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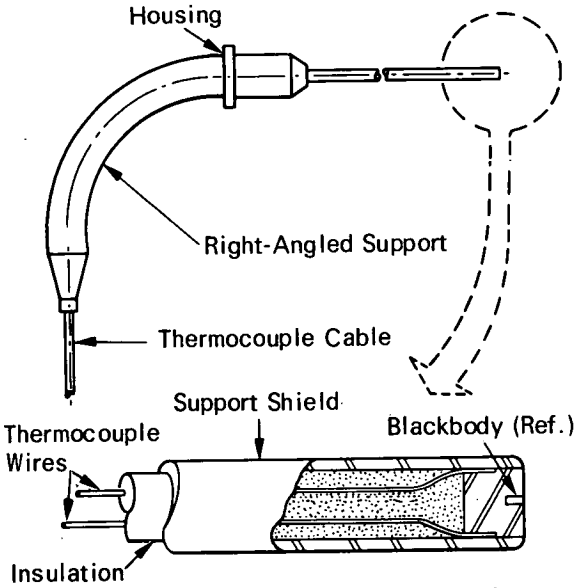
AEC-NASA TECH BRIEF

High-Temperature Rapid-Response Thermocouple for Reducing Atmospheres

A new thermocouple has been developed that can measure continuously in flowing gaseous hydrogen at up to 4500°F, in environments made hazardous by radiation, where rapid response and calibration reproducibility are critically important.



High-Temperature Thermocouple

The probe, made of tungsten−5% rhenium and tungsten−26% rhenium wire, is insulated by beads of beryllium oxide inside a tungsten−26% rhenium tube. The sensor junction is formed near the probe's tip, diametrically opposed by a tungsten−26% rhenium plug that forces each wire against the side of the tube and shorts them electrically through the plug.

The outer end of the plug is fused to form a gas-tight metallurgical seal as well as a mechanical force-fit of the junction. A small hole, drilled part way into the plug, serves as a blackbody reference for furnace calibration with an optical pyrometer. The wires are housed in a right-angled support, made of type-347 stainless steel, to prevent breakage of leads.

Location of the two thermocouple lead wires on opposite sides of the plug, 180° apart, eliminates accidental shorts in the probe's stem, and effects a position of the sensory junction at the wall and plug that minimizes the distance of the heat's flow before it reaches the junction. As a result the design reaches 63% of a step change in temperature within 0.25 sec; this rapidity is essential for dynamic stability in an automatic control loop system requiring 1-sec overall response.

The thermocouple wires extend continuously, without splice or foreign material, from the cold junction to the probe's tip so that errors from secondary effects are eliminated. An operational range of from 500° to 4500°F has been achieved, with accuracy within 1% at the high end and less than 1% at the low end.

The probe can measure high-temperature gases in nonoxidizing atmospheres; after some development it could be modified for use in oxidizing atmospheres.

Note:

Requests for further information may be directed to:

Technology Utilization Officer
AEC-NASA Space Nuclear Propulsion Office
U.S. Atomic Energy Commission
Washington, D.C. 20545
Reference: B70-10564

Patent status:

No patent action is contemplated by AEC or NASA.

Source: C. M. Gracey and R. G. Hoff of
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under contract to
Space Nuclear Propulsion Office
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Category 03