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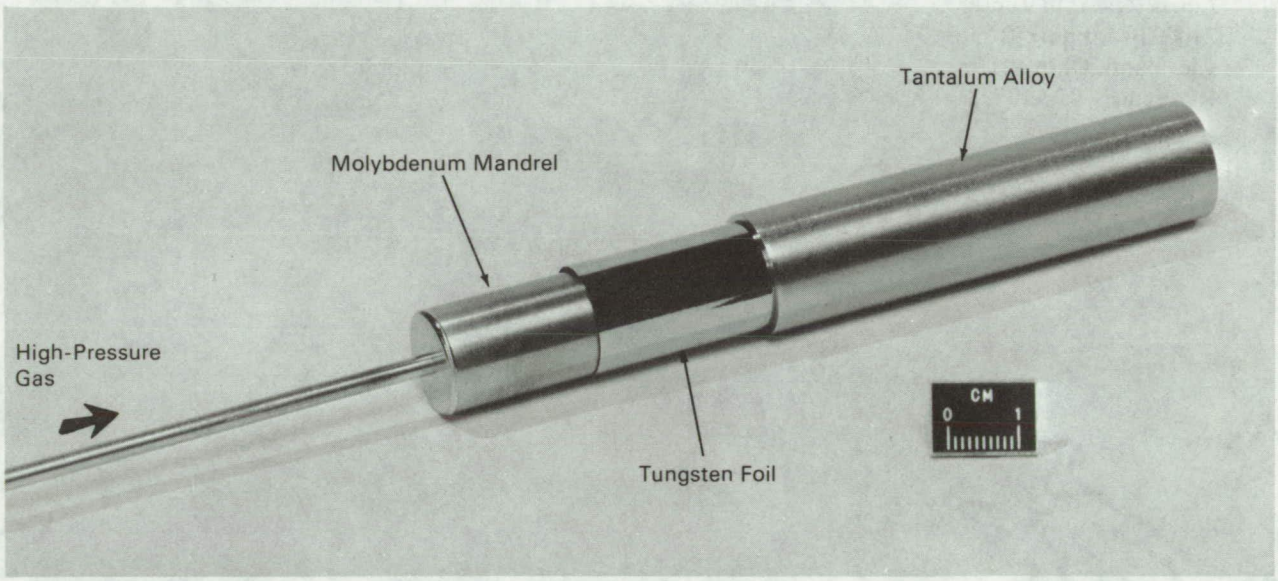
# NASA TECH BRIEF



## Improved Method for Cladding the Inside of Metal Tubes




### The problem:

To combine two concentric cylinders of different metals into one composite cylinder. Specifically, to apply a thin tungsten lining on the inside surface of a tantalum alloy cylinder.

### The solution:

Utilize the creep characteristics of molybdenum at high temperature and stress to compress the tungsten liner against the inner surface of the tantalum alloy cylinder and form a bond at the interface.

### How it's done:

Several layers of one-mil-thick tungsten foil are wrapped around the outside of a tubular molybdenum mandrel and inserted into a tantalum alloy cylinder of slightly larger diameter. The assembly is placed in a furnace and the molybdenum tube connected to a high pressure gas source outside the furnace. The furnace is heated to a high temperature (typically 3000°F) and the molybdenum tube is internally pressurized according to a predetermined schedule. Under the high temperature and stress, the weaker molybdenum creeps diametrically until its outside surface contacts and compresses the tungsten against the stronger tantalum alloy outer cylinder. This process firmly bonds the tungsten layers to each other and to the tantalum alloy cylinder. The molybdenum mandrel is then dissolved in an acid solution that does not react with the tungsten and tantalum alloy, leaving the tungsten-lined tantalum alloy cylinder. Alternatively, the mandrel can be removed by machining.

(continued overleaf)

This new compression bonding method is superior to previous bonding methods for the following reasons: (1) The temperature and pressure can be accurately controlled to ensure uniform bonding conditions, regardless of size; (2) the size of the work piece is limited only by the furnace size; (3) the equipment is readily available and relatively inexpensive; (4) the dimensional tolerances between the two concentric cylinders are not critical; and (5) the bonding process can be performed at any temperature high enough to cause creep of the mandrel material.

## Note:

No additional documentation is available. Specific questions, however, may be directed to:

Technology Utilization Officer
Lewis Research Center
21000 Brookpark Road
Cleveland, Ohio 44135
Reference: B70-10723

## Patent status:

Inquiries about obtaining rights for the commercial use of this invention may be made to:

Patent Counsel
Mail Code 500-311
Lewis Research Center
21000 Brookpark Road
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(LEW-11174)