

## Acknowledgment

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## References

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## DISCUSSION

### R. B. Furst<sup>2</sup>

The authors are to be complimented for their carefully conducted test effort and the presented evaluation of the test results. The information is valuable in the analysis of cavitating flows as well as flow of liquids with entrained gases.

Selection of approximately the mean radius for the

presented experimental results would be expected to provide the closest agreement with potential flow analytical procedures such as presented in references [3 and 4] of the paper. Comments on any of the authors experiences with the flow in regions of the impeller near the hub and the tip would be appreciated. Particularly of interest is the influence of deviation from potential flow in the region of the hub and tip in addition to the influence of the tip clearance flows mentioned by the authors.

The uncertainty of relative flow measurement of  $\pm 5.5$  degrees appears substantially greater than desirable. Measurements with a laser velocimeter could substantially reduce the uncertainty.

### Author's Closure

This paper is an experimental confirmation of the calculated results of bubble motion in an impeller of an axial flow pump by the numerical method published in our previous paper. Mr. Furst refers to the effects of the secondary flows prevailing in the regions near the hub and the tip. The flows in these regions will be affected considerably by the secondary flow which does not obey the potential flow rule.

In the experiment, however, measurement of the secondary flow was not performed, but it may be assumed that its effects on the air bubble motion in the impeller channel are considered to be small, because the secondary flow velocity is generally much smaller than the through flow velocity within the region in which the bubbles move. In order to clarify the detailed effects of the secondary flow on the bubble motion a more precise method of flow measurement, for example, that by use of a laser velocity meter will be needed and also a three dimensional flow analysis may be required.

Further researches on these subjects will be indispensable.

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