# NASA TECH BRIEF

*NASA Pasadena Office*



## Gas Leak-Detection System

### The problem:

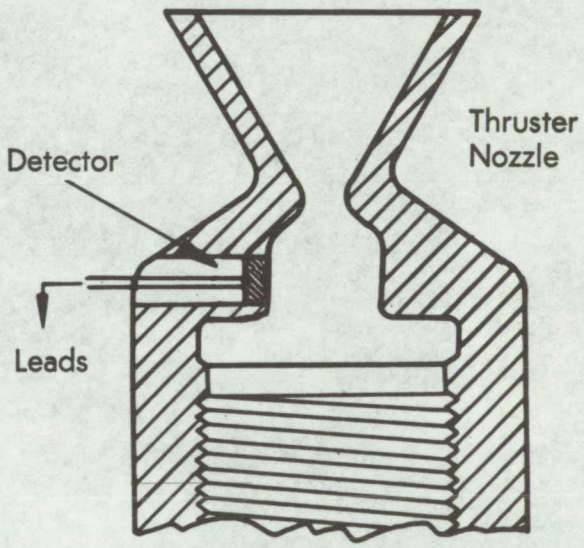
The attitude-control system for a satellite or a spacecraft uses compressed gas as a working fluid; solenoid-actuated valves allow the gas to flow through nozzles to provide the small thrust forces needed to change or maintain the position of the spacecraft. Since a perfectly-sealing jet valve is technically improbable, a certain amount of leakage is expected, and it would be desirable for the mission controller on earth to be provided with data on leakage rate.

### The solution:

Add a gaseous radioisotope to the cold compressed gas and mount a detector in the thrust nozzle.

### How it's done:

The radiation detector is located between the jet valve seat and the nozzle aperture, as indicated in the diagram. A radiotracer such as krypton (Kr-85) or carbon (C-14) is added in small quantity to the compressed gas. The sensitive element of the leakage detection system is an avalanche detector which consists of an avalanche diode coupled with a tunnel diode amplifier. The avalanche diode is a silicon device with a gallium-diffused structure. When radiation is absorbed in conventional silicon diodes, hole-electron pairs are created which reach the PN junction and are swept across to provide a current. In contrast, the avalanche diode has a high internal field and when radiation produces a hole-electron pair, silicon atoms are ionized; if the internal field is high, a cascade of electrons is produced. Charge multiplications of the order of 100 to 1000 are realizable when bias voltages are in the range of 1500 to 1800 volts; if the signal is generated near the front surface, it is multiplied to a greater extent than noise components resulting from the reverse-bias leakage current.




It has been shown that a small avalanche detector can sense radioactive gas leaking through a gas jet nozzle, but only marginally. On the other hand, if the detector area can be increased, the lower limit for sensing leak rates is lowered proportionally and quantitative measurements of leak rate can be made.

### Reference:

Locker, R. J.; and Huth, G. C.: A New Ionization Radiation Detection Concept Which Employs Semiconductor Avalanche Amplification and the Tunnel Diode Element. Applied Physics, Vol. 9, No. 6, page 227, 1966.

(continued overleaf)

## Note:

Requests for further information may be directed to:

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Pasadena, California 91103
Reference: TSP72-10087

## Patent status:

No patent action is contemplated by NASA.

Source: Francesco G. Roselli-Lorenzini of
Caltech/JPL
under contract to
NASA Pasadena Office
(NPO-11405)