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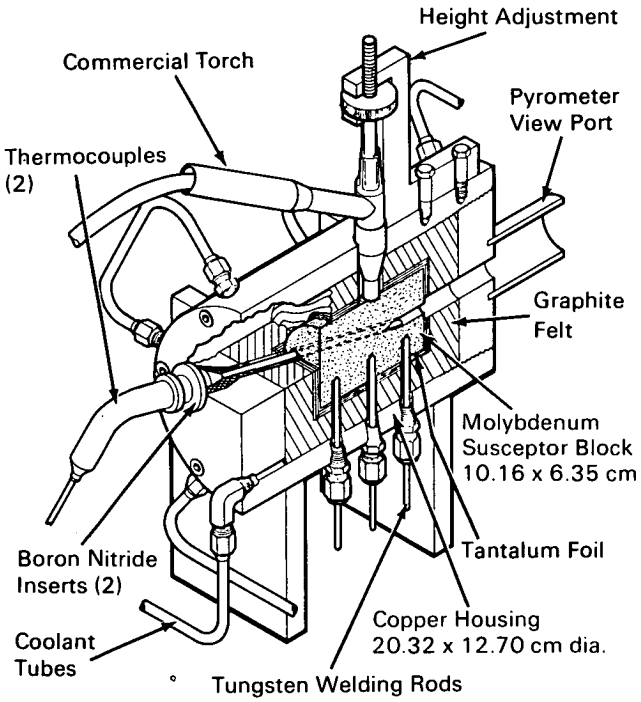
AEC-NASA TECH BRIEF

Space Nuclear Systems Office

Inexpensive High-Temperature Furnace for Thermocouple Calibration

A commercial inert-gas arc torch used in a furnace configuration provides an inexpensive solution to high-temperature thermocouple calibration problems. Thermocouples used in nuclear rocket development are



Calibration Furnace

subjected to temperatures approaching 2755°K (4500°F) and must be calibrated periodically at high temperatures, under inert atmospheres to prevent contamination and corrosion. Because the thermocouples may also be radioactive, the heat source must not only be simple but must be accessible by remote manipulators and inspection instruments. Commercial furnaces previously used were expensive and only partially capable of satisfying the calibration requirements.

The new furnace calibrates the unknown thermocouple by comparing its electrical output to that of a reference thermocouple (previously calibrated by optical pyrometry), as both are heated simultaneously. The thermocouples are mounted in a molybdenum "susceptor" block (see fig.) which evenly distributes the heat delivered by the 4145°K (7000°F) arc of a helium-shielded arc torch mounted on a bracket above the furnace. A screw adjustment on the bracket allows the torch to be raised or lowered as desired. The susceptor temperature is monitored through a viewing port, using an optical pyrometer.

Molybdenum is used for the susceptor because of its machinability and its ability to withstand the 2755°K temperatures indefinitely, with cooling. The block is physically supported and electrically grounded by three tungsten welding rods, which are in turn connected to the water-cooled copper jacket housing the furnace. Three layers of tantalum foil and three layers of graphitic felt provide intermediate thermal insulation. The foil blocks radiated heat and prevents the formation of a molybdenum-graphite eutectic which would ruin the insulation effects.

The two boron nitride inserts into which the thermocouples are placed provide electrical insulation between the probes and the outer jacket so that most of the current from the arc returns to ground through the welding-rod supports rather than through the thermocouple sheaths. The inserts are closely fitted to minimize gas leakage around the thermocouples and to ensure that gas from the torch escapes through the viewing port.

(continued overleaf)

Operationally, the furnace has several advantages: the thermocouples are easily inserted; the arc is controlled by a single rotary adjustment; the view of the optical pyrometer is unobstructed; and the outside of the furnace remains cool during operation, making manual control possible. Use of tungsten for the susceptor block would yield 3310°K (5500°F). With modifications, the furnace could be used to test materials for melting or heat treating effects.

Note:

Requests for further information may be directed to:

Technology Utilization Officer
AEC-NASA Space Nuclear Systems Office
U.S. Atomic Energy Commission
Washington, D. C. 20545
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Patent status:

No patent action is contemplated by AEC or NASA.

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