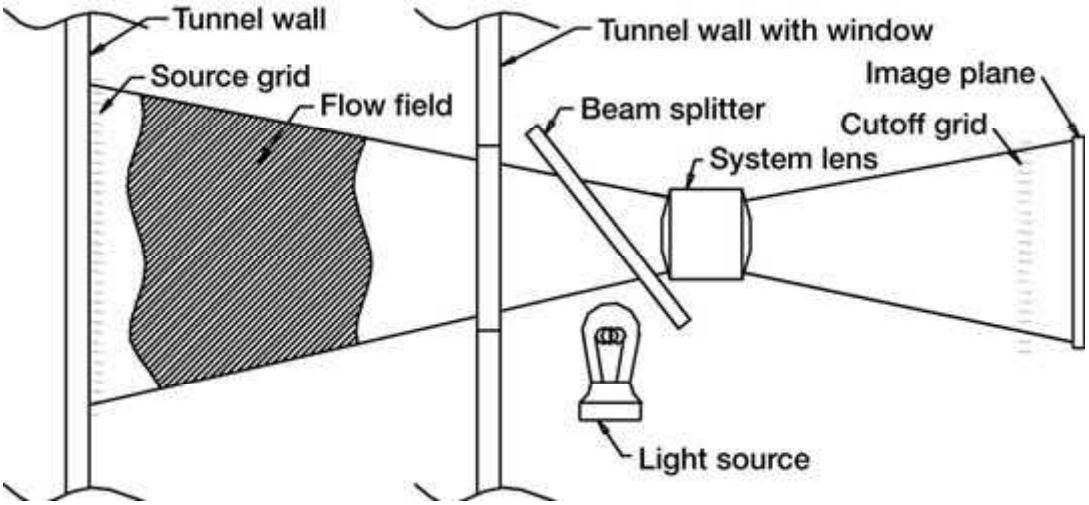
Reflective Focused Schlieren System Improved for Use in 10- by 10-Foot Supersonic Wind Tunnel



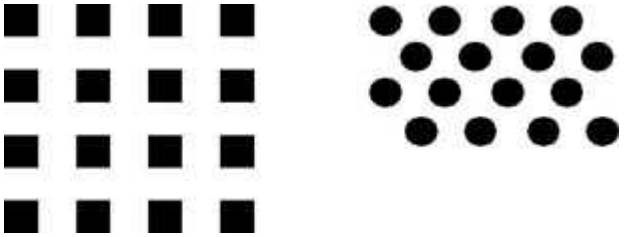
Reflective focused schlieren system (not drawn to scale).

The reflective focused schlieren system that was developed for use in the 10- by 10-Foot Supersonic Wind Tunnel (10×10 SWT) at the NASA Glenn Research Center at Lewis Field as part of the Unstart Test Program was improved this past year. In April 1999, the development and use of the system was presented at the Supersonic Tunnel Association International in Bedford, England. A focused schlieren system is similar to a standard schlieren system in that shock waves coming from an object in supersonic flow can be seen using a standard video camera. Unlike the standard schlieren system, which produces a two-dimensional schlieren image, a focused schlieren system can produce a three-dimensional image. The preceding drawing shows the components of the reflective focused schlieren system being developed for use in the 10×10 SWT.

Although the system worked well for the Unstart Test Program, it was not sensitive enough to be classified as a facility capability. Therefore, a program was implemented to improve the sensitivity of the reflective focused schlieren system so that it could be a facility capability for Glenn's 10×10 SWT. Several techniques were implemented to increase the sensitivity and to improve the overall operation of the system. These included refinement of the source grid, improvement in the cutoff grid production, improvement of the source grid and cutoff grid alignment, installation of an improved light source, and incorporation of an image-enhancing system. These changes are being implemented with the system set up in the laboratory. A checkout test of the system is planned in the 10×10 SWT in March 2000.

Of these techniques, the most developed is the refinement of the source grid. The original

system had a pattern of ¼-in. by ¼-in. squares on ½-in. centers (distance between the center points of adjacent squares). This gave a ratio of light to dark (reflective to nonreflective area) of 3:1. The recommended ratio is 1:1. In order to accomplish this, a pattern of ¼-in.-diameter dots on 3/8-in. centers was developed. Preliminary tests with this pattern showed an increase in system sensitivity and image clarity. Further testing and refinement are scheduled. The following figure shows the former and improved dot patterns.



Source grid patterns. Left: Original pattern. Right: New pattern.

The use of glass plates to produce the cutoff grid improved the cutoff grid's quality and helped to align it with the source grid. The cutoff grid, which is the negative of the source grid, is made by exposing photography film (or glass plates) to the proper light while it is installed in the focused schlieren system. The exposed film or plate is removed from the system and then developed as a photograph negative. Because the glass plates are rigid, they eliminate the risk of distortion when the negative is reinstalled in the system and realigned with the source grid.

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