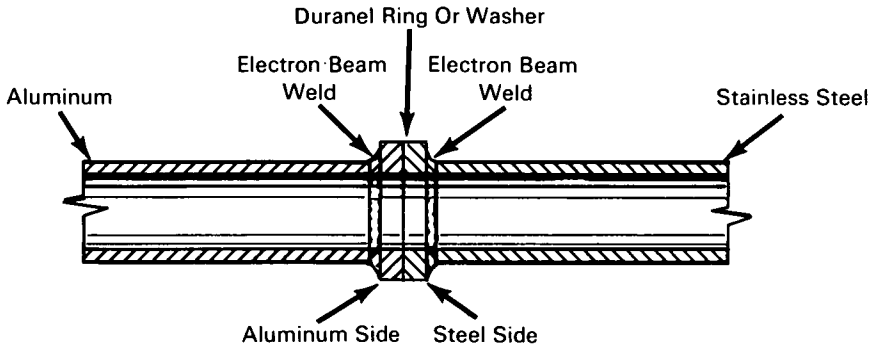
NASA TECH BRIEF

Aluminum and Stainless Steel Tubes Joined by Simple Ring and Welding Process



The problem:

To join aluminum and stainless steel tubes by a simple and economical method which would replace the expensive titanium brazing process. The prior process involved plating titanium to the stainless steel tubing, and then brazing the titanium to the aluminum with aluminum-silicon braze alloy. The flux used in the process caused some corrosion of the metals.

The solution:

A ring or washer of Duranel, a bimetal made up of roll-bonded aluminum and stainless steel, used as a transition piece between the tubes to be joined. The Duranel ring is welded to the aluminum and stainless steel tubes.

How it's done:

To join tubing of 6061-T6 aluminum and stainless steel, a ring is cut from a Duranel metal sheet having the same sized hole as the tubing ID, and an OD of 0.75 inch. In this application, the steel tube OD is 0.625 inch, with a wall thickness of 0.067 inch. The aluminum tube OD is 0.625 inch with a wall thickness of 0.049 inch. The OD of the Duranel ring on each end is machined down to match the OD of the tubing for a distance of 0.062 inch.

The three parts are assembled on a mandrel so that the aluminum tube contacts the aluminum side of the Duranel ring, and the steel tube contacts the steel side of the ring. Pressure is applied to the outer ends of the tubes and the assembly is welded with a Hamilton Standard Electron Beam machine. The process produced joints having a leakage rate of less than 1.5×10^{-10} cc/sec, as determined by a mass spectrometer.

Notes:

1. This method of joining aluminum and stainless steel tubing is economical and requires only two welding operations. Also, since the electron beam weld needs no flux or filler rod, there is no risk of corrosion of the metals.

(continued overleaf)

2. In pressure tests, the aluminum tube section burst at a minimum of 4000 psi, and there was no failure in the Duranel joint. The tensile strength of the aluminum tube was measured at 27,000 psi, although the minimum strength should have been 38,000 psi. The difference was due to the annealing of the tube during the welding process.
3. While the electron beam process of joining the metals is described, more economical welding processes which are not size limited could be used.
4. The type of joint described is not limited by the diameter of the tubing, but by the available thicknesses of the Duranel plates. Duranel is a product of Alcoa.
5. Inquiries concerning this innovation may be directed to:

   Technology Utilization Officer
   Marshall Space Flight Center
   Huntsville, Alabama 35812
   Reference: B67-10472

Patent status:

No patent action is contemplated by NASA.

Source: A. Townhill
of North American Aviation, Inc.
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