DEVELOPMENT OF A LASER VELOCIMETER FOR A LARGE TRANSONIC WIND TUNNEL

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At the Lewis Research Center 8 × 6 Foot Supersonic Wind Tunnel a laser velocimeter (LV) has been utilized in the testing of advanced high speed turbo-propellers (fig. 1). The system, using a 15-W argon-ion laser, a 3-beam 2-axis transmitting-receiving optics package, a zoom lens with 1- to 4-m focal lengths, and a 0.4-m corner mirror was initially assembled and tested in the checkout room shown in fig. 2. During the time the system was located in the checkout area, experience was acquired in the alignment and operation of the system and the data acquisition system and software were developed. By using air jets to simulate tunnel air flow, the system worked quite well.

With the checkout of the system complete, the velocimeter was relocated adjacent to the wind tunnel test section on a 2-axis positioning platform (fig. 3). Because the area surrounding the test section is subjected to reduced atmospheric pressures, elevated temperatures, and high noise levels, access to the velocimeter is impossible during tunnel operations. All controls, instrumentation, and computing equipment are remotely located.

The relocated system again underwent testing using air jets to simulate tunnel flows and worked very well. However, the first attempts to operate the system during actual tunnel runs revealed several unforeseen problems. The laser, when subjected to reduced atmospheric pressures, would cease lasing and intense vibration caused a loss of beam alignment. Consequently, the laser was mounted into a vessel maintained at atmospheric pressure and deflectors were mounted to the external tunnel walls to shield the system from the air blast created by the wall bleed holes. Limited LV data was attainable with this configuration, but the system would become misaligned after 1 or 2 hours of operation. A combination of vibrations induced by the high acoustic pressure loadings and the rise in temperature of about 50°F were suspected to cause the loss of alignment.

The system was remounted to the positioning platform in an enclosure that provides both thermal and acoustic isolation (fig. 4). The enclosure has water cooling lines affixed on all 6 internal surfaces and lead sheet-foam acoustic insulation on all external surfaces. The optical table carrying the LV system is mounted to the base plate of the enclosure on rubber shock mounts.

Concurrent with the installation of the isolation system, a 4-beam 2-axis transmitting-receiving optics package was obtained (fig. 5). This package appeared to be more tolerant of vibrations as well as being easier to align.

The present instrument described above with its isolation system has been successfully operated with runs of 8 hours endurance being routine.

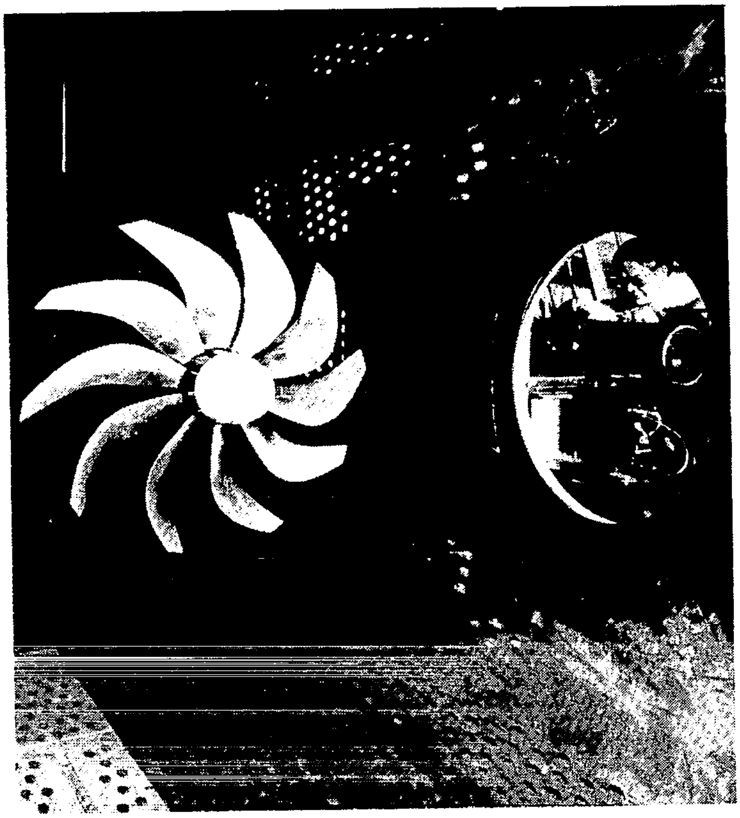

Figure 1.- The NASA Lewis LV system at the 8 X 6 wind tunnel.

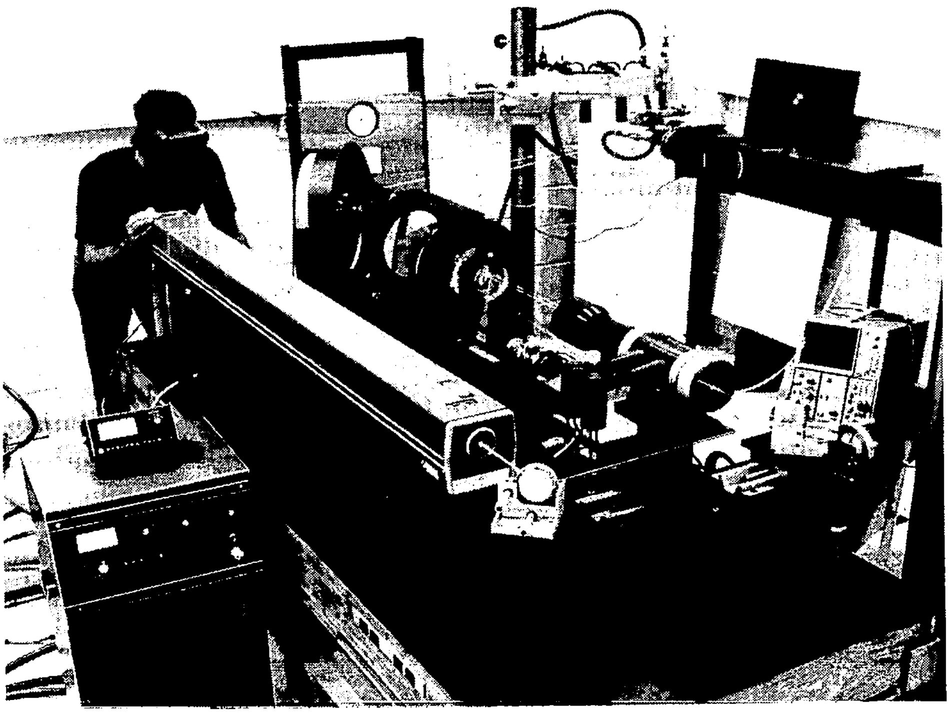

Figure 2.- The LV checkout area.

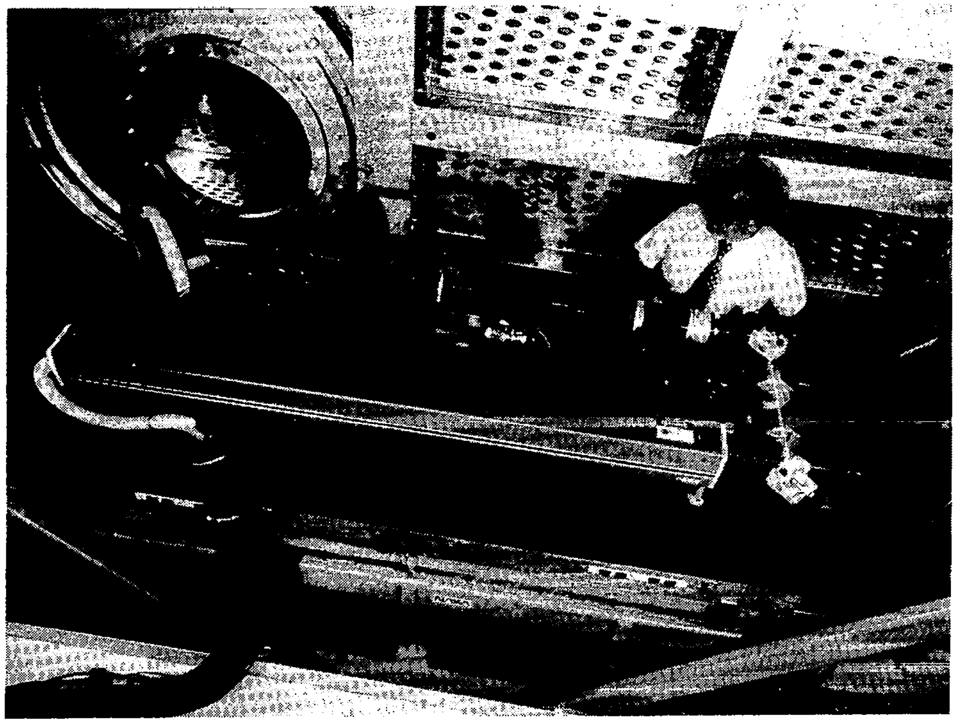

Figure 3.- Initial installation of the LV at the 8 X 6 wind tunnel.

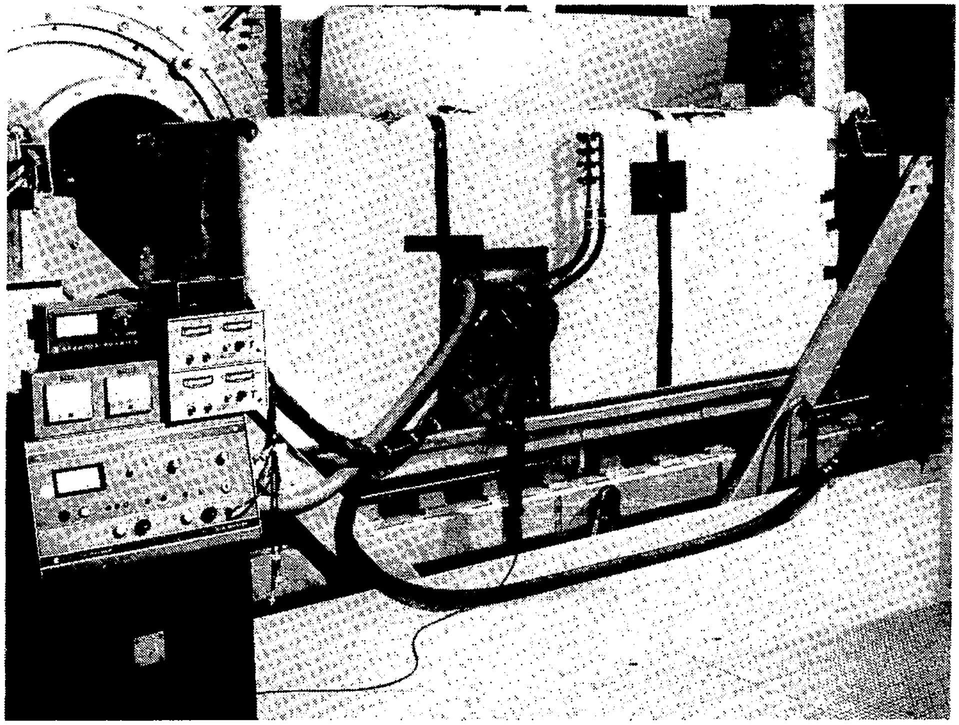

Figure 4.- Laser velocimeter environmental isolation enclosure.

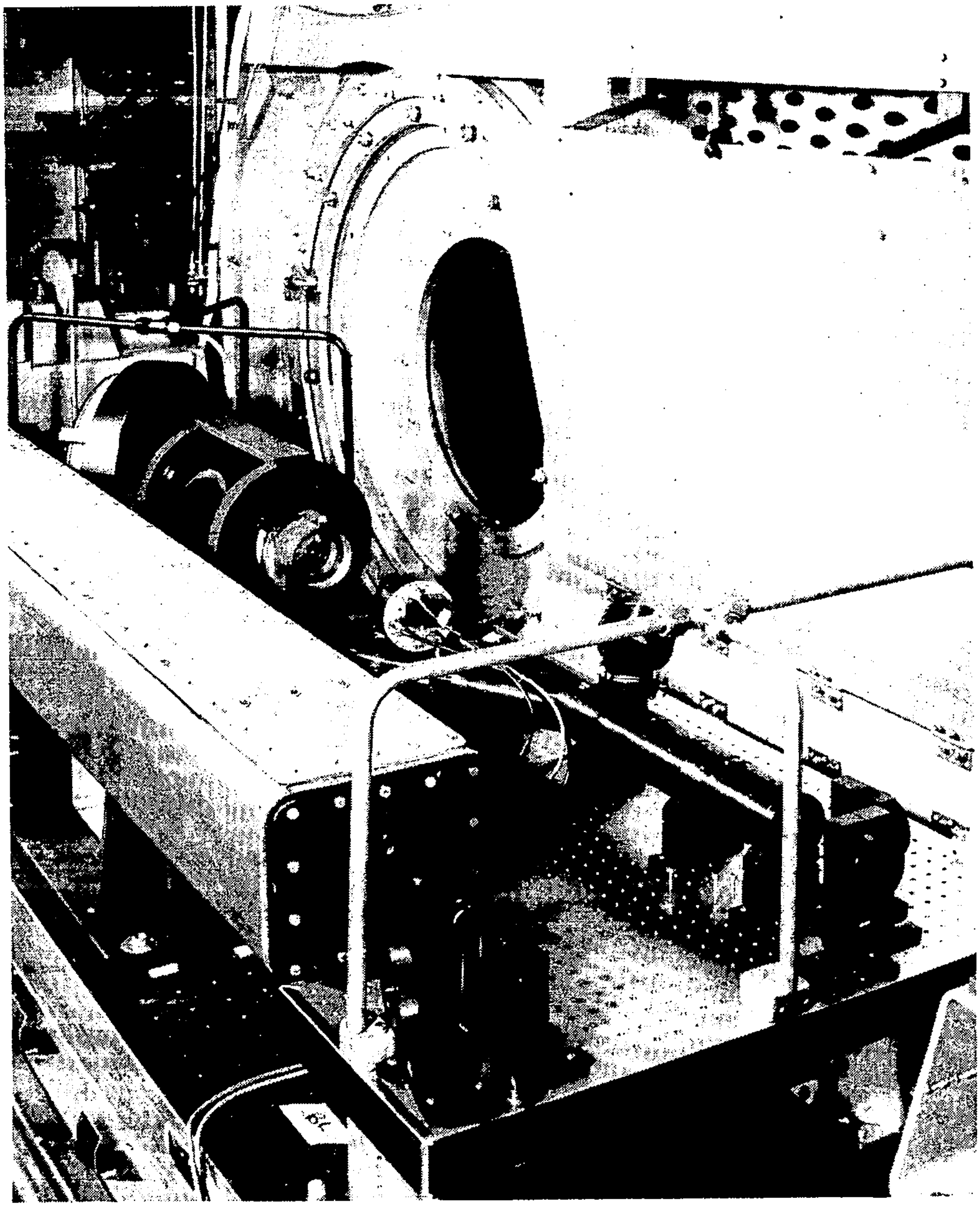

Figure 5.- Laser velocimeter optics system.