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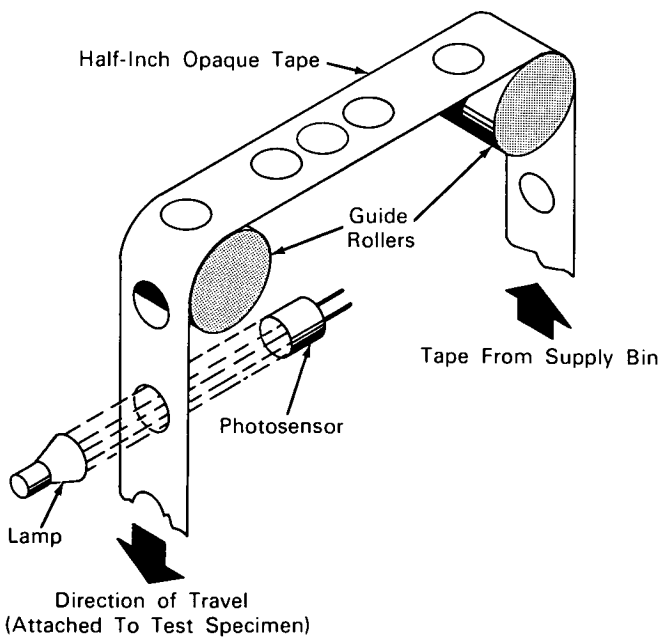
NASA TECH BRIEF

This NASA Tech Brief is issued by the Technology Utilization Division to acquaint industry with the technical content of an innovation derived from the NASA space program.

Low-Cost Tape System Measures Velocity or Acceleration



The problem: Measurement of velocity and acceleration of a moving body where conventional instruments are difficult to use and cost considerations rule out complex systems. Accurate tests were needed, in particular, to measure the erection (inflation) rate of a balloon satellite so that criteria could be established to protect the skin from excessive strains. Problems included various unknowns plus the unsuitability of optical methods arising from the balloon's random shape in the inflation mode. Accurate data at velocities up to 80 feet per second were needed.

The solution: A new device using perforated opaque tape attached to the moving body. Data is obtained through a photoelectric sensor readout device. Both velocity and acceleration of the moving body can be obtained by graphic differentiation.

How it's done: Conventional 1/2-inch magnetic recording tape is perforated along its longitudinal axis with two series of 1/4-inch-diameter timing holes. The first series consists of holes spaced on one-inch centers. This series is interrupted every 12 inches by the second series consisting of three-hole groups on 1/2-inch centers. The tape, in loose random coils, is held in a bin adjacent to the sensing device. For the particular series of tests on which the system was used, the movement of the edge of a typical gore during the opening of the balloon was simulated by draping the gore loosely between two walls of a vacuum test

(continued overleaf)

chamber, and dropping one end of the gore. The motion of the falling end simulated the opening motion satisfactorily, and, by affixing the free end of the tape to the falling end, its acceleration and velocity were measured. The measurement was made by allowing the tape to be freely paid out and passing it between a light source and a photoelectric sensor. The output from the photosensor was fed to a suitable readout device and displayed in the form of a conventional inked plot on a travelling paper graph.

Opening velocities (as high as 80 feet per second) of a satellite balloon in a vacuum environment have been recorded with consistently high accuracy. Relative velocity and acceleration have been determined for each drop. In one of the tests, the instrument revealed the unexpected occurrence of several velocity fluctuations at the end of the drop, or opening mode of the satellite balloon. During a typical test, about 35 feet of tape was used.

Primary benefits of this instrumentation were found to be low cost, high accuracy, ease of use, and very low inertia of the tape attached to the falling body.

Notes:

1. This innovation seems to be useful primarily as a research tool, in such applications as munitions work, underwater studies of model sinking rates, etc.
2. As an alternative to perforated tape, magnetically coded wire used with a sensing head would be a useful variation of the method; this would also permit information to be transmitted along the same wire.
3. For further information about this innovation inquiries may be directed to:
   Technology Utilization Officer
   Goddard Space Flight Center
   Greenbelt, Maryland 20771
   Reference: B63-10512

Patent status: NASA encourages the immediate commercial use of this invention. It is owned by NASA and inquiries about obtaining royalty-free rights for its commercial use may be made to NASA Headquarters, Washington, D.C. 20546.

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