

# NASA TECH BRIEF

## Marshall Space Flight Center



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### Two-Axis Leveling Detector System

#### The problem:

In situations in which optical contact with a system is not feasible, a nonoptical method is needed to monitor alignment or co-alignment of the system.

#### The solution:

A gravity reference system, designed as an environmentally controlled and hermetically sealed electro-mechanical device without optics, can monitor alignment or co-alignment to an accuracy of  $\pm 1$  sec.

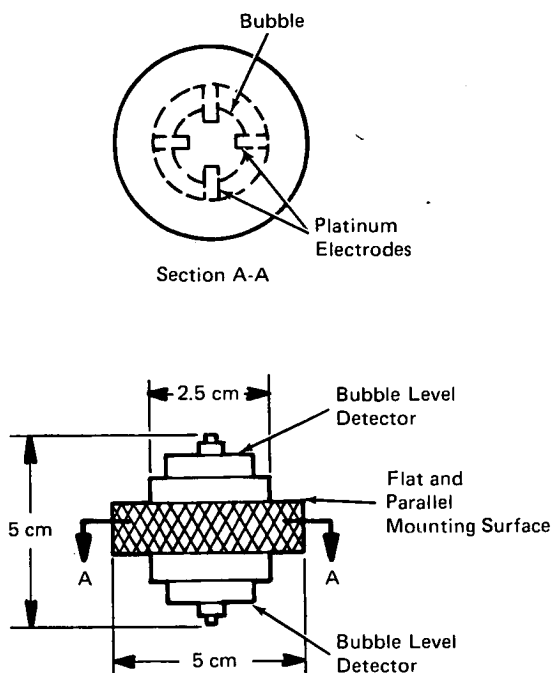
#### How it's done:

The two-axis leveling detector system is an electro-mechanical device that measures tilt angles without the

aid of optics. Angular displacement is detected by the movement of a bubble in a conducting fluid that contains an electrode network. As shown in Figure 1, two level detectors are mounted back-to-back on the parallel sides of a flat reference surface. The axes of the bubble level detectors are physically defined and the bubble level detectors are mounted so that the axial planes of each level are coincident to each other.

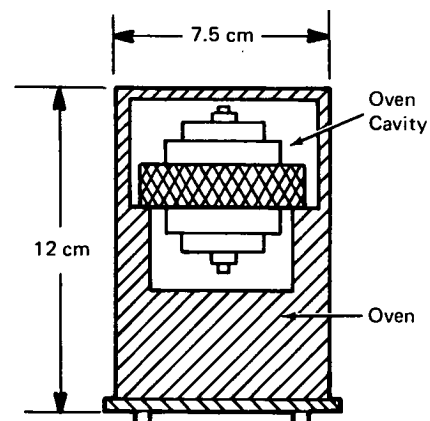
The level assembly is mounted in the internal cavity of a high stability oven, as in Figure 2. The internal oven cavity is keyed or referenced to an external oven case marking so as to define the level's axes. The oven assembly is well insulated and then mounted inside a hermetically sealed chamber, shown in Figure 3. The hermetic chamber is internally keyed and externally referenced to the axes of the level through the oven reference marking.

The level detector senses extremely small rotations of its case with respect to the local gravity vector and produces an electrical signal that is a measure of the amount and direction of rotation. The electrical output



NOTE: ALL DIMENSIONS ARE APPROXIMATE

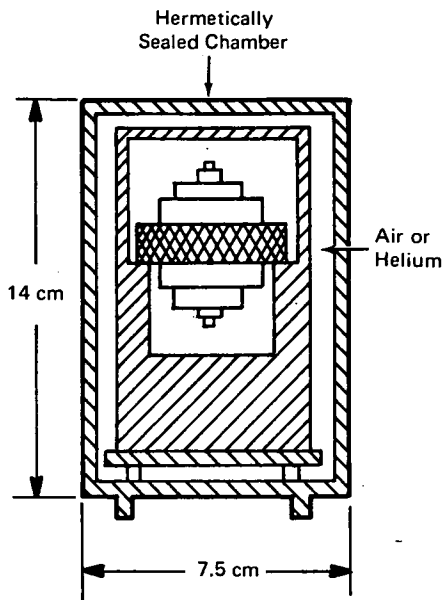
Figure 1. Bubble Levels Mounted Back to Back



NOTE: ALL DIMENSIONS ARE APPROXIMATE

Figure 2. Bubble Levels Mounted in Oven Cavity

(continued overleaf)



NOTE: ALL DIMENSIONS ARE APPROXIMATE

Figure 3. Oven Assembly Mounted in Hermetically Sealed Chamber

is presented in terms of rotation about two orthogonal level axes. The system is sensitive enough to accurately measure slight changes in the horizontal or vertical planes or small changes in movement, and may be utilized in various machine tool, construction, quality control, freight loading, and surveying applications.

#### Notes:

1. Information concerning this innovation may be of interest to the designers, manufacturers, and users of angle measuring instruments.
2. Requests for further information may be directed to:  
Technology Utilization Officer  
Marshall Space Flight Center  
Code A&TS-TU  
Huntsville, Alabama 35812  
Reference: B72-10392

#### Patent status:

Inquiries about obtaining rights for the commercial use of this invention may be made to:  
Patent Counsel  
Marshall Space Flight Center  
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Source: L. Weiner of  
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