GREAT DESIGNS IN STEEL

MULTI-SPOT LASER JOINING APPLICATIONS IN BIW

Oleg Raykis

Sales Manager – Laserline Inc.

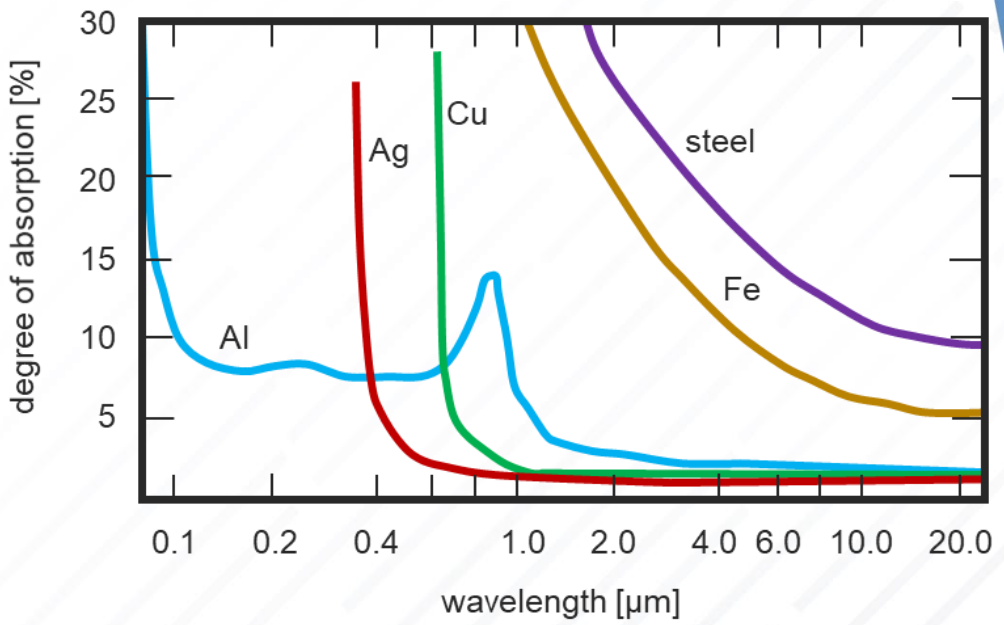
COMPANY IN BRIEF

- Head office, Mülheim-Kärlich, Germany
- Founded in 1997, privately owned and managed company
- Approx. 350 employees globally
- Approx. 6,000 laser systems delivered

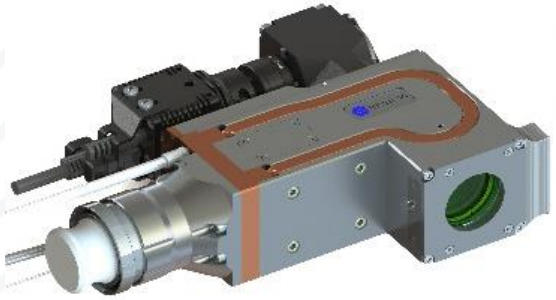
- Global presence with Laserline subsidiaries and distributors
- Leading company in high power diode lasers
- Diode lasers, Converted diode lasers, Blue diode lasers
- Beam deliveries, optics, accessories, process know how

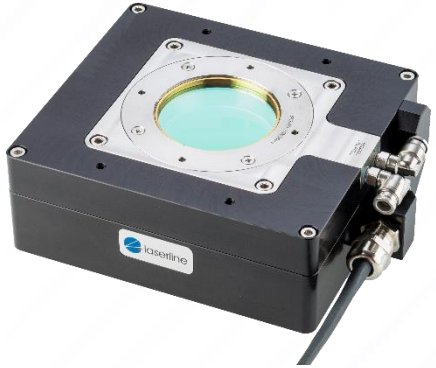
JOINING TASK – DIODE LASER SELECTION

- Depending on wavelength (blue or IR)
  - *Base material: degree of absorption*
- Depending on base material thickness
  - *Laser power up to 45kW*
  - *Using the advantages of spot sizes*
- Depending on joining task
  - *Beam shaping: using the right beam shaping for special geometrical welding tasks or replacing other joining processes*

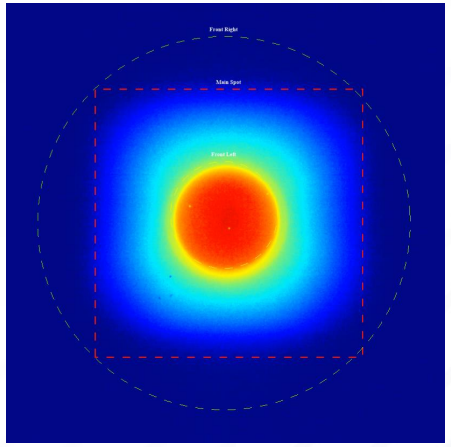


LASER TOOLS FOR METAL WELDING



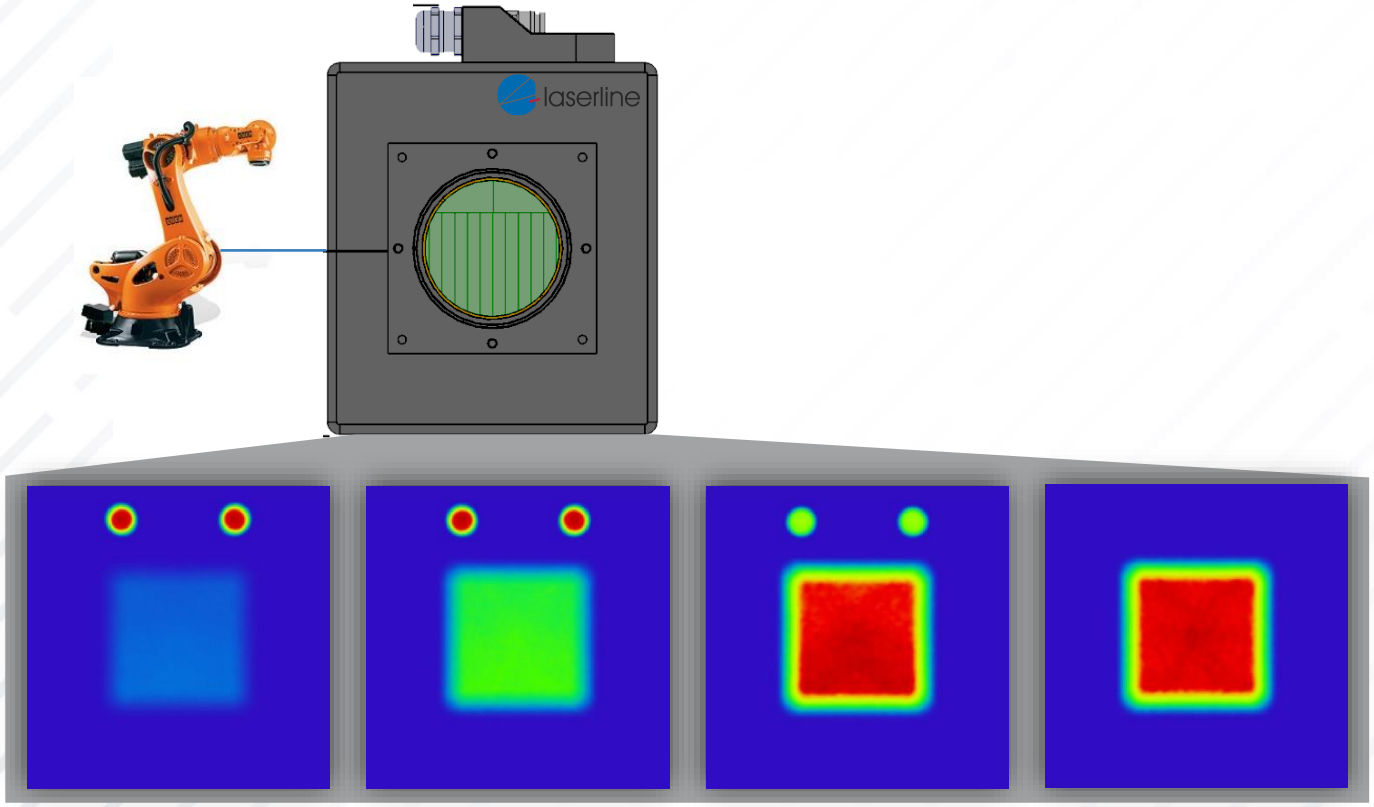


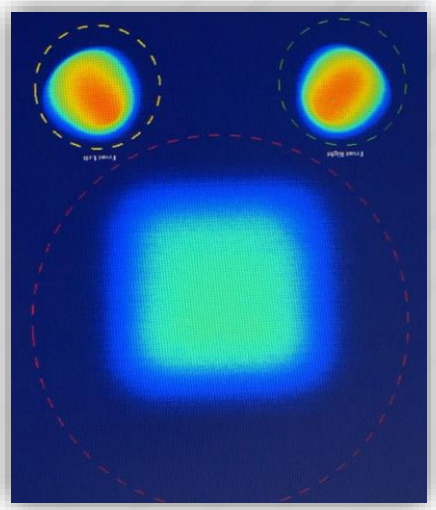
- Complete Welding Optics
  - OTS-5 optics
  - OTS-3 optics
  - OTC-3 optics
  - Spot-in-Spot Module
  - Cross-jet
  - Cover slide monitoring
  - Camera with cross-hair generator



BEAM SHAPING – TRIPLE SPOT FOR LASER BRAZING

Power Distribution





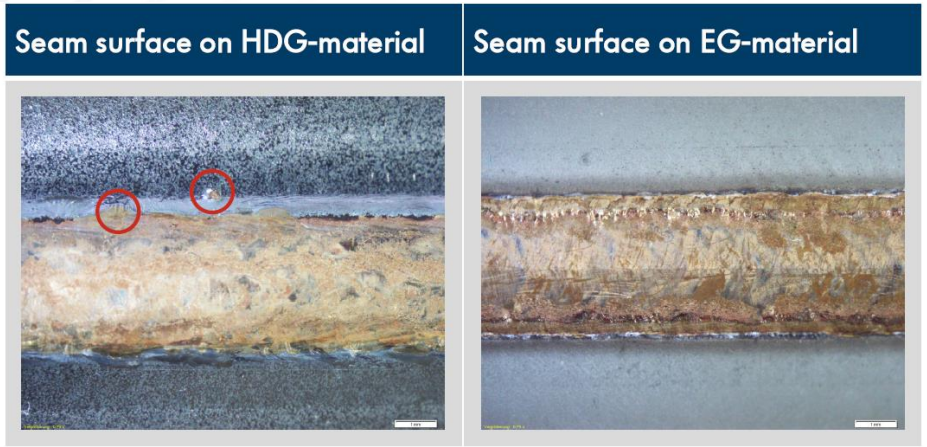
Latest Developments

Enlarged range of settings

Switching front spots on/off by robot

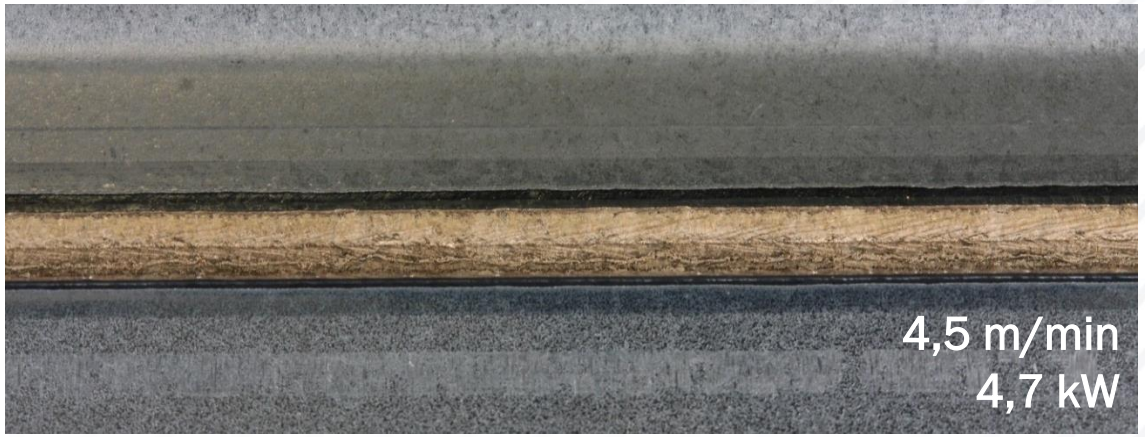
BRAZING HOT DIP GALVANIZED STEEL

State of the art – critical processes



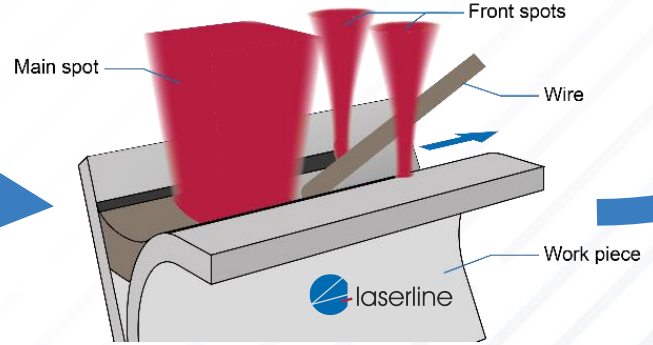
[W. Reimann, VW, EALA 2015]

"OR"-Module integrated in Scansonic ALO3



Critical Processes

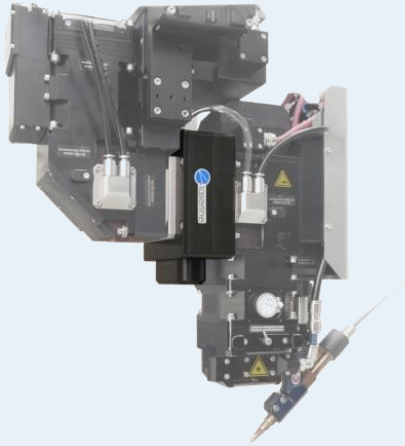
Laserline „OR"-Module



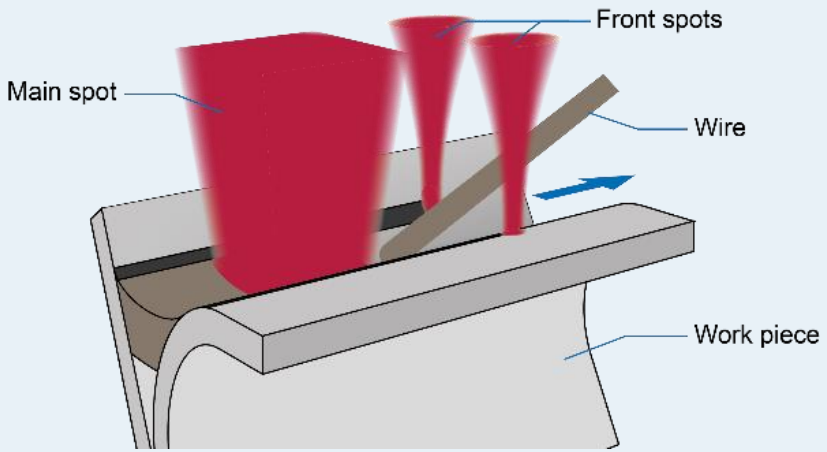
Improved Quality and Speed

BRAZING HOT DIP GALVANIZED STEEL

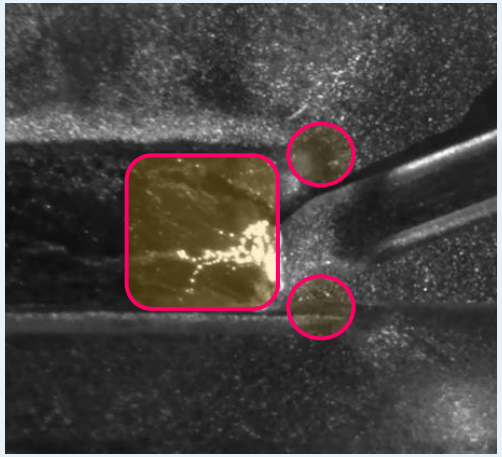
Processing Head with „OR“-Module



Schematic Overview



Live Camera View



- Process qualified since 2016
- Installed currently in many production lines
- HDG applications in tailgates and roofs all around the world
  USA, Mexico, Germany, Slovakia, Czech Republic, South Africa, China, Portugal and Russia

SPOT-IN-SPOT MODULE FOR WELDING

Module

E.g. integrated in Scansonic ALO3 (M1,7/ 1,1/ 0,9)

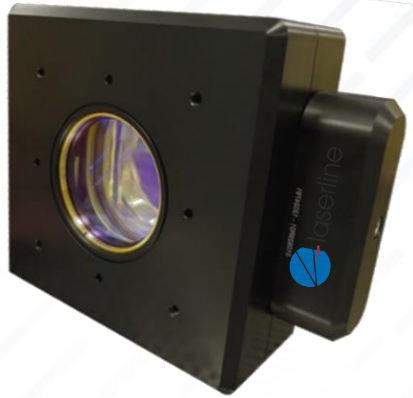
Designed for welding with max. BPP 40

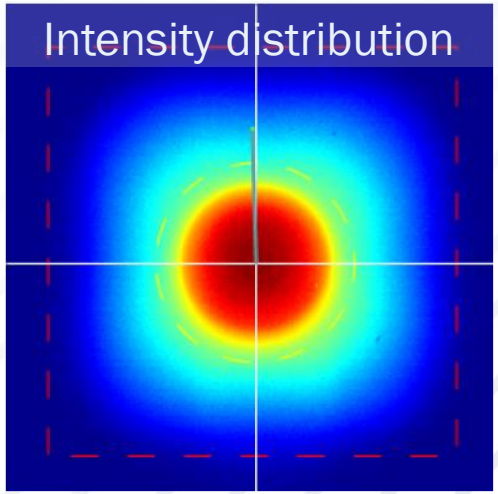
Circular center spot

Square outer spot

Processing optics

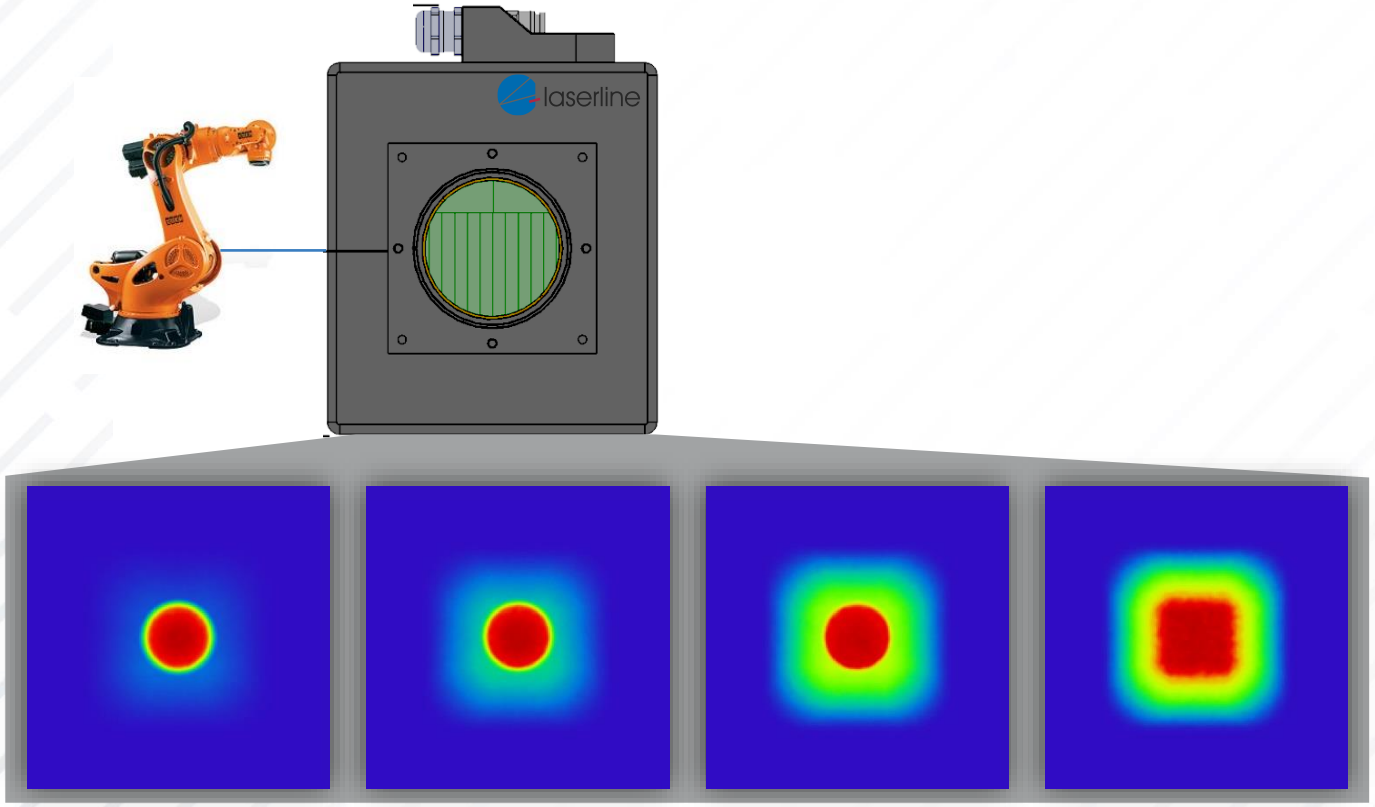
Module

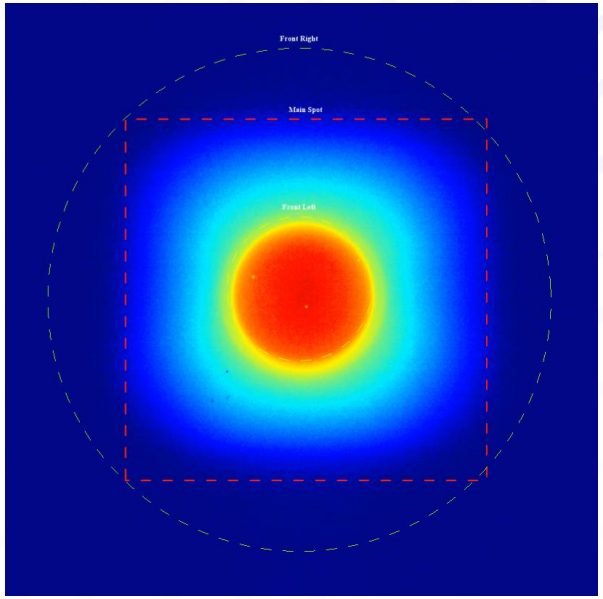




SPOT-IN-SPOT MODULE: ADJUSTMENTS

Power Distribution



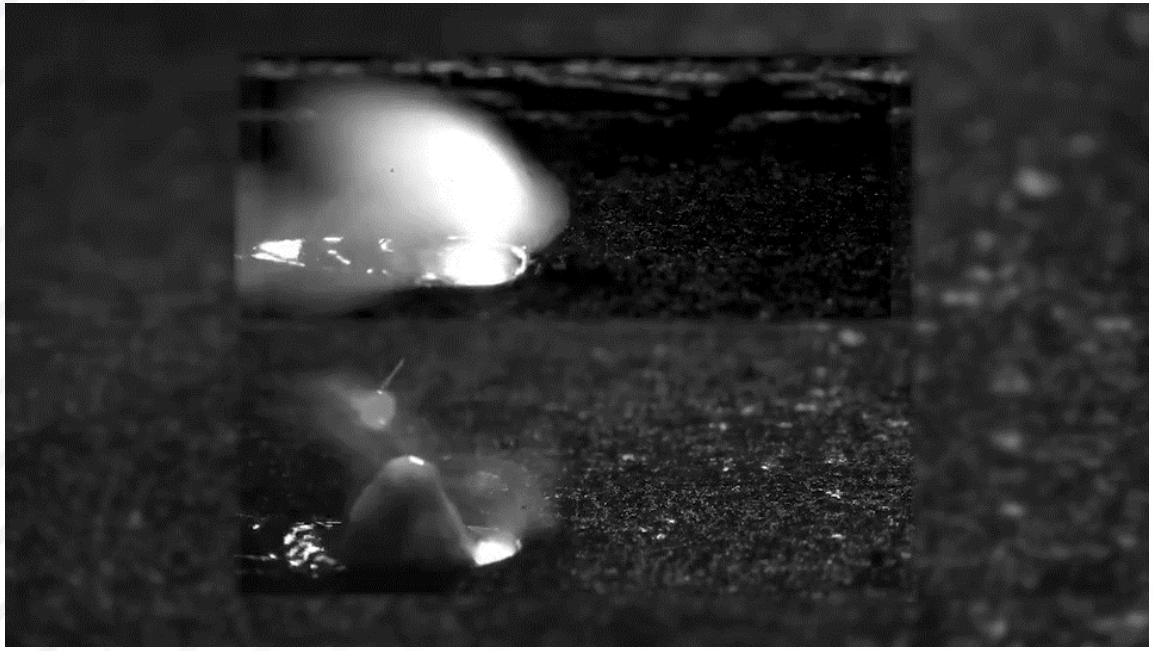


Latest Developments

Enlarged range of settings

70% of the total laser power can be shifted between inner and outer spot

SPOT-IN-SPOT MODULE: BENEFIT OF LESS SPATTERS



Comparison Single Spot and Spot-in-Spot welding

- Same power of 7 kW and welding speed of 2.5 m/min
- Spot-in-Spot intensity shift leads to less dynamics in weld pool

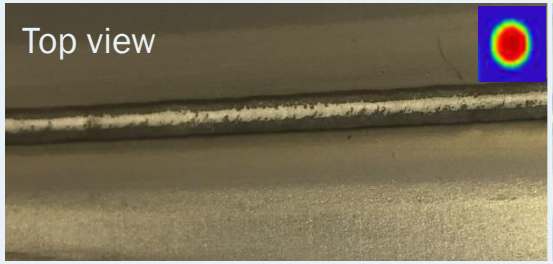
➔ Less spatters

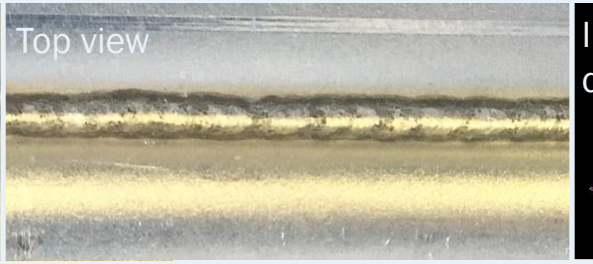
SPOT-IN-SPOT MODULE: SINGLE VS. SPOT-IN-SPOT

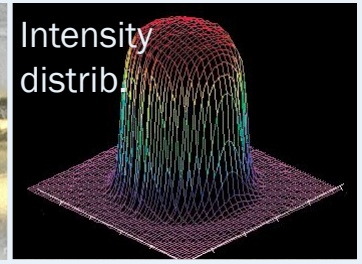
Single Spot

Al 6000 with AlSi 12 wire

- Uneven seam with notches
- Welding speed 3 m/min
- Risk of micro cracks



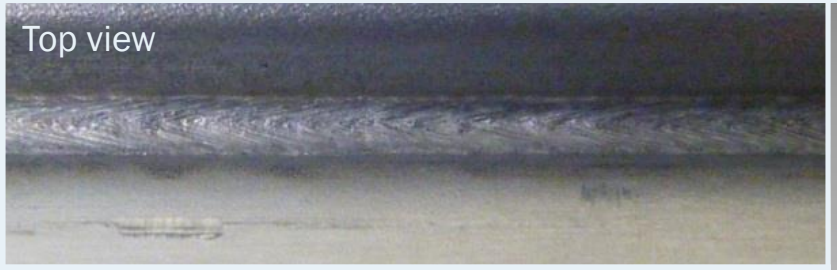


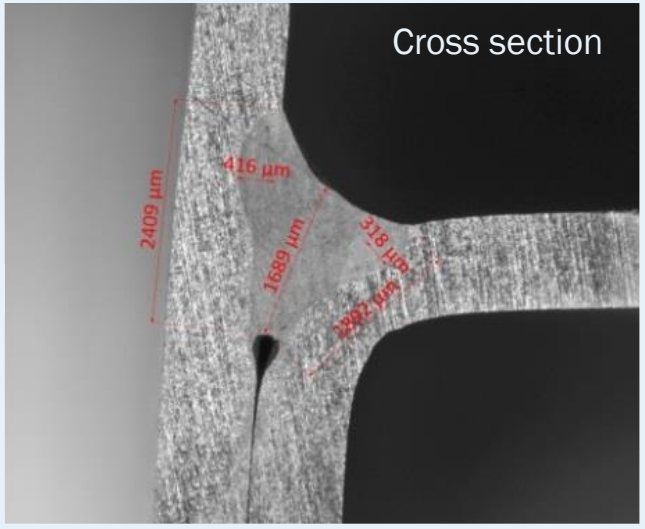


Spot-in-Spot

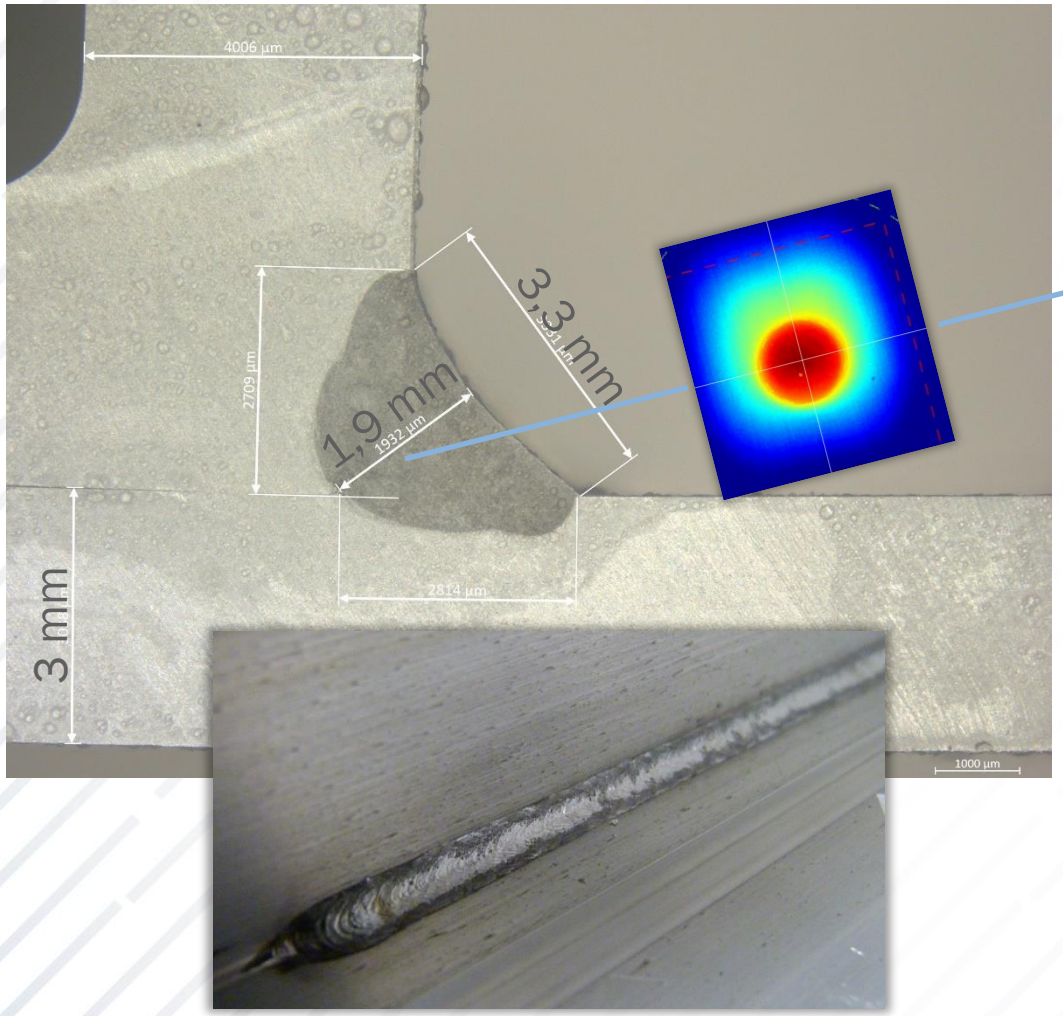
Al 6000 with AlSi 12 wire

- Smooth seam
- $v_{welding}$ = 8 m/min @ 4,1 kW,
  v_{wire} = 10 m/min
- 1.2 mm AlMg4.5MnZr wire



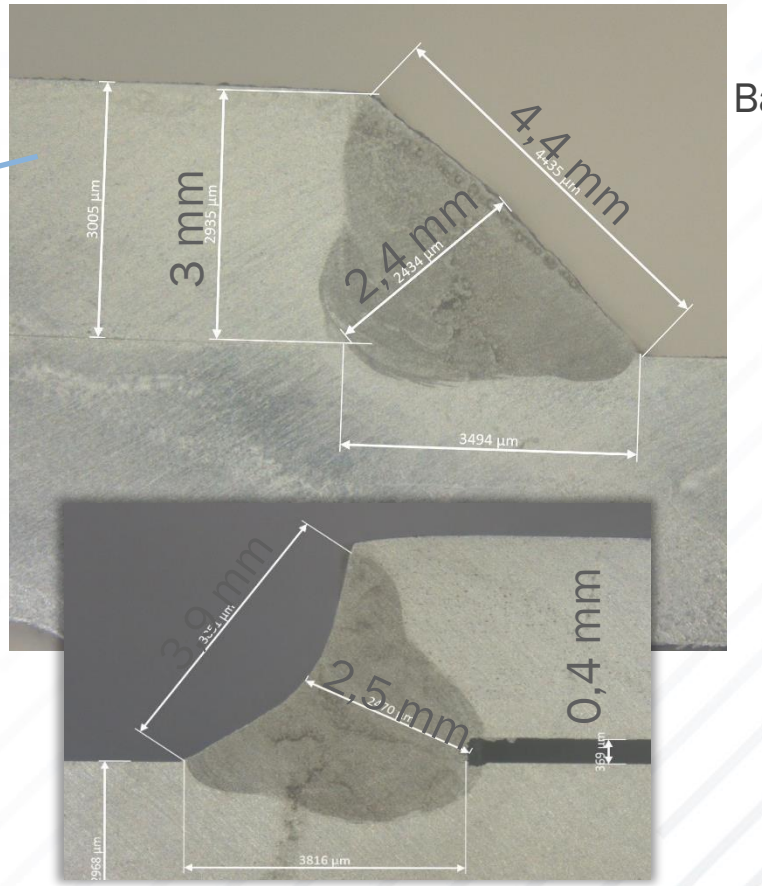


SPOT-IN-SPOT MODULE: ASYMMETRIC WELDS



P = 5 kW AlSi12 Ø1,6 mm

v_W = 4 m/min

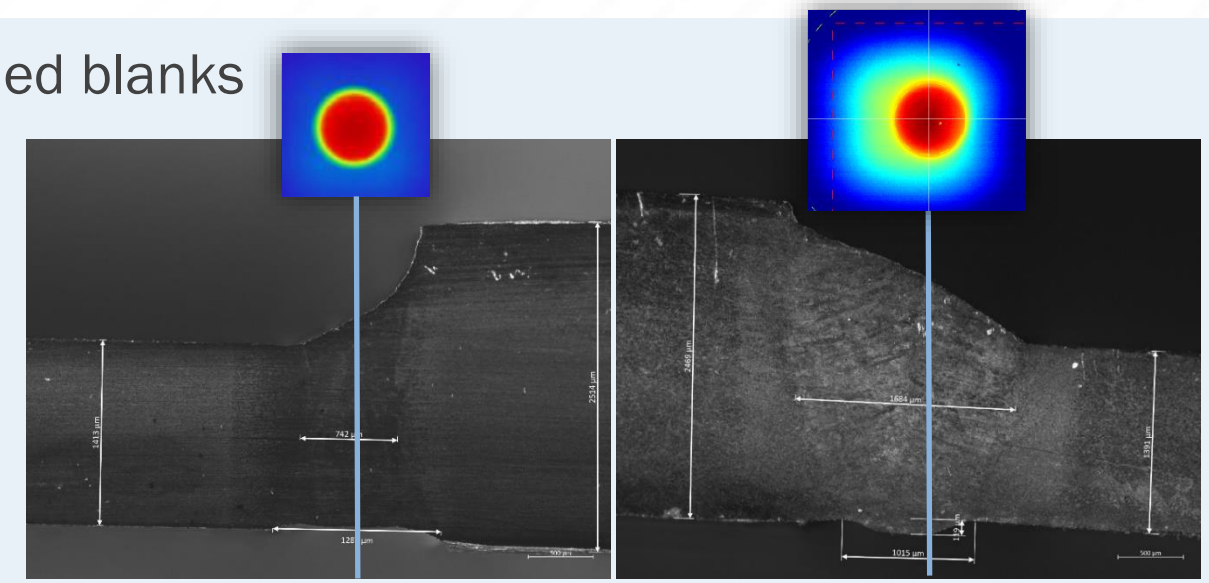


Batterry package applications

- Sheet / extruded aluminum
- Tight seams
- Fillet seams
- T-joints

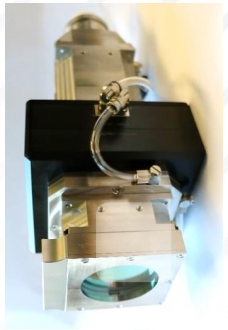
SPOT-IN-SPOT MODULE: ASYMMETRIC WELDS

Tailored welded blanks



Single Spot

Spot-in-Spot



Advantages of Spot-in-Spot Module

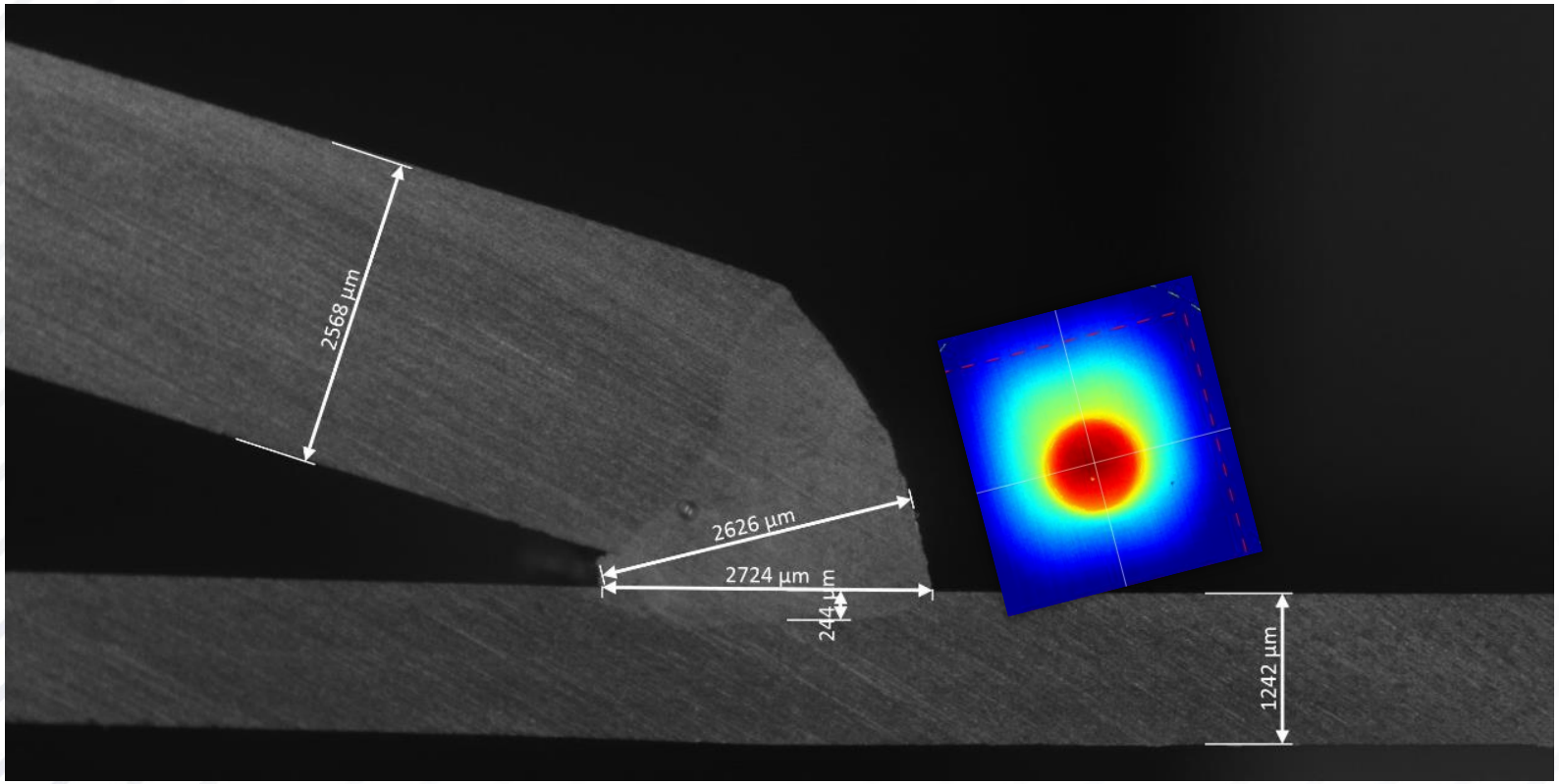
Higher speed

Improved gap bridging behavior

Less seam undercut

Bigger process window

SPOT-IN-SPOT MODULE: ASYMMETRIC WELDS



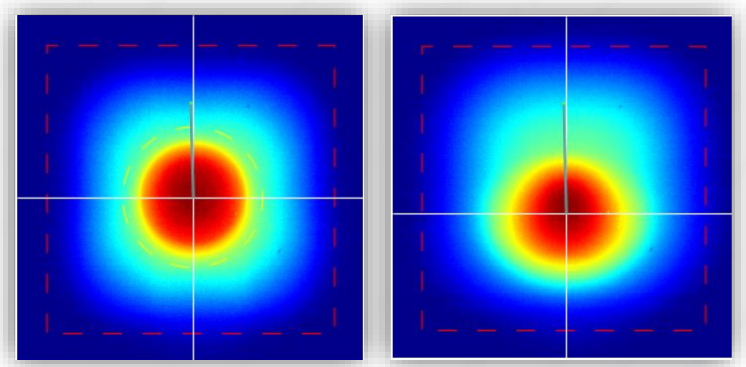
Advantages

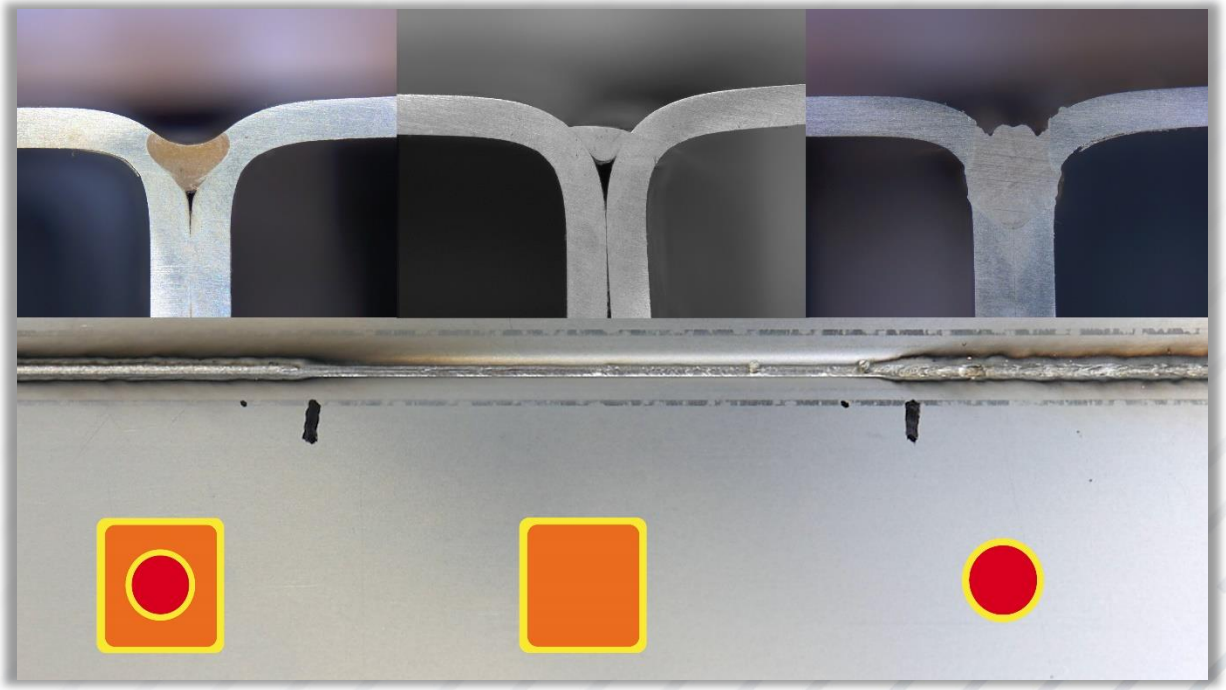
- Improved appearance
- Reduced spatter formation
- Improved gap bridging behaviour
- Increased welding speed

SPOT-IN-SPOT MODULE: SYMMETRIC WELDS

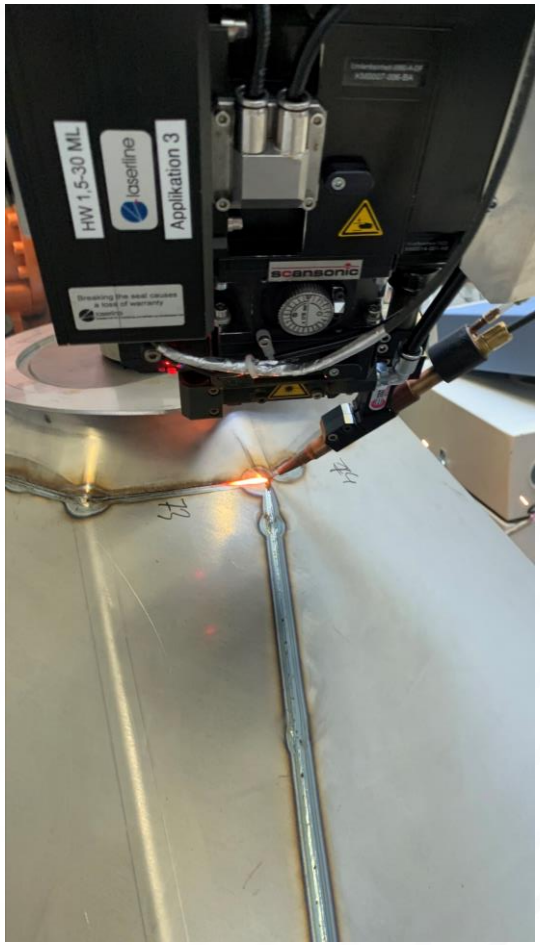
Advantages

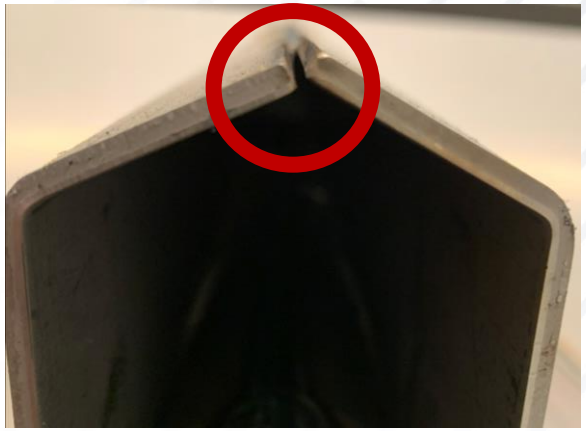
- Improved appearance
- Reduced spatter formation
- Improved gap bridging behaviour
- Increased welding speed

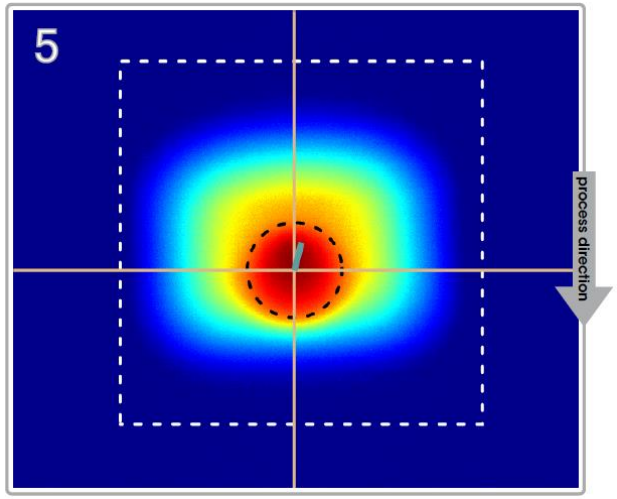




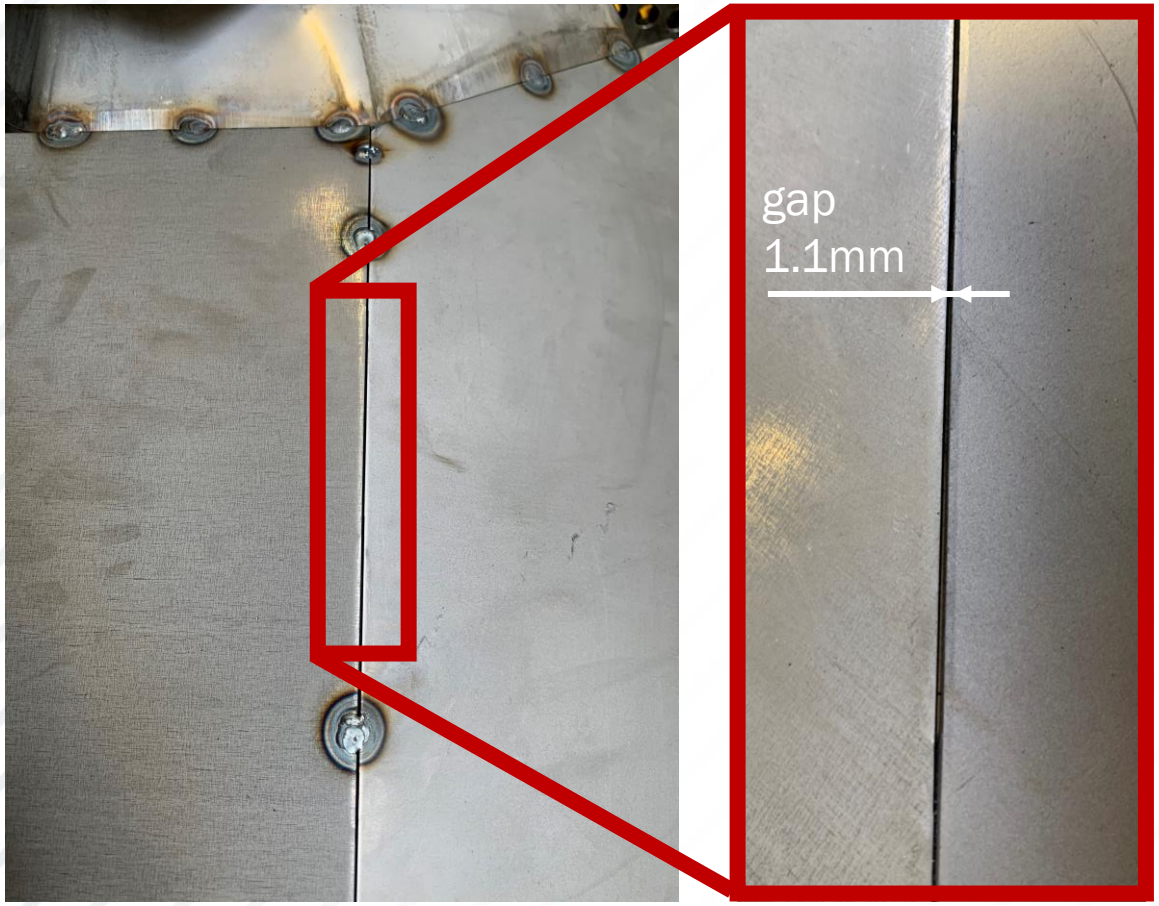
SPOT-IN-SPOT-MODULE WITH WIRE: REPLACING GMA

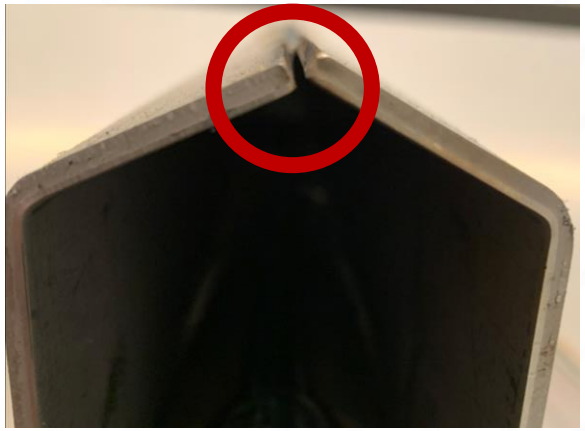






MULTI-SPOT-MODULE WITH COLD-WIRE: REPLACING GMA

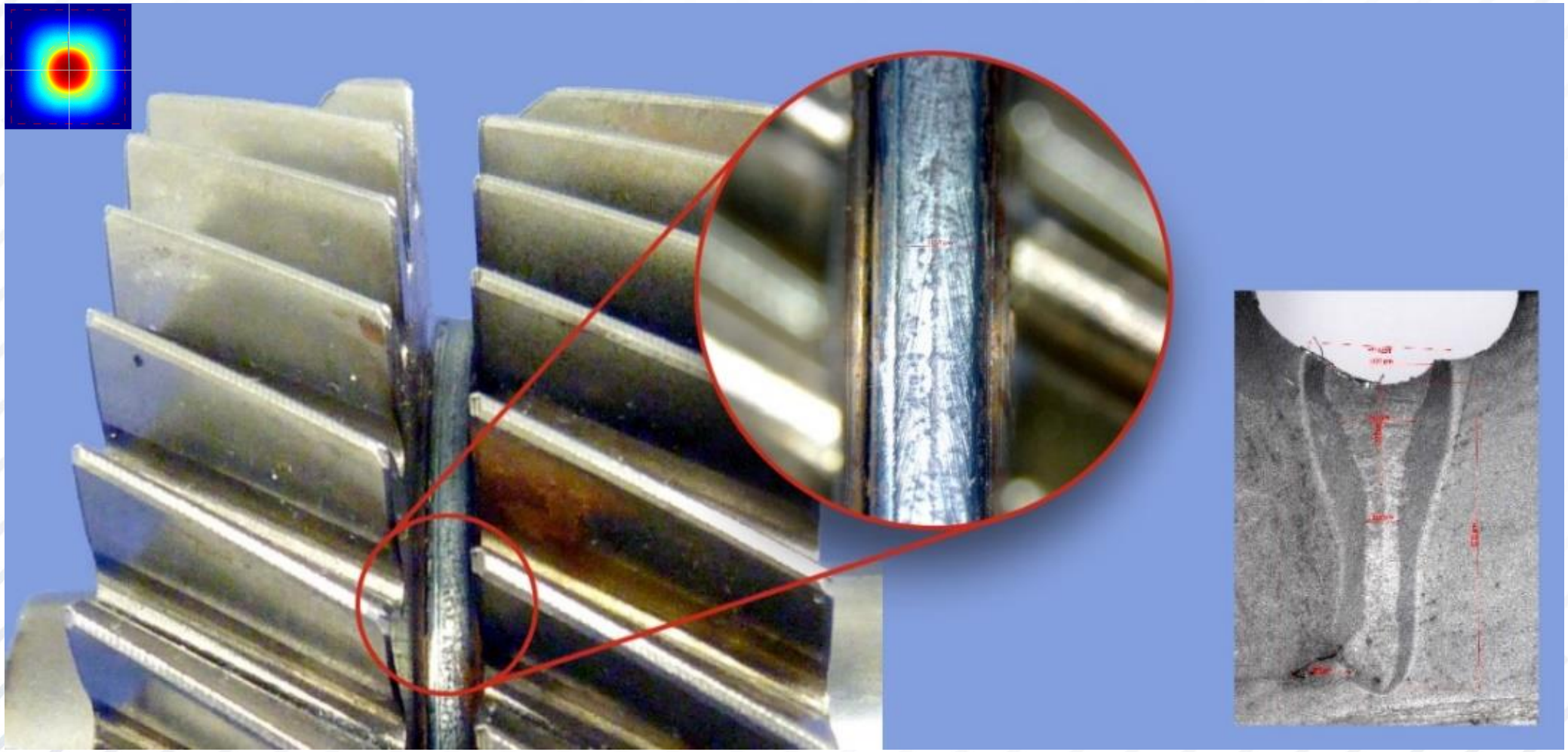


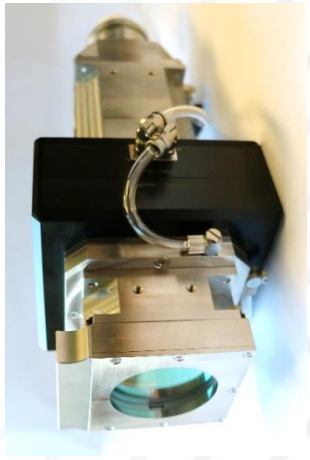


Advantages

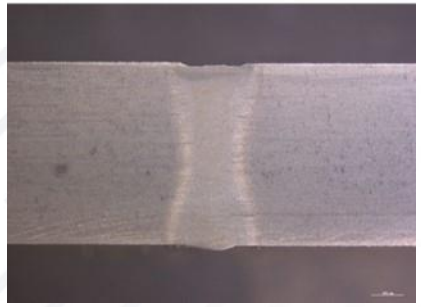
- Higher welding speed
- Less distortion
- Gap bridging
- Less spatters

MULTI-SPOT-MODULE: WELDING IMPROVEMENT

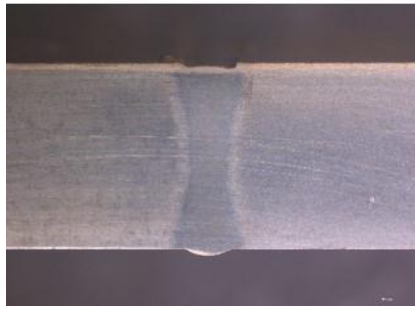




BUTT- AND FILLET WELDS



t = 5 mm, g = 0, PA	
P_{Laser} [W]	v_w [m/min]
7,700	2.0



t = 5 mm, g = 0.1, PA	
P_{Laser} [W]	v_w [m/min]
7,700	2.0

t = 10 mm, g = 0, PA	
P_{Laser} [W]	v_w [m/min]
8,500	1.0

t = 5 mm, g = 0, PB	
P_{Laser} [W]	v_w [m/min]
7,200	1.5

- Mild steel
- Free root formation
- Pore and crack free welding
- Spot Ø 0.9-1.12 mm

P = Power, v_W = welding speed, v_{Wire} = wire feed rate, g = gap dimension, t = thickness, PA/PB = welding position A/B

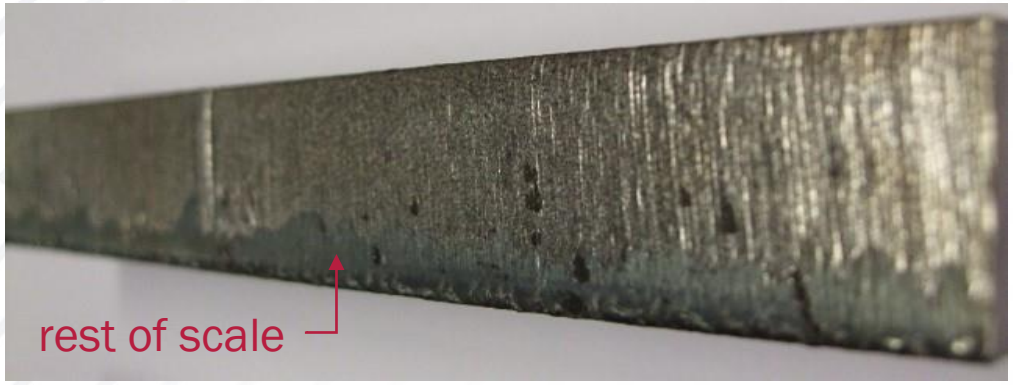
APPLICATION EXAMPLE

t = 11 mm, g = 0, PA	
P_{Laser} [W]	v_w [m/min]
11,000 (wp)	1.5
P_{GMA} [W]	v_{wire} [m/min]
0	0

Top side

Root

INACCURATE SEAM PREPARATION



- Seam preparation: flame cut

➔ Rough surface and inaccurate seam preparation

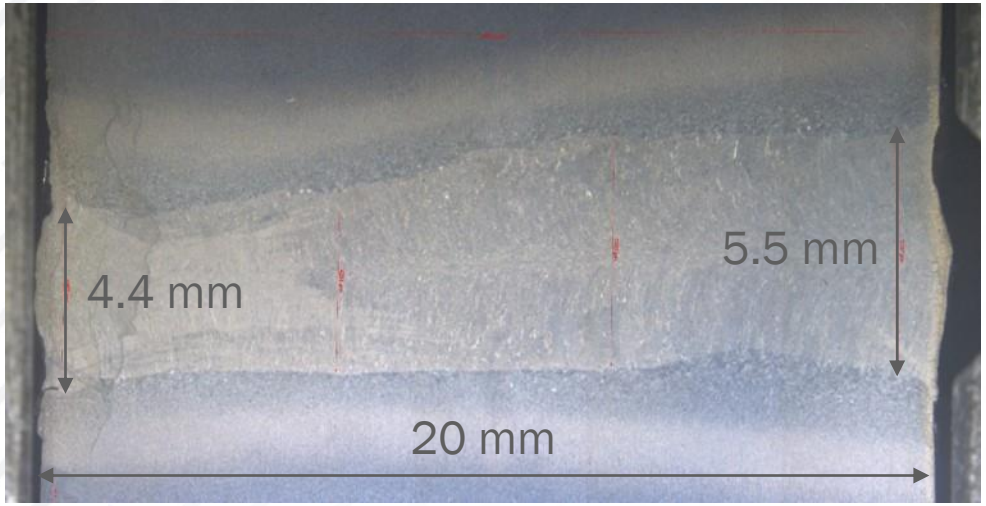
➔ Wide gap range (depending on quality cutting process)

➔ Gap has to be filled with wire

- Positioning of flame cut forms a V-gap

➔ 0.8 -2.0 mm

INACCURATE SEAM PREPARATION: BUTT WELD WITH FILLER METAL

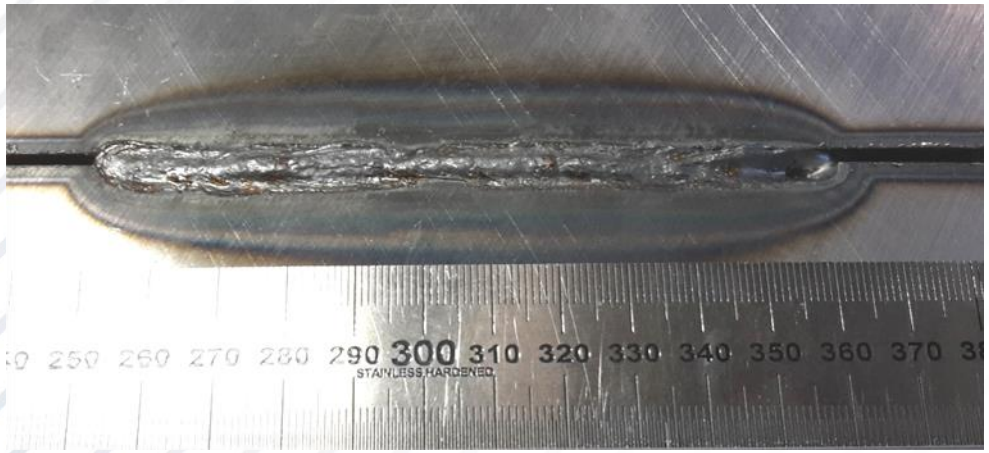


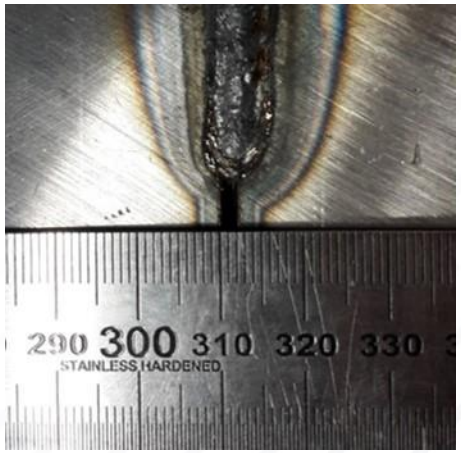
- Free root formation in PC

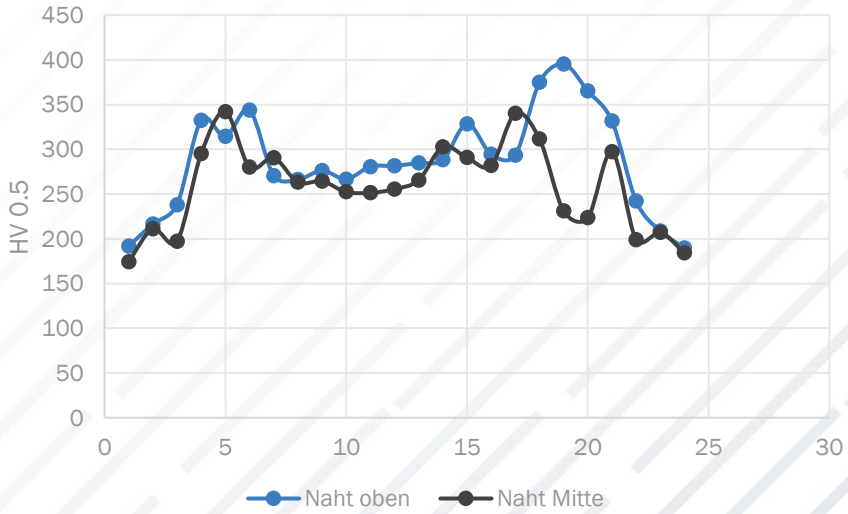
➔ No conter pressure necessary

- Steel with yield strength 355 MPa

➔ tends to hardness increase

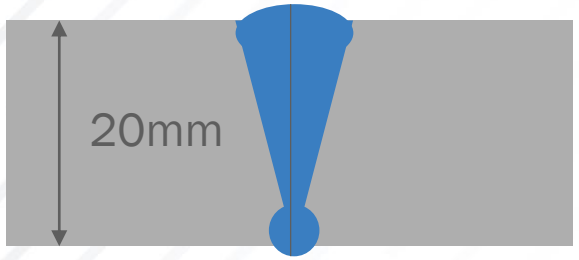




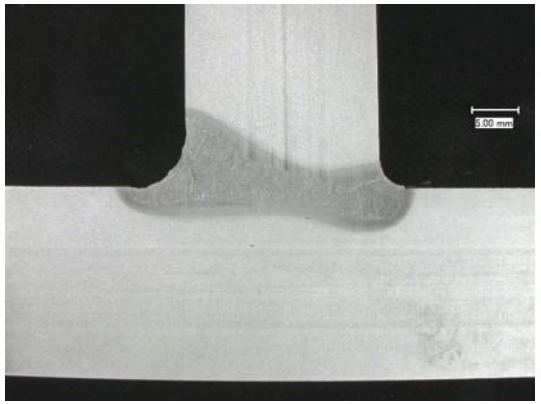


P = Power, v_W = welding speed, v_{Wire} = wire feed rate, g = gap dimension, t = thickness, PC = welding position C

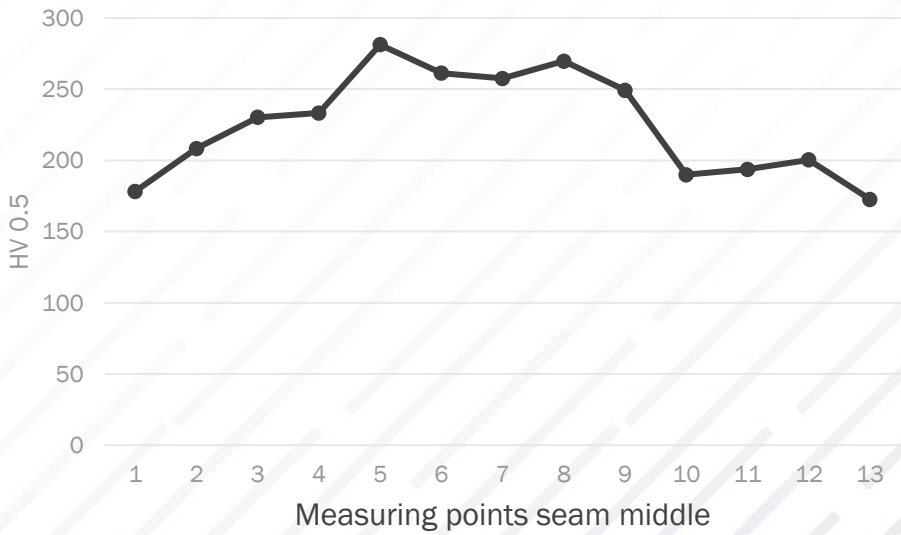
HIGH POWER WELDS



Butt weld with inaccurate seam preparation



t = 20 mm, g = 0, PA	
P_{Laser} [W]	v_S [m/min]
50,000	0.6



FOR MORE INFORMATION

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