Laserhybrid welding of thin sheets in automotive industries

MERA project:

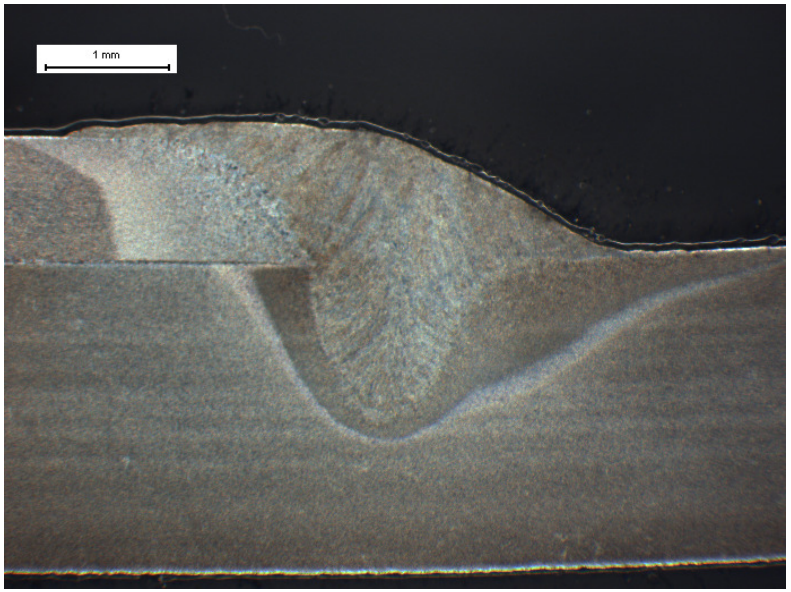
PROHYB- Production development with laserhybrid welding

Presentation Laserdagen 1, 2010-05-27 hos ESAB
Joakim Hedegård, Swerea Kimab
Tore Salmi, Permanova Lasersystem AB

Implementing a process with welding speed of 12 m/min?

Overlap fillet, zero gap, Docol 420 (1,0 mm) + Boloc (2,5 mm)

Weld speed 12 m/min



Weld speed 6,5 m/min

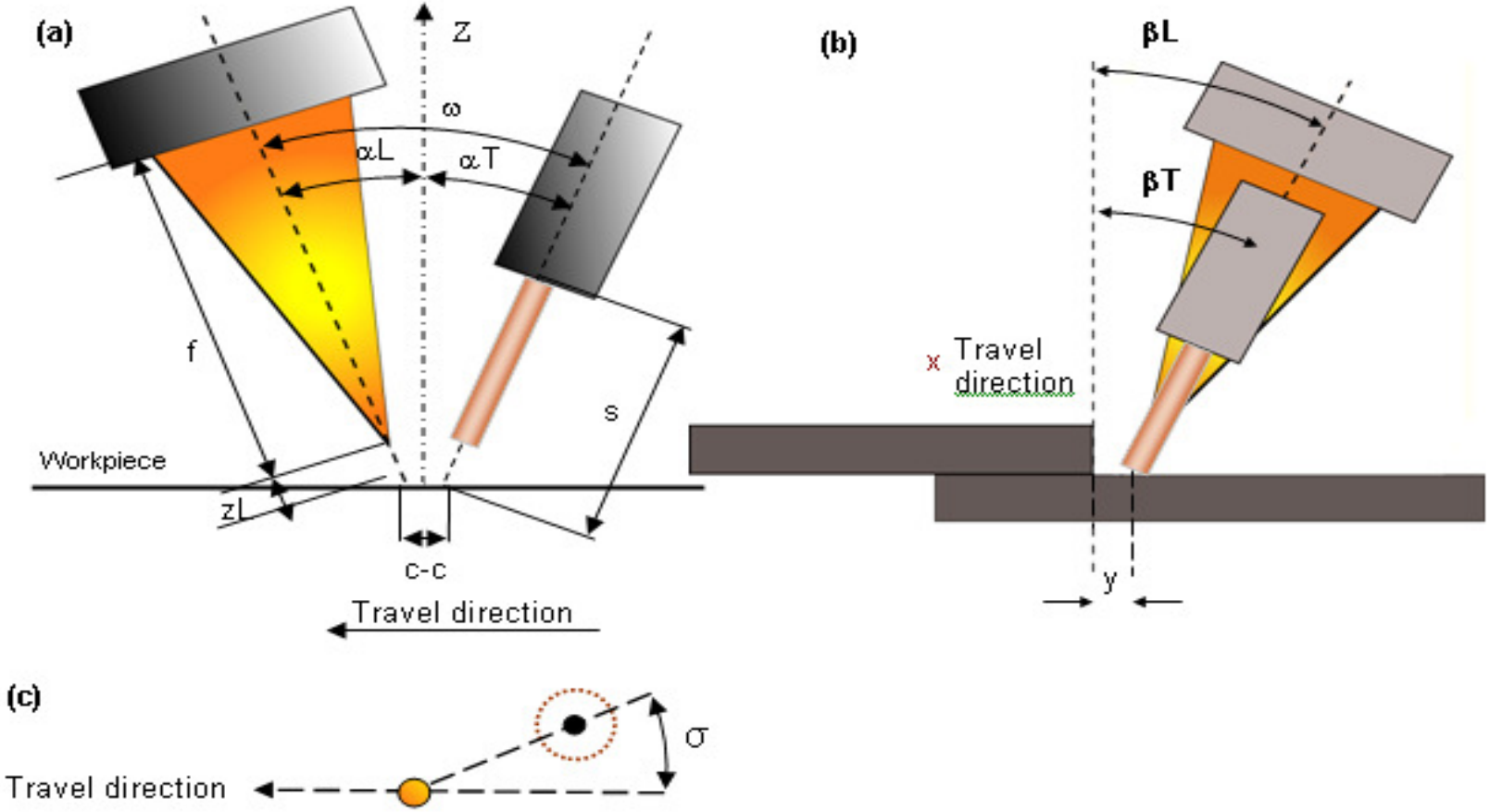
Of particular interest in this project was:

- Evaluate laserhybrid-MAG welding in thin sheet automotive components
- Improve the weldability of coated materials through process optimization
- Improve and secure the supply of shielding gas

Expected advantages with implementation of laserhybrid welding

- Increased productivity, (compared to MAG or laser)
- Robustness of the process, (compared to MAG or laser)
- Decreased amount of production steps, improved lead time and freed production space.
- Improved quality by increased joint strength, tolerances and sealed joints to a lower cost.
- Greater possibilities to optimise joint geometry

- Contact to work piece distance (s)
- Set-up angle (ω)
- Travel angle (αL, αT)
- Side angle (βL, βT)
- Inter distance (d)
- Focal length (f)
- Focal point off-set (zL)
- Off-set from joint centre (yL, yT)
- Torch rotation (σ)

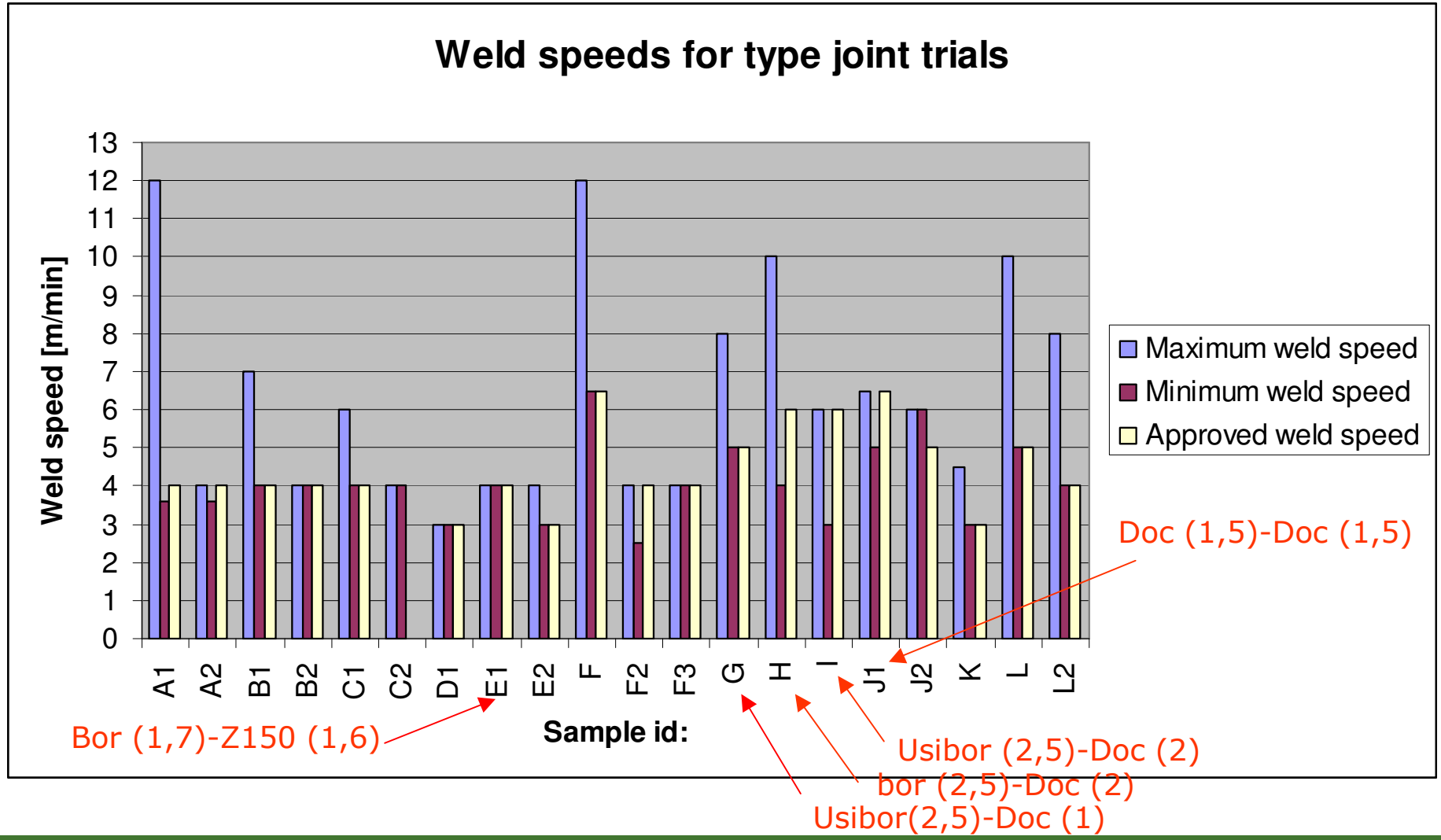


Material combinations

Joint type	Material 1	Material 2	Thickness	Other
G: Overlap fillet joint, zero gap	Usibor Hardened AlSi	Docol 420 uncoated	2.5+1.0	Docol420 is top sheet
H: Overlap fillet joint, zero gap	Boloc Hardened	Docol 420 uncoated	2.5+2.0	Docol420 is top sheet
I: Overlap fillet joint, zero gap	Usibor Hardened AlSi	Docol 420 Uncoated	2.5+2.0	Docol420 is top sheet
E1: Overlap fillet joint, zero gap	Boloc Hardened	V1478 Z140	1.7+1.6	V1478 is top sheet
J1: Overlap fillet joint, zero gap	Docol 420 Uncoated	Docol 420 Uncoated	1.5+1.5	

Weld speed

Conclusion: high welding speeds reached – fixturing important



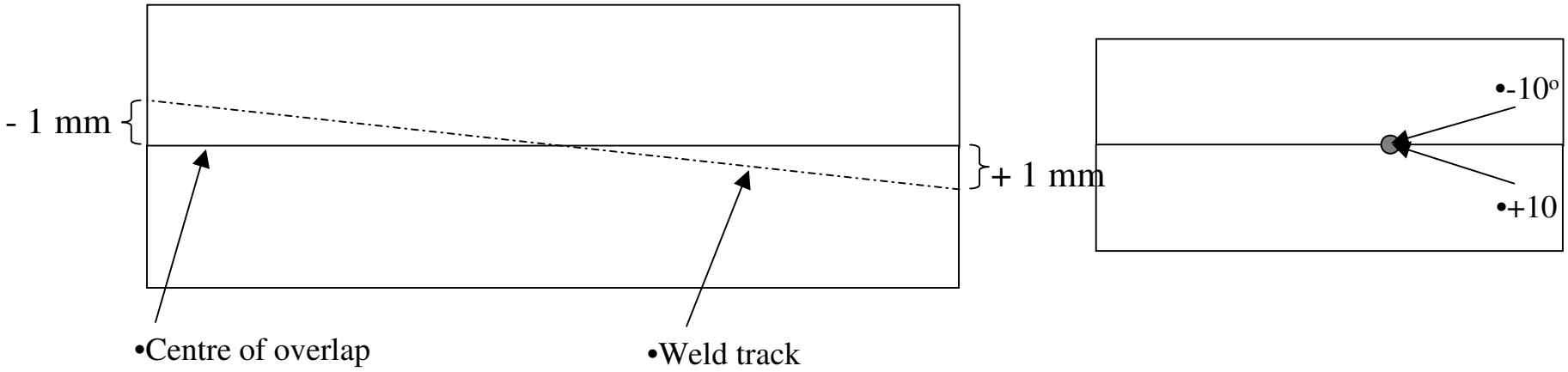
Power balance

		Grading
PL/PA = 0,93	PTOT = 7,3 kW	3
PL/PA = 0,87	PTOT = 8,6 kW	4
PL/PA = 0,39	PTOT = 9,4 kW	5
PL/PA = 0,15	PTOT = 7,7 kW	1

- *Note: weld speed = 6,5 m/min*

- Power distribution is hard to evaluate
- Parameters are interacting.
- Changes in MAG effect influence currents, frequency pulse time etc.
- Changes in laser power changes the total heat input

Robustness



• Variations in inter-distance between arc and laser influence robustness

• Robustness was increasingly affected by the positioning with increased weld speed.

• Highest weld class could be maintained between + 0,5mm and -0,5mm. Rotation did not affect quality.

Zinc coated materials

- When welding Zinc coated materials it is hard to avoid spatter and porosity.
- Optimising pulse parameters gave best results. One droplet per pulse improves process stability and anxiety of weld pool.
- If the droplets are to small they deviate from the melt pool.
- Fixturing with enough pressure, too loose positioning problems, too hard blow holes, spatter and pores

Shielding gas

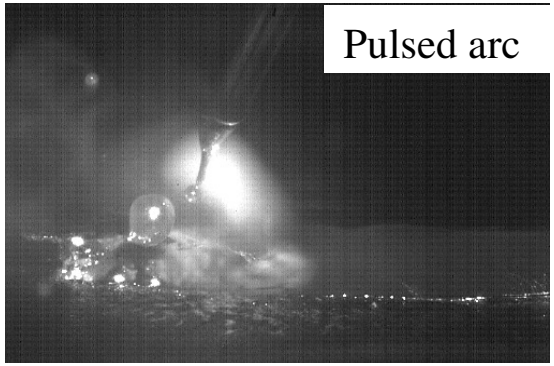
Conclusion: MISON 8 was working best for these applications

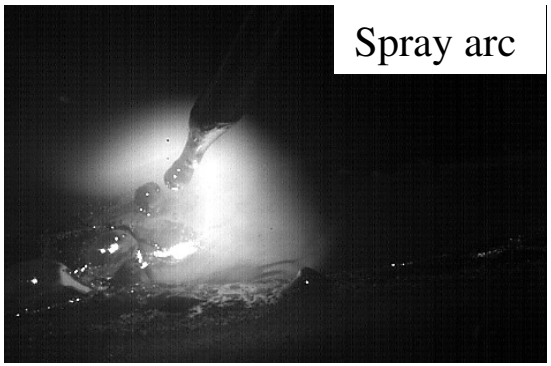
Shielding gas	Grading
MISON 8	**5**
Ar	**1**
MISON 2	**4**
MISON He30	**2**
ROBINON	**5**

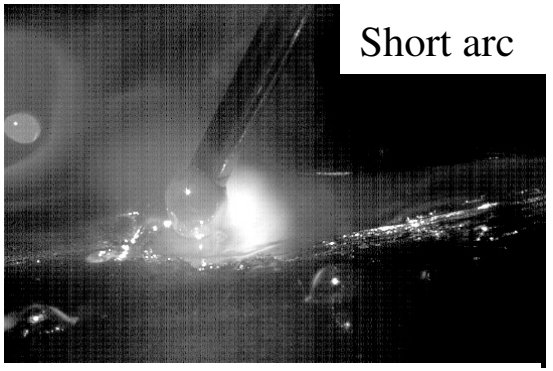
- Stabilising elements as CO2 and O2 are preferable if best quality is needed, min 2% CO2 and max 8%
- Sharper drop transfer for pulsed welding with shielding gas containing CO2 which could work stabilising.
- MAG shielding gas nozzle approved with some oxidation, with collector shoe oxidation on the surface can be avoided.
  The process stability was unaffected by the oxidation

Arc type

Arc type	Grading	ID
Pulsed arc	5	F-CAM-026
Spray	5	F-CAM-020
Short arc	3	F-CAM-020







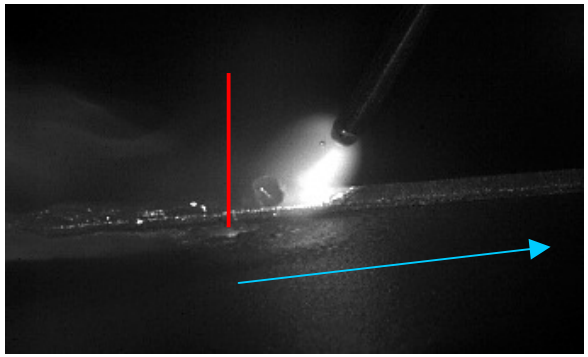
Conclusion: Possible to weld with both spray and pulsed arc with approved result, pulsed best.

- laser key hole seems to attract the melt from the MAG acting stabilising
- The spray arc shows tendencies to interfere with the laser, no problems visual with pulsed arc.
- Hard to achieve ”clean” arc types. Distinct drop transfers are preferable.

Influence of weld direction and inter-distance

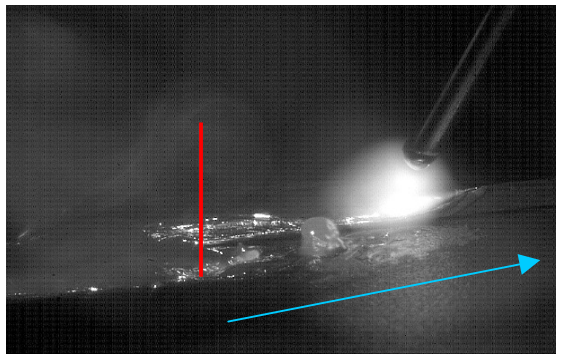
Conclusion: leading laser more favourable than trailing in thin sheet applications

d = 0 mm



d = 2 mm

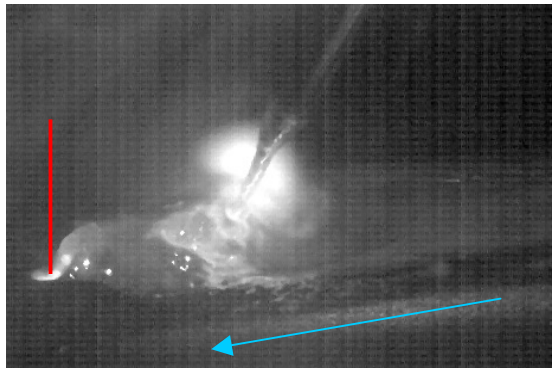
Weld speed 6,5 m/min



d = 4 mm

d = 0 mm

d = 2 mm



d = 4 mm

Weld speed

Conclusion: high welding speeds reached – fixturing important and designing for the process