

106-1

prologue

FILE IN VAULT

Tom Dugelby

Productions

QCX
AVRO
CF105
MISC-
19

CF-105 Engineering

Chronology.

Sections ^{ANALYZED} 1-3

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CP-105 ENGINEERING CHRONOLOGY

Prologue
Tom Dugelby
Productions

COPY NO. 5

Design Research Group
Avro Aircraft Ltd.,
September, 1955.

13723557

C O N T E N T S

	<u>PAGES</u>
SUMMARY	1
CF-105 Abbreviated Chronology	2 - 16
CF-105 Design Summary & G.A. Drawing	
INTRODUCTION	1
1. Project Study Stage (July/48 - August/53)	1 - 14
2. Specifications	1 - 6
3. Contractual & Fiscal	1 - 9
4. Schedules	1 - 5
5. Design Changes & Program Philosophy	1 - 8
6. Performance & Stability	1 - 7
7. Aerodynamic Testing	1 - 2
8. Armament & Electronics	1 - 17
9. Armament & Electronics Testing	1
10. Engines	1 - 10
11. Structures	1 - 4
12. Structural & Functional Testing	1
13. Miscellaneous Equipment & Services	
General	1 - 4
13.1 Radio	5 - 6
13.2 Hydraulics System	7 - 8
13.3 Cockpit	9 - 12
13.4 Electrical System	13 - 14
13.5 Fuel System	14 - 15
13.6 Oxygen System	16
13.7 Damping System	17 - 18
13.8 Air Conditioning	19
14. Flight Testing	1 - 2
15. Readiness & Standby	1 - 2

CONTENTS (cont'd.)

TABLES & CHARTS

- TABLE 1 Structural Plastic & Antenna Research Model Programs.
- TABLE 2 Wind Tunnel Model Program.
- TABLE 3 Free Flight Model Program.
- APPENDIX 1 Supersonic C_{Dmin} .
- APPENDIX 2 Subsonic C_{Dmin} .
- APPENDIX 3 Weight Progress (Trend).
- APPENDIX 4 Weight Progress (Detailed).

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AUG 50 TO NAE UNDER LOOK PROJECT STUDIES ON POSSIBLE CONFIGURATIONS
AND ISSUED REPORT "FURTHER STUDIES OF THE REQUIREMENTS & DESIGN
OF AN INTERCEPTOR FIGHTER" DATED OCT 50

C-103 STUDY SUBMITTED BY AVROE - SWEEP WING VERSION OF
CF-100 AVRO AUTHORISED TO PROCEED WITH DESIGN & DEVT

C-103 PRELIMINARY & DETAIL DESIGN

PROJECT STUDY OF SINGLE SEAT, 6% $\frac{1}{2}$ DELTA MID WING CONFIGURATION, PITST INTAKE,
APG-37 RADAR, 2 SAPHIRE 4 ENGINES + ROCKET MOTOR - C.104
PROJECT STUDY OF SINGLE & 2 SEAT, 3% - 6% $\frac{1}{2}$ DELTA MID WING CONFIGURATION, PITST INTAKE,
APG-37 & 40 RADAR, 5 MISSILES, 2 x T.R.9 ENGINES + ROCKET MOTOR - C.104
C-104 PROJECT STUDY - 3% $\frac{1}{2}$ DELTA HIGH WING, 2x T.R.9 ENGINES, SIDE INTAKES

C-104 PROJECT STUDY, 3% $\frac{1}{2}$ LOW WING DELTA. C-103 PROJECT CANCELLED - PERFORMANCE
& DELIVERY INCOMPATIBLE WITH THREAT

COMPARISON OF HIGH & LOW WING CONFIGURATIONS

ISSUE BY R.C.A.F. OF "FINAL REPORT OF THE ALL-WEATHER INTERCEPTOR REQUIREMENTS TEAM"

C.104/1 & 104/2 BROCHURES SUBMITTED BY AVRO TO RCAF. SINGLE & TWIN ENGINE STUDIES USING
T.R.9, B.O.I.3 OR J.67 ENGINES + A.I.B. 3% $\frac{1}{2}$ DELTA, 6 FALCON + 24x275 ROCKETS, UX-1179 R.C.S, SIDE INTAKES, NO A/C WTS

N.A.E. ISSUE REPORT LR-38 "EXAMINATION OF AVRO C-104/1 & 2 SUPERSONIC A.W. AIRCRAFT" - CRITICAL OF "g" PERFORMANCE & WEX
SUGGEST VERSION WITH 2x30" DIA. ENGINES WOULD ACHIEVE PERFORMANCE IMPROVEMENT FOR LOWER SIZE, WEIGHT & COST.
R.C.A.F. ISSUE OPERATIONAL REQUIREMENT O.R.11-63, 1st ISSUE "SUPERSONIC A.W. INTERCEPTOR A/C"

APPRAISAL OF LR-38 COMPLETED BY AVRO, 30" DIA. ENGINE PHILOSOPHY REJECTED SINCE NO SUCH REF AVRO
ENGINES UNDER DEVELOPMENT & USE OF THIS SIZE ENGINE RESTRICTS FLEXIBILITY RELATIVE TO C.104/2 NOTE 12 JAN

RCAF SPEC. AIR 7-4 ISS.1 ISSUED, "DESIGN STUDIES OF PROTOTYPE SUPERSONIC A.W. FIGHTER A/C." VISIT OF RCAF TE
TO AVRO TO DECIDE MINIMUM SIZE A/C TO FILL REQUIREMENT, SINGLE OR TWIN ENGINE, ETC.

AVRO SUBMIT DESIGN STUDY P/C-105/1 BASED ON AIR 7-3 & MINIMUM WEIGHT STUDY TO R.C.A.F

AVRO SUBMIT PROPOSAL PK-105/2 TO RCAF COVERING DESIGN, DEVELOPMENT & MANUFACTURE OF
2 PROTO A/C - TOTAL FINANCIAL FORECAST \$22,925,000 TO 31 MARCH 57.
AERO REPORT P/C-105/5

COMPLETED 2x30" ENGINE STUDY TO MEET SPEC. AIR 7-3, FINANCIAL AUTHORITY \$200,000 TO COVER THIS PHASE

R.B. 106 ENGINE SELECTED FOR INSTALLATION IN CF-103

RELEASE OF PRELIMINARY PROJECT SCHEDULES TO DRAWING OFFICE COMMENCED

SUB-SONIC & TRANSONIC WIND TUNNEL TESTING OF C-105 MODEL COMMENCED AT CORNELL - 5% 30% NO CAMBER
AMEND #2 TO MIN. DIRECTIVE RECEIVED. OFFICIAL STOP WORK ON PROJECT FROM D.P. DUE TO N.A.E
2x30" ENGINE CONTROVERSY, FINANCIAL AUTHORITY INCREASED TO \$500,000 TO COVER WORK DONE. AVRO
AUTHORISED TO MAINTAIN SMALL STAFF ON PROJECT TO BE CHARGED TO O/H HEAD.

AVRO SUBMIT PROPOSAL TO RCAF FOR DESIGN, DEVELOPMENT TOOLING & MFR OF 2 PROTO. A/C.
FORECAST TO 1st FLIGHT 2nd A/C \$22,925,000. ENG^c ESTIMATE TOTAL COST PROGRAM \$27,664,513.

COMMENCEMENT OF MINOR STRUCTURAL & FUNCTIONAL TESTING (e.g. WEAR CHECK ON HANO HINGE,
HONEYCOMB PANEL TESTS, BEARING SELECTION TESTS
AMEND #4 TO MIN. DIR. REINSTATED CF-103 PROGRAM TO DESIGN, DEVELOPE & PROTO MFR

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2 x J.75 ENGINES AVAILABLE (EST.)

ESTIMATED 1ST FLIGHT OF 1ST AIRCRAFT

ESTIMATED 1ST FLIGHT OF 2ND A/C

ESTIMATED 1ST FLIGHT OF 6TH & 7TH A/C WITH P.S.13'S

ESTIMATED AVAILABILITY OF 1ST HUGHES I.E.S.

ESTIMATED DELIVERY OF 1ST A/C (#16) FOR R.C.A.F FLIGHT TEST PROGRAM.

ESTIMATED DELIVERY OF 1ST OPERATIONAL A/C (#37) TO R.C.A.F SQUADRONS

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PAGE 1

ESTIMATED 1ST FLIGHT OF 2ND A/C
ESTIMATED 1ST FLIGHT OF 6TH & 7TH A/C WITH P.S.13'S

ESTIMATED AVAILABILITY OF 1ST HUGHES I.E.S.

ESTIMATED DELIVERY OF 1ST A/C (#16) FOR R.C.A.F FLIGHT TEST PROGRAM.

ESTIMATED DELIVERY OF 1ST OPERATIONAL A/C (#37) TO R.C.A.F SQUADRONS

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C F - 1 0 5 D E S I G N									
<u>ITEM</u>	<u>DATE</u>	<u>DESIGN</u>	<u>WING</u> <u>SPAN</u> <u>(FT)</u>	<u>OVERALL</u> <u>LENGTH</u> <u>(FT)</u>	<u>OVERALL</u> <u>HEIGHT</u> <u>(FT)</u>	<u>WING</u> <u>AREA</u> <u>(SQ.FT.)</u>	<u>WING</u> <u>t/c</u> <u>(%)</u>	<u>CREW</u> <u>NO.</u>	<u>POWER UNIT</u>
1	July 1948	C100S	52	51.25	13.0	624	9.0	Two	2 x Orenda
2	July 1949	C100D	50.0	67.6	22.0	850	6.58	Two	2 x Orenda + A
3	Nov. 1949	C104	49.5	68.5	21.0	888	6.58	Two	2 x Orenda + A
4.	July 1950	C104	49.5	67.0	20.5	888	6.58	Two	2 x Orenda + A + 2 Rocket Eng
5	Jan. 1951	C103	50.5	54.25	17.6	800	8.0	Two	2 x Orenda + A
6	Aug. 1951	C104	46.5	61.0	17.0	770	6.5	Single	2 x Sapphire 4 + Rocket Engine
7	Aug. 1951	C105	41.0	63.0	16.0	600	6.5	Single	Rocket Engines (30,000 lb.)
8	Sept. 1951	C104	48.0	56.0	16.75	1200	6.0	Single	2 x Sapphire 4 +A/B + 5000 lb. rocket engine.

105 DESIGN SUMMARY

<u>CREW NO.</u>	<u>POWER UNIT.</u>	<u>INTAKE TYPE</u>	<u>RADAR</u>	<u>ARMAMENT</u>	<u>GROSS DESIGN WEIGHT</u>	<u>REMARKS</u>	<u>REFERENCE DRAWING</u>
Two	2 x Orenda	Pitot Nacelles	British Mk.9 AI	Guns and Rockets (as C100)	32,930	Modified C100 Fuselage and nacelles and 35° swept low wing with fixed tailplane on top of fin. Became C103 in 1951.	SK 20000 July 13/48.
Two	2 x Orenda +A/B	Flush Fus. Intakes	AN/APS 19A	4 Aden 30mm Cannon	40,610	43° swept low wing with fixed tailplane. Became C104. Major changes from (1): buried engines in fus. and flush intakes.	SK 20002 July 4/49
Two	2 x Orenda + A/B	Fus. Side	AN/APS 19A	4 Aden 30 mm Cannon	41,000	43° swept low wing with fixed tailplane. Major changes from (2): wing root intakes, buried engines side by side.	SK 20037 Nov.7/49
Two	2 x Orenda + A/B + 2 Rocket Eng.	Fus. Pitot	AN/APS 19A	Armament Bay for 18 Small Missiles	48,000	43° swept mid wing with fixed tailplane. Major changes from (3): fus. nose intake, mid wing armament bay, engines over each other.	SK 20066 July 24/50.
Two	2 x Orenda + A/B	Pitot Nacelles	AN/APS 19A	T160 Guns Rocket Pack	46,670	40° swept low wing with fixed tailplane. Development of item (1) above with 5° more sweep and redesigned tailplane.	SK 20155 Jan.12/51
Single	2 x Sapphire 4 + Rocket Engine	Fus. Pitot	APG 37	Provision for missiles and/or rockets.	38,400	55° swept low wing with flying horizontal tailplane. Major changes from (4): sweep increased to 55°, single crew.	SK 20308 Aug.24/51
Single	Rocket Engines (30,000 lb.)	None	APG 37	Provision for missiles &/or rockets.	50,580	55° swept low wing with flying horiz. tailplane, proposed as lower cost airplane with limited endurance. Combat radius 104 n.mi.	SK 20309 Aug.27/51.
Single	2 x Sapphire 4 +A/B + 5000 lb. rocket engine.	Fus. Pitot	APG 37	Provision for missile bay.	-	First delta configuration developed from item (6) above.	SK 20312 Sept.6/51.

ITEM	DATE	DESIGN	WING SPAN (FT)	OVERALL LENGTH (FT)	OVERALL HEIGHT (FT)	WING AREA (SQ.FT.)	WING t/c (%)	CREW NO.	POWER UN.
9	Oct. 1951	C104	48.0	54.0	17.0	1200	6 body side 3 T.J.-tip	One	2 x Orenda + 5000 lb. Rocket Engi
10	Nov. 1951	C104	48.0	56.25	14.5	1200	3	Two	2 x Orenda + A/B + 5000 Rocket Engi
11	Dec. 1951	C104	48.0	59.5	16.0	1185	3	Two	2 x Orenda + A/B
12	June 1952	C104/1	32.5	58.8	18.5	617	3	One	1 x Orenda T + A/B or 1x B tol OL3 + A/ 1 x C.W.J.67
13	June 1952	C104/2	48.0	70.25	21.25	1189	3	One	2 x Orenda T + A/B or 2x B tol OL3 + A/ 2x C.W.J.67
14	Mar. 1953	C104/2	50	73.14	19.75	1225	3	One	2 x C.W.J.67 + A/B
15	Aug. 1953	C105	50.0	73.14	19.75	1225	3	Two	2 x R.R. RB + A/B

F - 105 DESIGN SUMMARY (cont'd.)

<u>CREW NO.</u>	<u>POWER UNIT</u>	<u>INTAKE TYPE</u>	<u>RADAR</u>	<u>ARMAMENT</u>	<u>GROSS DESIGN WEIGHT (LB.)</u>	<u>REMARKS</u>	<u>REFERENCE DRAWING</u>
One p	2 x Orenda TR9 + 5000 lb. Rocket Engine	Fus. Pitot	APG 37	Provisbn for miss- ile bay.	52,050	Delta configuration. Main changes from item (8): wing t/c reduced from T.J. to tip to 3%: use Orenda TR9.	SK 20317 Oct.5/51
Two	2 x Orenda TR9 +A/B + 5000 lb. Rocket Engine.	Fus. Pitot	APG 40	5 Missiles (Falcon)	52,050	Main changes from item(9): 3% wing throughout, high wing, two crew, increased sweep to 50° intakes in fus. side.	SK 20323 Nov.15/51.
Two	2 x Orenda TR9 + A/B	Fus. Side	APG 40	5 Missiles (Falcon)	51980	Main changes from item (10): low wing (part of general high/low wing studies), engine removed from above. Deletion of rocket engine.	SK 20328 Nov.15/51.
One	1 x Orenda TR9 +A/B or 1x Bris- tol OL3 + A/B or 1 x C.W.J.67 +A/B	Fus. Side	MX 1179 I.E.S.	6 Falcon Missiles 24-2.75" FFAAR	28,200	Subject of study submitted to RCAF for A.W. high performance fighter. Main changes from item(11): single engine, single crew, introduction of MX 1179 I.E.S. light weight.	SK 20432 June 5/52.
One	2 x Orenda TR9 +A/B or 2x Bris- tol OL3 + A/B or 2x C.W.J.67 + A/B.	Fus. Side	MX 1179 I.E.S.	6 Falcon Missiles 24-2.75" FFAAR	52,000	Subject of study submitted to RCAF for A.W. high performance fighter. Submitted in conjunction with item(12).	SK 20433 June 5/52.
One	2 x C.W.J.67 + A/B	Side + Ramp + B.L. Bleed	MX 1179 I.E.S.	6 Falcon Missiles 48-2.75" FFAAR	54,000	Development to C104/2 sub- mitted to RCAF. Introduc- tion of electronics crate, V windshield and ramp with boundary layer bleed.	SK 20669 Mar.23/53.
Two	2 x R.R. RB 106 + A/B	Side + Ramp + B.L. Bleed	MG3/E9	6 Falcon Missiles 50-2.75" FFAAR.	56,865	Major changes from item (14): re-arrangement for two crew capable of conversion to single crew when complete integrated electronic system MX 1179 available. Meanwhile E9 fire control. Introduce negative camber 0.75%, and RB 106.	SK 20785 Aug.29/53.

ITEM	DATE	DESIGN	WING SPAN (FT)	OVERALL LENGTH (FT)	OVERALL HEIGHT (FT)	WING AREA (SQ.FT.)	WING t/c (%)	CREW NO.	POWER UNIT
16	May 1954	C105	50.0	73.14	20.75	1225	3.5 B.S.-T.J. 3.8 Tip	2	2 x C.W. J.67 + A/B
17	Nov. 1954	C105	50.0	75.95	21.3	1225	3.5 B.S. - T.J. 3.8 Tip	2	2 x C.W. J.67 + A/B
18	June 1955	C105	50	75.95	21.25	1253	3.5 B.S. - T.J. 3.8 Tip	2	2 x P & W J.75 + A/B 2 x Orenda P.S.13 + A/B

05 DESIGN SUMMARY (cont'd.)

<u>CREW NO.</u>	<u>POWER UNIT</u>	<u>INTAKE TYPE</u>	<u>RADAR</u>	<u>ARMAMENT</u>	<u>GROSS DESIGN WEIGHT (LB.)</u>	<u>REMARKS</u>	<u>REFERENCE DRAWING</u>
2	2 x C.W. J.67 + A/B	Side + Ramp + B.L. Bleed	MG3/E9	8 Falcon (Model E)	65,393	Major changes from item (15): increase wing t/c to 3.5% between B.S. and T.J. and 3.8% tip in- crease fin t/c to 3.5% root and 3.8% tip, C.W. J.67 engine, delete avionics crate, delete rockets.	7-0100-1 May 31/54.
2	2 x C.W. J.67 + A/B	Side + Ramp + B.L. Bleed	MX 1179 (Mod.)	8 Falcon (GAR-1A)	67,730	Major changes from item (16): introduction of 5% notch, 10% L.E. extension 15% increase in fin area, large nose for increased radar antenna (38" dia. scanner) fin t/c increased to 4%.	7-0100-6 Nov. 25/54.
	2 x P & W J.75 + A/B 2 x Orenda P.S. 13 + A/B	Side + Ramp + B.L. Bleed	MX 1179 (Mod.)	8 Falcon (GAR-1A/1C)(J.75) 4 Sparrow II	68,196	Major changes from item (17): introduction of L.E. droop, Area Rule mods., engine J.75 or P.S. 13.	General Illustrating 775-105-1 June/55.

INTRODUCTION

The CF-105 'Engineering Chronology' is the result of considerable sifting of the multifarious data relating to the CF-105 project between the time of the inception of a 'high performance, all-weather fighter' in 1948, and the concept now, to NCAF Spec. AIR-7-4.

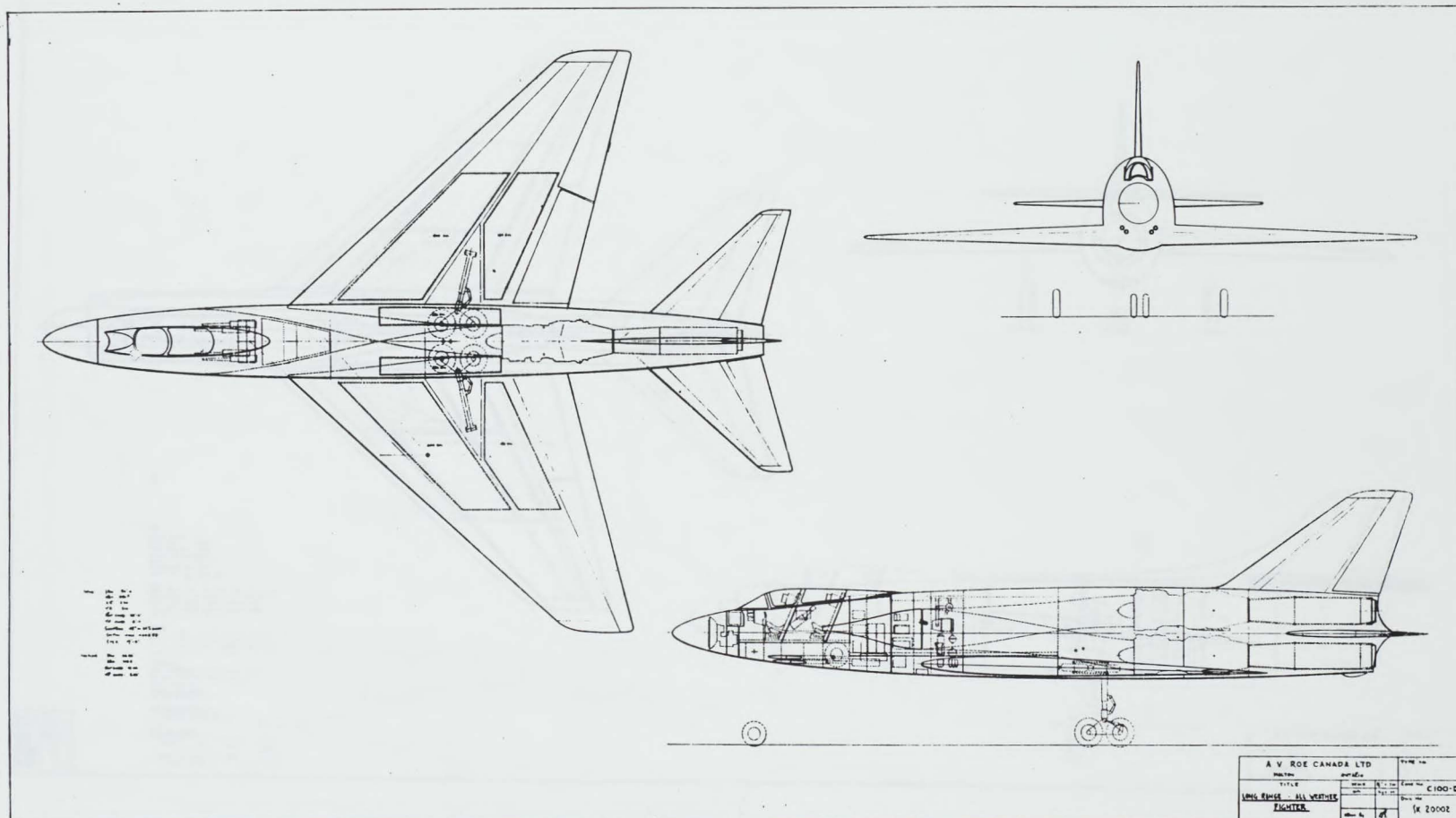
The 'Chronology' is based on correspondence, meeting minutes, schedules and internal memoranda. It is primarily restricted to engineering fact, recommendation and decision though it does contain a certain amount of the contractual and fiscal data. It includes test programs, other than structural and functional which are presently incomplete for presentation, weight progress, drag assumptions and the highlights of the configurations which have evolved through the design period.

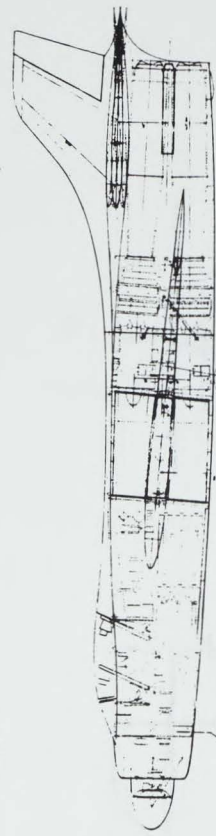
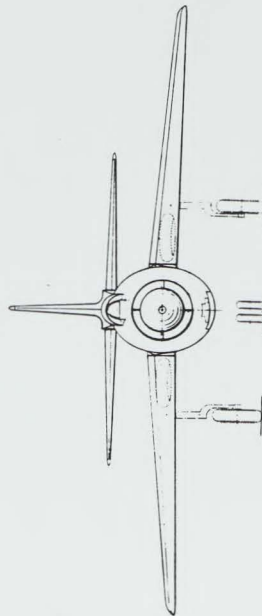
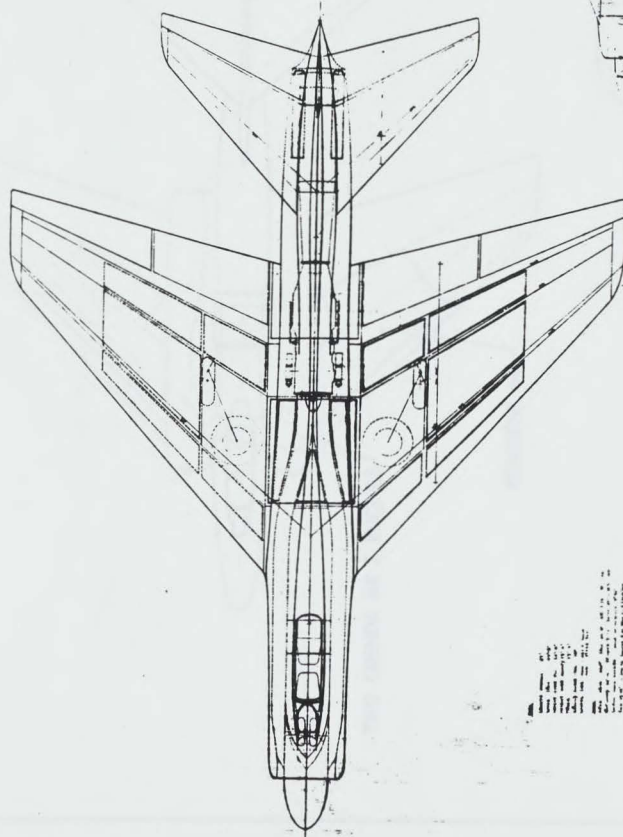
For simplicity, the 'Chronology' is presented under broad subject headings and to some extent referenced, to enable, as far as possible, the progress of a particular item (e.g. engine, armament, etc.) to be readily analysed.

The 'Chronology' is believed to be reasonably complete within the scope of available data. This is scant for the earlier years and it is perhaps noteworthy that there are instances where it is known a decision is made, but ratification, generally on the part of the Air Force, has been overlooked.

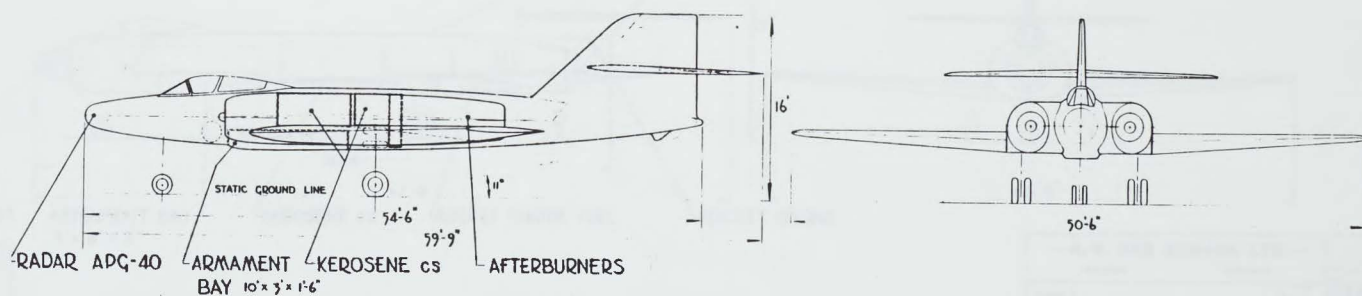
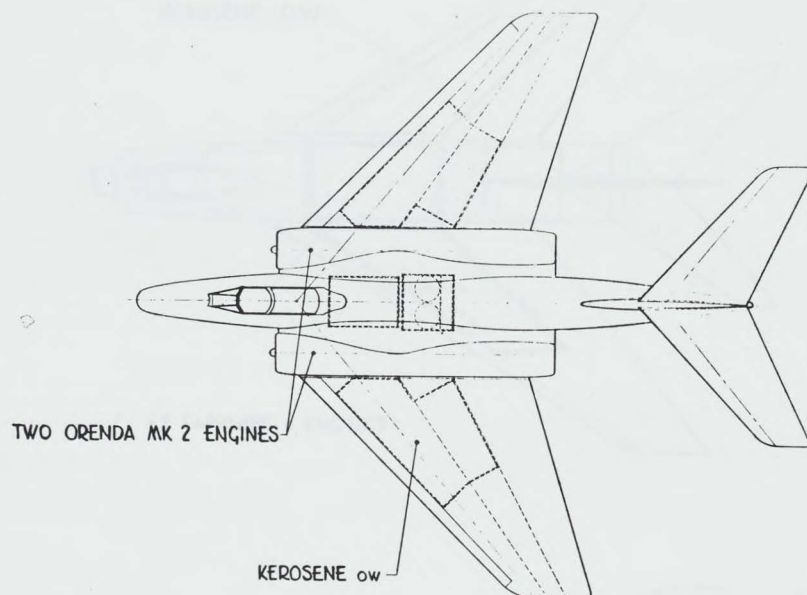
It is important to remember that during project study years (1948-1953) the C103 and C104 were separate entities in so far as design concept. The C103 was essentially developed from the C100, whereas the C104 was an entirely new design.

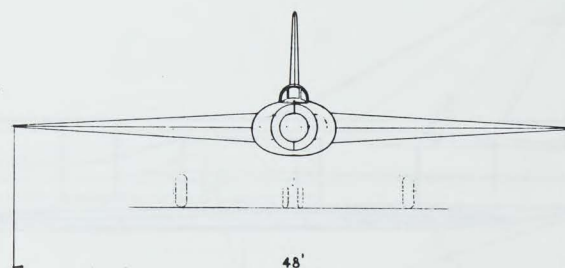
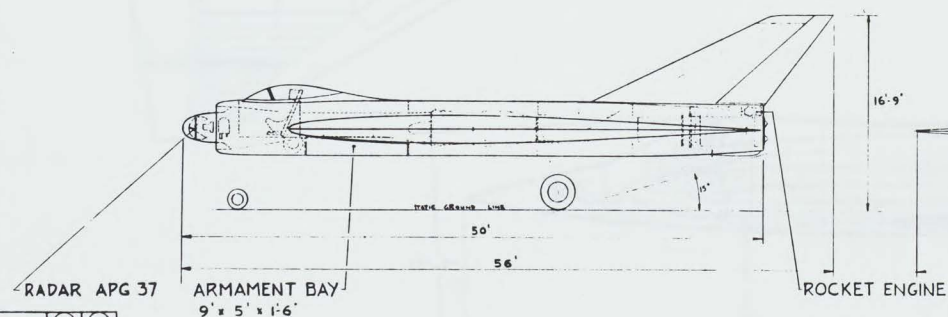
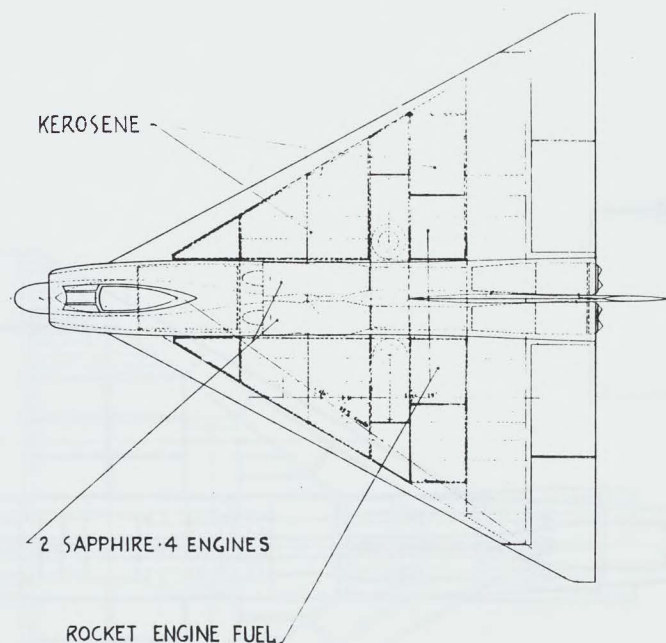
As a preliminary step the 'Chronology' is presented in 'draft' form, without much attention to finesse to enable the value of the document to be assessed and perhaps modified, for the best final presentation.





A. V. ROE CANADA LTD.	
Project No.	100-100
Sheet No.	100-100
Scale	1/2" = 1'-0"
Author	J. H. Jones
Checked	
Approved	

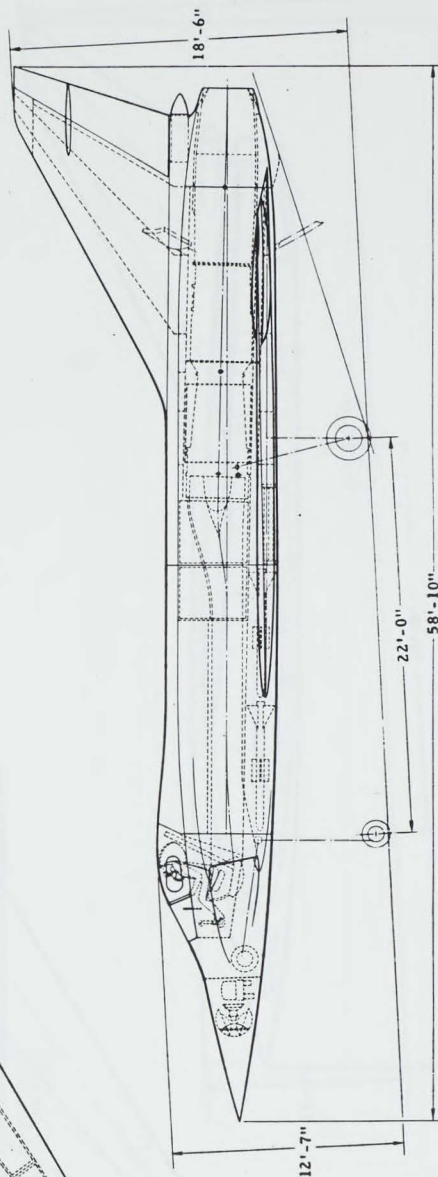
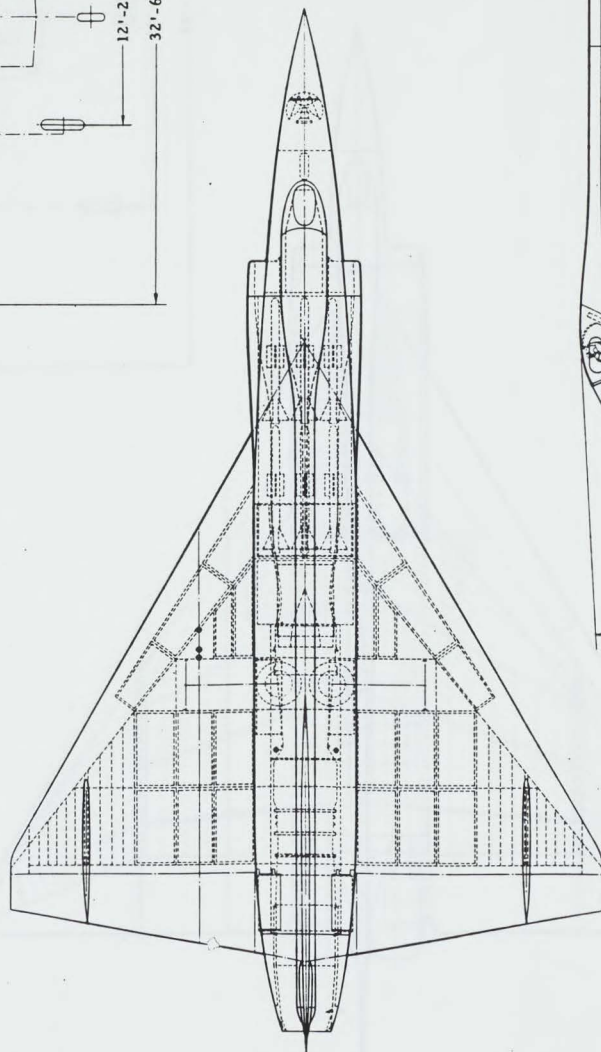
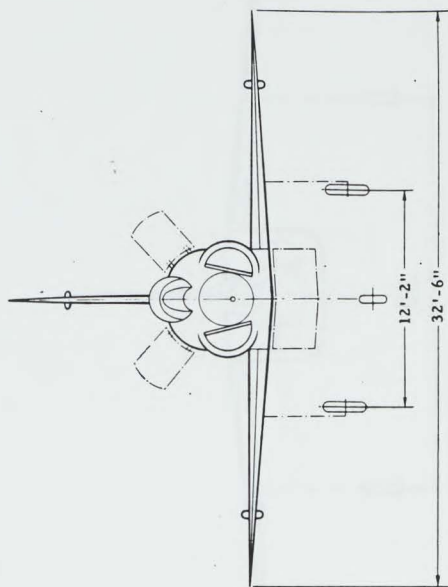




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DATE	11-1-51	
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TERMINAL APP.		
CONTRACT APP.		

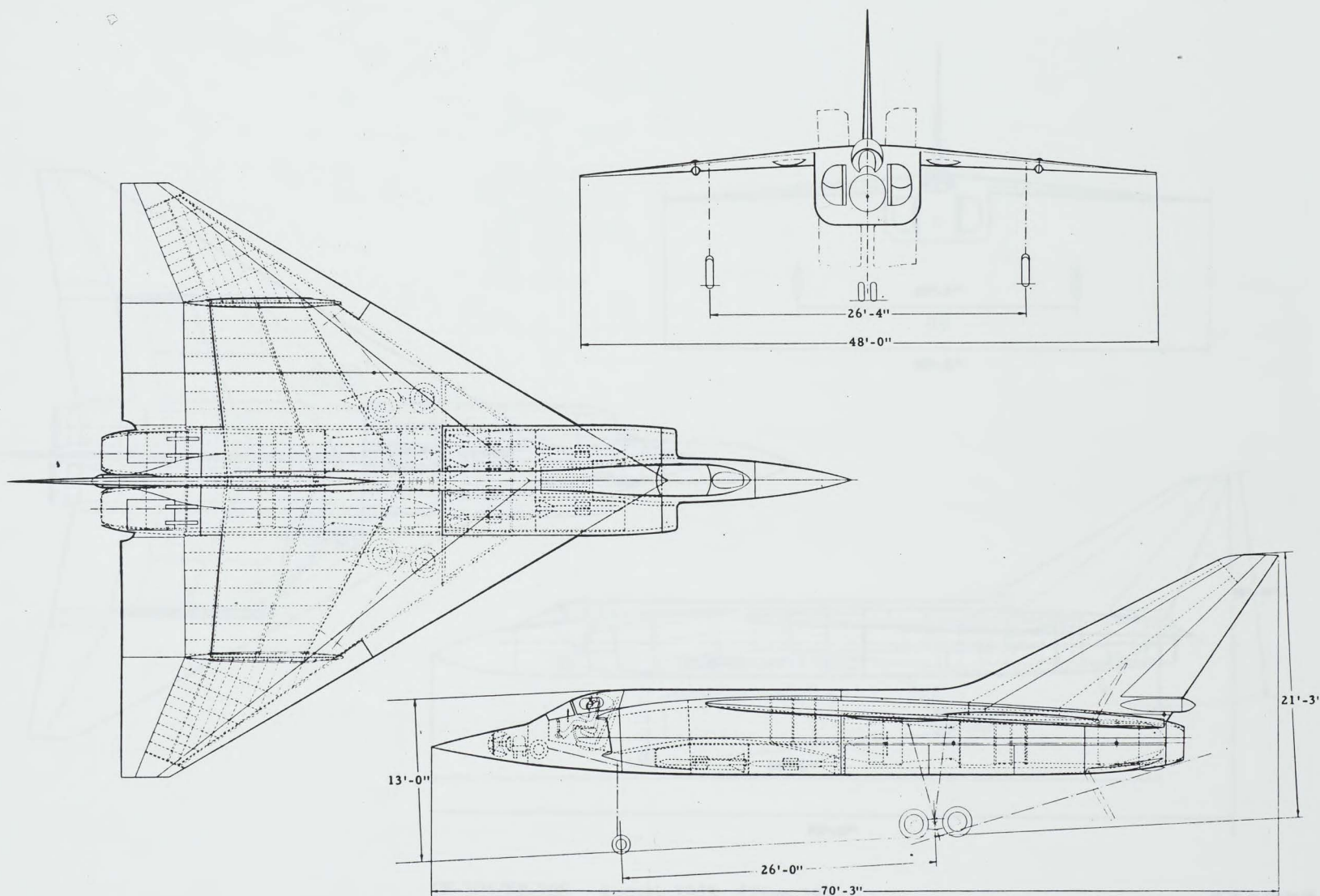
— A. V. ROE CANADA LTD. —			
MALTON		ONTARIO	
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DESCRIPTION	SINGLE SEAT - ALL WEATHER	TYPE	C103 DATA
GROUP	FIGHTER	DRAWING NO.	SK 20312
COMMENTS		DATE	

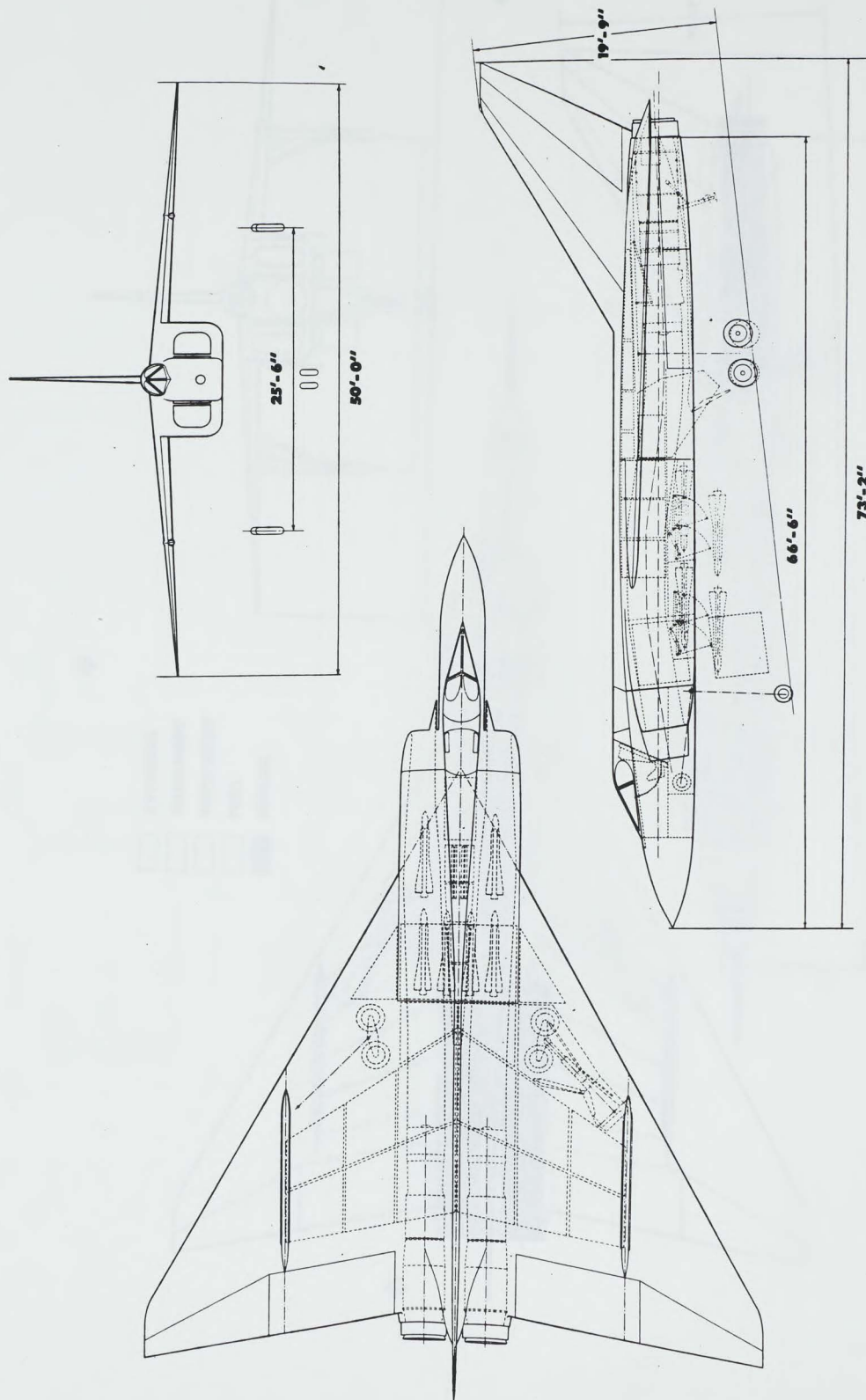
C103/Sn. 4 September 1951 (Item 5)



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01017 - HMC T-1000 (T-1000)





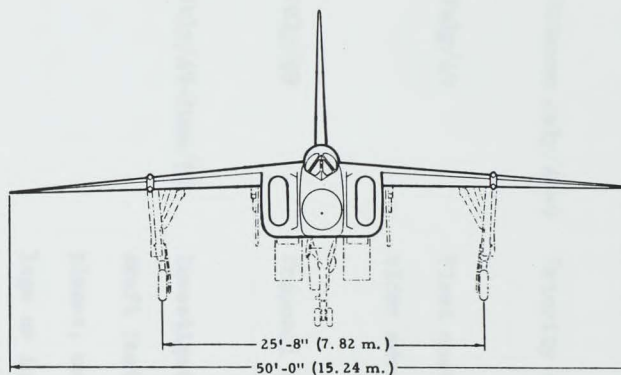
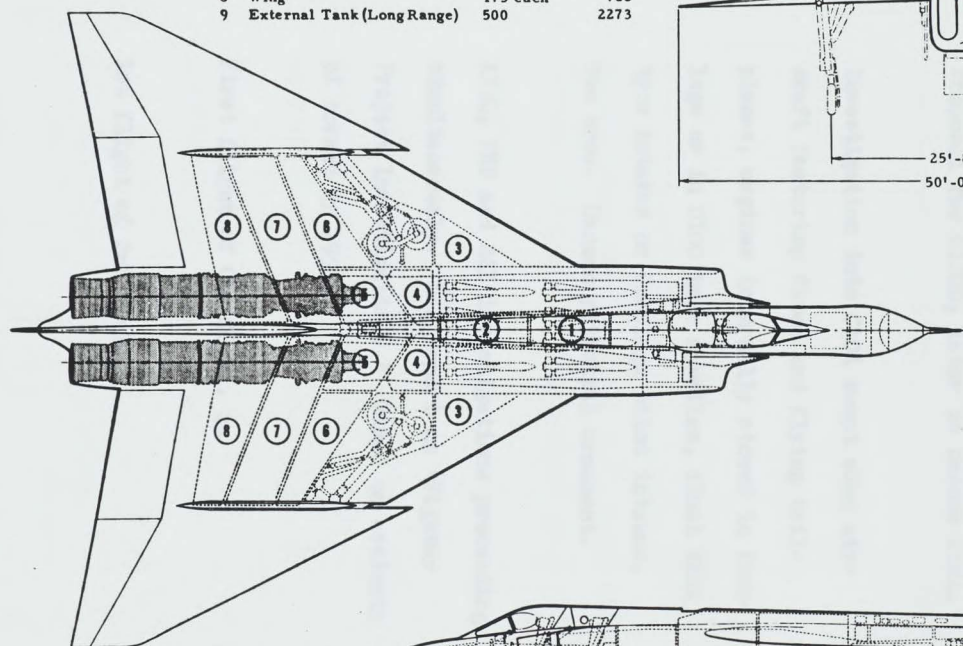
CF-105/BB.106 August 1953 (Item 15)

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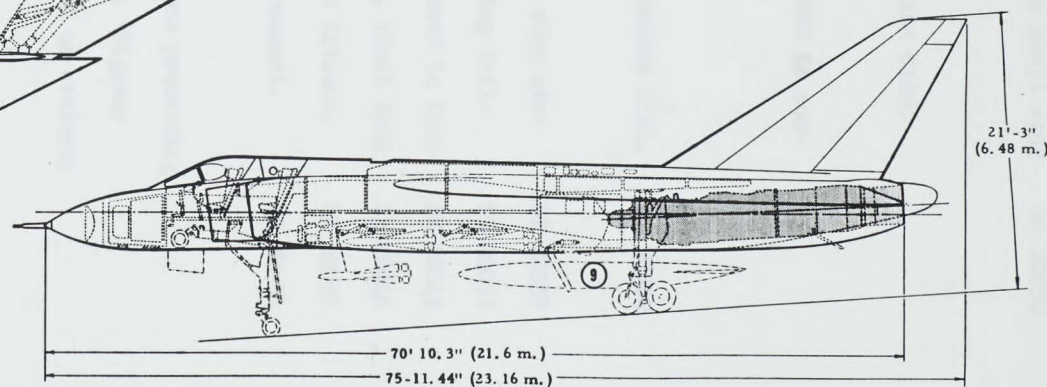
Page 14

SECRET

Tank	Location	Capacity	
		Imp. Gal.	Litres
1	Fuselage	277	1259
2	Fuselage	281	1277
3	Wing	151 each	686
4	Wing	90 each	409
5	Wing (collector)	146 each	664
6	Wing	154 each	700
7	Wing	279 each	1268
8	Wing	173 each	786
9	External Tank (Long Range)	500	2273



AVIONICS
ARMAMENT
EQUIPMENT
FUEL
ENGINE



CF-105/P.S.13 June 1955 (Item 18)

775-105-1

D R A F T

1. PROJECT STUDY STAGE (July/48 - August/50)

<u>DATE</u>	<u>DETAILS</u>	<u>REFERENCES</u>
July/48	Avro submit to AF proposal for swept wing C100, later to become C-103.	SK 20000
Between July/48-9	Priority development of C100 and C102.	
July/49	First meetings AFHQ, DRB and NAE to consider advanced fighter.	
July/49	Proposal for C100D, later to become C104.	SK 20002
July/49-June/50	Investigation into C104 swept wing aircraft featuring fixed and flying tail-planes, engines internally stowed in fuselage or in C100 type nacelles, flush NACA type intakes or fuselage pitot intakes.	SK 20037 SK 20038 SK 20045 SK 20046 SK 20055
	Two crew. Cannon principal armament.	SK 20058
	AFHQ, DRB and NAE investigations proceeding simultaneously. NAE report on 'Fighter Project Investigations.' Based on estimate of threat in 1956.	
Jan./50	First flight of CF-100 Mk. 1.	Jan./50
July/50	1st flight of 2nd CF-100	July/50

<u>DATE</u>	<u>DETAILS</u>	<u>REFERENCES</u>
July/50	Dept. of Trade and Commerce requested by AF to authorise Avro to commence design studies on an advanced fighter. Charge cost to CD-87 (CF-100).	
July/50	Preliminary brochure on C104. 3 schemes for long range all-weather fighter. Swept wing, twin Orendas (8000 lb.) engines plus rocket motors (6000 lb.), 2 crew t/c 6.58%.	Prelim. brochure 'L.R. All-weather Fighter' - Dec./49.
Sept./50	Outbreak of Korean war.	
Dec./50	Swept wing C100 submitted to AF, designated C103. 2 Orendas (8000 lb.), rockets and guns, 2 crew, low wing, 800 ft. ² , sweep 40°. Company authorized to proceed with this airplane.	SK 20155 - Jan.12/51
Jan.- Aug./51	Priority given to C103 development. Only slight progress with C104 due to heavy commitment on C100 and C103 programmes.	
Feb./51	C103 Detail design commenced.	
Mar./51	C103 Wind tunnel testing commenced.	
June/51	C103 Jig and tool manufacture commenced.	

<u>DATE</u>	<u>DETAILS</u>	<u>REFERENCE</u>
Aug./51	Proposal for C105 Rocket aircraft. Lower cost, short range (120 n.m. rad.) project using 30,000 lb. rocket thrust, 600 ft. ² , t/c 6.5%, sweep 55°.	Brochure on 'Proposed Rocket-Powered Interceptor' - Aug./51 also SK 20309 Aug. 27/51.
Aug. - Sept./51	First delta configuration C104. 2 Sapphire 4, plus 1 rocket engine, 1200 ft. ² , t/c 6%, 1 crew, APG 37 radar, missile bay, mid-wing.	SK 20312, Sept./51
Sept./51	Avro submit to AF, at their request, 3 studies of an advanced supersonic fighter with a view to establishing a specification for this type of aircraft. Project designs between July and Sept./51. (a) C103 swept wing development for short range interceptor (C104/SP) 220 st.mi. radius. Auxiliary rocket, 55° sweep, single crew, t/c 6.5%, 770 sq.ft. wing area. (b) C103 swept wing development for long range search and interceptor aircraft (C104/LR) 350 st. mi. radius with auxiliary rocket OR 760 st. mi. with afterburners only. 55 deg. sweep, 2 crew, t/c 6.5%, 900 sq. ft. wing area.	Brochure on 'Proposed Supersonic Fighters' - Sept./51.

DATE

DETAILS

REFERENCES

(c) Delta version - C104 having similar performance to the short range version (a) above, single crew, t/c 6%, 1200 sq.ft. wing area.

Each version powered by 2 Sapphire 4's plus rocket motors. Submitted also to Avro Manchester (see Comments Jan./52).

Sept - Oct./51	C104 investigate t/c reduction from 6% to 3%, 2 crew vs. 1 crew, Falcon missiles introduced, 2 Orenda TR-9 plus 1 rocket engine, radar changed from AFG 37 to AFG 40 1155 ft. ²	SK 20317, 20320 Oct./51
Oct./51	1st C100 delivered to RCAF (Mk. 2).	
Oct. - Nov./51	C104, investigate engine removal, mid wing to high wing, engine intakes from fuselage pitot to fuselage side, t/c fixed at 3%, 5 Falcon missiles, 2 TR-9 plus A/B plus 1 rocket engine, 2 crew.	SK 70323/24/28 Nov./Dec./51
Dec./51	C103 Project cancelled. Performance and delivery incompatible with threat.	
Dec./51 - Mar./52	C104 - Further studies comparison high/low wing, undercarriage with outriggers, engine intakes now at fuselage side, 24 - 2.75" FFAAR plus 6 Falcon missiles.	SK 20348-91 Jan./Mar./52.

<u>DATE</u>	<u>DETAILS</u>	<u>REFERENCES</u>
Jan./52	C104 performance summarized. 450 n.mi. radius with 10 mins. combat at 50,000 ft. at 1.4 M.N. and reserves. General outline of C104 Advanced Fighter Project.	DND file. Letter E.H. Atkin to A/C Carscallen - Jan. 4/52
Jan./52	Avro Manchester comment on 'Proposed Supersonic Fighters' brochure issued Sept./51 to RCAF. 3 versions of C104: C104 L.R., C104 S.R., C104 delta. Avro Manchester suggests: (a) Aircraft too large, therefore too heavy. (b) t/c too high. Suggest 4% maximum. (c) Intake bullet too blunt. Low intake efficiency. (d) Dubious advantage of rocket motors.	Avro Manchester IPD report no. 143 - Jan. 1 1952
Mar./52	All-weather interceptor requirements received from RCAF: (a) <u>Combat performance with internal armament installed</u> Combat speed $M = 1.5$ @ combat load factor $n = 2$ @ combat altitude $H = 50,000$ ft. (b) <u>Combat performance with external armament installed</u> Combat speed $M = 1.2$ @ combat load factor $n = 2$ @ combat altitude $H = 50,000$ ft.	Advanced all-weather interceptor req'ts. Letter received June 25/52 after advance information Mar./52.

DATE

DETAILS

REFERENCES

- (c) Reach 50,000 ft. and combat speed from rest at S.L. in 6 mins.
- (d) Capable of 5 mins. combat at 200 n.mi. radius, supersonic cruise out.
- (e) Capable of 5 mins. combat at 300 n.mi. rad., subsonic cruise out. Capable of operation from 6000 ft. runways.
- (f) Internal Armament
6 missiles of Falcon size plus 50 folding fin 2" calibre rockets.
- (g) External Armament
2 missiles of 600 lb. weight, Meteor dimensions
OR
4 missiles of 300 lb. weight, Velvet Glove dimensions.
- (h) Design diving speed $M = 2$, but less than 700 knots E.A.S.
- (j) Design load factor 7.33, ultimate 11.0.

Mar. - June/52

C104 - Designed to Interceptor Requirements C104/1 June/52
of March/52. Issue brochures, C104/1 and C104/2 June/52
C104/2 to RCAF, June/52.
Basically the C104/1 was single engine as
against twin, wing area 617 ft.² (1189 ft.²)
gross design weight 28,200 lb. (52,000 lb.).

<u>DATE</u>	<u>DETAILS</u>	<u>REFERENCES</u>
	Both aircraft had 2 crew and carried 6 missiles and 24 - 2" FFAR rockets. C104/2 was computed to have slightly better performance, twin engine reliability, more range, more 'stretch' and the better buy! (See 'Comparison of C104/1 and C104/2 Supersonic Fighters' by J.C. Floyd and J.A. Chamberlin, Dec. 1, 1952. Bristol OL3 and C.W. J.67 now considered along with Avro TR-9 with Solar A/B. MX 1179 integrated electronic fire control system included in design proposal.	Comparison C104/1 & 2 Dec. 1/52.
June - Oct./52	Development work on single seat C104/2 version.	SK 20433-45 June/Oct./52.
Sept./52	Hughes confirm proposed launching arrangement for Falcon missiles from C104 is satisfactory.	Armament File Hughes letter ref. 4M25/301, Sep.19/5
Oct./52	1st Flight T.I. C100 Mk. 4.	
Oct./52	NAE report received on analysis of C104/1 and C104/2 proposals. NAE are broadly in agreement on the analysis of the aircraft. NAE recommend that C104/2 is unsuitable on the grounds of	NAE Laboratory Report LR-38, Oct.20/5

DATE

DETAILS

REFERENCES

excessive weight and expense. However, C104/2 features were preferable to those of C104/1 and NAE recommend that Avro evolve from C104/1 all the features of the larger aircraft for no appreciable increase in size, weight or expense. NAE recommend the use of hypothetical 10,000 lb. engines of approx. 30" dia. for the study.

Oct./52

Receipt of requirement changes for all-weather interceptor fighter concept from RCAF. Primarily the combat altitude is increased from 50,000 ft. to 60,000 ft.

Letter from AF
Oct./24/52.

Oct./52 - Jan./53

Study using 2 x 30" dia. engines per NAE suggestion in NAE report LR-38. Study changed altitude requirement.

Nov./52

Receipt of RCAF operational requirement OR1/1 - 63" Supersonic All-Weather Interceptor Aircraft" - 1st issue.

Dec. '52

Results of investigation into meeting increased altitude requirement indicate that unless a rocket engine is used not too much gain in altitude is achieved by modifying the planform in terms of wing

Operation of C104/1 & 2
at 60,000 ft. Dec.1/52

DATE

DETAILS

REFERENCES

area or span which would theoretically contribute a lower span loading and would reduce the excessive drag due to lift at high altitude.

Dec./52

Critical review of engine situation for C104. The basic requirement is for an engine giving at least 21,000 lb. with afterburner at sea level. Even then the 'g' performance will not be entirely satisfactory. The most suitable engines are as follows:

- (a) Bristol Olympus OL.3
- (b) Wright J.67
- (c) Rolls Royce P.A. 17
- (d) Pratt & Whitney J.57/75

Concluded that the Olympus 3 is the most suitable engine with respect to thrust, timing and availability.

Engines for C104

Dec. 1/52.

Dec./52

Estimated completion date of the first Prototype C104 is January 1956.

Engines for C104

Dec. 1/52.

Jan./53

Avro complete appraisal of NAE LR-38, incl. proposed 30" dia. engine. NAE concede 104/1 & 104/2 performance realistic. Philosophy rejected since no such engines

Aerodynamics Note

Jan. 12/53 in DND file.

Also Aerodynamics

Report July 29/53.

<u>DATE</u>	<u>DETAILS</u>	<u>REFERENCES</u>
	under development and use of this size engine restricts flexibility relative to C104/2.	
Feb./53	RCAF and Avro decide to proceed with C100 Mk. 6.	
Mar./53	Avro request use of CARDE facilities for aerodynamic testing. (Considered premature by AF since no specification issued for C105: Letter in Armament file, Mar. 25/53.	Armament file, JCF letter, ref.3171/02/3 Mar. 5/53.
Jan. - Mar./53	C104/2 - Development of Project. Introduction of Wright J.67 engine, air intake investigation resulting in fixed ramp and boundary layer bleed, V-windshield incorporated and removable electronics crate considered. Wing area 1225 ft. ²	SK 20669 - Mar.23/53.
Apr./53	Avro receive advance notice of RCAF Spec. AIR-7-3, Iss. 2, " <u>Design Studies</u> of Prototype Supersonic All/Weather Interceptor A/C".	RCAF Spec. AIR-7-3/1 May/53.

DATE

DETAILS

REMARKS

Apr./43

C104 - Exhaustive minimum weight study of C104 project to attempt to find the minimum weight of airplane required to meet RCAF Spec. AIR-7-3.

"Minimum Weight Study"

- J.A. Chamberlin,

Apr. 30/53.

Principally the investigation involved:-

(a) Reduction of Fuel weight to exactly that required to meet the spec. range.

(b) The use of 0.75% camber to reduce the drag and hence the fuel for missions.

(c) The use of lower stressing weight which is obtained by taking into account the above savings.

(d) The use of an ultimate load factor of 10 at the half fuel weight in place of 11 at the take-off weight as specified in AIR-7-3, para. 5.02.01.

The resultant weight saving under these headings was 5500 lb. Aircraft size was investigated for wing areas 1,225, 1,100 and 1,000 sq.ft., 3% t/c, cambered and adjustments to fuselage for balance. A further 2,000 lb. could be saved using a reduced wing area, but with certain disadvantages and risks dependent upon the weight growth of the airplane and uncertainties of drag estimation.

DATEDETAILSREFERENCES

Apr./53

Meetings with RCAF to discuss minimum weight airplane on basis of AIR-7-3. RCAF agreed to major concessions to permit Avro to design an optimum configuration. RCAF appreciate design problems and realize high design weight unavoidable if the stringency of AIR-7-3 is to be satisfied.

Avro anticipate an ultimate design gross weight 48,500 lb. Agreed that RCAF issue contract request to DDP for \$200,000 to be allocated Avro for further design work. RCAF will issue new specification.

Avro asked submit complete details of minimum weight investigation (see P/C-105/1).

May/53

Avro submit to RCAF results of minimum weight study and general design studies of C105 project including appendices for version with podded engines at the wing tips and version at 900 sq.ft. wing area. All studies with Rolls Royce RB-106 engines with afterburners and all based on AIR-7-3 with single crew. (Discussed with RCAF in June/53 - See minutes of meeting held June 8/53, ref. S1038-104(AMTS/DDA).

Meetings with RCAF
Apr. 27-30/53 - JCF
Note. Also DND file
Meeting Minutes: ref.
S1038-104(AMTS/DDA)
Apr./53.

Avro Report for C105
to AIR-7-3. P/C-105/1
May/53.

Avro rpt. P/C105/1
May/53.

<u>DATE</u>	<u>DETAILS</u>	<u>REFERENCES</u>
June/53	Avro submit proposal P/C-105/2 to RCAF covering design, development and manufacture of two prototype aircraft. Total financial forecast to flight of 2nd prototype (estimated Aug./57) is \$22,925,000.	P/C-105/2 June 2/52
July/53	AF/Avro discuss 2 x 30" dia. engine C105 version. AF agree impracticable. Stevenson happy that all versions now examined. Final discussions for Cabinet Defense Committee 2 x 30" dia. engine version AWW 41,000 lb., wing area 1000 ft. ² , t/c 3%, combat ceiling 61,700 ft., 'g' @ 50,000 ft. and 1.5 M.N. = 1.85, 6 Falcons. Fuel capacity 11,400 lb.	DND file. AF minutes of meeting July 6/53 ref.S1038-104(AMTS/DDA) July 9/53.
July/53	RCAF decide to abandon Mk. 6. Performance and delivery incompatible with threat.	C105 Costs file: letter FTS July 22/55
July/53	2 crew proposal due to uncertainties in development of fire control system suitable for single crew operation.	
July/53	Avro meeting with RCAF. Agree company proceed with 2 crew airplane with E9 electronic fire control system capable of being retrofitted with MX 1179 and changed to a single crew version.	Minutes of Meetings with RCAF - JCF July 2 also C105 Costs file: letter FTS July 22/53.

<u>DATE</u>	<u>DETAILS</u>	<u>REFERENCE</u>
July/53	Preliminary outline of proposal to fire rocket-propelled models of the C105 in co-operation with CAPDE.	Armament file, JAC letter ref. 5649/03/J
July/53	Ministerial Direction ACDA-4 received, authorizing design study of C105 to meet specification AIR-7-3. Financial authorization \$200,000 to cover phase until Sept. 30/53.	ACDA-4 July 29/53.
July/53	Avro conclude work on supersonic fighter with 2 x 30" dia. engines. Risk too great to design airframe around hypothetical engine which may never be designed.	P/C-105/5 - July 29/55
Aug./53	RB.106 selected for installation in C105. C105 design in progress on 1225 sq.ft. version, 2 crew.	SK20785 - Aug. 29/53.
Aug./53	J.A. Chamberlin quells internal criticism of basic wing structure. Agreed that layout of wing structure was basically right, that no advantage gained by changing over U/C attachment position or retracting space, or by reverting to low wing to ease U/C elastic problems.	C105 Meetings file G. Hake memo Aug. 31/53

2. SPECIFICATIONS

<u>DATE</u>	<u>DETAILS</u>	<u>REFERENCES</u>
Mar. '52	All-weather interceptor requirements received from RCAF.	Advanced All-weather Interceptor Req'ts. Letter received June 25/52 after advance information Mar./52.
	(a) <u>Combat performance with internal armament installed</u> Combat speed $M = 1.5$ @ combat load factor $n = 2$ @ combat altitude $H = 50,000$ ft.	
	(b) <u>Combat performance with external armament installed</u> Combat speed $M = 1.2$ @ combat load factor $n = 2$ @ combat altitude $H = 50,000$ ft.	
	(c) Reach 50,000 ft. and combat speed from rest at S.L. in 6 mins.	
	(d) Capable of 5 mins. combat at 200 n.mi. radius, supersonic cruise out. Capable of 5 mins. combat at 300 n.mi. radius, subsonic cruise out.	
	(e) Capable of operation from 6000 ft. runways.	
	(f) <u>Internal Armament</u> 6 missiles of Falcon size plus 50 folding fin 2" calibre rockets.	
	(g) <u>External Armament</u> 2 missiles of 600 lb. weight, Meteor dimensions OR 4 missiles of 300 lb. weight, Velvet Glove dimensions.	

(CARDE)

<u>DATE</u>	<u>DETAILS</u>	<u>REFERENCES</u>
	(h) Design diving speed $M = 2$, but less than 700 knots E.A.S.	
	(j) Design load factor 7.33, ultimate 11.0.	
Oct./52	Receipt of requirement changes for all-weather interceptor fighter concept from RCAF. Primarily the combat altitude is increased from 50,000 ft. to 60,000 ft.	Letter from AF Oct. 24/52.
Nov./52	Receipt of RCAF operational requirement OR 1/1 - 63" Supersonic All-Weather Interceptor Aircraft" - 1st issue.	
Apr./53	Avro receive advance notice of RCAF Spec. AIR-73 Issue 2, "Design Studies of Prototype Supersonic All-Weather Interceptor Aircraft."	RCAF Spec. AIR-7-3/2 May/53.
Apr./53	Meetings with RCAF to discuss minimum weight airplane on basis of AIR-7-3. RCAF agreed to major concessions to permit Avro to design an optimum configuration. RCAF appreciate design problems and realize high design weight unavoidable if the stringency of AIR-7-3 is to be satisfied. RCAF will issue new specification. Avro anticipate an ultimate design gross weight 48,500 lb.	Meetings with RCAF Apr. 27-30/53 - JCF Note. Also DND file Meeting Minutes, ref. S1038-104(AHTE/DEA)

<u>DATE</u>	<u>DETAILS</u>	<u>REFERENCE</u>
Apr./54	Receipt of RCAF spec. AIR-7-4 Iss. 1 for proto-type supersonic all-weather interceptor aircraft.	Apr. 23/54.
Apr./54	Avro comments on Spec. Air-7-4 Iss. 1 (Apr. 23/54) forwarded at AFHQ request.	Avro 2996/38/J June 4/54.
June/54	Avro receive ^C RAF "Operational Requirement for Fighter Aircraft". DRG carry out CF-105 performance comparison based on this OR.	June /54.
July/54	10th Steering Comm. states that upon approval of model spec. AIR-7-4 revision will be discontinued (Model Spec. target date Jan. 1/55.)	Meeting Minutes July 22/54.
Aug./54	C105 presentation to USAF in Baltimore. Extract received of preliminary USAF "Design Spec. for Long Range Interceptor". DRG evaluate C105 against this Spec. May 19/54.	
Oct./54	Avro receive advance copy of AIR-7-4 Iss. 2 "Prototype Supersonic All-Weather Interceptor Aircraft Type C105".	DND file, AF letter ref. S1038-105-9 TSDs/ Avro/ACE - Oct. 22/54
Nov./54	Advance notice of AIR-7-4 amendment to call up recording test instruments on designated aircraft.	S1038-105-9 TSDs/Avro (ACE) - Nov. 22/54.

<u>DATE</u>	<u>DETAILS</u>	<u>REFERENCES</u>
Dec./54	RCAF advise Interchangeability Specification MIL-1-8500A, Jan./54 has been approved by the RCAF as pertinent to C105. AIR-7-4 will be amended.	RCAF letter ref. S1038-105-3(TSR 1202) Dec. 3/54.
Jan./55	RCAF decide that C105 will be designed in accordance with AND 10048 rather than E075-40-10. (Nuts and bolts - Avro already doing this)	RCAF letter ref. 1038-105(ACE-1) Jan. 13/55.
Feb./55	RCAF outline requirements for C105 model spec. and accept proposed interim model spec.	RCAF letter ref. S1038-105-9(ACE) Feb. 4/55.
Feb./55	Draft Spec. AIR-7-4 for development of an integrated electronic system brought for Avro consideration prior to discussions with USAF and Hughes.	Feb. 9/55.
Mar./55	Copies of second draft of Spec. AIR-7-5 distributed at Avro.	Mar.17/55.
Mar./55	RCAF inform Avro, Spec. AIR-7-5 (basis of integrated electronic and control systems) is issued. Extensive discussion between RCAF and Hughes pertaining to RCAF Spec. and MX 1179 system.	Int. Elec. & Con. System Meeting Mins. Mar. 31/55.
Apr./55	Spec. Inst. 92-1, Issue 1 for development of automatic flight control system signed Apr. 6/55.	DRD file, letter AF to Avro - May 16/55.

<u>DATE</u>	<u>DETAILS</u>	<u>REFERENCES</u>
Apr./55	Spec. AIR-7-5 Iss. 1 for Integrated Elec. System signed Apr. 7/55.	DND file, letter AF to Avro - May 16/55.
Apr./55	C105 runway strength requirements.	DND file, Apr. 15/55.
Apr./55	Preliminary Model Specification forwarded to AFHQ.	Apr. 23/55
May/55	C105 19th Development Co-ord. Comm.: Avro urge AF acceptance of MIL-S-700 landing weight definition in lieu of AIR-7-4.	Notes on 19th Meeting C105 Dev. Co-ord. Comm. - May 18/55.
June/55	RCAF tentatively agree to use of MIL-S-5700 definition of landing weight. With P.S.13 as basis for weight definition new landing weight is 45,000 lb. (previously 47,000 lb.) RCAF do not agree to reduction in brake capacity and weight requirement for brake design remains at 47,000 lb.	C105 Dev. & Des. file RNL memo ref.2238/116 June 2/55.
July/55	Avro receive RCAF Spec. AIR-7-4 Iss. 3.	
July/55	Draft Spec. AIR-7-4 Iss. 3 forwarded by AFHQ for Avro comment.	July 6/55.
July/55	RCAF/Avro meeting held to discuss amendments to draft AIR-7-4 Iss. 3.	July 12/55.

3. CONTRACTUAL & FINANCIAL

<u>DATE</u>	<u>DETAILS</u>	<u>REFERENCES</u>
July/50	Dept. of Trade and Commerce requested by AF to authorize Avro to commence design studies on an advanced fighter. Charge cost to CD-87 (CF-100).	
Apr./53	Agreed that RCAF issue contract request to DDP for \$200,000 to be allocated Avro for further design work.	Avro report for C105 AIR-7-3. P/C105/1 - May/53.
June/53	Avro submit proposal P/C-105/2 to RCAF covering design, development and manufacture of two prototype aircraft. Total financial forecast to flight of 2nd prototype (estimated Aug./57) is \$22,925,000.	P/C-105/2 - June 2/52.
July/53	Ministerial Direction ACDA-4 received, authorizing design study of C105 to meet specification AIR-7-3. Financial authorization \$200,000 to cover phase until Sept. 30/53.	ACDA-4 July 29/53.
Sept./53	Amendment No. 1 to Ministerial Direction rec'd. Time limit extended to Nov. 30/53.	Amend. No. 1 - Sep.30/53.
Oct./53	Amendment No. 2 to Ministerial Direction rec'd. Financial authorisation increased to \$500,000. Time limit cut back to Oct. 20/53. This effectively cancelled the program, due to Avro/NAE controversy on 2 x 30" engine philosophy.	Amend. No. 2 - Oct.20/53.

DATE

DETAILS

REFERENCES

DDP officially stopped further work on C105 as of Oct. 20/53, but authorized Awo to maintain a small staff to be charged to overhead until further decision.

Dec./53 Avro submit proposal to RCAF for design, development, tooling and manufacture of 2 prototype aircraft. This amounted to confirmation of the \$22,925,000 requested in June/53 for the costs up to first flight of the second aircraft. Engineering estimate total cost programme \$22,664,513, Nov./53.

Dec./53 Amendment No. 3 to Ministerial Direction rec'd.
Time limit extended from Oct. 20/53 to Oct.23/53 to pick up end-of-week costs.

Amend. No. 3 - Dec.16/53

Mar./54 Amendment No. 4 to Ministerial Direction rec'd.
Reinstated C105 program to design, develop and manufacture all-weather fighter to specifications AIR-7-3 and AIR-7-4 (advance data rec'd.).
Manufacturing program authorized but number of aircraft not specified. Financial authority \$1,325,000 cum. (increase of \$825,000). Time limit Mar. 31/54 (1 month) due to lack of commitment authority.

Amend. No. 4 - Mar.1/54

<u>DATE</u>	<u>DETAILS</u>	<u>REFERENCE</u>
Apr./54	Amendment No. 5 to Ministerial Direction rec'd. Financial authority increased to \$1,703,600 (increase of \$378,000). Time limit extended to Mar. 31/55 which re-activated programme by removing original one month time limit (See Mar.1/54)	Amend. No. 5 - Apr.8/54
Apr./54	Amendment No. 6 to Ministerial Direction rec'd. Time limit in Amend. No. 3 (to Oct. 23/53) deleted since funds expended between Oct. 23/53 and Mar.1/54 were not previously authorized by DDP.	Amend. No. 6 - Apr.12/54
Apr./54	7th Steering Comm. agrees two prototypes inadequate Request Avro proposal for increased number.	Meeting Minutes - Apr. 26/54.
May/54	Amendment No. 7 to Ministerial Direction rec'd. Financial authority increased to \$4,322,600 (increase of \$2,619,000).	Amend. No. 7 - May 13/54
May/54	Proposal A.D. 14 submitted to DDP for design, development and manufacture of 2 prototype C105 aircraft. Financial forecast to first flight of 2nd prototype (Feb./57) \$22,925,000. Tooling excluded and separate (A.D.13) proposal submitted. Financial forecast of \$9,250,000.	Analysis of C105 program - June 20/55

<u>DATE</u>	<u>DETAILED</u>	<u>REFERENCES</u>
June/54	Preliminary forecast of expenditures to 1960 given to DDP and PCAF for planning purposes. Financial forecast showed additional continued development for 57/58, 58/59, 59/60 at rate of \$6,000,000 per year.	Analysis C105 Program - June 20/55.
July/54	Amendment No. 8 to Ministerial Direction rec'd. Financial limit on wind tunnel work deleted since Avro over-expended wind tunnel funds (limit of \$50,000).	Amend. No. 8 - July 16, 5
Sept./54	11th Steering Comm. Meeting decides: (a) Costs of maintenance of C100 aircraft to be used on C105 development to be charged to flight test vehicles funds. (b) Costs of modifying aircraft, installing the necessary equipment and instrumentation and flying the aircraft to be charged against the C105 development funds.	Meeting Minutes - Sept. 23/54.
Sept./54	Proposal AD 15 submitted to DDP Sept. 24/54 for design and development of C105 airplane. Financial forecast \$19,750,000 up to flight of 2nd A/C. Separate proposal submitted for tooling and manufacture (AD 16). Tooling forecast \$18,250,000.	Analysis C105 Program - June 20/55.

<u>DATE</u>	<u>DETAILS</u>	<u>REFERENCES</u>
	Manufacturing forecast for 11 aircraft \$54,749,060, for 40 aircraft \$61,253,435. Engineering costs for AD 15 were \$12,960,000 forecast for 55/56 was \$7,195,200.	
Oct./54	Amendment No. 9 to Ministerial Direction rec'd. Financial authorization increased to \$6,842,000 (increase of \$2,519,000).	Amend No. 9 - Oct. 7/54
Nov./54	Engineering indicates in discussions that finan- cial costs for 55/56 might be exceeded (by small amount). No confirmatory documents provided. No action taken.	Analysis C105 Program - June 20/55
Dec./54	C105 program delayed until DDP satisfied that C105 satisfactory from technical viewpoint, DDP question drag estimate. Discussions held and performance figures checked with NACA.	Analysis C105 Program - June 20/55.
Jan./55	Between Jan. and Apr./55 it became more apparent that with increased scope of work expenditures would exceed forecast shown in AD 15, issue 1 (\$19,750,000). Series of Management meetings held to determine if estimated increase in costs was correct and if so, if any steps could be taken to reduce expenditures. DDP not advised officially until forecast changes were confirmed. Number of aircraft was increased from 2 to 5 and program delayed by engine & other change.	Analysis C105 Program - June 20/55.

<u>DATE</u>	<u>DETAILS</u>	<u>REFERENCE</u>
Jan./55	Lugnos proposal Dec. 23/54 for TEE, including flight testing and the assurance of a satisfactory system for the RCAF costs \$15,322,279 covering a period through Dec./58.	Amendment file: C.R. Once letter ref. 8237/03A/J, Jan. 6/55.
Mar./55	15th Dev. and Steering Comm. discusses flight simulator required before C105 first flight. Agree Avro only firm to do the job. Avro requested to show cost of simulator design and dev. in proposal for training aids.	
Mar./55	Avro submit contract proposals to Ottawa for: (a) C105 Development contract. (b) C105 Tooling contract. (c) C105 Production contract.	DDP file, ref. SO.4877/752 - Mar. 15/5
Apr./55	Purchase order for manufacture of 4 aircraft increased to 5 aircraft.	Analysis C105 Program - June 20/55.
Apr./55	Development Steering Comm. request review of fiscal year's expenditure and forecast of complete program to 1960.	Analysis C105 Program - June 20/55.
Apr./55	Amendment No. 10 to Ministerial Direction rec'd. Apr. 14/55. Financial authorisation increased to \$7.6m. (increase of \$757,600) to Mar. 31/55. Manufacture of prototype aircraft deleted and transferred to separate authority. Subject matter amended to read 'Design & Development of A.M. Fighter to Spec. AIR-7-A, Iss. 3.'	Analysis C105 Program June 20/55.

<u>DATE</u>	<u>DETAILS</u>	<u>REFERENCES</u>
Apr./55	C105 program re-scheduled Apr. 15/55 retarding 1st flight 6 months to bring airframe into phase with engines and integrated electronic system. Schemes A & B considered. Scheme B adopted as follows: (See Schedule, Apr./55 for details.)	C105 Program file,
May/55	Avro outline production tooling philosophy to BDP based on one per month aircraft production rate. Eventually four/month.	Letter J.A. Morley to BDP - May 16/55, ref. SO 4877/1105 (C105 Program file)
May/55	C105 19th Development Co-ord. Comm. decides: Financial authority granted RCAF purchase of 21 Falcon (GAR-1A) missiles for early test program. 1st in Sept. 1/55, 10 by Dec. 31/55, 21 by June/56. One inert, remainder with motors, but no guidance.	Notes on 19th Meeting C105 dev. co-ord. comm. May 18/55.
May/55	Amendment No. 11 to Ministerial Direction rec'd. May 17/55. Financial Authorization increased to \$8,276,632 (increase of \$676,632) due to overrun of \$676,632 during '54/55.	Analysis C105 Program - June 20/55.
June/55	Forecast of costs given (June 1/55) to RCAF financial (W/C Eward). Development program forecast to 1960 \$57m.	Analysis C105 Program

<u>DATE</u>	<u>DETAILS</u>	<u>REFERENCES</u>
	Forecast for 55/56 \$13.9m. Fiscal year costs for 55/56 given verbally to DDP.	
June/55	Monthly forecast of expenditures given to DDP indicating monthly forecast for 55/56 and forecast for programme to 1960 \$57m.	Analysis C105 Program - June 20/55.
June/55	Proposal AD 15 - Issue 2 submitted to DDP June 15/55. Program cost to 1960 \$57m. Fiscal year costs 55/56 \$13.9m.	Analysis C105 Program
July/55	Comprehensive note by JCF on means of accomplishing reduced C105 Development costs together with outline of work content in C105 Design. Conclusion that with certain risk acceptance including that of incorporating P.S.13 in 6th and subsequent aircraft approx. \$5m. could be saved from original estimates covering more comprehensive program with less risk.	C105 Costs file, JCF draft of AD 15 Iss.3 & 4 June 14/55.
July/55	Comprehensive outline of revised costs from AD 15, Issue 1 from \$19,750,000 to flight of 2nd aircraft in Feb./57 (AD 15 Iss. 1, Sept./54) to \$40,574,625 to flight of 5th aircraft (AD 15, Iss.2). Original estimate to 40th aircraft was \$61,253,435 and now \$83,927,676 (increase \$22,675,000).	DDP file, letter FTS to DDP, July 14/55.

DATEDETAILSREFERENCES

July/55	Avro has no authorisation to spend funds in fiscal year '55/56 or beyond.	DDP file, JCFletter July 22/55.
July/55	Hughes have run out of money for C105 damping system. Will continue work on reduced scale with delivery postponed one day per day of delay in receiving contractual coverage after July 1/55. Hughes estimate \$120,000 required to complete work.	Damping System tile, JAC memo - July 28/55
July/55	Revised brochure AD 16, Iss. 2 for Tooling and Manufacturing programs for C105 forwarded to DDP. Avro deem it essential to have authority to manufacture up to 11th aircraft now since agreed timing could not otherwise be achieved. Avro presently authorized to build 5 aircraft. Similarly Avro understand that the ultimate program is for 40 aircraft and wish confirmation of this from DDP.	DDP file, ITS letter July 29/55.

