IT 1002

Stud Welding Unit

Ceramic/Gas Version
93-66-1202

HBS EFFICIENT TECHNOLOGY

Operating Manual

2025

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IT 1002 Operating Manual Issue 2025-04 Order No. US-BA 93-66-1202

Translation of the Original Operating Manual

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

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Dear Customer,

Many thanks for buying a stud welding machine from HBS Welding Systems.

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.

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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.

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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.

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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 equipment, 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.

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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.

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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 equipment 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.**

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☞ **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**

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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

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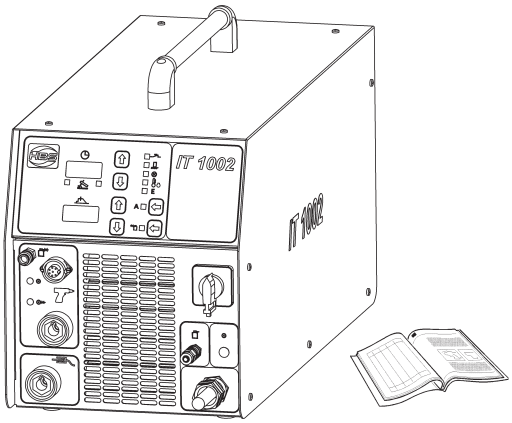
3 Scope of Supply

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

No. of pieces	Part	Type	Order No.
1	Stud welding unit	IT 1002	93-66-1202
1	Operating manual	IT 1002	US-BA 93-66-1202



- 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).

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4 Accessories

The following stud welding guns are recommended for **IT 1002**:

Welding range*)	M3 - M12 / Ø 3 - 12 mm		M6 - M16 / Ø 6 - 16 mm	Shear connectors (SD) Ø 16 mm
Stud length	10 - 150 mm		15 - 170 mm	up to 150 mm*) / 300 mm**)
	A 12	**A 12-FL**	**A 16**	**A 16**
	• Compact gun for ARC/ SC welding • Length compensation (stable welding results)	• Simple set-up of the gun without length compen-sation	• All-rounder for construction sites • Now with new leg guidance • Robust gun with plunge damper and length compen-sation	
Welding elements				
Welding process	ARC (Ceramic)	ARC (Ceramic)	ARC (Ceramic)	ARC (Ceramic)
Stud type	ARC threaded studs (FD/MD(DD)/PD/RD), pins (UD/ND), pins with internal thread (ID)			Shear connectors (SD)
Length compensation	3 mm automatic	--	6 mm automatic	
Lift	Adjustment range 3 mm, lockable	Fixed 6 mm	Adjustment range 4 mm, (0.25 mm steps, arresting)	
Spring force	Adjustable, arresting	Fixed	Oildamper	
Welding cable	4.8 m, 35 mm², SK 50	5 m, 35 mm², SK 50	4.8 m, 50 mm², SK 50	
	Order No.	**Order No.**	**Order No.**	**Order No.**
	93-20-275 (welding gun A 12 incl. ceramic leg assembly PSC-1)	**93-20-260** (welding gun A 12-FL without leg assembly) **93-40-022** (ceramic leg assembly PSC-1) not included in delivery	**93-21-280C** (welding gun A 16 without leg assembly) **93-40-028** (ceramic leg assembly PSC-2) not included in delivery	**93-21-280C** (welding gun A 16 without leg assembly) **93-40-041** *) (ceramic leg assembly PSC-2) not included in delivery **93-40-074** **) (ceramic leg assembly PSC-2) not included in delivery

*) recommended welding range IT 1002 / welding gun with this equipment

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Welding range*)	M3 - M12 (type RD) / Ø 3 - 10 mm			M6 - M16 / Ø 6 - 16 mm
Stud length	10 - 120 mm	10 - 150 mm	10 - 120 mm	10 - 150 mm
	A 12	**A 12**	**A 12-FL**	**A 16**
	• Compact gun for ARC/SC welding • Length compensation (stable welding results)		• Simple set-up of the gun without length compen-sation	• All-rounder for construc-tion sites • Now with new leg guidance • Robust gun with plunge damper and length compensation
Welding elements				
Welding process	ARC (Shield. gas)	ARC (Shield. gas)	ARC (Shield. gas)	ARC (Shield. gas)
Stud type	ARC threaded studs (FD/MD(DD)/PD/RD), pins (UD/ND), pins with internal thread (ID), SC threaded studs with flange (PS), pins with flange (US), pins with internal thread and flange (IS)			
Length compensation	3 mm automatic		--	6 mm automatic
Lift	Adjustment range 3 mm, lockable		Fixed 6 mm	Adjustment range 4 mm, (0.25 mm steps, arresting)
Spring force	Adjustable, arresting		Fixed	Oildamper
Welding cable	4.8 m, 35 mm², SK 50		5 m, 35 mm², SK 50	4.8 m, 50 mm², SK 50
	Order No.	**Order No.**	**Order No.**	**Order No.**
	93-20-274 (welding gun A 12 incl. shield. gas leg assembly PSS-2 and protective hose)	**93-20-277** (welding gun A 12 incl. shield. gas shroud PSS-1, spacer ring and protective hose)	**93-20-260** (welding gun A 12-FL without leg assembly) **93-40-021** (shield. gas leg assembly PSS-2) not included in delivery	**93-21-280C** (welding gun A 16 without leg assembly) **93-40-017** (shield. gas leg assembly PSS-3) not included in delivery

*) recommended welding range IT 1002 / welding gun with this equipment

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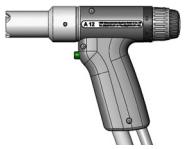
Welding range*)	M3 - M8, Ø 3 - 8 mm	M3 - M8 / Ø 2 - 8 mm		
Stud length	10 - 40 mm	8 - 30 mm		16 - 40 mm
	A 12	**CA 08**	**CA 08**	**CA 08**
				
	• Compact gun for ARC/ SC welding • Length compensation (stable welding results)	• Entry-level version used for SC welding without length compensation		
Welding elements				
Welding process	SC	SC	SC	SC with shield. gas
Stud type	ARC threaded studs with flange (PS), pins with flange (US), pins with internal thread and flange (IS) SC Fir tree stud, SC Paint clearing threaded stud			
Length compensation	3 mm automatic	--	--	--
Lift	Adjustment range 3 mm, lockable	Adjustment range 4.5 mm, lockable		
Spring force	Adjustable, arresting	Adjustable, arresting		
Welding cable	4.8 m, 35 mm², SK 50	3 m, 25 mm², SK 50		
	Order No.	**Order No.**	**Order No.**	**Order No.**
	93-20-276 (welding gun A 12 incl. centering tube PPR-2 and spacer ring)	**92-20-255** (welding gun CA 08 with foot ring and feet)	**92-20-281** (welding gun CA 08 incl. centering tube PPR-2 and spacer ring)	**92-20-283** (welding gun CA 08 incl. shielding gas shroud PSS-1 and spacer ring)

*) recommended welding range IT 1002 / welding gun with this equipment

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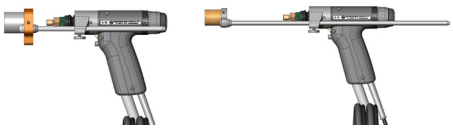
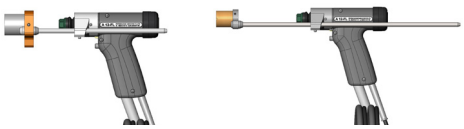
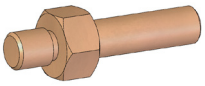
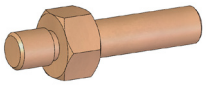
Welding range*)	Ø 3 - 6 mm			
Stud length	up to 150 mm*) / 300 mm**)	up to 460 mm	up to 150 mm*) / 300 mm**)	up to 460 mm
	A 12		**A12-FL**	
				
	• Compact gun for ISO welding • Length compensation (stable welding results)		• Simple set-up of the gun without length compensation	
Welding elements				
Welding process	ISO		ISO	
Stud type	ARC Pins (UD), ISO pins (ND)			
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		10 m, 35 mm², SK 50	
	Order No.	**Order No.**	**Order No.**	**Order No.**
	93-20-270 (welding gun A 12 without leg assembly)	**93-20-270** (welding gun A 12 without leg assembly)	**93-20-26010** (welding gun A 12-FL without leg assembly)	**93-20-26010** (welding gun A 12-FL without leg assembly)
	93-40-066 *) (ISO leg assembly PSI-3) not included in delivery	**93-40-026** (ISO leg assembly PSI-3) not included in delivery	**93-40-066** *) (ISO leg assembly PSI-3) not included in delivery	**93-40-026** (ISO leg assembly PSI-3) not included in delivery
	93-40-065 **) (ISO leg assembly PSI-3) not included in delivery		**93-40-065** **) (ISO leg assembly PSI-3) not included in delivery	
	Chuck adaptor 80-05-689 (included in delivery)		Chuck adaptor 80-05-689 (**not** included in delivery)	
				
	(only necessary when using ARC chucks)		(only necessary when using ARC chucks)	

*) recommended welding range IT 1002 / welding gun with this equipment

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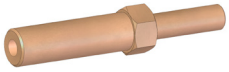
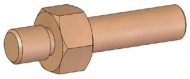
Welding range*)	MARC welding nuts type Hex[Nut] M6 - M12 Hexagon nuts DIN 934 M6 - M12	SC welding elements M5 - M10, Ø 5 - 8 mm CD welding elements M5 - M10, Ø 5 - 8 mm
Stud length	---	10 - 120 mm
	A 12 M	
	• Compact gun for nut and stud welding with magnetic rotating arc • Length compensation (stable welding results) • For welding on perforated and unperforated metal sheets • Especially suitable for workshop and assembly area	
Welding elements		
Welding process	Drawn arc welding with magnetically impelled electric arc and shielding gas	
Stud type	MARC welding nuts type Hex[Nut] Hexagon nuts DIN 934	ARC SC welding elements with flange (PS), pins with flange (US), pins with internal thread and flange (IS) CD threaded studs (PT), pins (UT), pins with internal thread (IT)
Length compensation	3 mm automatic	
Lift	Adjustment range 3 mm, lockable	
Spring force	Adjustable, arresting	
Welding cable	4.85 m connecting cable, 35 mm² / 1.73 m field former cable, 10 mm² (0.61 m welding current connection, 0.85 m control cable connection)	
	Order No.	**Order No.**
	93-20-244 (welding gun A 12 M with field former) incl. chuck adaptor 88-26-647	**93-20-244** (welding gun A 12 M with field former) chuck adaptor 80-05-689 (not included in delivery)
		

*) recommended welding range IT 1002 / welding gun with this equipment

The following **accessories** are available:

No. of pieces	Part	Type	Order No.
1	Ground cable	5 m, 25 mm²	93-40-020

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5 Technical Data

Stud welding unit IT 1002

– for ARC stud welding

– for MARC welding with magnetically impelled electric arc

according to current standards

Gas/Automation/Process control	Series/---/---
Welding range	Studs #4 to 5/8‘‘, dia. 14 ga to 9/16‘‘ (M3 to RD16, dia. 2 to 14 mm) Sleeves and MARC welding nuts type Hex^{Nut} M6 to M12
Welding material	Studs: Mild steel, stainless steel, aluminum Sleeves and MARC welding nuts type Hex^{Nut}: Mild steel, stainless steel
Welding rate	Stud welding: M12 = 25 studs/min Nut welding [1]: Welding nuts type Hex^{Nut} M12 = 4 sleeves/min
Welding current	1 000 A (max.)
Current adjustment range	100 to 1 000 A Electrode: 50 to 400 A (stepless)
Welding time	5 to 1 000 ms (stepless)
Primary power	480/460 V, 3 phases, 50/60 Hz, 35 AT (alternative input voltages available)
Connected load	50 kVA (400 V mains), 40 kW
Cooling type	F (temperature controlled cooling fan)
IP Code	IP 23 (also permits operation outdoors)
Ambient temperature limits	32 °F to 104 °F (0 °C to 40 °C)
Dimension L x W x H	26“ x 11“ x 13.4“ (660 x 280 x 340 mm) without handle
Weight	68.343 lbs (31 kg)

[1] The maximum welding rate is limited by a variety of parameters.

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6 Intended Use

Our stud welding units are designed and built exclusively for industrial use. Nonindustrial 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:

– for drawn arc stud welding with the welding guns A 12, A 12-FL, A 16 and CA 08 or

– for MARC welding with magnetically impelled electric arc with the welding gun A 12 M.

The intended use also implies observance of the operating manual of the component used 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.**

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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.

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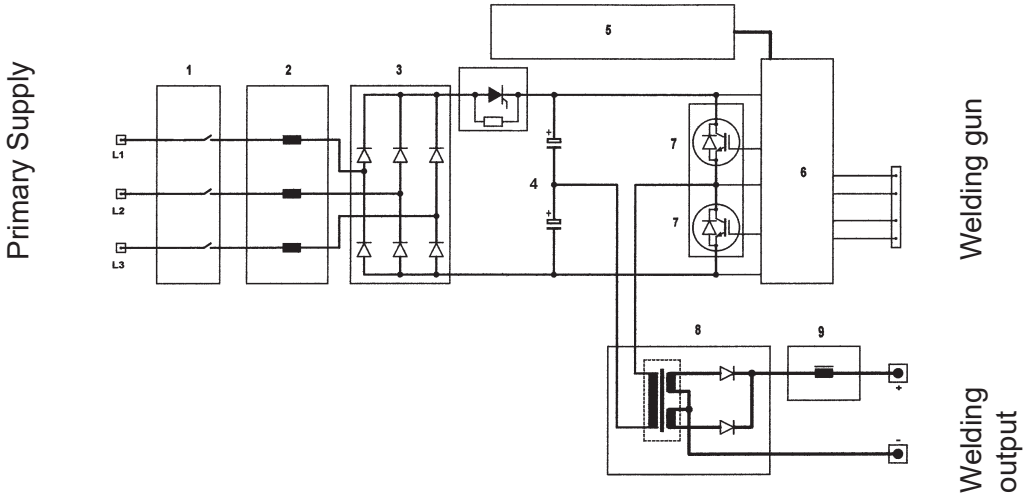
8 Components of the Stud Welding Unit

8.1 Main Assemblies



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

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

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

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

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

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

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The **control unit (5)** synchronises the mechanical sequence (lifting the welding element) with the electronic control (ignition of pilot arc, ignition of main arc, sequence of welding time).

Welding with shielding gas/forming gas

During the welding processes, the stud welding unit automatically regulates the timing of the gas flow.

Welding time and welding current are steplessly adjustable.

Type plate

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

The type plate contains the following information:

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

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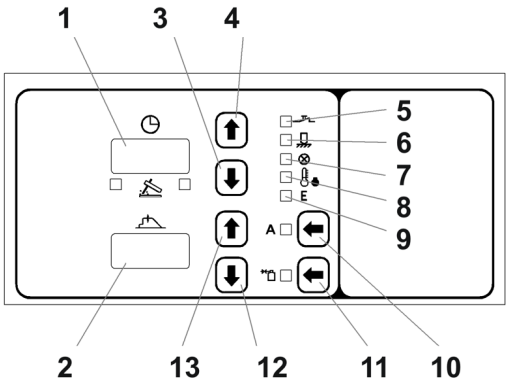
8.2 Control Panel and Display



1 - Welding time
2 - Welding current
3 - Shorter
4 - Longer
5 - Trigger
6 - Contact
7 - Locked
8 - Temperature
9 - Error (fault)
10 - Automation (not available)
11 - Shielding gas
12 - Lower
13 - Higher

The condition of the welding unit is monitored after switching-on.

After self-test, the digital displays show the last set **welding time (1)** and **welding current (2)**.

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To the right of the displays (1) and (2) are light-emitting diodes (LED) with the following meanings:

	Yellow	Lights up when the welding gun button is triggered.
	Yellow	Lights up when electrical contact exists between the welding element and the workpiece.
	Red	The stud welding unit is locked – After welding as long as there is electrical contact with the workpiece.
	Green	The stud welding unit is ready for welding.
	Red	The stud welding unit is locked – if the stud welding unit is overheated. (8888 appears on the display and LED E lights up). After a short cooling period, the work can be continued.
E	Red	The stud welding unit is locked – if the stud welding unit is overheated. – if there is a malfunction of the power element.
A		(not available)
	Green	Lights, shielding gas is switched on.

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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:

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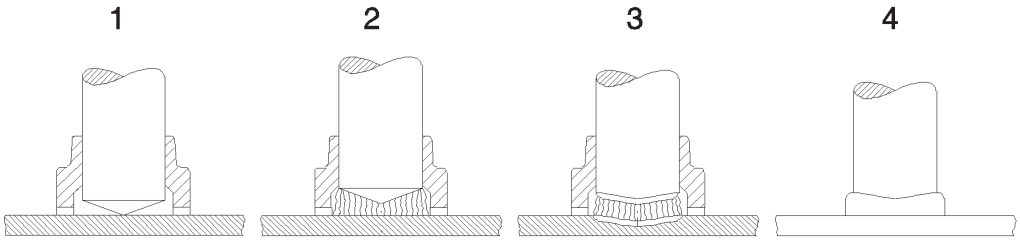

– At the beginning of the welding process, the welding element (stud) in the welding gun is lifted clear off the workpiece by a lifting device (solenoid). An initial switched current triggers a pilot arc of a low current power (see figure, **position 2**). Then the main arc ignites between the face area 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.

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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	3 000	3 000	2 000
Welding time t in ms	100 - 2 000	100 - 2 000	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 min. 1 mm	1/8 d min. 1 mm	1/10 d approx. 0.7 mm
Adjustable parameters	Welding current I in A = 80 x d (up to 16 mm)	Welding current I in A = 80 x d (up to 16 mm)	Welding current I in A = 100 x d (up to 12 mm)
	Welding time t in ms = 20 x d (up to 12 mm)	Welding time t in ms = 20 x d (up to 12 mm)	Welding time
	Lift (arc length)	Lift (arc length)	Lift (arc length)
	Protrusion, immersion speed (plunge damper from 14 mm diameter)	Protrusion, immersion speed (plunge damper from 14 mm diameter)	Protrusion, immersion speed

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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 2 000 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.

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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: (82 % Ar / 18 % CO_2)	90 % Ar / 10 % CO_2 *) 92 % Ar / 8 % CO_2 *)
Aluminium and aluminium alloys	DIN EN ISO 14175-I1 DIN EN ISO 14175-I3	85 % Ar / 15 % He 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.

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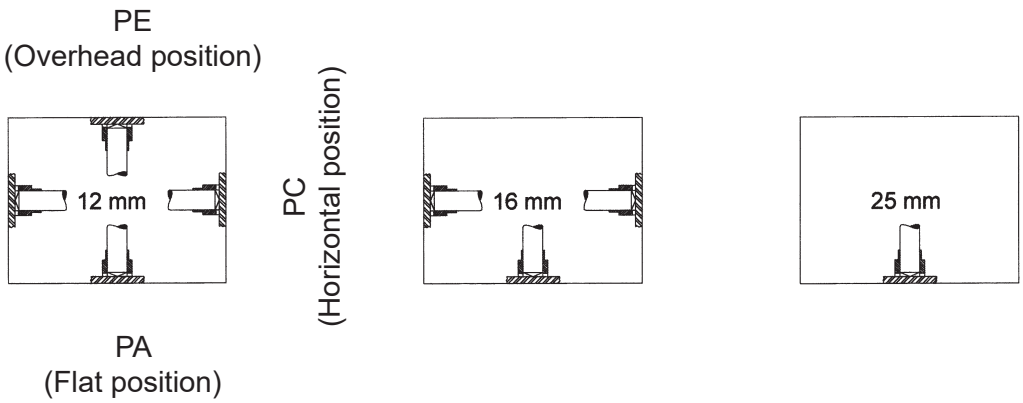
☞ **With shielding gas, you should only weld in position PA (flat position) because due to gravity, the shielding gas cannot prevent flow of the molten metal.**



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.

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MARC - Welding with magnetically impelled electric arc

MARC – Magnetic Rotated Arc, is an innovative stud welding process with rotating electric arc. This new process permits the gas-tight welding of threaded sleeves, nuts and pipe fittings, etc., up to 30 mm outside diameter to even thin sheets of metal.

Conventional stud welding processes allow only pins and studs to be welded. A electric arc is generated by an electricity source. This arc locally melts the underside of the studs and the surface of the workpiece within tenths of a millimetre. The two melt zones are then pressed together under slight pressure before they cool and solidify again. The conventional stud welding process cannot be used for ring-shaped geometries as the electric arc burns only at one point and hence cannot produce a continuous, ring-shaped weld seam.

That is the difference compared with the MARC process. The electric arc generated between e.g. a sleeve and the workpiece is set in rotation by an external magnetic field (field former) at the welding head (up to 1 800 rotations per second). This produces a uniform, circular weld pool. At the end of the necessary welding time (200 - 1 000 milliseconds), the sleeve is pressed with slight pressure into the still molten weld pool. A gas-tight and pressure-tight joint with high strength is thus created with a low energy input.

The reason for the movement of the electric arc in the magnetic field is the Lorentz force.

In order for the welding electric arc to constantly travel along a closed circular path, e.g. at the end face of a sleeve, there must be a radial magnetic field component at every point along this path. For an optimum electric arc movement, the magnetic field lines should pass radially and symmetrically through the weld gap (figure 1).

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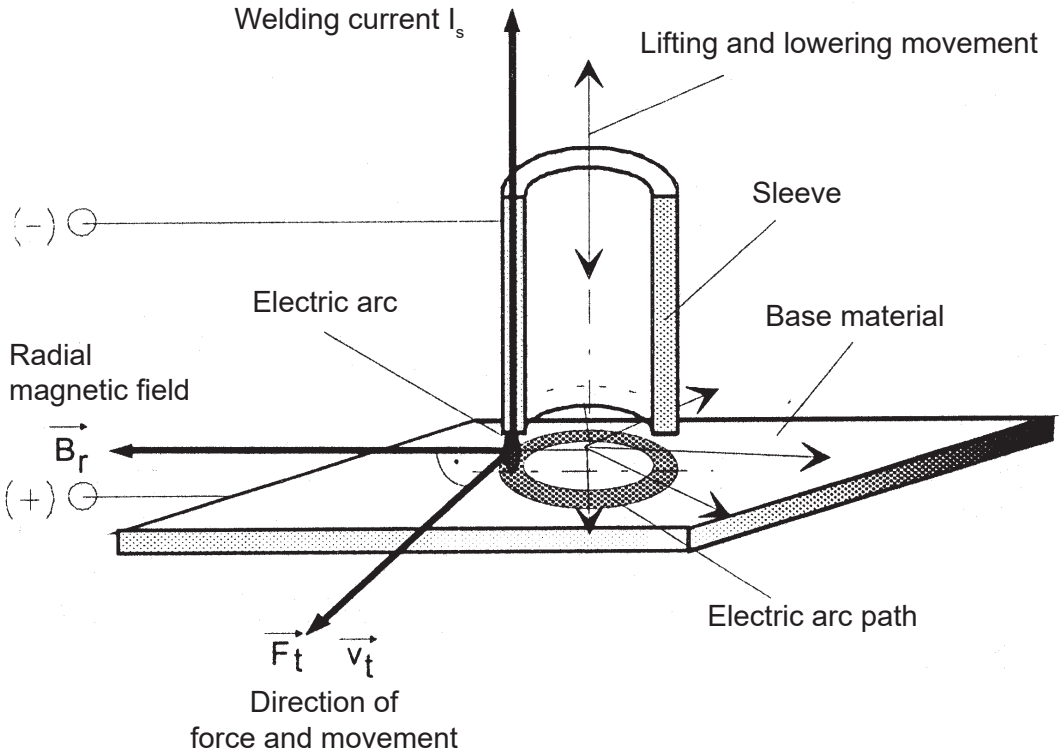

Figure 1:
Movement of a DC electric arc between sleeve and plate under the influence of a radial magnetic field

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A DC-excited magnetic coil is used to move the DC-fed welding electric arc on a circular path. This is located concentrically to the path of the electric arc so that its magnetic flux lines pass as perpendicularly as possible through the electric arc (figure 2). The ring coil is thereby completely embedded in a housing that serves as a magnetic return path.

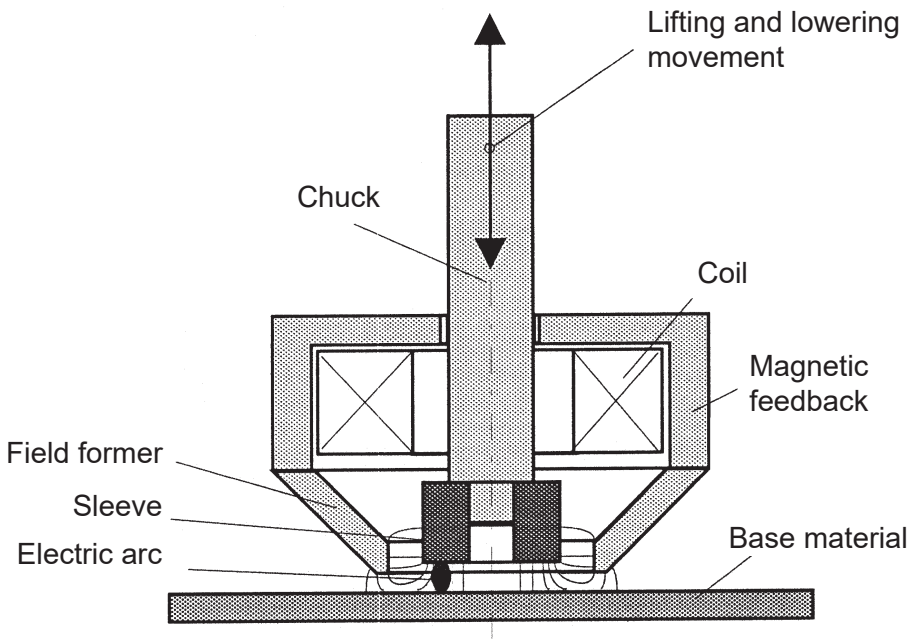

Figure 2: Principle diagram of the head of the welding gun

A cone-shaped field former guides the flux lines in the immediate vicinity of the welding point and concentrates them in this area. The magnetic flux thus passes over practically its whole path through chuck, sleeve, weld gap, field former and return path in material with good magnetic conduction. This closed guidance of the magnetic flux results in high flux densities in the weld gap.

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Advantages of MARC welding:

- Very short welding times
- Minimum component distortion due to controlled heat input
- Transportable current source with handy welding gun
- All welding positions can be controlled
- Comparatively low procurement costs
- Very high quality of the welded joints

Fields of application are to be found wherever nuts, sleeves, bushes or similar structural elements are to be welded quickly and reliably to perforated or unperforated sheet metal or any thickness.

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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.

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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*).

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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:

– for drawn arc stud welding with the stud welding guns A 12, A 12-FL, A 16 and CA 08 or

– for MARC welding with magnetically impelled electric arc with the nut welding gun A 12 M.

◆ Check the chuck of your welding gun for proper fit and ensure it is tightened.

◆ Check the bellows of your welding gun for damage.

◆ Check if spring force and lift are set according to the welding parameter table in the operating manual of the welding gun.

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

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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.

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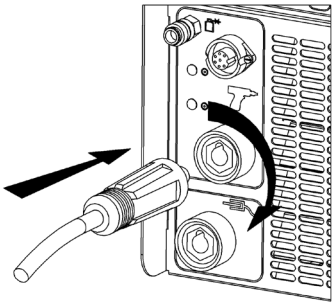
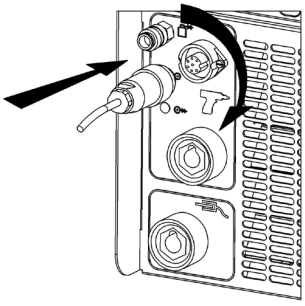
11.1 Connecting the Welding Gun to the Stud Welding Unit



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 in the connector 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.

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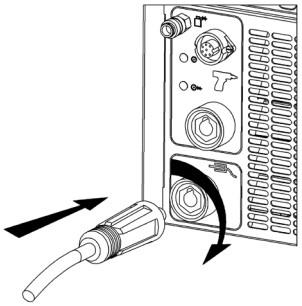
11.2 Connecting the Ground Cable



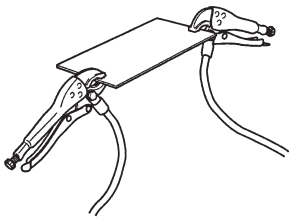
Connect the ground cable

- 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.

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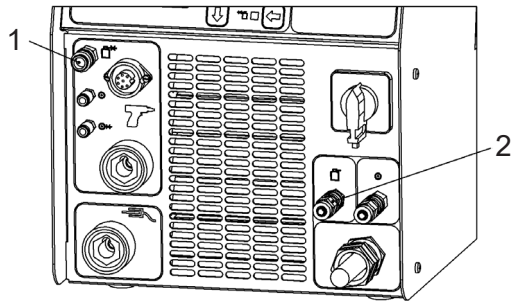
11.3 Shielding Gas Connection



1 - Gas outlet

2 - Gas inlet shielding gas bottle

- 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.

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Danger from incorrect securing and handling of shielding gas cylinders

Incorrect handling and insufficient securing of shielding gas cylinders can result in severe injury!

- Follow the instructions from the gas manufacturer and given in the relevant compressed gas regulation.
- Place the shielding gas cylinder in the cylinder holder intended for this purpose.
- Secure the shielding gas cylinder properly!

Do not secure the cylinder by its valve!

- Take measures to prevent the shielding gas cylinder from heating up.

11.4 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.

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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.

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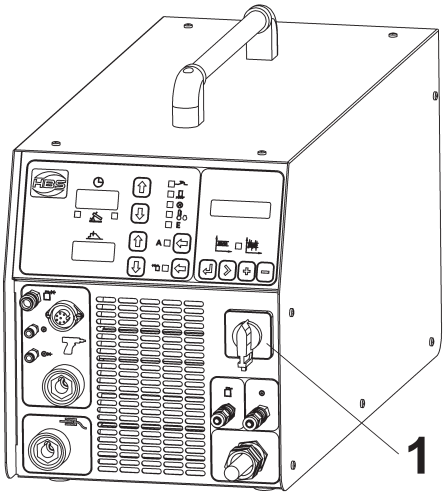
12.1 Switching on the Stud Welding Unit



1 - Mains switch

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

12.2 Determining the Welding Time and the Welding Current

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

– the welding gun used,

– the material of the welding element,

– the diameter of the welding element,

– the material of the workpiece.

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

☞ **The figures in these tables 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.**

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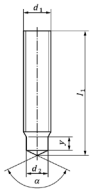
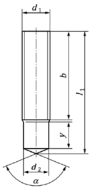
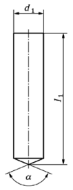
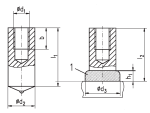
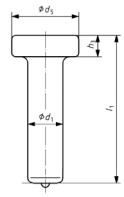
Determining the Welding Time and the Welding Current for Welding Guns A 12, A 12-FL and A 16

for drawn-arc stud welding with ceramic ferrule

Welding elements Material: 4.8 (suitable for welding)		Diameter of welding elements				Welding current [1] IT 1002 I in A	Welding time [1] IT 1002 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) [2]							
		Ø d_1	Ø d_2	Ø d_1	Ø d_2		
	RD (MR) [3]	M6	4.7	1/4	0.185	300	150
	RD (MR) [3]	M8	6.2	5/16	0.244	450	170
	RD (MR) [3]	M10	7.9	3/8	0.311	500	250
	RD (MR) [3]	M12	9.5	1/2	0.374	550	330
	RD (MR) [3]	M16	13.2	5/8	0.520	800	550
		Ø d_1	Ø d_2	Ø d_1	Ø d_2		
	FD/PD/MD (DD) [3]	M6	5.35	1/4	0.211	450	100
	FD/PD/MD (DD) [3]	M8	7.19	5/16	0.283	500	250
	FD/PD/MD (DD) [3]	M10	9.03	3/8	0.356	550	330
	FD/PD/MD (DD) [3]	M12	10.86	1/2	0.428	675	420
		Ø d_1		Ø d_1			
	UD/ND [3]	3 (ISO)		#4 / 12 gage		--- [5]	--- [5]
	UD/ND [3]	4 (ISO)		#8		--- [5]	--- [5]
	UD/ND [3]	5 (ISO)		#10 / 3/16		--- [5]	--- [5]
	UD [3]	6		1/4		300	180
	UD [3]	8		5/16		500	250
	UD [3]	10		7/16		550	330
	UD [3]	12		1/2		675	420
		Ø d_1	Ø d_2	Ø d_1	Ø d_2		
	ID [3]	M6	10	1/4	0.394	550	330
	ID [3]	M8	12	5/16	0.472	675	420
		Ø d_1 - 0.4		Ø d_1 - 0.4			
	SD [3]	10		3/8		550	330
	SD [3]	13		1/2		675	420

1) to be checked by test weldings

2) When using alloyed steels, the welding energy (welding time) must be reduced by about 10 %.

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

5) We recommend the “drawn arc stud welding with shielding gas” welding procedure.

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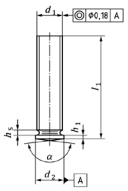
Determining the Welding Time and the Welding Current for Welding Guns A 12, A 12-FL and CA 08

for drawn-arc stud welding without ceramic ferrule

Welding elements Material: 4.8 (suitable for welding)		Diameter of welding elements				Welding current [1] IT 1002 I in A	Welding time [1] IT 1002 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) [2]							
		Ø d_1	Ø d_2	Ø d_1	Ø d_2		
	PS (US, IS) [4]	M3	4	1/8	0.157	400	10
	PS (US, IS) [4]	M4	5	5/32	0.197	600	15
	PS (US, IS) [4]	M5	6	3/16	0.236	700	15
	PS (US, IS) [4]	M6	7	1/4	0.276	800	20
	PS (US, IS) [4]	M8	9	5/16	0.354	--- [5]	--- [5]
	PS (US, IS) [4]	M10	11	3/8	0.433	--- [5]	--- [5]

[1] to be checked by test weldings

[2] When using alloyed steels, the welding energy (welding time) must be reduced by about 10 %.

[4] Information and recommendations on this can be found in **DVS 0902**.

[5] We recommend the “drawn arc stud welding with shielding gas” welding procedure.

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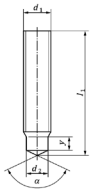
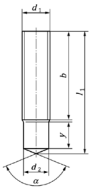
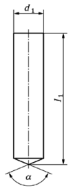
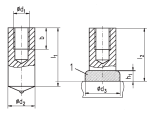
Determining the Welding Time and the Welding Current for Welding Guns A 12, A 12-FL, A 16 and CA 08

for drawn-arc stud welding with shielding gas [6)]

Welding elements Material: 4.8 (suitable for welding)		Diameter of welding elements				Welding current [1)] IT 1002 I in A	Welding time [1)] IT 1002 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) [2)]							
		Ø d_1	Ø d_2	Ø d_1	Ø d_2		
	RD (MR) [3)]	M6	4.7	1/4	0.185	400	100
	RD (MR) [3)]	M8	6.2	5/16	0.244	525	160
	RD (MR) [3)]	M10	7.9	3/8	0.311	670	160
	RD (MR) [3)]	M12	9.5	1/2	0.374	800	210
	RD (MR) [3)]	M16	13.2	5/8	0.520	1 000	550
		Ø d_1	Ø d_2	Ø d_1	Ø d_2		
	FD/PD/MD (DD) [3)]	M6	5.35	1/4	0.211	490	120
	FD/PD/MD (DD) [3)]	M8	7.19	5/16	0.283	670	180
	FD/PD/MD (DD) [3)]	M10	9.03	3/8	0.356	840	220
	FD/PD/MD (DD) [3)]	M12	10.86	1/2	0.428	970	275
		Ø d_1		Ø d_1			
	UD/ND [3)]	3 (ISO)		#4 / 12 gage		250	60
	UD/ND [3)]	4 (ISO)		#8		320	90
	UD/ND [3)]	5 (ISO)		#10 / 3/16		425	150
	UD [3)]	6		1/4		500	120
	UD [3)]	8		5/16		680	170
	UD [3)]	10		7/16		840	220
	UD [3)]	12		1/2		970	275
		Ø d_1	Ø d_2	Ø d_1	Ø d_2		
	ID [3)]	M6	10	1/4	0.394	840	220
	ID [3)]	M8	12	5/16	0.472	970	275

1) to be checked by test weldings

2) When using alloyed steels, the welding energy (welding time) must be reduced by about 10 %.

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

6) Shielding gas according to DIN EN ISO 14175-M21, see *chapter 9 "Welding Process"*

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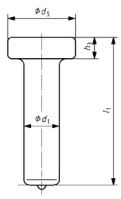
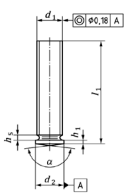
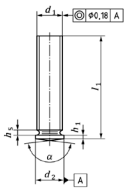
Welding elements Material: 4.8 (suitable for welding)	Diameter of welding elements				Welding current [1] IT 1002 I in A	Welding time [1] IT 1002 t in ms
	metric		imperial (US)			
	Stud diameter in mm	eff. diameter in mm	Stud diameter in inches	eff. diameter in inches		
Material of workpiece: Mild steel (suitable for welding) [2]						
		Ø d_1 - 0.4		Ø d_1 - 0.4		
	SD [3]	10		3/8	840	220
	SD [3]	13		1/2	970	275
		Ø d_1	Ø d_2	Ø d_1	Ø d_2	
	PS (US, IS) [4]	M3	4	1/8	0.157	400	20
	PS (US, IS) [4]	M4	5	5/32	0.197	500	25
	PS (US, IS) [4]	M5	6	3/16	0.236	600	30
	PS (US, IS) [4]	M6	7	1/4	0.276	700	40
	PS (US, IS) [4]	M8	9	5/16	0.354	950	40
	PS (US, IS) [4]	M10	11	3/8	0.433	1 000	100

Welding elements Material: AlMg3 [7]	Diameter of welding elements				Welding current [1] IT 1002 I in A	Welding time [1] IT 1002 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: Aluminium [7]						
		Ø d_1	Ø d_3	Ø d_1	Ø d_3	
	PS (US, IS) [3]	M6	7	1/4	0.276	850	15
	PS (US, IS) [3]	M8	9	5/16	0.354	900	40
	PS (US, IS) [3]	M10	11	3/8	0.433	1 000	120

1) to be checked by test weldings

2) When using alloyed steels, the welding energy (welding time) must be reduced by about 10 %.

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

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

7) Shielding gas according to DIN EN ISO 14175-I1/HBS recommendation, see *chapter 9 "Welding Process"*; for better welding results, we recommend changing the polarity of the welding voltage by reversing the welding current and ground cables.

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Determining the Welding Time and the Welding Current for Welding Gun A 12 M

for MARC welding with magnetically impelled electric arc and shielding gas [6)]

Welding on hole

Material HBS Hex[Nut]	Size of the metric thread in mm	Hole-diameter in mm	Welding current [1) 8)] IT 1002 I in A ± 50 A	Welding time [1) 8)] IT 1002 t in ms ± 50 ms
Workpiece material: Stainless steel (suitable for welding) [2)]				
A2-50	M6	10.7 - 11.0	300	300
			400	250
			450	200
	M8	10.7 - 11.0	300	300
			400	250
			450	200
	M10	12.7 - 13.0	400	300
			500	200
			550	150
	M12	15.0 - 15.3	min. 350	650
			400	500
			500	400
			max. 550	375

Welding on metal sheets

Material HBS Hex[Nut]	Size of the metric thread in mm	Welding current [1) 8)] IT 1002 I in A ± 25 A	Welding time [1) 8)] IT 1002 t in ms ± 50 ms
Workpiece material: Stainless steel (suitable for welding) [2)]			
A2-50	M6	300	350
		400	250
	M8	400	250
	M10	400	500
	M12	450	550

Material Nut DIN EN ISO 4032/ DIN 934	Size of the metric thread in mm	Welding current [1) 8)] IT 1002 I in A ± 25 A	Welding time [1) 8)] IT 1002 t in ms ± 50 ms
Workpiece material: Stainless steel (suitable for welding) [2)]			
A2-50, A2-70 A4-50, A4-70 A5-50, A5-70	M6	350	150
	M8	300	350
	M10	400	500
	M12	450	550

1) to be checked by test weldings

2) When using alloyed steels, the welding energy (welding time) must be reduced by about 10 %.

6) Shielding gas according to DIN EN ISO 14175-M21, see *chapter 9 "Welding Process"*

8) Material thickness s = 2 mm

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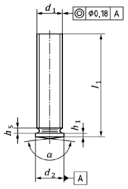
Determining the Welding Time and the Welding Current for Welding Gun A 12 M

for MARC welding with magnetically impelled electric arc and shielding gas [6)]

Drawn arc stud welding (shielding gas application)

Material of welding elements: 4.8 (schweißgeeignet) / A2-50		Diameter of welding elements				Welding current [1)] IT 1002 I in A	Welding time [1)] IT 1002 t in ms
		metric		imperial (US)			
		Stud diameter in mm	eff. diameter in mm	Stud diameter in inches	eff. diameter in inches		
Workpiece material: Mild steel (suitable for welding) / stainless steel (suitable for welding) [4)]							
		Ø d_1	Ø d_2	Ø d_1	Ø d_2		
	PS (US, IS) [4)]	M5	6	3/16	0,236	300	110
						350	100
						400	80
						450	70
	PS (US, IS) [4)]	M6	7	1/4	0,276	300	130
						350	110
						400	100
						450	90
						500	80
						550	70
						600	60
	PS (US, IS) [4)]	M8	9	5/16	0,354	350	150
						400	130
						450	120
						500	110
						550	100
						600	90
						650	80
	PS (US, IS) [4)]	M10	11	3/8	0,433	400	350
						500	270
						600	200
						700	150
						800	120
						900	110

[1)] to be checked by test weldings

[4)] Information and recommendations on this can be found in **DVS 0902**.

[6)] Shielding gas according to DIN EN ISO 14175-M21, see *chapter 9 “Welding Process”*

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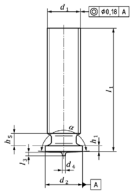
Material:	Diameter of welding elements				Welding current [1] IT 1002 I in A	Welding time [1] IT 1002 t in ms
	metric		imperial (US)			
	PT, UT [4]	IT [4]	PT, UT [4]	IT [4]		
Workpiece material: Mild steel (suitable for welding) / Material of welding elements: 4.8 (suitable for welding) / Workpiece material: Galvanised steel (suitable for welding) / Material of welding elements: 4.8 (suitable for welding) / Workpiece material: Alloyed steel (suitable for welding) / Material of welding elements: A2-50 / Workpiece material: Alloyed steel (suitable for welding) / Material of welding elements: CuZn37						
	M5, 5 mm	5 mm, M3	3/16	#10-32	300	110
					350	100
					400	80
					450	70
	M6, 6 mm	6 mm, M4	1/4	1/4-20	300	130
					350	110
					400	100
					450	90
					500	80
					550	70
					600	60
	M8, 7.1 mm	7.1 mm, M5	5/16	5/16-18	350	150
					400	130
					450	120
					500	110
					550	100
					600	90
					650	80

[1] to be checked by test weldings

[4] Information and recommendations on this can be found in **DVS 0902**.

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☞ The welding parameters necessary for **welding aluminium studs** according to DIN EN ISO 13918 are to be ascertained and checked by the user due to the material characteristics (differences in alloy composition) and the used shielding gas options.

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

☞ When **welding with shielding gas**, an approximately 10 % longer welding time is generally selected for the same welding current. When using the library mode, the values for welding current and welding time are automatically adapted to the welding process.

For alloyed steel a 10 % lower current is generally selected.

The specified values apply for welding in welding position PA. When welding in welding position PC, the welding time must be reduced.

For short-cycle stud welding with drawn arc, the welding time is less than 100 ms. It is dependent not only on the stud diameter, but also on the available current:

(I in A = min. 100 x Ø in mm)

When welding without weld pool protection, the welding time should be selected as short as possible.

The welding energy is selected through the welding time alone.

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12.3 Checking Shielding Gas Flow Rate

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

- Check that the stud welding unit is switched on.
- Switch on the „Shielding gas“ option on the stud welding unit.
- Actuate the welding gun button without placing the stud welding gun on the workpiece (= „air shot“).

The flow meter displays the amount of shielding gas flowing in l/min.

- Set the flow rate according to your welding task.

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12.4 Possible Settings

12.4.1 Setting the Welding Parameters

Adjusting the Welding Time

- **First determine the necessary welding time.**
- Read and observe here Point 12.2 *„Determining the Welding Time and Welding Current“*.

- Only now set the welding time (digital display) with the arrow keys.

Adjusting the Welding Current

- **First determine the necessary welding current.**
- Read and observe here Point 12.2 *„Determining the Welding Time and Welding Current“*.

- Only now set the welding current (digital display) with the arrow keys.

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Adjusting the Gas Pre-Flow Time

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

- Adjust the flow meter at the gas bottle to 8 to 16 litres/min (minimum 8 l/min.).
- Press the shielding gas key, LED shielding gas lights up.
- The display welding time ( ) shows the gas pre-flow time.
- Set the gas pre-flow time with the two arrow keys (longer – shorter).

After approx. 2 seconds, the display welding time ( ) automatically switches back to the previously set welding time.

- **If you are working with ceramic ferrules, then trigger the shielding gas key, the shielding gas LED is off. In this way, the gas valve remains closed during the welding procedure.**

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12.4.2 Library Mode

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

- Simultaneously press both arrow keys of welding time ( ) next to the welding time display ( ) for about one second.

The display welding time shows 0 - 06 (06 means the set welding current and welding time for stud diameter of 6 mm).

- You can pre-select the stud diameter (6 mm to 12 mm) with both arrow keys (longer – shorter).

After about 3 seconds the display ( ) jumps onto the preselected welding time and the display ( ) onto the pre-selected welding current.

- In addition, you can modify the welding time and welding current individually by pressing the arrow keys (as described above).

- **If you are working with shielding gas, different welding parameters for stud diameters (from 6 mm to 12 mm) are available in library mode.**

12.4.3 Electrode Mode

You can switch the stud welding unit to electrode mode.

- Simultaneously press both arrow keys ( ) next to the welding current display for about one second.

The display welding time shows EL.

- You can pre-select the welding current (from 50 to 400 A) with both arrow keys (lower – higher).

If you touch the work piece with the electrode, the stud welding unit is switched on.

- **If you switch the stud welding unit off and on, the stud welding unit is automatically reset to stud welding.**

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12.5 Performing the Welding Process

- **First set the necessary welding parameters.**
- Read and observe here point *12.4.1 „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.

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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.

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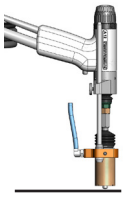
Danger due to noise

- Wear your ear protection during welding.
- Observe furthermore your working instructions and the accident preventi-on 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 workpie-ce.

- 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.

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☞

- **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*.

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13 Checking the Quality of the Weld

You can check the quality of the weld by

– Status displays and message of the welding system on the display

– Visual inspection

– Torque test

– Macrosection and hardness test as well as

– Tensile test.

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

13.1 Quality Check - Drawn-Arc Stud Welding

13.1.1 Carrying Out Visual Inspection

Criteria are:

– Ease of movement of the thread,

– Uniformity of the weld seam,

– Weld spatter and

– Porosity.

◆ Carry out the visual inspection on all welding elements.

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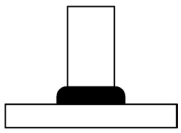
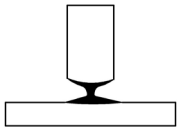
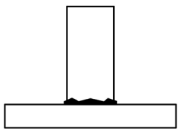
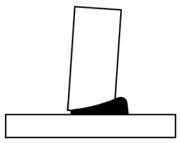
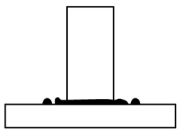
Visual Inspection			
Condition		Possible cause	Corrective actions
	Collar regular, bright and complete. Lengths after weld within tolerances	Correct parameters	none
	Contraction of weld collar Welding element too long	Plunging depth or lift too low Weld power too high Ceramic ring not centered correctly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

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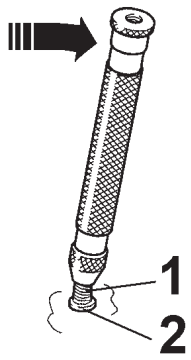
13.1.2 Carrying out Bending Test

You can purchase from HBS a bending device with inserts for various diameters of the welding elements.

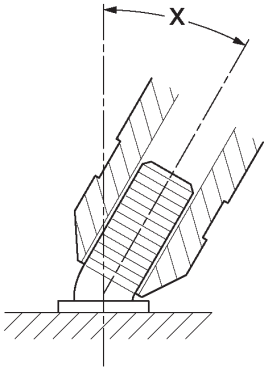
The bending test serves as an easy work sample and as a check for the selected welding parameters. The welded joint is stressed by bending in a non-defined way.



1 - Welding element

2 - Welded joint

◆ Place the bending device on the **welding element (1)** and



◆ bend the **welding element (1)** with the bending device once by 60° in any direction.

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

☞

◆ **Further tests should be conducted if the connection fails in the weld area.**

◆ In this case, **bend** the welding element exactly in the opposite direction by 60° towards the failing seam.

For a **non-destructive strength test** of the welding elements HBS offers a **torque bending test device** in accordance with DIN EN ISO 14555 (Order No. 92-40-135A).

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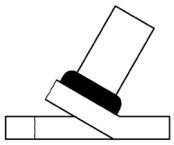
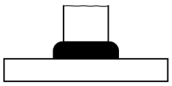
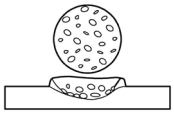
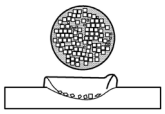
☞

◆ You don’t need to test all studs.

It is sufficient to carry out stud tests on several production samples that are picked at random.

Bending Test			
Type of fracture		Possible cause	Corrective actions
	Tearing of parent material	Correct parameters	none
	Fracture above collar after sufficient deformation	Correct parameters	none
	Fracture within the weld. High porosity	Weld energy too low Unclean surface Material not suitable for stud welding	Increase current and/or welding time Clean the surface Select suitable material
	Fracture of weld Bright appearance	Welding time too low.	Increase welding time

If the strength of the joint is inadequate, then:

◆ check the setting of the stud welding unit.

◆ check whether the surface of welding element and base material are clean and electrically conductive.

They must be free from scale, oil, paint, oxide layers.

◆ Grind off hardened workpiece surfaces (e.g. roll hardening).

◆ Check the piston of the welding gun for ease of movement.

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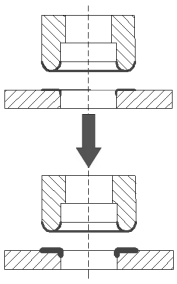
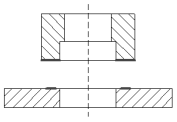
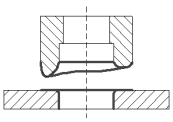
13.2 Quality Check - MARC Welding Procedure

13.2.1 Carrying Out Visual Inspection

Criteria are:

- Ease of movement of the thread/through-screwing
- Uniformity of the weld seam,
- Spatter and
- porosity.

◆ Carry out the visual inspection on all welding elements.

Melting behaviour and forming of the weld seam			
Characteristic		Possible cause	Corrective measures
	Welding seam uniform, shiny and closed Length of the welding element after welding within tolerance **Optimisation of the results:** Increase penetration by extending the welding time while reducing the welding current	Correct parameters	None
	Poorly formed, irregular welding seam with matt surface	Welding energy too low	Increase current and/or time
	Welding seam one-sided Drop formation on the welding element Drop short-circuit	Welding energy too high	Reduce current and/or time

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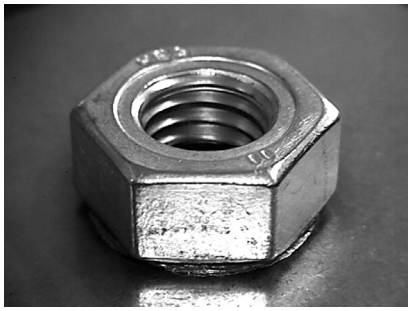
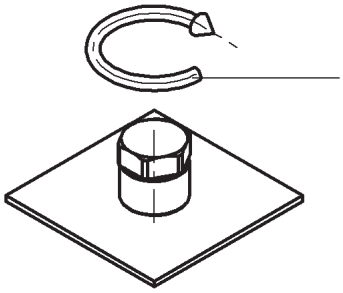
As an example of a very good weld seam appearance, here a standard sleeve of size M8 is welded to a drilled stainless steel plate (1.4301).

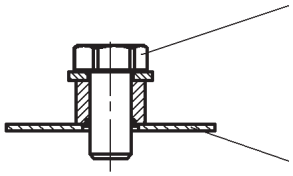


Front and rear view of a specimen part

13.2.2 Performing Torque Test

The torque test can be performed as follows:





During the torque test, pay attention that no transverse or shearing forces are exerted on the test piece.
This can falsify the determined strength.

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

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If the strength of the joint is inadequate, then:

- check the setting of the stud welding unit.
- check whether the surface of welding element and base material are clean and electrically conductive.

They must be free from scale, oil, paint, oxide layers.

- Grind off hardened workpiece surfaces (e.g. roll hardening).
- Check the piston of the welding gun for ease of movement.

13.2.3 Welding Seam Errors during MARC Welding Procedure

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

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 and Welding Current".*

- 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.**

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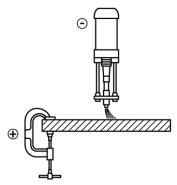
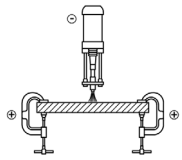
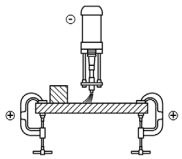
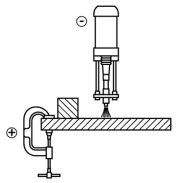
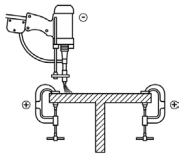
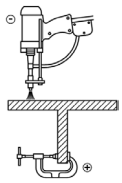
13.4 Blowing Effect and Remedies

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
	
	
	

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14 Troubleshooting

Danger from insufficiently qualified operating personnel

- Carry out only the work described here on your stud welding unit or stud welding gun.
- Repairs may only be carried out by appropriately qualified personnel.
- Inform your dealer or your maintenance department.

Fault	Possible cause	Fault localisation	Fault remedy	Performance
Primary switch does not rest in position 1	Primary switch defective	Check primary switch*)	Replace primary switch*)	Qualified specialists
	Fuse F4 1 AF for primary switch defective	Check voltage supply of primary switch*)	Replace fuse F4 1 AF*)	Qualified specialists
	Primary cable defective	Check primary cable for breaks*)	Replace primary cable*)	Qualified specialists
No LED display at the front	Fuse F5 1 AF defective	Check fuse F5 1 AF*)	Replace fuse F5 1 AF*)	Qualified specialists
No display	No ground connection	Check ground connection on workpiece	Tighten ground connection properly	Trained personnel
	Welding gun not connected	Check welding gun connection	Connect welding gun properly	Trained personnel
	Transition resistance (between stud and workpiece) too high	Check material surface	Clean or grind material surface	Trained personnel
	Ground cable broken	Check ground cable*)	Replace ground cable*)	Qualified specialists
	Welding gun cable broken	Check welding gun cable*)	Replace welding gun cable*)	Qualified specialists
No display	Defective connecting line of welding gun	Check function of connecting line*)	Replace connecting line*)	Qualified specialists
	Welding gun trigger button defective	Check control cable for electrical flow with triggered start button*)	Replace welding gun trigger button*)	Qualified specialists
	Control cable broken	Check control cable for electrical flow*)	Replace control cable*)	Qualified specialists

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Fault	Possible cause	Fault localisation	Fault remedy	Performance
Continuously red Display: 8888	Welding sequence too fast	Stud welding unit resets automatically	Let switched on stud welding unit cool down	Trained personnel
Gun does not lift, in spite of and	No lift adjusted	Check settings of welding gun	Modify set parameters	Trained personnel
	Short circuit of solenoid circuit of the gun	Check resistance value at control cable connector (18 Ω to 22 Ω) between Pin 1 and Pin 2*)	Replace control cable connector, control cable and solenoid*)	Qualified specialists
	Solenoid defective	Check solenoid (18 Ω to 22 Ω)*)	Replace solenoid*)	Qualified specialists
	Fuse F3 4 AF defective	Check fuse F3 4 AF*)	Replace fuse F3 4 AF*)	Qualified specialists
Lifting impossible	Solenoid circuit interrupted	Check resistance value at control cable connector (18 Ω to 22 Ω) between Pin 1 and Pin 2*)	Replace solenoid or control cable*)	Qualified specialists
No shielding gas	Shielding gas not connected	Check shielding gas connection	Connect shielding gas	Trained personnel
	Shielding gas control not enabled	Check gas control for activity	Switch on shielding gas control	Trained personnel
	Shielding gas valve defective	Check shielding gas valve*)	Replace shielding gas valve*)	Qualified specialists

STOP

Work marked with *) may only be carried out by qualified electricians!

- Please contact our Service department if none of the measures described remedies the situation.
- Please use the form „Service & Support“ in the annex to send in the stud welding unit.

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15 Shutting Down

- Switch off the stud welding unit.
- Pull out the mains plug.
- Disconnect the control cable and welding cables from the stud welding unit.
- Protect the stud welding unit and its components against the ingress of liquids and foreign matter.

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16 Maintenance and Care

Electric shock hazard

- Always switch off the stud welding unit before starting maintenance and care work.
- Pull out the mains plug.

Danger from insufficiently qualified operating personnel

- Carry out only the work described here on your stud welding unit.
- Repairs may only be carried out by appropriately qualified personnel.
- Inform your dealer or your maintenance department.

16.1 Cleaning

- Clean the surface of the stud welding unit with a slightly damp cloth, when necessary.
- Add a little household detergent to the cleaning water.

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

  These can damage the surface of your stud welding unit.

The inside of the stud welding unit must be cleaned at least every three months.

- Inform your dealer or your maintenance department.

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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

We recommend that the stud welding unit be subjected to an annual periodic inspection in compliance with the standard IEC 60974-4 “Periodic inspection and testing”.

Please contact your customer advisor for further information.

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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.

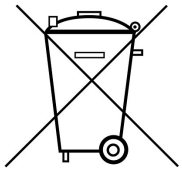
Storage temperature:

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.

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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

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