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Brief 67-10183

NASA TECH BRIEF

Continuous Internal Channels Formed in Aluminum Fusion Welds

The problem:

To determine if continuous internal channel systems can be produced on a repeatable basis in 2014-T6 aluminum by the TIG machine fusion-welding process, and also to determine the feasibility of using a chem-mill process for enlarging such channel systems.

The solution:

A process that uses standard machining to form the initial channel, which is then filled with tungsten carbide powder (45 micron). Standard TIG machine fusion welding completes formation of the internal channel. The tungsten carbide is removed and standard chem-mill techniques are used to enlarge the channel to the desired size.

How it's done:

A test panel of 2014-T6 aluminum is provided with a 3/32-inch machined groove to an appropriate depth and weld start, and stop tabs are manually tack welded to the panel at each end. The tungsten carbide powder is then poured into the groove with a leveling funnel to a uniform height of 1/16 inch. A rectangular section of type 4043 filler metal is press-fit into the groove above the powder, and welding performed in a single pass using conventional welding machine settings. After welding and removal of the tabs, the tungsten powder is removed either by vacuum or compressed air. A metallurgical analysis of the bead-on-plate welds reveals weld penetration beyond the depth of groove and that the tungsten has provided a rectangular inner channel 3/32 by 1/16 inch in an otherwise sound fusion weld.

The two rectangular openings are drilled out to a depth of ½ inch, and pipe fittings are manually welded to them. A low concentration chem-milling solution maintained at 160°F is circulated through the weld joint channel for approximately 1 hour and 20 minutes. The weld test panel is sectioned in two separate locations and measurement of the channel openings reveal new channel dimensions of approximately 3/16 inch and 5/32 inch, representing a dimensional increase of approximately 100%.

Notes:

1. There is an appreciable difference in the etchant characteristics of the weld metal and parent metal. The weld metal appears approximately 30% more sensitive to etchants.
2. Chem-milling is not useful in welds containing cracks as the etchant finds its way through to the weld surface.
3. Complex internal channel patterns may be produced by this method and are limited only by the machining and welding equipment available.
4. Inquiries concerning this innovation may be directed to:

   Technology Utilization Officer
   Marshall Space Flight Center
   Huntsville, Alabama 35812
   Reference: B67-10183

Patent status:

No patent action is contemplated by NASA.

Source: J. Gault and W. Sabo
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Category 05