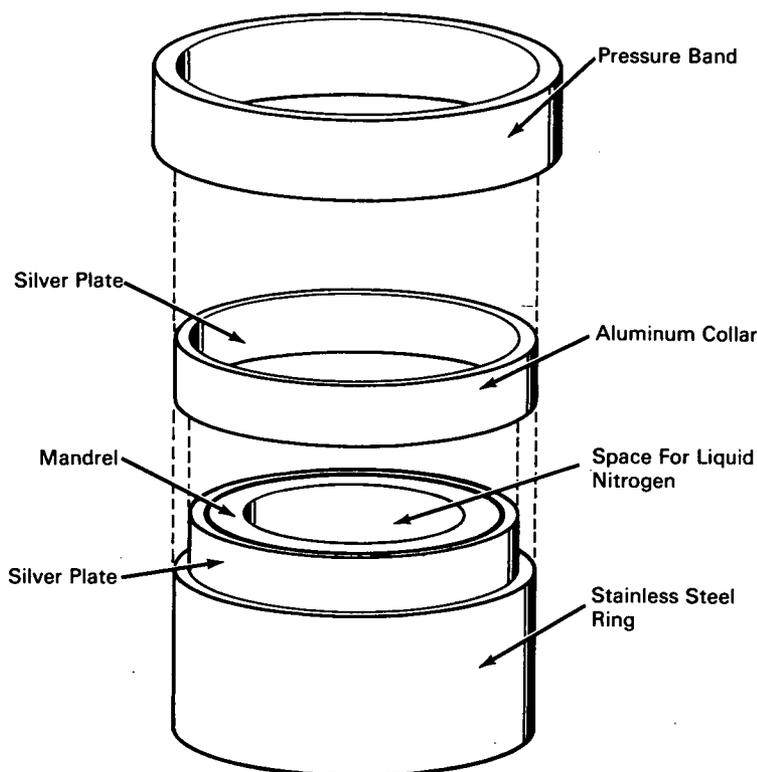


# NASA TECH BRIEF



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## Differential Expansion Provides Pressure for Diffusion Bonding of Large Diameter Rings



### The problem:

To bond aluminum alloy collars to large diameter, stainless steel rings without adversely affecting the properties of the aluminum. The process should also hold aluminum deformation to a minimum and not require an inert gas atmosphere.

### The solution:

A method employing an external pressure band that contracts while cooling to exert pressure on the

joint between silver plated contacting surfaces of the stainless steel ring and aluminum collar, which expand toward the pressure band.

### How it's done:

The contacting surfaces of the aluminum and stainless steel are silver plated. The stainless steel ring is positioned around a mandrel, and the aluminum collar is placed on the ring to form a lap joint. Liquid nitrogen is then poured into the assembly to cool and thereby shrink the ring and collar.

A close fitting steel pressure band is heated to 600° F and placed around the outside of the lap joint. As a result of heat transfer from the hot exterior into the cold interior, the stainless steel ring and aluminum collar assembly expands while the pressure band contracts around the outside of the joint. The oppositely directed expansion and contraction cause pressure from both sides to be exerted on the aluminum collar and the stainless steel ring, bringing them into intimate contact. The entire assembly is then held at 500° F for 4 hours to effect diffusion bonding at the joint interface.

**Notes:**

1. The aluminum collar deforms by about 5%, as compared to 10% to 50% deformation in diffusion bonding processes which are conducted at 700° to 950° F. These higher temperatures also degrade the properties of the aluminum alloy.
2. A tight fitting inner mandrel with a relatively high coefficient of thermal expansion may be

used in place of the liquid nitrogen cooling method to provide the required bonding pressure.

3. A conventional platen press with heated dies may be used to bond aluminum alloys and steel by this diffusion method.
4. Inquiries concerning this invention may be directed to:

Technology Utilization Officer  
Marshall Space Flight Center  
Huntsville, Alabama, 35812  
Reference: B66-10269

**Patent status:**

Inquiries about obtaining rights for the commercial use of this invention may be made to NASA, Code GP, Washington, D.C., 20546.

Source: The Boeing Company  
under contract to  
Marshall Space Flight Center  
(M-FS-588)