But only the absolute frequency of thr tracks. Therefore the absorption curves of Fig. 1 were calculated assuming a threshold of REL = 10^3 Mev g^{-1} cm^2 and omitting tracks of particles incident under angles flatter than 15° to the plastic foils. The absolute intensities were normalized so that the differences to the measured values are a minimum.

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A Miniature Solid State Pressure Transducer for R/V Flight Test Applications

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Introduction

THE purpose of this Note is to present the results of a flight experiment which has demonstrated the feasibility of a miniaturized solid-state pressure sensor to measure steady-state pressures in an R/V flight test application. These recently developed solid-state transducers operate on the strain gage principle and are an order of magnitude smaller than potentiometer type transducers utilized in past and current R/V flight vehicles. Since R/V's invariably are weight and volume limited, use of the miniaturized sensor allows more flight pressure measurements to be made. In addition, pressure data can now be obtained in the nose region of R/V's (an area hitherto inaccessible for pressure measurements because of volume constraints or time lag effects) if long pressure tubing were utilized in conjunction with conventional "pot" sensors.

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An extensive development program has been in existence at GE/RESD since late 1971 to gain experience with miniaturized solid-state pressure sensors for flight test applications, and has been structured to take maximum advantage of existing wind tunnel programs on which "piggyback" measurements of both steady-state and fluctuating pressures were made. In addition, other tests were conducted consisting of: static calibration, accuracy/resolution and linearity, time response, temperature effects, and long-term stability (results of the development program are presented in Refs. 1 and 2). The present flight results represent the culmination/end product of the development program.

Sensor Description

The miniaturized solid state pressure sensor under consideration is manufactured by the Kulite Corporation[3] and is compared to a typical conventional potentiometer type pressure sensor in Fig. 1. The solid state pressure sensor uses a (semiconductor) strain gage having a four-active element bridge circuit as an integral part of the diffused silicon diaphragm. The transducer has a reference pressure tube to permit operation as a differential or an absolute pressure sensor. The sensors utilized in the present program were all absolute units and employed a sealed reference pressure.

In addition to the obvious size advantage, the solid state sensor has a high enough frequency response to measure fluctuating as well as steady-state pressures. This represents an advantage over conventional "pot"-type sensors since the solid state sensor can be used to determine both frustum or nose tip loading and frustum or nose tip transition. Figure 2 shows the sensor packaged in the screw thread configuration with protector screen utilized for the flight experiment.

Flight Results

Although the prime forcing function for the new minaturized solid state sensor is pressure measurements on or near the nose tip of re-entry vehicles, the purpose of the present experiment was to demonstrate flight feasibility only and frustum pressure measurements were "piggybacked" on two R/V flights. Data will be presented herein on only one flight to illustrate the results. Complete flight results can be obtained in Ref. 1.

The re-entry vehicle for the second flight experiment was a slightly blunt slender cone and utilized an ablative heat shield

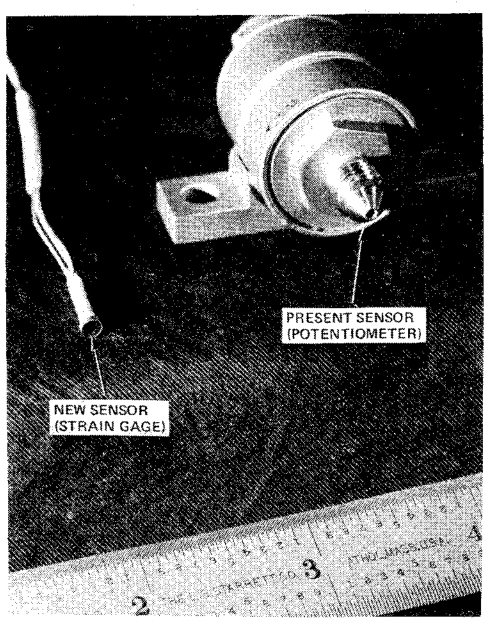

Fig. 1 Pressure sensor size comparison.

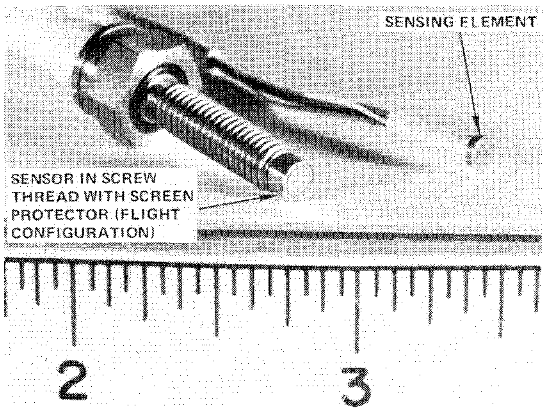

Fig. 2 Solid state pressure sensor for flight experiment.

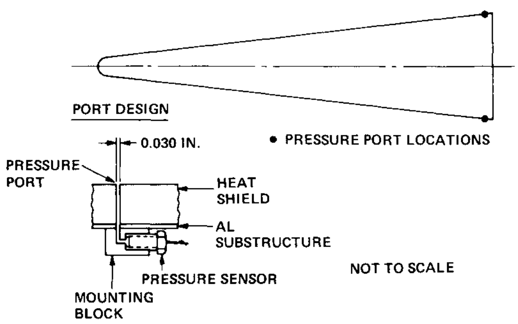

Fig. 3 Flight 2 re-entry vehicle configuration.

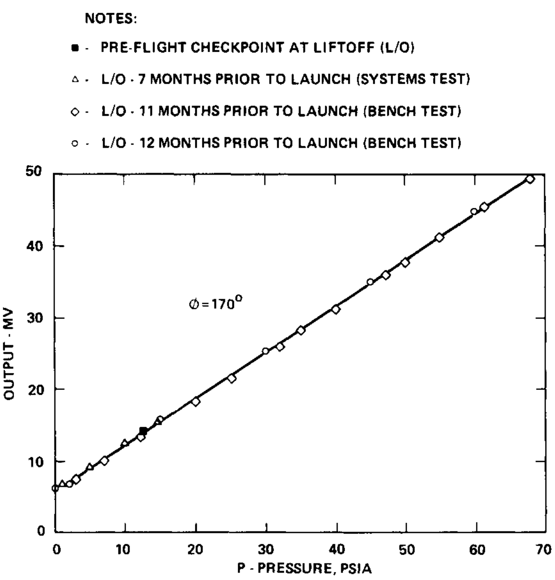

Fig. 4 Pressure sensor calibration curve.

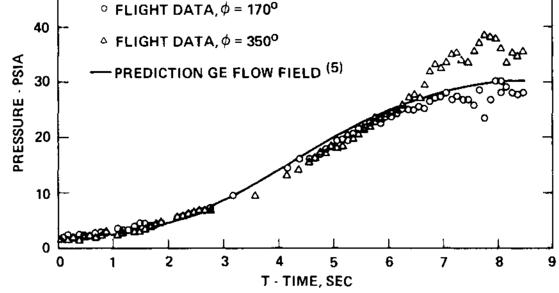

Fig. 5 Forebody flight test pressure data in laminar and turbulent flow: flight 2.

(Fig. 3). The two diametrically opposed pressure ports were located 98% of the vehicle length and utilized a 0.030-in. diam hole with a right-angle configuration. The small port diameter was chosen to minimize pressure port erosion effects in turbulent flow.[4]

The pressure sensors were calibrated several times prior to lift-off ranging from 7 to 12 months and a preflight check point a few minutes prior lift-off was obtained. A typical calibration curve for one sensor is presented in Fig. 4. Agreement among data points is generally good. The preflight lift-off checkpoint shows that the sensor was stable since the calibration curve had not shifted prior to the flight.

The reduced flight data for the diametrically opposed ports are shown in Fig. 5. The flight data are in good agreement with the GE flowfield predictions[5] for both laminar and turbulent flow. For times greater than 7 sec the pressure data show a pressure differential of $\approx$ 10 psia which is due to R/V angle of attack.

Conclusions

The flight test experiment has met its objective and has demonstrated that the miniaturized solid state pressure sensor can measure steady-state pressures in an R/V flight test application. Forebody pressure data were obtained in laminar and turbulent flow on a slightly blunted slender cone using the solid-state pressure sensor. The flight data were found to be in basic agreement with flowfield predictions.

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Energetic Solar Proton vs Terrestrially Trapped Proton Fluxes

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Introduction

THIS Note is intended to demonstrate the relative importance of solar and trapped proton fluxes in the consideration of shielding requirements for 1977-1983 geocentric space missions. Using the latest solar proton[1] and trapped proton[2,3] models, fluences of these particles encountered by spacecraft in circular orbits have been computed as functions of orbital altitude and inclination, mission duration, threshold energy (between 10 and 100 MeV), and, for solar

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