AVRO Canada V.T.O. Project
Revised general plan for preliminary wind tunnel testing at N.A.E., Ottawa

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A. V. ROE CANADA V.T.O. PROJECT
REVISED GENERAL PLAN FOR PRELIMINARY WIND TUNNEL TESTING AT N.A.E., OTTAWA

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To - T. D. Earl

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REVISED GENERAL PLAN FOR PRELIMINARY WIND TUNNEL TESTING AT N.A.E., OTTAWA

1. MODUS OPERANDI

Pending decision on these matters we assume that the firm will design and manufacture the required models and design and/or procure the ancillary equipment necessary, such as heaters, air supply and modified balance parts.

Close collaboration with N.A.E. as to layout of equipment etc. will be essential and it is assumed that N.A.E. will carry out and supervise installation.

In collaboration with N.A.E. the firm will prepare a detail test schedule.

If this general basis is agreed, a provisional data schedule can be set up having regard to the priorities allocated and the firm can put out orders for the required equipment without delay. Immediate discussion is required to confirm scale, and agree on balance modification required, etc.

2. SUBSONIC MODELS

Two models are basically required. One with jet simulation and one with intake and jets represented; however, to expedite matters it is suggested that the existing 1/14 scale model is used for a preliminary investigation of similarities; further it is desirable to make some general allowance for changes. In detail:

2.1 1/14 Scale Model

This model is built and a preliminary series of tests have already been run with it in the L.S. tunnel at Woodford. It is suggested that a further series of tests should be run on it in the Ottawa tunnel.

The main purpose of this series will be to establish similarities and a moderate degree of heating of the jet air flow will be necessary. It is suggested that the model will be tested at two or three incidences only in varying conditions of jet mass flow ratio, thrust coefficient, Mach No. and Reynolds No. A fully detailed plan covering the required range of these parameters is in course of preparation.

A great advantage seen in using this model is that tests can be put in hand immediately. Further to the main purpose outlined above it will be the greatest advantage to all concerned to acquire experience in the technique of testing with the large air supply required and will also serve to assemble the instrumentation and air supply so that the tests to follow can be got through more expeditiously.

It is expected that this series of tests will also form a useful check on the tests carried out at Woodford and in the following respects will improve on them:

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2. SUBSONIC MODELS

2.1 1/14 Scale Model (continued)

a) A continuous air supply will be provided.

b) The model support strut will be faired right up to the model and no additional tunnel blockage from cross struts will be introduced.

c) It will be more accurate down to much lower thrust coefficients, first because the accuracy of the balance is better and secondly because the tunnel runs to considerably higher q so that aerodynamic forces will form a larger proportion of the total.

d) Although the tunnel is closed circuit it is intended that static thrust forces will be zeroed in the open.

e) More careful correlation of quantities will be carried out, mass flow and temperature measurements will be taken and heating of the jet stream will be tried.

Photographs of this model are attached.

2.2 1/10 Scale $\frac{1}{2}$ Plane Model

This model is half-built and is the subject of a report (W/T 3) outlining the sort of tests required. It is presently being slightly modified to improve the internal air flow characteristics. As well as simulating the jet flow it calls for a simulation of intake flow and for pressure plotting. Further equipment is, therefore, necessary at this stage to cater for the simulation of intake flow to a suction source and the measurement of surface pressure. This equipment can be assembled while the first series of tests is being carried out.

2.3 1/10 Scale Half-Plane Model

To complete this series of tests it is envisaged that a representative $\frac{1}{2}$ plane model omitting only the intake will be designed. This will completely eliminate any constriction in the internal flow, the entire volume inside the model being almost a plenum chamber. This is looked upon as repeating the more preliminary tests with the 1/14 scale model but eliminating the avoidable error of this model, the whole test being very carefully controlled. Accurate data on the effect of the jets on pitching moment must be obtained and the model would be designed to allow various control surface schemes to be tested.

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2. SUBSONIC MODELS

2.4 Configuration Changes

Allowance should also be made for a small number of ad hoc investigative models designed to explore the possibilities of configuration improvements. In particular it is generally agreed that flat take-off is most desirable; it will not be possible to establish whether any of the schemes which can be produced to fulfill this requirement are worth proceeding with, without simple wind tunnel tests on control possibilities.

3. SUPERSONIC MODELS

Basically, again, two models are required in as large a scale as possible and preferably for the 16" x 30" tunnels: for evaluating the effects of jet and intake flow. It is considered, however, that the major part of the job is in setting up the required equipment for supplying air and measuring forces and that other models can be quickly constructed for interchange to evaluate special effects. The following is tentatively suggested pending further consideration.

3.1 ½ Plane Model Similar to (2.3)

Representative model except for intake, with provision for interchange of side nozzles for direct check on efficiency of poorly angled jets at high Mach No. and with adjustable control surfaces and possibly making provision for several types of control.

3.2 ½ Plane Model with Intake

A model is required to investigate effects of flow and pressure recovery into intake and a direct measurement of intake afterbody drag is needed to complete the story on zero-lift drag when added to 3.1. For this the model would have a fairing in front to take the pressure drag, attached to the tunnel with the rear half-model on the balance. This would be tested with intake on and off. It may be necessary to investigate the effect of jet flow for its influence on breakaway at the rear. The side jets would be omitted and straight blow through from atmospheric pressure would be adequate.

3.3 Configuration Changes

A similar allowance for a small number of runs on ad hoc models as in 2.4 is desirable.

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4. COMPRESSED AIR AND VACCUUM SUPPLY AND ADDITIONAL EQUIPMENT ETC.

It is envisaged that compressed air and air heating arrangement and instrumentation for measurement of air flow, pressure and temperature will be required for both supersonic and subsonic tests.

Additionally, the subsonic tunnel will require a low pressure sink for simulating the intake flow.

The quantities required are:

Compressed air	5.0 lb./sec. at about 100 psig
Max. Temperature	200°C
Suction	4.0 lb./sec. at about 2 psia

The high and low pressures are required to overcome the constrictions unavoidable in leading air into the model through the balance plate. Several schemes for supplying air to both tunnels have been suggested and this matter requires decision as to the most suitable arrangements.

5. TUNNEL TIME

On the question of tunnel running time it is considered that the programmes suggested in the firms reports Project 'Y' W/T 1, 2 and 3 would form the basis of estimates. It is the intention to keep the runs required to the minimum necessary to establish the effects of the large distributed flows.