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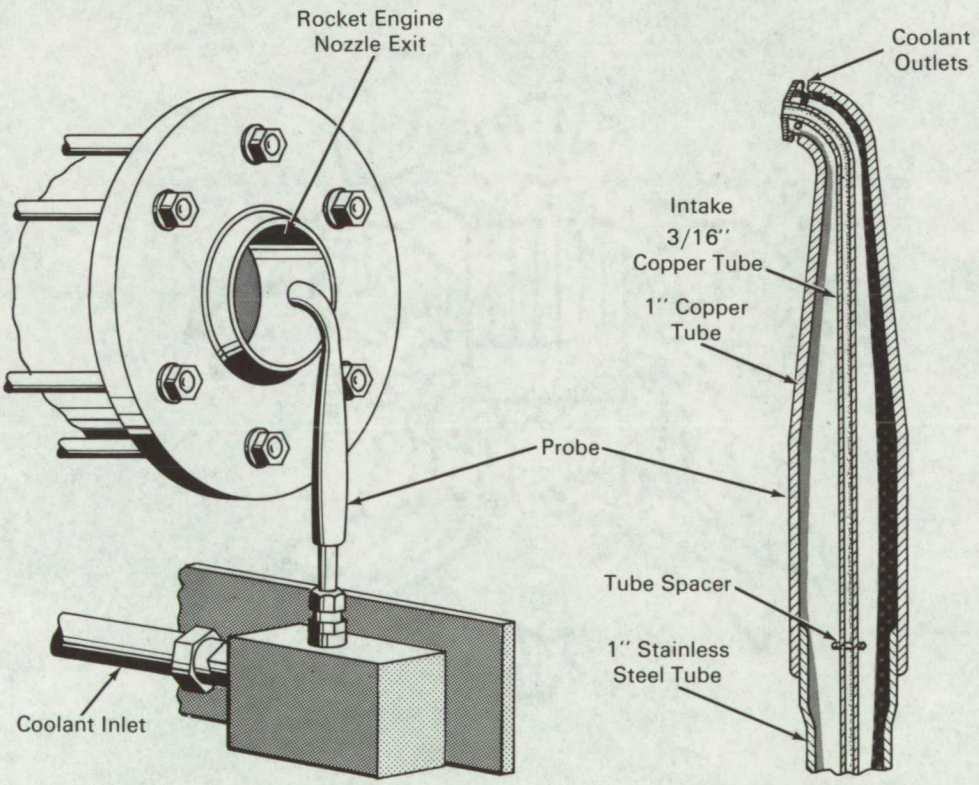
NASA TECH BRIEF

Probe Samples Components of Rocket Engine Exhaust



The problem: Sampling the exhaust plume of rocket engines to recover particles for size and crystallographic examination and to establish the particle-to-gas mass ratio. This exhaust imposes severe physical and mechanical forces on any device placed in its path.

Configuration of the probe must be such that the shock wave is attached to the probe inlet. This is necessary to prevent the separation of particles and gas that causes a higher than normal proportion of particles to enter the probe due to their inertia. A certain fraction of the lighter gas flow would thus be diverted.

The solution: A water-cooled, cantilevered probe that delivers the exhaust sample to a container that entraps particles on electron microscope viewing

(continued overleaf)

grids. The probe is designed and fabricated to withstand the stresses of a rocket exhaust plume environment for a sufficient period to obtain a useful sample of the exhaust components.

How it's done: A 3/16-inch copper tube to carry the exhaust gases is mounted axially inside a 1-inch copper tube that carries cooling water. A copper probe tip supports the 3/16-inch tube. The bend in the probe adjacent to the tip is well rounded to offer the least possible restriction to the free flow of the sample. The outer tube has holes drilled around its periphery at the probe tip to exhaust the cooling water directly into the exhaust plume just behind the probe inlet. The 1-inch copper tube is relatively short and is swaged into a 1-inch stainless-steel pipe to accommodate the bending stresses involved since they are much greater than the shear stresses experienced at the inlet.

Notes:

1. This type probe would be useful wherever there is a requirement to analyze the components of high-temperature gases moving at high velocity.
2. Inquiries concerning this innovation may be directed to:

   Technology Utilization Officer
   Marshall Space Flight Center
   Huntsville, Alabama, 35812
   Reference: B65-10384

Patent status: NASA encourages commercial use of this innovation. No patent action is contemplated by NASA.

Source: Paul E. Schumacher of North American Aviation, Inc., under contract to Marshall Space Flight Center (M-FS-485)