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Small Turbine-Type Flowmeters for Liquid Hydrogen

Statistical data have been obtained on the reproducibility and linearity of turbine-type flowmeters in 2.5 and 4 cm sizes and with various types of bearings. The results indicate design principles, installation practices, and inspection procedures that are conducive to reliability. Comparisons are made between calibrations obtained with liquid hydrogen, with water, and with high-pressure nitrogen gas. Actual calibration in liquid hydrogen is required to identify meters of good quality (calibration reproducibility with less than 0.3 percent probable error) and to establish the mean calibration curve with minimum error.

The results showed that designs operating at fluid velocities up to 30 m/sec can yield a calibration factor that is constant to 0.5 percent over a 10:1 flow range. The experiments also indicated that it is now possible to obtain meters whose calibration factor is reproducible to a probable error on the order of 0.1 percent at full scale. The worst value of probable error was only 0.2 percent. Curves were obtained from which probable error can be determined at velocities lower than that at full scale. Water calibrations are unlikely to yield values of calibration factor with values of probable error as small as those derivable from a liquid-hydrogen calibration. Small blade-tip clearance, which is feasible in a clean fluid like hydrogen, appears to improve meter performance.

Observations on reliability suggest that a meter that has passed preliminary inspection should be run in for a few hours at a variety of positive and negative velocities, and then calibrated at least four times preferably over an interval of several days. If all calibrations consistently

show a probable error of a single observation of less than 0.3 percent of the calibration factor, the meter is usable. Good meters showed a probable error on the same order as that of the calibration facility. The cleanliness, fit, and alignment of bearings is considered most important. This fact should dominate the packaging, storage, repair, and handling of any meter.

Notes:

1. The following documentation may be obtained from:
National Technical Information Service
Springfield, Virginia 22151
Single document price \$3.00
(or microfiche \$0.95)

Reference: NASA TM-X-52984 (N71-19703),
Small Turbine-Type Flowmeters for Liquid
Hydrogen

2. Technical questions may be directed to:
Technology Utilization Officer
Lewis Research Center
21000 Brookpark Road
Cleveland, Ohio 44135
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Patent status:

No patent action is contemplated by NASA.

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