Aug./Sept. 55

FIGHTER CONFIGURATION STUDY

A performance analysis is to be made to arrive at one or more possible fighter configurations which, it is hoped, would compare favourably with the C-105. Following are some notes and suggestions on this study.

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1. Assumed Specification (Suggested Only)

$n = 2.0$ at $M = 1.5$ at 50,000 ft.

Combat radius of action (with supersonic cruise out) = 200 n.m.

Armament = 8 Falcons

Equipment = MX 1179 fire control system

No. of Engines (and Type) = 2x PS13

Take off and Landing Distances over 50 ft. = 6000 ft.

No. of crew = 2

Also good flying qualities at, say, $M = 2$ at 50,000 ft.

Attention to be paid to dynamic stability without artificial aids other than yaw dampers.

Attention to be paid to loss of performance in turns beyond thrust limitation.

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2. NAE Project Studies

Following are some suggestions for procedure in carrying out internal project studies in such a way that fair comparison is possible with each other and with C-105.

(a) Engine installed thrust and specific fuel consumption to be taken as given by Avro Aircraft for C-105. This will obviate need for intake and duct design in project studies, and leads to more straightforward comparison with C-105.

(b) For purposes of weight estimation it is proposed to use Michaelsen's methods for wing, undercarriage, fuselage, tail, fuel tanks, and to use Avro Aircraft's values for air conditioning, electric and hydraulic system and other equipment items.

(c) Estimates of aerodynamic parameters (drag, control effectiveness, etc.) to be left up to study groups. Standardization of procedure here would be very difficult and might restrict scope of studies in an arbitrary way.

(d) Dynamic stability to be investigated theoretically or with EASE computer. In interests of simplicity, take 2 degrees of freedom longitudinal, and 3 lateral, with no coupling. This is good enough for comparison with C-105.

(e) Pay little attention to detailed structural design, except to throw out "dangerously unorthodox" arrangements (e.g., mounting an engine on tip of fin).

(f) Pay certain amount of attention to internal arrangement of fuel, equipment, etc., at least so that C.G. position has some chance of coming close to position demanded for stability, and so that undercarriage of required length can be retracted.

(g) Final aim is to arrive at possibly 2 NAE configurations which should meet the above specification as closely as possible and which, it is hoped, would show theoretical advantages over C-105 configuration.

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3. Theoretical Comparison of Configurations

Suggested procedure for theoretical comparison of internal studies with each other and with C-105 is as follows:

(a) Establish a "datum" C-105 configuration as follows:

(i) Start with geometry as given by Avro and estimate weight (less fuel) as in 2(b) above (rather than taking Avro value).

(ii) Calculate performance by agreed methods (e.g., Michaelsen's formulae for climb, etc.) and in the course of doing so calculate the fuel required for combat mission and thus get combat weight. This presumably would be an iteration process which would rapidly converge.

(iii) Since item (i) above might lead to weights which at first differ from Avro values, the methods of weight estimation laid down in 2(b) above might have to be revised slightly. It is suggested that Michaelsen be given job of working out "datum" C-105 configuration in order that he can then produce accurate weight formulae to be used in NAE studies.

(b) For estimation of weights and performance of NAE configurations, use same methods as for datum C-105.

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4. Experimental Comparison of Configurations

If, later, it is felt advisable to compare configurations in the wind tunnel, the following procedure is suggested. This might well be changed when the time comes, however.

(a) Make one model for each configuration, including datum C-105 configuration. These should be full models for 16 x 30 inch tunnel (to permit a few yaw tests)

(b) Models should have adjustable controls for pitch only (i.e., movable elevators or tailplanes as case may be).

(c) Models should be designed as follows:

(i) For each configuration define "basic bodies" to be bodies of revolution having same area distribution as actual configuration after subtraction of wing, tail, canopy and canopy fairing (if any).

(ii) To these basic bodies add correct wing, tail, canopy and canopy fairing. This is made clearer in Fig. 1.

(d) For each model, probably the following runs would be required.

Cover angle of attack range at, say, 6 Mach numbers, with 4 different elevator or tail angles. Measure lift, drag, and moment.

No. of runs = 6 Mach nos. x 4 angles
= 24 runs

Additional runs at 6 Mach numbers with tail off (if applicable) = 6 runs

Cover angle of yaw at two values of C_L at 4 Mach numbers = 8 runs

Total = 38 runs

(e) For datum C-105 it is suggested that model need have no camber (since separate effects of camber on C_{m_0} etc., are now known) and need have no adjustable controls (since by that time all control parameters will be known from Avro estimates or tunnel tests on correct models. Only zero lift drag need be measured for datum C-105 model. Maybe this makes this model unnecessary, but at most this means 6 tunnel runs (No yaw tests since results would be affected by leaving off camber)

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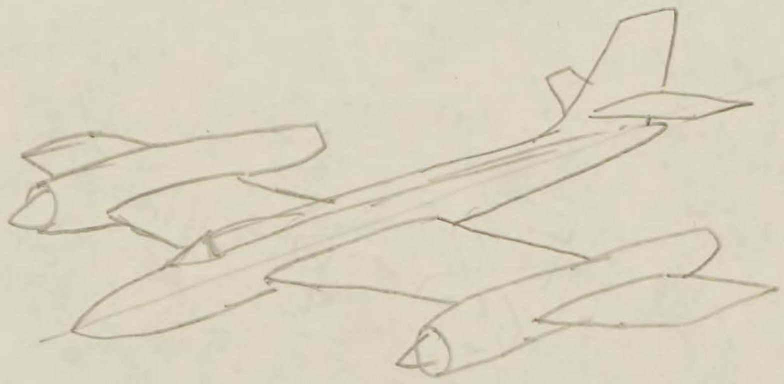
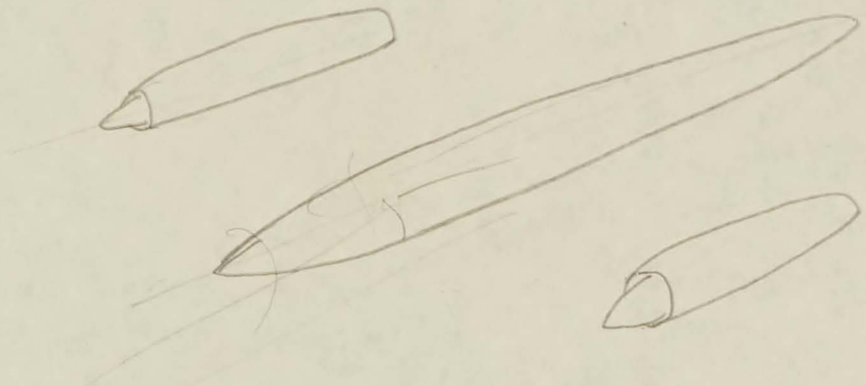
5. Target Date

A target date should be set for completion of theoretical configuration study. Suggested date is 4 months (say, Jan. 1/56).

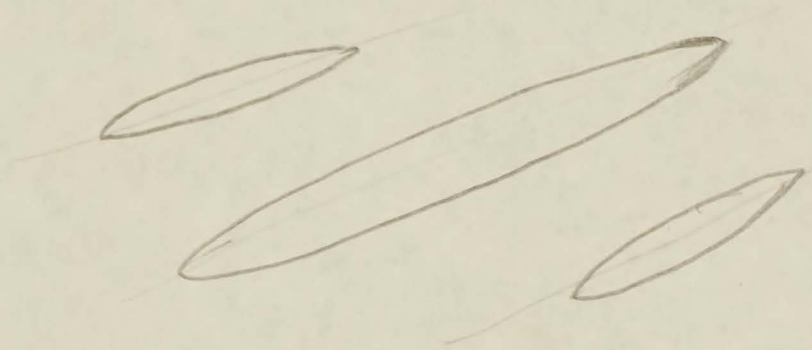
DESIGN OF CONFIGURATION STUDY MODELS — FIG 1



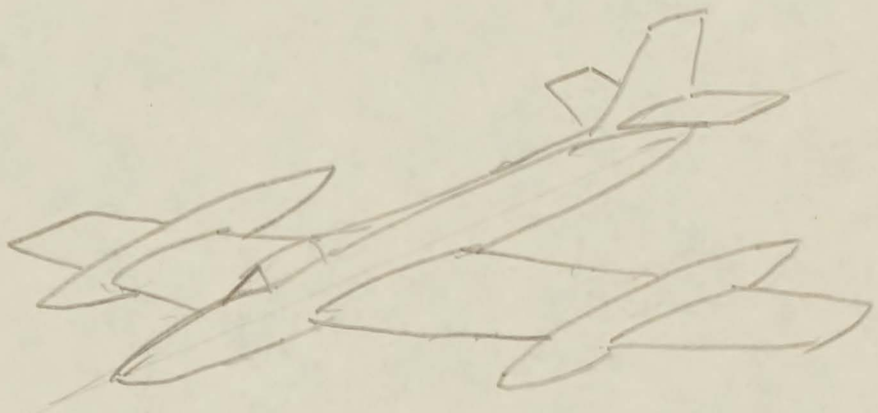
ARBITRARY CONFIGURATION



AFTER SUBTRACTION OF WING, TAIL, CANOPY, CANOPY FAIRING



AFTER SUBTRACTION OF STREAM TUBE AREAS, AND AFTER TURNING ALL BODIES INTO BODIES OF REVOLUTION.



MODEL IS OBTAINED BY ADDING WINGS, TAIL, CANOPY, AND CANOPY FAIRING BACK ON.