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~~S E C R E T~~ P/C 105/5

SUPERSONIC FIGHTER

WITH 2 - 30" DIAM.

ENGINES

July 29, 1953 J. Chamberlin

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By: (Name) ....

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Signature

SUPERSONIC FIGHTER WITH 2 - 30" DIAM. ENGINES

In the search for a method of obtaining a lighter version of the C 105, the use of engines of 30" diameter but developed to the same state as the larger engines specified in AIR 7 - 3 has been suggested.

This proposal has been investigated along the lines followed in the Design Study Report P/C105/1 for the engines specified in the R.C.A.F. Spec. AIR 7 - 3.

It has been assumed that an engine with a 30 in. overall envelope diameter has characteristics similar to the Rolls-Royce RB 106 engine, but with 2/3 of the thrust. Since the Rolls engine is regarded as exceptionally ambitious project from the point of view of thrust per unit frontal area, it is felt that assuming that an engine can get 2/3 of the thrust with 51% of frontal area is very optimistic to say the least.

Since the flight conditions are much more severe, it was felt that weight of the engine could not be reduced substantially below the weight of the Orenda. The afterburner with convergent divergent nozzle and the attendant control system would undoubtably weigh somewhat more than the equivalent simple system for the Orenda. A total installed weight of 3,500 lb. for each engine has accordingly been assumed. While it is felt that this weight is realistic, it may be argued that savings could be made. It is however, exceedingly hard to believe that these could exceed 500 lb. at the outside. In view of the magnitude of the design problem of getting the thrust from an engine of this size, savings of this order are regarded with great skepticism. However, if they prove possible they are not sufficient to alter the overall picture materially.

An airframe similar to those studied in P/C 105/1 was tailored as closely as possible around the small engines. The weights and performances for three wing areas are given in tables I and II. From this, it appears that 1000 sq. ft. is about the best compromise.

DISCUSSION

The following points emerge from an inspection of the data.

1. The margin of fuel capacity for contingencies is not adequate with a 3% t/c wing.

2. If a thicker wing is used to lessen the risk of not meeting the range due to lack of fuel, then the risk of not getting the full drag reduction due to camber is increased. Also the transonic stability and control characteristics will certainly be worse.

3. The rocket armament must be placed in the missile doors. This increases their inertia to a point where it is impossible to close them on the lowering of the missiles as on the C 105 design. This will probably interfer with the trajectory.

4. Because the cockpit size cannot be reduced, and the overall width must be reduced in proportion to the engine size, the width remaining for intakes is reduced by a greater proportion than the engine size. This causes the intake design to be unfavorable.

5. The reduction in weight over the C 105 is only about 15%, while the loss in manoeuvrability at M = 1.5 and 50,000 ft. is 25%. These figures compare with a reduction of weight of 40% and a loss in manoeuvrability at M = 1.5 and 50,000 ft. for a single engine airplane similar to the F 102 but put on a comparable basis.

6. Sufficient detail information on a 30 in. engine is not available to permit an airframe to be designed around it at this time. It is not believed that these data could be obtained in less than about 2 years. This would delay the airframe design by that amount.

7. If a 30 in. engine is projected there are no alternates in design elsewhere, should the program slip or fail to meet is objectives in an adequate way. The importance of this cannot be over emphasised when considering a project that must be more highly developed than the RB 106 in order not to result in an excessive drop in performance over the C 105.

8. There would be no proven engines of the requisite dimensions to power prototypes.

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Ref: F/Wts/X7/0000/9-1

Sheet 2

TABLE 1

WEIGHTS STATEMENT

2 - 30" DIAM. ENGINES

Wing Area (Sq. Ft.)		900	1000	1100
Engine & Afterburner	6340	7000	7000	7000
Fixed Items:				
Power Plant:				
Fuel Tanks	250	250	260	270
Fuel System	250	420	420	420
Fire Exting.	50	65	65	65
Access. Gears	10	15	15	15
Eng. Controls	15	20	20	20
Group Total	6945	770	780	790
Equipment:				
Instruments	50	50	50	50
Probe	35	50	50	50
Surface Controls	500	665	675	685
Hydraulic System	600	650	660	670
Electrical System	700	700	700	700
Radar & Elect.	1800	1800	1800	1800
Ejector Seat	132	132	132	132
Emerg. Prov.	15	15	15	15
Oxygen	20	20	20	20
? 105 Air Conditioning & L.P. Pneumatics	300	625	625	625
Anti-icing System	200 ~~150~~	300	300	300
Brake Parachute	55	75	75	75
External Finish	50	75	75	75
Crew	230	230	230	230
Oil	30	40	40	40
Residual Fuel	160	225	225	225
Armament Provisions	410	410	410	410
Armament: Rockets	520	520	520	520
Missiles	792	792	792	792
Group Total	6599	7374	7394	7414
Fin	525	675	675	675
Fuselage	4750 3900	5351	5351	5351
Group Total	5275	6026	6026	6026
Sub Total	17,419	21170	21200	21230
Wing	5000	6600	7000	7400
Undercarriage	1500 ~~1770~~	1770 ?	1800 ?	1830 ?
Group Total	6,500	8370	8800	9230
Operational Weight Empty	25,319	29540	30000	30460
Fuel	9,200	10800	11000	11200
Gross Weight	34,519	40340	41000	41660
Internal Fuel Capacity - Lbs. (Assuming Specific Gravity = 0.75)		9700	11400	13100

.715 of C-105/1200

2 2 1
6,945
6,599
5,275
6,500
25,319#

TABLE II

PERFORMANCE AND WEIGHTS COMPARISON OF AN AIRCRAFT

WITH GROSS WING AREAS OF 1100, 1000, 900 SQ. FT.

(2 x 10,000 lb. Thrust S.L.S. Engines of RB 106 Characteristics
3% t/c: 0.5% Camber: Armament stowed internally)

WITH THE C 105 AND F 102

AIRCRAFT			2 - 30" Engines			F 102	* C 105
GROSS WING AREA		Sq. Ft.	1,100	1,000	900		
GROSS WEIGHT		lb.	41,660	41,000	40,340	27,400	48,400
FUEL LB.	Supersonic Mission		11,200	11,000	10,800	8,000	12,900
	Subsonic Mission		10,400	10,300	10,400		
INTERNAL FUEL CAPACITY		lb.	13,100	11,400	9,700		16,500
COMBAT CEILING FT. ½ FUEL WEIGHT	0.95 M.N.		52,000	51,400	50,400		55,100
	1.50 M.N.		62,300	61,700	61,000	60,000	65,100
	1.75 M.N.		65,300	64,800	64,200		67,800
TIME TO 50,000 Ft. FROM STANDING START		Mins.	4.9	4.9	4.8		3.2
'g' AT 50,000 FT. AT 1.5 M.N. AT ½ FUEL WEIGHT			1.85	1.85	1.80	1.75	2.14
LANDING DISTANCE FROM 50 FT. - FT. STANDARD DAY	½ Fuel Wt.		5,400	5,810	6,310		5,630
	5 Min. Fuel Reserve Wt.		4,710	5,050	5,500		4,900
TAKE-OFF DISTANCE TO CLEAR 50 FT. - FT. HOT DAY	Gross Weight		2,100	2,220	2,380		2,440

* C 105 at 48,400 lb. with RB 106 Engines.

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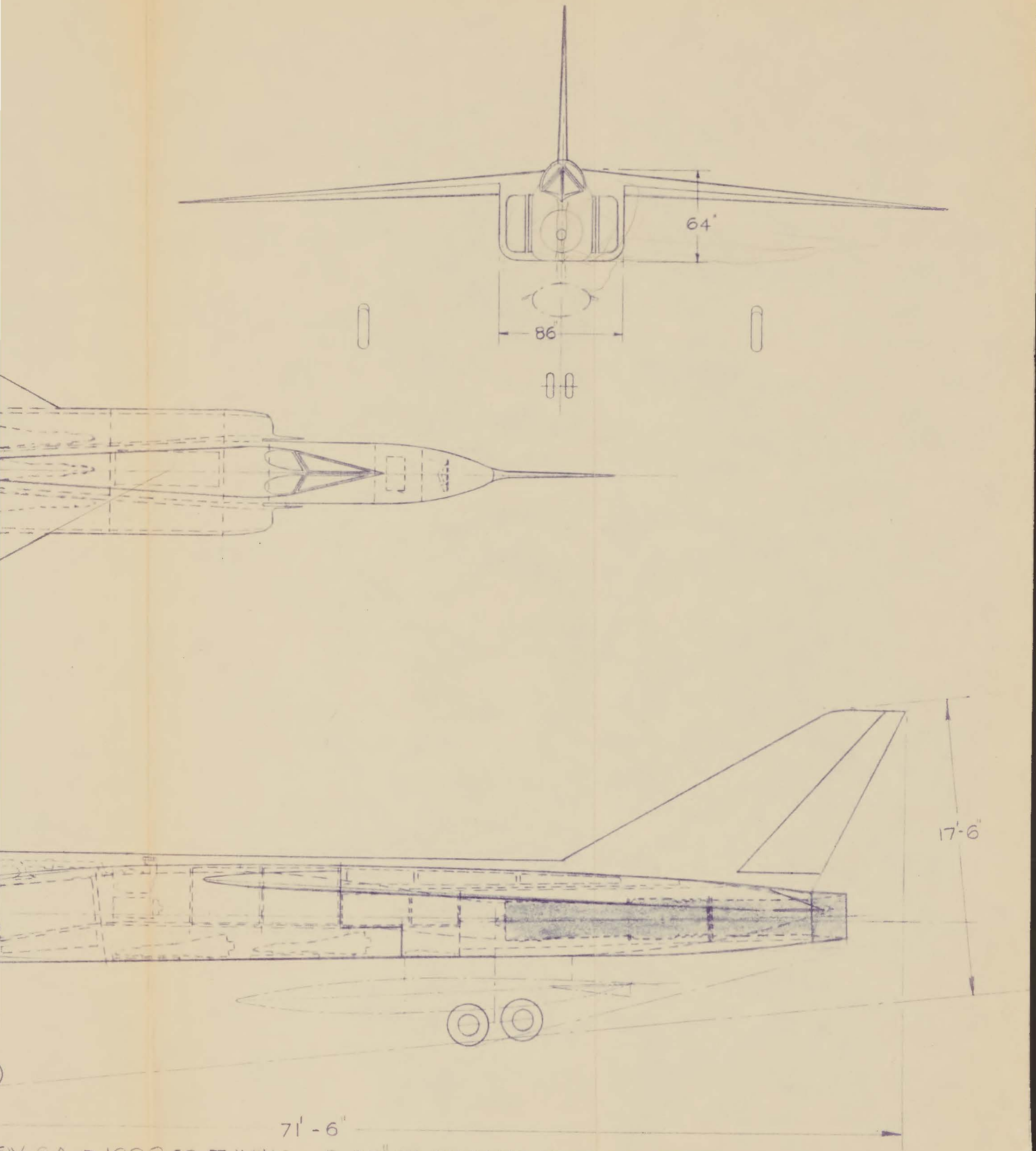

EW G.A. - 1000 SQ. FT. WING - 2-30" DIA. ENGINES, 10 000 LB. THRUST.