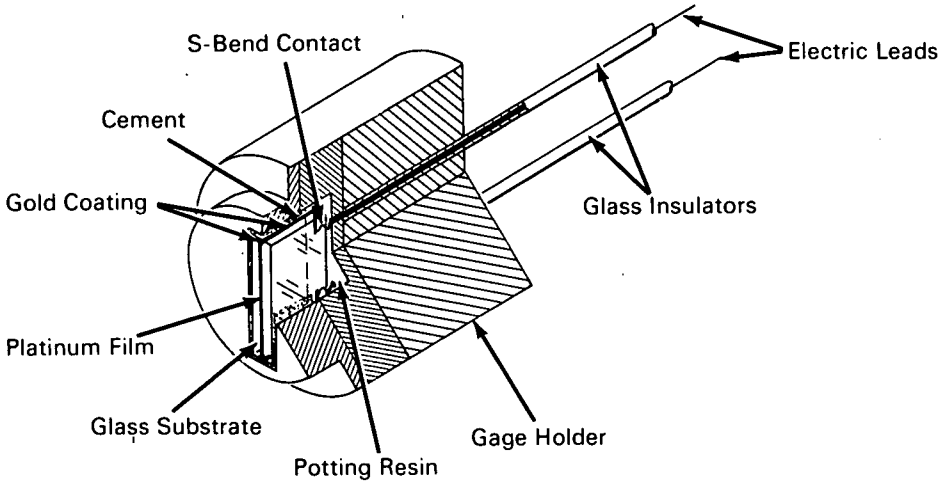
March 1968 Brief 68-10051

NASA TECH BRIEF

Thin Film Heat Transfer Gage Is Stable at Higher Temperatures



A new thin film convective heat transfer gage that has been designed will function effectively for prolonged periods at temperatures up to 1000° F. Previous designs which employ metal-to-glass seals for the electrical leads from the thin film sensing element (as in the rod and tube design summarized in Tech Brief 66-10180) are subject to failure at the higher temperatures. The failures are primarily due to rupture of the thin film under the stresses produced by the large difference in thermal expansion between the glass and metal leads in the earlier designs.

The new gage eliminates the problems due to differences in coefficient of thermal expansion between glass and metal by replacing the earlier metal-to-glass seals with spring-like (S-shaped) pressure contacts between a gold thin film deposit and electrical leads to the monitoring circuit. The gold thin film is formed by painting a commercial gold suspension (liquid gold) from both ends of the normal platinum thin film sensing element, around the sides of the glass substrate, and onto its back side to form a gold pad. Each of two S-shaped (0.010×0.002 inch) pieces of gold-plated Inconel-X wire is forced at one end into contact with the gold pad and at the other end is spot welded to an electrical lead. The two leads are made of a copper alloy whose thermal expansion coefficient matches that of the glass tubing used as electrical insulation for the leads. Potting material, which is placed around the S-shaped wires in the gage holder, is cured while the compressed spring condition of the S-bend is maintained in a small vise. An appropriate cement is used to secure the heat sensing assembly to a gage holder.

Notes:

1. The platinum film must be coated with silicon monoxide to prevent contamination by foreign materials under vacuum and high temperature.
2. An initial resistance shift does not inhibit the performance or accuracy of the gages, as the original resistance–temperature relationship remains unchanged.

(continued overleaf)

3. The small effective surface area of the gage, 0.025 square inch, minimizes radiation losses.
4. The gage was designed for use in conjunction with a base which could be regulated to operate at any preselected temperature between 75° and 1000°F.
5. Inquiries concerning this convective thin film heat transfer gage may be directed to:

   Technology Utilization Officer
   Marshall Space Flight Center
   Huntsville, Alabama 35812
   Reference: B68-10051

Patent status:

No patent action is contemplated by NASA.

Source: R. F. Pickard and J. R. Loyd
of Astro-Space Laboratories, Inc.
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