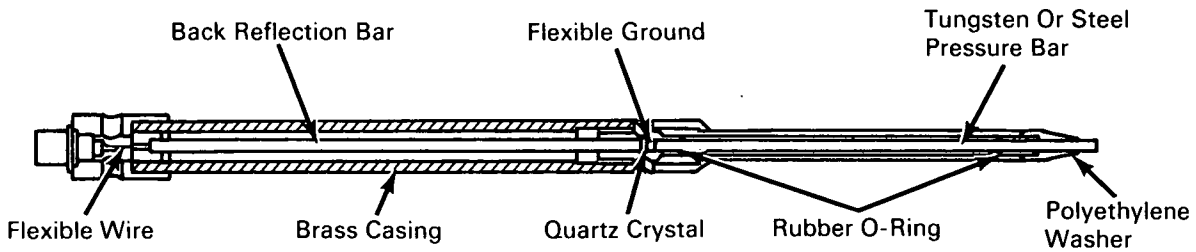
NASA TECH BRIEF

A Piezo-Bar Pressure Probe



The problem:

To measure the impact velocity or pressure of a moving cloud consisting of a heterogeneous mixture of solid particles and gas molecules. When a high-speed pellet, propelled by a hot gas stream, strikes a thin sheet target, an impact cloud is generated. This gas/debris cloud results from the fragmentation of the solid components which in turn mix with the propelling gas stream. Such an expanding high velocity (of the order of 15 kilometers per second) cloud, consisting of very small particles associated with high-temperature gas is highly erosive; consequently, commercial piezoelectric transducers could not be expected to survive in such an environment.

The solution:

A piezo-bar pressure-type probe for measuring pressures up to 200,000 psi within the impact-generated debris cloud. Its construction is similar to that of other piezoelectric pressure-bar instruments. Peak pressures may be recorded with a total pulse duration between 5 and 65 μsec.

How it's done:

The pressure sensing elements of the probe, the pressure bar, the quartz crystal, and the back reflection bar are supported within a two-piece brass outer casing by polyethylene washers and rubber O-rings. The washers and O-rings provide radial support for the sensing elements plus electrical and acoustical isolation from the outer casing.

A pressure pulse incident on the measuring end of the bar causes a local strain (stress) that travels down the bar in the form of a wave at a velocity equal to the acoustic response of the bar. When this wave passes through the piezoelectric crystal element, it strains the element causing a signal to be generated in the form of an electrical charge. The magnitude of this charge is proportional to the magnitude of the pressure force exerted on the pressure bar and transmitted by it to the crystal element. The rear face of the back reflection bar is restrained axially by a light spring that permits essentially free axial motion of the sensing system. All of the momentum transferred to the pressure bar by the gas cloud is thereby retained in the bar/crystal system for a period greater than the useful linear response period of the probe.

Note:

Inquiries concerning this innovation may be directed to:

Technology Utilization Officer
Lewis Research Center
21000 Brookpark Road
Cleveland, Ohio 44135
Reference: B67-10259

(continued overleaf)

Patent status:

No patent action is contemplated by NASA.

Source: W. H. Friend, C. L. Murphy, and I. Shanfield of McGill University under contract to Lewis Research Center (Lewis-393)