

GREAT DESIGNS IN **STEEL**

Process Comparison of Hotwire Laser and GMAW on HSLA & Gen. III Steels

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Objective

- Compare conventional GMAW-P process with Laser Hotwire (LH) in welding HSLA and Generation III (GEN III) steels for the automotive and general fabrication industries.
 - 2.5mm HSLA – 550 MPa Galvanized
 - 2.0mm Gen III – 980 MPa Galvanized

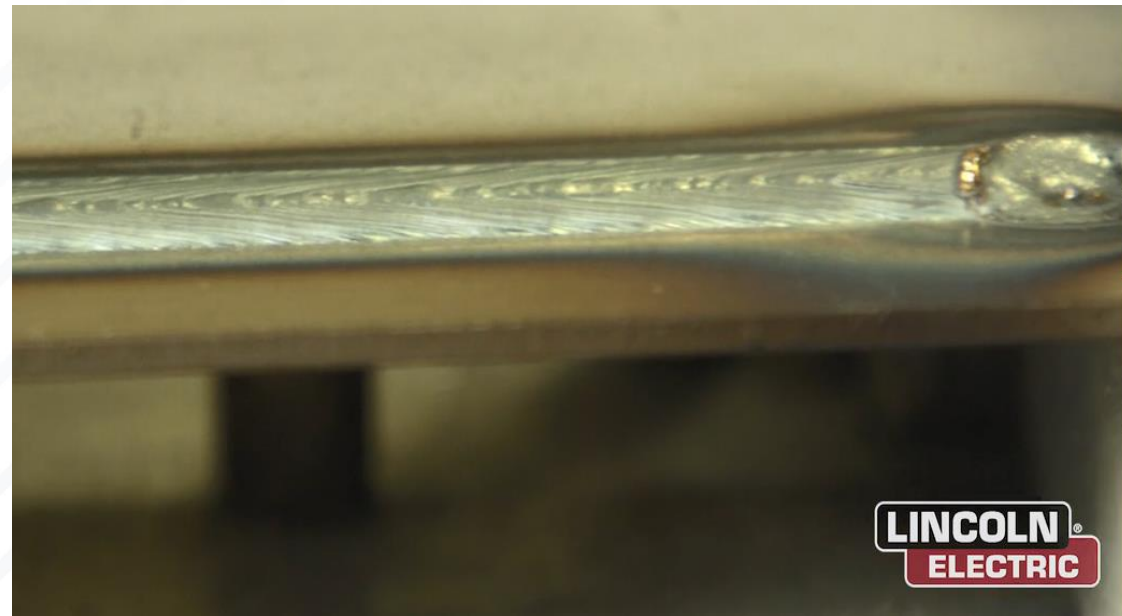
Test Setup



Laser Hotwire Example



GMAW-P Example



Test Setup (Cont.)

- Galvanized coupons with 200 x 100 mm in dimension with 25mm overlap.
- Welded in flat 2F lap position
- Using ER70S-3 Wire

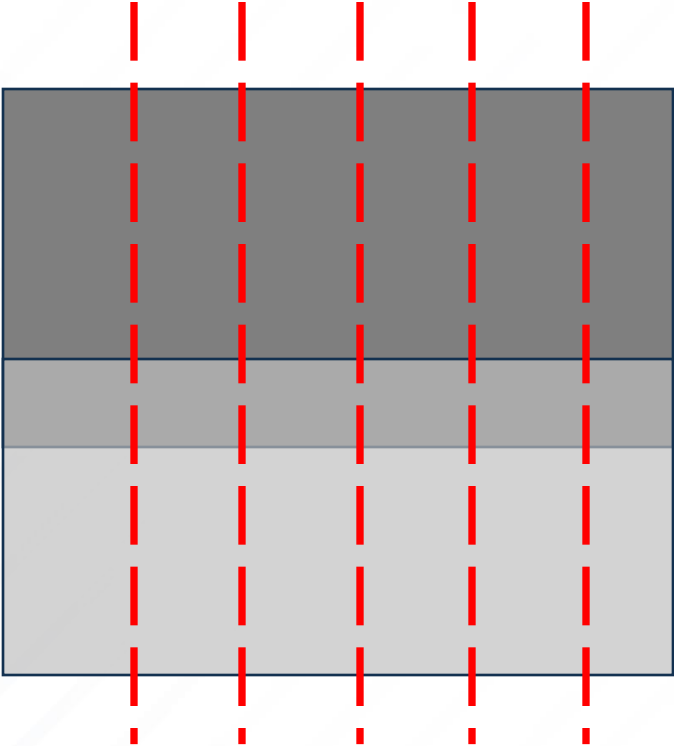
Process	WFS (in/min)	Trim	Travel Speed (in/min)	Laser Power (kW)	Wire Power (kW)	Coupon Thickness (mm)
HSLA – GMAW-P	450	1.0	30	-	-	2.5
HSLA - LH	500	-	80	12KW (6X6) Spot	2.1	2.5
GEN III – GMAW-P	420	1.0	30	-	-	2.0
GEN III - LH	450	-	80	12 (6X6) Spot	1.7	2.0

Test Methodology

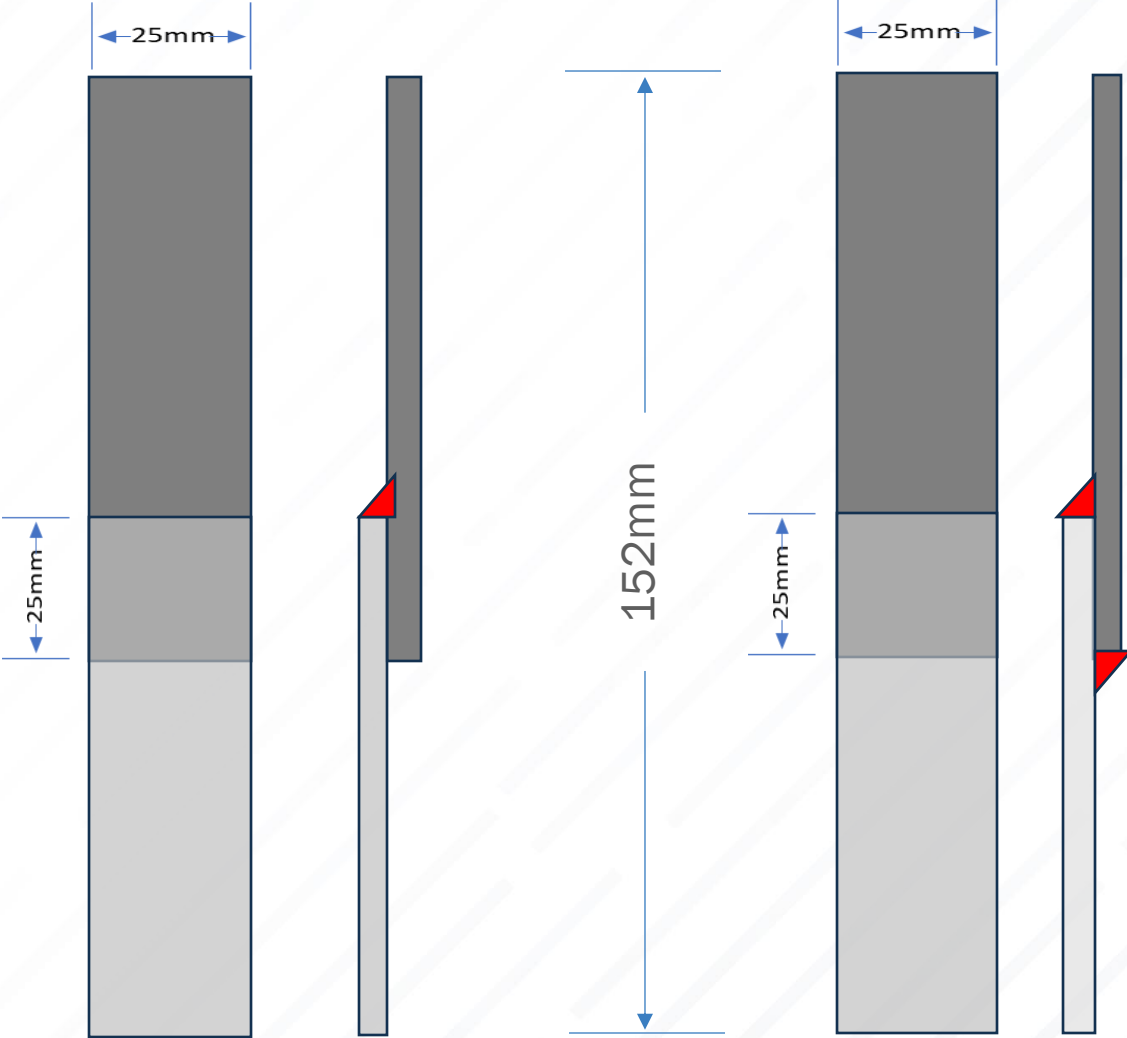
- Hardness mapping
- Tensile tests: Single sided weld
- Fatigue tests: Double sided weld
- All weld samples were cut into 25mm wide strips, no reduced section

Sample Prep

Waterjet cut lines



Not to scale



Tensile Samples(weld 1 side only)

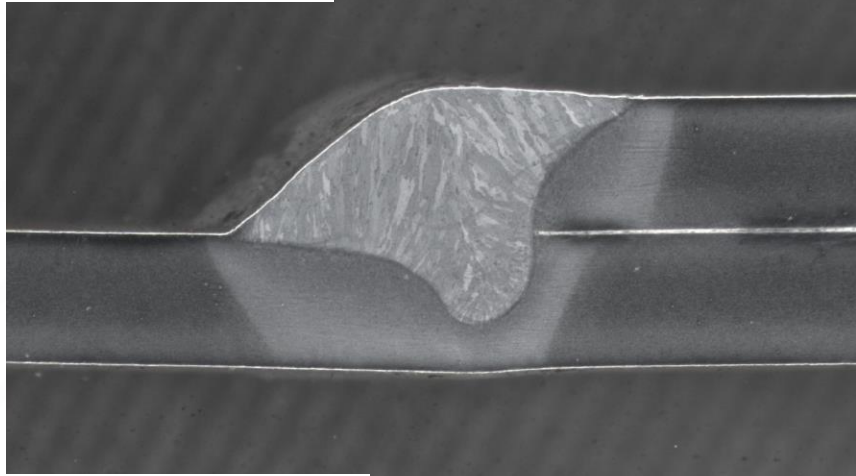
Fatigue Samples(Welded both sides)

Red  are welds

Results – Bead Profile

HSLA + GMAW

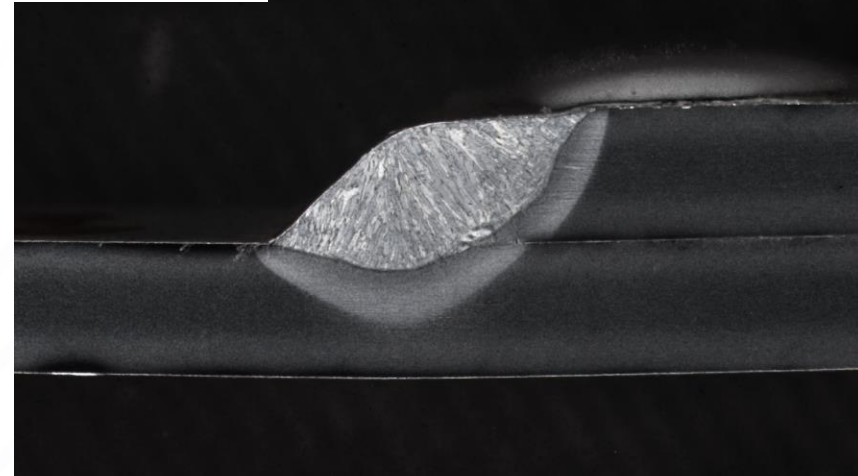
10-4485E



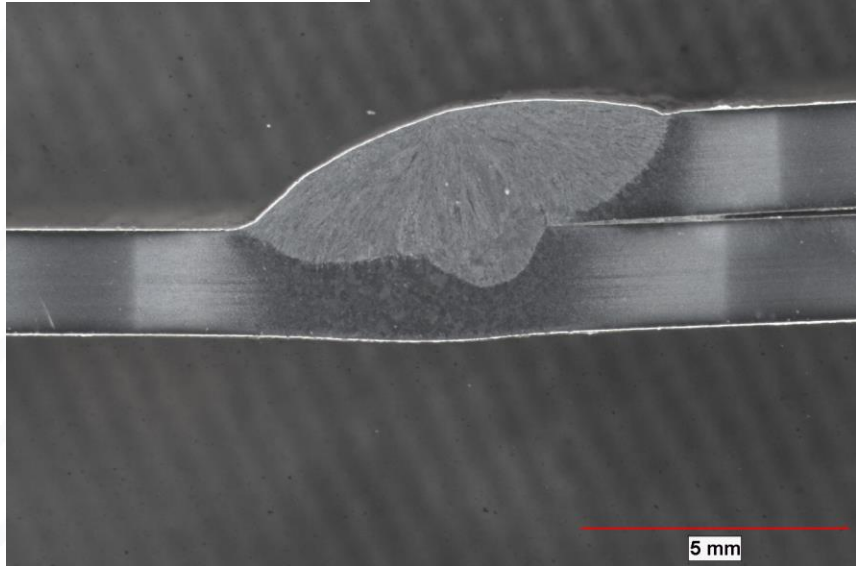
~60% Reduction
in HAZ



HSLA + LH



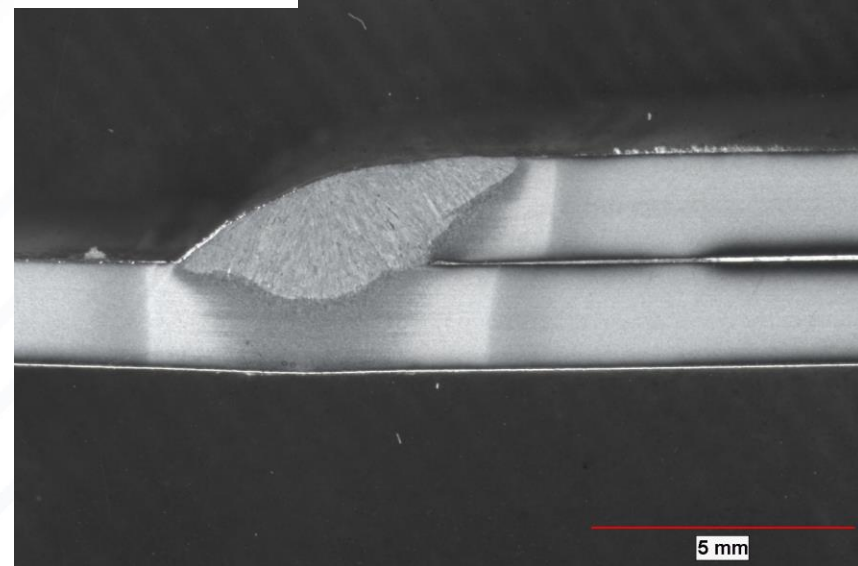
GEN III + GMAW



~40% Reduction
in HAZ

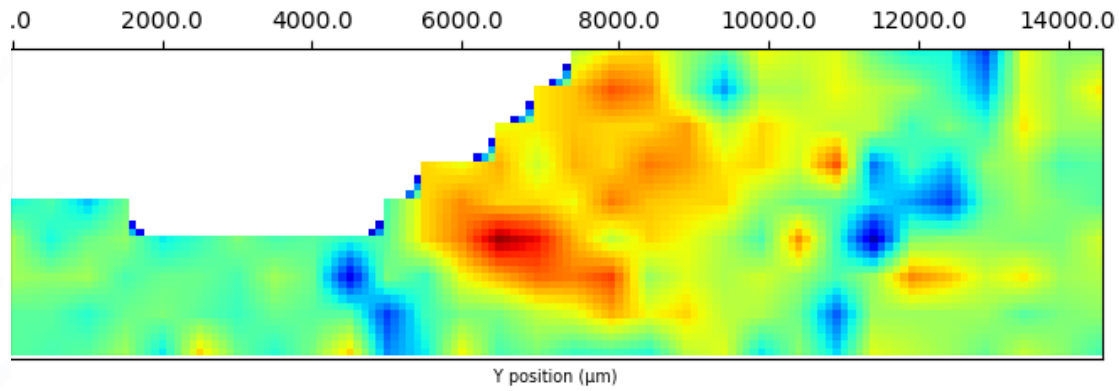


GEN III + LH

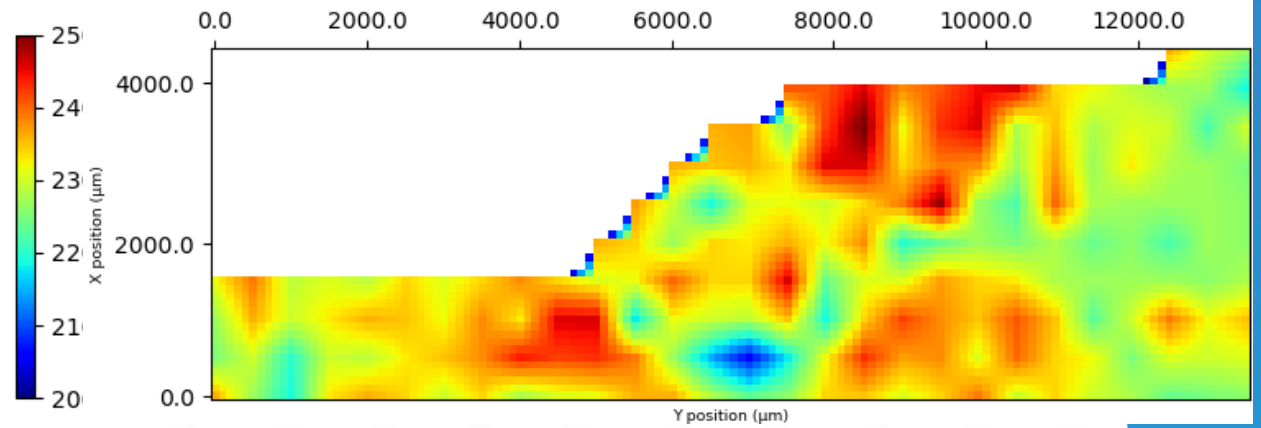


Results – Hardness

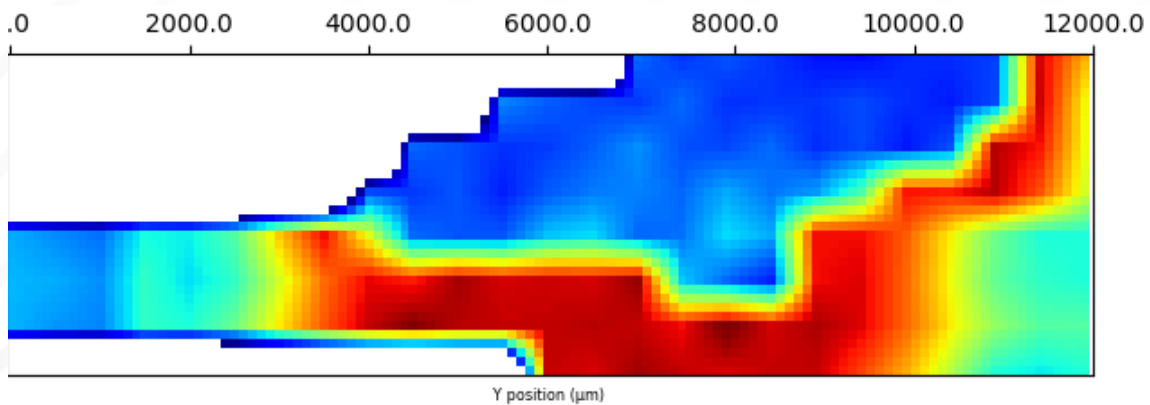
HSLA + GMAW



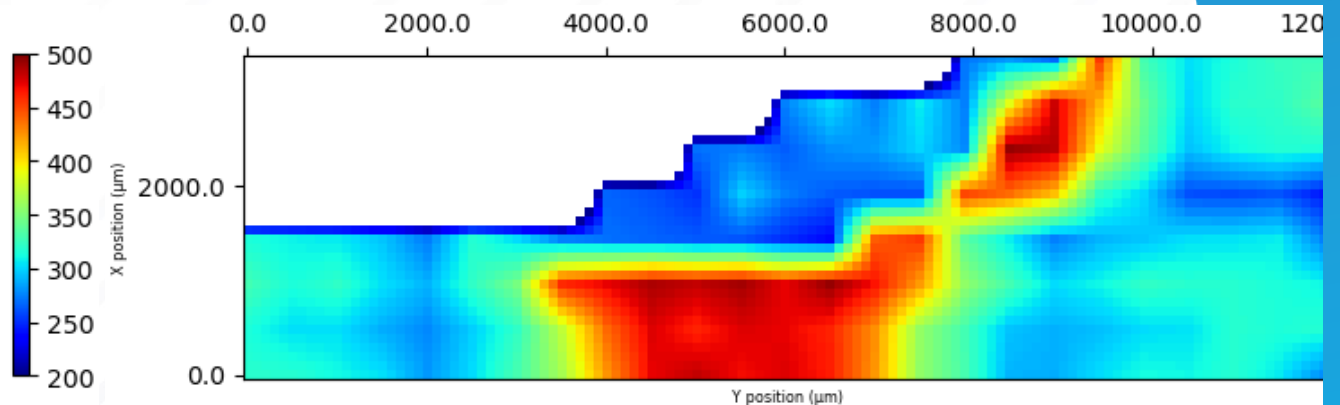
HSLA + LH



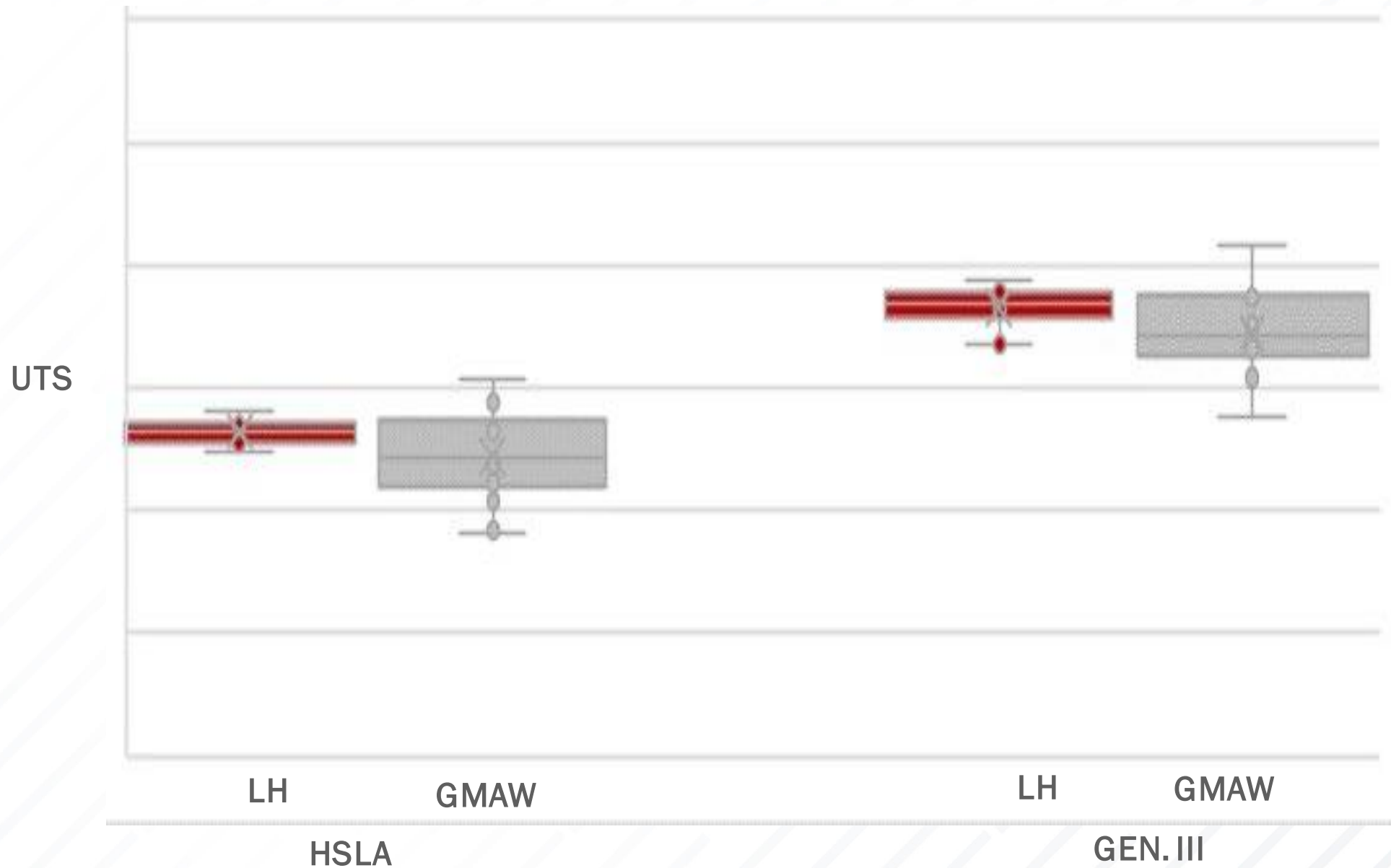
GEN III + GMAW



GEN III + LH

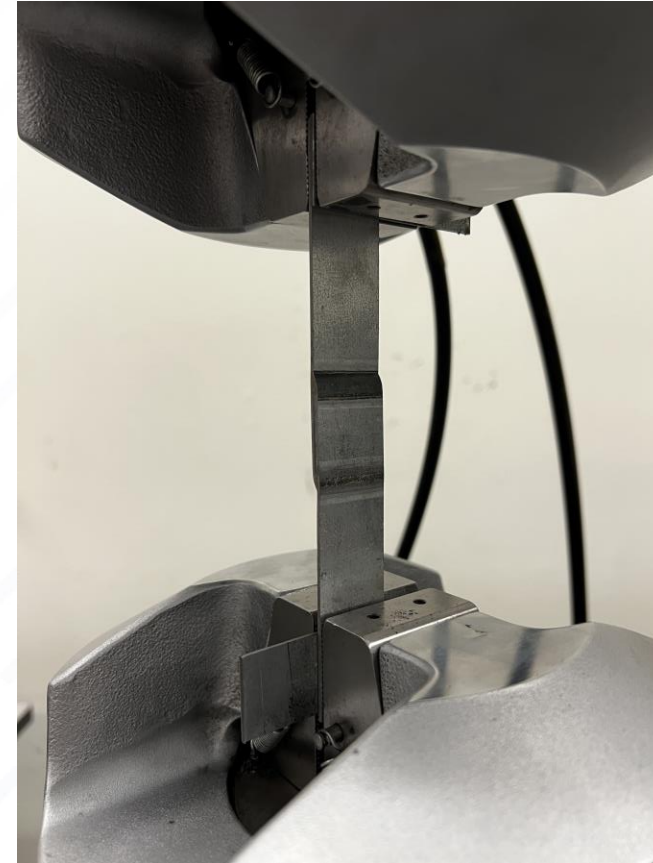


Results – Tensile

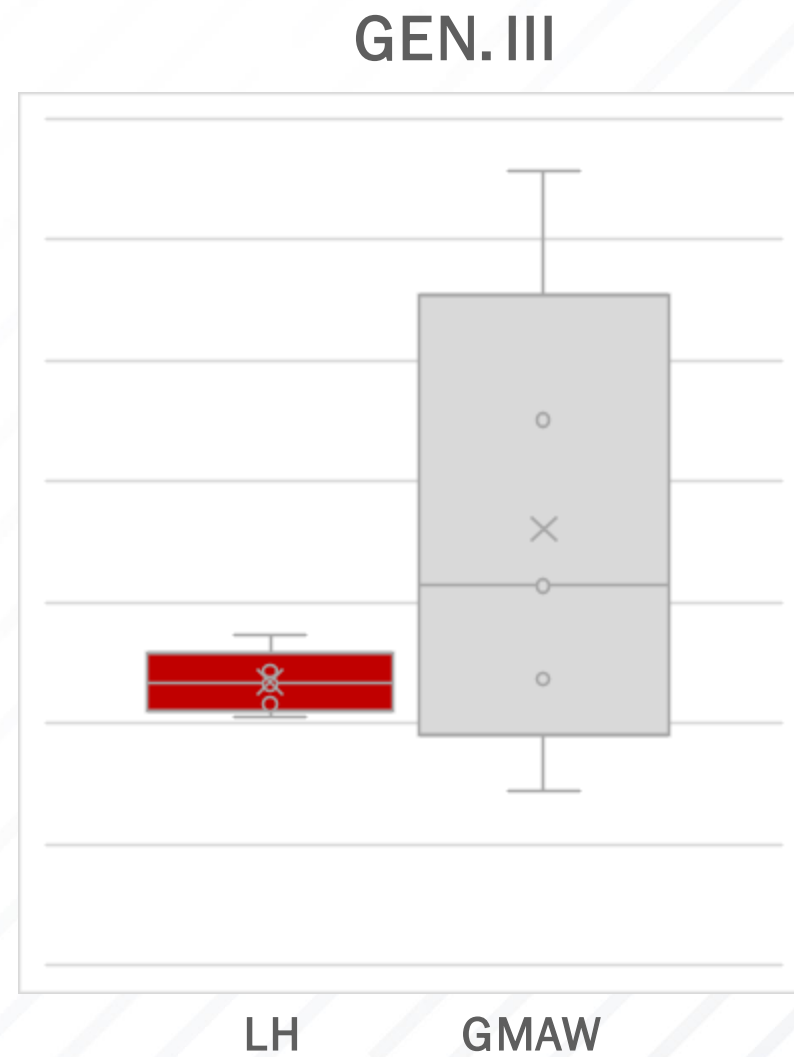
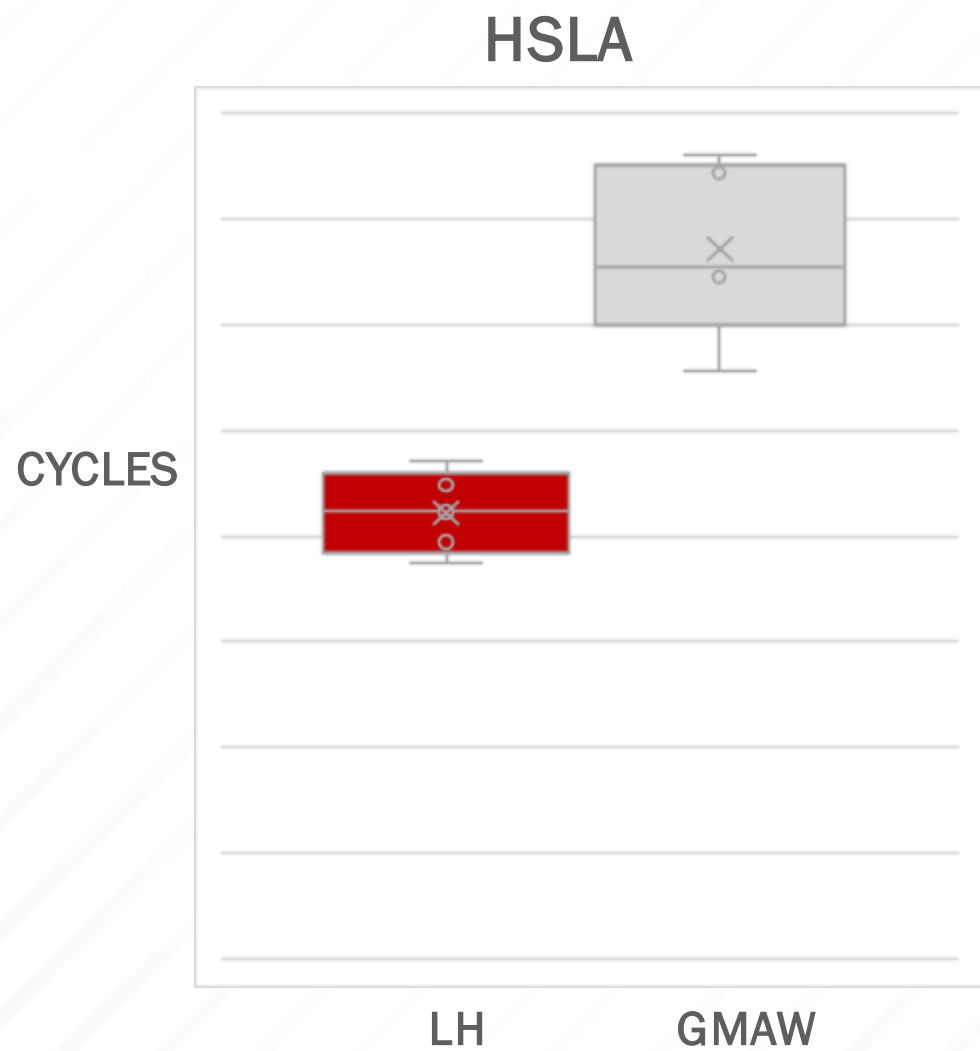


Fatigue Setup

Parameter	HSLA	Gen. III
R Factor	0.1 (0.083)	0.1
Frequency (Hz)	10	10
Min. Load (kN)	1	1
Max. Load (kN)	12	10



Results – Fatigue



Discussion

- Laser Hot Wire had a smaller heat affect zone which should be a direct correlation to reduced weld distortion
- Laser Hot Wire showed an increase in the median value tensile strength
- Laser Hot Wire showed a significantly smaller standard deviation in results in both tensile and fatigue testing results
- GMAW-P showed increase in the fatigue life when pulled to complete failure

Acknowledgements

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For More Information

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