AD-A181 922 EXPERIMENTAL INVESTIGATION OF TURBULENT FLAMES(U) 1/1
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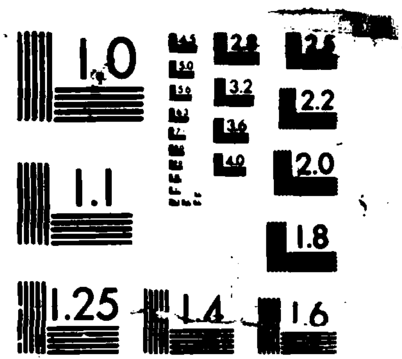

MICROCOPY RESOLUTION TEST CHART

(2)

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The instrumentation grant was awarded to the University of Illinois for the purchase of a laser velocimeter needed for experimental investigation of turbulent reacting flows in the combustors. The requested instruments are purchased and installed. Fabrication of an experimental facility for investigating isothermal flow fields in combustors is complete. The unique capabilities of this facility and the current status of the experimental work are described in this report.

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INTRODUCTION

The instrumentation grant was awarded to the University of Illinois for the purchase of a laser velocimeter needed for experimental investigation of turbulent reacting flows in the combustors. The instruments purchased on this grant are listed on page 2 of this report. The instruments have been installed and an experimental facility for investigating isothermal flow fields in a co-axial dump combustor is operational. The problem addressed by my current experimental work is described below. It is followed by a brief description of the experimental facility and the current status of the experimental work.

THE PROBLEM

Investigations of the time averaged, turbulent recirculation regions in isothermal and reacting flow fields of bluff-body near wakes have been motivated in the past by the need to understand flame stabilization by bluff bodies. Recently the confined recirculating flow in a co-axial dump combustor has been the focus of an ongoing diagnostic and predictive research program at the Aero Propulsion Laboratory of the Air Force Wright Aeronautical Laboratories. Experimental investigations of these flows face the following problems.

Hot wire anemometry is not a convenient technique in the flows with recirculation. If LDV technique is applied to air flows in a glass tube, one needs to consider the refraction of laser beams at the curved surfaces of the glass tube. To measure Reynolds stresses, one uses 2 color 4 beam LDV which measures two velocity components simultaneously. In the above apparatus, it is not possible to make all four laser beams to cross at a single point because of the refraction at the glass tube. Therefore the Reynolds stresses such as $\overline{u_r u_\theta}$, $\overline{u_r u_z}$ and $\overline{u_\theta u_z}$ cannot be measured. To deal with this problem, an experimental facility has been constructed to eliminate the problem of refraction and to make the measurements of Reynolds stresses possible.

EXPERIMENTAL FACILITY

The problem of refraction comes into the picture because the refractive index of air is different from that of glass. If the fluid flowing through the glass pipe has the same refractive index as the glass, the problem of refraction of the beams is eliminated. This technique has been successfully used by Rosenstein et al. (1981) to make velocity measurements by LDV in a flow through porous structure constructed of glass rods. They use a mixture of silicone liquids to match the refractive index of glass. Other fluids also can be used. Pyrex brand 7740 glass has a refractive index of 1.474, so does a solution of 16 parts by volume of methyl alcohol in 84 parts of benzene.

In the experimental facility constructed at the University of Illinois, the apparatus shown in Figure 1 is used for investigating the flow of methyl alcohol/benzene mixture through a model co-axial dump combustor. The test section is enclosed in a box containing the same methyl achohol/benzene mixture. The box has a glass window to provide the optical access to the test section. The laser beams are refracted only at the flat surface of the glass window. This refraction does not cause any problem for LDV measurements. It is expected that accurate measurements of the Reynolds stresses would be possible.

CURRENT STATUS OF THE EXPERIMENT

The experimental facility has been designed and fabricated. Figures 2 and 3 show the laser velocimeter and the model co-axial dump combustor. At present water is used as the fluid in the model combstor. A computer program is developed to take into account the refraction of the laser beams at the glass tube and thus correctly interpret the output of the laser velocimeter. The mean velocity measurements are compared with those obtained using hot wire anemometry. The comparision is shown in figure 4. The next step in this investigation would be to replace water by the benzene and methyl alcohol mixture and measure the mean velocity and the Reynolds stresses in the flow field.

INSTRUMENTS PURCHASED

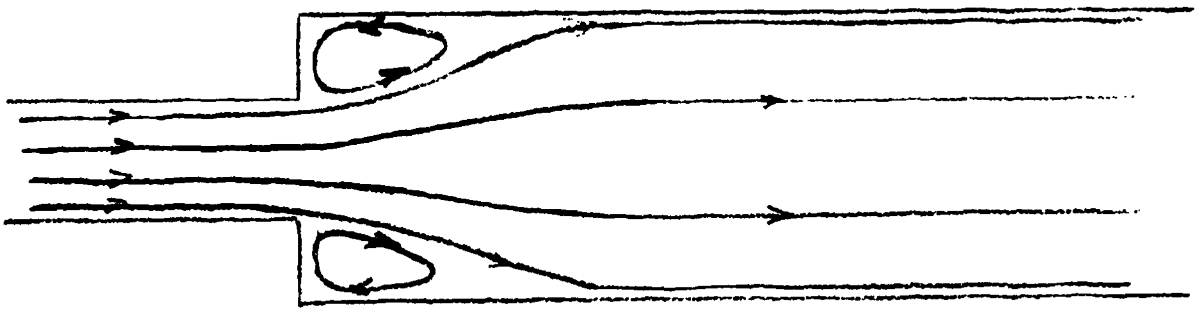
The following instruments were purchased from Thermo Systems Inc.

model number	item
9100-7	Laser velocimeter system
6250	2-channel data analysis system
6209	IDS Prism 80 printer
3400	Fluidized bed particle generator
9500	3 axis traverse system with manual controls
9129	Receiving optics base.
9167-350	Lens

The cost of the above instruments (with educational discount) is $159,840. The cost of freight and installation is $3,356.

REFERENCE

Rosenstein, N.D., Dybbs, A. and Edwards, R.V. 1981 Computers in Flow Predictions and Fluid Dynamics Experiments (ASME publication), edited by Ghia, Mueller and Patel, pp 223-227.



Model Co-axial Dump Combustor

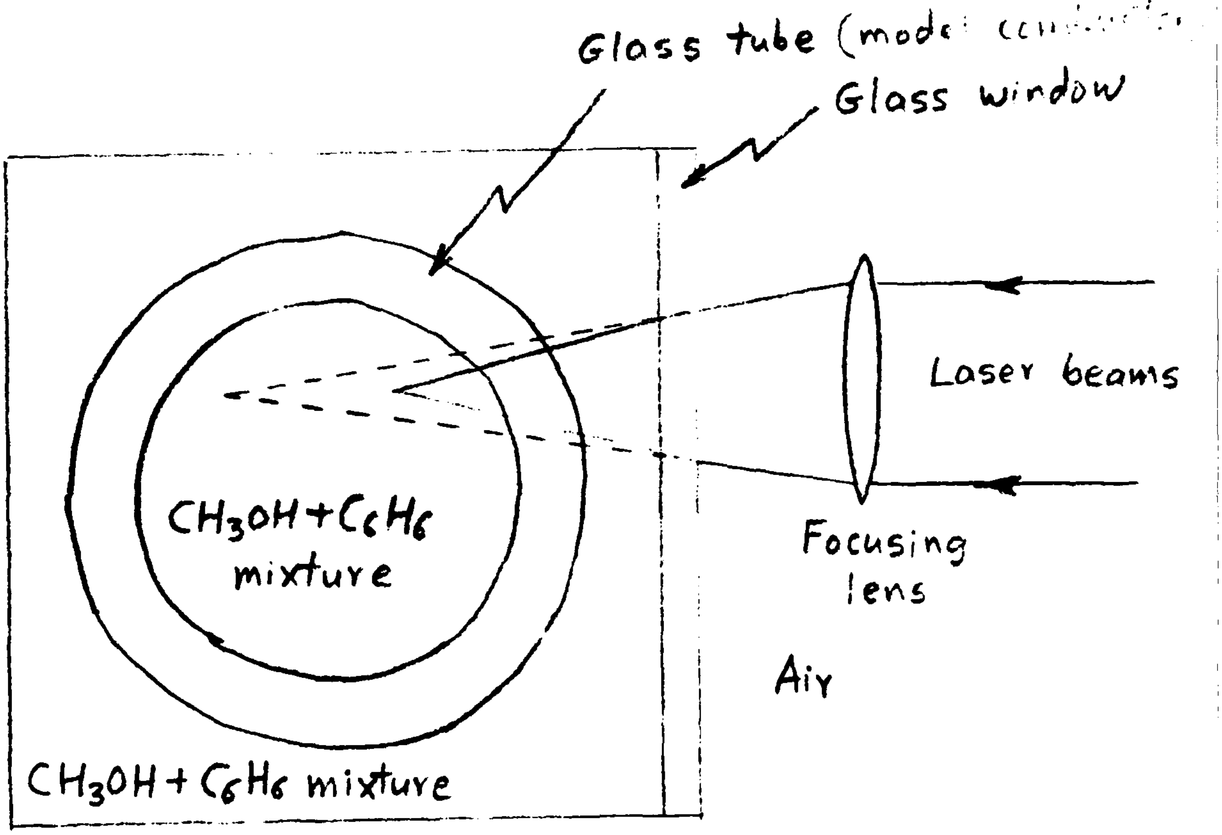


Figure 1 : Experimental Facility

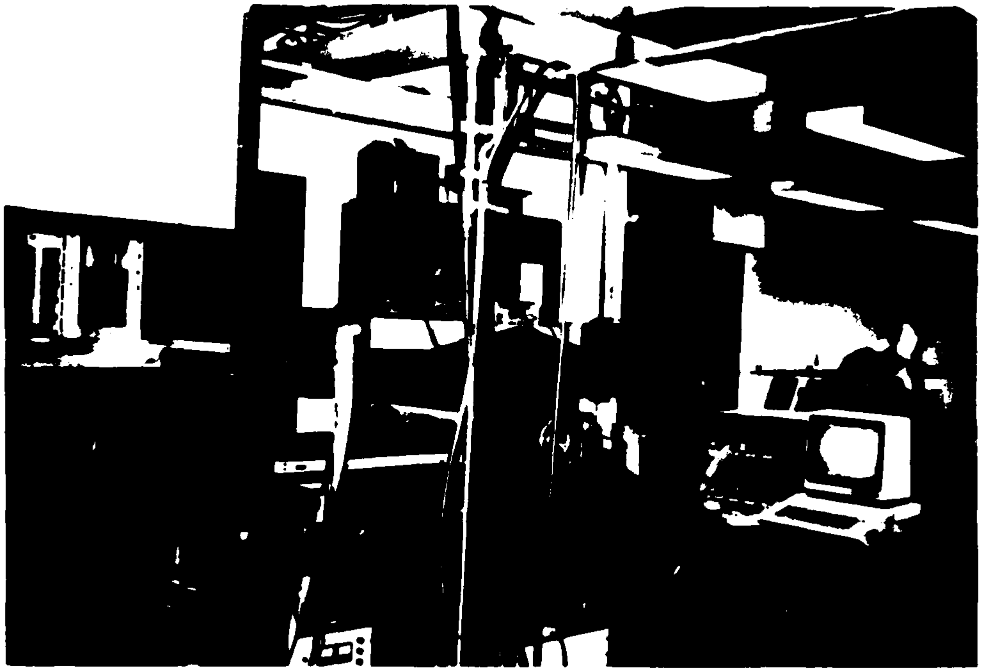


Figure 2 : Laser Velocimeter

Figure 3 : Test section

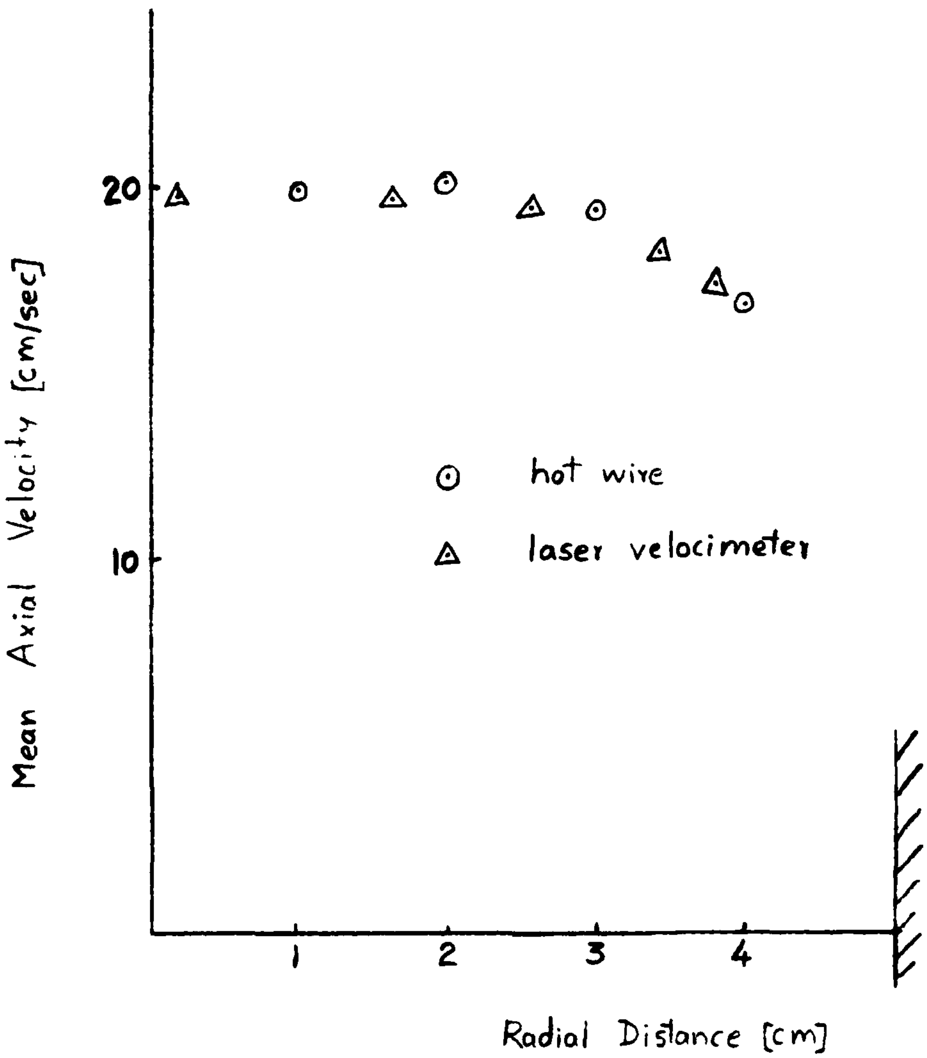


Figure 4 : Velocity measurements in a pipe flow

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