Robot automated EMPT sheet welding

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Motivation

Light weight design is today hindered by:

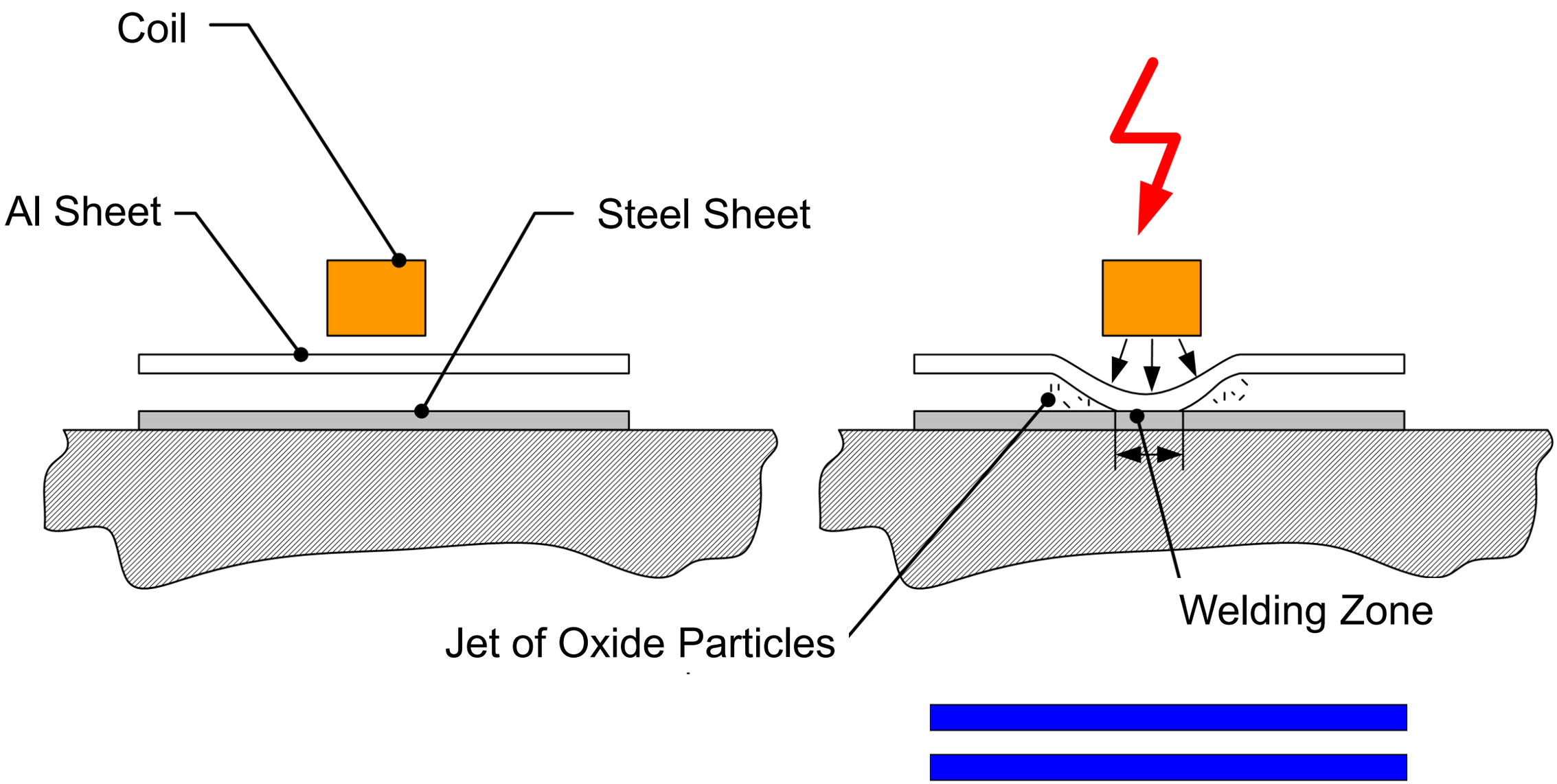
Reason	Effect	Workaround	
Heat affected zones	**Material softening**	**Increase in wall thickness**	**Increased weight**
Thermal loading	**Thermal distortion**	**Flattening work/ complex clamping & positioning devices**	**Increased costs**
Strongly differing melting points of aluminum and steel	**Al to steel is not weld able**	**No technique for robust and cost efficient production of high strength hybrid joints**	**Poor use of light weight potential**

EMPT Sheet Welding: Process characteristics

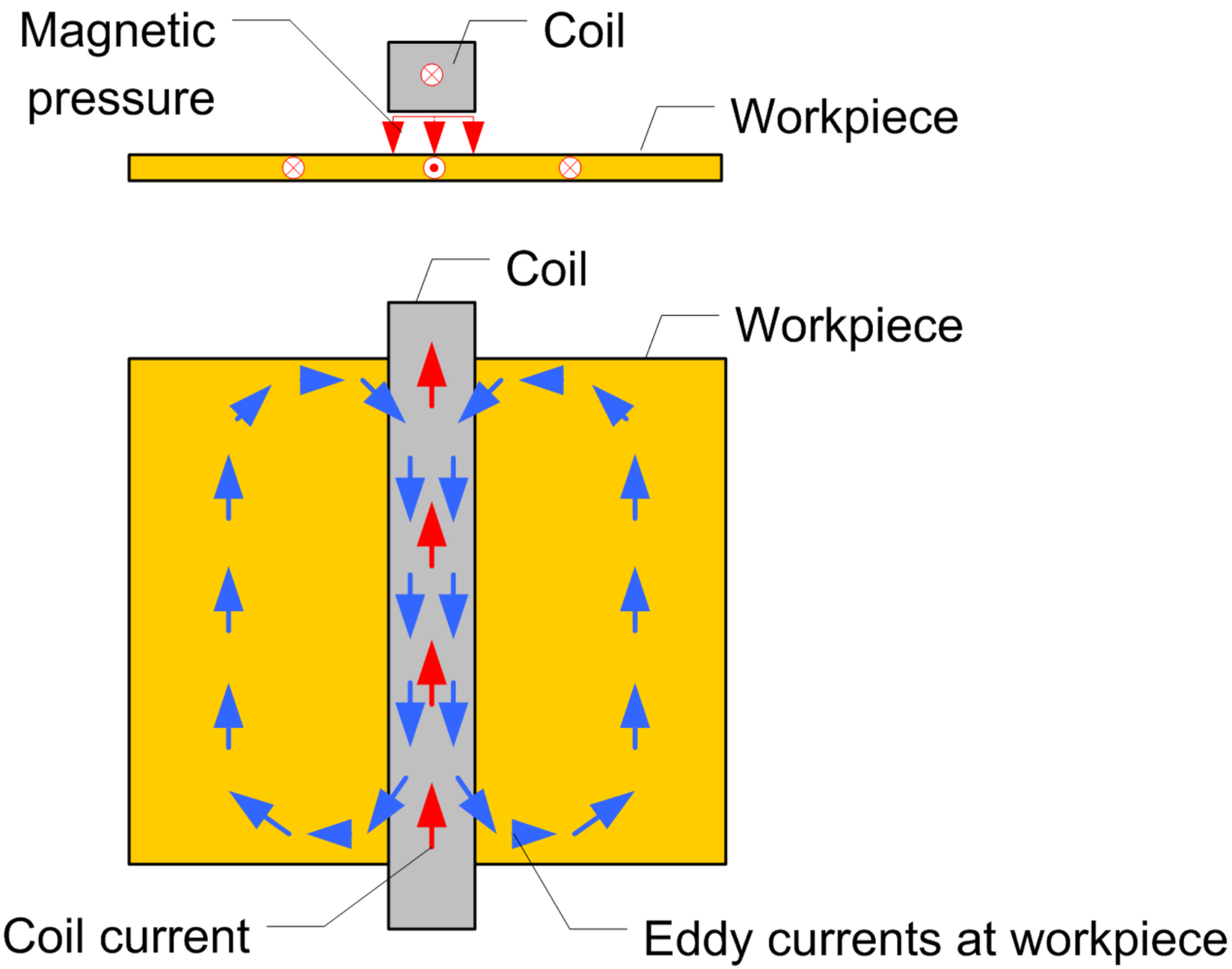
Characteristics

- 20µs processing time
- No Heat Affected Zone (HAZ)
- No thermal distortion
- Atomic bonding (solid phase weld)
- No metallurgic changes in the weld area
- No inter-metallic phases
- Contact less
- No shielding gases

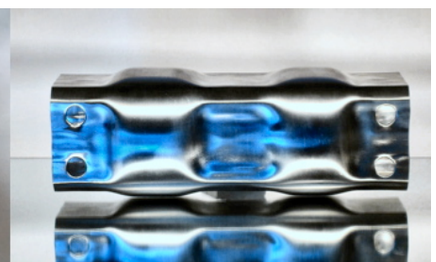
EMPT Welding of Sheets: Process fundamentals



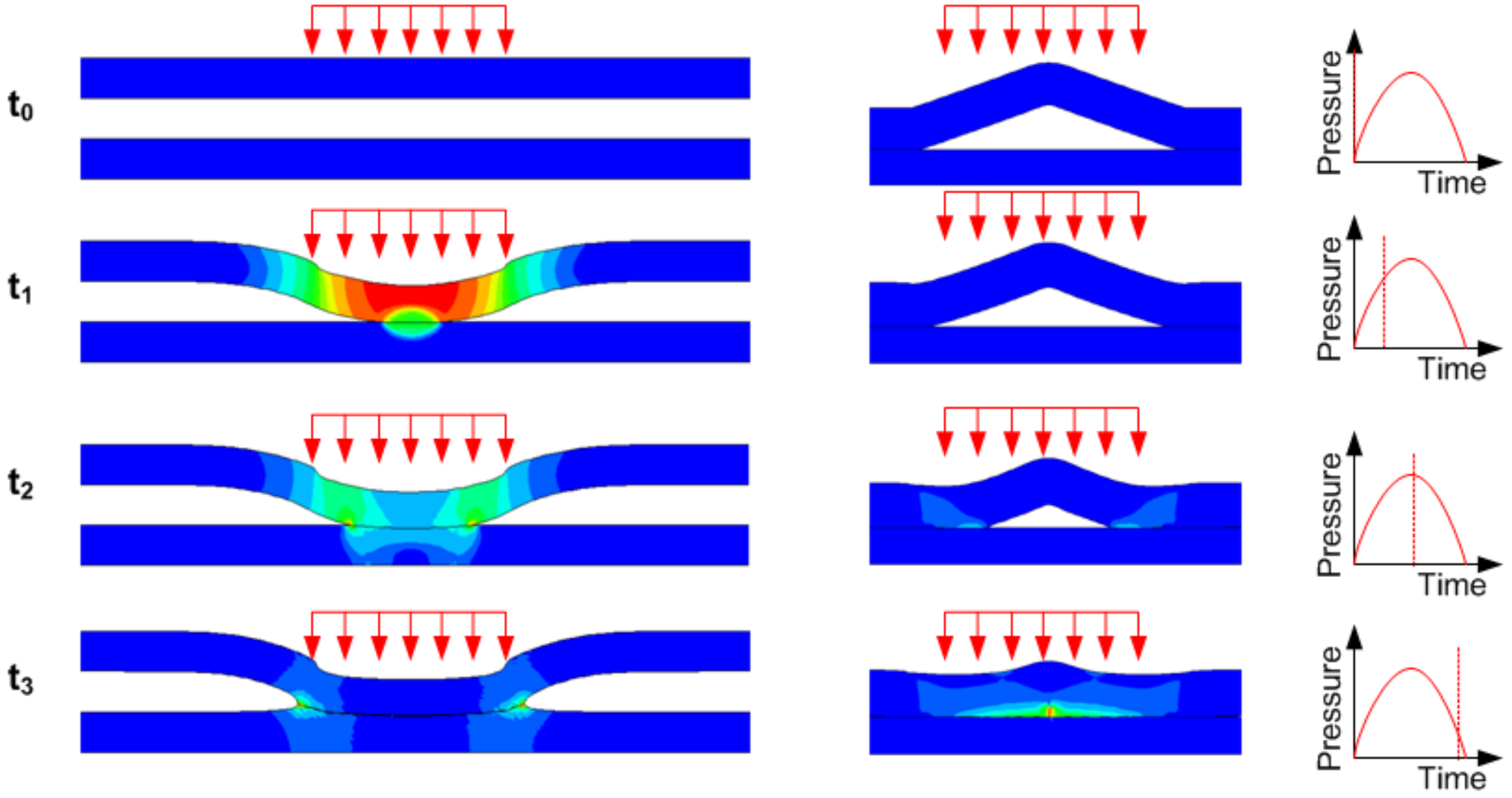
EMPT Welding of Sheets: Process fundamentals





EMPT Welding of Sheets: Process fundamentals



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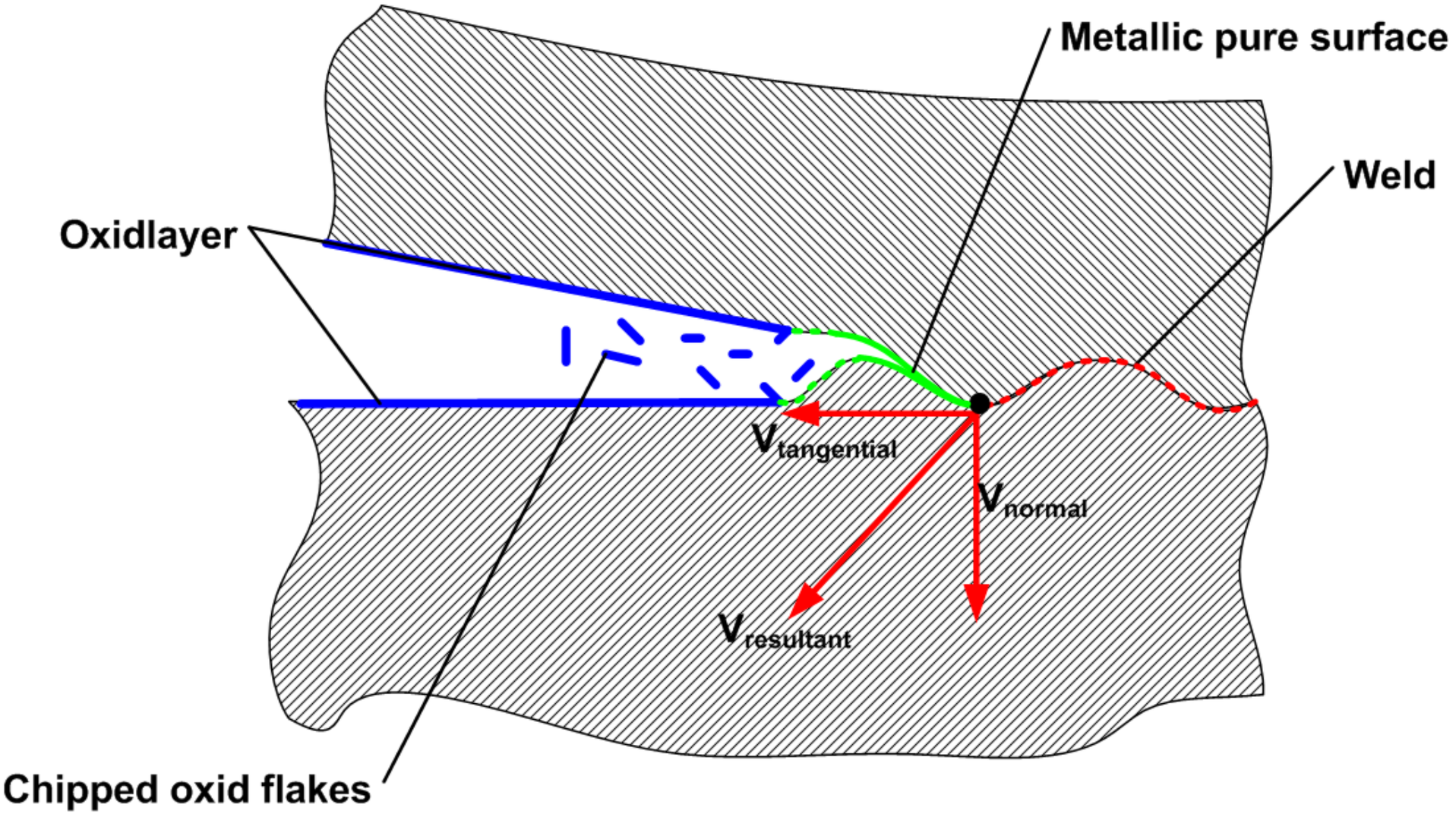

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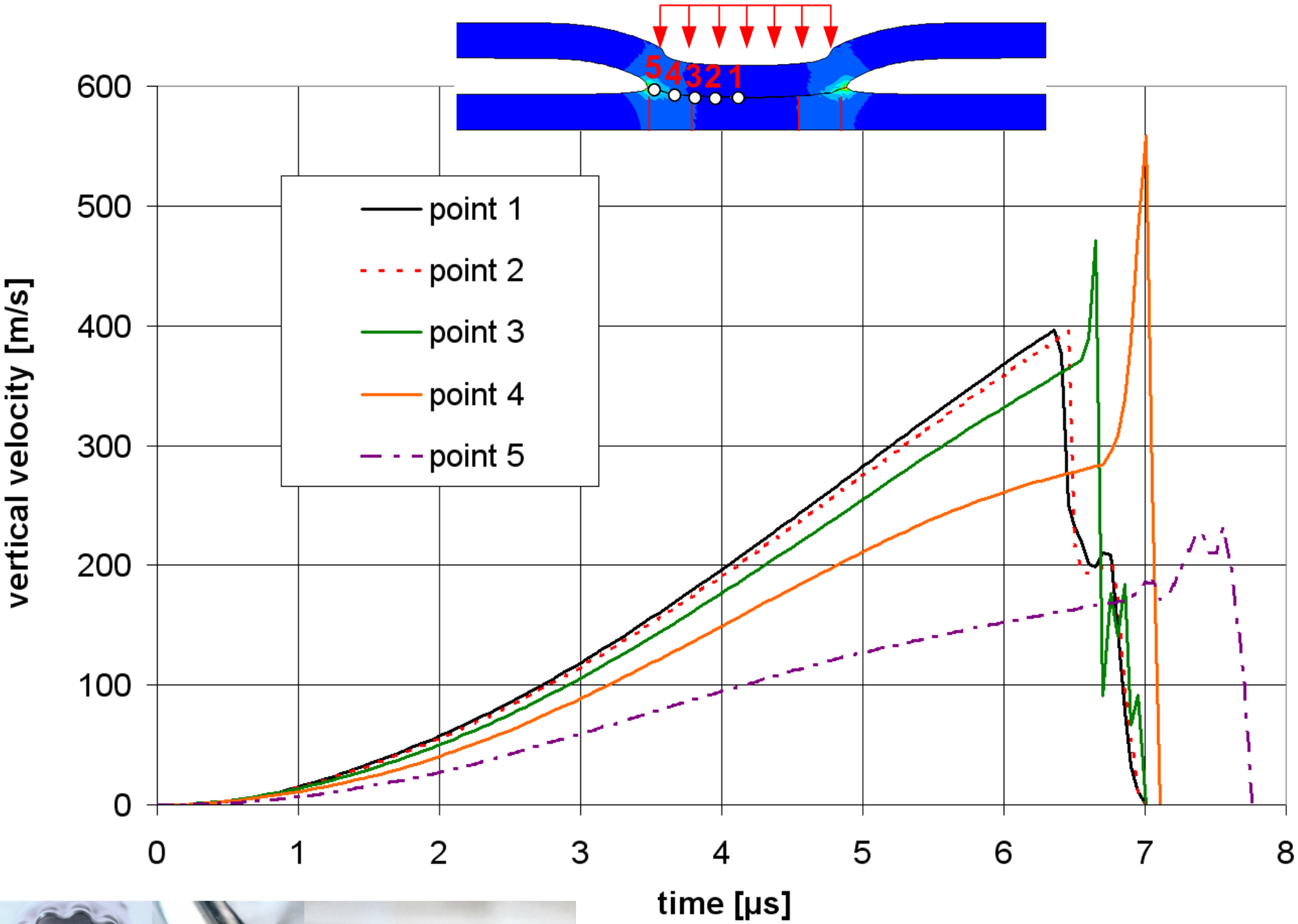
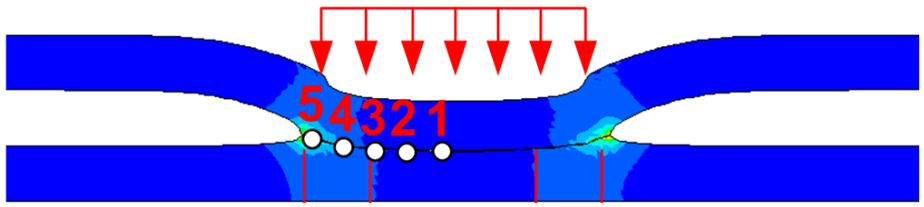


EMPT Welding of Sheets: Process fundamentals



Point #	Time after first impact [ns]	Tangential Velocity [m/s]	Normal velocity [m/s]	Contact tangential stress [N/mm²]	Contact normal stress [N/mm²]
1	0	0	396	0	2700
2	250	179	395	70	2800
3	550	471	471	260	6500
4	1000	723	558	190	4700
5	1750	520	230	25	4700

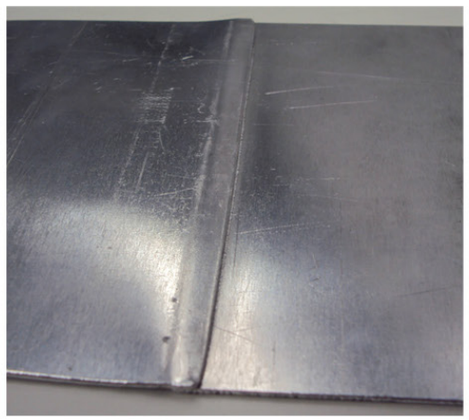
EMPT Sheet Welding: Small samples

Al- Steel, wallthickness=1 mm

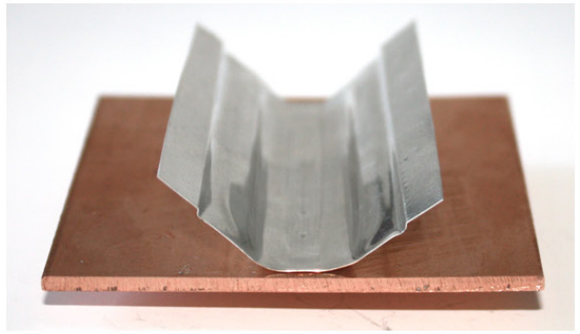
L_{weld}= 200 mm

L_{weld}= 450 mm

L_{weld}= 50 mm

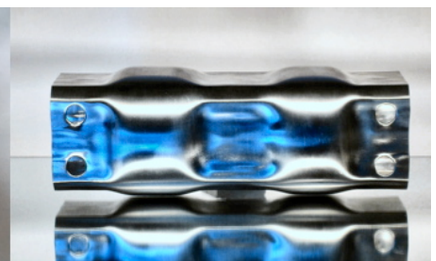


Al, 5mm overlap

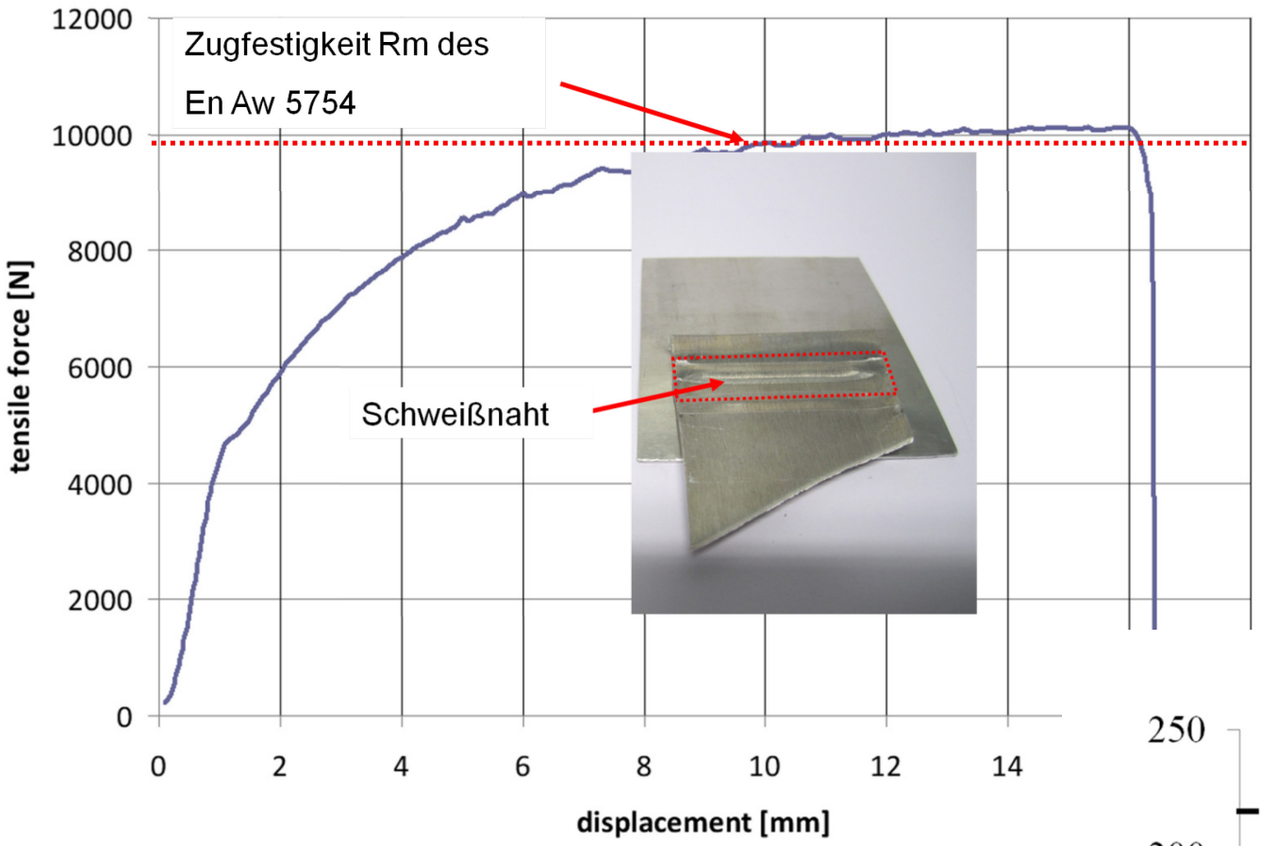


280 µm Al -2mm Copper

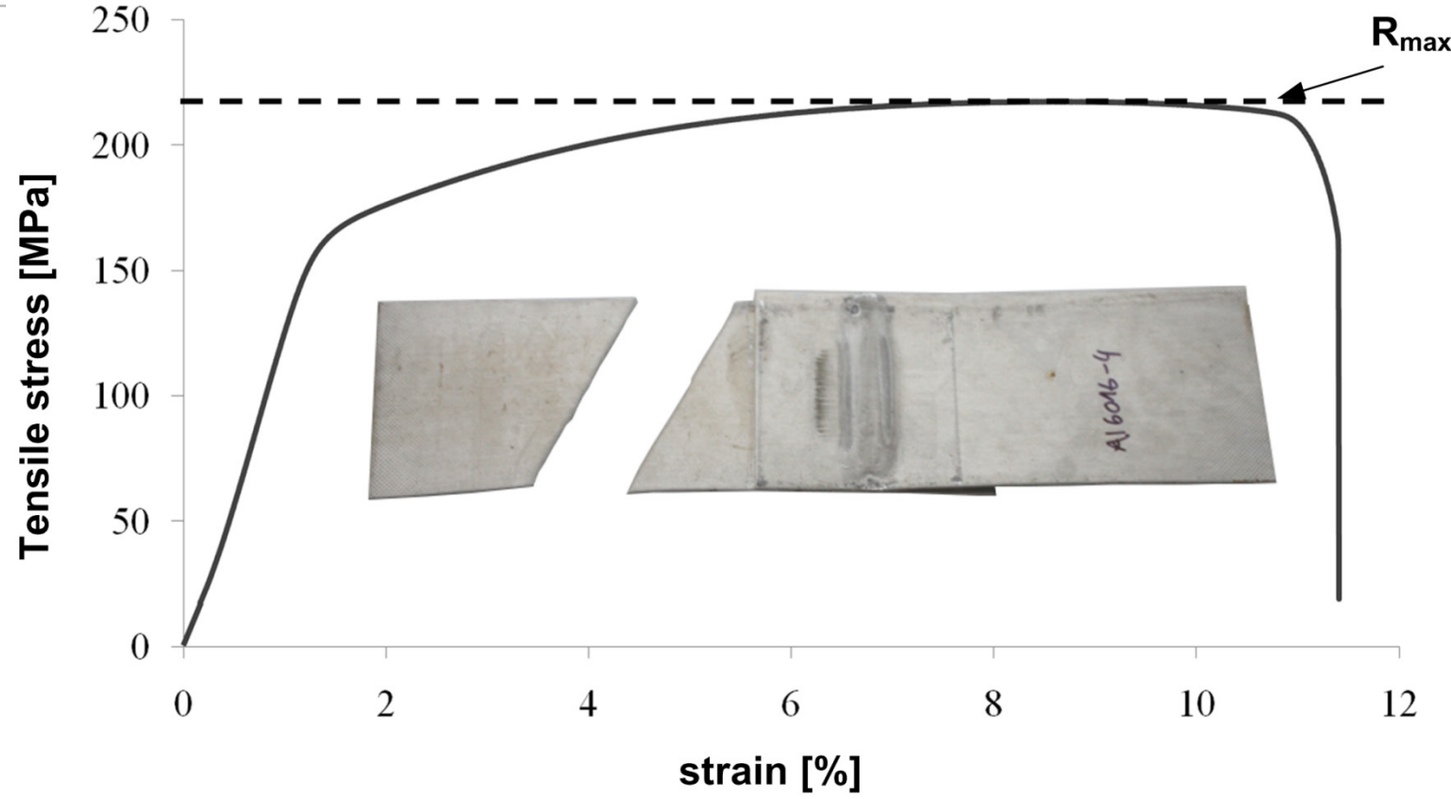
10 x 200 µm Copper



EMPT Sheet Welding: properties



Al 6016 - Al 6016

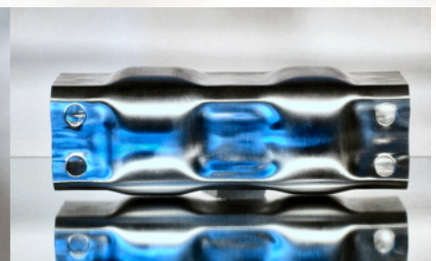


EMPT Sheet Welding: Al, Mg and Steel alloys

		Flyer							
		En AW 1050 A (O-H14)	En AW 3003 (O-H14)	EnAW 3130 (O-H14)	En AW 5754 (O-H14)	En AW 5083 (O-H14)	En AW 6016 T4/T6*	En Aw 6082 T4/T6*	1.4301
Target	En AW 1050 A	+	+	+	+	+	+	+	i.w.
	En AW 3003	+	+	+	+	+	+	+	i.w.
	En AW 5754	+	+	+	+	+	+	+	i.w.
	En AW 5083	+	+	+	+	+	+	+	i.w.
	En AW 6016 T4/T6*	+	+	+	+	+	+	+	i.w.
	En Aw 6082 T4/T6*	+	+	+	+	+	+	+	i.w.
	DC 01	+	+	+	i.w.	i.w.	+	+	i.w.
	DC 04	+	+	+	i.w.	i.w.	+	+	i.w.
	St 37	+	+	+	i.w.	i.w.	+	+	i.w.
	H400 LA	+	+	+	i.w.	i.w.	i.w.	i.w.	i.w.
	ZStE 500	+	+	+	i.w.	i.w.	i.w.	+	i.w.
	Trip 700 (Zinc coated)	+	+	+	i.w.	i.w.	i.w.	i.w.	i.w.
	Docol 800	+	+	+	i.w.	i.w.	i.w.	i.w.	i.w.
	Usibor 1500 (grinded)	+	+	+	i.w.	i.w.	i.w.	i.w.	i.w.
	1.4301 steel	+	i.w.	i.w.	i.w.	i.w.	i.w.	i.w.	+
	1.4301-cast	+	+	+	i.w.	i.w.	i.w.	i.w.	i.w.
	Mg	+	+	+	i.w.	i.w.	i.w.	i.w.	i.w.
	AZ91 Tixomold	+	+	+	i.w.	i.w.	i.w.	i.w.	i.w.

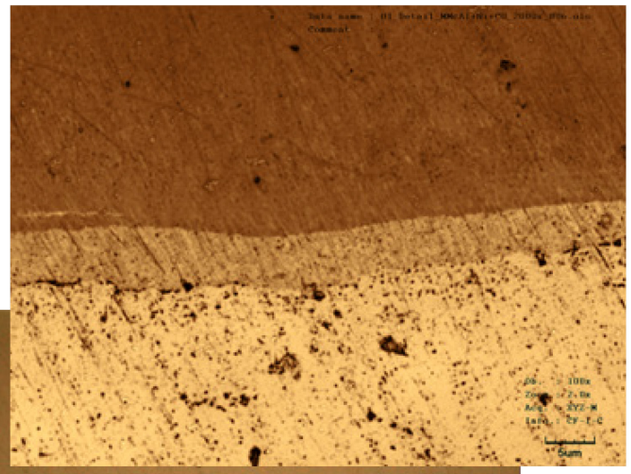
EMPT Sheet Welding: electromobility and special alloys

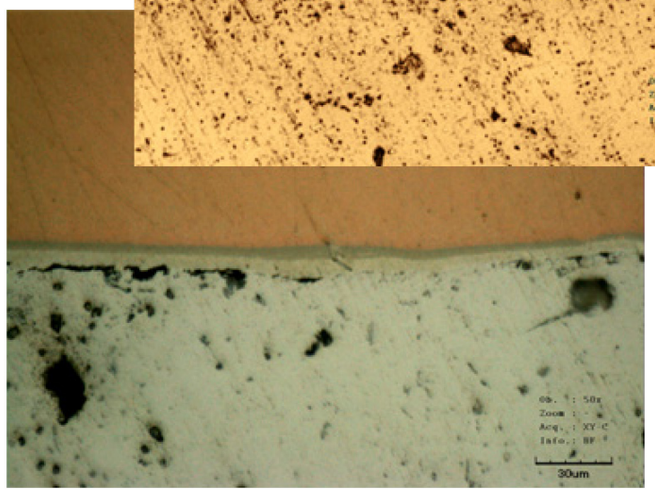
		Flyer					
		En AW 1050 A (O-H14)	En AW 3003 (O-H14)	EnAW 3130 (O-H14)	Cu 99,5	Cu 99,5 (zinc coated)	Pt
Target	En AW 1050 A	+	+	+	+	+	-
	En AW 3003	+	+	+	+	+	-
	En AW 3130	+	+	+	+	+	-
	Ni 201	+	+	+	i.w.	i.w.	-
	Cu 99,5	+	+	+	+	+	-
	Cu 99,5 (zinc coated)	+	+	+	+	+	-
	Mild steel	+	+	+	+	i.w.	i.w.
	Steel 1.4301	+	+	+	+	+	i.w.
	Pt	i.w.	i.w.	i.w.	+	i.w.	+

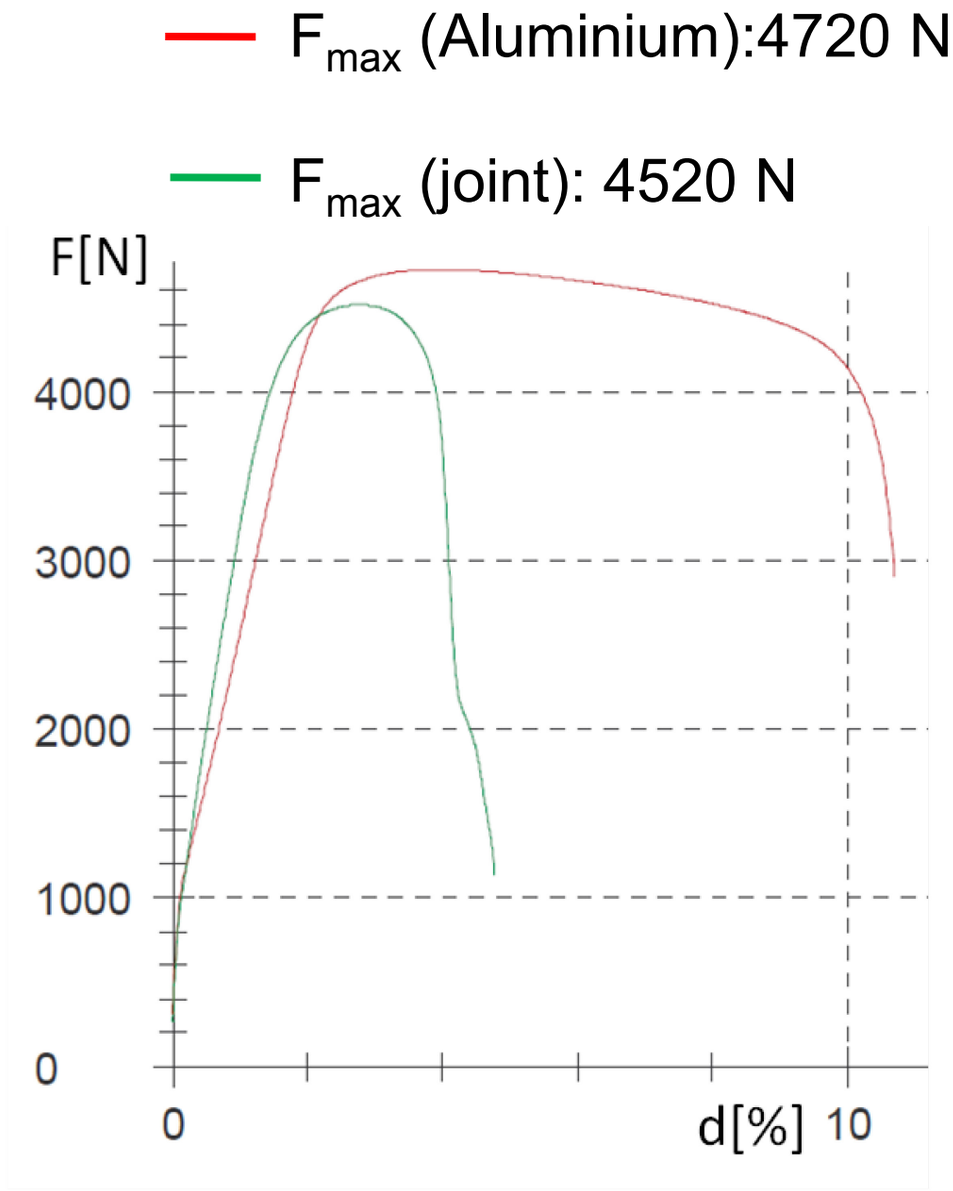


EMPT Sheet Welding: electromobility and special alloys

Aluminium
Copper (zinc coated)

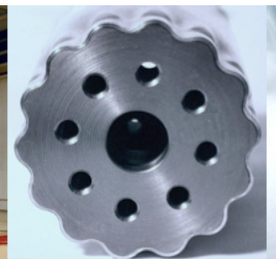


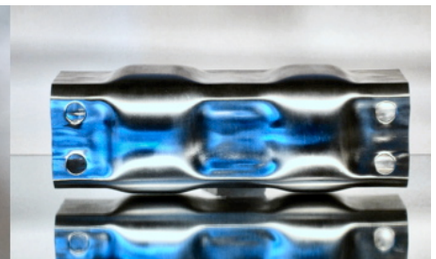




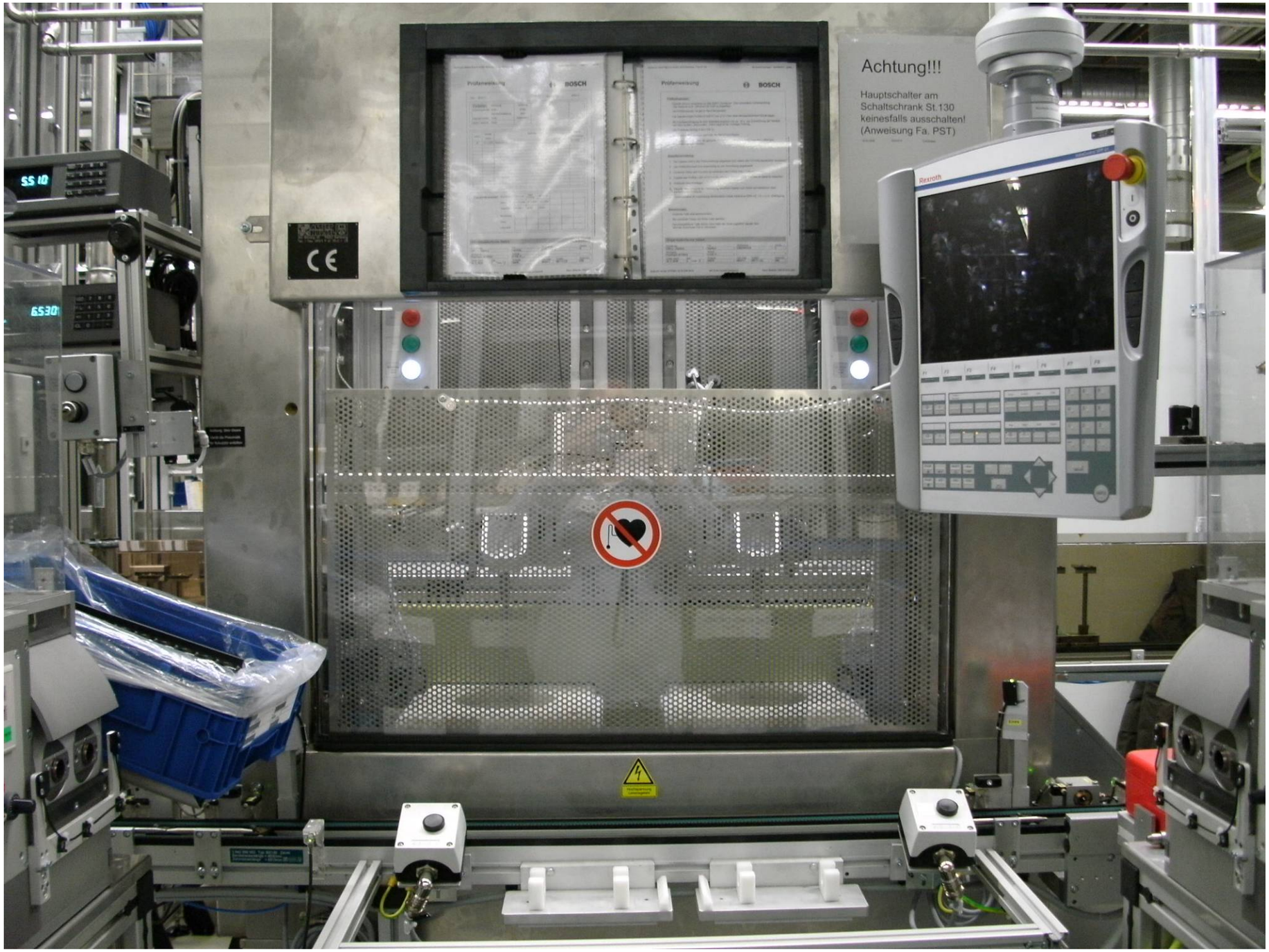
EMPT Equipment

EMPT sheetwelding coil for stationary component assembly

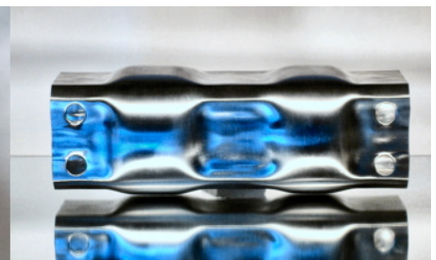





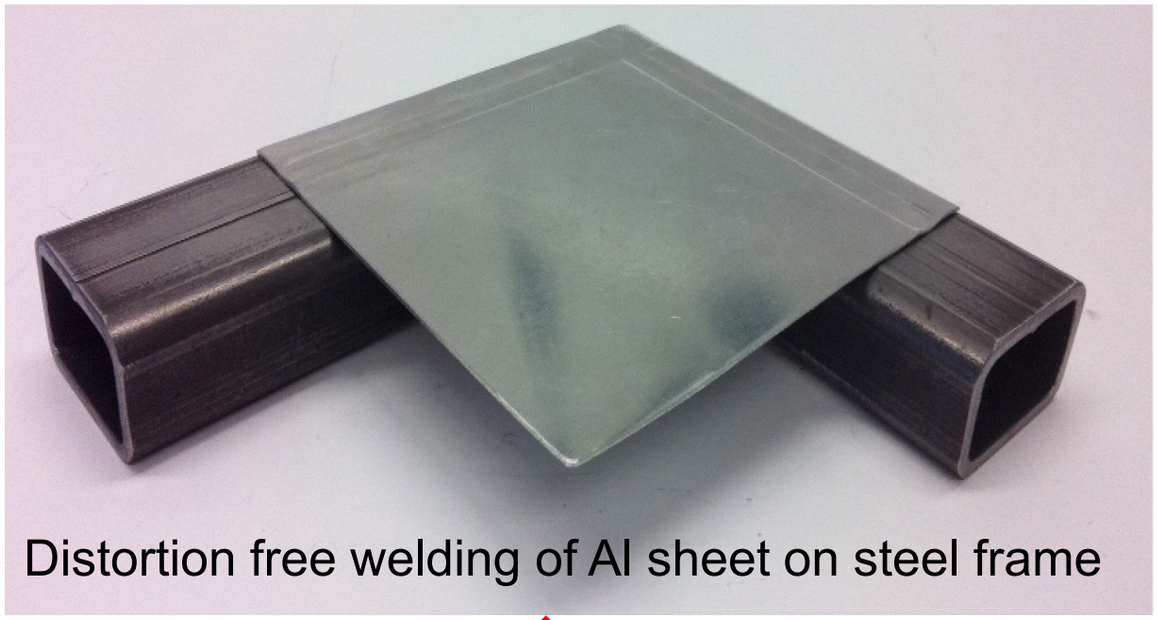
EMPT Equipment in automated production lines



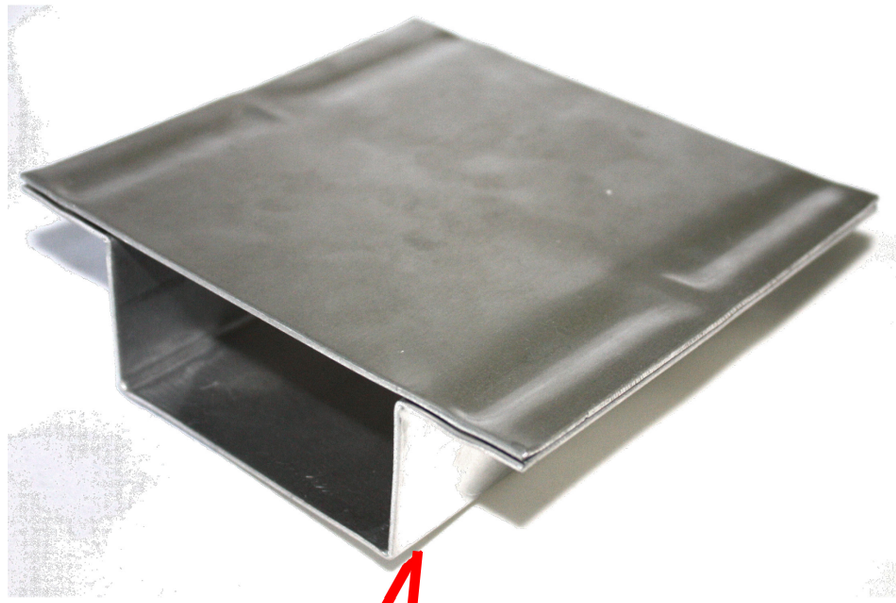


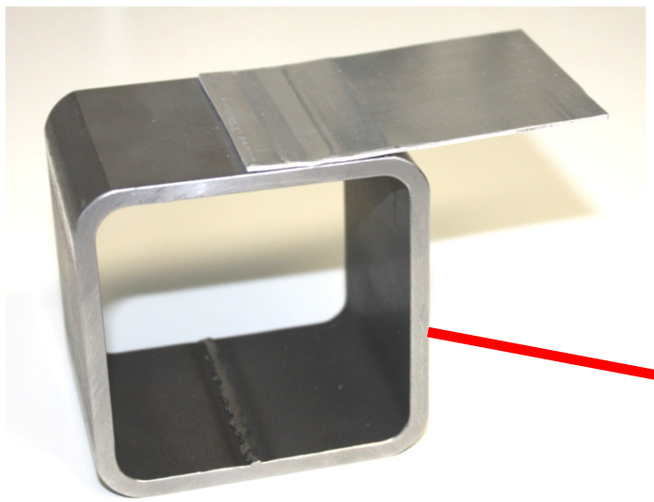



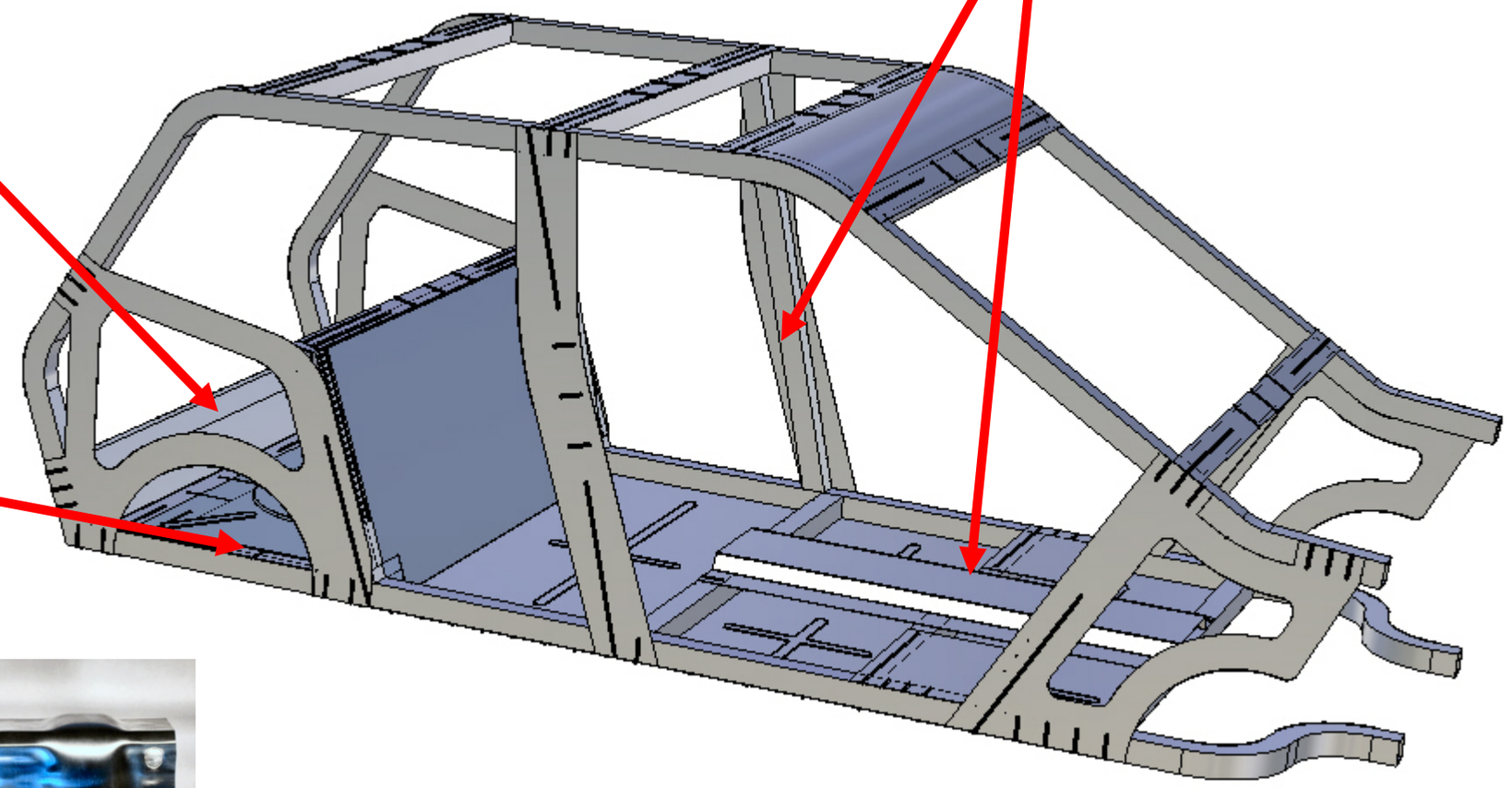
EMPT Sheet Welding: Small samples

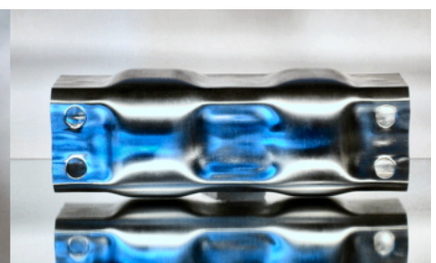


Distortion free welding of Al sheet on steel frame

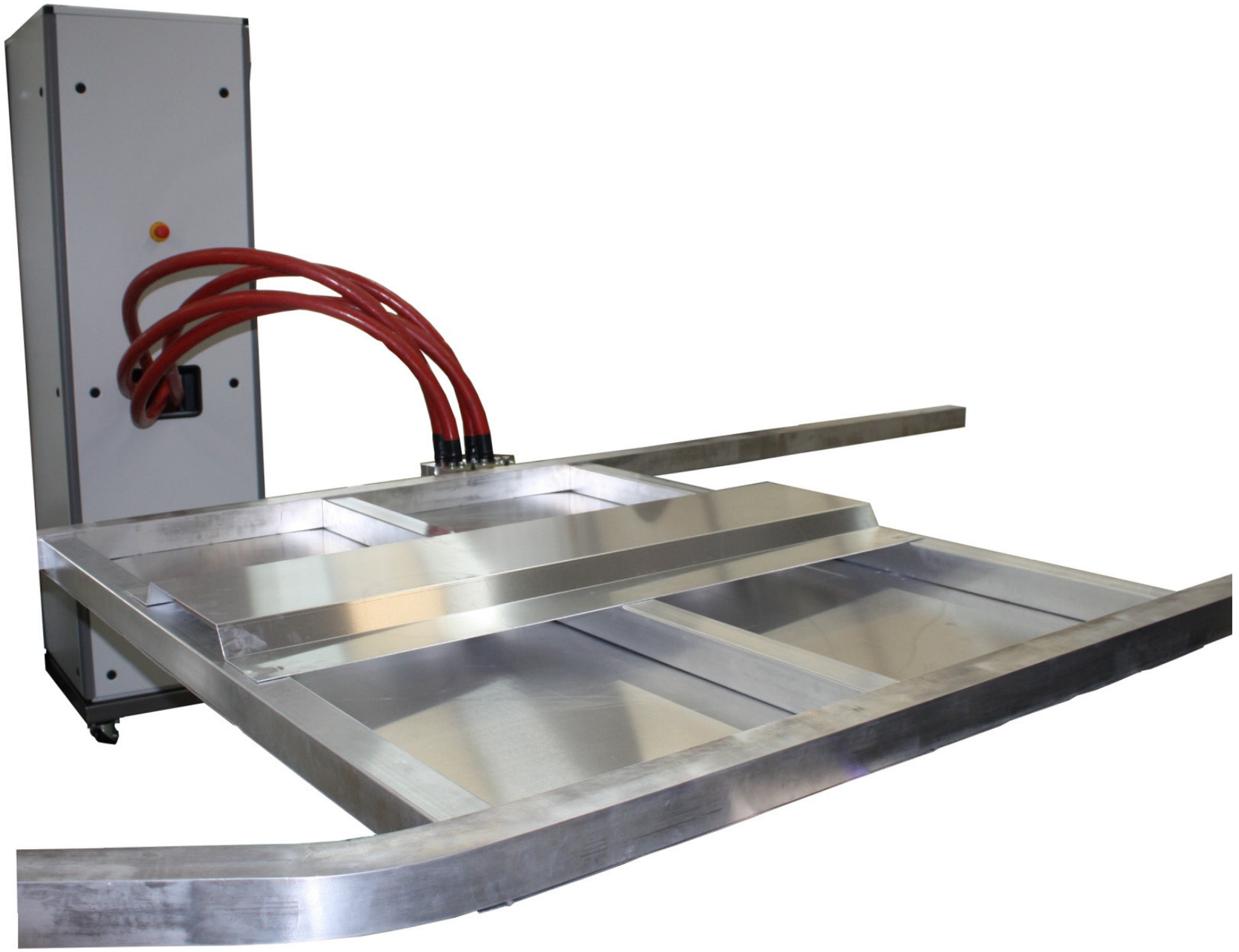


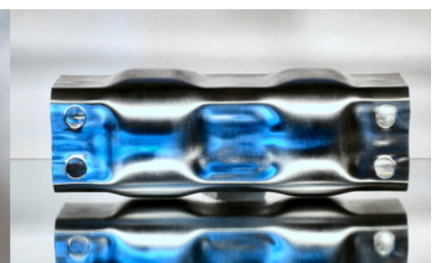




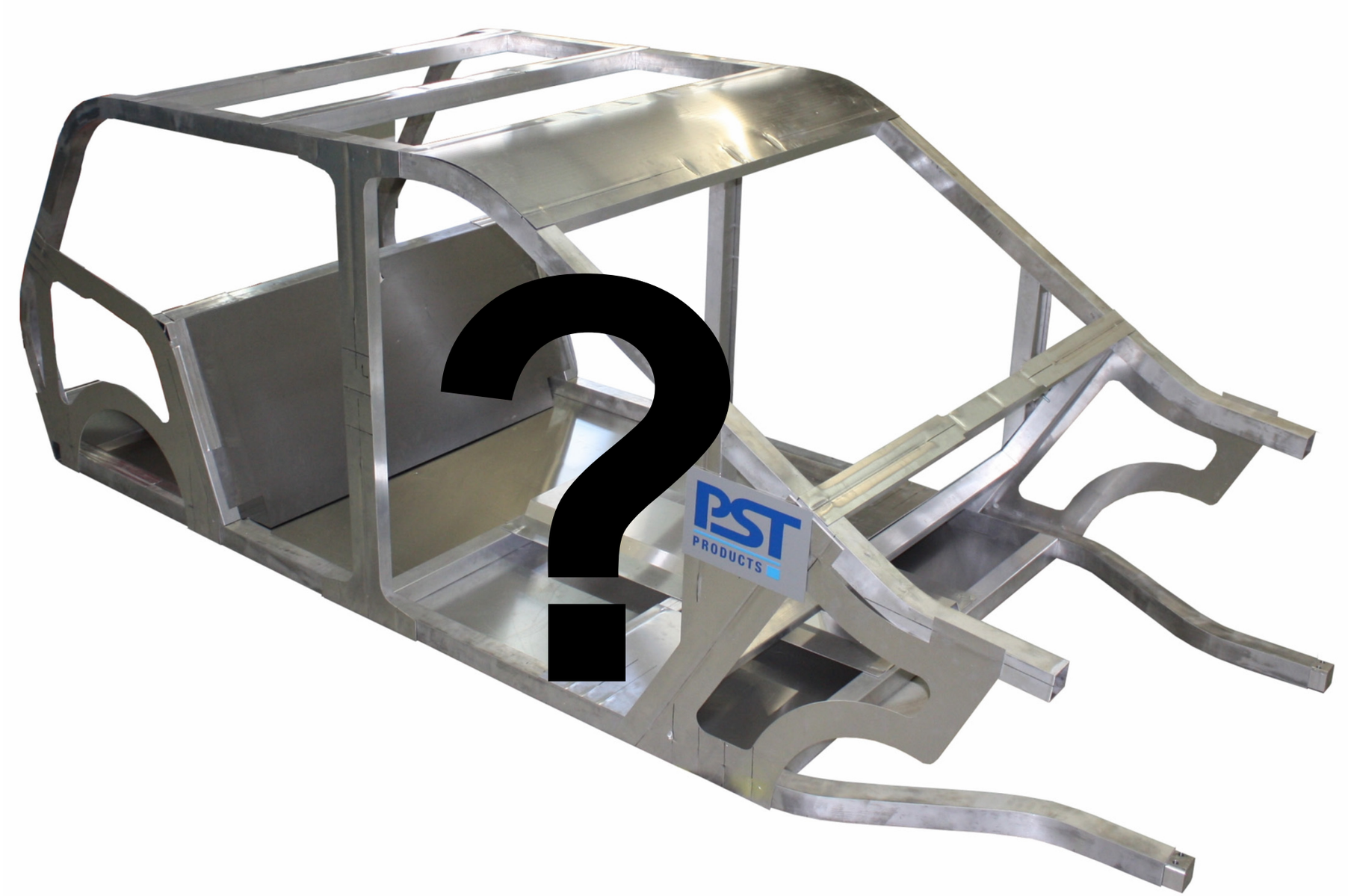


EMPT Sheet Welding: big plane samples

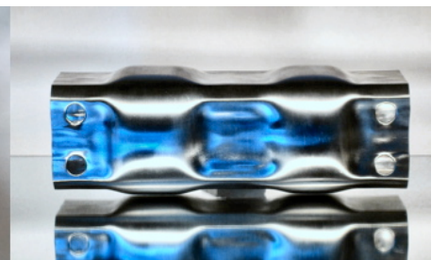




EMPT Sheet Welding: big 3D samples





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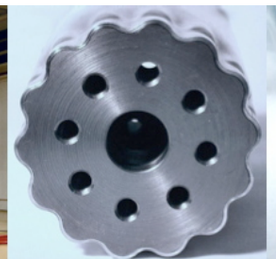
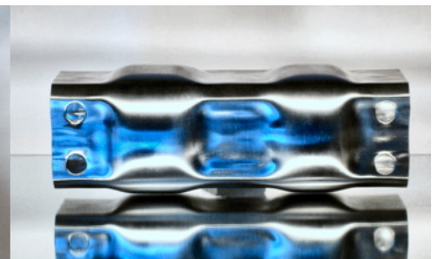
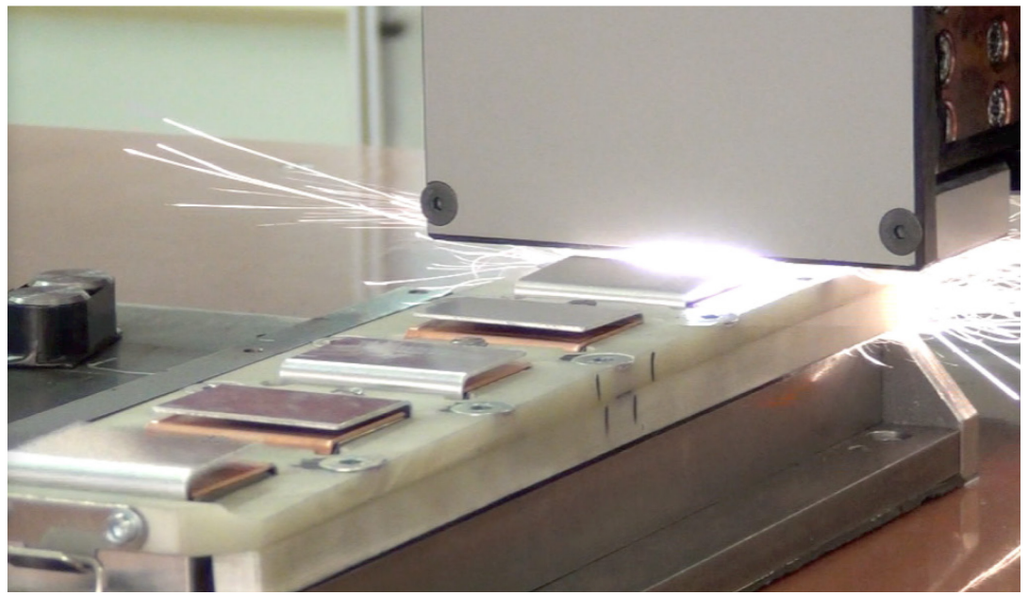


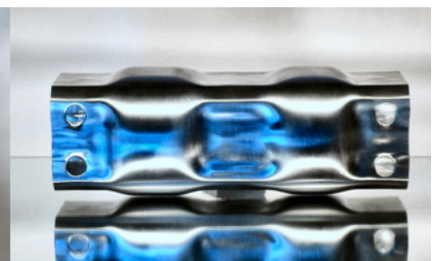


EMPT Robot assisted welding requirements

1. Special coil, mountable at robot
2. Cable duct
3. EMV considerations
4. Mechanical impulse protection of the robot
5. Robot cell security aspects
6. Robot program bibliotheca





EMPT Equipment

PSTproducts PSxx Series

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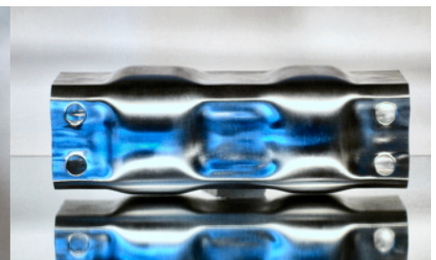
F: +49 6023 94 78 29
I: www.pstproducts.com

January 2010

Characteristics	PS8-16/25 to PS32-16/25	PS48-16/25 to PS96-16/25	PS112-16/25 to PS160-16/25
switchable banks	up to two	up to six	up to ten
normal rated discharge energy	8kJ to 32kJ	48kJ to 96kJ	112kJ to 160kJ
charging voltage	16kV or 25kV	16kV or 25kV	16kV or 25kV
normal rated discharge current (repetitive)	up to 320kA	up to 960kA	up to 1600kA
max peak current	up to 480kA	up to 1440kA	up to 2400kA
short cut current (non repetitive)	up to 800kA	up to 2400kA	uo tp 4000kA
pulses per minute	up to 12	up to 12	up to 12
cable length (standard)	5m	5m	5m
switching technology	mercury free, long life industrial switches	mercury free, long life industrial switches	mercury free, long life industrial switches
number of pulses with one switch set	up to 400 000	up to 400 000	up to 400 000
process control	LAN and/or VPN	LAN and/or VPN	LAN and/or VPN
life time capacitor	2 to 2,5 millions	2 to 2,5 millions	2 to 2,5 millions
number of joints per pulse	depends on coil concept : 1 to 20 joints	depends on coil concept : 1 to 20 joints	depends on coil concept : 1 to 20 joints
dimensions (without tooling space)	800 x 1200 mm	1600 x 1200 mm	1600 x 2400 mm
price	on demand	on demand	on demand



Thank you!


2. EMPT Konferenz und Anwendertreffen
27. Juni 2012, Alzenau
Informationen und Anmeldung:
www.pstproducts.com
2. EMPT Conference and Users Meeting
27 June 2012, Alzenau, Germany
Information and Registration:
www.english.pstproducts.com
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