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Abstract

Many applications today involving high pressure, low or high temperatures, and intense loading scenarios often call for a strong, durable material. While arc welding has often been the conventional method for combining plates of metal, a newer method called friction stir welding has recently surfaced. Friction stir welding is simply a process where two plates of metal are combined by heating the plates to the point of plasticization and mixing the material together with a pin. Although this technique has many advantages, there are still some disadvantages associated with friction stir welding. In some cases, an unavoidable keyhole is left in the material after the pin is retracted. For this experiment, the residual stresses in the plug welds used to seal these holes for 2195 Al-Li were investigated.

Conventional Methods of Welding



<http://www.italiankart.com/immagini/articoli/arcwelding.jpg>

- Electric arc
- Gas
- Resistance
- Energy beam
- Solid-state
- Many more

Problems

- Introducing another material to form bond
- Losing nominal material characteristics
- Distortion from cooling
- Cracks

Hazards

- Burns
- Debris
- Electric shock
- Fumes from shielding gas

Friction Stir Welding

- Two types of materials
 - Metals
 - Thermoplastics
- Two types
 - Conventional
 - Self-reacting
- Characteristics
 - Pin
 - Frictional heat
 - Applied heat



http://www.corpserv.nrc.ca/images/photos/200701/surface_1.jpg

Applications



http://www.aerospaceguide.net/spacepictures/suttle_endeavour.jpg

- External tank of space shuttle
- Rockets
- Aircraft
- Ships
- Automotives



http://reactorfire.files.wordpress.com/2009/03/st_tool_f.jpg

Advantages

- Elimination of
 - Porosity
 - Defects in redistribution of material
 - Cracks
 - Toxic fumes
- Maintain desired mechanical properties
- Reliable

Disadvantages

- Need pins with different lengths
- Keyhole



Research Project



- Objective: Learn method used to study residual stress
- Analyze residual stress in plug welds

Method

- Apply strain gages
- Clean metal
- Attach gages with tape and adhesive
- Apply weights and place into oven



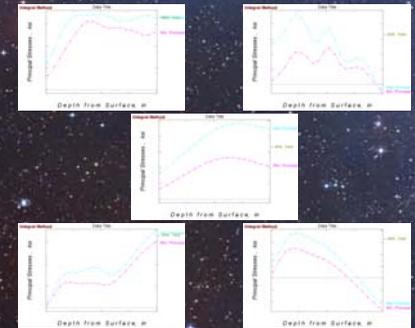
- Attach wires to strain gage
- Place solder on soldering tabs
- Tint ends of wires
- Connect wires with soldering tabs



- Analyze stress in gages
 - Connect other ends of wires to computer set up
 - Mark out location of pneumatic drill
 - Attach drill and hook up gas lines
 - Open software
 - Run test
- Evaluate results



Results



Conclusions

- Purpose: Compare and determine the efficiency of the mechanical planishing residual stress relief method

Newer Technology



<http://www.nasatech.com/Spinoff/spinoff2002/images/043.jpg>

- Self-retracting pin
- Eliminate keyholes
- Use for varying thickness
- Use with many different alloys

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