Operating manual

Stud welding unit INTRA 2100/1400

for drawn arc and short-term drawn arc processes

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INTRA 2100/1400

Operating manual

Model / Device: Stud welding unit

Original-

Manufacturer

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Imprint

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1 Introduction

1.1 General remarks

This operating manual is about the INTRA 2100/1400 welding device and is intended for operating and service personnel.

The INTRA 2100/1400 welding device can only be operated safely and reliably with knowledge of the contents of this operating manual. Before starting up your device, we ask that you thoroughly read this operating manual.

If anything is difficult or unclear, please contact Tucker customer service, who will be glad to help you.

The illustrations, information and data in this operating manual were valid as of July 2021.

Tucker reserves the right to make technical changes that contribute to improvement of the INTRA 2100/1400 welding device.

Also follow our instructions for safely operating the system in chapter 8.2 “Troubleshooting” of this operating manual. This will greatly ease independent solution of problems.

In addition, we recommend looking through DVS leaflet 0902 “Arc stud welding with drawn arc” and DGUV information 209-010 “Arc welding”, as well as standards EN ISO 14555 “Welding - Arc stud welding of metallic materials” and EN ISO 13918 “Welding - Studs and ceramic ferrules for arc stud welding”.

1.2 Device description

The INTRA 2100/1400 is a robust, high-performance welding control device and together with the NS 40 B or NS 40 SL welding gun forms a reliable stud welding system.
When properly used, this device will always provide good, reliable work results.

Welding Process

– *Drawn arc* process

- *Short cycle* weld process

High weld performance

INTRA 2100: 2100 A, up to 22 mm weld diameter

INTRA 1400: 1400 A, up to 16 mm weld diameter

High weld safety

This device's premium characteristics ensure consistently reliable operation and outstanding work results.
Welding is automatically prevented if there is overheating, a phase failure or an electrical fault in the welding gun current circuit.

The 35% power reserve ensures automatically ensures safe welding even under maximum loads and in continuous operation.
High-quality weld results are even achieved with very long connections and under unfavourable conditions.

Weld current and weld time settings

Continuous adjustment of these two important weld parameters is crucial to safe, reproducible welding.

Constant current automation

The built-in constant current automation reliably evens out primary system voltage fluctuations (max. ± 10%) within wide limits up to maximum weld current. Modern micro-electronics ensure consistent quality of your work results.

Re-release lock

The re-release lock prevents unintentional double welding if the welded stud is still in the placed welding gun.

S symbol

The INTRA 2100/1400 devices bear the “S” symbol and are approved for “welding in tight spaces and under elevated electrical hazards” (see DGUV Information 209-010).

Standard equipment

- 1 INTRA 2100/1400 control device with crane lugs and fixed casters (casters with parking brakes).
- 1 NS 40 B or NS 40 SL welding gun with 5 m or 3 m connecting cable, with customer’s choice of stud holder (NS 40 B welding gun complete with foot plate and ceramic ring holder).
- 2 earth cable, 5 m long, with clamp

Special equipment

- Weld gun extension cable
- Earth cable extension
- Table device for stationary use of welding gun for recurring tasks

Options

- Shielding gas module for drawn arc welding without ceramic ring
- Automatic stud feeder

1.3 Description of stud welding process

According to DIN 1910-100, the stud welding processes are to be assigned to arc pressure welding. This weld process generally welds peg-shaped connection elements full surface to the workpiece.

The INTRA 2100/1400 welding device can be used to weld ordinary commercial studs both in the drawn arc process (abbreviated BH 100 according to DVS 0902) and the short cycle drawn arc process (abbreviated BH 10 according to DVS 0902):

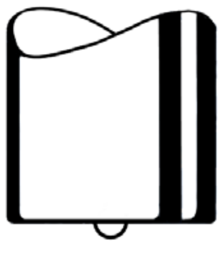
1. **Drawn arc process**
   (red NS 40 B welding gun)
   Welding with ceramic ring
2. **Short cycle weld process**
   (dark grey NS 40 SL welding gun)
   Welding without a ceramic ring, especially on thin (and galvanized) sheet metal

The desired process is selected by moving the selector switch (→ see Chapter 5.1 “Operating elements”) and connecting the matching welding gun (→ see Chapter 4.2 “Welding gun connection”).

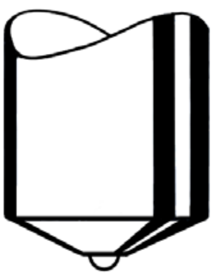
1.3.1 Drawn arc process

Usually, this process is called the “normal” stud welding process. It is generally used in a diameter range from 3 mm to 25 mm with weld times up to 1 second. The INTRA 2100/1400 compact devices allow welding of maximum diameters of 16 mm to 22 mm.

The Tucker weld studs have a specially shaped tip (see the following illustrations) with a special aluminium preparation adapted to the stud diameter. The aluminium serves as an ignition aid and reliably deoxidizes the melt.



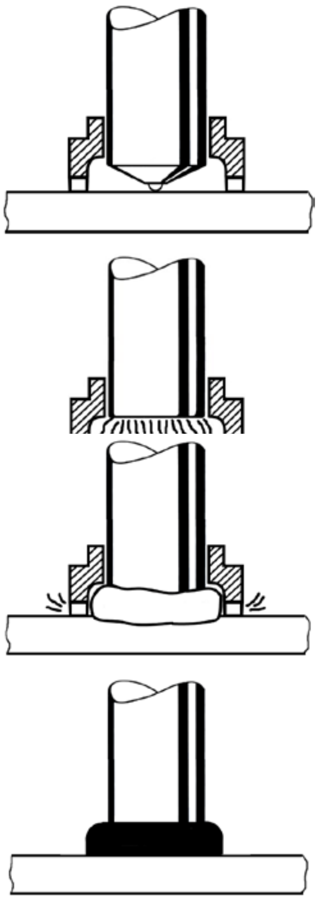
Stud with even front surface



Stud with conical front surface

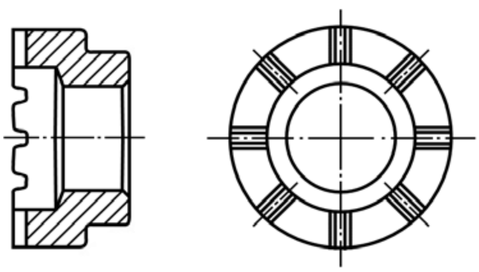
Process

1. **Placing the stud**
   The stud is inserted into the stud holder and ceramic ring in the welding gun's ceramic ring holder. The tip of the stud rests on the base material and the welding gun is pressed against the workpiece until the ceramic ring's entire surface lies on the workpiece.
2. **Lifting and igniting the arc**
   When the release button is pressed on the welding gun, the stud lifts and an auxiliary arc is created. Then the main arc is ignited; the stud and the base material fuse.
3. **Immersion**
   After the weld time is over, spring pressure presses the stud into the liquid weld pool.
4. **Welded stud**
   The bond is created a few tenths of a second after the release button is pressed. The welding gun is not pulled from the stud until about 1 second of dwell time. The melted material is then hardened. Then the ceramic ring is removed.



Drawn arc process with ceramic ring
(BH 100 KR per DVS 0902)

For this standard process, for every weld, a ceramic ring adapted to the weld stud is necessary. The ceramic ring concentrates the arc on the weld point and shields the melt from the ambient air, preventing harmful oxidation of the melt. It holds the melt together and forms a defined, reproducible weld bead. The ceramic ring also decreases the cooling speed of the weld point, preventing undesirable hardening of the base material. Moreover, it protects the welder from the arc and hot weld splatter.



Ceramic ring

Drawn arc process with shielding gas
(BH 100 SG per DVS 0902)

For special cases, the INTRA 2100/1400 welding device can be retrofitted with a gas module for stud welding under shielding gas. Here changes to the performance data and parameter inputs must be taken into account.
Ceramic ring not required.
The weld studs for this weld process contain no aluminium preparation.

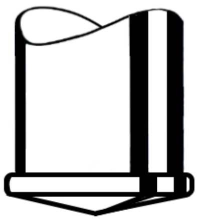
Only diameters up to 10 mm can be welded under shielding gas. The weld must be in tub position, because otherwise the fluid weld metal will flow out of the welding location. A fillet-shaped weld bead always forms, no dimensionally accurate reproducible bead, as when welding with a ceramic ring.

For this, follow the applicable special regulations for welding under shielding gas (e.g. DGUV-R 100-500, Chapter 2.26: "Welding, cutting and related processes"). Your Tucker technical consultant will be happy to give you more information.

1.3.2 Short cycle weld process
(BH 10 per DVS 0902)

Due to its easy, flexible use, the short cycle weld process is one of the safest, most versatile processes in sheet metal working.

In this process, generally studs up to 8 mm in diameter without a ceramic ring are welded. Due to the short weld times of no more than 0.1 second, the melt zone is narrow and the heat input is low, so that welding can easily be done on sheet metal as thin as 0.6 mm. The short weld time also allows welding of some materials of different kinds (e.g. brass studs on sheet steel), welding of galvanized studs on galvanized sheet metal, and welding on easily contaminated surfaces.

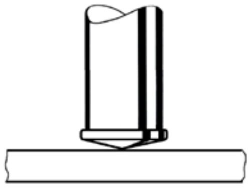


Stud with
welding flange

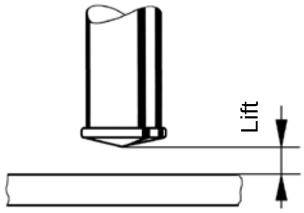
Tucker SC weld studs have a special conical welding tip adapted to this process. The enlarged flange diameter increases the mechanical resilience of short cycle welding.

Process

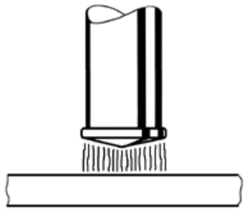
1. **Placing the stud**
The stud is slid into the stud holder with its tip placed on the workpiece and welding gun pressed down against the workpiece to the mount of the support tube.



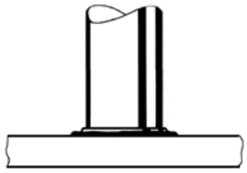
2. **Lift**
When the release button is pressed on the welding gun, the stud lifts and an auxiliary arc is created.



3. **Igniting the arc**
Then the main arc is ignited, and the stud front surface and base material are fused.



4. **Welded stud**
After the weld time is over, spring pressure presses the stud into the liquid weld pool. A few hundredths of a second after the release button is pressed, the joint is created.



In comparison to the drawn arc process, the same weld diameters are welded weld time decreased by a factor of 10, but considerably increased current. Therefore, no additives to deoxidize the weld point are needed.

1.4 Material combinations

The material combinations listed in the table below have already been tested. The weld angle for the material combinations is defined as follows:

a = suitable for any application, such as force transfer,

b = suitable with limitations for force transfer,

c = suitable with limitations only for heat transfer,

– = cannot be welded.

Explanation of superscript numbers:

1) Up to 10 mm diameter and shielding gas in tub position (PA),

2) Only during short cycle stud welding with drawn arc,

3) Maximum yield strength $R_{eH} \leq 460$ N/mm^2.

Material combination		Base material			
		EN ISO 15614-1*) Groups 1 and 2 3)	EN ISO 15614-1*) Groups 3 and 4	EN ISO 15614-1*) Group 9	EN ISO 15614-2*) Groups 21 and 22.1
Stud	S 235 4.8 (weld suitable) 16 Mo 3	a	b	b 2)	–
	X 10 CrAl 18 X 10 CrAl 24 X 10 CrNiSi 25-4	c	c	c	–
	1.4301, 1.4303 1.4401, 1.4451 1.4571	b (a) 1)	b	a	–
	EN AW-AlMg 3 EN AW AlMg 5	–	–	–	b

Group 1: Steels with minimum yield stress of $R_{eH} \leq 360$ N/mm^2

Group 2: Standardized or thermodynamically treated fine-grain structural steels with a minimum yield stress of $R_e > 500$ N/mm^2

Group 3: Annealed fine-grain structural steels with a minimum yield stress of $R_e > 500$ N/mm^2

Group 4: Steels with Cr max. 0.75%, Mo max. 0.6%, V max. 0.3%

Group 9: Austenitic stainless steels

Group 21: Pure aluminium with max. 1.5% impurities

Group 22.1: Non-curable AlMg alloys with ≤3.5% Mg content

Material combinations that are not listed in the table can be tested in the welding laboratory. Contact your Tucker GmbH technical consultant.

*) EN ISO 15614-1, 2: Specification and qualification of welding procedures for metallic materials – Welding procedure test

Therefore, all weldable materials can be processed with the stud welding process. The standards and regulations that apply to construction technology, boiler, machine, reactor and shipbuilding in regard to mechanical properties, chemical composition and suitability of the materials for welding must be observed.

1.4.1 Combinations for the drawn arc process

Generally, for the drawn arc process, combinations of like materials are to be preferred (see the table on the previous page).
This means that steel-steel and aluminium-aluminium joints can be created.
So-called “black-white joints” (e.g. S235 with 1.4301) lead to a hard martenistic, brittle weld metal in the welding zone. This welding is not suitable for high-strength joints. For such applications, we recommend using Tucker DUO studs that always have the same kind of material in the welding zone. Please ask your Tucker technical advisor.
During execution of aluminium welds, you should also get in touch with your Tucker technical consultant.

1.4.2 Combinations for the short cycle process

To a limited extent, the short cycle process also allows some combinations of unlike materials (see the table on the previous page).
The special advantage here is the option to weld galvanized studs with galvanized sheet metal. Generally, however, cold-rolled sheet metals and profiles should be favoured.

1.5 Technical data

1.5.1 INTRA 2100 technical data

Max. weld diameter - Drawn arc - Short cycle	22mm 9mm		
Weld current, continuously adjustable Current reserve for weld Ø (measured with standard equipment on a stable network)	200 – 2100 A		
Welding output in continuous operation (drawn arc, with standard equipment)	Stud	Weld Ø	Welding sequence
	KB 7/8”	22.2mm	3 units/min
	S 16	16.0mm	6 units/min
	MP 16	14.6mm	8 units/min
	S 10	8.0mm	∞
Weld time, continuously adjustable - Drawn arc - Short cycle	0.1 s – 1 s 0.01 s – 0.1 s		
Dimensions width Height Depth Weight	520mm 750mm 770mm 248 kg		
Connection voltage 50/60 Hz – Standard (options upon request) Nominal power Network protection per phase (at 400 V) Connected load Protection type CEE power plug (at 400 V)	3 ~ 400 V 29 kVA 63 A 168 kVA IP 23 63 A (3L+PE)		
Cooling type	External cooling (fan installed)		
Operating temperature	0°C to +40°C		
Storage temperature	-25°C to +55°C		
Relative humidity	0% to 50% at 40°C 0% to 90% at 20°C		

1.5.2 INTRA 1400 technical data

<table>
<tr><td>Max. weld diameter - Drawn arc
- Short cycle</td><td colspan="3">16mm
9mm</td></tr>
<tr><td>Weld current, continuously adjustable
Current reserve for weld Ø
(measured with standard equipment on a stable network)</td><td colspan="3">200 – 1400 A</td></tr>
<tr><td rowspan="5">Welding output in continuous operation
(drawn arc, with standard equipment)</td><td>Stud</td><td>Weld Ø</td><td>Welding sequence</td></tr>
<tr><td>S 16</td><td>16.0mm</td><td>6 units/min</td></tr>
<tr><td>MP 16</td><td>14.6mm</td><td>8 units/min</td></tr>
<tr><td>MR 16</td><td>13.2mm</td><td>10 units/min</td></tr>
<tr><td>S 10</td><td>10.0mm</td><td>∞</td></tr>
<tr><td>Weld time, continuously adjustable - Drawn arc
- Short cycle</td><td colspan="3">0.1 s – 1 s
0.01 s – 0.1 s</td></tr>
<tr><td>Dimensions width
Height
Depth

Weight</td><td colspan="3">520mm
750mm
770mm

190 kg</td></tr>
<tr><td>Connection voltage 50/60 Hz – Standard
(options upon request)

Nominal power
Network protection per phase (at 400 V)
Connected load
Protection type
CEE power plug (at 400 V)</td><td colspan="3">3 ~ 400 V

25 kVA
63 A
51.8 kVA
IP 23
63 A (3L+PE)</td></tr>
<tr><td>Cooling type</td><td colspan="3">External cooling (fan installed)</td></tr>
<tr><td>Operating temperature</td><td colspan="3">0°C to +40°C</td></tr>
<tr><td>Storage temperature</td><td colspan="3">-25°C to +55°C</td></tr>
<tr><td>Relative humidity</td><td colspan="3">0% to 50% at 40°C
0% to 90% at 20°C</td></tr>
</table>

1.6 Accessories (optional):

- **Weld guns for manual stud loading:**

1 Welding gun:	Type NS 40 SL
complete with accessories:	see operating manual NS 40 SL
1 Welding gun:	Type NS 40 (B-1, B-2, B-3, B-4)
complete with accessories:	see operating manual NS 40 B

- **Stud (types and dimensions):**

SC stud for short cycle drawn arc process:

SC stud (type)	Shaft Ø / weld Ø
Threaded stud (SC - B)	M3 - M8 / 4 mm - 9 mm
Stud bolt (SC - S)	3 mm - 9 mm
Internally threaded socket (SC - I)	M3 - M5 / 7 mm - 9 mm
Sawtooth stud (SC - Z)	M 3 -M8 / 4 mm - 9 mm

DA stud for drawn arc process:

DA stud (type)	Shaft Ø / weld Ø
Threaded stud (MP, MPF)	M6 - M12 / 5.3 mm - 10.8 mm
Threaded stud (M, MD)	M8 – M12 / 6 mm - 12 mm
Threaded stud (MR)	M6 – M12 / 4.7 mm – 9.5 mm
Stud bolt (SC - S)	3 mm - 12 mm
Internally threaded socket (MI)	M4 – M8 / 10 mm - 12 mm
Head bolt (KB)	≤ 10 mm

1.7 Declaration of Conformity

EU Declaration of Conformity in accordance with Machinery Directive 2006/42/EU Appendix II 1A

Document name:	Intra 1400_00_EN
Manufacturer:	**Authorized to compile technical documentation:**
STANLEY Engineered Fastening	Matthias Appel
TUCKER GmbH	TUCKER GmbH
Max-Eyth-Strasse 1	Max-Eyth-Strasse 1
35394 Giessen	35394 Gießen
Germany	Germany
Product name:	Control and power unit for stud arc welding
Models:	Intra 1400, Intra 2100
Serial Number:	
Year of construction:	

The manufacturer hereby declares that the products stipulated above comply with all relevant provisions and requirements of the following applicable directives:

2006/42/EU – Machine directive

2014/30/EU – EMC Directive

The conformity assessment was conducted for machines not subject to Appendix IV with internal production controls for manufacturing machines according to Appendix VIII.

References of the directives as published in the Official Journal of the European Union.

The following harmonized standards were used:

DIN EN IEC 60974-1:2018-12	Arc welding equipment - Part 1: Welding power sources
DIN EN IEC 60974-12:2012-03	Arc welding equipment - Part 12: Coupling devices for welding cables
DIN EN 60204-1:2019-06	Safety of machinery - Electrical equipment of machines - Part 1: General requirements
DIN EN 60529:2014-09	Degrees of protection provided by enclosures

Notified body:	EMC Test NRW GmbH Emil-Figge-Straße 76, 44227 Dortmund
EU ID number:	1946
EU type examination certificate:	010/21-d

Represented by the chief executive officer: Thomas Ehrhardt

Location, date: Giessen, 2021-08-25

Legally binding signature:

This declaration certifies conformity with the above-mentioned guidelines

2 Work safety

2.1 Safety symbols

Safety instructions and warnings are for your personal safety and for product safety. In this operating manual, they are highlighted by the following safety symbols.

The safety symbol used has the following meaning:

The caution sign calls attention to potentially hazardous situations. It is always used in connection with one of the additional terms defined below.

The additional terms have the following meaning:

Danger: This means that death, severe bodily injury or severe property damage will occur if the appropriate precautionary measures are not taken.

Warning: This means that death, severe bodily injury or severe property damage may occur if the appropriate precautionary measures are not taken.

Caution: This means that minor bodily injury or property damage may occur if the appropriate precautionary measures are not taken.

This sign indicates important information about proper handling of the product or special instructions that should receive special attention.

Warning:

- Everyone who works on the INTRA 2100/1400 is obligated, before starting work, to read and follow the safety instructions in this operating manual!
- The system owner is obligated to allow only people familiar with the work safety and accident prevention regulations to work on the INTRA 2100/1400.

2.2 Safety instructions

A prerequisite for safe handling and trouble-free operation of the INTRA 2100/1400 welding device is knowledge of the following safety instructions.

Informal safety instructions:

- The operating manual must always be stored at the place where the INTRA 2100/1400 is used.
- The safety symbols and type plate must be kept legible.

Training of personnel:

- The stud welding system's operating personnel must:
  - be trained in handling welding technology equipment,
  - have had stud welding qualification training,
  - know the content of this operating manual.
- Set-up and electrical personnel must:
  - have had training enabling them to make repairs,
  - have authorization to start up electrical circuits and devices according to the safety standards.
- Personnel in training are allowed to:
  - work on the welding system only under the supervision of experienced technical personnel.

Personal safety equipment:

- It is mandatory to wear the following safety equipment:


flame-resistant safety clothing covering the entire body,


welder's goggles with protection filter (per EN 169),


Safety gloves,


safety helmet (for overhead welding),


Ear protection (plugs, headset) is recommended.

- During welding, touchable parts of the welding gun, such as studs, stud holder and all electrically connected parts carry current.
  Therefore, do not wear any electrically conductive jewellery (ring, watch or chain)!

Safety measures at the workplace:

The workplace must be so arranged that people nearby are adequately protected against damaging effects of optical radiation.

Spacial boundaries and shields must be set up to prevent reflections and penetration by radiation to the greatest extent possible.

Combustible and flammable materials must be removed from the welding zone. It must be ensured that a fire extinguisher is available at the workplace.

Ensure adequate ventilation and lighting at the workplace.

Weld only in rooms and areas where no hazards from fire, explosion, smoke, fumes or moisture can occur.

When in doubt, an authorized welding supervisor or fire protection officer must be consulted.

Depending on the process, stud welding can produce strong electromagnetic fields. These can:

- be life-threatening for people with heart pacemakers,

- disturb or damage electrical or electronic devices,
- irrecoverably erase magnetic storage media,
- magnetize and damage watches.

The weld current cables also produce strong electromagnetic fields.

Make sure that the welding and earthing cables are as free of loops as possible and are laid at an adequate distance from unrelated electrical devices.

This especially applies when welding at construction sites and on special equipment.
When in doubt, check with the device manufacturer for the construction site or special equipment.

The system owner is obligated to take suitable corrective measures.

Warning:

- The INTRA 2100/1400 welding device is suitable according to standard EN 55011 for use in an industrial environment (limit class A).
- It is explicitly pointed out that devices in limit class A can cause radio interference in residential and business areas.

Safety measures before starting work:

- Before starting work (shift change), check:
  - all safety equipment for correct attachment,
  - all system components for externally visible damage,
  - all connection cables for loose contacts and scorch marks.

Warning:

- During the welding process, touchable parts of the welding gun, such as studs, stud holder and all electrically connected parts carry current. These components must not be touched during the welding process!
- Do not wear any electrically conductive jewellery, such as rings, watches or chains!
- It is explicitly pointed out that devices in limit class A can cause radio interference in residential and business areas.

Safety measures during normal operation:

- Use welding systems only in technically perfect condition.
- Any unsafe way of working must be avoided.

Safety measures after finishing work:

- Turn off the welding device and pull the power plug.
- Secure and mark the welding device against unauthorized use.
- Adhere to the specified maintenance intervals.

Safety measures during malfunction mode:

- Turn off the welding device and pull the power plug.
- Secure and mark the welding device against being turned back on.
- After repair, the system's operational capability must be ensured.

Warning:

- Only authorized electro-technical personnel are allowed to open the welding device or work inside its housing.
- Before the welding device is closed, the earth conductor must be connected to the device housing.

Safety measures during elevated electrical hazard:

There is an elevated electrical hazard especially during work:

- in tight spaces with electrically conductive walls,
- in wet, moist or extremely dry and hot spaces,
- with limited freedom of movement on electrically conductive parts (metallic cables, grates, support rails, bottom plates, etc.),
- under narrow conditions between or on electrically conductive parts.

Under these work conditions, the following safety measures must be taken:

The welder must be adequately protected against electrical hazards through use of insulating pads or intermediate layers.

The insulating material must be attached such that conductive parts, moist walls and moist floors cannot be touched.

If it is not possible to use insulating materials due to additional hazards (falling hazard, special spacial conditions, etc.), work must be done at least in dry, undamaged work clothing.

Safety features of the INTRA 2100/1400 welding device

The INTRA 2100/1400 welding device bears the “S” symbol and is suitable for “welding in tight spaces and under elevated electrical hazards” (for more details, see DGUV Information 209-010).

- The peak value of open-circuit voltage is less than 113 V.

For protection against direct and indirect touching, the welding device must be equipped with the following safety measures:

- Protection class IP 23: Protection against penetration by foreign bodies (Ø ≥ 12 mm).
  Protection against dripping water, slanted to 60° from horizontal.

- Protection class I: Device with basic insulation and connection of all touchable, conductive parts to the earth conductor.

2.3 Intended use

During development of the INTRA 2100/1400 welding device, the relevant standards and accident prevention regulations were taken into account. The welding device has been built to the current state of the art and is safe to operate.

However, the INTRA 2100/1400 can pose hazards when operated improperly or by untrained people.

Intended use includes adherence to the following points:

- The INTRA 2100/1400 welding device is designed for welding studs according to the “BH 100” drawn arc process and the “BH 10” short cycle drawn arc process.
- The information in this operating manual regarding material combinations and characteristics of studs and base materials must be observed.
- The INTRA 2100/1400 welding device’s place of use is limited to the industrial and commercial sector.

  The INTRA 2100/1400 is not suitable for use in residential and business areas because, depending on the process, there may be electromagnetic disturbances to external electrical and electronic devices.
- The INTRA 2100/1400 is to be configured only with the device components indicated in Chapter 1.6. Configuration with device components from other manufacturers or independent design changes to the system are not allowed.
- The welding device is to be operated only with the replacement parts and accessory parts indicated in this operating manual.
- The indicated maintenance and inspection routines and replacement of wear-prone parts absolutely must be adhered to.

Intended use also includes observance of all general and special safety instructions in this operating manual and of the relevant accident prevention regulations (DGUV Specification 3; DGUV-R 100-500 Chapter 2.26*)).

Violations of intended use or resulting applications are prohibited and may be dangerous. The manufacturer is not liable for resulting damages; the user bears the full risk.

*) DGUV regulation 3: UVV “Electrical systems and equipment”

*) DGUV-R 100-500, Chapter 2.26: “Welding, cutting and related processes”

2.4 Warranty and liability

Warranty and liability claims regarding damage to people or property are void if they can be traced to one or more of the following causes:

- Unintended use of the INTRA 2100/1400 welding device
- Failure to follow the operating manual of the INTRA 2100/1400 welding device.
- Failure to follow the operating manuals of the system components.
- Improper start-up, operation or maintenance of the system.
- Use of the welding system in residential and business areas.
- Improper handling of the shielding gas consumption equipment.
- Use in moist, combustible or explosion prone environments.
- Start-up without properly attached safety equipment.
- Start-up after improperly done repairs.
- Start-up after repair done by unqualified personnel.
- Independent design changes to the system.
- Failure to adhere to the specified maintenance intervals.

The INTRA 2100/1400 welding device is designed only for the range of application indicated in Chapter 2.3 “Intended use”.

Before using the welding device outside its contractual range of use, Tucker GmbH customer service must be consulted, or else the warranty will be void.

2.5 Copyright

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3 Delivery and transport

3.1 Scope of delivery

Delivery of the INTRA 2100/1400 welding device includes the following device components and accessory parts:

- 1 INTRA 2100/1400 welding device,
- 1 INTRA 2100/1400 operating manual.

3.2 Packaging and dispatch

Unless agreed otherwise, the packaging type corresponds to the HPE regulations established by the Federal Association for Wood, Pallets and Export Packaging.

3.3 Incoming inspection

The welding device has been carefully inspected at the factory before delivery.

However, slight damage during transport is not always avoidable. We therefore ask that upon delivery the welding device be inspected for transport damage an for completeness of the parts included in delivery.

Any transport damage and/or missing parts must be reported to the manufacturer or the authorized carrier company immediately.

3.4 Interim storage

If the INTRA 2100/1400 welding device is not put into operation immediately after delivery, it must be temporarily stored in a secured area.

The welding device must be adequately protected against dust and moisture. The storage temperature can be found in the technical data (→ see Chapter 1.5).

3.5 Transport

To prevent damage to the welding device, the INTRA 2100/1400 must be transported only on the casters provided for the purpose, using the carrying handles, crane lugs or with a suitable lift device.

Neither the power supply, earth, welding or control cable is to be used as a pulling line or as a handle for transporting the device!

3.6 Location of use

The INTRA 2100/1400 welding device's place of use is limited to the industrial and commercial sector. During bad weather, such as rain, snow, etc., welding outdoors or in unprotected rooms is prohibited.

In residential and business areas, welding can cause radio interference.

This radio interference can:

- be life-threatening for people with heart pacemakers,
- disrupt and/or damage other electrical devices,
- damage or erase electronic storage media.

During use in residential and business areas, the system operator must ensure that the electromagnetic fields produced during welding pose no danger to people or property.

Warning:

- Beware of death hazard! People with heart pacemakers must always stay away from stud welding systems!
- External electrical devices may be disrupted or damaged by the electromagnetic fields that occur during welding!
- Welding near flammable materials or in fire- or explosion-prone areas or damp environments is explicitly forbidden!

3.7 Device set-up

When setting up the system, pay special attention to the general safety regulations and accident prevention regulations (DGUV Regulation 3 “Electrical systems and equipment” and DGUV-R 100-500, Chapter 2.26 “Welding, cutting and related work processes”) and DVS 0902 (“Arc welding with drawn arc”).

Special attention should be paid to the fire prevention regulations.

Chapter 2 in this operating manual provides additional safety instructions.

When setting up the welding device, it is necessary to provide a level, vibration-free, anti-slip placement surface. The casters must always be locked.

The placement surface’s load capacity must be at least double the weight of the welding device.

The INTRA 2100/1400 must be protected from high humidity and entry of fluids.
It must not be set up on fluid-carrying lines.

To ensure the fan’s temperature exchange with the environment, maintain a minimum distance of one metre from any heat sources.

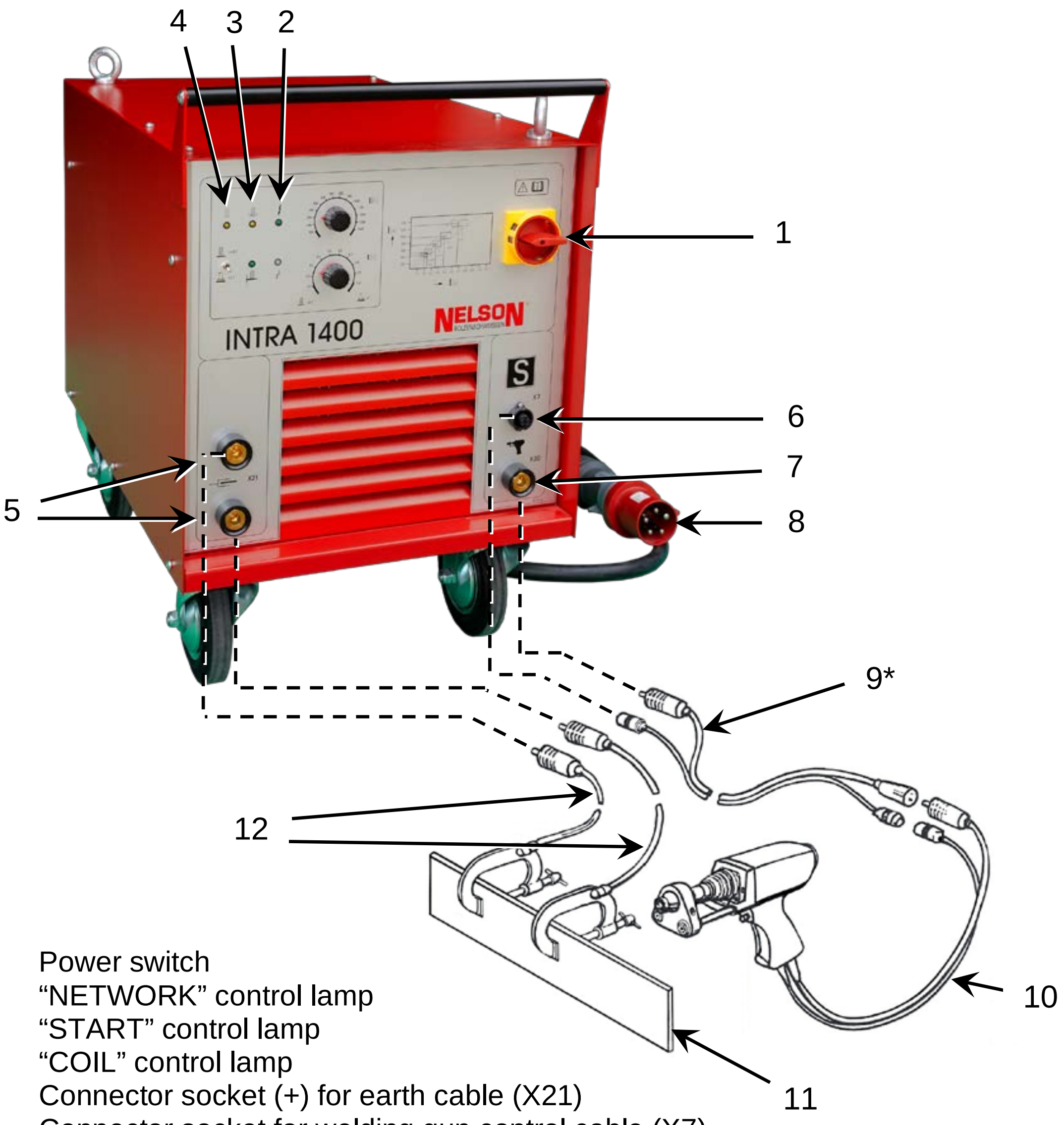
To cool the device, a fan is built in, which provides the necessary air circulation in the device. Therefore, the air intake and air exhaust slots on the front and back of the device must NOT be clogged or covered. A safety distance of at least 30 cm from the device must be maintained.

Thermal overload of the device is shown by the MALFUNCTION (= red) control lamp (→ see Pos. 7 in the illustration “Control and display elements” in Chapter 5). Further welding are then prevented. Welding cannot begin again until this control lamp goes out again after a certain cooling time. Check whether the ventilation slots are clear and not covered.

4 Connection tasks

The connecting parts are functionally arranged on the front plate of the INTRA 2100/1400 welding device.

> **Warning:**
>
> - Before starting connection work, turn off the INTRA 2100/1400 welding device!
>   The power switch (1) must be in the “O” position.



1 Power switch
2 “NETWORK” control lamp
3 “START” control lamp
4 “COIL” control lamp
5 Connector socket (+) for earth cable (X21)
6 Connector socket for welding gun control cable (X7)
7 Connector socket (–) for welding gun (X20)
8 power cable with power supply plug (Standard 63 A-CEE)
9 Gun-extension cable (7.5 m) ***Special accessory Item No. 67-01-16
10 Welding gun with gun cable (5 m)
11 Work piece
12 Earth cable (5 m), 2× Item No. 50-05-63

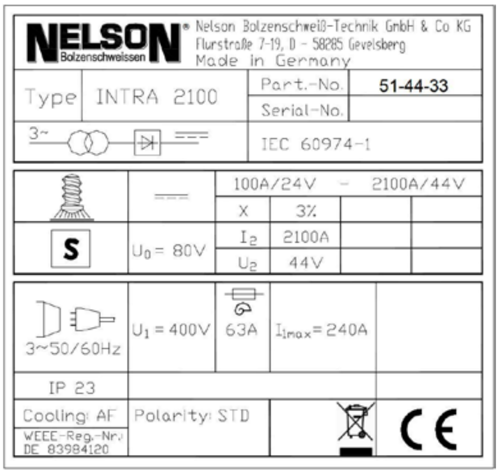
4.1 Power cable connection

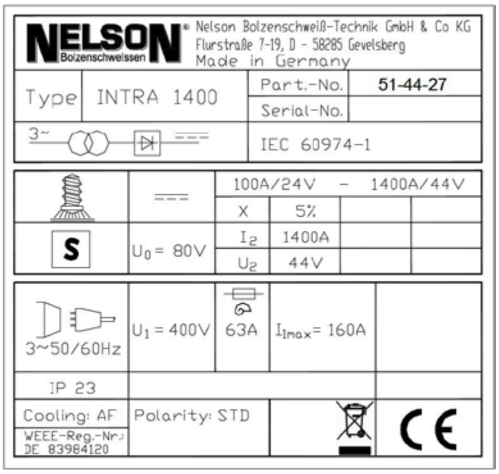
The power cable must be connected only to a grid connection socket with a tested earth conductor function.

Warning:

- Before connection, the power socket's earth conductor function must be checked!
- The power supply connection must be checked only by electro-technical personnel!
- Only electro-technical personnel are to open the welding device or work within its housing!

The power supply values are marked on the INTRA 2100/1400 type plate.





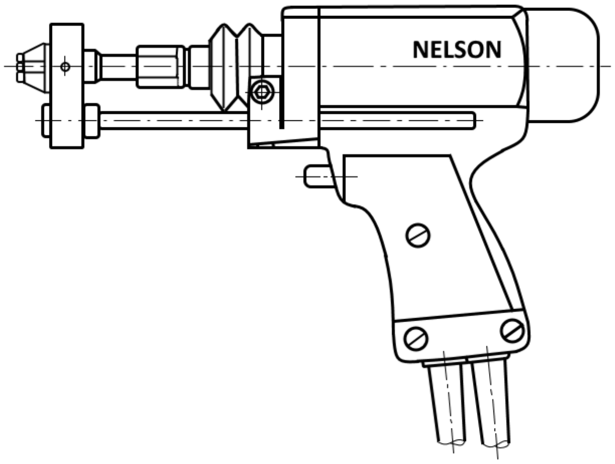
***: *following (Pos. No.) → see illustration on page 24*

After the device is switched on with the power switch (1*), the network control lamp lights up green (2*).
The connection should be made to a stable electrical system. Consistent power supply voltage and network frequency ensure consistent high-quality weld results. The built-in constant current automation reliably evens out primary system voltage fluctuations within broad limits and works up to the maximum weld current.

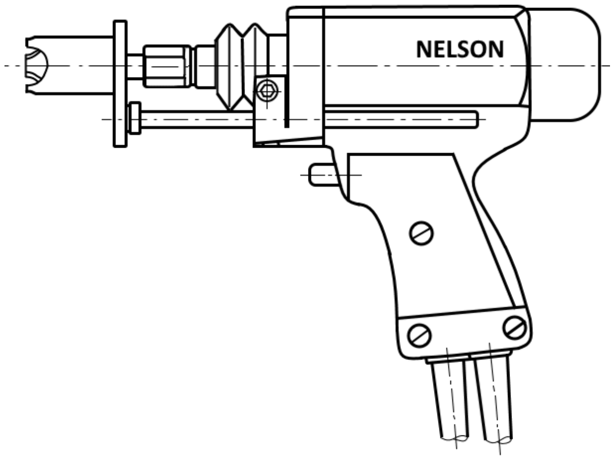
4.2 Welding gun connection

Choose the welding gun according to your welding task and the selected weld process:

DRAWN ARC = RED GUN
NS 40 B with ceramic ring holder:



SHORT CYCLE = DARK GREY
NS 40 SL GUN:



Warning:

- Always use only original NELSON/Tucker welding guns on the INTRA control device. Otherwise, the control device can get damaged!
- To protect inductive shunts that decrease weld performance, the welding cable should be kept as short as possible and free of loops!

*****: *following (Pos. No.) → see illustration on page 24*

The welding cable of the welding gun (10*) is connected to the connector socket X20 (7*). This plug connection is secured by turning the plug rightward to the stop.

To increase the work area, an extension cable (9*) can be connected between the control device and the welding gun. The total cable length should not exceed 50 m (INTRA 1400) or 25 m (INTRA 2100). The loss of performance that then occurs leads to an undesirable decrease in weld quality, among other things. Therefore avoid unsuitably long cable connections that promote loop formation and, in any case, cause a loss of performance.

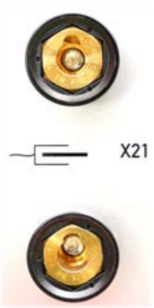
The welding gun’s control cable is connected to the X7 socket (6*) and is secured by turning the cap nut rightward. The control cable transfers the signals to the welding gun controls.

Then the device is on, the yellow COIL control lamp (4*) lights up. When the release button on the welding gun is pressed, the yellow START control lamp (3*) lights up.

During the welding process, the COIL control lamp (4*) goes off briefly. If this control lamp does not light up at all, the welding gun’s magnetic coil circuit is defective. If the START control lamp (3*) does not light up when the welding gun is activated, the trigger current circuit is defective (→ see Chapter 8.2 “Troubleshooting”).

4.3 Earth cable connection

The weld current return goes through the two earth cables, which must be connected to the INTRA 2100/1400 welding device as follows:



Earth cable plug connections:

The earth cables’ plugs must be connected to the two sockets marked X21
(→ see Pos. 5 in the illustration on page 24).

The connections must be secured by strongly pressing rightward to the stop.

Earth cables and earth clamps are not delivered with the INTRA 2100/1400.

Warning:

- The earth cable connections cannot be locked! The connection must be tested regularly for tightness!
- To prevent inductive shunts, the earth cables must be laid without looping, to the degree possible.

4.4 Workpiece connection

The earth cables are standard-equipped with an earth clamp that must be connected to the workpiece (→ see Pos. 11 or 12 in the illustration on page 24).

When connecting the two earth clamps, observe the following:

1. The earth clamps must be connected directly to the workpiece or workpiece mount (welding table, welding frame).
Steel constructions, railway tracks, pipes, etc., must not be used as current conductors if they are not the workpiece to be welded.

2. Place the earth clamps at equal distance (symmetrically) from the welding location, if possible.

3. The weld current circuit is not to be earthed, except if the workpiece or workpiece mount are mandatorily earthed (pipes, ship construction, etc.).

4. Before connecting the earth clamps, the following instructions for preventing the "arc blow effect" must be observed!

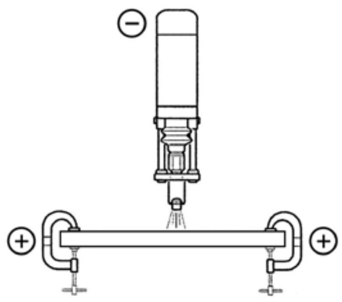
Arc blow effect

"Blow effect" means lateral deflection of the arc from the central position. Based on the cause, a distinction is made between the following blow effects:

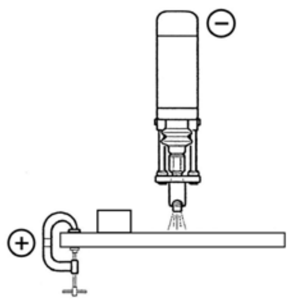
- Thermal blow effect: Deflection of the arc through expansion and turbulence of heated gases in the arc combustion chamber.
- Magnetic blow effect: Deflection of the arc through the influence of magnetic or electromagnetic fields.

The possibilities for reducing thermal blow effect are limited. They are limited to the most exact possible centring of the stud and stud holder.

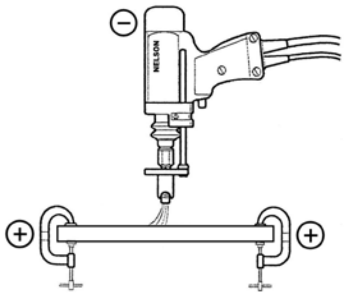
To reduce the effects of magnetic blow effect, several corrective measures are available, some of which are shown below.



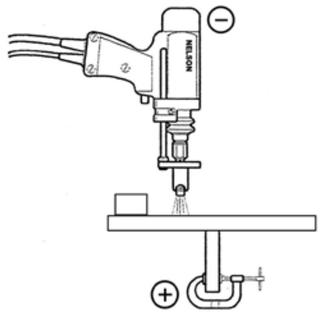
To favourably influence the arc, the earth clamps must be arranged as symmetrically as possible at the welding location.



With a one-sided earth clamp, the arc blows away from the clamp. This situation can be eliminated with additional metal plates.



Influences on the arc by the welding cable can largely be prevented by turning the welding gun 90°.

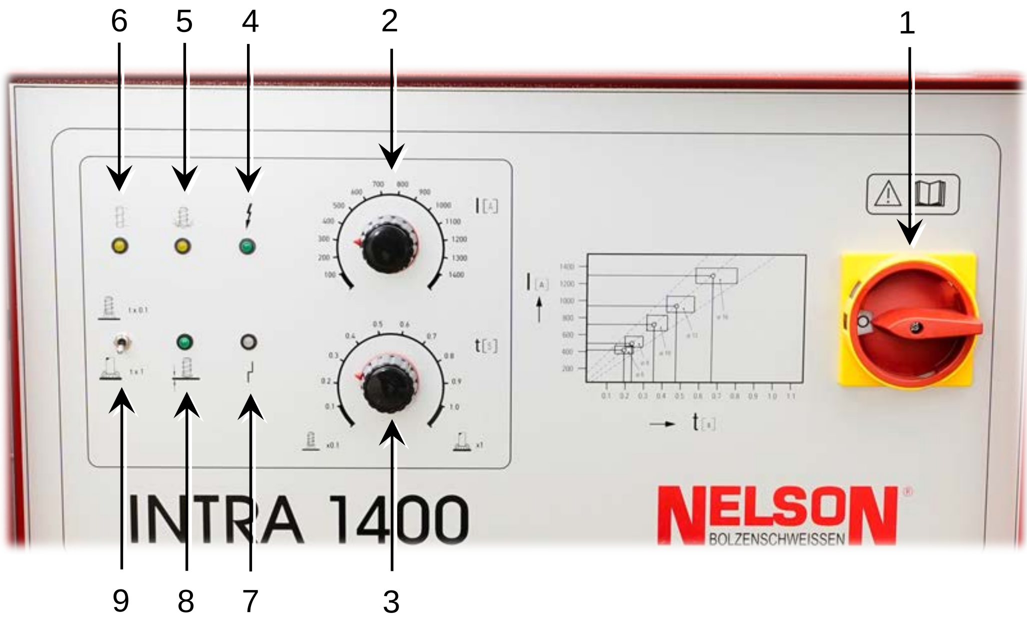


When welding profiles, the arc blow can be reduced by placement of the earth clamp and additional metal plates.

Note: The polarity in the illustration relates to ferromagnetic materials. When welding aluminium, the opposite polarity must be ensured!

5 Control and display elements

All control and display elements of the INTRA 2100/1400 welding device are on the upper front plate and marked with graphic symbols.



1	Power switch	6	LED for gun coil circuit
2	Weld current potentiometer	7	Malfunction LED
3	Weld time potentiometer	8	Contact LED
4	System voltage LED	9	Operating mode selector switch
5	Start weld cycle LED		

5.1 Operating elements

*****: *following (Pos. No.) → see illustration above*

Power switch (1*)

Function: Turning the INTRA 2100/1400 on and off.

Switch position: I = ON

O = OFF

When the welding device is turned on, the system voltage LED (4*) goes on. The network phases are monitored with the fault LED (7*).

“Weld current” potentiometer (2*)

The required weld current is set from the potentiometer.

Function: Selection of weld current range

Setting range: 100 A – 1400/2100 A

The welding currents can be continuously set based on the requirements of the weld process used (short cycle/drawn arc).

Note: Guidelines for weld current are shown in Chapter 6.2.

“Weld time” potentiometer (3*)

The weld current switch-on time is set from the potentiometer.

Function: Selection of weld time.

Setting range: 0.1 s – 1.0 s / 10 ms – 100 ms

The setting is done according to the weld process BH 10 or BH 100. The appropriate setting range is chosen using the operating mode selector (9*) switch.

Note: Guidelines for weld time are shown in Chapter 6.2.

Operating mode selector switch

The toggle switch is for presetting the weld time for the welding process used:

Drawn arc process: Scale value of welding timer

Short cycle process: Scale value of welding timer x 0.1

Function: Selection of weld process

Switch position: ⇧ = drawn arc process (BH 100)

⇩ = Short cycle process (BH 10)

The setting is done according to the weld process BH 10 or BH 100.

5.2 Display elements

The LED display elements signal specific functions of the welding process and are useful for troubleshooting the welding system.

After connection of the INTRA 2100/1400 welding device (see Chapter 4), the following functions can be understood visually.

**) The position numbers in parentheses refer to the position numbers in the illustration on page 30.*

LED (white, green, red): Fault (Pos. 7*)

Base colour: white: no fault

Colour change: green: Fault (no network phase)

Colour change: red: Fault (overheat)

LED (green): Contact (Pos. 8*)

LED lights up when the stud contacts the workpiece.
The external welding circuit is closed.

LED goes out when the stud is lifted from the workpiece.

LED (green): System voltage (Pos. 4*)

LED lights up when the INTRA 2100/1400 is switched on.

LED goes out when the INTRA 2100/1400 is switched off.

LED (yellow): Start weld cycle (Pos 5*)

LED lights up when a start signal is issued:

- Standard operation: The gun's start button is pressed.
- Automatic mode: Pulling the stud holder off the stud.

LED goes out when the start button is let up or when the weld signal is taken away.

LED (yellow): Welding gun coil circuit (Pos. 6*)

LED goes on when a welding gun is correctly connected.

The coil current circuit is closed.

LED goes out when the coil current circuit is interrupted.

6 Start-up and weld quality check

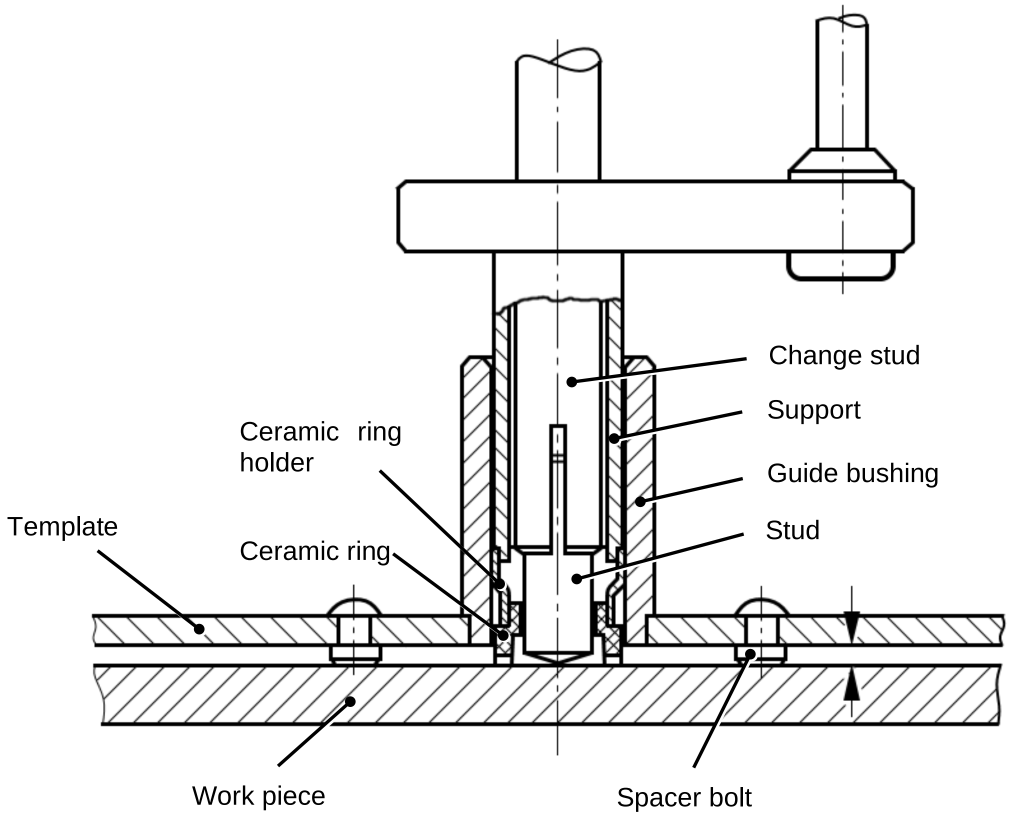
6.1 Notes about stud welding

Before welding starts, the stud welding instructions must be followed.
They contain important information for achieving good weld joints.

1. Of course, good weld joints are only achieved with technically perfect devices. Observe the safety measures and instructions in Chapter 2.
2. Studs and ceramic rings must be stored dry, because rust on the stud tips and damp ceramic rings decrease weld quality. Damp ceramic rings can be dried in an electrode drying oven, for example.
3. The weld elements and workpieces must be suitable for welding. Use only material combinations indicated in the operating manual (→ see Chapter 1.4 “Material combinations”).
4. The surface of the base material at the weld point must be even and metallically blank, so that there is contact between the workpiece and weld stud for the ignition process. Note that roughness greater than 80 µm in the welding zone should not be exceeded.
5. Contaminations of the welding zone, such as rust, scale, zinc, paint, moisture, greases and oils must be removed immediately before welding. In most cases, it is enough to briefly grind them off with an angle grinding machine or wipe them off with a dry cloth.
6. Workpieces made of aluminium or workpieces with aluminium coating must be cleaned only with a rust-free (V2A) wire brush. Otherwise, harmful oxides will get worked into the base material.
   Anodized workpiece surfaces must be stripped (such as with caustic soda).
7. At low workpiece temperatures, the base material must be preheated to prevent harmful hardening of the material:
   Limit value: - at S235: 0°C
   - at S355: +5°C

   The welding location must be adequately protected against rain and snow. Otherwise, welding must **NOT** take place.
8. The “blow effect” (or “arc blow”) impairs the quality of the stud weld connection. “Blow effect” describes when the arc is diverted by external induction fields that mainly originate in asymmetrical current movement. Causes and remediation actions are detailed in Chapter 4.4 “Connecting the workpiece”.
9. Always lay the welding and earth cable without loops. This can largely prevent electromagnetic influences.

10. Position markings are generally made by drawing or punching at the welding location directly on the workpiece. To achieve good welding, the punches must not be made to large or deep.
For recurring work and special cases, there is an advantage to use welding templates (→ see the following illustration).



11. Make sure the workpiece is placed free of vibration (especially important for large and thin-walled workpieces).

12. Solvents that contain chlorine absolutely must be removed from the welding zone. They are not to be exposed to arc radiation.

13. Check the setting values required for your welding task*) on the INTRA 2100/1400 welding device and on the connected gun.

14. During the welding process, the position of the gun and welding process are not to be changed.

15. Welding on one workpiece with more than one welding device must be avoided (electrical hazard from high open-circuit voltage).

16. If welding on one workpiece with more than one welding device cannot be avoided, the welds must be alternated in time.

*) To make sure the setting parameters are correct, always do some test welds before starting work. The quality of the weld results must be checked.

6.2 Adjusting the weld parameters

The settings to the electrical and mechanical weld parameters must be made on both the welding device and on the welding gun.

“Weld current” and “Weld time” parameters:

- The electrical parameters must be set application-specific on the appropriately marked potentiometer of the INTRA 2100/1400.
- The guidelines for the affected weld process can be found in the following tables or graphics.

“Lift dimensions” and “Stud stick out” (projection) parameters:

- The mechanical parameters must be set on each connected welding gun.
- The settings can be found in the operating manual of the appropriate welding gun.
- The guidelines for the weld process can be found in the gun operating manual or the following graphic.

Guidelines for weld parameters:

The settings values indicated in the following tables or graphics should be considered only as guidelines to be achieved under optimized welding conditions.

The optimal weld parameters must always be determined in consideration of factors such as material and surface characteristics of the workpiece, sheet metal thickness, welding position, stud type, stud dimensions, etc., through test welds.

Make sure the test welds reflect real conditions during the production process as much as possible.

Based on the weld result, the settings to the electrical and mechanical weld parameters must be adjusted to the specific welding task.

If defective welds are suspected, the settings on the INTRA 2100/1400 welding device and the welding gun must be optimized.

The results of the test welds must be checked according to EN ISO 15614-1, 2*),

*) EN ISO 15614-1, 2: Specification and qualification of welding procedures for metallic materials – Welding procedure test

6.2.1 Settings data for drawn arc process

The weld parameters Current and Time indicated in the following table are based on the recommendations in DVS information sheet 0902. These parameters relate to the standard equipment of the welding system and welding in tub position on blank, de-oiled surfaces.

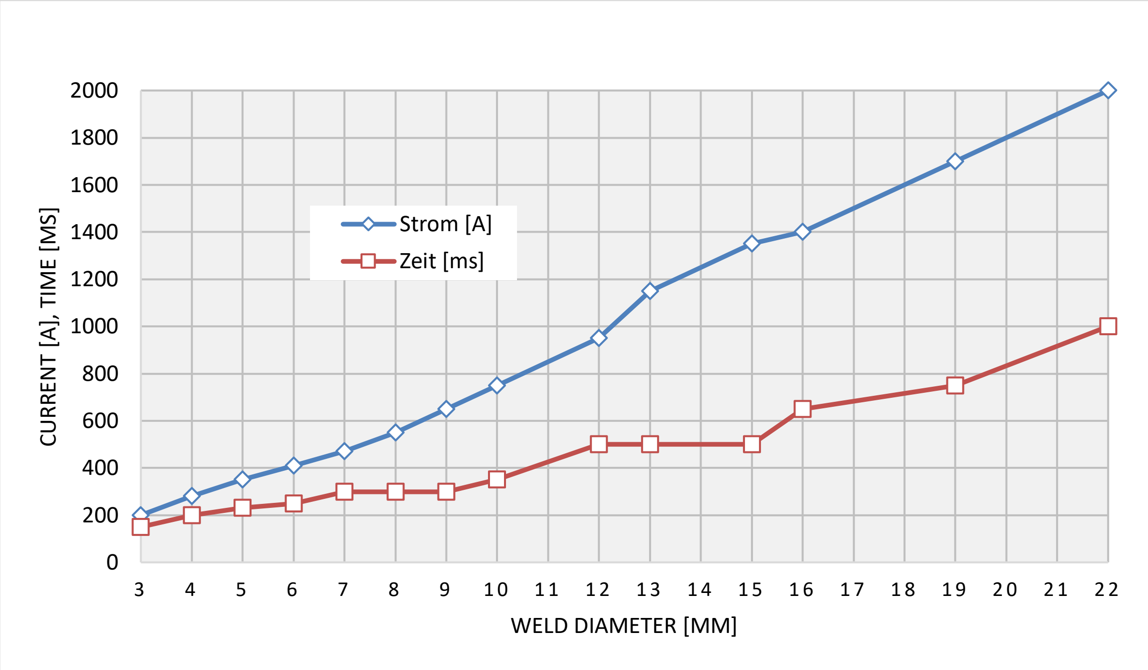
- **Electrical weld parameters for the drawn arc process**

Stud type according to Tucker	Weld Ø [mm]	Welding current I [A]	Welding time t [ms]
IS 3	3	200	150
IS 4	4	280	200
IS 5	5	350	230
KB6, MR M8, S6	6	400	250
MP (F) M8	7	450	300
MR M10,S8	8	550	300
MP (F) M10	9	700	350
KB10, MR M12, S10	10	750	400
MM12, S12	12	950	500
MR, M 16	13	1150	500
MP, M 16, MI, M 10	15	1350	500
S 16, KB 16	16	1400	650
For INTRA 2100 only:			
KB 19	19	1700	750
KB 22	22	2000	1000

Rule of thumb for drawn arc process:

- Weld current I [A] ≈ 80 × Weld Ø [mm]
- Weld time t [ms] ≈ 40 × Weld Ø [mm]

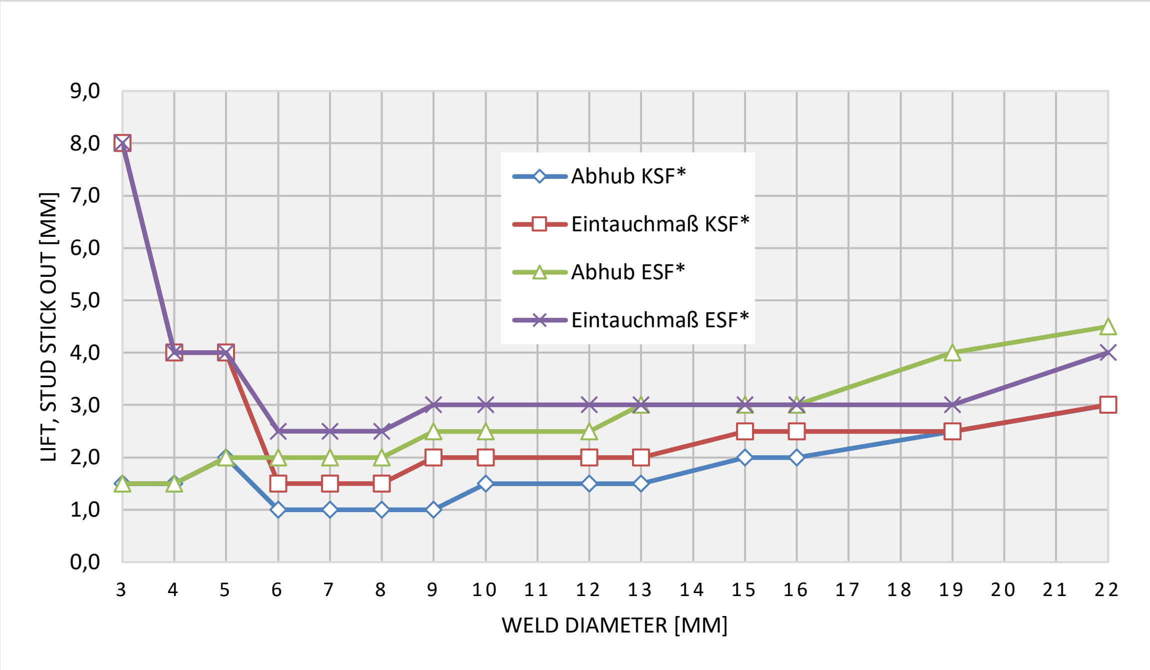
Fluctuations in sheet metal thickness and properties or changed work conditions, longer welding cables or heavily loaded power grids make the true values slightly differ from the settings data. This also applies when welding in forced positions, such as vertically on the wall or welding overhead. Therefore, before starting work, you should check the settings with test welds.



- **Mechanical weld parameters for the drawn arc process**

Stud type according to Tucker	Weld Ø [mm]	Lift [mm]		Stud stick out t[mm]	
		ESF*	KSF*	ESF*	KSF*
IS 3	3	1.5	1.5	8.0	8.0
IS 4	4	1.5	1.5	4.0	4.0
IS 5	5	2.0	2.0	4.0	4.0
KB6, MR M8, S6	6	2.0	1.0	2.5	1.5
MP (F) M8	7	2.0	1.0	2.5	1.5
MR M10,S8	8	2.0	1.0	2.5	1.5
MP (F) M10	9	2.5	1.0	3.0	2.0
KB10, MR M12, S10	10	2.5	1.5	3.0	2.0
MM12, S12	12	2.5	1.5	3.0	2.0
MR, M 16	13	3.0	1.5	3.0	2.0
MP, M 16, MI, M 10	15	3.0	2.0	3.0	2.5
S 16, KB 16	16	3.0	2.0	3.0	2.5
For INTRA 2100 only:					
KB 19	19	4.0	2.5	3.0	2.5
KB 22	22	4.5	3.0	4.0	3.0

*) ESF: Weld stud with even front surface
*) KSF: Weld stud with conically tapered front surface



The instructions regarding correct set-up of lift dimensions (length of arc) and stud stick out (combustion) can be found in the user manual of the NS 40 B welding gun.

The minimum thickness for base material is:

- for steel: approx. ¼ of stud diameter,
- for aluminium: approx. ½ of stud diameter.

For stud types not listed, the settings data must be selected according to the weld diameters listed in the tables or graphics above. Please note that generally the stud's nominal diameter, e.g. MR-M 8 = 8 mm, do NOT correspond to the diameter to be welded (weld diameter). For example, the weld diameter of the reduced MR stud is about 20% smaller than the nominal diameter.
When in doubt, determine the weld diameter by measurement.

6.2.2 Settings data for short cycle process

The short cycle process is also the weld process suitable for galvanized surfaces.
Cold-formed sheet metals and profiles should be favoured.
Light oil films generally don't decrease the weld quality.

The weld parameters Current and Time indicated in the following table are based on our many years of experience and should be seen as guidelines. These parameters relate to the standard equipment of the welding system and welding in tub position on blank, de-oiled surfaces.

- **Parameters for the short cycle drawn arc process**

Stud type Shaft Ø [mm, M]	Weld Ø [mm]	Welding current I [A]	Welding time t [ms]
SC stud [3.0, M3]	4	400	15
SC stud [4.0, M4]	5	650	15
SC stud [5.0, M5]	6	850	20
SC stud [6.0, M6]	7	1000	20
SC stud [8.0, M8]	9	1000	35

Rule of thumb for short cycle drawn arc process:

- Weld current [A] ≈ 140 × Weld Ø [mm]
- Weld time [ms] ≈ 4 × Weld Ø [mm]

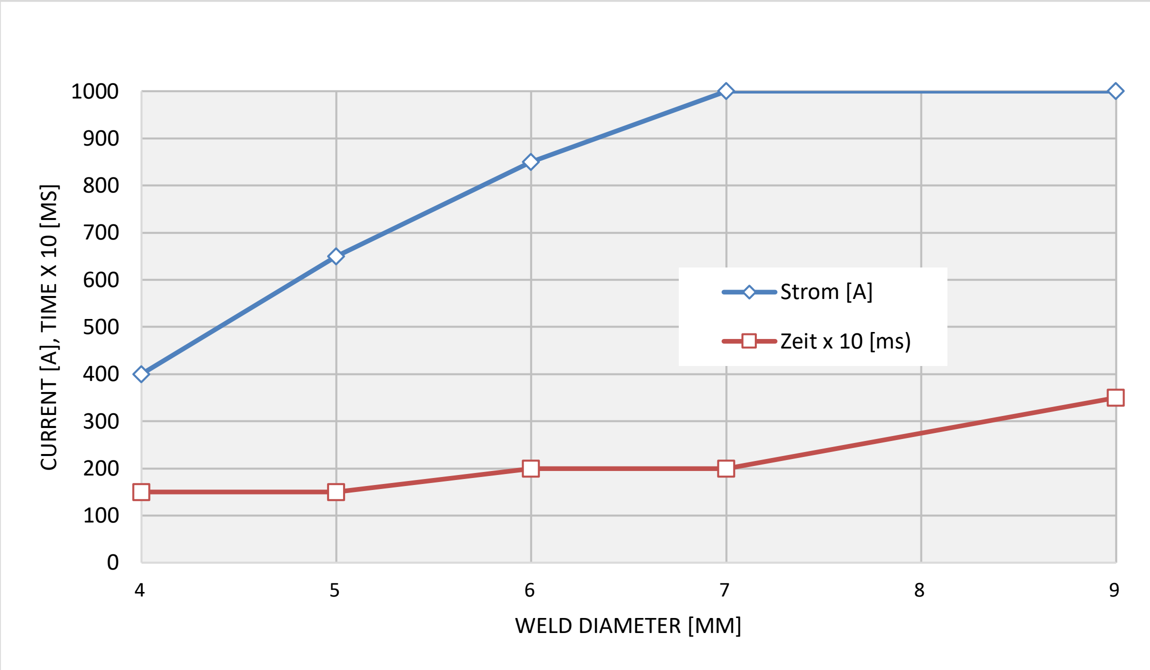
Deviations in sheet metal thickness and properties, such as oily or galvanized surfaces, allow the parameters to deviate slightly from the settings values.

This also applies to longer weld cables, unstable networks and to welding in forced positions, such as vertically on the wall or welding overhead. Therefore, before starting work, you should check the settings with test welds. In general, choose the highest possible current with the shortest possible weld time!

TAKE NOTE:

The actual weld time is only a tenth of the value indicated on the "Weld time" potentiometer (→ see position (3) in the illustration on page 30 "Operating and display elements")!
Don't forget to set the operating mode selector switch (9) upward!

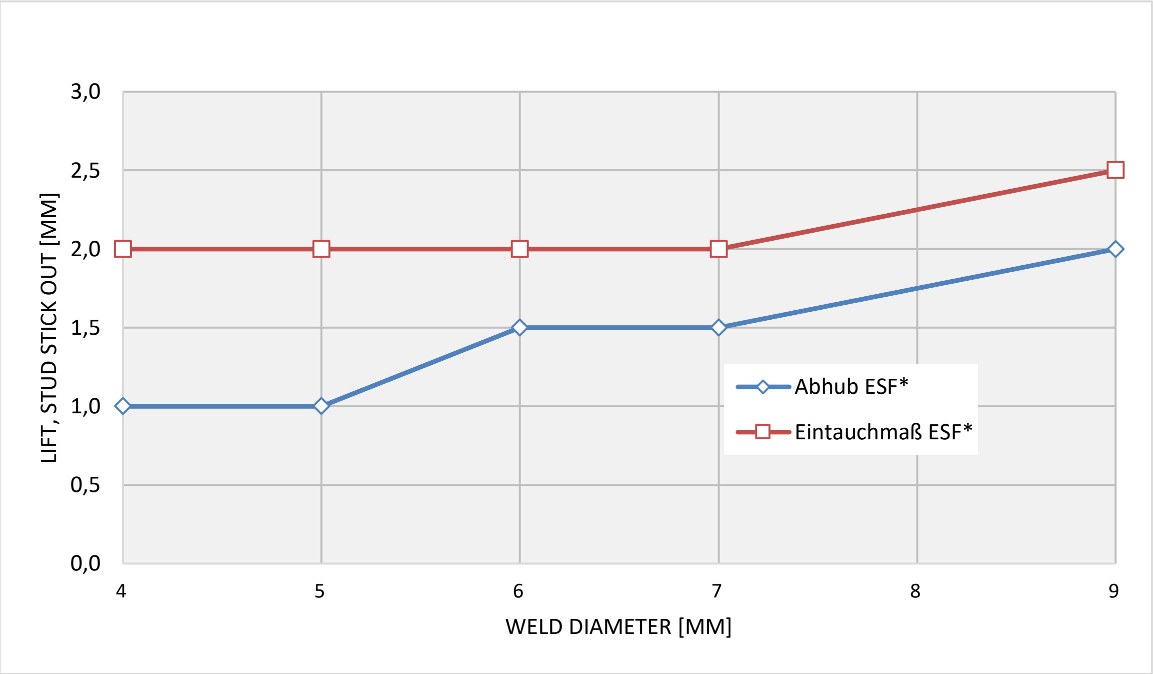
Electrical weld parameters (short cycle process)



The instructions regarding correct set-up of lift dimensions (length of arc) and stud stick out (combustion) can be found in the user manual of the NS 40 SL welding gun (→ also see the following table/diagram "Mechanical weld parameters").
For stud types not listed, the settings data must be selected according to the weld diameters listed in the table above.
Please note that generally the stud's nominal diameter, e.g. SC-B M 8 = 8 mm, do NOT correspond to the diameter to be welded (weld diameter). Generally, the weld diameter of the short cycle stud is 1 mm larger than the nominal diameter. When in doubt, determine the weld diameter by measurement.

Mechanical weld parameters
(short cycle process with NS 40 SL welding gun)

Stud type Shaft Ø [mm, M]	Weld Ø [mm]	Lift [mm]	Stud stick out [mm]
SC stud [3.0, M3]	4	1.0	2.0
SC stud [4.0, M4]	5	1.0	2.0
SC stud [5.0, M5]	6	1.5	2.0
SC stud [6.0, M6]	7	1.5	2.0
SC stud [8.0, M8]	9	2.0	2.5



*) ESF: Weld stud with even front surface

6.3 Commissioning conditions

Before each start-up and before each time welding starts, the welding system's readiness for operation must be checked as follows:

Warning:

- Everyone who works on the welding system is obligated, before starting work, to read and follow the safety instructions in Chapter 2!
- Additionally, the operating manuals of the connected device components (welding gun, sorter) must be followed!

1. Make sure that the welding system's location of use meets the requirements in Chapters 3.6 and 3.7.
2. Secure the welding location such that people nearby are adequately protected against blinding and electromagnetic fields (Chapter 2).
3. Check the configured device components for correct connection.
    - When connecting a gun with manual stud loading, the inspection is limited to the electrical connection of the gun and workpiece.
    - When connecting a welding gun with automatic stud loading, the pneumatic connections on the sorter and welding gun must be checked.

      The instructions and information required for this are found in the specific devices' operating manuals.
4. Make sure that the electrical and, if present, pneumatic line routing poses no danger of people tripping.
5. Make sure that the welding gun is loaded only with studs designed for the gun.
6. It must also be ensured that, during overhead welding, wearing a safety helmet is mandated.
7. Check all system components for visible damage, such as wear and electrical or mechanical defects.

6.4 Functional test

Warning:

- Before each time work begins, a welding expert must perform a functional test.

The functional test includes configuration of the INTRA 2100/1400 welding device with a manually loaded NS 40 B/SL gun.

1. Set the mechanical weld parameters on the gun. The settings can be found in the NS 40 B/SL operating manuals.
2. Turn on the INTRA 2100/1400. When the welding device is turned on, the “System voltage” LED goes on.

   The welding gun is supplied with 90 VDC and 24 VDC.
3. Select the appropriate weld process (short cycle/drawn arc).
   The operating mode selector switch setting determines the weld time range.

   Short cycle process: 10 ms – 100 ms

   Drawn arc process: 0.1 s – 1.0 s
4. Load a stud into the gun’s stud holder. For welding with ceramic rings, the ceramic ring holder must be loaded correspondingly.
5. Set the electrical weld parameters on the INTRA 2100/1400. The parameter guidelines can be found in the table in Chapter 6.2.
6. Position the gun on the weld point. As soon as the stud contacts the workpiece surface, the “Contact” LED goes on.

Danger:

- During the welding process, touchable parts of the welding gun, such as studs, stud holder and all electrically connected parts carry current.
  These components must not be touched during the welding process!

7. Press the gun with both hands as vertically as possible (90° angle) to the workpiece.
8. Hold the gun still and press the start button. The “Start weld cycle” LED is on as long as the start button is pressed.

A pilot current flows through the external welding circuit “Welding cable - Stud - Workpiece - Earth cable”.

9. The gun coil activates and lifts the stud from the workpiece surface. The “Contact” LED goes out.
10. The main welding current is switched on.
When the weld time ends, the solenoid actuator is depowered.
11. The stud dips into the melt bath, the arc goes out, and the weld current is switched off.
12. Pull the welding gun as straight as possible off the stud.
13. Before the welding system is used for series production, the quality of the weld joint must be checked (see the following chapter).
14. To make sure the weld parameters are correct, always do some test welds before starting work.
15. If the weld results are poor, optimize the weld parameters.
The test welds must be repeated until the optimal weld quality can be achieved.

6.5 Checking weld quality

To ensure quality stud weld connections, the following tests must be made before, during and after production:

- Normal work inspection,
- simplified work inspection,
- ongoing production monitoring.

- **Normal work inspection:**

For welding according to the drawn arc and short cycle drawn arc process, 10 studs must be welded, on which the following tests are to be made:

1. Visual inspection	2. Bend test	3. Macrosection
(all studs)*)	(5 studs)	(2 studs)

The test results must be documented and added to the quality documentation.

- **Simplified work inspection:**

To check the device settings and functionality, before start of shift, three studs must be welded, on which the following tests must be made:

1. Visual inspection (all studs)*)   2. Bend test (all studs)

The test results must be documented and added to the quality documentation.

- **Ongoing production monitoring:**

During ongoing production monitoring, generally a visual inspection of all welded studs is adequate. If an incorrect weld joint is suspected, a bending test or tensile test must be done.

If the requirements are not met, bending or tensile testing must also be done on the three next welds.

The test results must be recorded in the production book.

Warning:

- Make sure welding work does not continue until the test results are satisfactory.

*) Information for visual inspection can be found on the following pages.

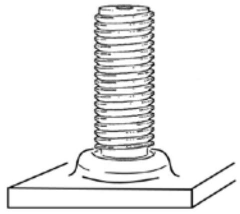
6.5.1 Visual inspection “drawn arc process”

During visual inspection, the interpretation of the appearance of the bead and welding zone is crucial. Properties, shape, surface and colour are the decisive criteria.

1. Defect-free weld

Weld bead is even, (bluish) glossy and closed. Stud length after welding within tolerance.

Corrective action: Not necessary. No change to the electrical and mechanical parameters.

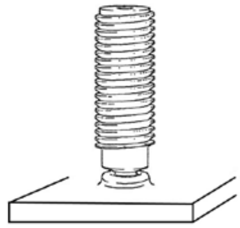


2. Defective weld

Constriction on the weld, stud too long.

Corrective action: Enlarge stud stick out, check lift, check centring of the ceramic ring.

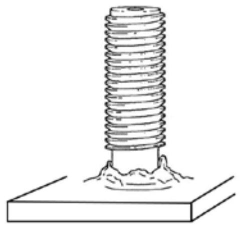
Decrease welding current and/or welding time.



3. Defective weld

Weakly formed, uneven weld bead with matt surface. Stud too long.

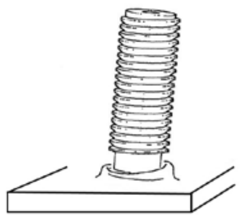
Corrective action: Increase weld time and weld current, dry the ceramic rings in the oven, if necessary.



4. Defective weld

Weld bead one-sided, undercut.

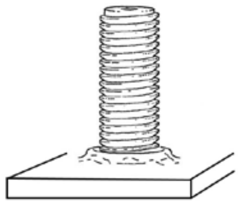
Corrective action: Eliminate arc blow effect, check centring.



5. Defective weld

Weld bead low, surface glossy with heavy spatter. Stud too short.

Corrective action: Decrease weld time and weld current, adjust stud stick out and/or damping.



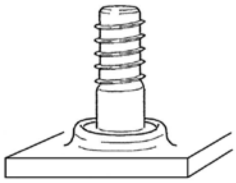
6.5.2 Visual inspection “short cycle drawn arc process”

In principle, an uneven bead with single-sided undercuts point to a suspicious weld. The weld parameters are optimized using work samples, where the highest possible current and the shortest possible weld time should be chosen.

1. Defect-free weld

Weld bead is even, no visible flaws.

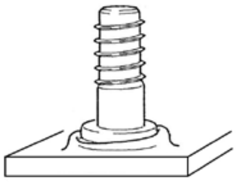
Corrective action: Not necessary. No change to the electrical and mechanical parameters.



2. Defective weld

Diameter not fully welded.

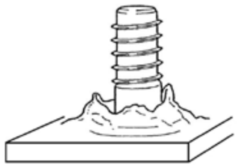
Corrective action: Increase welding current and/or welding time, possibly change polarity.



3. Defective weld

Large, uneven weld bead.

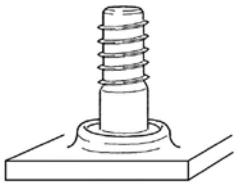
Corrective action: Reduce weld time.



4. Defective weld

Pores in the weld bead.

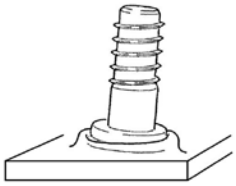
Corrective action: Reduce weld time or increase weld current, weld under shielding gas.



5. Defective weld

Weld bead one-sided.

Corrective action: Eliminate blow effect by applying smoothing compound or correcting the earth clamps. Large weld diameters 8 mm and above encourage the influence of the blow effect.



6.5.3 Mechanical inspection (general)

If visual inspection has shown some welds to be inadequate, a mechanical inspection is necessary.
We also recommend this test if you perform a series of test welds to determine the best settings.

Suitable mechanical testing procedures for work samples (for suitability test, also see EN ISO 15614-1, 2*)) include:

- Tube bending test,
- Impact bending test,
- Tensile test,
- Folding test,
- Impact bending test,
- Notch bending test,
- Macrosection,
- Hardness test.

The most commonly used test procedure, even for series work (for simplified work inspection, also see EN ISO 15614-1, 2*)) is the pipe or impact bending test.

A detailed description of these mechanical and technological tests would go beyond the scope of this operating manual.

Detailed information on this can be found in EN ISO 15614-1, 2.*)

*) EN ISO 15614-1, 2: Specification and qualification of welding procedures for metallic materials – Welding procedure test

7 Maintenance

7.1 Care and cleaning

The stud welding system requires no special care.

The required cleaning tasks for the gun and sorter can be found in the specific devices' operating manuals.

For the INTRA 2100/1400 welding device, the following cleaning tasks are required. Here it should be noted:

> **Warning:**
>
> - Before cleaning starts, the welding device must be switched off, unplugged and secured against restart.

The cleaning intervals depend on the degree of soiling, but cleaning should be done regularly every 3 months.

- For cleaning, use no aggressive or alcohol-laden substances or flammable liquids.
- The INTRA 2100/1400's device housing must be wiped with dry cloths.
  The type plate and safety instructions must be easily readable.
- The INTRA 2100/1400's front plate must be cleaned with a grease-cutting cleaning agent. The LED display elements must be recognizable.
- The electrical connection cables must be cleaned with a dry cloth.
  This makes scorch marks or mechanical defects easy to notice.
- Depending on the conditions of use and the level of soiling, cleaning may be needed inside the device.
- Impurities within the welding device, such as metal dust or conductive shavings should be wiped or vacuumed out.

> **Warning:**
>
> - Only authorized electro-technical personnel+) are allowed to open the welding device or clean inside its housing.
> - Blowing the welding device out with compressed air is strictly forbidden due to risk of injury to the respiratory organs and eyes!

+) Technical personnel in the field of electrical repair, preferably familiar with welding, cutting and related processes (see EN 60974-4)

7.2 Maintenance intervals

The recommended maintenance intervals and instructions in the following table are limited to the INTRA 2100/1400 welding device.

The maintenance intervals for the connected guns and for the sorter can be found in the specific devices' operating manuals.

Warning:

- Before maintenance starts, the welding device must be switched off, unplugged and secured against restart!
- If there are malfunctions, mechanical defects, overheating damage or contact with liquids, the INTRA 2100/1400 must shut down and repairs made!

Maintenance interval	Warnings
Daily	**Visual inspection outside the device housing:** - welding cable, control cables and hoses - Power plug and power cable *) - Display and control elements *) - Connector sockets and connection plugs *) Components/assemblies marked with *) are only to be replaced by electrical experts+).
Every 3 months	**Visual inspection inside the device housing:** *) - cabling - printed circuit boards - electrical connections and components *) Visual inspection inside the INTRA 2100/1400 must be done only by electro-technical personnel+).
Annual	According to DGUV V3, the welding device must regularly undergo professional inspection. The requirements for inspecting welding devices are specified in EN 60974-4 (DIN VDE 0544-4) 2017-05 Arc welding equipment - Part 4: Periodic inspection and testing.

+) Technical personnel in the field of electrical repair, preferably familiar with welding, cutting and related processes (see EN 60974-4)

8 Repairs

8.1 Notes on repair

Defective components and cleaning tasks inside the INTRA 2100/1400 require the welding device to be dismantled.
Observe the following instructions:

Warning:

- Before repair work starts, the welding device must be switched off, unplugged and secured against restart!
- Only authorized electro-technical personnel+) are allowed to open the welding device or work inside its housing.

+) Technical personnel in the field of electrical repair, preferably familiar with welding, cutting and related processes (see EN 60974-4)

- Repairs to the INTRA 2100/1400 welding device are to be done only as part of maintenance.
- The INTRA 2100/1400 can be repaired with ordinary commercial tools. No special tools are needed.
- Troubleshooting can be done with ordinary commercial measuring devices.
- Defective components on printed circuit boards require replacement of the entire printed circuit board. Defective printed circuit boards must be sent to Tucker for repair.

Caution:

- Printed circuit boards must not be removed or inserted if the welding device is carrying system voltage!

Warning:

- All responsibility and liability are rejected if repairs are improper or external replacement parts are used.

8.2 Troubleshooting

The tables on the following pages will enable you to individually detect occurring faults AND to fix them yourself, if possible.
Tasks marked “+)”, however, are limited to actions to be done only by repair and electro-technical personnel. This especially applies to checking fuse elements (F1–F3), plug connections (X1–X4) and the LEDs (H2–H14) on the internal PCB, for which opening the device is necessary.
Also, always check the correct construction of the complete welding system and the external connections of all cables using the connection diagram in Chapter 4 (→ see illustration on page 24).

Warning:

If there is a system malfunction, the welding device must be switched off, unplugged and secured against restart!
After the problem has been repaired, it is absolutely necessary to perform a functional inspection of the welding system!

The following tables will make remote diagnosis over the phone easier for Tucker technical personnel. This avoids expensive field visits by our service technicians.
If, despite use of original Tucker accessories and original Tucker weld studs, you don’t get satisfactory weld results, please contact your Tucker technical consultant.
If, despite full use of weld time and current, you don’t get satisfactory weld results, we recommend use of the next larger Tucker stud welding system. Your Tucker technical consultant will be happy to help you make the right choice.

8.2.1 Fault: Power supply

Features:

- INTRA 2100/1400 shows no reaction
- “System voltage" LED doesn’t light up (→ see Pos. 4 in Chapter 5, page 30)
- Fan won’t run
- Gun doesn’t work
- no weld

No.	Possible cause	What is to be tested or how?	Test result	Test result achieved? yes	no
1	INTRA 2100/1400 not switched on	Switch on the INTRA 2100/1400	Features removed	ready	No. 2
2	Power supply defective or loose contact	Check fan $^{+}$) Check power supply $^{+}$)	Fan runs	No. 3	No. 3
3	Power supply defective or loose contact	Check network protection $^{+}$) Check power supply $^{+}$)	OK	No. 4	Replace fuse *)
4	Cable break	Measure through the cable *)	OK	No. 5	Replace the cable *)
5	Power switch error Power supply clamp error	Check the power cable connection at the power plug $^{+}$) Check the transformer connection on the power switch $^{+}$)	Features removed	ready	No. 7
6	Fuse F1[1)] or cable connection	Check “Transformer PCB” cable $^{+}$)	OK	No. 7	Correct the cable connection *)
7	Power switch error Cabling error Transformer error	Shut down INTRA 2100/1400, notify Tucker service!			

⚠ Tasks indicated with $^{+}$) must be done only by electro-technical personnel!

[1)] The arrangement of fuse F1 on the internal control card can be found in the illustration on page 58.

8.2.2 Fault: Overload/phase error

Features:

- INTRA 2100/1400 is switched on
- “System voltage” LED (Pos. 4*) goes on
- Gun doesn’t work when start triggered
- no weld

No.	Possible cause	What is to be tested or how?	Test result	Test result achieved? yes	no
1	Device overloaded or phase error	“Fault” LED (Pos. 7*) lights green or red?	Green LED	No. 2	Red LED No. 3
2	Phase error L1/L2/L3	Check power supply *) (fuse, plug, cable) Check the power cable connection at the power plug +) Check the transformer connection on the power switch +) Set the connection voltage +)	White LED	ready	No. 7
3	Device overloaded, inadequate cooling	Check fan +)	Fan runs	No. 5	No. 4
4	Phase error L1 Fuse F4[1] defective Blower connection fan	Check power supply +) (fuse, plug, cable) Check the fuse (315 mA) +) Check fan connection +) Check fan +)	Features removed	ready	No. 7
5	Welding sequence too high	Let the welding device cool Reduce the welding sequence	White LED	ready	No. 6
6	Fan disabled or dirty	Improve air circulation +) Check the ventilation slots Clean inside of device +)	White LED	ready	No. 7
7	PCB defective	Replace the PCB +)	Features removed	ready	No. 8
8	Transformer error	Shut down INTRA 2100/1400 Notify Tucker service!			

⚠ Tasks indicated with +) must be done only by electro-technical personnel!

*) The position numbers in parentheses refer to the position numbers in Chapter 5, page 30.

1) The fuse element **F4** is on the transformer clamping strip:

8.2.3 Fault: Gun function

Features:

- INTRA 2100/1400 is switched on
- “System voltage” LED (Pos. 4*) goes on
- Fan runs
- “Fault” LED (Pos. 7*) doesn’t light up
- Gun doesn’t work when start triggered
- no weld

No.	Possible cause	What is to be tested or how?	Test result	Test result achieved? yes	no
1	Gun cable has no connection	The “Coil” LED (Pos. 6*) does or doesn’t go on?	lights	No. 9	No. 2
2	Gun cable has no connection	Check control cable connection	OK	No. 3	Make the connection
3	Control line defective	Control cable: Measure Pin 1 against Pin 2	R ≈ 20 Ω	No. 7	No. 4
4	Coil defective	Measure the coil	R ≈ 20 Ω	No. 5	No. 6
5	Control line defective	Replace the control cable Replace gun	OK	ready	No. 12
6	Coil defective	Replace the coil Replace gun	OK	ready	No. 12
7	PCB connection defective	Check the connection plug for PCB X1/X3[1] +)	OK	No. 8	Make the connection *)
8	Fuse defective	Check the equipment fuse F2 and F3[1] +)	OK	ready	No. 12
9	Start button defective	“Start weld cycle” LED (Pos. 5*) ON?/OFF? when triggered?	OFF	No. 10	No. 11
10	Start button defective	Replace the start button Replace gun	OK	ready	No. 12 Start detection
11	No lift set	Set lift	OK	ready	No. 12
12		Shut down INTRA 2100/1400 Notify Tucker service!			

⚠ Tasks indicated with +) must be done only by electro-technical personnel!

*) The position numbers in parentheses refer to the position numbers in Chapter 5, page 30.

1) The arrangement of the fuses (F2, F3) and plug connections (X1, X3) on the internal control card can be found in the illustration on page 58.

8.2.4 Fault: Welding

Features:

- INTRA 2100/1400 is switched on
- “System voltage” LED (Pos. 4*) goes on
- Fan runs
- “Fault” LED (Pos. 7*) lights up white
- Gun works at start trigger (air release)
- no weld

No.	Possible cause	What is to be tested or how?	Test result	Test result achieved? yes	no
1	No contact detection of INTRA 2100/1400	Does the “Contact” LED (Pos. 8*) light up upon contact of the stud and workpiece?	YES	No. 8	No. 2
2	No earth connection	Check the earth connection	OK	No. 4	No. 3
3	No earth connection	Connect the earth plug and earth clamps	OK	ready	No. 4
4	Weld point not conductive	Clean the weld point	OK	ready	No. 5
5	Contact detection defective	Check the PCB plug X4[1)]	OK	No. 7	No. 6
6	Connection X4[1)] open	Make the connection	OK	ready	No. 7
7	PCB defective	Replace the PCB [+])	OK	ready	No. 14
8	Pilot current fault	Does the arc ignite?	YES	No. 9	No. 12
9	Arc break or short circuit	Lift set incorrectly?	YES	No. 10	No. 14
10	Lift error	Set lift	OK	ready	No. 11
11	No phase L2	Check the transformer connection on the power switch	OK	ready	No. 14
12	Cabling error	Pilot current choke connected wrong?	YES	No. 13	No. 14
13	Pilot current choke connected wrong?	Connect the pilot current choke correctly [+])	OK	ready	No. 14
14		Shut down INTRA 2100/1400 Notify Tucker service!			

⚠ Tasks indicated with [+]) must be done only by electro-technical personnel!

[*)] The position numbers in parentheses refer to the position numbers in Chapter 5, page 30.

[1)] The arrangement of plug connections X4 on the internal control card can be found in the illustration on page 58.

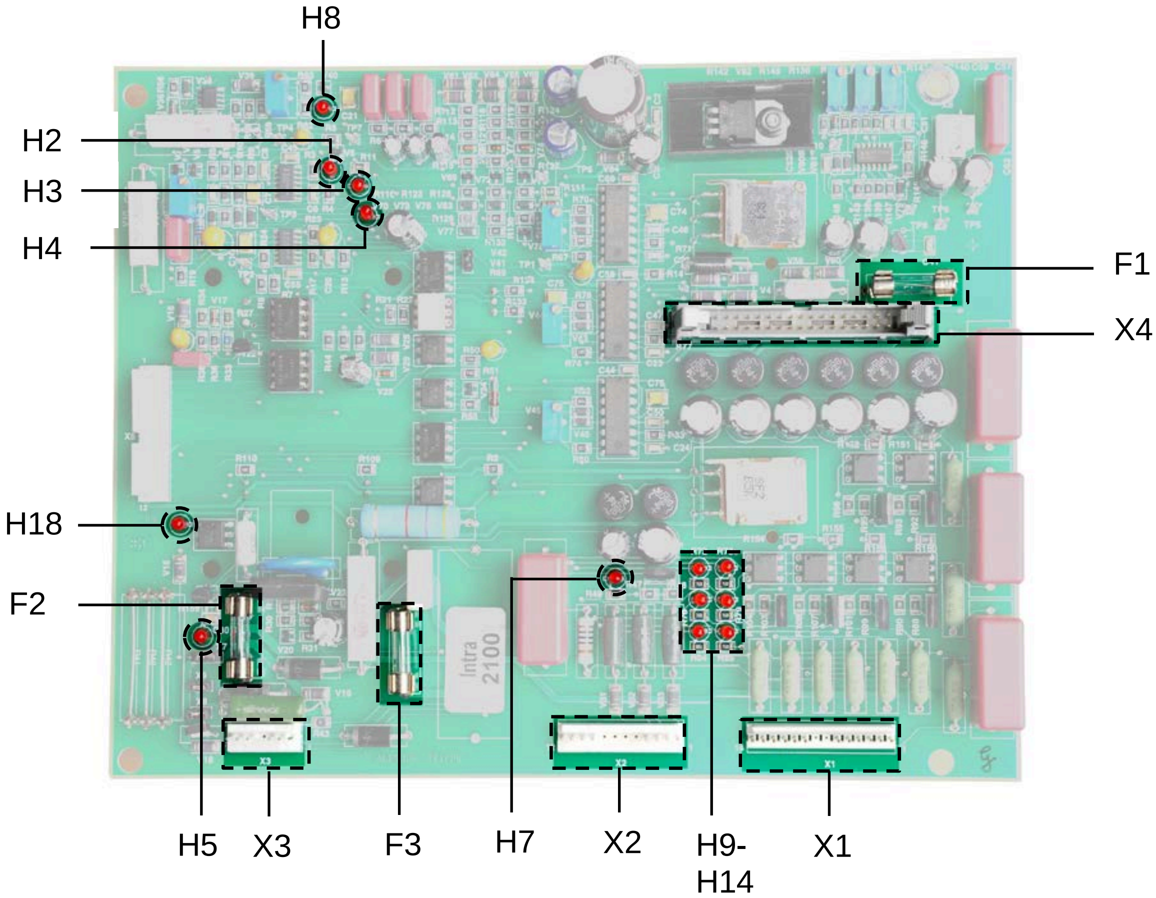
8.2.5 Electronics error search

LED displays on the control device and diagnostic LEDs on the internal control card:

Action	Display	Comments
Switching on	- System voltage LED (Pos. 4*) goes on	- no display: Replace fuse F1[1)] on the PCB
	- Coil circuit LED (Pos. 6*) goes on	- lights only if the welding gun is connected
	- Diagnostic LED H2[1)] lights up for about one second after switch-on.	- Diagnostic LED H2[1)] must not light up in any other operational state
Air release (Confirmation of the welding gun without workpiece contact)	- Start weld cycle Loosening (Pos. 5*) glows as long as the release button on the welding gun is pressed	- If no display: connect correctly - If still no display: Remove the welding gun and check/make the electrical connections
	- Diagnostic LEDs H3, H4, H7, H9 - H14[1)] briefly go on when the release button on the welding gun is pressed	
Place the welding gun on the workpiece	- Contact LED (Pos. 8*) goes on	- If no display: Connect the earth cable and welding gun correctly
	- Diagnostic LED H8[1)] always goes on upon workpiece contact	- Display goes out during welding - Welding in short circuit (no arc occurs); set the welding gun up correctly
Welding	- Diagnostic LED H8[1)] goes out	
	- Diagnostic LEDs H3, H4, H7, H9 - H14[1)] go on only during welding	- If no display: Welding in short circuit (no arc occurs) - Set up the welding gun correctly
Other general displays	- Diagnostic LED H5[1)] always goes on, regardless of welding gun connection	- no display: Replace fuse F2[1)] (welding gun) on the PCB

*) The position numbers in parentheses refer to the position numbers of the LEDs on the front plate of the control device (→ see chapter 5, page 30).

1) The arrangement of the fuses (F1, F2) and the diagnostic LEDs (H2–H18) on the internal PCBs can be found in the illustration on the next page.



F1 – F3: Fuse elements

X1 – X4: Plug connection

H2 – H18: Diagnostic LEDs

Internal control card (example illustration for the INTRA 2100 device)

9 Appendix

9.1 Disposal of the welding device

Complying with the following measures can ensure proper disposal of the INTRA 2100/1400 with as little damage as possible.

In this way, you make an important contribution to environmental protection and waste management.

Name	Specification	Storage	Disposal
Ferrous metals and non-ferrous metals	Free of GB*	No requirements	VER*
Printed circuit boards	Free of GB*	No requirements	VER*
Plastics, (single type)	Free of bromine compounds	No requirements	VER*
Plastics, (mixed)	None	No requirements	HM*, V*
Electrolyte capacitors	Undamaged, free from mounting and cable	Plastic container over collection tank, marking	UTD*, SA*, V*
Battery, dry	None	Plastic container	VER*, SA*
Components containing mercury	Undamaged	Closed plastic container, Hg absorber!	VER* of mercury
LCDs	Undamaged	Dense container	HM*, VER*
Cables, wires	None	No requirements	VER*
Components containing gold	None	No requirements	VER*
Packaging	Separate collection	None	VER*
Other materials	According to requirements	According to composition	Decide in individual case

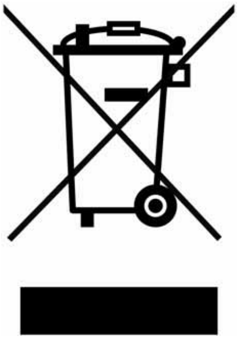
GB: Components containing hazardous materials (condensers, LCDs, ordinary and rechargeable batteries, etc.)
VER: Recycling (according to the state of technology)
HM: Disposal as household waste or commercial waste similar to household waste
V: Incineration
UTD: Underground landfill
SA: Disposal as waste requiring special supervision

When storing materials, environmental regulations must be complied with. Proof is required of proper disposal according to KrWG*)!

ℹ In terms of product stewardship, Tucker offers fee-based return and disposal of its device and system components.

*) KrWG; Circular Economy Act

Disposal according to European directive 2012/19/EU



<u>For EU countries only</u>

Never throw Tucker stud welding units or system components out with household waste!

Tucker stud welding units and system components are B2B devices[1] and therefore intended only for commercial use.

Tucker stud welding units and system components must never be disposed of with household waste or at municipal collection points!

According to European directive 2012/19/EU on used electrical and electronic devices and implementation in national law, Tucker offers fee-based return and environmentally sound disposal of its devices and system components.

Please contact us!

[1]) B2B device: Business-to-business device, device intended only for commercial use.

9.2 Abbreviations

The abbreviations used in this documentation in alphabetical order:

AlMg	Aluminium-magnesium alloy
CF	Ceramic ring
Cr	Chromium
DA	Drawn arc process
DGUV	German statutory accident insurance
DIN	German Institute for Standardization
DIN EN	a European standard adopted into the German standards
DIN ISO	an international standard adopted into the German standards
DVS	Deutscher Verband für Schweißen und verwandte Verfahren e. V.
EMC	Electromagnetic compatibility
EN	European standard
ESF	Weld stud with even front surface
HPE	Bundesverband Holzpackmittel, Paletten, Exportverpackung e. V.
I [A]	amperage in [amperes]
IEC	International Electro-technical Commission
IEC-Norm	International standard
IP	Protection type code
ISO	International Standards Organization
Cooling type AF	Fan (forced air cooling)
KrWG	Circular Economy Act
KSF	Weld stud with conically tapered front surface
LED	light emitting diode
Mg	Magnesium
m [kg]	Mass in [kilogrammes]
Mo	Molybdenum
PA	Tub position (horizontal welding position)
P [VA], [W]	Output in [volt × amperes], [watt]
R_{eH}	yield strength
SC	Short cycle drawn arc process
SG	Shielding gas
T [°C]	Temperature in [degrees Celsius]
t [ms], [s]	Time in [milliseconds], [seconds]
U [V]	Voltage in [volts]
VDE	Verband der Elektrotechnik Elektronik Informationstechnik e. V.

9.3 Bibliography

The bibliographic sources used in this documentation in alphanumeric order, indicating the title and time of publication:

DGUV information 209-010:	“Arc welding”
DGUV reg. 3:	Accident prevention regulation “Electrical systems and work equipment”
DGUV-R 100-500:	Chapter 2.26 “Welding, cutting and related processes”
DIN 1910-100:	“Welding and related processes - Terminology” - Part 100: Metal welding processes with additions to DIN EN 14610
DVS 0902:	“Arc stud welding with drawn arc” (information sheet)
EN 169:	Personal eye protection – Personal eye protection - Filters for welding and related techniques - Transmittance requirements and recommended use
EN 55011: (VDE 0875-11)	Industrial, scientific and medical equipment – Radio-frequency disturbance characteristics. Limits and methods of measurement
EN 60529:	Degrees of protection provided by enclosures (IP code)
EN IEC 60974-1:	Arc welding equipment Part 1 - Welding power sources
EN 60974-4: (VDE 0544-4)	Arc welding equipment Part 4 – Recurring inspections and tests
EN IEC 60974-9:	Arc welding equipment Part 9 – Installation and use
EN IEC 60974-10:	Arc welding equipment Part 10 – Electromagnetic compatibility (EMC) requirements
EN IEC 60974-12:	Arc welding equipment Part 12 – Coupling devices for welding cables
EN ISO 13918:	Welding – studs and ceramic rings for arc stud welding
EN ISO 14555:	Welding – Arc stud welding of metallic materials

EN ISO 15614-1:	Specification and qualification of welding procedures for metallic materials – Welding procedure test Part 1: Arc and gas welding of steels and arc welding of nickel and nickel alloys
EN ISO 15614-2:	Specification and qualification of welding procedures for metallic materials – Welding procedure test Part 2: Arc welding of aluminium and its alloys
KrWG:	Circular Economy Act