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Laser Spot Weld Repair of MC4779 Shunt Wire Resistance Weld

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NNSA National Nuclear Security Administration

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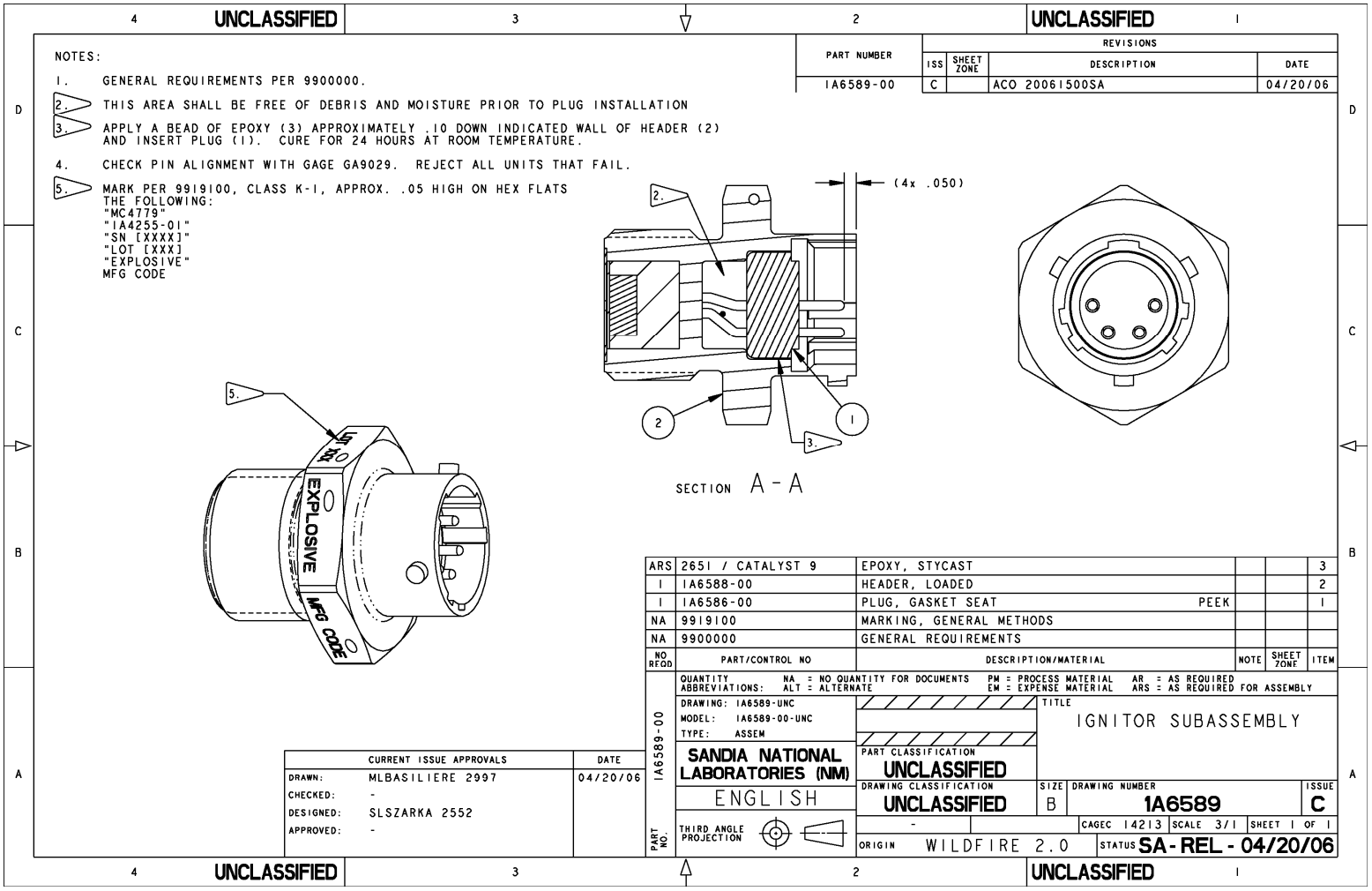
Overall View of MC4779 Igniter



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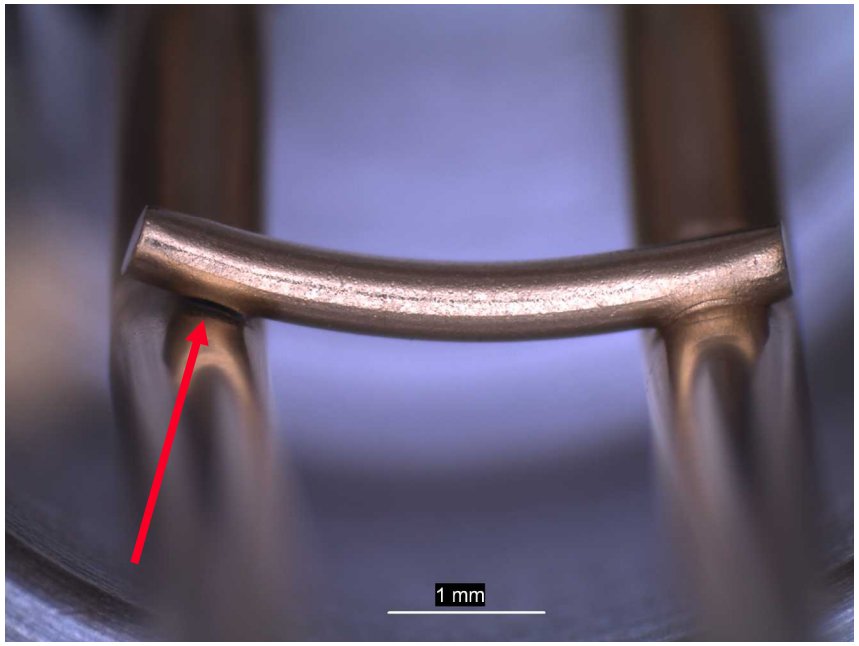
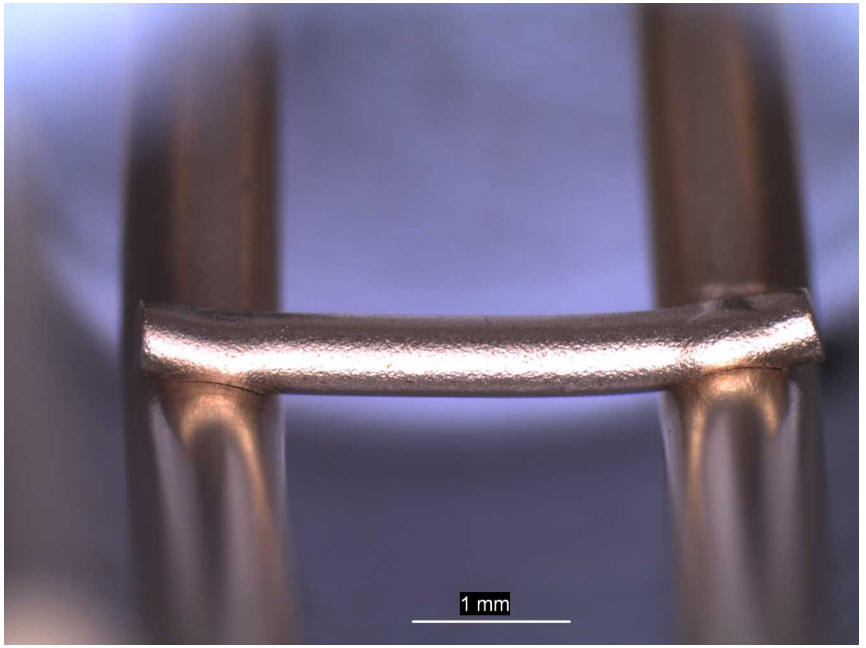
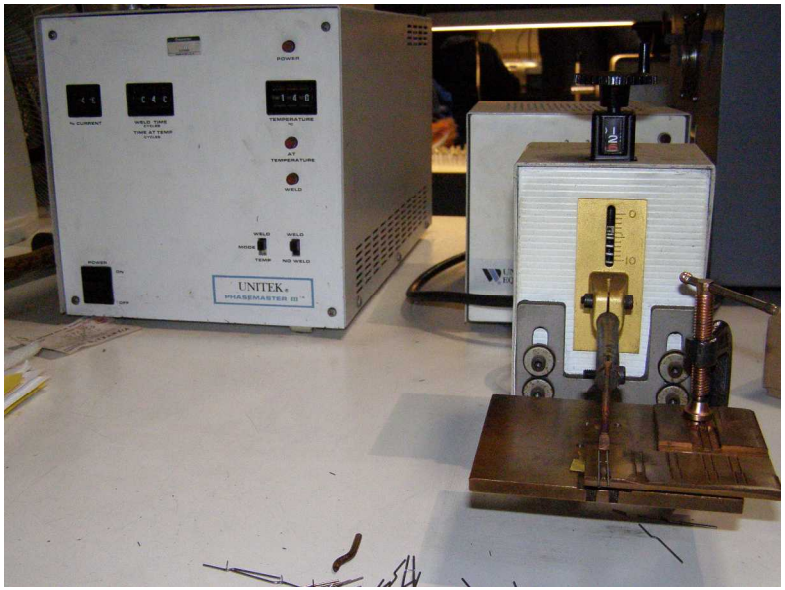
Alloy 52 Resistance Welded Shunt Wire

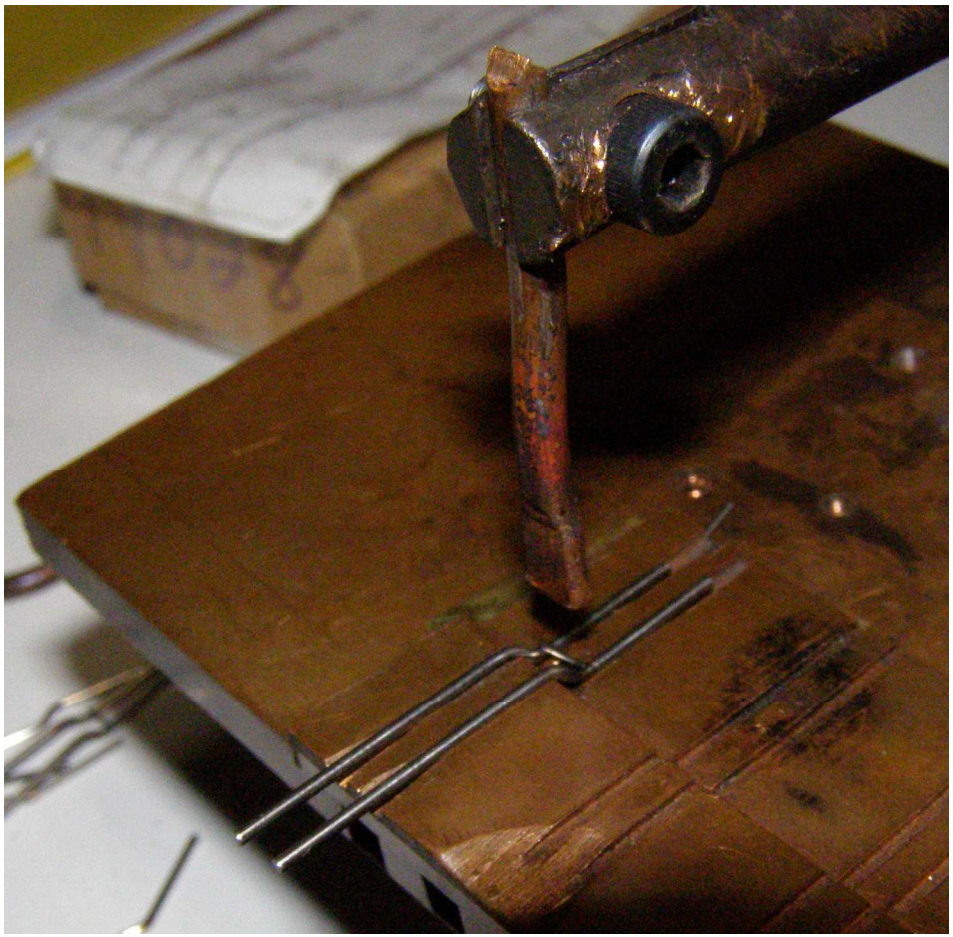




Normally cross-wire resistance welds are pretty bullet-proof. Not this time!

Vendor's RW Set-up





The vendor set up to make both welds simultaneously; apparently, the electrodes weren't precisely aligned and tended to underheat the right hand bond

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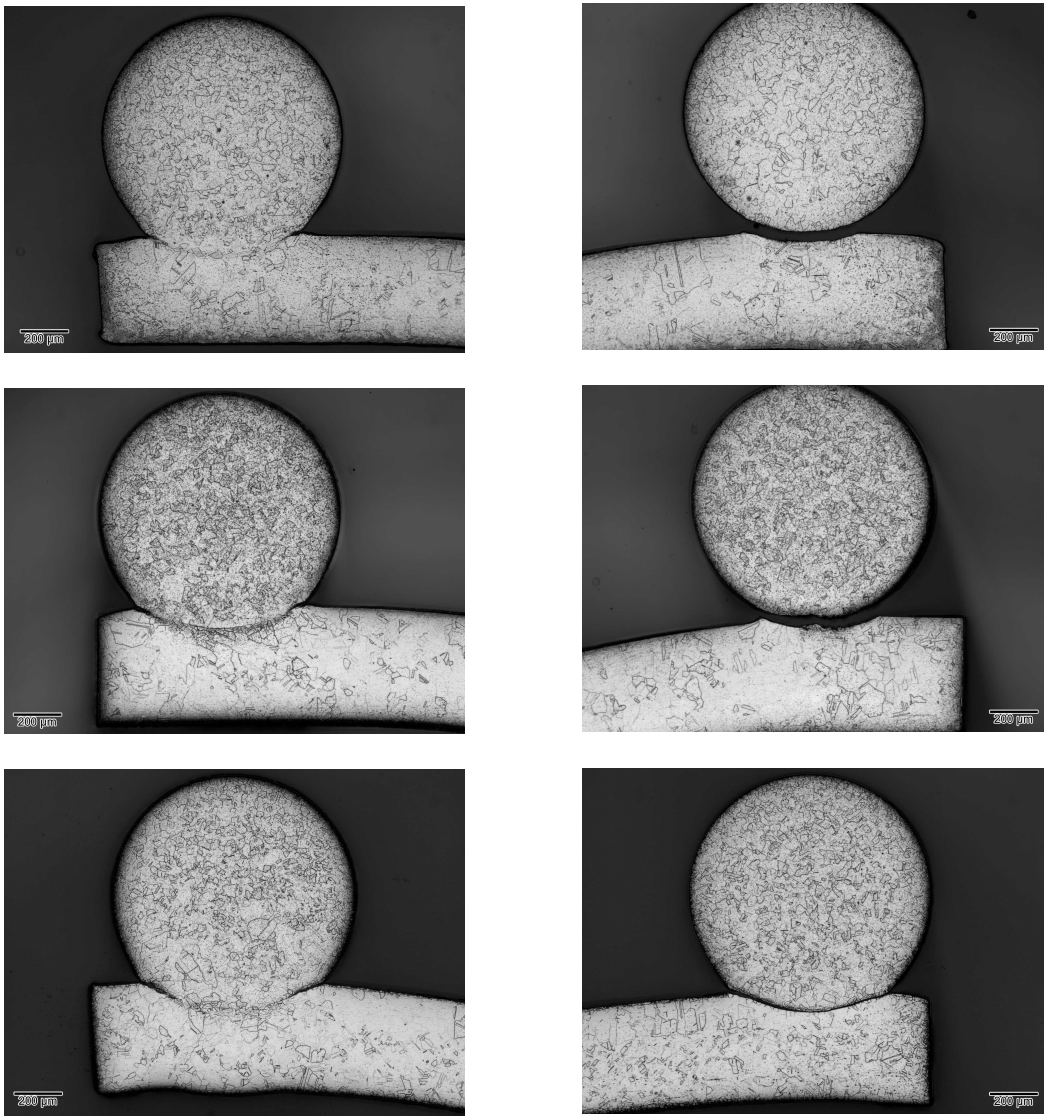
Metallography of RW

"good?" side



bad side

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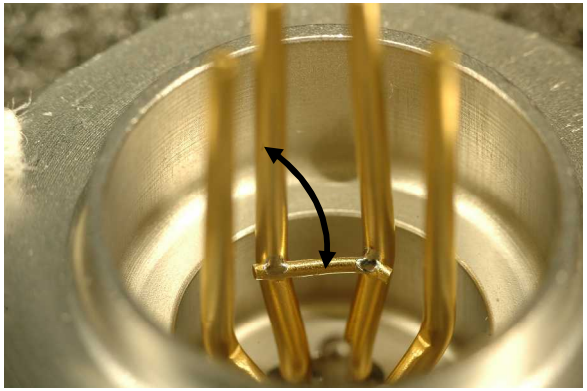
We proposed a Laser Spotweld repair

Laser

Baasel AB Laser spot welder

Igniter Connector Pin Housing requires steep angle for weld and shooting through another pair of pins while avoiding the pin connector body



Igniter Connector Pin Housing: Alignment/Sighting

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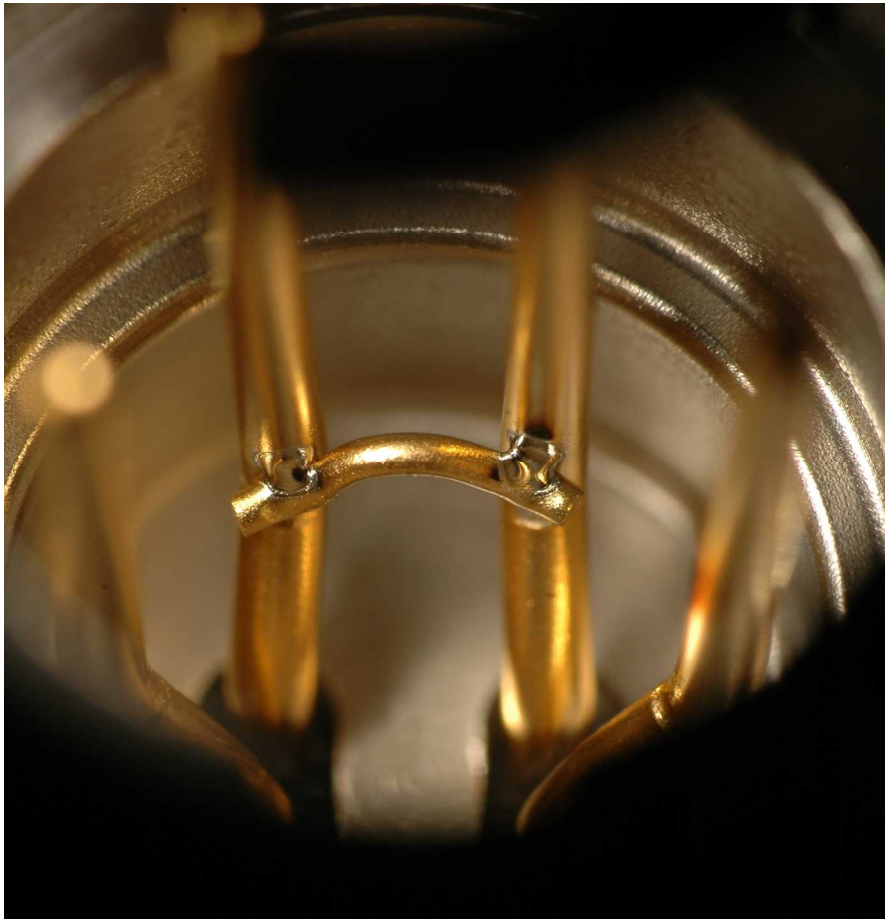
Details of LBW Schedule



RHS: welded broken arm
LHS: welded intact arm

Laser Parameters

- 5 J/p (220 V at 1.5 Hz)
- 10 ms pulse length
- At focus with 5” f.l. lens
- Igniter Connector Pin Housing requires steep angle for weld
- No clamping of broken weld; i.e., there can exist a small initial gap for the laser spot weld to bridge
- UHP Ar shield gas

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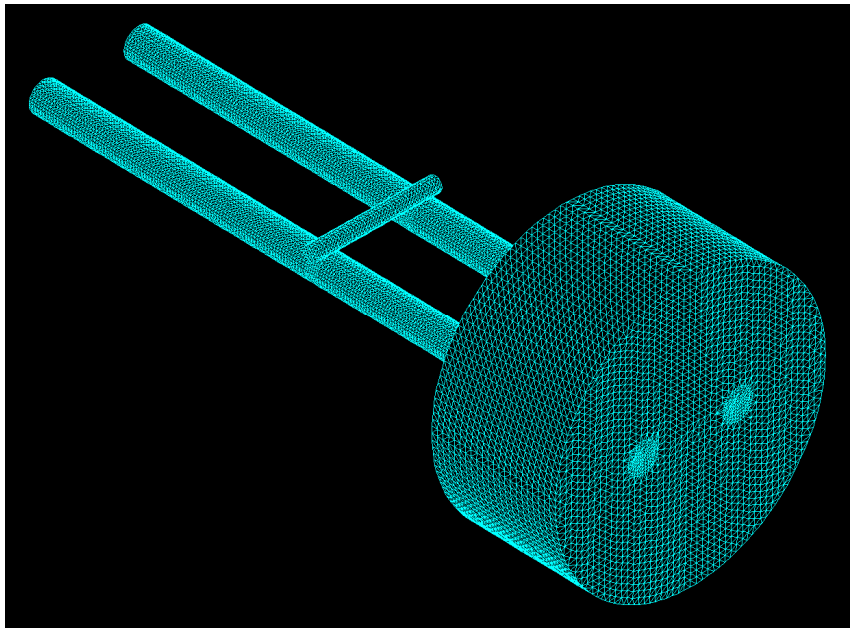
FEA Model to determine Heat rise at Powder surface



Heat transfer can take place along the vertical pins, through the glass seal to the explosive powder !

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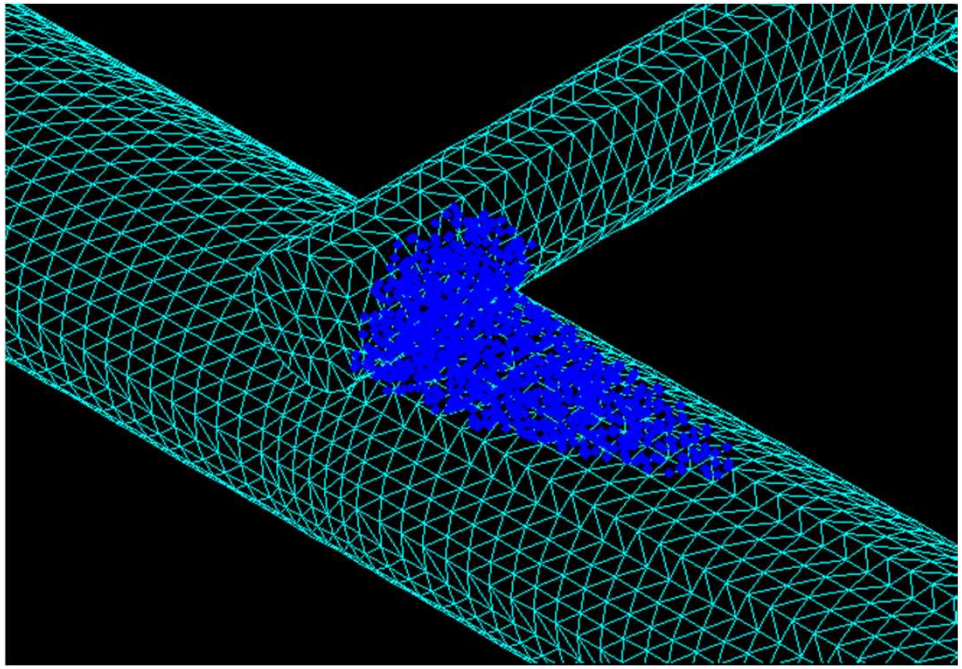
Heat Source



Volume-elements heat source impinging with a slightly more than 50% illumination of vertical post.

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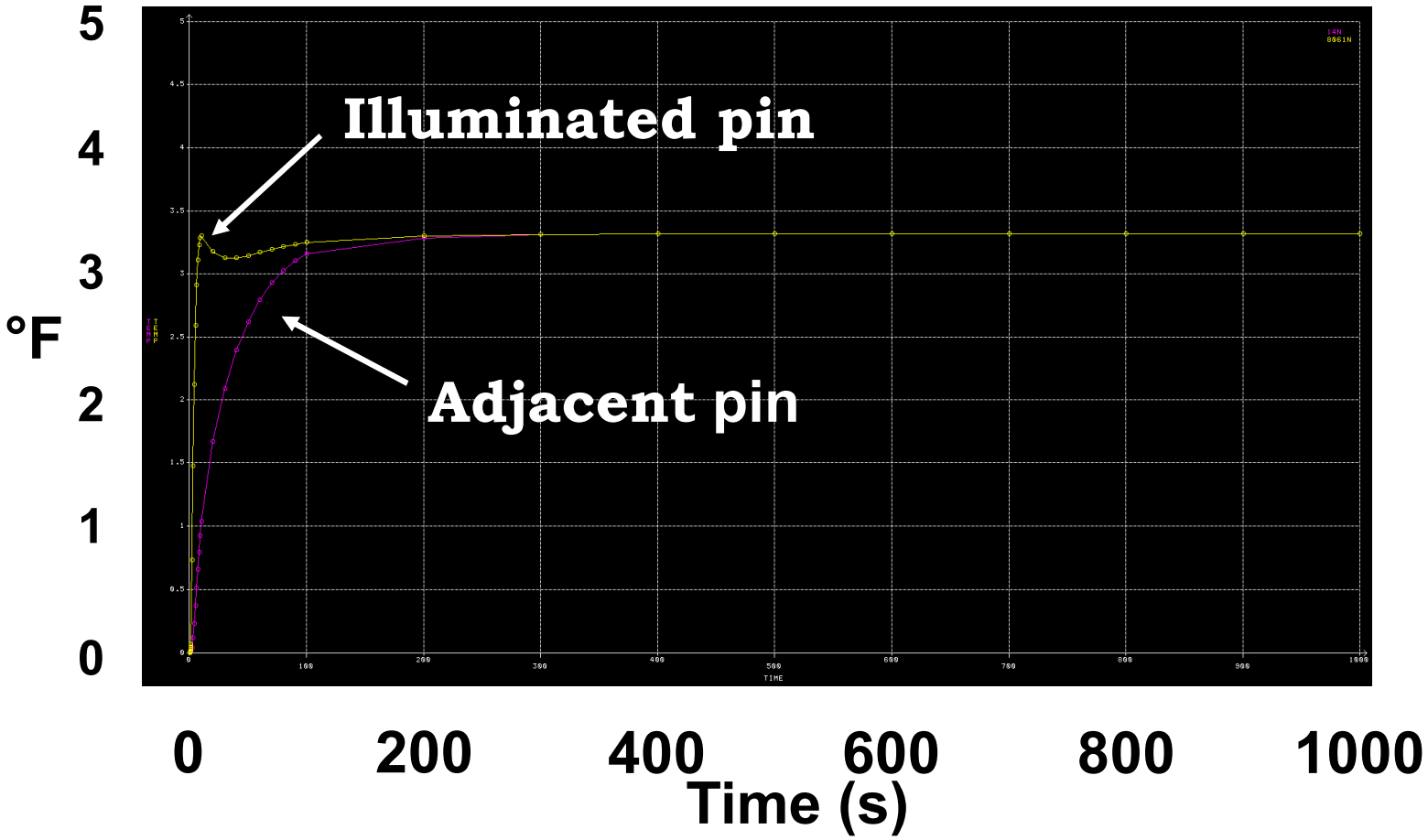
Temperature Rise Negligible



The predicted temperature RISE is 3.3 °F.

Note: this is for a <u>single</u> pin.

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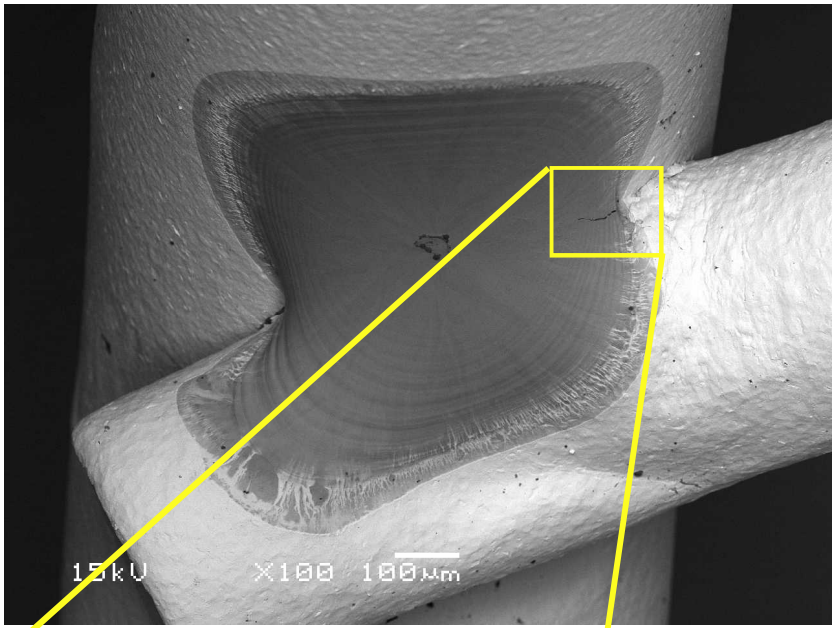
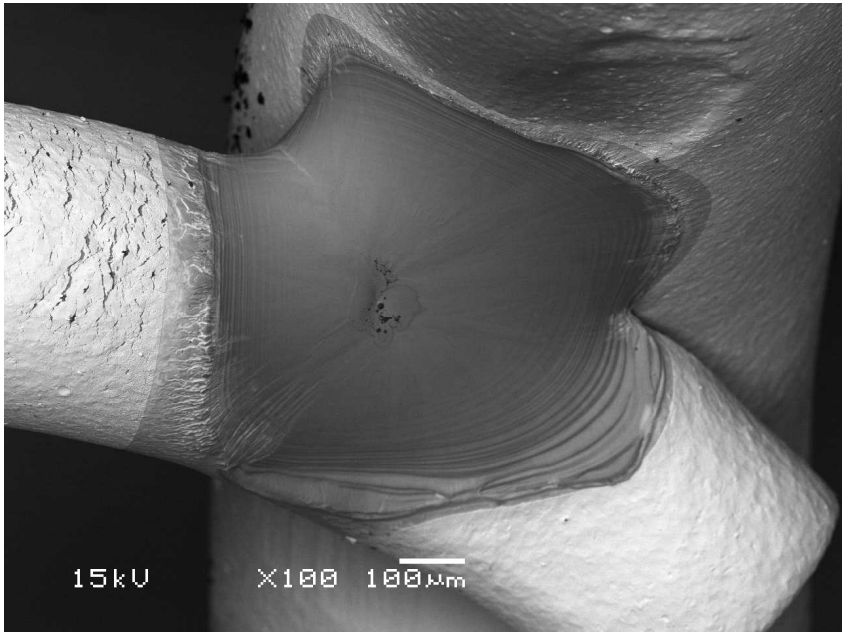
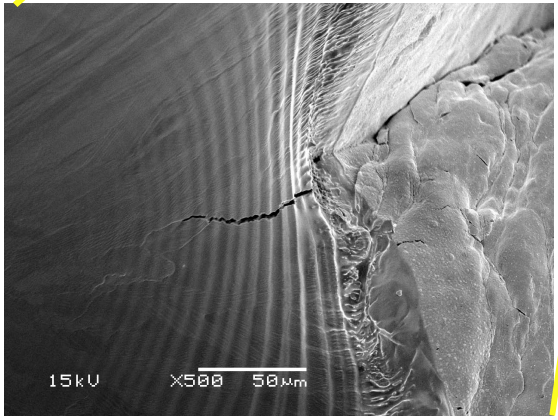
SEM of LBW







- Au plating mixed into Alloy 52 leads to occasional hot cracks.
- The joint is not intended to bear a mechanical load; electrical only

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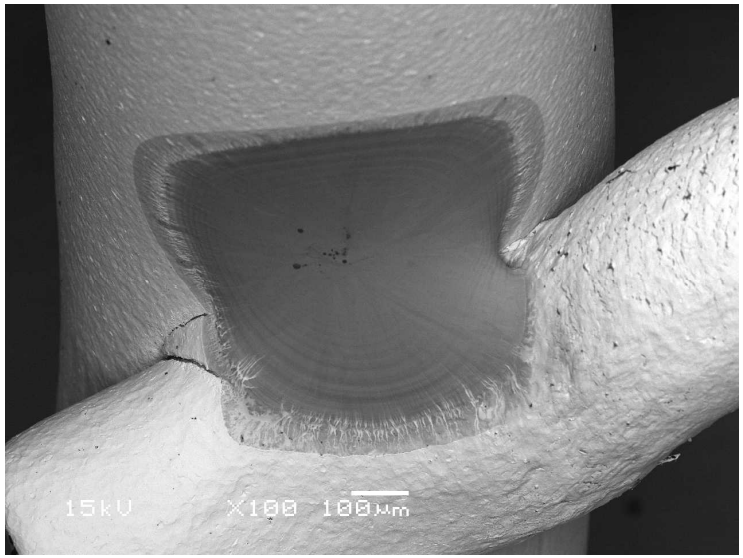
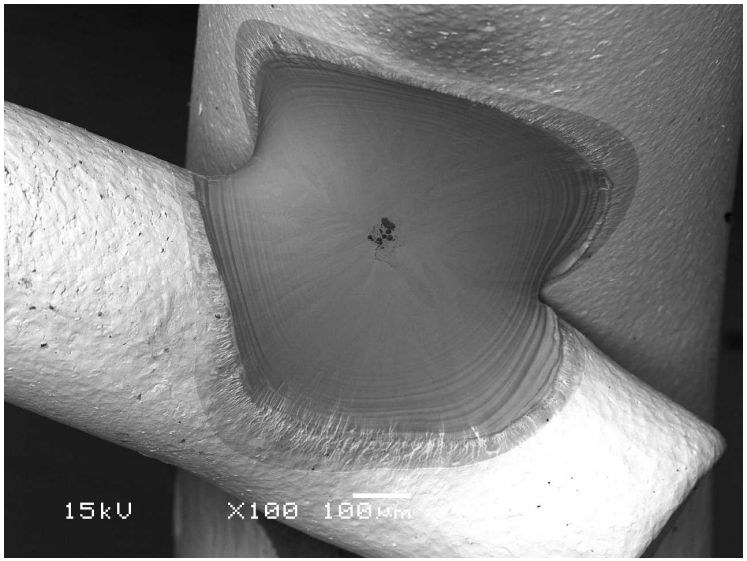
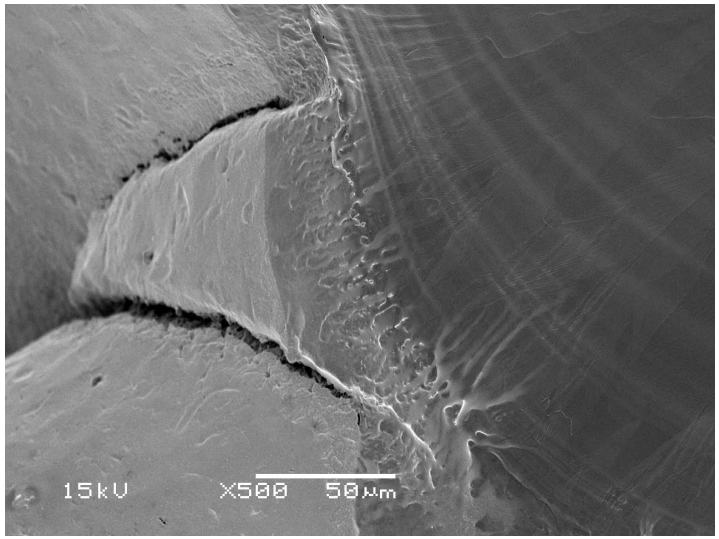
More SEM Pictures







No pre-clamping of shunt-wire to pin was used.

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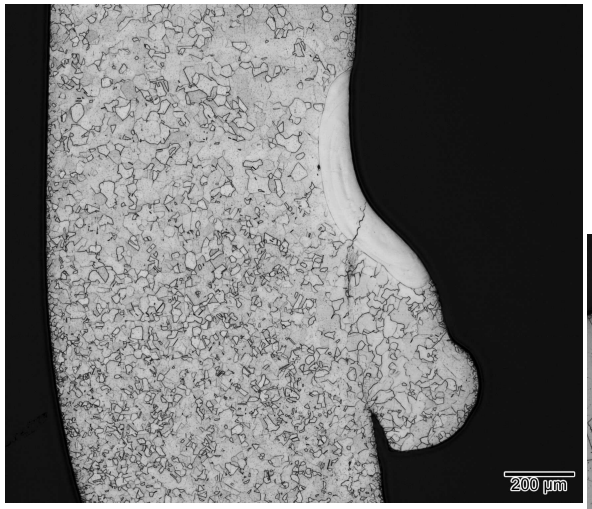
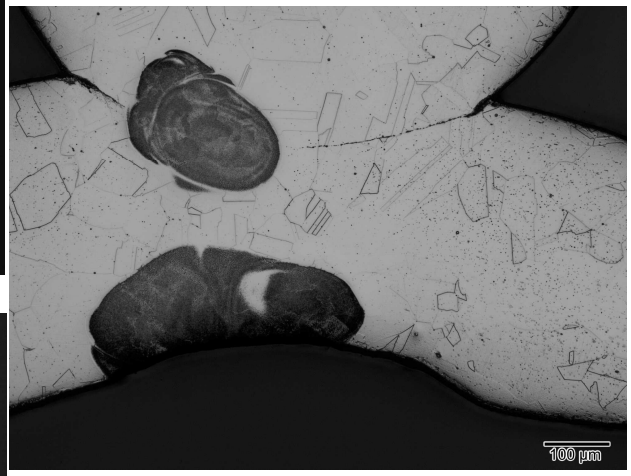
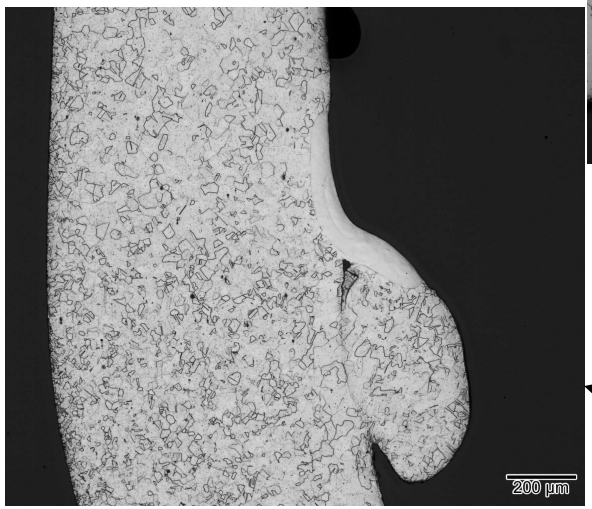
Metallography of LBW Repair Welds

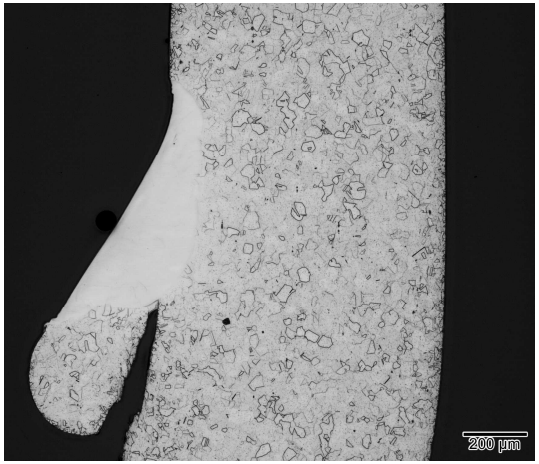


section parallel to shunt wire





sections parallel to pins



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Summary

- Vendor's cross-wire resistance welds were at best "cold" and at worst, non-existent.
- We proposed a pulsed Nd:YAG laser spotweld repair.
- Modeling showed virtually no heat rise at the powder cavity.
- Occasional small hot cracks were seen at the edge of the LB fusion weld; since need is for conductivity only, not thought to be a problem.

Acknowledgments

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