Visit of Lockheed and IAF representatives to FSRD on Sept 13 to discuss methods of handling propulsion system inflow on FZ models at transonic speeds

Company representatives were John Stroed of Lockheed, plus Francis Isely and Robert Stansil of IAF. NASA employees present during all or part of the discussions were T.C. Ayers, R.T. Whitcomb, A.W. Robins, and L.E. Hazel.

Lockheed and IAF have "joined forces" for the FZ competition. They recognize that the incorporation of the propulsion system on transonic windtunnel models presents problems. The purpose of their visit was to determine NASA opinions on this matter. It should be noted that the FZ statement of work states that "Windtunnel models should be designed and constructed to be compatible with selected (to be stated later) NASA windtunnel facilities insomuch as it is anticipated that selected configurations may be tested by NASA ....".

Lockheed - IAF have been considering designing their models either with through flow ducts or with simulators. Mr. Stroed discussed the simulated duct design on a model with an inlet installation similar to that of the FZ A4. The bottom of the duct was open for the entire length of the propulsion system. The correct frontal areas were obtained by thickening the side walls of the duct. Mr. Stroed stated that they were favoring this model approach because of anticipated difficulties of measuring internal drag and of obtaining choked flow at the inlet throat with realistic exit areas. It was pointed out to the company representatives that simulation problems on the FZ are completely different than on the SSF. On the FZ true simulation is much more difficult to obtain because the interference flow fields set up by the inlet can influence the pressure fields on a major portion of the airplane surfaces. These interference flow fields will have significant effects on airplane drag and stability characteristics.

Dr. Whitcomb mentioned that if Lockheed - IAF used the simulator approach on their models they would have to prove that the correct stability and drag characteristics were being obtained from the model tests. It was the NASA opinion that use of through flow models was a more desirable approach. This approach has its problems but these problems are more amenable to a quantitative error analysis than those of the simulator. Furthermore, these problems are primarily associated only with drag. Although it may not be possible to achieve choked throat flow, airplane characteristics at this condition can probably be obtained by extrapolation as a function of inlet mass flow.
Messrs. Stroud and Ayers discussed in considerable detail the 3' tests of the F-111 ducted models. Figures 1, 2, and 3, which show the rake design, typical total pressure distributions at the duct exit, and the associated internal drag values were given to Messrs. Stroud and Icely for further study. Mr. Stroud stated that the exit total pressure profiles were much smoother than he had anticipated and that this fact alleviated, to a significant degree, his hesitation to test ducted models.

The rotating rake designed at Unitary was also shown to the visitors. It was suggested that the company models might incorporate such a rake so that very detailed exit surveys could be made at a few selected conditions to evaluate the drag errors introduced by use of the rake in a fixed position mode during most of the tests.

It is the opinion of the writer that the Lockheed - NAMC representatives were convinced by the discussions that through flow ducts should be used on the F4 models.

As a result of this visit the writer has initiated analyses of the inlet flow and internal drag problems of typical F4 ducted models at transonic speeds. The results of this work will be written up in an informal manner suitable for distribution to interested individuals.

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cc: W.J. Alford
    T.C. Ayers
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LEHase:jd
Figure 1

Duct E

EXIT PLANE
Point pressure recovery, He/110

LRC NACA

$M = 1.25 \alpha = 1^\circ$

$\phi$, deg

○ 0

□ 60

◇ 120

△ 180

△ 240

△ 300

Figure 2.