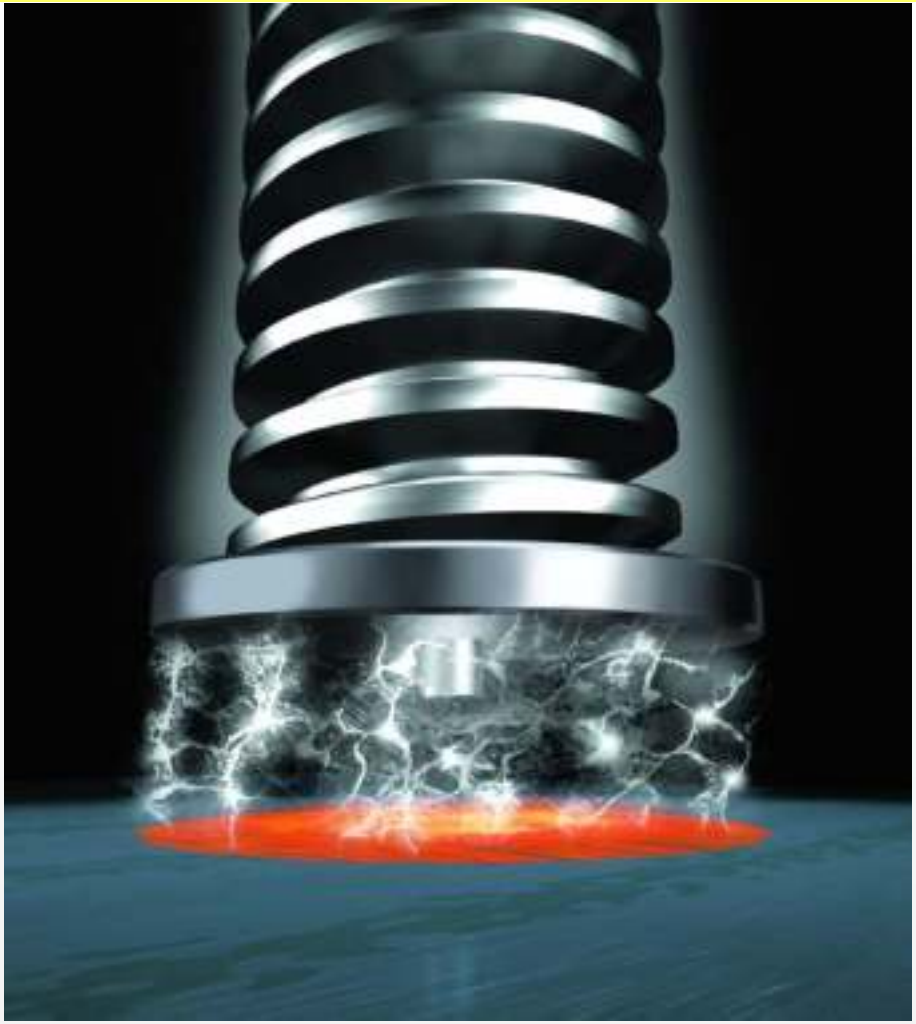
CD Process Training

Part 1 – Welding process

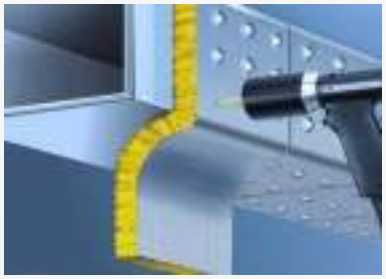


CD Process Training

CD Stud welding with tip ignition (TS)

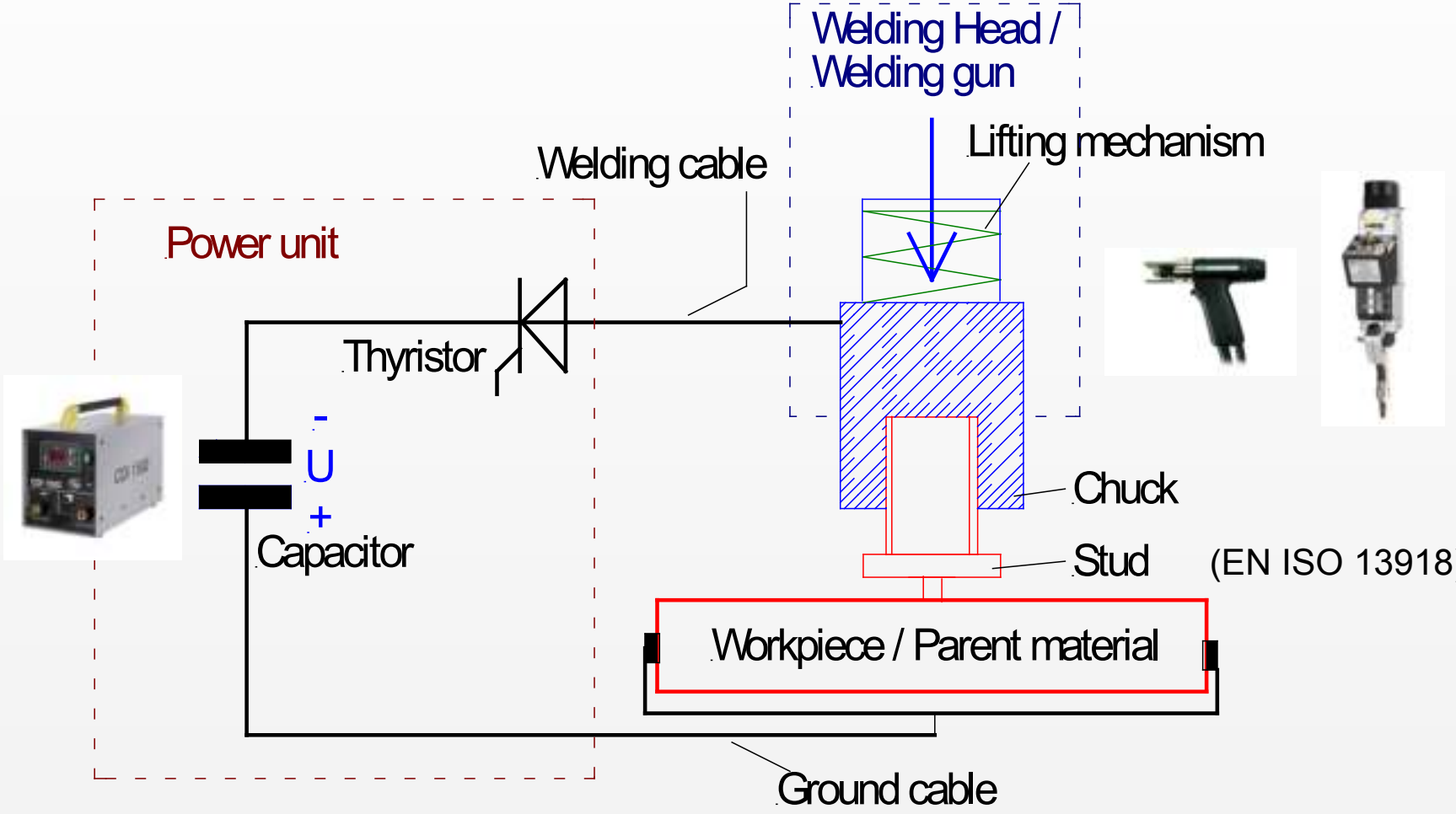
- **With gap**
  - Aluminum
  - Thin sheet metal
- **With contact**
  - Mild steel
    Stainless steel
  - Coated Plates
  - Insulation pins

ISO- Insulation
Cupped head pins

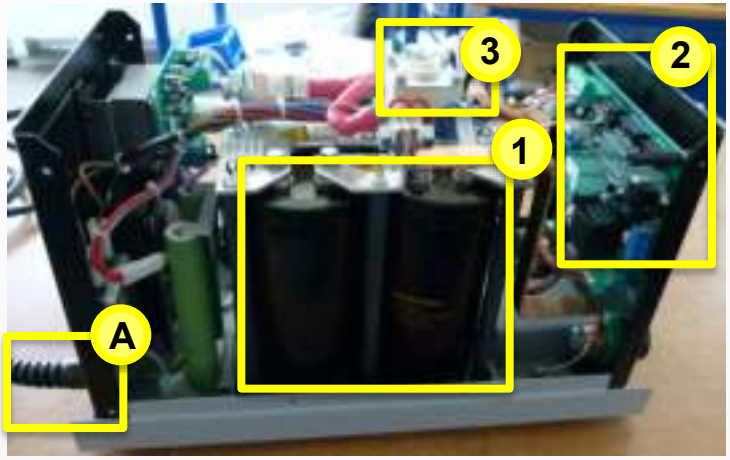


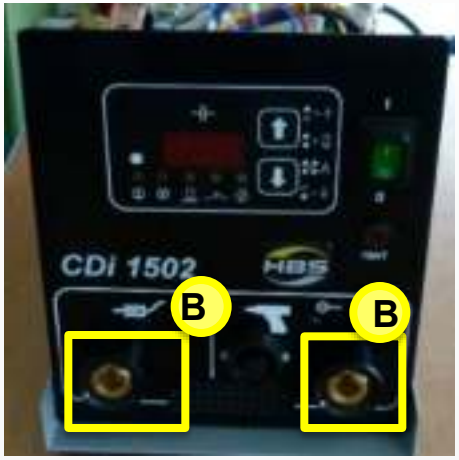
CD Stud Welding

Cirquit diagram



Aufbau Leistungseinheit





A – Net Power supply

1 – Capacitor bank

2 – Controlling board

3 - Thyristor

B – Weld circuit (ground cable / weld cable)

CD Stud Welding

Process Methods

Welding with Contact (ISO 4063: 786)

CD Stud Welding

Process Methods

Welding with Gap (ISO 4063: 786)

CD Stud Welding

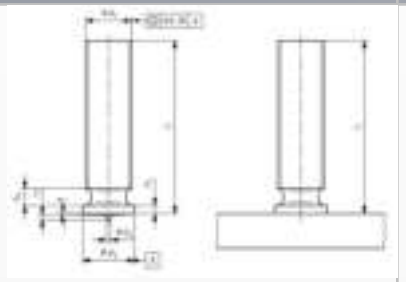
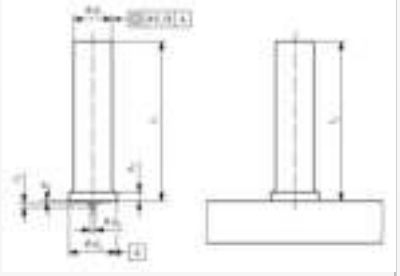
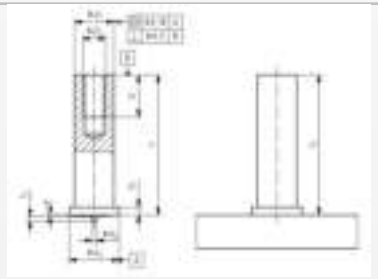
Tip Ignition – Welding Method

Method	Characteristic							
	Welding process [a]	Welding diameter d_w mm	Peak current $\approx I$ A	Welding time ≈ ms	Spring force ≈ N	Plunging speed ≈ m/s	Ignition	Typical application
Contact method	786	0,8 to 10	5 000	1 to 3	60 to 100 depending on piston mass	0,5 to 0,7	Always correct	Welding of (unalloyed and alloyed) steel, galvanized or oily surfaces
Gap method	786	0,8 to 10 (aluminium up to 6)	10 000	0,5 to 2	40 to 60	0,5 to 1, aluminium 1 up to 1,5	Mostly correct, advanced ignition possible	Welding of aluminium and brass

[a] In accordance with ISO 4063.

CD Welding Elements

Type of studs (EN ISO 13918)

Capacitor discharge stud welding with tip ignition Type of studs				Symbols for studs
Features: • defined ignition tip (length and diameter closely tolerated) • Flange • flat ignition cone (3 °)	Threaded stud (**P**itch)			PT
	Unthreaded stud			UT
	Stud with **I**nternal thread			IT

CD Welding Elements

Type of studs - customised

Thread	Form / Design	ISO	Material Surface
• Coarse thread • Lacknut • Inch • Left turning	• Ground connector • Ball • T-Stud	• Pins & nails	• 6.8 • A2-70 • A4-50 / A4-70 • EN AW - Al 99,5 • E-Cu

Welding Parameters

Power unit - Welding Parameters

Charging voltage

- Together with the capacitance, the **charging voltage** determines the welding energy

  W [Ws] **= 0.5 x C** [F] **x U²** [V]

- The required energy is proportional to the weld cross section

Example: PT M8 - 4.8

Capacitance: C = 0,066 F
Charging Voltage: U = 220 V

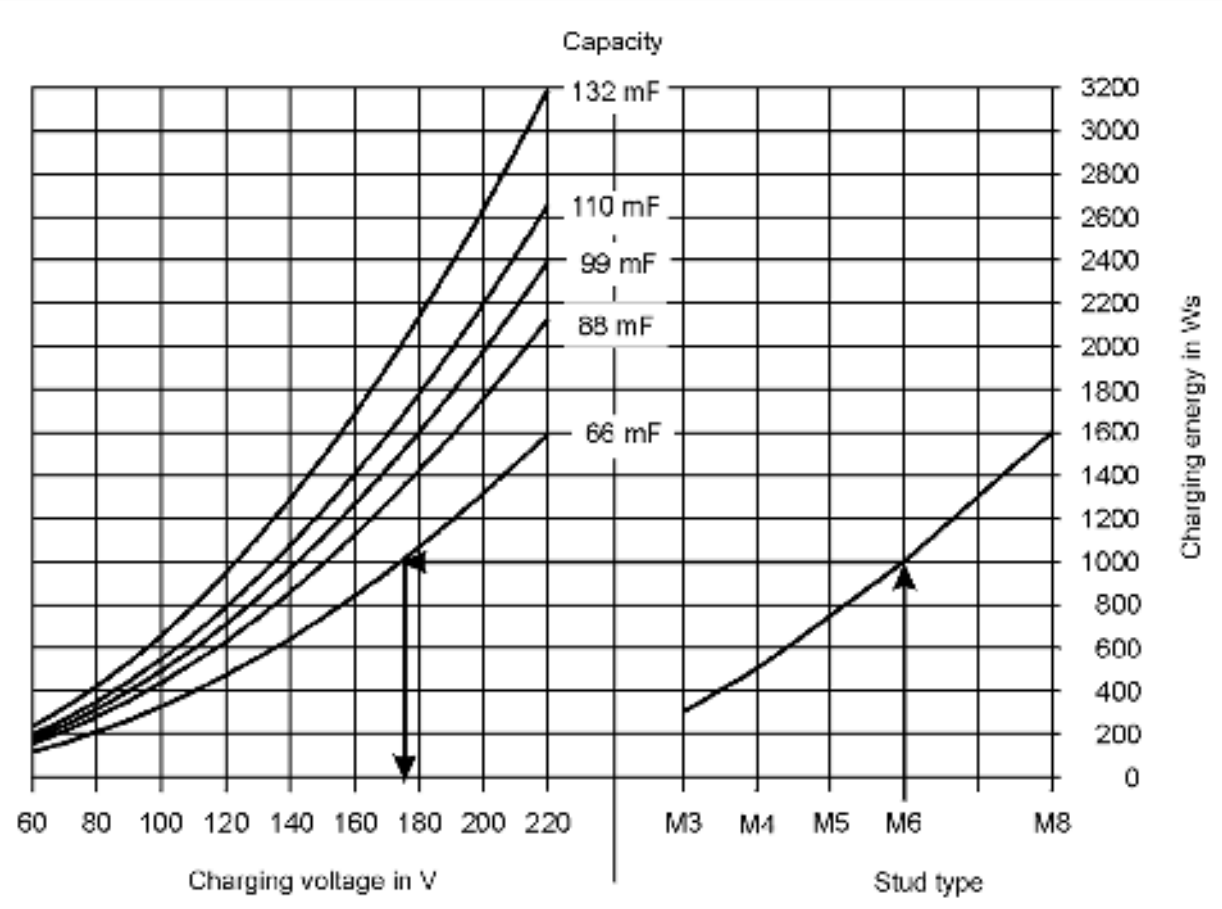
E = 0.5 x 0, 066 x 220²

E = 1,600 Ws

HBS CD- Series			
Kapazität	66.000 µF	99.000 µF	132.000 µF
Manually	CDi 1502	CDi 2302	CDi 3102
Automation	CDi 1502	CDM 2401	CDM 3201
Max. Charging Voltage	220 V	220 V	220 V
Max. Charging Energy	**1.600 Ws**	**2.400 Ws**	**3.200 Ws**
Competition			
Max. Charging Voltage	200 V	200 V	200 V
Max. Charging Energy	1.320 Ws	1.980 Ws	2.640 Ws
Difference (18%)	- 280 Ws	- 420 Ws	- 560 Ws

Welding Parameters

Reference points (DVS 0903, 0904)

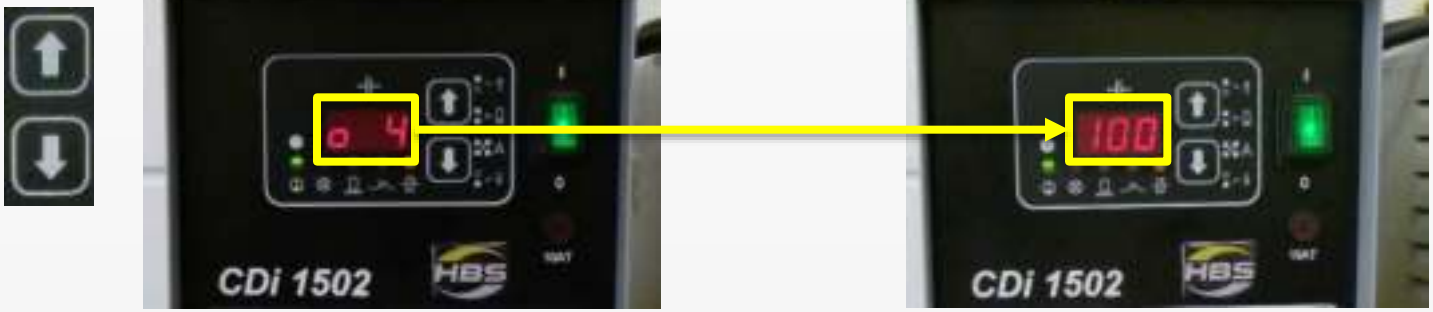


Example: PT M6 – 4.8 : U = 175V, C=66.000µF, E=1000Ws

Welding Parameters

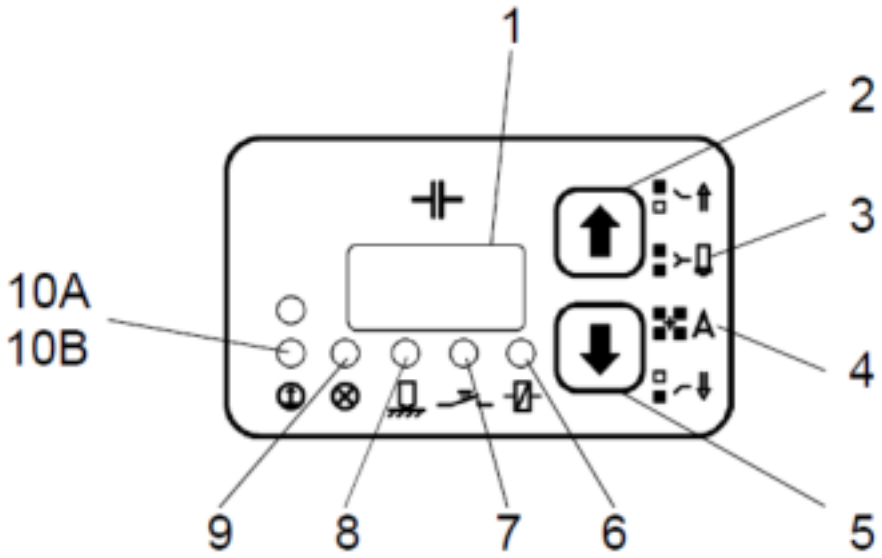
Welding parameters – Power unit

Library function (CDi-Series)



Welding Parameters

Welding parameters – Power unit



1 - Display

2 - größer

3 - Bibliothekmodus
(Bolzendurchmesser)

4 - Automatikbetrieb
(nicht verfügbar)

5 - kleiner

6 - Magnet

7 - Taste

8 - Kontakt

9 - Gesperrt

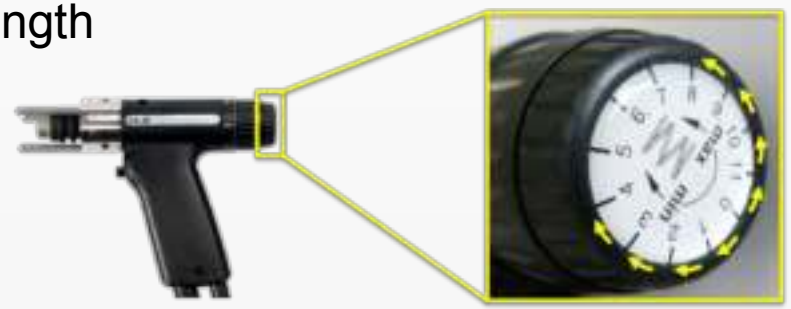
10 - Bereitschaftsanzeige
- 10A - Bereit
- 10B - Laden

Welding Parameters

Weld gun - Welding Parameters

Welding time

- 1 to 3 ms (No direct selection)
- Dependent on the stored energy, the process (contact or gap) and the inductance of the welding circuit
- A longer welding time simplifies welding on coated surface by virtue of better degassing
- Is also dependent on the stud tip length



Plunging Speed

- Dependent on the stored energy, the process (contact or gap) and the inductance of the welding circuit
- Must be kept constant inside narrow limits for high quality joint.

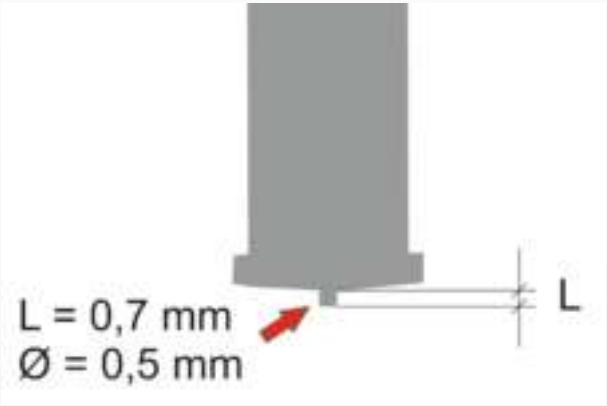
Welding current

- The peak current is between 1,000 A and 10,000 A
- Dependent on the charging voltage, the capacitance and the resistance of the welding cable

Welding Parameters

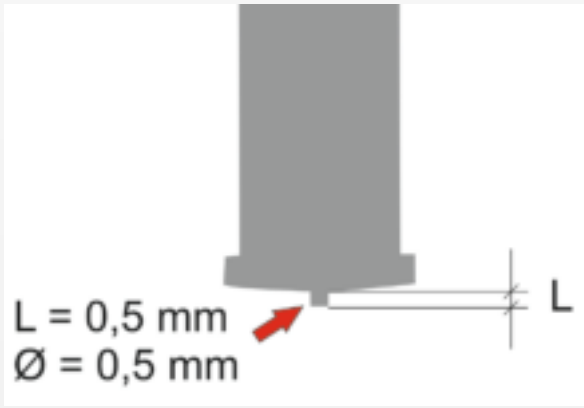
Tip Ignition – Dimension of the Tip

v = 0,7m/s … constant
v = L / t
t = L / v



Stud 1:
L = 0,7 mm
t = 0,7 mm / 700 mm/s t = 0,001 s

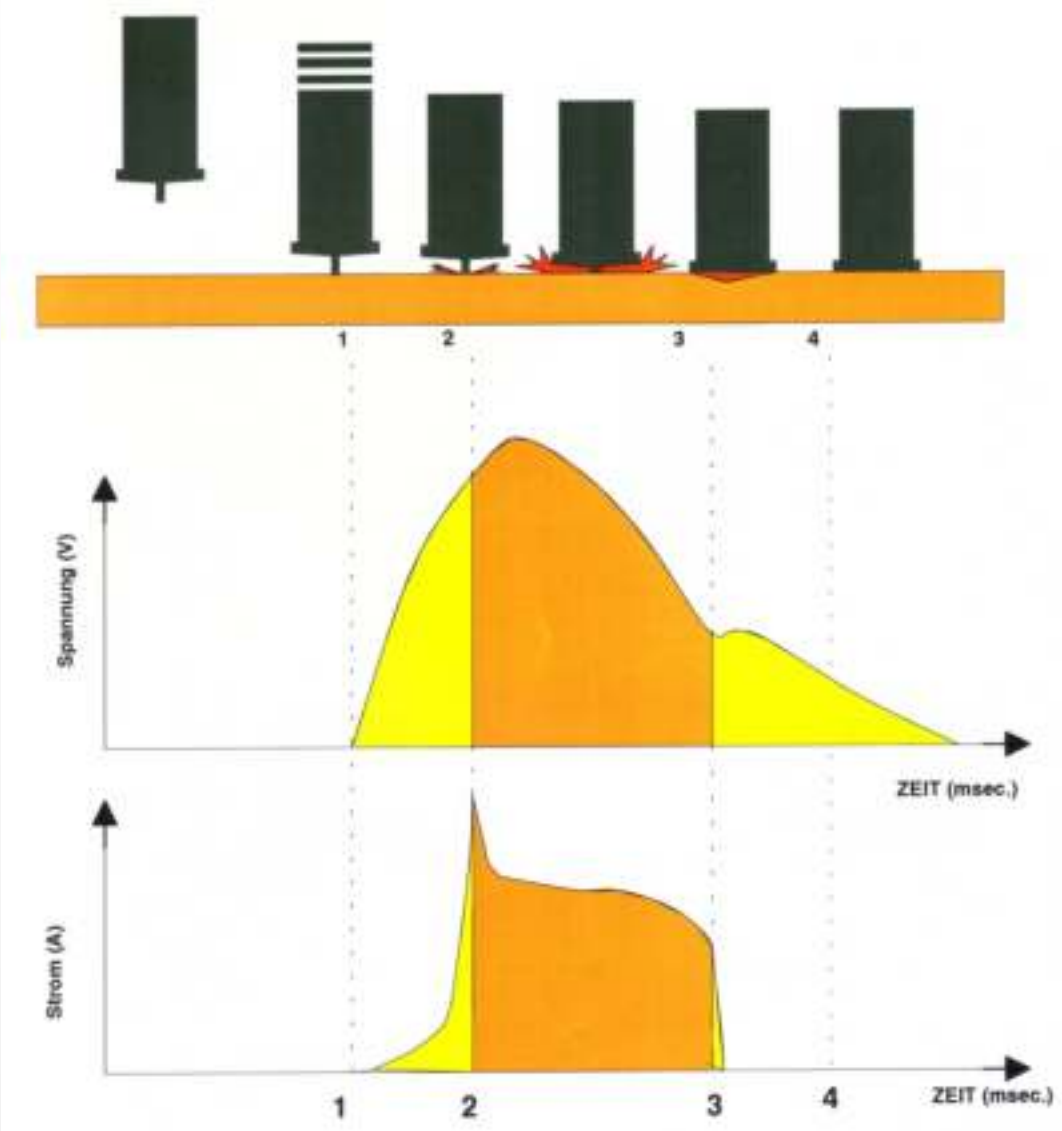
Difference: 30%



Stud 2:
L = 0,5 mm
t = 0,5 mm / 700 mm/s t = 0,0007 s

Welding Parameters

Process Monitoring



Materialcombinations

Materials & Weldability

Stud material	Work piece / Parent metal				
	Mild steel (R_{eH} ≤ 360 N/mm²) **Fine-grain steel** (R_e > 360 N/mm) (R_e > 500 N/mm²)	**Coated plates** (µ<25µm) **Mild steel** Fine-grain steel	Austenitic **Stainless steel**	**ETP Copper** & lead free **brass** (e.g. CuZn37 / C26000, C 26800)	**Aluminium**, & **Al-Mg-Alloys** (Mg ≤ 3.5%)
Low carbon steel 4.8 (weldable) AISI 1006 to 1020	**a**	b	**a**	b	-
Stainless steel 300 and 400 series	**a**	b	**a**	b	-
CuZn 37 Copper alloy 260 and 268	b	b	b	**a**	-
Al 99,5 **1100 series**	-	-	-	-	b
AlMg 3 5000 series	-	-	-	-	**a**

a) Well suited and recommended for all applications
b) Suitable on a limited scale for force transmission
- Not suitable

Materialcombinations

Materials & Weldability

	Type	Stud diameter [mm]							
Sheet metal	UT / IT	Ø2	Ø3	Ø4	Ø5	Ø6	ø7,1	Ø8	Ø10*
	PT		**M3**	**M4**	**M5**	**M6**		**M8**	**M10***
Mild steel (4.8)									
Stainless Steel (A2-50)									
Aluminum (AlMg3)									
Brass (CuZn37)									

*M10 (Ø10) is not a standard stud dimension according to ISO 13918.
The selection of the welding design is at the discretion of the producer (based on ISO 13918).

CD Stud Welding

Process characteristics

Welding method	Tip ignition
Power source	Capacitor
Power supply	115V (230V), single phase
Welding time	1 - 3 ms
Welding current	max. 10.000 A
Welding diameter	M3 - M8 (M10) Ø 2 – 8 mm
Stud design	Ignition tip
Material	Mild steel, stainless steel Aluminium, Brass
Sheet metal thickness	> 0.6 mm

CD Stud Welding

Process characteristics

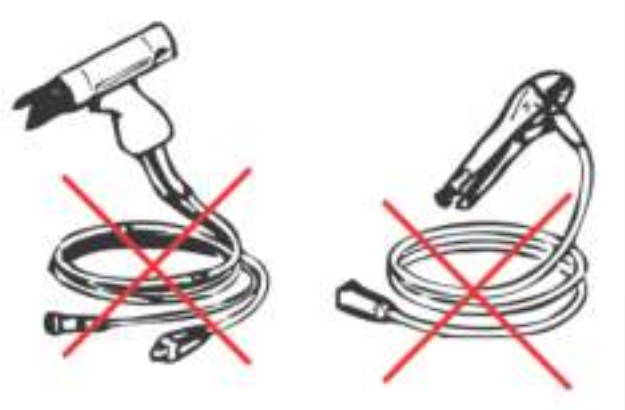
Process dependability	Medium to high
Visible weld spatter ring Form/Shape	Yes (with water none) Small
Marking on the reverse side (Mechanical / Thermal)	None/slight
Automation	Ideal
Centering of Element	Difficult (Flange) Centering with fixtures NO centering by manual center punch
Applications/Uses Sheet Metal Automobiel Manufacture Construction Insulation	 Yes No Restricted **H**eat/**V**entilation/**A**irCondition/**C**lima

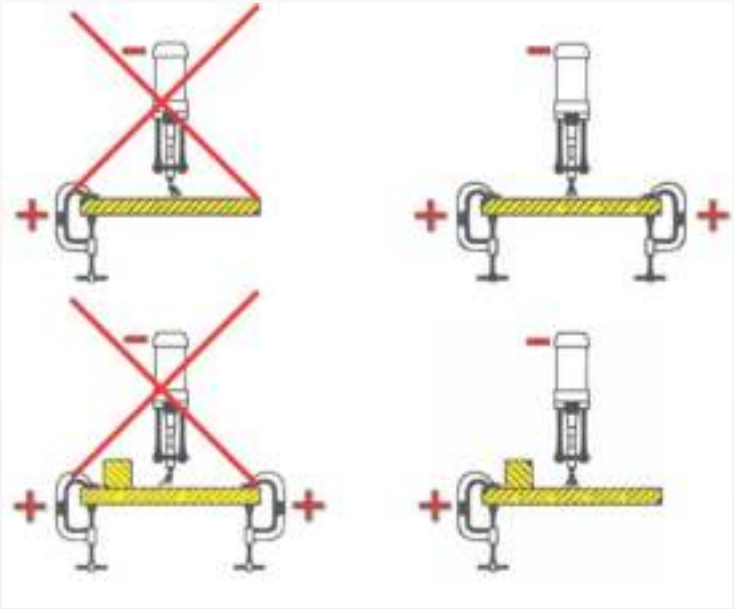
CD Stud Welding

Advantages

- **Simple adjustment** of the welding parameters
  (charging voltage, spring force, gap)
- **Short welding time**,
  no thermal marks on the reverse side of the sheet metal
- **Flanged studs** for high weld strength
- Weld on **one side** coated sheet metal
  without damage on the reverse side
- Weld on **thin sheet metal**,
  minimum sheet metal thickness of 0.6 mm
  or ratio stud-diameter to sheet metal thickness 10 : 1
- **230 V mains voltage**
  (single phase)

Grounding and arc blow effect





CD Stud Welding

Remarks

- No control of the welding-process due to short welding time
- Flanged studs for high weld strength
- Out-of-flatness of the surface leads to reduced strength
- Down holder to avoid vibrate of the work piece
- Ground clamps close to welding-position
- Clean surface of the work piece required