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SEATTLE, WASHINGTON

# PROGRESS REPORT NO. 1

for

# EXPERIMENTAL AND THEORETICAL INVESTIGATION OF WIND TUNNEL GEOMETRY, EMPHASIZING FACTORS PERTINENT TO V/STOL VEHICLES TESTING

at

THE UNIVERSITY OF WASHINGTON

SEATTLE, WASHINGTON 98105

for

The Period from September 16, 1964 to March 15, 1965

under

NASA Grant NGR-48-002-010

by

R. G. Joppa
Principal Investigator
November 15, 1965

N 66-16701

## ABSTRACT

During the reporting period September 15, 1964 to March 15, 1965, the detailed objectives of the study were established within the general subject of V/STOL aircraft testing in wind tunnels. Personnel were engaged for the experimental phase and this work was begun with a survey and adjustment of flow in a 1/8 scale model of an 8 x 12 ft. wind tunnel modified to include a 21 x 19 ft. test section in tandem. Flow fields were measured and it was concluded that the tandem test section wind tunnel could provide an adequate aerodynamic environment for testing at low speeds. The velocity measured along the center line of the model tunnel was found to agree closely with that predicted by the vortex ring method. An experiment was designed to determine the effects of length of the large test section by use of a powered model which could be installed at various locations along the center line. Pilot tests were made to explore the problems of this experiment.

Author

## DEFINITION OF INITIAL GOAL

The general problem of acquiring good aerodynamic data in wind tunnels was studied further in an effort to define it in practical terms with very specific goals to be accomplished under this grant. One must be careful to state the problem in terms that include the practical testing environment, i.e., testing will take place in tunnels whose cross section is limited by cost, and whose test section length may be too short to satisfy the assumption of infinite length. The most pressing problem in terms of its possible effect on tunnels under construction is the length question, for the cost of adequate test section length is much less than the cost of adequate cross-section area.

Tools available at the start included the vortex ring method of predicting flow fields in square tunnels as reported in Reference (1) and a just completed 1/8 scale model of the UWAL 8 x 12 ft. wind tunnel. The model had been equipped with a large test section (21 x 19 x 60 ft. long full scale) in tandem and was thought to be typical of modified tunnels expected to be used for V/STOL testing.

From these considerations emerged the first objective - to combine the analytical method with experiment to attempt to answer to the questions of minimum test section length for powered model testing in a two-test section wind tunnel.

That this should be chosen as the first step was further made necessary by personnel problems. Graduate students are normally available to start work in the fall, but they are admitted, selected, and assigned projects in the previous winter and spring. Due to an unfortunate set of circumstances, it was not certain the previous spring that this project would be approved and, consequently, no students were allocated to assist in the analytical work in the fall. However, the research engineer and instrumentation technician were available, and the program of putting the model tunnel into operation was under way. Hence, the experimental program aimed at establishing the minimum test section length was chosen for first emphasis.

## THE EXPERIMENTAL PROGRAM

The initial experiments were the continuation and completion of a program to demonstrate, if possible, that a large low speed test section could be installed in the contraction between the bell mouth and the standard small test section without damaging the flow quality in the smaller test section; and second, to show that sufficient control power was available in the form of vanes, screens, etc., to produce good flow in the larger section. This work was completed and a report (Reference 2) was issued confirming both the above objectives.

An experiment was then designed and construction begun to attempt to define the influences of test section length experimentally. The analytical

## CURRENT STATUS AND PLANS

At the end of the reporting period the model and balance had been re-installed and were ready for the series of tests to begin. All the difficulties with the model and balance appeared to have been overcome, and it was anticipated that the test series would go rather quickly. It was expected that some additional personnel would be available to begin extensions of the analytical work in the next period.

# BIBLIOGRAPHY

1. R. G. Joppa, V. M. Ganzer, An Aerodynamic Feasibility Study of Two-Test-Section Wind Tunnels for V/STOL Testing, paper presented at AIAA Aerodynamic Testing Conference, Washington, D.C., March, 1964.

2. Shojiro Shindo, R. G. Joppa, An Experimental Investigation of Feasibility of a V/STOL Test Section in UWAL 8 x 12 Wind Tunnel by Using a 1/8 Scale Model of the Tunnel, UWAL Report No. 801, 1965.