PRELIMINARY NOTE ON PROJECT 'Y'
LOW SPEED TUNNEL TESTS

July 14, 1953.

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Copy to - R. J. Templin - N.A.E.

SECRET

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INTRODUCTION

Some tests on a 1/14 scale low speed tunnel model of the Project 'Y' aircraft, incorporating the jet flow simulated by an airflow, have been carried out in the A. V. Roe 9' x 7' tunnel at Woodford.

Air for blowing the jets was fed to the model from a 100 p.s.i. 1750 cu. ft. tank, which was pumped up between runs by a large compressor. Photographs of the air supply arrangements and the model mounted in the tunnel are included with this note. A labyrinth seal at each side of the tunnel was designed to isolate the air supply lines from the balance and this worked extremely well.

The object of these tests was principally to discover the important effects resulting from the peripheral jet flow, in particular what modification of the C_L vs. curve defining the transition through the "stall" - and the equivalent modification of the drag curve - would be found; and also what the effect on moment co-efficient would be, i.e. whether the centre of pressure position would be considerably modified.

In the very limited time available it has not been possible to analyse some 60 pages of instrument recording thoroughly. This note contains tentative conclusions and should be understood only to present some of the big effects of the jet in a rough way. A full analysis of the results will be made as soon as possible and a report issued.

SUMMARY AND DISCUSSION

The jet flow has been found to have a very important influence on the lift curve and to prevent the wing from stalling. This is shown in Fig. 1. Curve 'A' is the net lift after the thrust component, due to the jet, has been subtracted from the gross lift. Curve 'B' is the lift of the model without jet flow. The tunnel was running at 160 f.p.s. and the points corresponding to jet flow were taken at 35 p.s.i. static pressure in the down pipe to the model. However, quite a small thrust is sufficient to keep the wing installed. It was observed that, even at 60° incidence with the tunnel speed as high as 160 f.p.s., and at this small scale, the wing was unstalled at 10 - 15 p.s.i., i.e. probably at about 20% thrust as will be seen from the specimen plot Fig. 2. (The maximum thrust to scale is of the order of 200 lb., but without a hot jet maximum thrust is not simulated).

Most significant is the phenomenal increase in maximum lift co-efficient, which comes out at 2.2. This is, of course, accompanied by a large increase in induced drag as is shown in Fig. 3. This means that slow flying and steep approach angles are possible, with the aircraft at very high incidence, and always flying unstalled.

Fig. 3 plots net drag with and without jet flow. It must be understood that it is not in the least possible to establish the actual C_{D_o} of the aircraft from this model, for besides not being entirely representative, C_{D_o} is a small quantity compared to the thrust and total drag values we are measuring; furthermore the strut and interference drag will probably be comparable to the C_{D_o} of the model, making the corrections as big as the value to be found. It will also be noticed from Fig. 1 that the lift curve slope is increased by the jet, increasing the aerodynamic efficiency and effective aspect ratio of the wing.

SUMMARY AND DISCUSSION (continued)

This means that present ideas on subsonic cruising duration will probably have to be considerably revised to take credit for this improvement.

It has not yet been possible to analyse, even briefly, the effect of the jet on centre of pressure position through the range of incidence, but Fig. 5 is included to show how the aerodynamic effectiveness of the control surfaces is going to be improved by the jet flow, as predicted. It seems that with the jet on, the aerodynamic effectiveness of the surfaces will be maintained up to quite large angles. How this effect depends on forward speed has not been evaluated, but this plot represents about ½ thrust (30 p.s.i.g.) and 160 f.p.s. forward speed at R.N. of 1.7×10^6.

Fig. 5 is included to give an idea of how conditions would vary in slow flying at very high incidence. 5(a) plots equilibrium level flight speed against incidence and 5(b) plots the thrust required for level flight, and each curve is extrapolated to the hovering condition at 20,000 lb. weight. Fig. 5(b) suggests that deceleration in level flight, or on the approach, progressively up to the vertical will be a smooth manoeuvre, accompanied by a gradual steady increase of throttle. It is notable that the thrust required will be quite adequate to keep the wing unstalled at the appropriate speed on a steep approach.

CONCLUSION

It is considered that these preliminary tests have been most successful in demonstrating the very considerable beneficial effects the jet flow may be expected to have, improving the slow flying conditions and the effectiveness of the controls. In fact, these tests have demonstrated that a smooth and easily practical landing manoeuvre can be carried out with this type of aircraft with its peripheral jet flow. Further analysis of these tests is required, other more exacting tunnel tests on a completely representative ½-plane model as proposed are needed as well as further complete demonstration of the landing manoeuvre at small scale; but it is not expected that the conclusions drawn from this series of tests about the large effects of the powerful jet flow will be in any way invalidated.

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Fig. 1.

PROJECT Y

WIND TUNNEL TESTS.

LIFT CO-EFFICIENT.

LIFT CHARACTERISTICS.

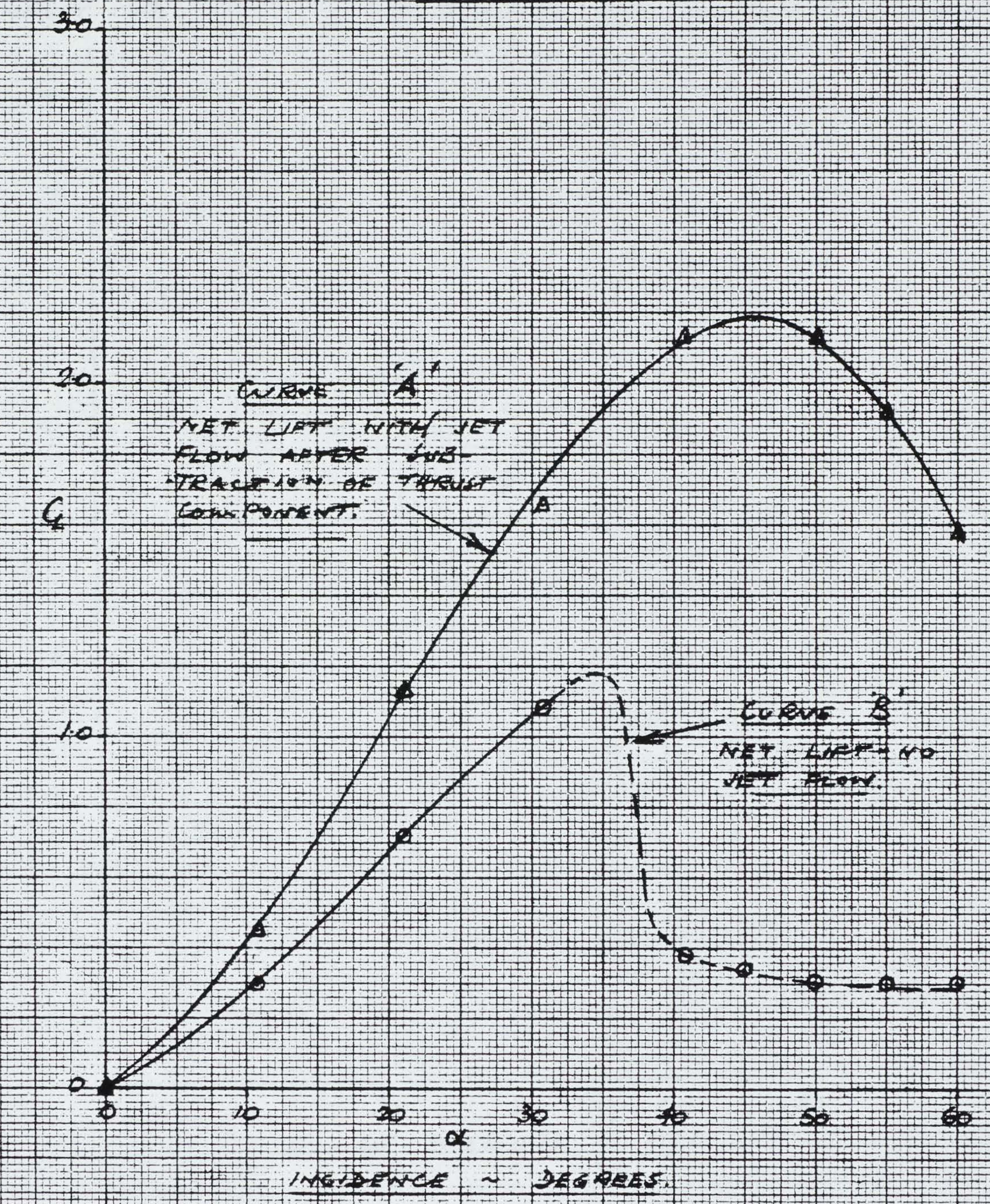

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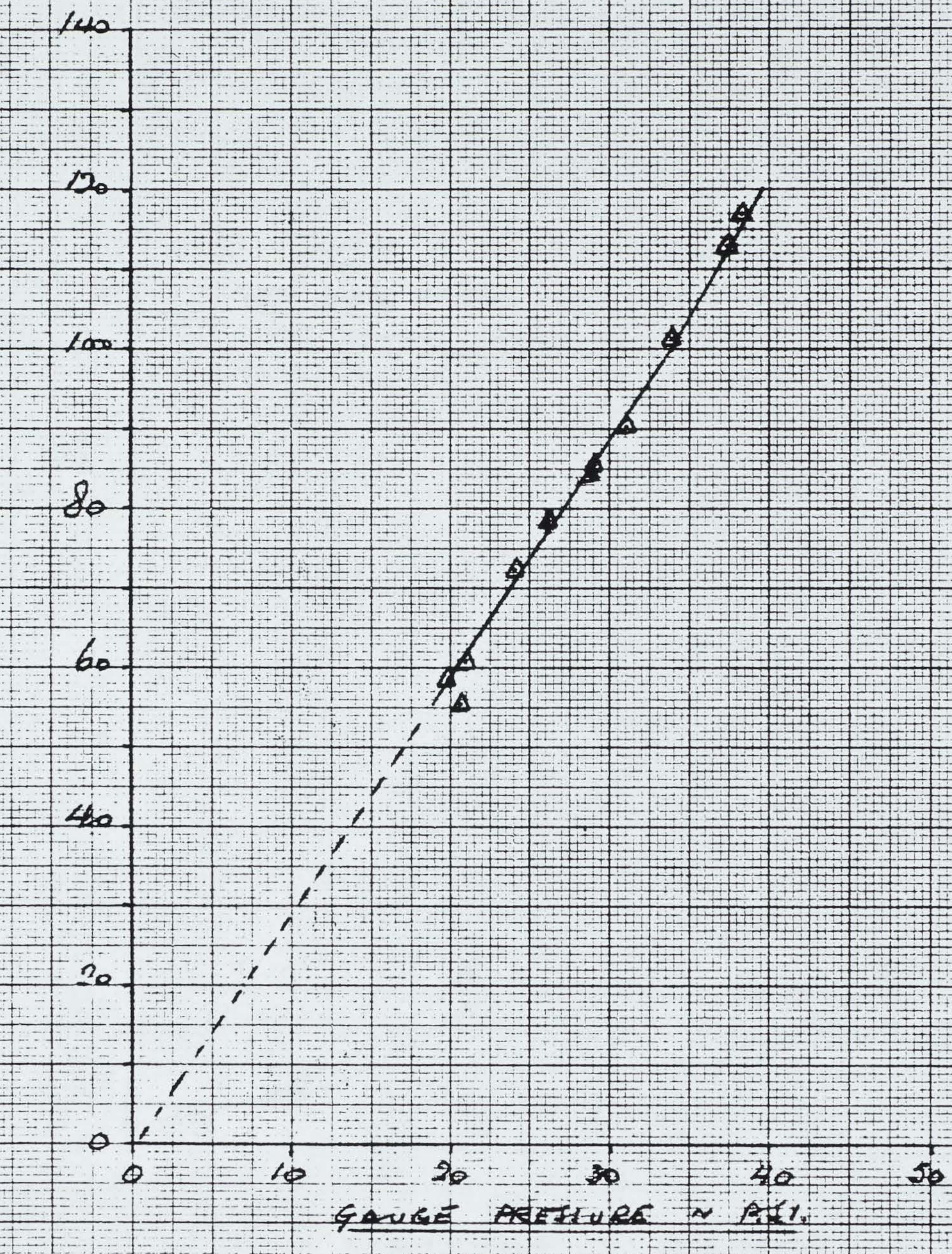
FIG 7.

PROJECT Y

WIND TUNNEL TESTS.

VARIATION OF THRUST AND P.S.I.G.

TUNNEL OFF.



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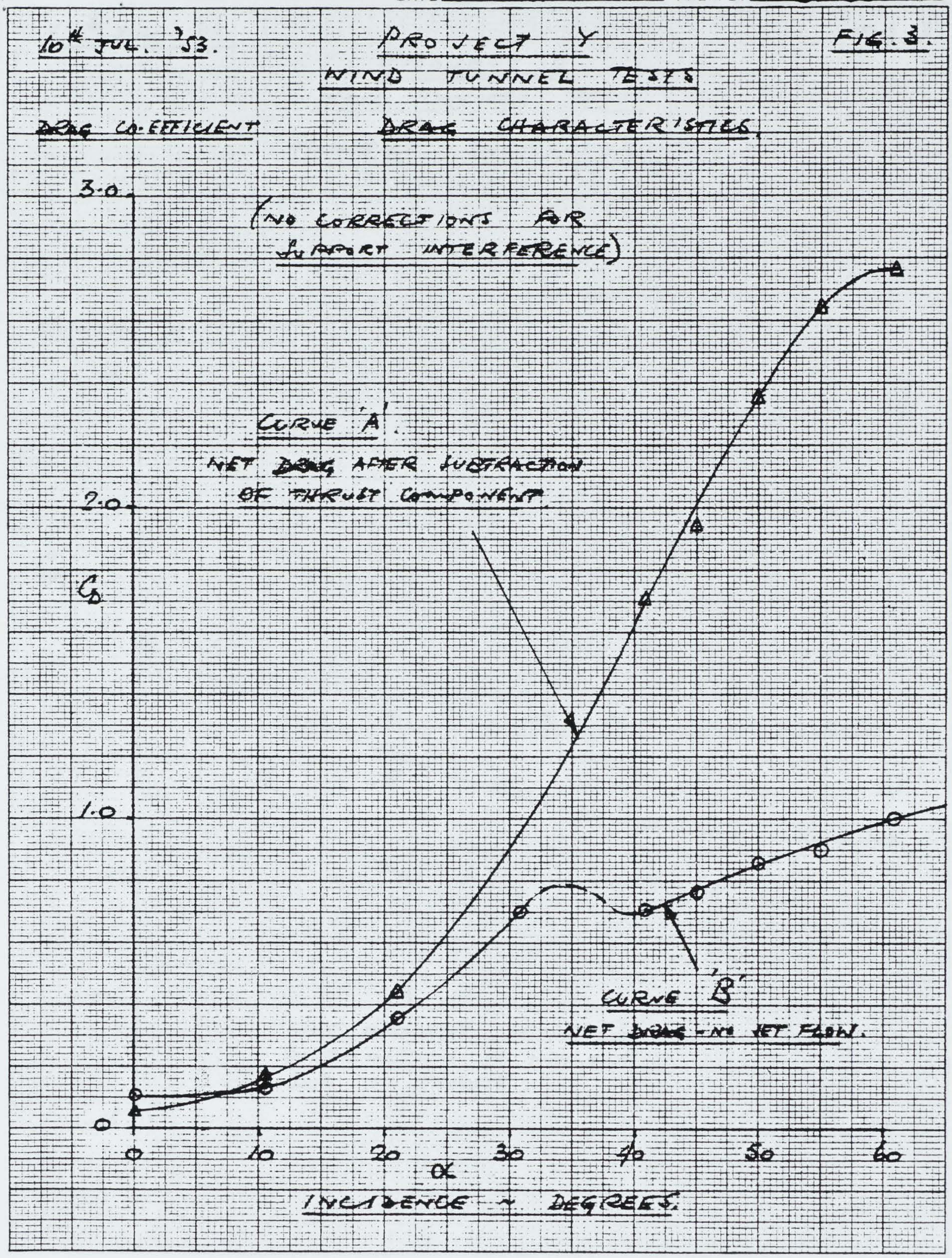

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PROJECT Y
WIND TUNNEL TESTS
MOMENT CHARACTERISTICS.

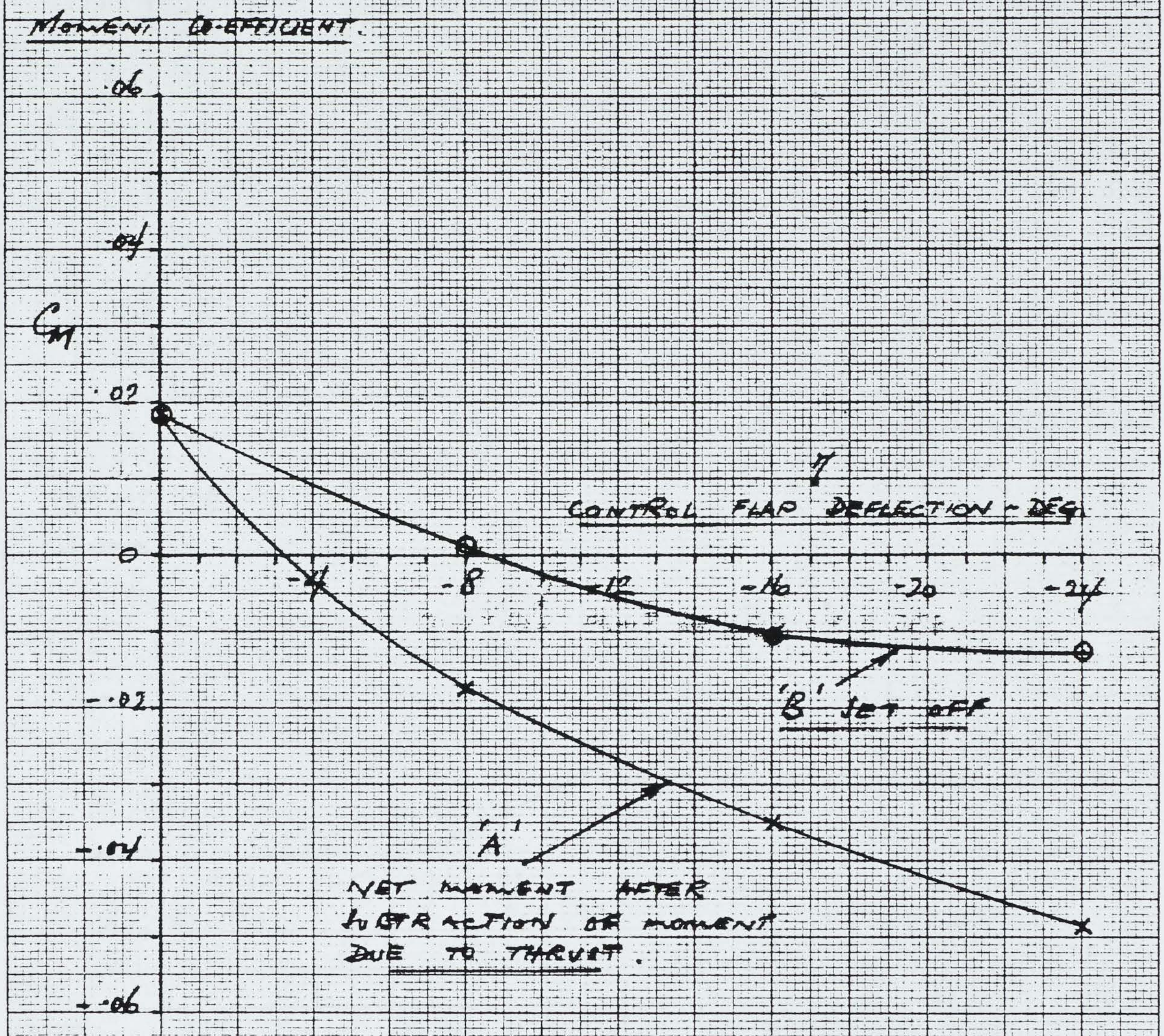

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FIG 5.

PROJECT Y

FROM WIND TUNNEL RESULTS.

LEVEL FLIGHT SPEED - THRUST

WEIGHT 20,000 LB.