# NASA TECH BRIEF

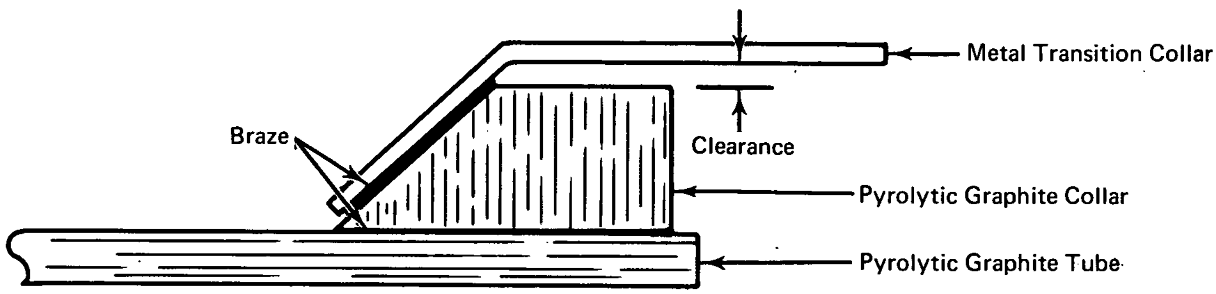
*NASA Pasadena Office*



## Improved Brazing Technique for Pyrolytic Graphite

### The problem:

Devise a means of joining pyrolytic graphite to itself and other metals. Pyrolytic graphite (formed by the deposition of carbon atoms from a vapor onto a substrate) has extremely attractive properties for use as a refractory material; i.e., melting point over 3589 K (6000° F), acceptable strength at elevated temperatures, and very high thermal conductivity to equalize local variations of wall temperature. Its anisotropic properties, however, make it one of the most difficult materials to work. In addition, it has a low coefficient of thermal expansion in the plane of deposition (A-B crystallographic axis) and poor strength to that plane (C direction).




### The solution:

Braze pyrolytic graphite pieces together, or to refractory metals, using a braze metal and a joint design that together compensate for the difficult properties of the materials and are usable at elevated temperatures.

### How it's done:

Brazing avoids the graphitic structure loss that occurs if fusion is attempted. Adequate wetting of the graphite surface, a suitable expansivity, and a melting point high enough to take advantage of the refractory property of the pyrolytic graphite are the principal requirements of the brazed metal.

Silicon is used to provide some degree of expansion match, but it does not wet graphite. A 2% addition of a strong carbide former (titanium) gives adequate wetting without excessive carbide formation. The brazing conditions are:

Braze alloy: Si-2Ti in 50 to 150 mesh powder
Braze cycle: 1866 K (2900° F) for one minute
Atmosphere: Argon

A compression joint (see fig.) is used because it is intrinsically fail-safe. The metallic member is made of tantalum-10% tungsten alloy because of its high-temperature strength and low 0.85% expansion up to 1644 K (2500° F).

The direct attachment of a metallic member to either the A-B or C surface usually results in failure because of excessive mismatch. However, the median expansion more closely paralleling that of the metal can be achieved by scarfing the pyrolytic graphite in the C direction. By selecting the appropriate scarf angle, expansivities for the components are ideally matched. In addition, a definite advantage is gained by placing the joint in compression because the strength of the graphite in that condition is five times greater than its tensile strength.

(continued overleaf)

**Note:**

Requests for further information may be directed to:

Technology Utilization Officer
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4800 Oak Grove Drive
Pasadena, California 91103
Reference: TSP71-10293

**Patent status:**

No patent action is conteplated by NASA.

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