

The Art of Metal Joining and How It's Used

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Educational Background

- B.S. Electrical Engineer, Louisiana State University 2002
 - Minor in Math
- Ph.D. Material Science, University of Alabama 2011
 - Concentration in Physics



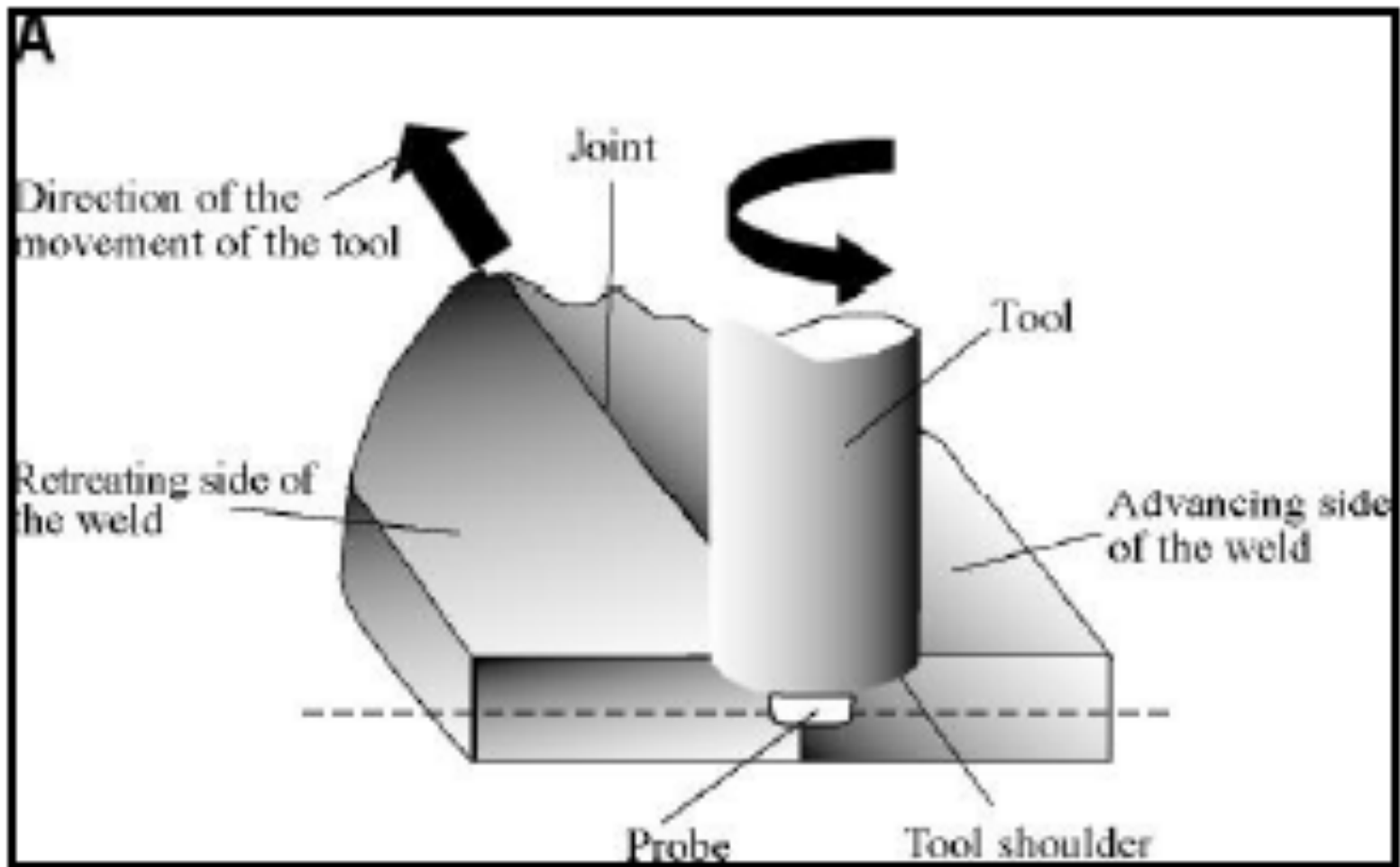
Friction Stir Welding

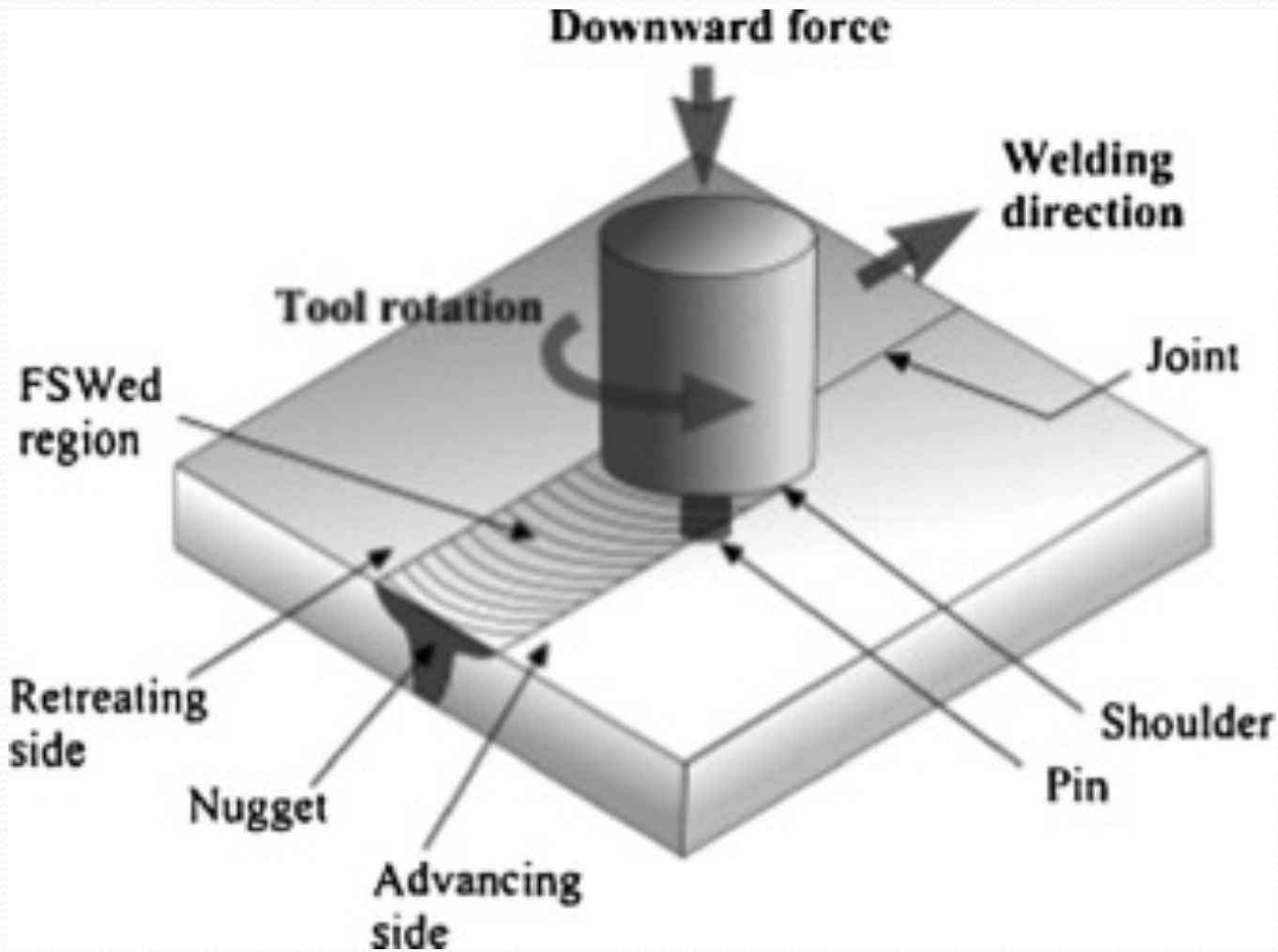
FSW utilizes frictional heating combined with forging pressure to produce high-strength bonds virtually free of defects. Friction Stir Welding transforms the metals from a solid state into a "plasticlike" state, and then mechanically stirs the materials together under pressure to form a welded joint.

A significant benefit of Friction Stir Welding

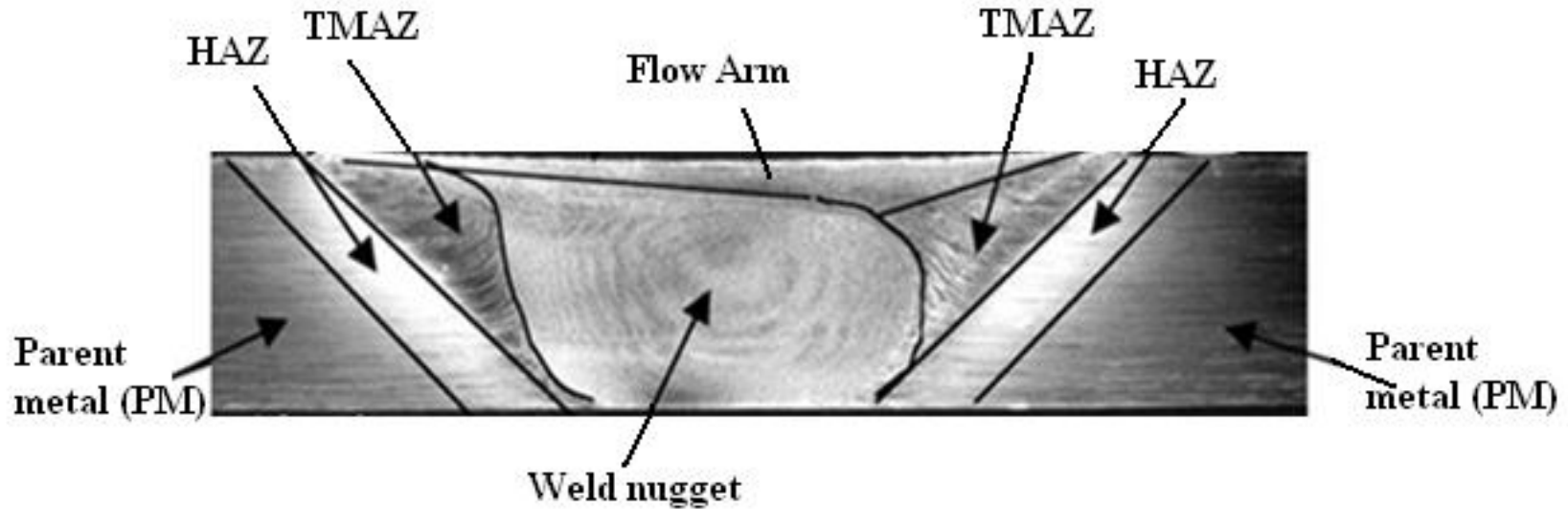
- significantly fewer process elements to control.
- three process variables to control:
 - rotation speed
 - travel speed
 - pressure







FSW Nugget



Self Reacting Friction Stir Welding

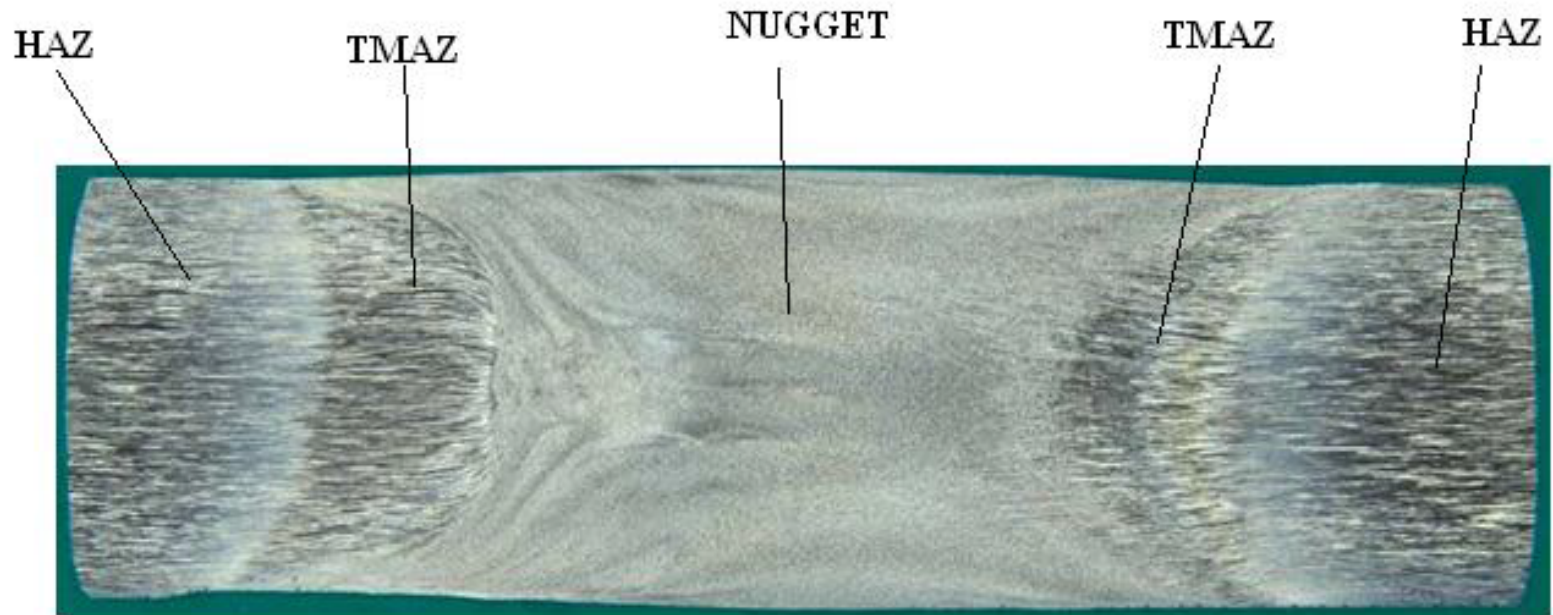
- Self-reacting friction stir welding incorporates two opposing shoulders on the crown and root sides of the weld joint.
- In self-reacting friction stir welding, the weld forge force is reacted against the crown shoulder portion of the weld pin tool by the root shoulder.
- The self-reacting feature reduces tooling requirements and, therefore, process implementation costs.
- This makes the process attractive for aluminum alloy circumferential weld applications





https://youtu.be/_qAOKR6mdTI

SR-FSW Nugget

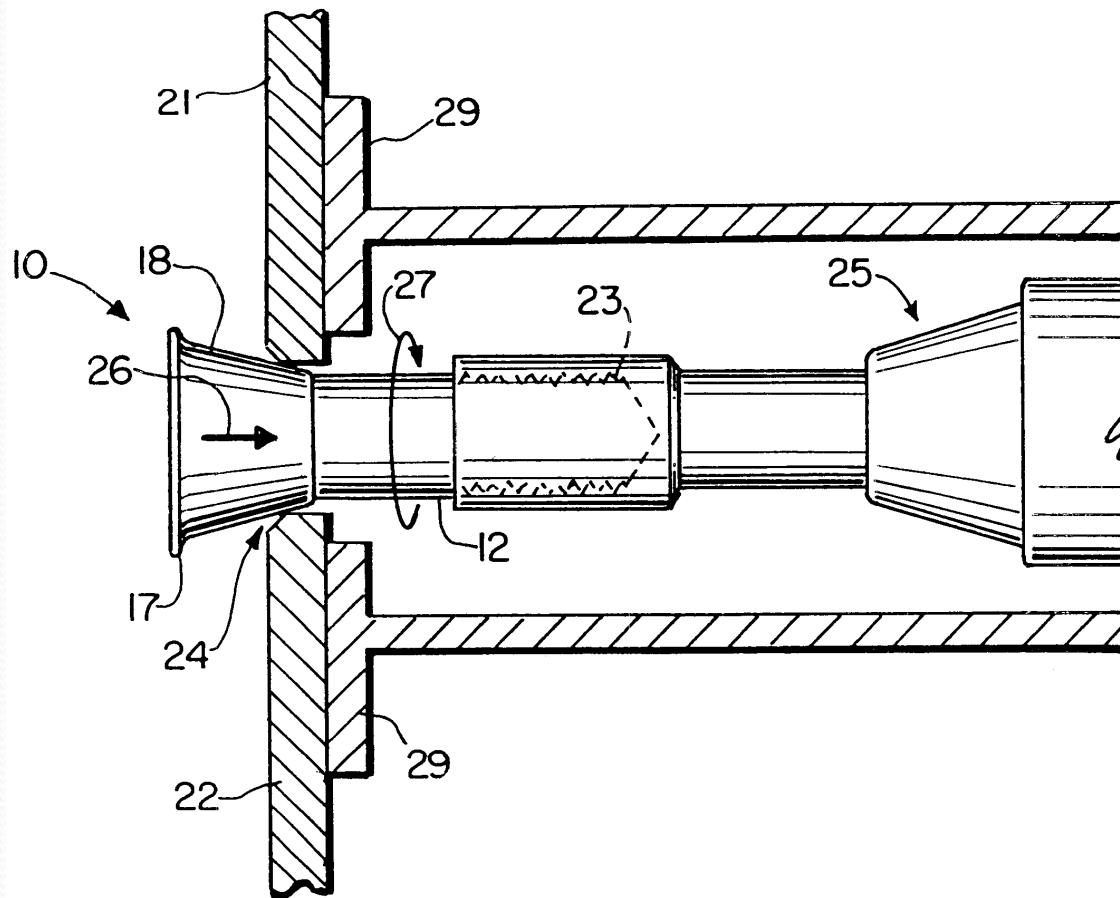


Dissertation

- Dissertation was an evaluation of strength, hardness, and strain field of self-reacting friction stir welding (SR-FSW) of dissimilar aluminum alloys both with and without a friction plug weld (FPW).
- Friction plug welding (FPW) is a solid phase welding technique in which a round plug is rapidly spun, with an applied force, to fill a hole



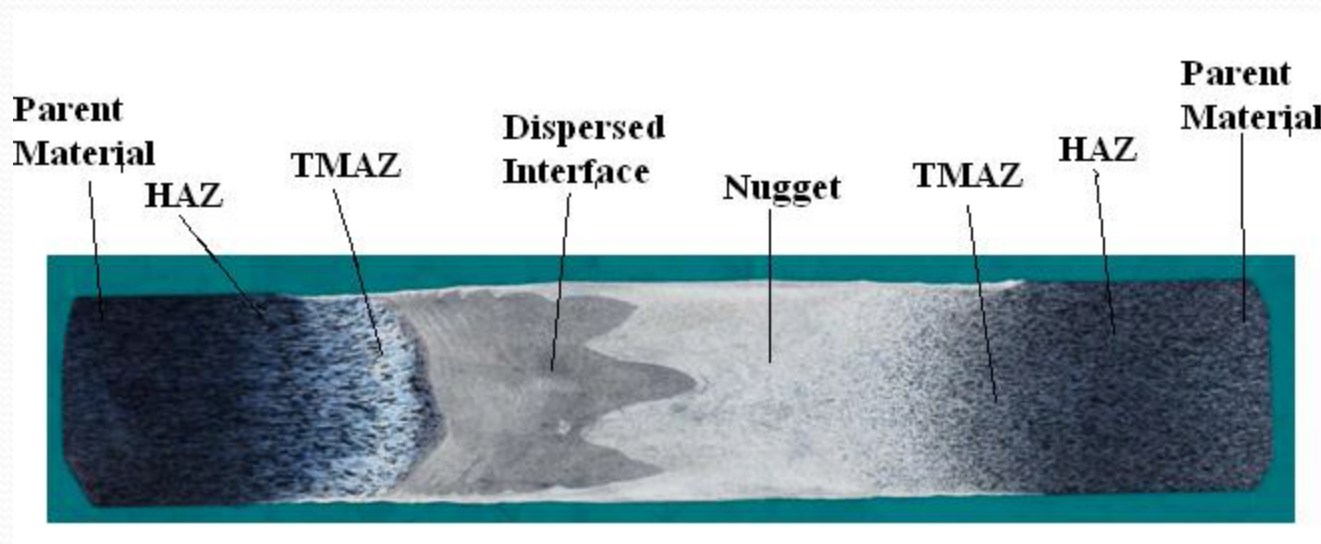
FPW



Results



- Macroscopic images of the cross-section of the initial weld are shown below In this figure, AA 2014 is on the advancing side and AA 2219 on the retreating side.
- It shows the HAZ, TMAZ and nugget region of the welds.
- Additionally the dispersed interface is readily visible in the macrograph

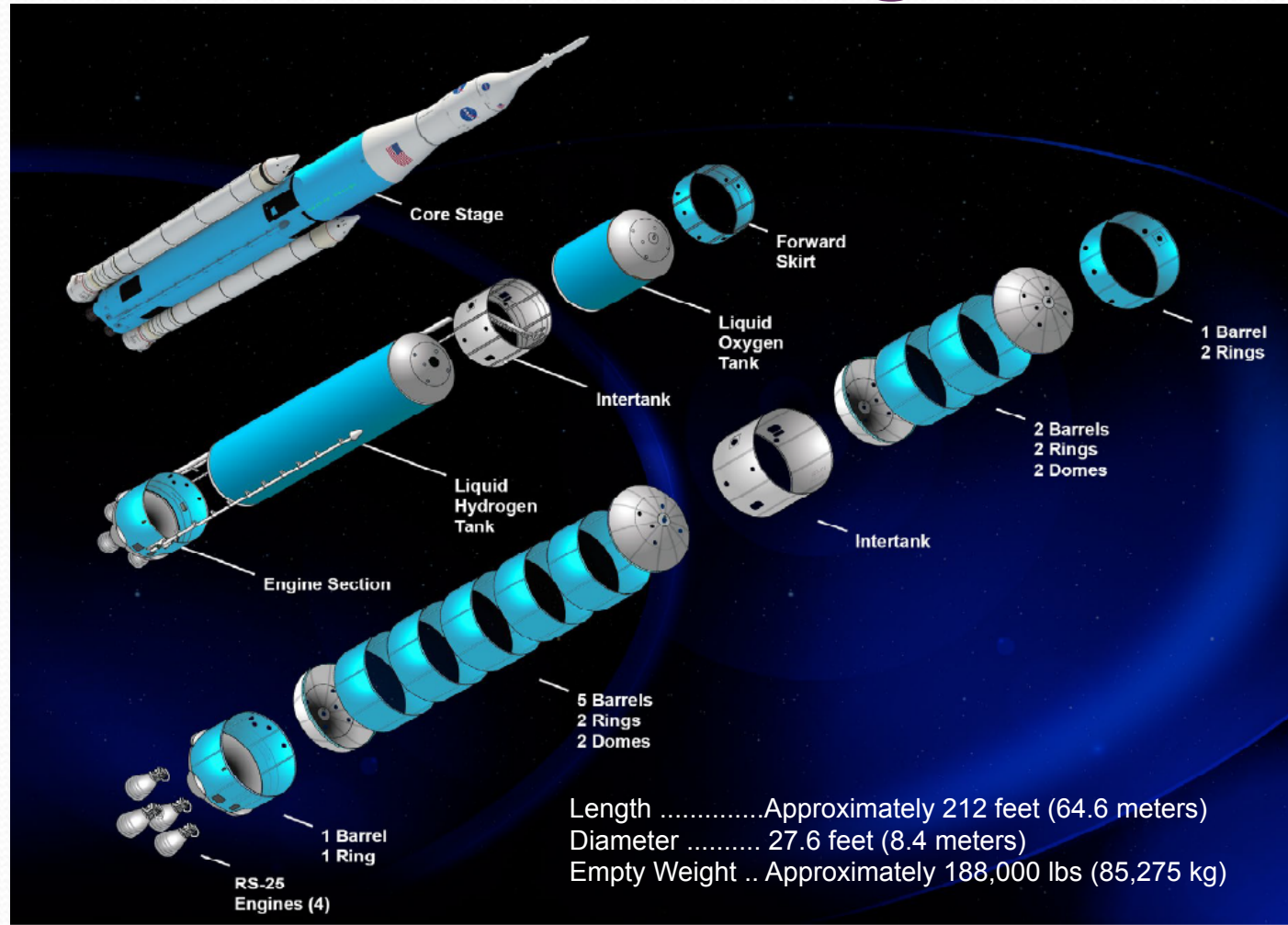


- Fine grained nugget region with a sharp demarcation seen on the advancing side of the weld,
- Fairly diffused flow observed on the retreating side of the weld,
- Displaced weld seam from the advancing side past the thermo-mechanical affected zone (TMAZ) into the nugget region,
- Same hardness for the displaced material as the parent material,
- Dynamic recrystallization was observed in the SR-FSW zone and the displaced weld seam region,

What do I do for NASA

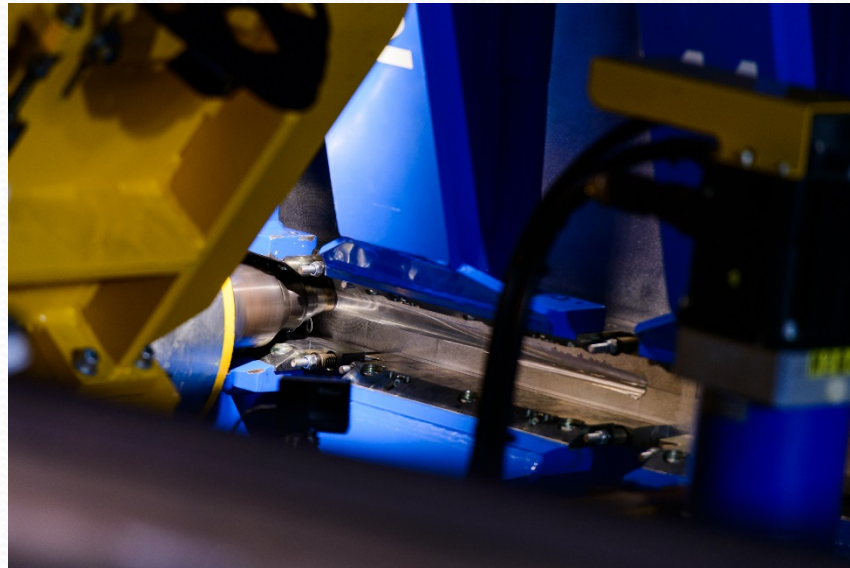
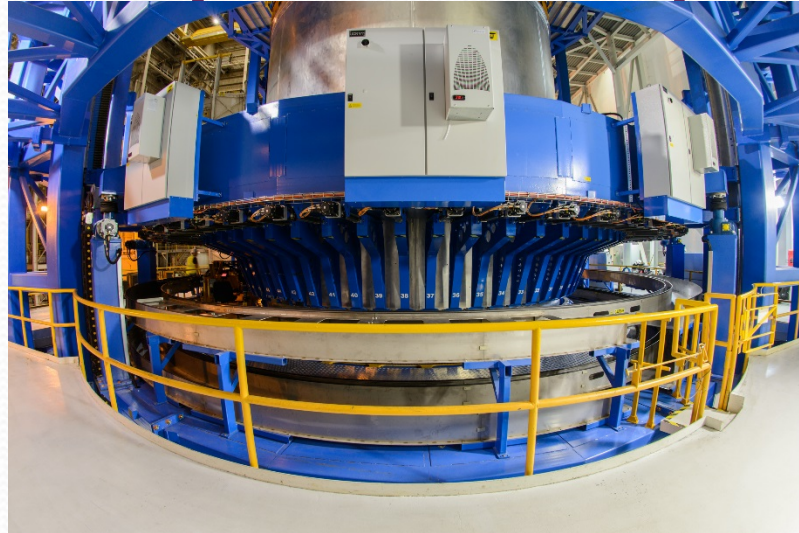


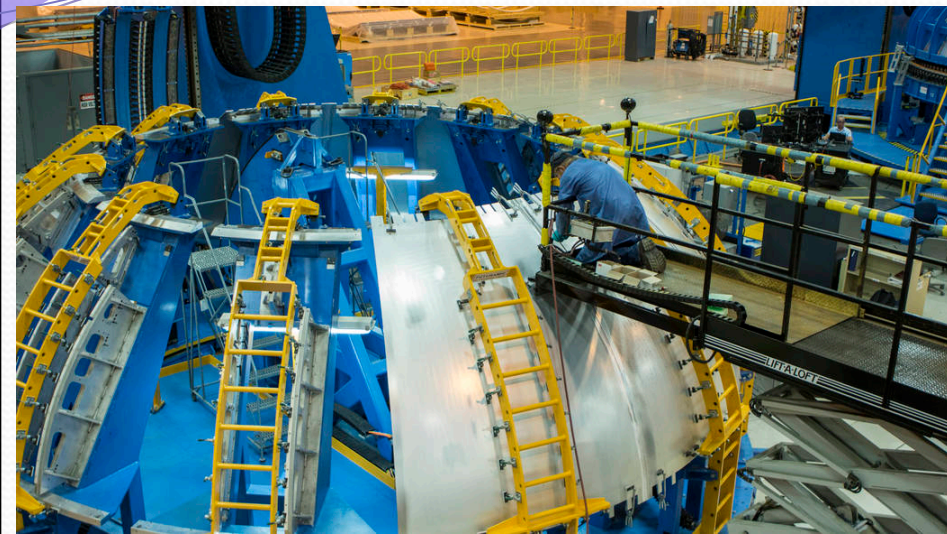
SLS Core Stage



https://www.nasa.gov/sites/default/files/files/SLS_Core_Stage_Fact_Sheet-2014-09a.pdf

Vertical Assembly Center (VAC)





Ken Kremer
kenkremer.com



Largest Pressure Vessel NASA has built





<https://www.youtube.com/watch?v=-IcPrSljxnc>





Questions?

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