# NASA TECH BRIEF

*Ames Research Center*



## Study of Fluid Flow by Charged Particles

An analytical and experimental effort has been undertaken to explore the possibility of using charged particles as a diagnostic tool in the study of fluid flows. Because the results of prior studies had indicated that secondary vortices can be predicted by ion measurements, there was ample reason to believe that the technique could be extended to include large-scale external flows around typical aerodynamic shapes. The test program involved a right circular cylinder and an airfoil located in a large wind tunnel; ions were injected into the flow and the resulting currents at the surfaces were monitored. The main effort of the program involved measurements of upstream motion and the nonsteady effects resulting from a nonsteady lateral force that was in phase with the Strouhal shedding frequency.

In the experimental work, ions were generated by corona discharge from a point or line source, or charges were obtained from the dust or water particles normally in ambient air. The charges were collected and measured as currents at selected positions downstream on the particular aerodynamic shape under study. Experimental data indicate periodic oscillations in the ion currents, as measured at the forward side of the cylinder in crossflow, corresponding to the Strouhal shedding frequency which is characteristic of the cylinder and the Reynolds number. In the aft portion of the cylinder, the oscillations were found to be nonperiodic, which would be characteristic of a large-scale, turbulent, separated flow.

Qualitative analysis of the data verifies the dependence of the ion currents (measured at the cylinder) on the vortex shedding frequency (or Strouhal number) that is characteristic of flow about a circular cylinder. In the tests conducted, this dependence is attributed to the fact that the fluid motions are sufficiently slow to permit ions to follow the fluid. For a period of vortex shedding that is small with respect to the time of ion traverse, the trajectories tend to vary less with fluid motion and, thus, flow measurement with ions becomes less useful; in this study, such action occurred only under conditions of artificially high Strouhal number.

**Note:**

Requests for further information may be directed to:

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**Patent status:**

NASA has decided not to apply for a patent.

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