STATUS REPORT ON A NATURAL LAMINAR-FLOW NACELLE FLIGHT EXPERIMENT

Summary
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Nacelle Design
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Nacelle Aerodynamic Performance
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Effects of Acoustic Sources
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SUMMARY

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EXPERIMENT DESCRIPTION

The natural laminar-flow (NLF) nacelle experiment is part of the Langley Research Center viscous drag reduction program, and has the dual objectives of studying the extent of NLF on full-scale nacelles in a flight environment and the effect of acoustic disturbance on the location of transition on the nacelle surface. It is a cooperative experiment between the General Electric Company, the Low-Speed Aerodynamics Division, and the Acoustics Division of Langley Research Center. Each of these organizations has contributed to this paper.

This flight experiment is being conducted in two phases. In Phase I, which has been completed, an NLF fairing was flown on a full-scale Citation nacelle to develop the experiment technique and establish feasibility. Results of Phase I are presented in references 1 and 2. In the Phase II configuration shown in the photograph, full-scale, flow through, NLF nacelles are being evaluated. The nacelles are located below the right wing of an experimental NASA OV-1 aircraft. One controlled noise source is located in an underwing pod outboard of the nacelle, and a second is located in the nacelle centerbody. Several NLF nacelle geometries will be flown during Phase II. The data presented here are for the shape defined as GE2 in Section II. Tests are now being conducted with a thicker shape (defined as GE3), but those data are not available at this time.

Phase II Configuration

SUMMARY (concl.)

The measurements of primary interest are the static pressure distribution and transition location on the nacelle surface, and the fluctuating pressure levels associated with the noise sources. (These measurements are discussed in more detail in later sections of the paper.) Data are collected in straight and level flight, with the noise sources off, and with various combinations of acoustic frequencies and sound pressure levels. The test unit Reynolds number is about 1.8×10^6 per foot. During data acquisition, the right hand aircraft engine is feathered to reduce propeller interference effects.

RESULTS

The results of the Phase II tests to date indicate that on shape GE2, natural laminar flow was maintained as far aft as the afterbody joint at 50 percent of the nacelle length. An aft facing step at this joint caused premature transition at this station. No change was observed in the transition pattern when the noise sources were operated. Computations of surface pressures, using a low-order surface-panel method, showed reasonable agreement with the measured pressure distributions, although the magnitude differed somewhat from the measured values.