

– Properties of the welding element (stud type, diameter, material)

**Adjustable welding parameters in "Professional" mode:**

– Properties of the welding environment (welding position)
– Properties of the welding element (stud shape: Standard / ISO / Custom-made, stud type, diameter, material)
– Properties of the workpiece (material, surface, workpiece thickness)
– Properties of the welding procedure (shielding gas / ceramic, welding according to standard: ISO / AWS / JIS, welding gun, temperature of the workpiece)

**MENU** **Program and system management**

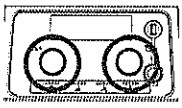
– Creating, saving and loading programs
– Optional: Locking program for changes
– Updates and special programs for creating QM documents
– Changing system settings (workpiece counter, measuring unit, language)

### Adjusting existing programs to local conditions

Using the "**ADV**" (advanced) option, saved programs can be adjusted and welding parameters can be documented.

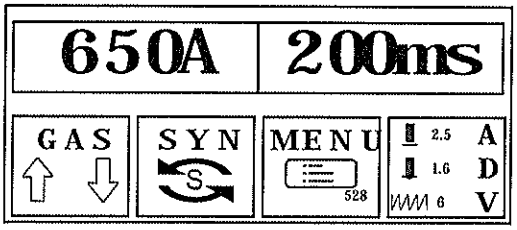
**Adjustable welding parameters:**

- Properties of the welding gun (lift, protrusion, spring force)
- Starting current adaption
- Process control
- Fine adjustment of the welding parameters (starting current, welding current tolerance range)



◆ Press both push/rotary buttons at the same time.

You can now have the preselected settings displayed:




◆ To do so, turn a push/rotary button to the right.

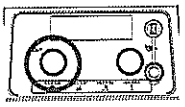
◆ To leave the display, turn a button to the left until <<<EXIT appears in the display.

◆ Press a button to confirm this selection.

### 12.3.1 Basic Settings

#### Setting welding current

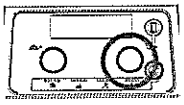
- **First determine the required welding current.**
- To do so, first read and follow *Section 12.2 "Determining welding current and welding time"*.



- Only now should you set the required welding current (Ⓐ) with the push/ rotary button.

#### Setting welding time

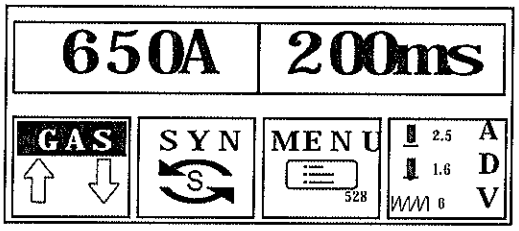
- **First determine the required welding time.**
- To do so, first read and follow *Section 12.2 "Determining welding current and welding time"*.



- Only now should you set the required welding time (ⓂⓈ) with the push/ rotary button.

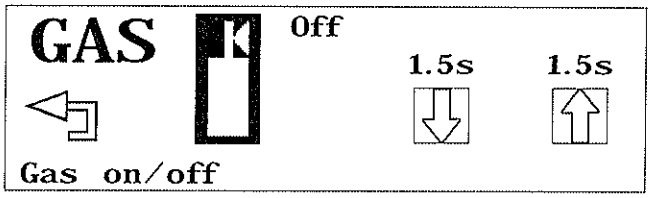
### The "GAS" option – shielding gas settings

- Press both push/rotary buttons at the same time.
- Select **GAS**.
- Press a button to confirm this selection.



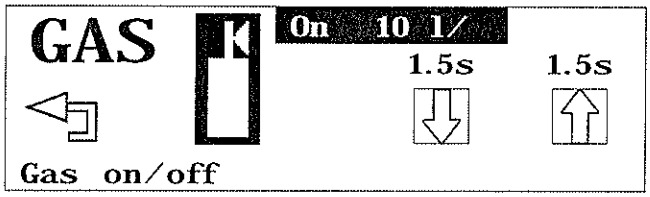

**Gas option:**

- Turn a button to the right and select the symbol.
- Press a button to confirm this selection.



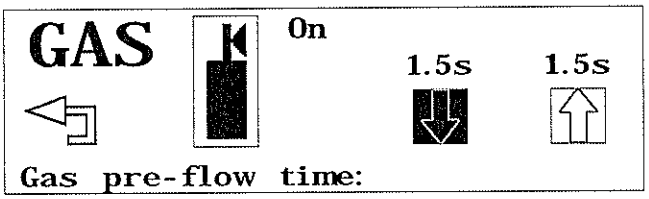

You can select or deselect the "GAS" option.

- To do so, turn a button to the right ("on") or the left ("off").
- Press a button to confirm this selection.



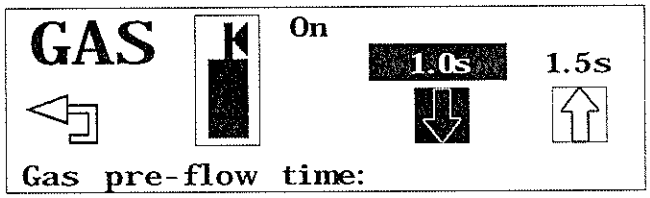
**Gas pre-flow time:**

- Turn a push/rotary button to the right and select the ⇩ symbol.
- Press a button to confirm this selection.



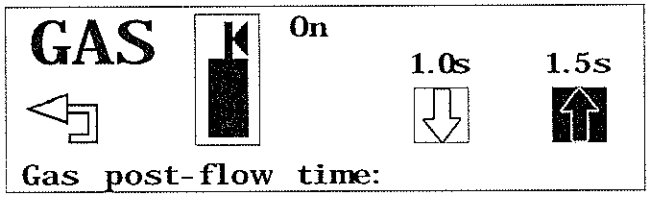

You can now directly set the gas pre-flow time.

- To do so, turn a button to the right ("more") or the left ("less").
- Press a button to confirm this selection.



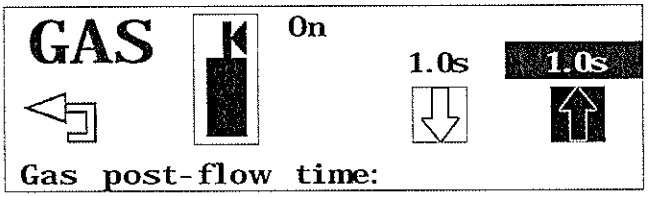

**Gas post-flow time:**

- Turn a push/rotary buttons to the right and select the ⇧ symbol.
- Press a button to confirm this selection.

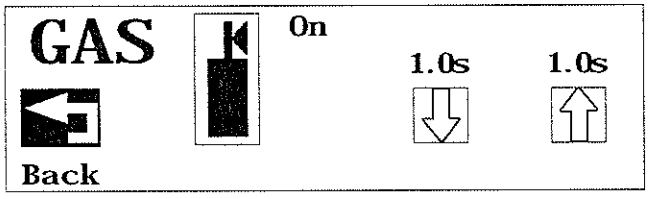



You can now directly set the gas post-flow time.

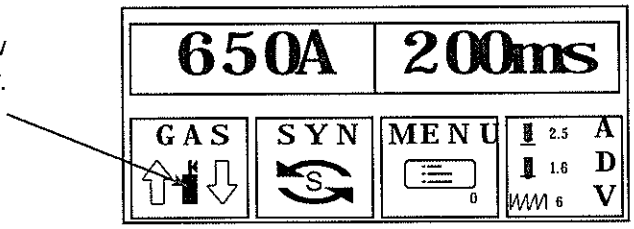
- To do so, turn a button to the right ("more") or the left ("less").
- Press a button to confirm this selection.




- Turn a button to the left to "Back" to leave the "GAS" option menu.
- Press a button to confirm this selection.

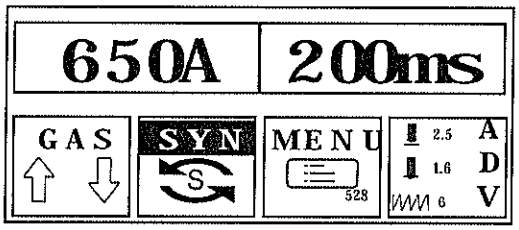



The "GAS" option now appears in the display.



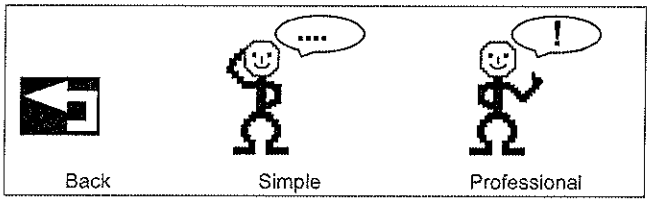
### 12.3.2 SYN Setting – "Synergic Stud Welding Mode"

- Press both push/rotary buttons at the same time.
- Select **SYN**.
- Press a button to confirm this selection.



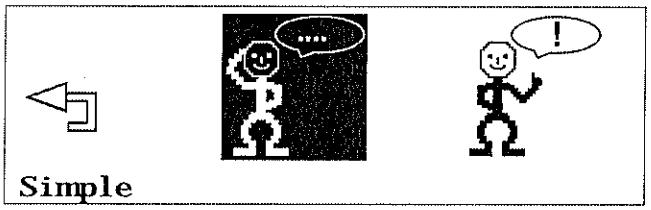

You can now select between the "Simple" or "Professional" modes.

- To do so, turn a button to the right.
- Press a button to confirm this selection.



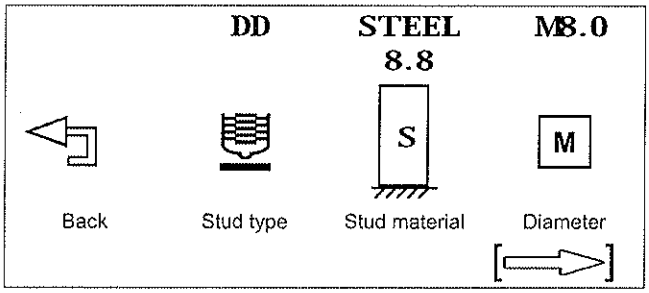

**"Simple" mode**

- Turn a push/rotary buttons to the right to the "Simple" symbol.
- Press a button to confirm this selection.




You can now define the properties of the welding elements.

- To do so, turn a button to the right.
- Press a button to confirm this selection.



The following selection options are available:

| - Stud type | | | | - Diameter (welding range) (metric) | (imperial) |
|---|---|---|---|---|---|
| DD [1] |  | DD_CF [2] |  | M6 to M8 | #00 to 5/16" |
| PD [1] |  | PD_CF [2] |  | M6 to M8 | #00 to 5/16" |
| RD [1] |  | RD_CF [2] |  | M6 to M10 | #00 to 5/16" |
| UD [1] |  | UD_CF [2] |  | 6 mm to 8 mm | 0.048" to 0.313" |
| ID [1] |  | ID_CF [2] |  | M5 | #00 to 5/16" |
| SD [1] |  | SD_CF [2] |  | 9.5 mm | 0.048" to 0.313" |
| PS |  | PT |  | M3 to M6 | #00 to 5/16" |
| US |  | UT |  | 3 mm to 6 mm | 0.048" to 0.313" |
| IS |  | IT |  | M3 to M4 | #00 to 5/16" |

[1] for stud welding with shielding gas or without weld pool protection
[2] for stud welding with ceramic ferrule (CF)

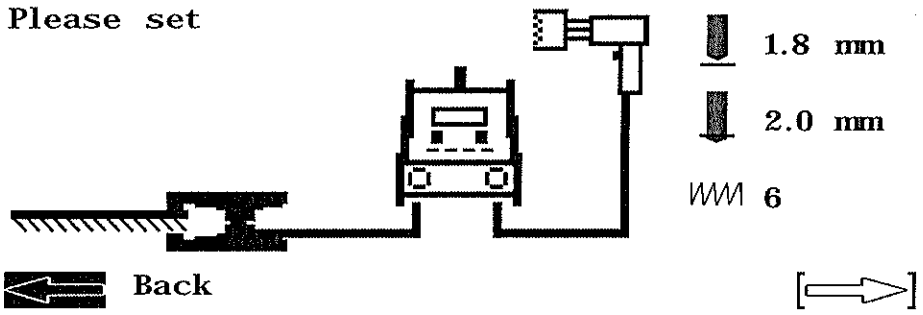
– **Stud material**

4.8 (S235), 5.8 (S355), 6.8, 8.8, A2-50 (1.4301), A4-50 (1.4571), 16Mo3, AlMg3 (5754), AlMg4.5, Al99.5, AlSi12

◆ Select the stud material, the welding range and the stud material in accordance with your welding task.

### Setting welding gun

◆ Now set the lift, insertion depth and spring force parameters in accordance with the display on your welding gun:




☞ ◆ To do so, read the operating manual of your welding gun.

Use the ⇨ arrow to end the "Simple" mode.

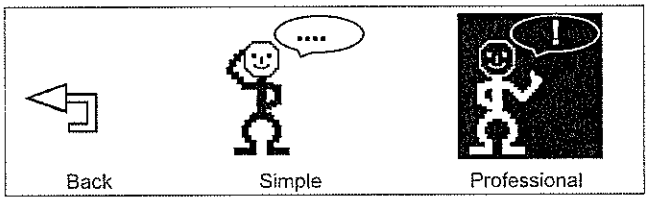
☞ If you would like to weld with shielding gas, you must switch the GAS option back on now.

◆ To do so, proceed as described in *Section 12.3.1 Basic settings, sub-section The "GAS" option – shielding gas settings.*

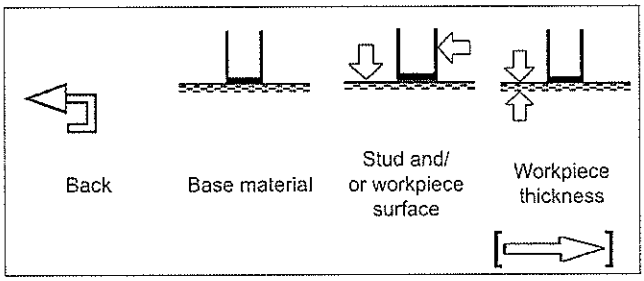
### "Professional" mode

Additional parameters can be defined in "Professional" mode.

- To do so, turn a push/rotary buttons to the right to the "Professional" symbol.
- Press a button to confirm this selection.



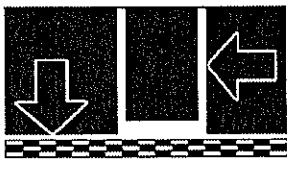

- Now select the workpiece properties in accordance with your task:




**– Base material and stud material – combination options:**

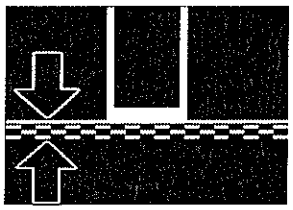
| Base material: | | Stud material: | |
|---|---|---|---|
|  | Stahl S235 / Stahl S355 / DC01, Usibor |  | 4.8 (S235) / Steel 5.8 / Steel 6.8 / Steel 8.8 |
| | 16Mo3 | | 16Mo3 |
| | 1.4301 | | A2-50 (1.4301) |
| | 1.4541 - 1.4571 | | A4-50 (1.4571) |
| | AlMg3, AlMg4.5, Al99 | | AlMg3 (5754), AlMg4.5, Al99.5, AlSi12 |

**– Stud and/or workpiece surface:**

| | |
|---|---|
|  | Bare |
| | Galvanized *) |
| | Nickel-plated *) |
| | Copper-plated *) |
| | Oiled |
| | Primered |

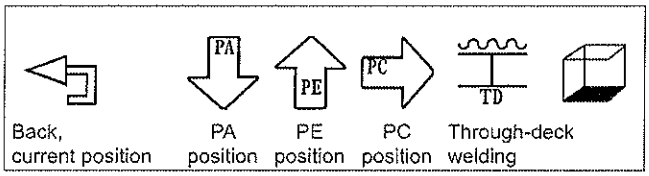
*) Galvanised surface ≤ 7 µm

– **Workpiece thickness:**

| | | |
|---|---|---|
|  | From 0.5 mm | Up to 200.0 mm |

Use the  arrow to get to the next selection window.

◆ Now select the welding position in accordance with your welding task:




The following selection options are now available:

**- Welding position**

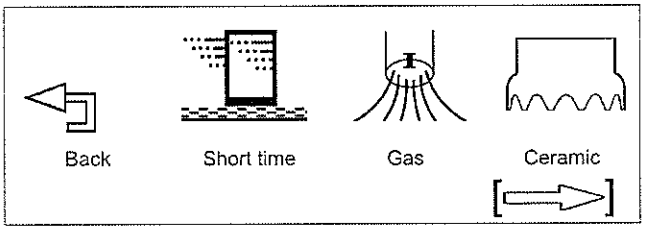
| | | |
|---|---|---|
| PA position (flat position) |  |  |
| PE position (overhead position) |  |  |
| PC position (horizontal position) |  |  |
| Through-deck welding |  |  |

◆ Select a welding position.

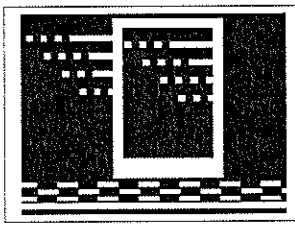
◆ To do so, turn a push/rotary button to the right.

◆ Press a button to confirm this selection.

◆ Now select the welding procedure in accordance with your welding task:



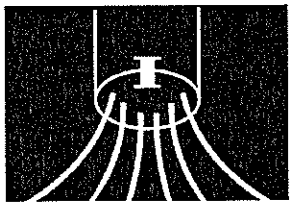

– Short time:



| |
|---|
| On |
| Off |

Optimisation of the welding time when adjusting the welding current

– **Gas / Shielding gas option:**



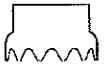
| |
|---|
| Off |
| 100Ar |
| 98AR/2$CO_2$ |
| 95AR/5$CO_2$ |
| 92AR/8$CO_2$ |
| 90AR/10$CO_2$ |
| 82AR/18CO2 |
| 85Ar/15He |
| 70Ar/30He |

Aluminium, very thin metal sheets

Steel, stainless steel

Aluminium, thicker metal sheets

– **Ceramic / Welding with ceramic ferrule**



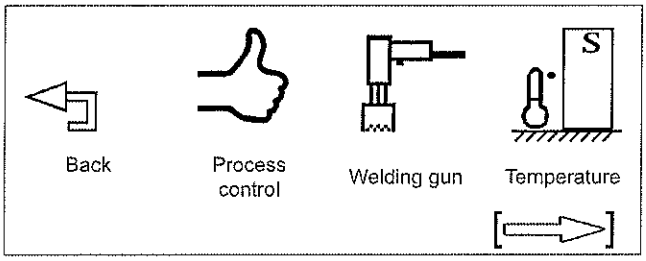
| |
|---|
| PA |
| No ceramic |

Welding with ceramic ferrule only in PA position (flat position)

Welding without ceramic ferrule

Use the  arrow to get to the next selection window.

◆ Now select the work environment in accordance with your welding task:




– **Process control:**

| | |
|---|---|
|  | Off |
| | On |

The process control set via SYN is a real-time process control. Deviations from set tolerances are signalled immediately after welding; corrective measures can be initiated.

◆ For further information, see section 8.4 *"Process control"*.

**Setting the welding process control for reference welds (learning phase)**

This is how you activate the control:

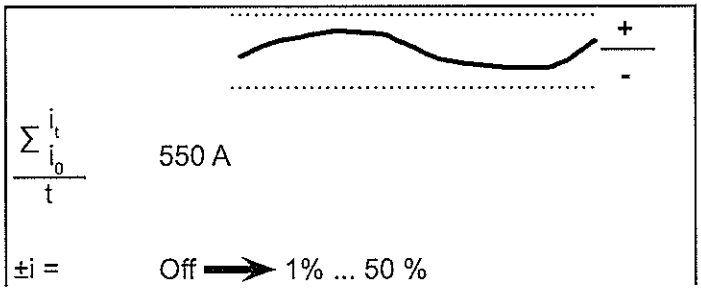
◆ Turn a pushbutton/knob to the right to the "Process control"  symbol.

◆ Select "Process control – On".

◆ Press a pushbutton/knob to confirm this selection.

◆ Now define your tolerances:

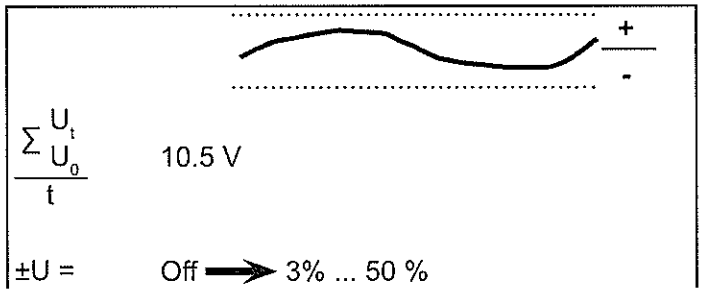
### Defining welding current tolerances




Welding current tolerance

◆ Define your welding current tolerances.

### Defining voltage tolerances

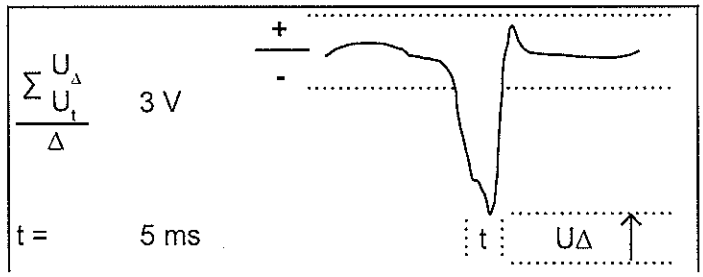



Voltage set value

Voltage tolerance

◆ Define your voltage tolerances.

### Defining transient voltages

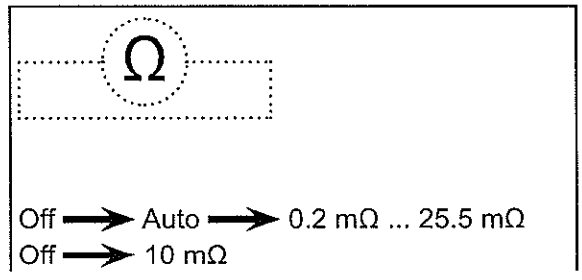



Voltage peak

Voltage acquisition time

◆ Define the tolerances for the transient voltage.

### Defining the resistance of the circuit



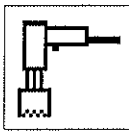

Resistance of the circuit

Resistance tolerance

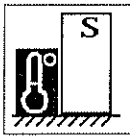
◆ Define the resistance of the circuit.

◆ Now select the extended work environment in accordance with your welding task:

– **Welding gun:**

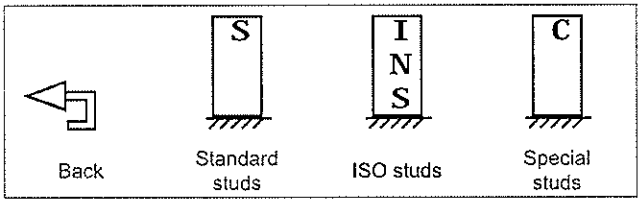
| | |
|---|---|
|  | A 12 |
| | A 12-FL |

– **Temperature of the workpiece:**

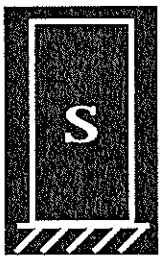
| | |
|---|---|
|  | From 0 °C / 32 °F To 800 °C / 1472 °F |

Use the  arrow to get to the next selection window.

◆ Now select the welding element in accordance with your welding task:




The following selection options are available:



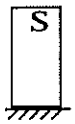
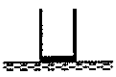

| Standard studs | | | | | |
|---|---|---|---|---|---|
| - Stud type | | | | - Diameter (welding range)<br>metric: Ø / M or<br>imperial: Ø / 1" | |
| DD [1] |  | DD_CF [2] |  | M6 to M8 or | #00 to 5/16" |
| PD [1] |  | PD_CF [2] |  | M6 to M8 or | #00 to 5/16" |
| RD [1] |  | RD_CF [2] |  | M6 to M10 or | #00 to 5/16" |
| UD [1] |  | UD_CF [2] |  | 6 mm to 8 mm or | 0.048" to 0.313" |
| ID [1] |  | ID_CF [2] |  | M5 or | #00 to 5/16" |
| SD [1] |  | SD_CF [2] |  | 9.5 mm or | 0.048" to 0.313" |
| PS |  | PT |  | M3 to M6 or | #00 to 5/16" |
| US |  | UT |  | 3 to 6 mm or | 0.048" to 0.313" |
| IS |  | IT |  | M3 to M4 or | #00 to 5/16" |

[1] for stud welding with shielding gas or without weld pool protection
[2] for stud welding with ceramic ferrule (CF)

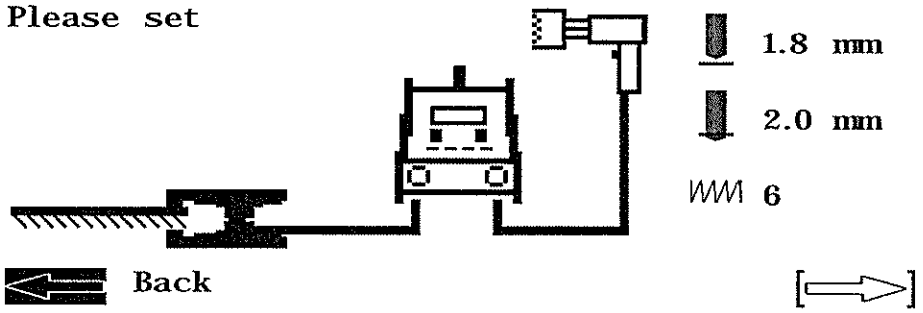
| ISO studs | | | |
|---|---|---|---|
| **- Stud type (design)** | | **- Basis and welding range (diameter or surface)** | |
| ISO-1 |  |  (Basis: Ø):  0.5 mm to 10.0 mm |  (Basis: Surface):  0.8 mm² to 31.2 mm² |
| ISO-2 |  | | |
| ISO-3 |  | | |
| ISO-4 |  | | |
| ISO-5 |  | | |

| Special studs | | |
|---|---|---|
| **- Stud type** | | **- Diameter (welding range)** |
| C1 |  |  (Basis: Surface): 0.8 mm² to 56.7 mm² |
| C2 |  | |
| C3 |  | |
| C4 |  | |
| C5 |  | |

**– Stud material and base material – combination options:**

| Stud material: | | Base material: | |
|---|---|---|---|
|  | 4.8 (5235) / Steel 5.8 / Steel 6.8 / Steel 8.8 |  | Steel S235 / Steel S355 / DC01, Usibor |
| | 16Mo3 | | 16Mo3 |
| | A2-50 (1.4301) | | 1.4301 |
| | A4-50 (1.4571) | | 1.4541 - 1.4571 |
| | AlMg3 (5754), AlMg4.5, Al99.5, AlSi12 | | AlMg3, AlMg4.5, Al99 |

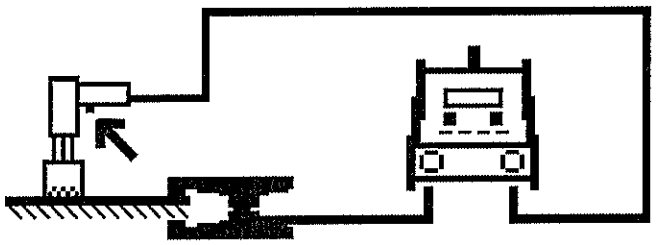
◆ Now set the lift, insertion depth and spring force parameters in accordance with the display on your welding gun:




◆ To do so, read the operating manual of your welding gun.

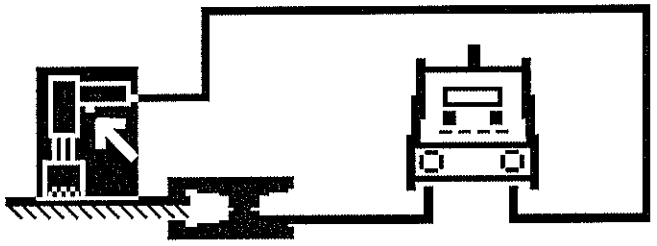
Use the [⇒] arrow to enter the Teach-in mode.

### Teach-in mode

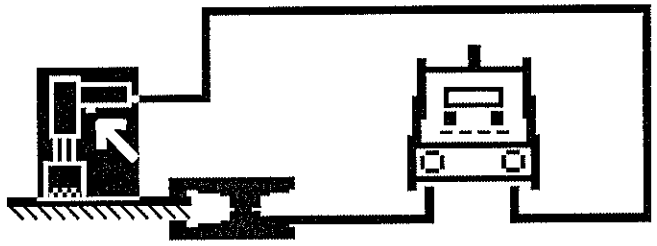



◆ Turn a push/rotary button to the right.

Teach-in mode starts:




◆ Press a button to confirm this selection.




◆ Set the welding gun on the workpiece **without the welding element** and press the gun button.

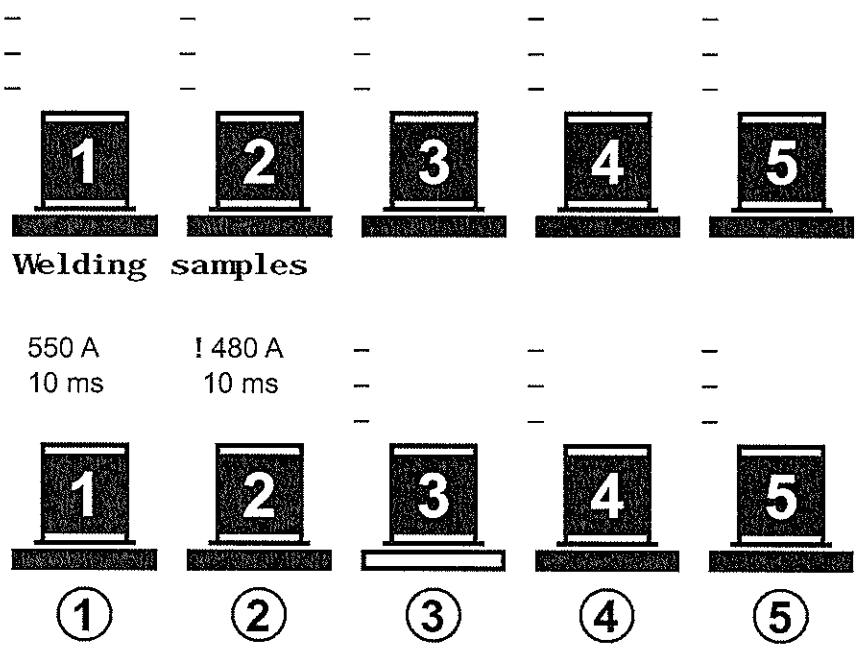
The welding time is now set to the welding gun and the previously set parameters.

Use the  arrow to abort the Teach-in mode.

### Performing reference welds

◆ Now perform your reference welds.

The progress of the welds is displayed:




① Welding was successful. The actual values are within the defined tolerances.

② Welding was not successful. The tolerance deviation is indicated with a !. The stud welding unit is locked.

After pressing the gun button for a longer period of time (> 2 seconds), the stud welding machine is again ready for welding.

③ The lower bar flashes. This weld is now pending.

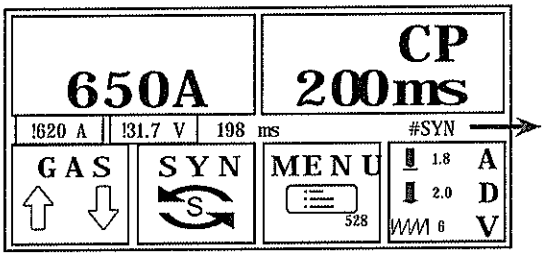
④ This reference weld was not yet performed.

⑤ This reference weld was not yet performed.

☞ ◆ If, for a weld that has already been performed, you determine that the tolerances are not maintained due to external influences, you can delete this welding result and repeat the weld.

### Display of deviations from the tolerances in the actual welding process

If the set tolerance range is not maintained, the system shows the deviation in the display:




| | |
|---|---|
| #SYN | The set parameters are on the stored characteristic curve |
| %SYN | Characteristic curve values were adapted to the settings |
| !SYN | Strong deviations from stored characteristic curve → Check settings! |

The triggering of another weld is blocked.

Only after pressing the gun button for a longer period of time (> 2 seconds) is the stud welding machine again ready for welding.

**HBS recommendation:**

◆ First set all parameters in synergy mode.

The device determines the recommended welding parameters from these settings.

◆ Then perform test welds.

If the welding results meet your requirements, we recommend saving these settings as a job. You then have the option of creating documentation or oscillograms.

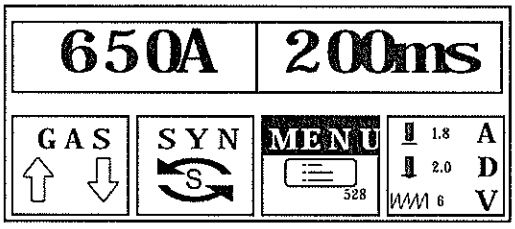
◆ Proceed as described in the following.

◆ Switch on process control only after doing this.

You thereby prevent unwanted deviations.

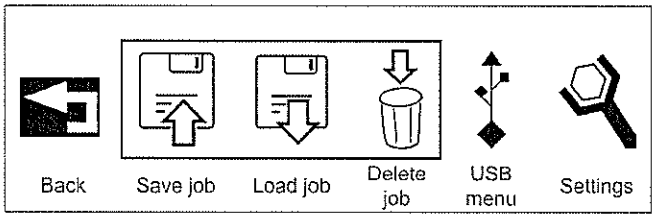
### 12.3.3 The "Menu" Option – Program and System Management

- Press both push/rotary buttons at the same time.
- Select **MENU**.
- Press a button to confirm this selection.



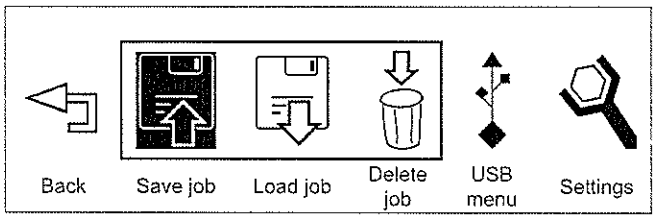

You can now select between the "Save job", "Load job" or "Delete job" modes. The "USB menu" and "Settings" options are also available here.

- Turn a push/rotary button to the right.
- Press a button to confirm this selection.



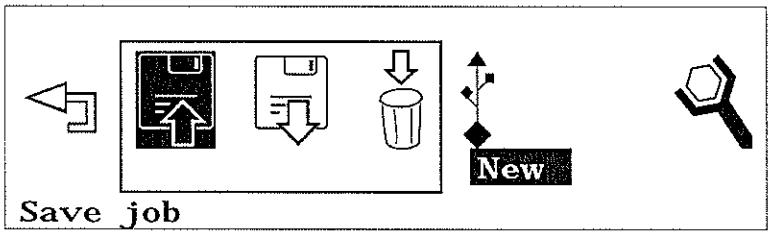

**Saving programs**

- Turn a push/rotary button to the right to the "Save job" symbol.




- Press a button to confirm this selection.

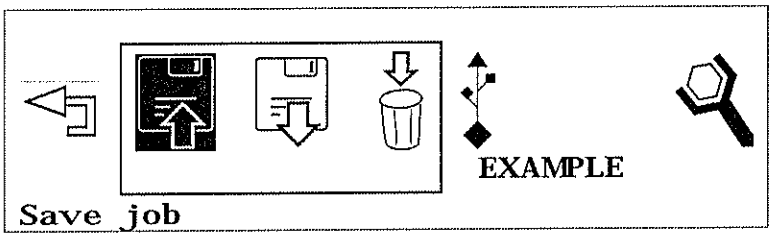
In the display, the note "New" appears next to the "USB menu" symbol:




- Press a button to confirm this selection.

An entry window now appears. Use the button (turn to the left or right) to select numbers and letters to name the program.

- Press a button to confirm this selection.
- Turn the button completely to the left until the ⏎ symbol appears to delete the last entry.
- Turn the button all the way to the right until the ⏎ symbol appears to end the entry process.
- Press a button to confirm this entry:

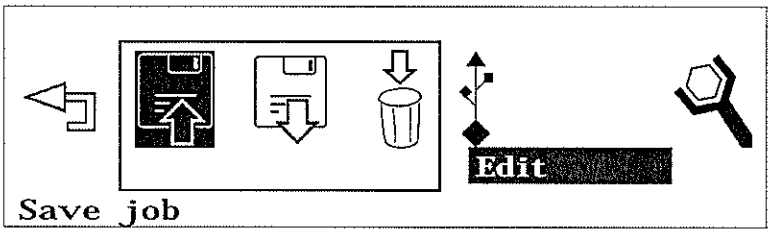



- You can assign a name with **up to eight characters** for your settings.

Use the ⏎ arrow to end the "Save job" mode.

### Changing program name

◆ Turn a push/rotary button to the right until "Edit" appears in the display.

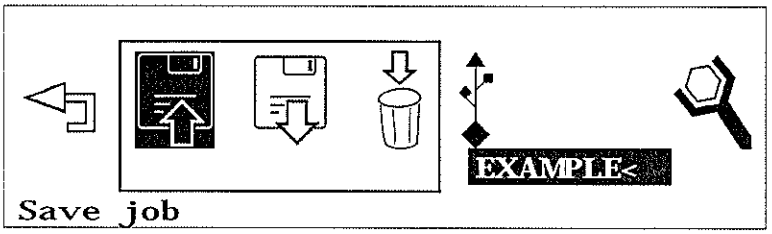



◆ Press a button to confirm this selection.

◆ Turn a button to the right and select the program that you would like to rename.

◆ Press a button to confirm this selection.

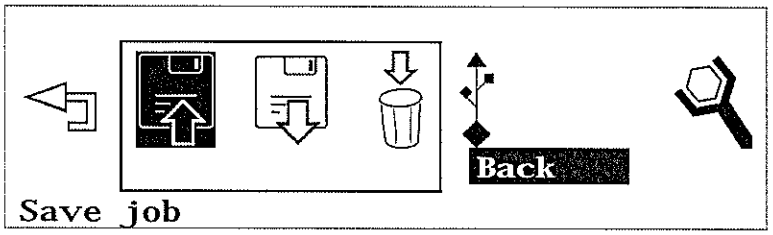
You can now change an already-assigned program name:




◆ Turn the button completely to the left until the ⏎ symbol appears to delete the last entry.

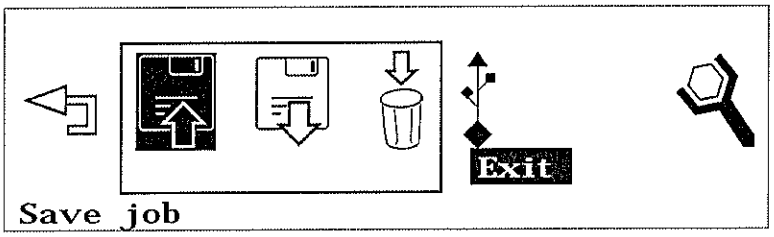
◆ Turn the button all the way to the right until the ⏎ symbol appears to end the entry process.

◆ Turn the button all the way to the left until "Back" appears in the display to leave the "Edit" menu without making changes.




◆ Press a button to confirm this selection.

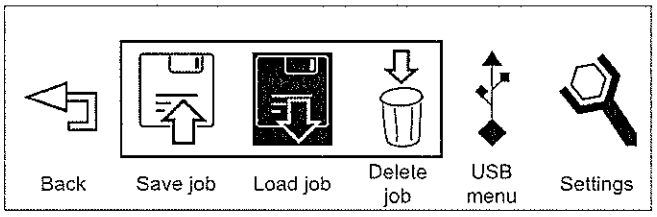
- Turn the push/rotary button all the way to the right until "Exit" appears in the display to end the "Save job" menu.




- Press a button to confirm this selection.

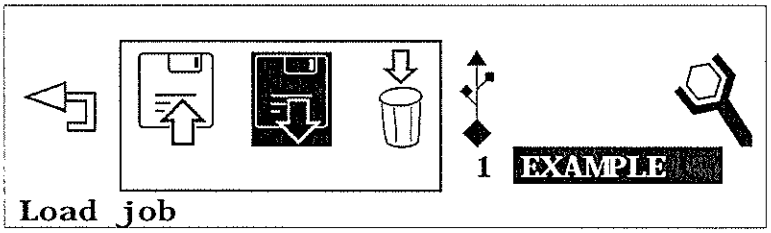
### Loading saved programs

◆ Turn a push/rotary button to the right to the "Load job" symbol.




◆ Press a button to confirm this selection.

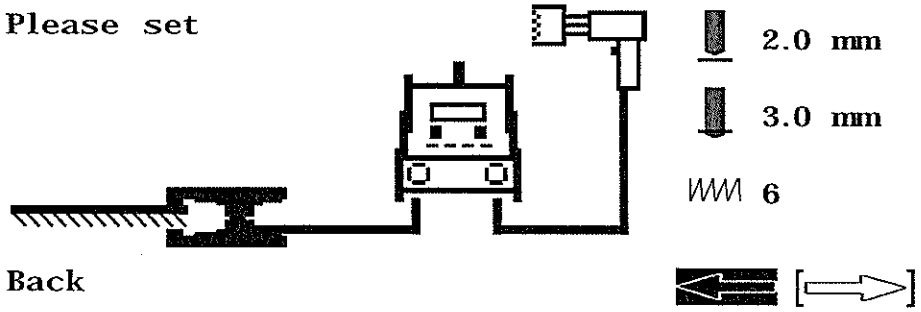
All previously saved programs now appear in the display:




◆ Turn a button to the right to display additional programs.

◆ Press a button to confirm the selection.

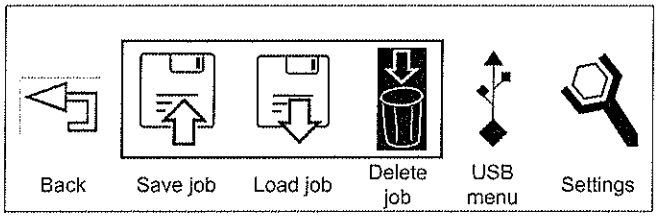
◆ Now set the lift and spring force settings in accordance with the display on your welding gun:




Use the [⇨] arrow to end the "Menu" option.

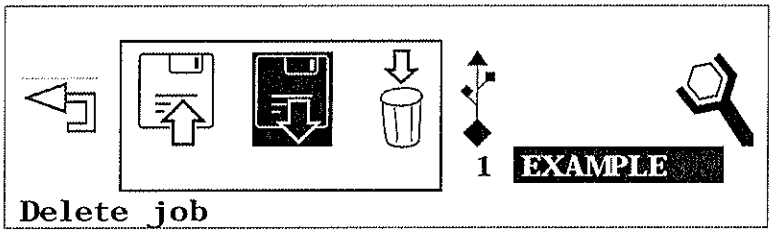
### Deleting program

◆ Turn a push/rotary button to the right to the "Delete job" symbol.




◆ Press a button to confirm this selection.

The first available program appears in the lower right section of the display:




◆ Turn a button to the right to display additional programs.

◆ Press a button to confirm the selection.

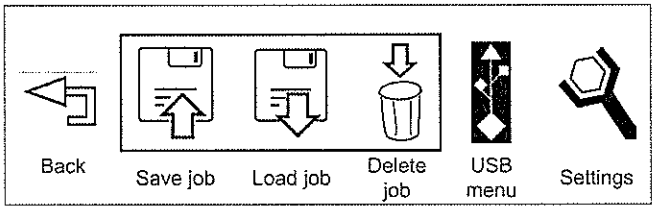
**Deleted programs cannot be recovered!**

Use the  arrow to end the "Delete job" mode.

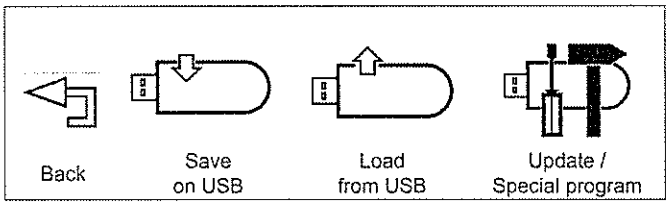
### The USB menu

This menu can be operated **only if the USB stick is inserted.**

- Turn a push/rotary button to the right to the "USB menu" symbol.
- Press a button to confirm this selection.



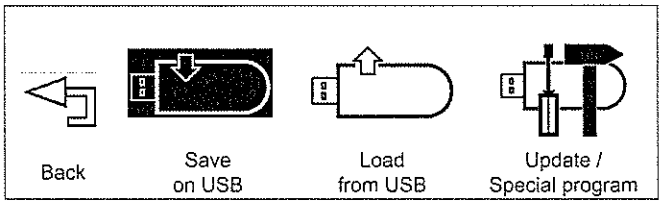

The following selection options are now available:



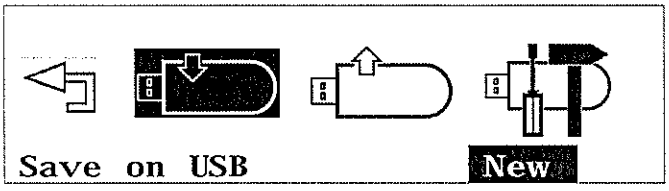

### Saving settings on a USB stick

In this menu, you can save programs on a USB stick.

- Turn a push/rotary button to the right to the "Save on USB" symbol.
- Press a button to confirm this selection.




The note "New" appears in the lower right section of the display:

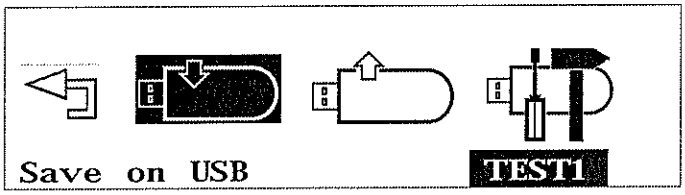



- Press a button to confirm this selection.

An entry window now appears. Use the button (turn to the left or right) to select numbers and letters to name the program.

- Press a button to confirm this selection.

- Turn the push/rotary button completely to the left until the ⏎ symbol appears to delete the last entry.
- Turn the button all the way to the right until the ⏎ symbol appears to end the entry process.
- Press a button to confirm this entry:

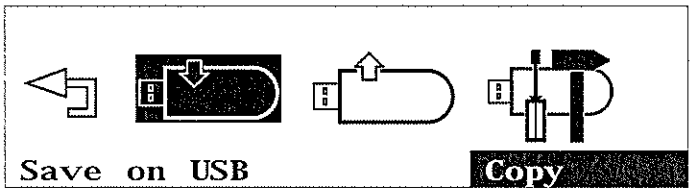



☞ ◆ You can assign a name with **up to eight characters** for your program.

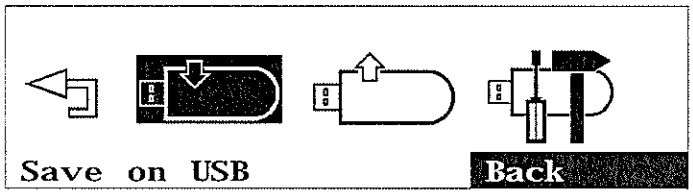
Use the ⏎ arrow to end the "Save on USB" mode.

### Copying saved programs onto a USB stick

- Turn a push/rotary button to the right until "Copy" appears in the display.

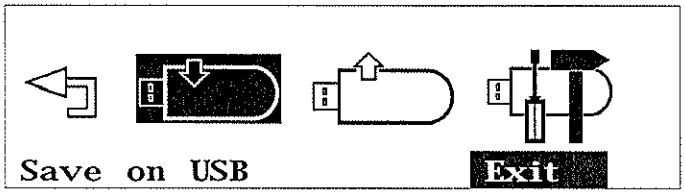



- Press a button to confirm this selection.
- Turn a button to the right and select the program that you would like to copy onto a USB stick.
- Turn the button all the way to the left until "Back" appears in the display to leave the "Copy" menu without making changes.




- Press a button to confirm this selection.

- Turn the button all the way to the right until "Exit" appears in the display to end the "Save on USB" menu.

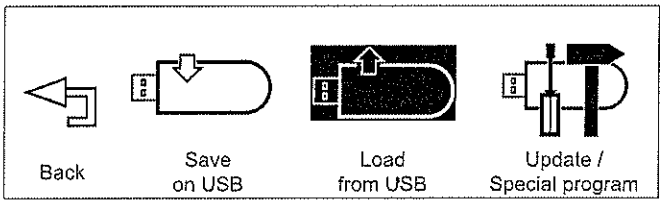



- Press a button to confirm this selection.

### Loading programs from a USB stick

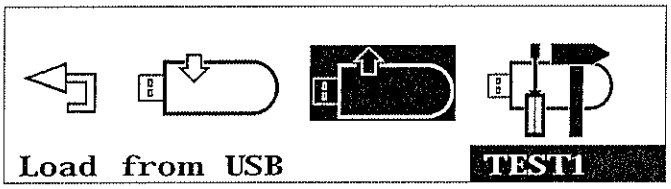
In this menu, you can load programs from a USB stick.

◆ Turn a push/rotary button to the right to the "Load from USB" symbol.

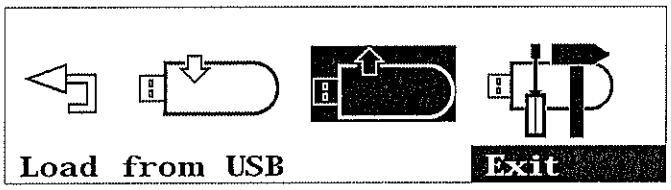



◆ Press a button to confirm this selection.

The first available program appears in the lower right section of the display:



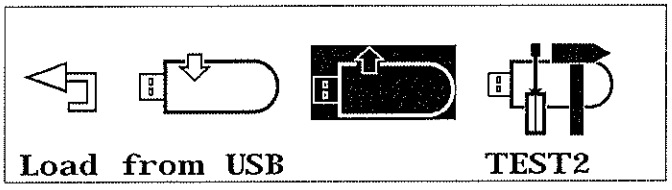

◆ Turn the button all the way to the right until "Exit" appears in the display to end the "Load from USB" menu without loading a program.



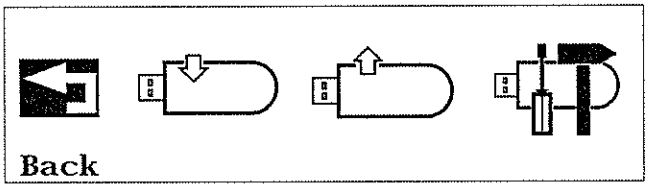

◆ Press a button to confirm this selection.

◆ Turn a button to the right and select the program that you would like to load from the USB stick.

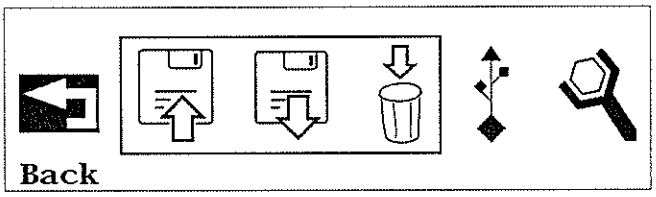
◆ Press a button to confirm this selection.

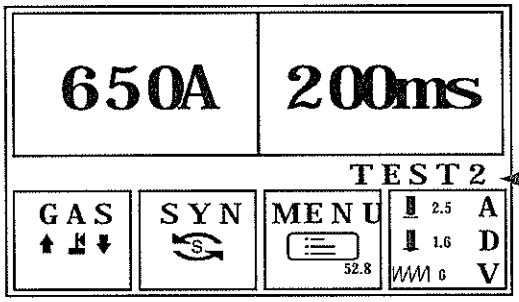


- Turn a push/rotary button to the left to the "Back" symbol to end the "USB menu".
- Press a button to confirm this selection.




- Turn a button to the left to the "Back" symbol to end the "Menu" option.
- Press a button to confirm this selection.




The loaded program now appears in the display.

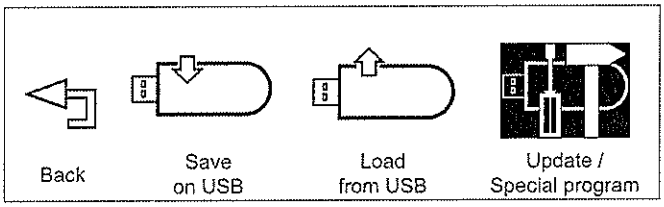
**The program is reset as soon as settings are changed using the push/ rotary buttons. The welding program must then be reloaded.**

Optionally, special programs can be loaded which lock the buttons to prevent unintentional changes to the welding parameters.

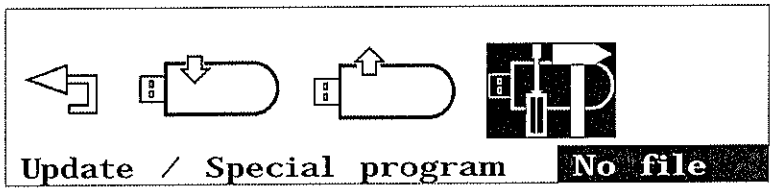
- Ask your application consultant for more information.

### Update / Special programs (optional)

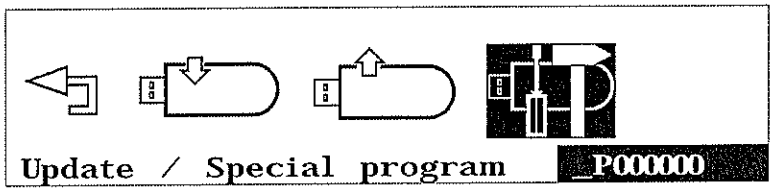
- Turn a push/rotary button to the right to the "Update" symbol.
- Press a button to confirm this selection.




If there is no update available, the following display appears:



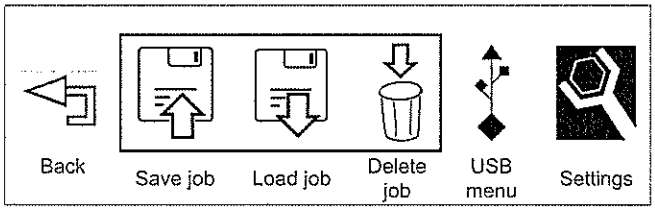

Please follow the instructions in the display for updates:



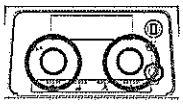

Updates and additional programs will be sent and explained by HBS as needed.

Use the  arrow to end the "Update / Special program" mode.

### Settings

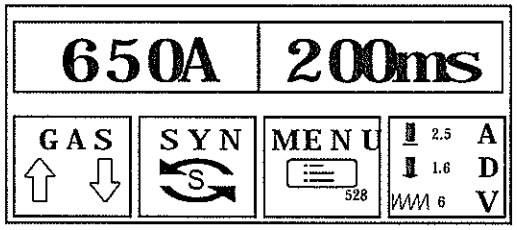



In this menu, you can set the stud welding machine in accordance with your work environment.



◆ Press both push/rotary buttons at the same time.

You can now have the preselected settings displayed:




◆ Turn a button to the right to the MENU symbol.

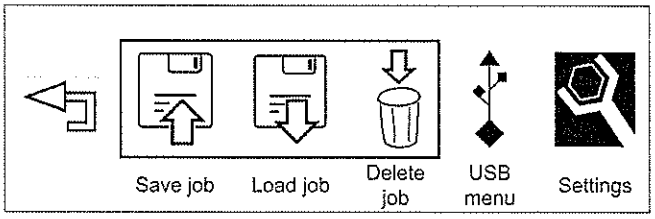
◆ Press a button to confirm this selection.

The following system settings are possible:

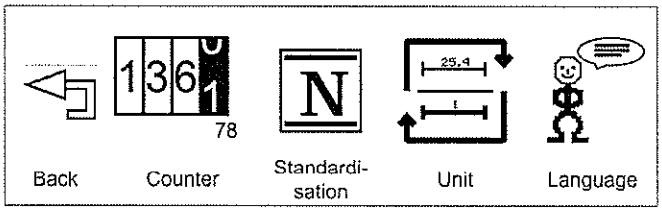
- Workpiece counter
- Standardisation (ISO, AWS, JIS)
- Unit: metric (mm) / imperial (inch)
- Language.

◆ Turn a push/rotary button to the right to the "Settings" symbol.

◆ Press a button to confirm this selection.



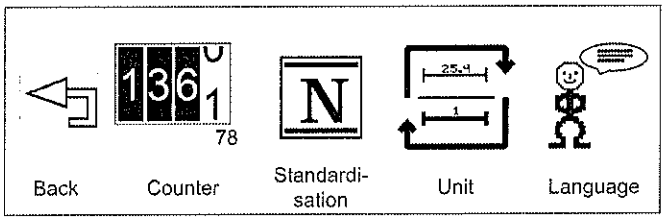

The following selection options are now available:



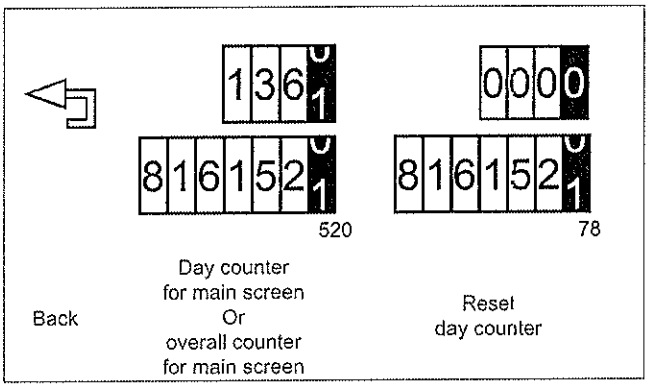
### Counter

In this menu, you can reset the counter for performed weldings or display it in the main menu:

- Turn a push/rotary button to the right to the "Counter" symbol.
- Press a button to confirm this selection.

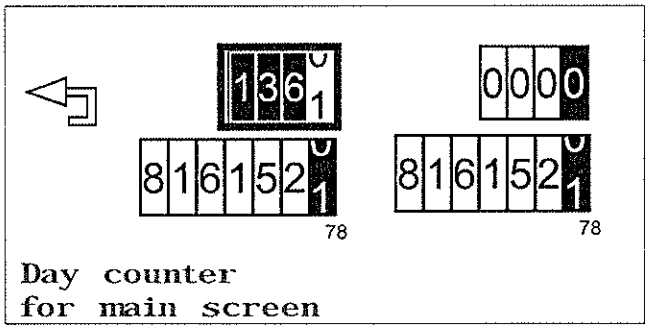



The following selection options are now available:

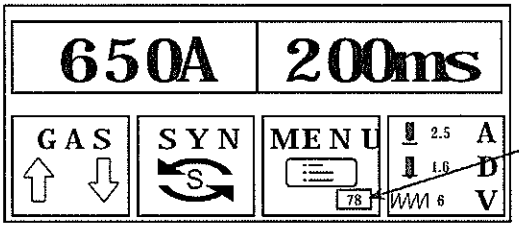


### Day counter for main screen

- Turn a push/rotary button to the right to the "Day counter for main screen" symbol.
- Press a button to confirm this selection.




Use the ⮌ arrow to end the "COUNTER" mode.

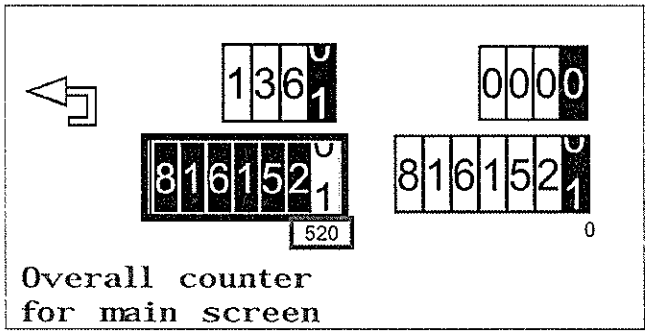



The day counter now appears in the display.

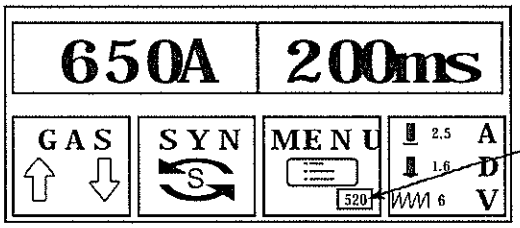
### Overall counter for main screen

- Turn a push/rotary button to the right to the "Overall counter for main screen" symbol.
- Press a button to confirm this selection.

The overall number of weldings appears in the lower right section.




Use the ⮌ arrow to end the "COUNTER" mode.

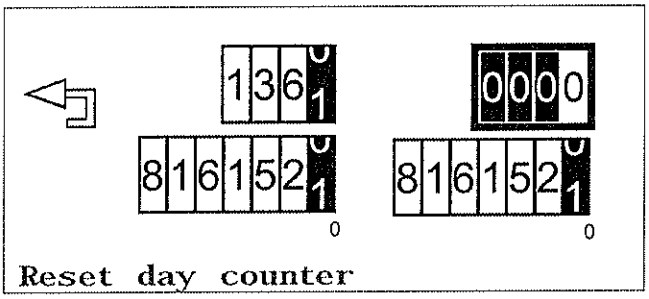



The overall counter now appears in the display.

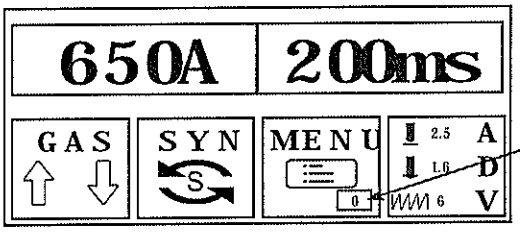
### Resetting day counter

- Turn a push/rotary button to the right to the "Reset day counter" symbol.
- Press a button to confirm this selection.

The day counter is now reset to zero.




Use the ◁ arrow to end the "COUNTER" mode.

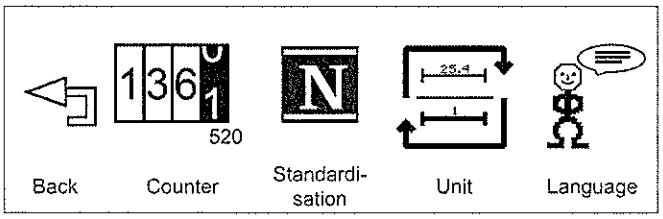



The day counter now shows "0" in the display.

### Standardisation

In this menu, you can preselect the standard according to which welding will be performed.

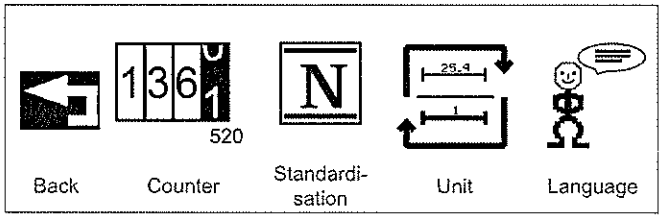
- ◆ Turn a push/rotary button to the right to the "Standardisation" symbol.
- ◆ Press a button to confirm this selection.



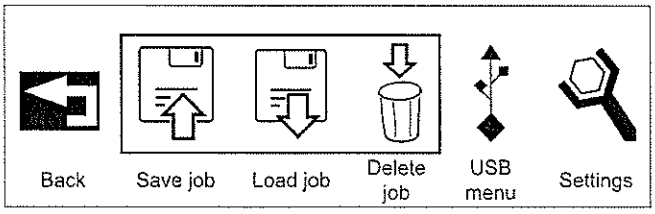

The following standard settings are possible:

- ISO: worldwide standard
- AWS: US national standard (American Welding Society)
- JIS: national standard in Japan

- ◆ Turn a button to the left to the "Back" symbol to end the "Standardisation" menu.
- ◆ Press a button to confirm this selection.




- ◆ Turn a button to the left to the "Back" symbol to end the "Settings" option.
- ◆ Press a button to confirm this selection.

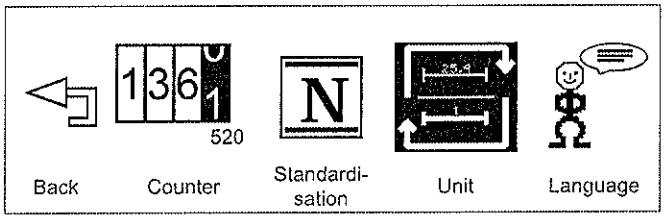



The following settings are now based on the set standardisation.

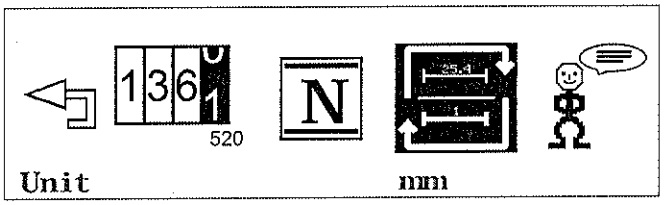
**Unit**

In this menu, you can set the measuring unit from mm to inch.

- Turn a push/rotary button to the right to the "Unit" symbol.
- Press a button to confirm this selection.

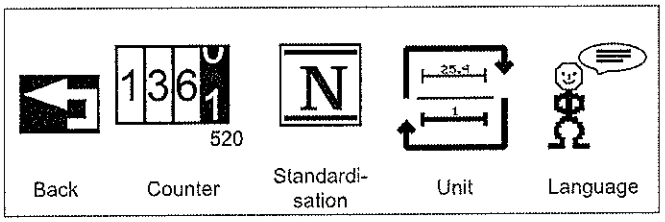



The last set measuring unit now appears in the display:

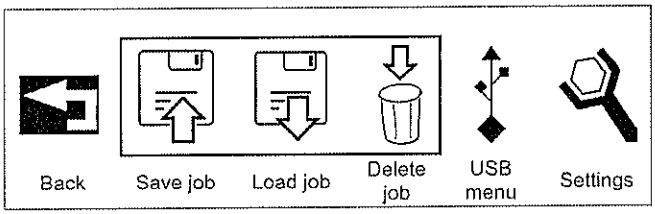



- Turn a button to the right or left and select "mm" or "inch".
- Press a button to confirm this selection.

- Turn a button to the left to the "Back" symbol to end the "Unit" menu.
- Press a button to confirm this selection.



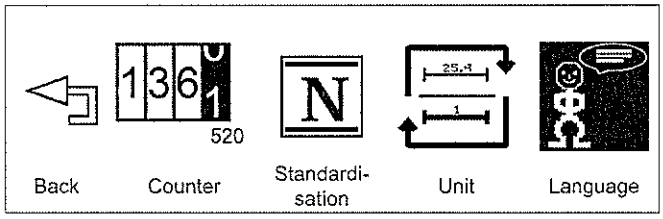

- Turn a button to the left to the "Back" symbol to end the "Settings" option.
- Press a button to confirm this selection.




The diameter specifications in the following menus now appear in the set measuring unit.

### Changing language

- ◆ Turn a push/rotary button to the right to the "Language" symbol.
- ◆ Press a button to confirm this selection.




You can now change the menu language.

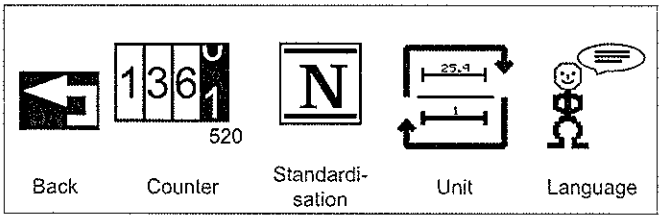
Here are some examples of possible languages [1]:

- German
- English
- Italian

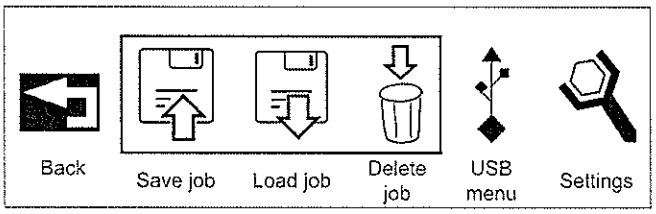
[1] Additional languages on request

- ◆ Turn a button to the right or left and select your language.
- ◆ Press a button to confirm this selection.

- ◆ Turn a button to the left to the "Back" symbol to end the "Language" menu.
- ◆ Press a button to confirm this selection.




- ◆ Turn a button to the left to the "Back" symbol to end the "Settings" option.
- ◆ Press a button to confirm this selection.




The menu now appears in the set language.

### 12.3.4 The "ADV" Option – Adjusting Process Parameters

Based on your inputs, the system uses algorithms stored to calculate various welding parameters that are necessary for the welding process. In ADV mode you have the opportunity to optimise these welding parameters on.

In addition, the ADV mode offers the possibility of traceability of each individual weld for your documentation.

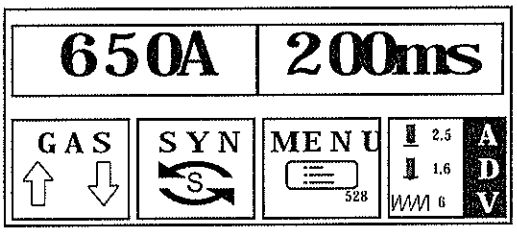
**Adjustable welding parameters:**

- Properties of the welding gun (lift, protrusion, spring force)
- Starting current adjustment
- Process control
- Fine adjustment of the welding parameters (starting current, welding current tolerance range).

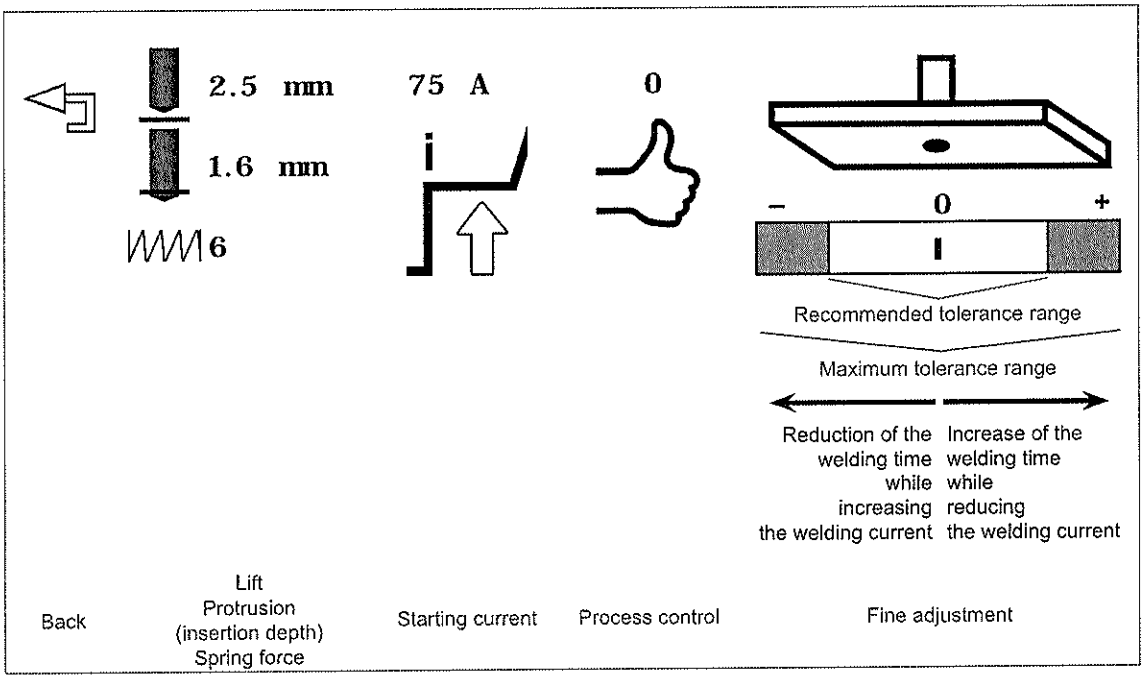
◆ Press both push/rotary buttons at the same time.

◆ Select ADV.

◆ Press a button to confirm this selection.




The following selection options are now available:



| Parameter | Setting range |
|---|---|
| Lift | 0.3 mm to 10 mm |
| Protrusion | 0 mm to 5.0 mm |
| Spring force | 0 to 10 |
| Starting current | 25 A to 650 A *) |
| Process control | On / Off |
| Fine adjustment | -20 to +20% *) |

*) Depending on the setting parameters, but up to max. 650 A or 200 ms.

- Turn a push/rotary button to the right to the respective symbol.
- Press a button to confirm this selection.


### Adjusting pre current

At the start of the welding process, the welding element (stud) is lifted into the welding gun by a lift mechanism (solenoid) and a low-power auxiliary electric arc (pilot arc) is ignited by the activated pre current.

- ◆ Correct the pre current in the event of the following errors:
  - The melt is only welded in dot-like manner; the stud only "sticks" to the workpiece.

    Cause: The auxiliary electric arc may be too strong, i.e., after lifting the welding element, the front of the welding element was melted, leading to a drop short-circuit and extinguishing of the auxiliary electric arc.

☞ A lift that is set too low can also cause the auxiliary electric arc to extinguish.

- ◆ Therefore, check the lift of the welding gun before adjusting the pre current.

  - The stud shows strong spatter rings around the weld.

    Cause: The auxiliary electric arc may be too weak, i.e., the electric arc breaks off during lifting. The front of the welding element and/or the surface of the workpiece are not sufficiently melted.

☞ A lift that is set too large can also cause the auxiliary electric arc to extinguish.

- ◆ Therefore, check the lift of the welding gun before adjusting the pre current.

On

### Process control

The process control set via ADV is a real-time process control. Deviations from set tolerances are signalled immediately after welding; corrective measures can be initiated.

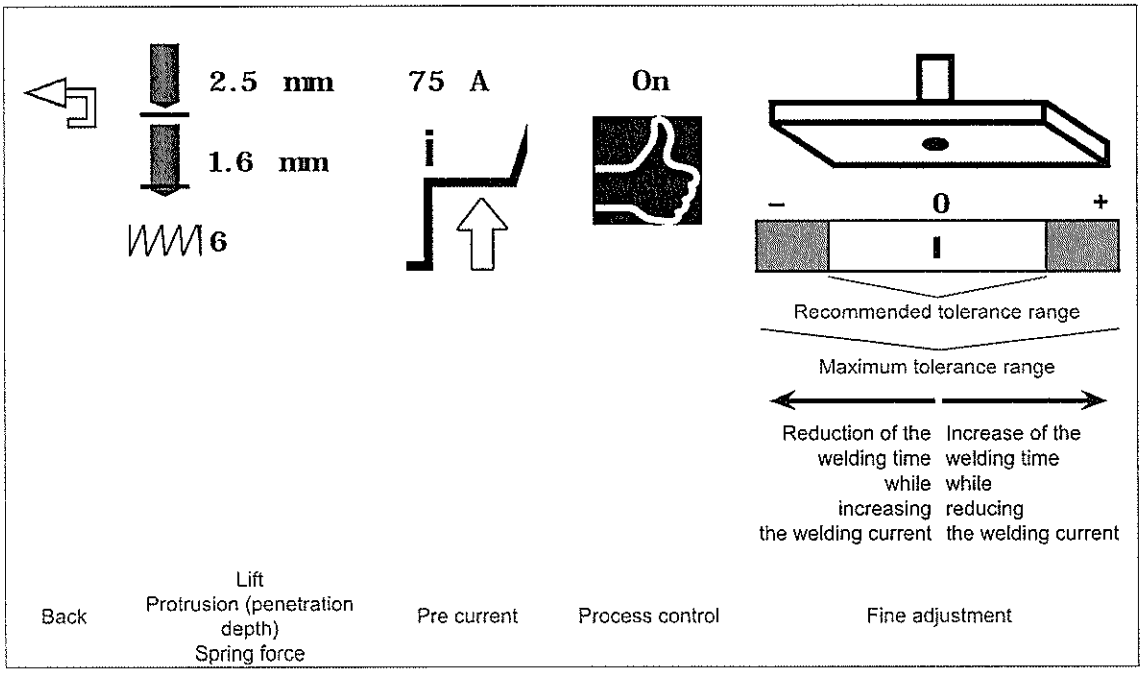
◆ For further information, see section 8.4 *"Process control"*.

### Setting the welding process control for reference welds (learning phase)

This is how you activate the control:

◆ Turn a pushbutton/knob to the right to the "Process control" symbol.

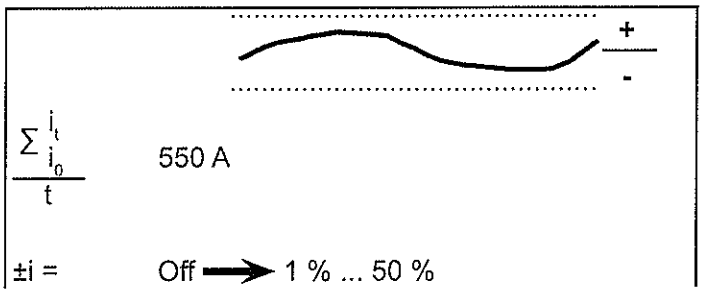
◆ Select "Process control – On".




◆ Press a pushbutton/knob to confirm this selection.

◆ Now define your tolerances.

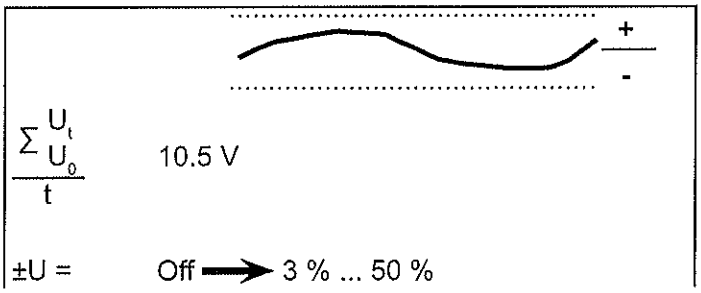
### Defining welding current tolerances




Welding current tolerance ±i = Off → 1 % ... 50 %

◆ Define your welding current tolerances.

### Defining voltage tolerances

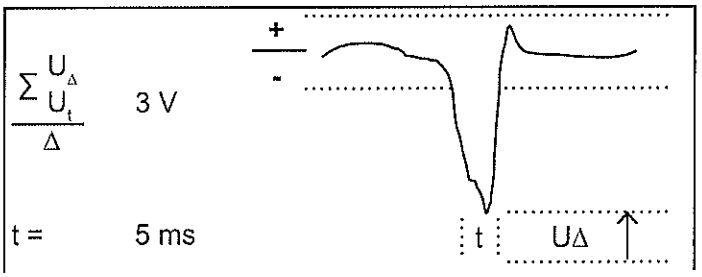



Voltage set value

Voltage tolerance ±U = Off → 3 % ... 50 %

◆ Define your voltage tolerances.

### Defining transient voltages

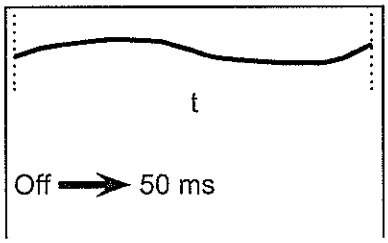



Voltage peak

Voltage acquisition time t = 5 ms

◆ Define the tolerances for the transient voltage.

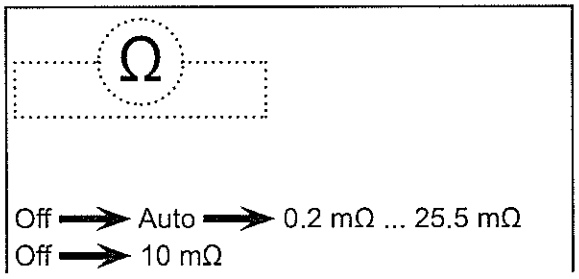
### Defining the tolerance time




Welding time tolerance: Off → 50 ms

◆ Define your welding time tolerances.

### Defining the resistance of the circuit




Resistance of the circuit: Off → Auto → 0.2 mΩ ... 25.5 mΩ

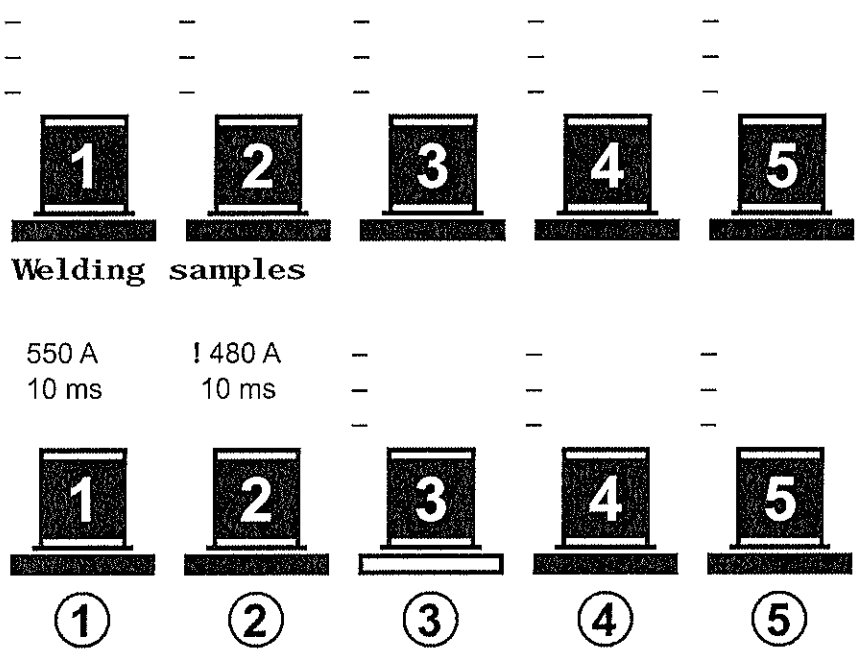
Resistance tolerance: Off → 10 mΩ

◆ Define the resistance of the circuit.

### Performing reference welds

◆ Now perform your reference welds.

The progress of the welds is displayed:




① Welding was successful. The actual values are within the defined tolerances.

② Welding was not successful. The tolerance deviation is indicated with a !. The stud welding unit is locked.

After pressing the gun button for a longer period of time (> 2 seconds), the stud welding machine is again ready for welding.

③ The lower bar flashes. This weld is now pending.

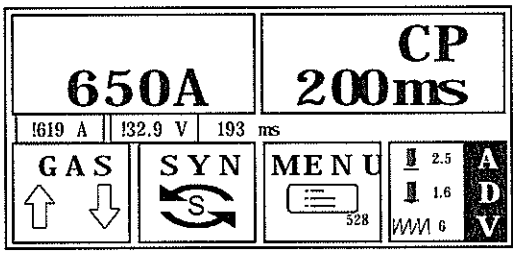
④ This reference weld was not yet performed.

⑤ This reference weld was not yet performed.

☞ ◆ If, for a weld that has already been performed, you determine that the tolerances are not maintained due to external influences, you can delete this welding result and repeat the weld.

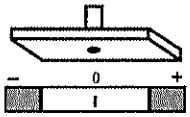
**Display of deviations from the tolerances in the actual welding process**

If the set tolerance range is not maintained, the system shows the deviation in the display:




The triggering of another weld is blocked.

Only after pressing the gun button for a longer period of time (> 2 seconds) is the stud welding machine again ready for welding.




**Fine adjustment**

This function can be used independently of the process control.

With this function, you can make fine adjustments to previously opened jobs according to your welding task if the conditions of the job change for a short time. The job settings themselves are not changed in this case.

With a constant energy input, you can thereby

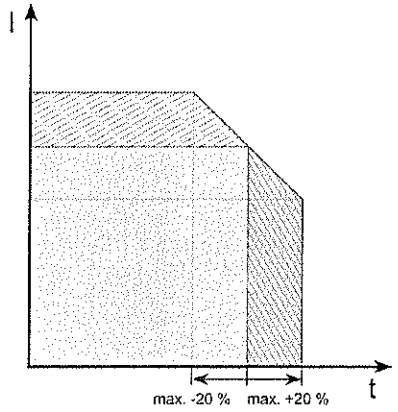
- reduce the welding time by max. 20%
  (while simultaneously increasing the welding current*) )

  or

- increase the welding time by max. 20%**)
  (while simultaneously reducing the welding current).

*) max. 650 A / **) max. 200 ms

After making your fine adjustment, the device then calculates the corresponding second welding parameter:




Reduction of the welding time while increasing the welding current, e.g., when working on warm workpieces

Increase of the welding time while reducing the welding current, e.g., when working on cold workpieces

☞ The tolerances of the fine adjustment affect the process control.

☞ If, while process control is switched on, you select the tolerances of the fine adjustment larger than previously set in the process control, problems or fault messages may occur when welding.

**HBS recommendation:**

Open a job that is appropriate for your welding task.

- Perform test welds.
- Check the welding results.
- Make fine adjustments if the welding results **do not meet** your requirements.

These fine adjustments are not stored in the opened job but rather support you only during your work under conditions that have changed for a short time.

With process control switched on and the "Documentation" USB command activated via a USB memory device, all fine adjustments made using this function are also recorded.

## 12.4 Performing the Welding Process

- **First set the necessary welding parameters.**
- Read and observe here point 12.3 *„Setting the Welding Parameters"*.

**Electric shock and electric arc hazard**

- Never touch the welding elements, chuck, retaining nut or electrically conductive parts in their vicinity during the welding process.

These parts are live.

- Never wear metal jewellery, even a wristwatch, on your body during the welding process.

This will help to avoid injuries and damage due to electric power or electromagnetic fields.

**Electric shock and electric arc hazard**

- Stand on an insulated mat if you have to weld under the following conditions:
  - In confined spaces with electrically conductive walls
  - Under cramped conditions between or against electrically conductive parts
  - Where there is limited mobility on electrically conductive parts
  - In damp, wet or hot rooms.

**Danger of deflagration of explosive gases and substances**

- Never weld in rooms with an explosion hazard.
- Never weld on vessels containing or that have contained substances
  - which are inflammable or promote combustion,
  - which may create health-endangering gases, fumes or airborne particulates,
  - or which could cause explosions.

Such work may only be carried out by welding specialists.

- Do not carry out such work if you have not been specially trained for it.

**Risk of fire and burns due to glowing weld spatter**

- Wear your personal protective equipment and
- your safety goggles with sight glass of protection class 2.
- Wear a protective helmet when welding over head.
- Remove all inflammable materials and liquids from the vicinity of the place of work before starting welding.
- Ensure that an approved fire extinguisher is available at the place of work.
- Observe furthermore your working instructions and the accident prevention regulations.

Glowing hot weld and liquid spatter occur during welding.

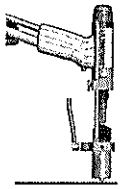
**Danger due to noise**

- Wear your ear protection during welding.
- Observe furthermore your working instructions and the accident prevention regulations.
- Inform colleagues working in the immediate vicinity accordingly before starting work.

**A > 90 dB (A) bang can occur during the welding process.**

- Ensure that the welding gun has been prepared in accordance with the corresponding operating manual.

- Check whether a welding element has been inserted into the welding gun.
- Insert a welding element, if necessary.



- Place the welding gun perpendicularly onto the workpiece as soon as the stud welding unit is ready for the welding process.
- Press the welding gun firmly with both hands against the workpiece until the welding gun attachment (spacer) is resting uniformly on the workpiece.

- Hold the welding gun firmly, steady and straight.
- Ensure that you do not touch any metal parts of the welding gun.
- Only now should you press the button of the welding gun.

The welding process is started.

- **Always pull the welding gun perpendicularly away from the welding element after the welding process.**

If you pull the welding gun away at an angle, you will strain the chuck and shorten its service life.

**Risk of burns**

The gun head becomes very hot during the welding process. The same applies to the welded element and the workpiece.

- Wear your proper protective clothing.

- **Use only welding elements of one batch.**
- Pay strict attention not to mix welding elements from different batches.
- Carry out test welds again after a batch change.

Even the slightest changes to the geometry, in particular to the tip of the welding elements require different settings for the welding process.

- Now check the quality of the welded joint before inserting a new welding element and repeating the welding process.
- Work in accordance with the following *point 13*.

## 12.5 Sleep Mode

If the stud welding unit is switched on and no welding is performed, sleep mode is started; internal energy consumption is reduced. The "Ready" LED ⏻ flashes slowly.

- End sleep mode by
  - actuating the welding gun start button or
  - placing the stud welding gun on the workpiece.

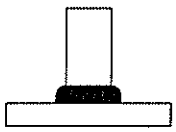
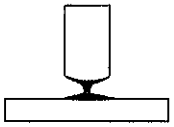
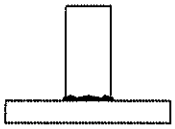
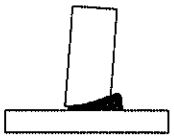
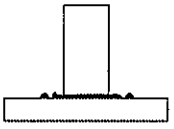
# 13 Checking the Quality of the Weld

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

The number and type or method of the tests to be performed and the acceptance criteria are defined in respective standards for quality demands.

## 13.1 Carrying out Visual Inspection

◆ Carry out a visual inspection on all welding elements.

| Visual Inspection | | | |
|---|---|---|---|
| Condition | | Possible cause | Corrective actions |
|  | Collar regular, bright and complete.<br>Lengths after weld within tolerances | Correct parameters | none |
|  | Contraction of weld collar<br>Welding element too long | Plunging depth or lift too low<br>Weld power too high<br>Ceramic ring not centered correctly<br>Plunge rate too high | Increase plunging depth, check lift and centering of the ceramic ring<br>Reduce current and/or time<br>Check centering<br>Adjust plunge and/or gun dumper |
|  | Weakly developed, uneven weld collar with mat surface<br>Welding element too long | Weld power too low<br>Ceramic ferrule is moist<br>Lift too low | Increase current and/or time<br>Dry out ferrules in oven<br>Increase lift |
|  | Collar off centre<br>Undercut | Effect of arc blow<br>Ceramic ferrule incorrectly centred | See arc blow effect<br>Check centring |
|  | Weld collar low, shiny surface with many spatters<br>Welding element too short | Weld energy too high<br>Plunging speed too high | Decrease current and/or time<br>Adjust plunging depth and/or damping factor |

## 13.3 Optimisation of Welding Parameters

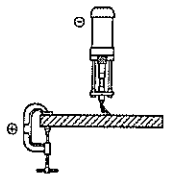
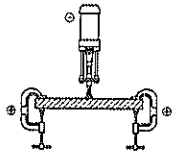
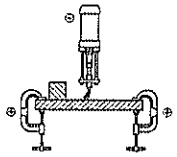
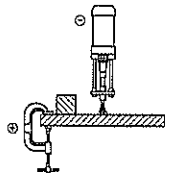
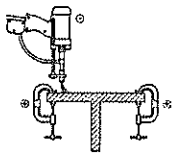
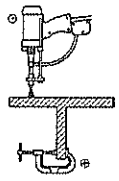
- **As first step, conduct the tests outlined under points 13.1 and 13.2.**
- As second step optimise the welding parameters according to the table under *point 12.2 „Determining the Welding Time"*.
- Optimise the welding parameters of the stud welding unit.
- Check the settings of the welding gun.
- If necessary re-adjust the lift and spring pressure.

- **Refer here to the operating manual of your welding gun.**

## 13.4 Blowing Effect and Remedies

With asymmetric ground connections, different material distributions or when welding at the edge of a workpiece a "blowing effect" can occur. This is an undesirable deflection of the electric arc. This results in uneven melting of the stud material, in increased poring and undercuts in the welding area.

The blowing effect is proportional to the current amperage and can be influenced by symmetrical connection of the ground terminals, by connecting compensating grounds or (on welding guns with external welding cable) by turning the welding gun about its vertical axis.

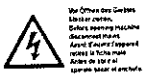
| Blowing effect | |
|---|---|
| Cause | Remedy |
|  |  |
|  |  |
|  |  |

## 16.2 Inspection and Tests


- **Inspect the condition of the mains cable.**
- Inform your dealer or maintenance department if you discover any damage.

- Check whether the readings on the display of the stud welding unit are still legible before starting work.
- Clean display and control panel in the event of soiling.

- Replace any removed or damaged signs:



*Before opening machine disconnect mains*

*Observe the operating manual*

*Warning of electric shock hazard*

# 17 Storage

- Store the stud welding unit in a safe and dust-free location when not in use.
- Protect the stud welding unit from moisture and metallic contamination.

- Store the stud welding unit only under the following ambient conditions.

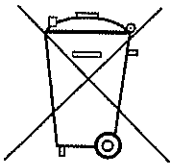
**Storage temperature:**

23 °F to 122 °F (-5 °C to +50 °C)

**Relative humidity:**

0 % - 50 % at 104 °F (+40 °C)
0 % - 90 % at 68 °F (+20 °C)

# 18 Disposal



- Dispose of the stud welding unit only via the manufacturer or a specialist disposal company.
- Never dispose of the stud welding unit in the domestic refuse.

# Service & Support

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

**Repair number**
(given by HBS)

Company: _____

Name / Surname: _____

Street: _____

City, State and ZIP/Postcode: _____

Country: _____

Phone & Fax: _____

E-mail address: _____

Stud welding unit / stud welding gun type of model: _____

Serial number: _____

Date of purchase: _____

Purchased at distributor: _____

**Detailed descriptions of errors:** _____

Service & Support may be done up to the value of EUR _____ without quotation: ☐ Yes ☐ No

Could you find any damage / burn marks

on the cables: ☐ Yes ☐ No

on chucks: ☐ Yes ☐ No

Are all plug and screw connections tightly fastened *: ☐ Yes ☐ No

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

Is there any other visual damage (e.g. cracks, dents): ☐ Yes ☐ No

Have you checked the fuses: ☐ Yes ☐ No

Default on the display of the stud welding unit:

| ARC / IT | | | | | CD / CDM / SC | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
|  |  |  |  |  |  |  |  |  |  |  ** |
| | | | | | | | | | | |

Which LED´s are illuminated (please mark with a cross)?

Please e-mail or fax this form to service@hbs-info.de or fax: +49 8131 511-100.
In case a repair is necessary a repair number will be given!

* See also operating manual chapter „Connection"
** Doesn´t light when using a contact welding gun

# Index

## T



## V



## W

(3)

(4)

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