

QCX
Avro
CF105
R-7-0400-44
Iss-14

FILE IN VAULT

ARROW 1

Report # 7-0400-44

A/C 25201

Issue 14

WEIGHT & O.C. SUMMARY

SECRET

NEA N.A.E.

Feb. 1/58



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Report no.: QCX - AVRO - CF105- R-7-0400-44-155-14

has been

☐

downgraded to : _____

☒

de-classified

by (Name): Michel W. Drapeau

(Dept): A/DND Coordinator, Access to Information

Date: Dec. 7, 1992

R. Auger

Signature

AVRO AIRCRAFT LIMITED
INTER-DEPARTMENTAL MEMORANDUM

UNCLASSIFIED / NON CLASSIFIED

Ref. 5864/11/J
Date February 1st, 1958
To See Distribution
From Mr. E.F. Burnett
Subject ARROW 1 A/C 25201 WEIGHT & C.G. SUMMARY - Report # 7-0400-44 Iss. 14

Attached is a copy of Weight and C.G. Summary Report # 7-0400-44 Iss. 14, date February 1st, 1958 for your retention.

This report is revised monthly and is issued complete on the 1st of each month.

Classification cancelled / changed to: UNCLASSIFIED

By authority of: DRDA 7/DARET 5-8/DAS Eng 6-4-5

Date: 5 Nov 1992

Signature: E. F. Burnett

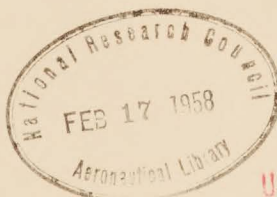
Unit / Rank / Appointment: DSIS 3, Secretary CRAD HQ DRP

E. F. Burnett

amc.

E. F. Burnett
Weights Supervisor

Messrs.	J.C. Floyd	F. Brame
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	D. Wade	N. Ring
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	D. Hayward	R. Cairns
	D. Scard	G. Eves
	J. Booth	



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52357

Date: February 1st, 1958
Aircraft: ARROW 1, A/C 25201
with J75 P3 Engines

Report # 7-0400-44 Iss. 14

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I N D E X

Sheet # 1

Content

- 1-1 to 1-5 Introductory notes and explanations
 of Weight Changes.
- 2-1 to 2-2 Weight & C.G. Summaries.
- 3 Horizontal C.G. Envelopes for
 Flight conditions with fuel
 proportioners used.
- 4-1 to 4-15 I.B.M. Detail Sheets of Weights
 & C.G.'s.

N.B. The C.G. Envelope for A/C 25201 with fuel
 sequencing has been omitted until a fully
 approved sequencing is established.

UNCLASSIFIED / NON CLASSIFIÉ

Date: February 1st, 1958
ARROW 1 A/C 25201 With
J75 P3 Engines

SECRET
Report # 7-0400-44 Iss. 14
Sheet # 141

INTRODUCTION & WEIGHT CHANGES

The following is a Weight & C.G. Summary for the first Arrow 1 Aircraft # 25201, with J75 P3 Engines, based on the latest information available. All weight and C.G. changes are relative to Issue 13 of January 1st, 1958.

Note 1) This summary does not apply for A/C 25202 and 25203 which will have J75 P5 Engines, nor for Aircraft 25204 and 25205 which are for full Astra I trial Installations etc.

2) The statement herein is for the Aircraft complete to drawings and not necessarily in the condition to be encountered for first flight.

For early flights there may be some shortages in non-essential equipment, some flight test installations will probably be incomplete etc. (see also general note (j)). A statement for first flight will be issued later.

GENERAL:

a) Pratt & Whitney J75 P3 Engines comprise the Power Plant for Aircraft # 25201. J75 P5 Engines, which are partially redesigned versions of the P3 Engines, are to be installed on Aircraft # 25202 and subsequent Arrow 1 Aircraft. (J75 P3 Engines = 6,175 lb each; J75 P5 Engines = 5,950 lb each).

b) The Instrument Package containing Flight Instrumentation is installed, the package for Aircraft # 25201 to 25203 differing from those for Aircraft 25204 and Aircraft 25205 (Astra I Trial Installations).

A relatively detailed estimate of other proposed Flight Test Installations throughout the Aircraft has been made. These installations amount to 1,457 lb (figure partially confirmed by Actual Weights of some cable assys.)

c) Emergency lowering for the Landing Gear and additional Fire Protection to be installed in the first aircraft, are allowed for in the summary.

d) An Interim Radio and Radar System with Minneapolis-Honeywell M.H 64 Damping System is installed. Currently there is no Doppler or Tacan installation, although provisions for future installation of Doppler, which is not yet available, will be made.

e) The original design of tailcones and stinger are recorded, the redesigned versions will be recorded at a later date, when they are available for retrofit. The ensuing weight changes will be:

Tailcones	+ 139.84 lb/A/C
Stinger	= 29.72
Net Change	+ 110.12 lb/A/C

f) Pending Flight Test requirements a "Buzz Damping" System may be installed on the first Aircraft. Provisions for this installation are already included in the structural group as modifications to the Control Boxes. For the first flight the control surfaces will be unmodified, however, if the need for Dampers is proven, a modified set of control Surfaces will be made available.

UNCLASSIFIED / NON CLASSIFIÉ

Date: February 1st, 1958
ARROW 1, A/C 25201 with
J75 P3 Engines

SECRET

Report # 7-0400-44 Iss. 14
Sheet # 142

INTRODUCTION & WEIGHT CHANGES

GENERAL:

f) (Continued)

The following weight penalties ensue:

Ailerons	+	11.68 lb/A/C
Elevators	+	11.07 lb/A/C
Rudder	+	8.78 lb
Equipment	+	123.97 lb
	+	<u>155.50 lb.</u>

- g) It should be noted that due to material substitutions and concessions introduced by Planning & Production Departments there is a structural weight penalty of 203 lb to-date. This is all recorded in the structural weight breakdown. No account has been taken of variations on machinings etc. nor of shop repair schemes, since it is impossible to assess these, except where actual weights have been obtained.
- h) A considerable number of Actual Weights have now been obtained. Structural weights are checking within 0.5% of estimates of sub-assemblies etc. However, equipment (excluding Engines and Gear Boxes) shows a consistent increase averaging about 11% over manufacturer's quotations or initial specification weights. Preceding the report titles on the I.B.M. Tabulation Sheets, will be found a number varying from 0 to 100, this is the percentage of actual weight recorded within the report.

A Summary of Actual Weights obtained so far is as follows:

Structure	74.87%
Landing Gear	98.75%
Power Plant	92.97%
Flying Controls	56.18%
Equipment	23.48%

i.e. 70.52% of the Basic Weight of A/C 25201.

- j) The Aircraft is ballasted such that the C.G. on a flight envelope (using fuel proportioners) does not travel aft of 31% M.A.C.

For first flight the aft restriction is 30% M.A.C., this may be achieved by installing maximum ballast in the Radar Nose, and any further ballast requirements in the Observer's cockpit.

1. STRUCTURE

WEIGHT (lb)

a) Wings:

No Weight Changes.

UNCLASSIFIED / NON CLASSIFIED

Date: February 1st, 1958
ARROW 1 A/C 25201 with
J75 P3 Engines

UNCLASSIFIED
SECRET
Report # 7-0400-44 Iss. 14
Sheet # 1-3
NON CLASSIFIED

INTRODUCTION & WEIGHT CHANGES

1. STRUCTURE:

WEIGHT (lb)

b) Fin & Rudder

No Weight Changes.

c) Front Fuselage, fwd. Sta. 255"

Navigator's Canopy - addition of insulation batting	+ 0.24
Miscellaneous Items - addition of Stainless Steel Fairings at canopy hinges	+ 1.33
<u>Front Fuselage Increase</u>	<u>+ 1.57</u>

d) Centre Fuselage Sta. 255"-485"

Dorsal Fairings over Fuel Tanks - alterations to insulation etc.	- 0.90
Structure for Ram Air Turbine - deleted, currently no longer a requirement on A/C 25201	- 40.74
Electronics Bay Structure - items (eg Side Access Door) that would have been removed for R.A.T. installation now reinstated	+ 9.74
Dorsal Fairing Sta. 268"-315" - modifications to aft end, skin Al. was Mg. etc.	+ 0.82
Deflector Shield - addition rubber seal fwd. end	+ 0.16
C.F. Duct - addition of inner seal ring, .016 Al. at joint to floating duct, aerodynamic requirement	+ 0.82
<u>Centre Fuselage Decrease</u>	<u>- 30.10</u>

e) Duct Bay Sta. 485"-591.65"

No Weight Changes

f) Engine Bay Sta. 591.65"-742.5"

No Weight Change

g) Rear Fuselage Sta. 742.5" Aft.

No Weight Change.

h) Fuselage "Marry-Up"

No Weight Change

TOTAL STRUCTURAL DECREASE

- 28.53

2. LANDING GEAR

Main Landing Gear - Dowty quote actual weight of main leg assy.

+ 4.12

continued.

UNCLASSIFIED / NON CLASSIFIED

Date: February 1st, 1958
ARROW 1 A/C 25201 With
J75 P3 Engines

SECRET
Report # 7-0400-44 Iss. 14
Sheet # 1-4

INTRODUCTION & WEIGHT CHANGES

		WEIGHT (lb)
2. <u>LANDING GEAR (Continued)</u>		
Nose Gear Door & Fairing - actual weight of Door obtained	+	0.53
addition of aerodynamic fairing		
to door	+	1.08
<u>TOTAL LANDING GEAR INCREASE</u>	+	<u>5.73</u>
3. <u>POWER PLANT & SERVICES</u>		
No Weight Changes		
4. <u>FLYING CONTROLS GROUP</u>		
Mechanical Controls - addition of self centring unit for		
elevator controls	+	3.01
Flying Control Hydraulics Fuselage - addition of two surge		
damping accumulators in return lines	+	13.40
addition of boosters to overcome		
friction in system plus associated		
values, filters and piping.	+	77.06
<u>TOTAL FLYING CONTROLS INCREASE</u>	+	<u>93.47</u>
5. <u>EQUIPMENT GROUP</u>		
Drag Chute - alteration to control mounting structure in		
cockpit and addition of inner race to release		
mechanism.	+	0.21
Electrics F.F. - Actual Weight of Master Warning Control		
Box	+	3.05
Air Conditioning System - incorporation of actual weights		
of engine manifolds, previously		
target weights used	+	9.66
Ram Air Turbine Equipment - the system is deleted from		
A/C 25201 currently. Unit when tested		
failed to give expected output	=	91.35
Flight Test Instrumentation in Pack - revised weight		
estimate by Flight Test, main patch		
panel deleted, but increases in cables etc	+	12.00
<u>EQUIPMENT GROUP DECREASE</u>	=	<u>66.43</u>

SUMMARY

Weight Change - Aircraft Basic Weight

Structure	=	28.53 lb
Landing Gear	+	5.73 lb
Flying Control	+	93.47 lb
Equipment	=	66.43 lb
	+	4.24 lb

Weight Change - Operational Weight Empty (A/C less Fuel)

UNBALLASTED CONDITION

Issue 13

Issue 14

47,999.68 lb

48,003.92 lb

+ 4.24 lb

UNCLASSIFIED / NON CLASSIFIÉ

Date: February 1st, 1958
ARROW 1 A/C 25201 with
J75 P3 Engines

SECRET

Report # 7-0400-44 Iss. 14

Sheet # 145

INTRODUCTION & WEIGHT CHANGES

- N. B. If Aircraft Ballasted such that the C.G. in the Flight Envelope, using correctly functioning fuel system proportioners, does not exceed 31% M.A.C., further 893 lb of ballast are necessary.

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Date: February 1st, 1958
Aircraft: ARROW 1, with
J75 P3 Engines

UNCLASSIFIED / NON CLASSIFIED
SECRET
Report # 7-0400-14 Iss. 14
Sheet 2-1

WEIGHT & C.G. SUMMARY

DESCRIPTION	WEIGHT lb	H. ARM ins.	V. ARM ins.
STRUCTURE	18,577.44	561.74	137.53
Wings:	9,963.50	642.82	142.26
Fin & Rudder	1,025.85	754.34	209.31
Fuselage Fwd. Sta. 255"	2,646.56	181.60	128.17
Sta. 255"-485"	1,652.04	379.71	130.79
Sta. 485" 591.65"	1,001.86	533.99	104.61
Sta. 591.65-742.5"	1,433.13	661.00	107.31
Sta. 742.5" Aft.	801.79	801.03	129.06
"Marry-Up"	52.71	469.18	103.86
LANDING GEAR - RETRACTED	2,606.56	488.21	134.89
Main Landing Gear	1,963.74	539.50	141.00
Main Gear Doors & Fairings	282.34	537.60	138.37
Nose Landing Gear	333.81	170.81	99.70
Nose Gear Door & Fairing	26.67	161.77	88.25
POWER PLANT & SERVICES	11,391.81	652.82	120.34
Engines & Accessories J75 P3	12,562.29	664.92	119.78
Gear Box & Drives on Fuselage	275.54	601.39	102.98
Gear Box & Starters on Engine	286.30	589.08	105.59
Engine Controls	32.43	375.76	118.62
Engine Nose Bullets	70.58	562.75	115.07
Fire Extinguishing System	65.46	700.45	134.21
Engine Mountings	206.21	635.04	127.71
Fuel System	893.00	536.67	136.12
FLYING CONTROLS GROUP	1,946.48	665.69	138.27
Mechanical Flying Controls	944.13	684.34	148.22
Hydraulic Flying Controls	1,002.35	648.12	128.90
EQUIPMENT FIXED & REMOVABLE	9,560.67	403.77	113.54
Instruments	46.07	163.68	138.70
Probe	15.00	38.14	108.00
Cockpit Pressure Sealing	5.00	186.00	130.00
Ejector Seats	339.06	204.43	134.10
Oxygen System	26.07	240.54	156.70
Air Conditioning System	822.07	339.45	134.46
Surface Finish	100.00	591.52	140.20
Hydraulics Main System	641.97	504.41	117.78
Cockpit Insulation	14.31	187.48	132.00
Drag Chute	90.99	786.18	143.17
Electrical System	1,122.03	416.87	112.94
Low Pressure Pneumatics	54.65	433.30	129.37
Intake De-icing Boots	88.00	195.82	118.00
Canopy Actuation	64.92	221.99	154.35
Console panels	17.45	174.76	124.34
M.H.64 Damping System	99.08	450.83	140.34
Interim Radio & Radar	631.89	340.18	124.23
Instrument Pack Structure	686.80	385.81	94.68
Pack Instrumentation (A/C 25201)	3,048.00	394.00	95.00
Flight Test Installations	1,456.73	488.48	128.90
Additonal Fire Protection	177.67	402.00	109.57
Emergency Landing Gear Lowering	12.91	458.83	128.60

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Date: February 1st, 1958
Aircraft: ARROW 1 with
J75 P3 Engines

UNCLASSIFIED / NON CLASSIFIÉ
SECRET
Report # 70400-44 Iss. 14
Sheet # 2-1

WEIGHT & C. G. SUMMARY

DESCRIPTION		WEIGHT lb	H. ARM ins.	V. ARM ins.	M.A.C. %
AIRCRAFT BASIC WEIGHT	U/C Up	47,082.96	557.73	127.29	
	U/C Down		559.81	123.85	
USEFUL LOAD (less fuel)		921.02	366.58	132.34	
Crew		390.00	194.00	136.50	
Engine Fire Extinguishing Fluid		25.00	730.00	129.00	
Residual Fuel		218.40	553.98	134.04	
Oxygen Charge		13.39	259.69	159.91	
Water for Air Conditioning		140.00	268.00	132.00	
Oil		134.25	608.92	115.68	
BALLAST		893.00	85.98	116.50	
Operational Weight Empty	U/C Up	48,896.98	545.51	127.19	30.25
	U/C Down		547.51	123.87	30.80
Maximum Internal Fuel (2,544 gals. @ 7.8 lb/gal.)		19,843.00	538.88	144.32	
A.U.W. Maximum Internal Fuel	U/C Up	68,739.98	543.60	132.13	29.72
	U/C Down		545.02	129.77	30.11

N.B. 1) Aircraft Datum is considered to be 120" above an arbitrarily chosen ground line.

2) The above figures are for the Aircraft in the BALLASTED condition such that the aft. C.G. on the horizontal C.G. Envelope does not exceed 31% M.A.C. i.e. 303 lb on Former Sta. 68.5 and 590 lb on the Shear Panel.

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REPORT NO: 7-0400-44-1A

DATE: Feb 1st 1958

BY: Kathleen Lythum

SHEET: 3

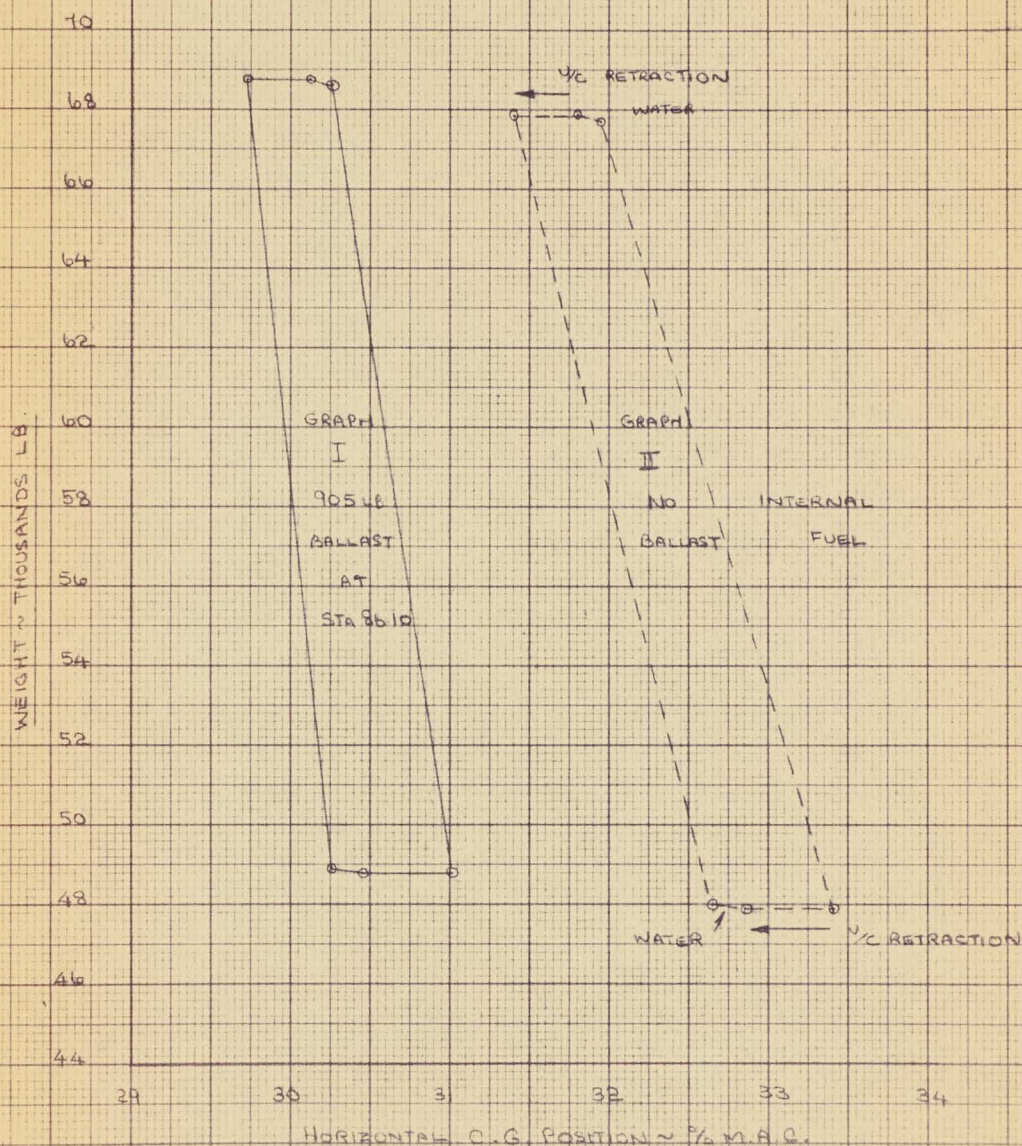
HORIZONTAL C.G. ENVELOPE

ARROW 1 - $\frac{1}{2}$ 25201

NORMAL FLIGHT CONDITIONS

FUEL SYSTEM PROPORTIONERS USED

UNCLASSIFIED / NON CLASSIFIED



PROJECT_____

WEIGHT AND C. OF G BY

[illegible]

WEIGHT AND C. OF G BY FUNCTIONAL COMPONENT

PROJECT_____

[illegible]

AVRO AIRCRAFT LTD.
MALTON, ONT.

WEIGHT AND C. OF G BY FUNCTIONAL COMPONENT

PROJECT _____

	DESCRIPTION	REFERENCE NO.	COMP. NO.	WEIGHT	H.
	TOTAL FUSELAGE GROUP	3000000			
	FUSELAGE BASIC STRUCTURE	3010000			
100	RADOME	3010000151		18100	3
100	RADAR NOSE ACCESS DOORS	3010000251		8008	9
	NOSE STRUCTURE FWD STA 120	3010000351		12188	9
	SKIN F F	3010000452		11054	19
88	SKIN C F	3010000554		21182	37
	SKIN D B	3010000656		5937	53
3	SKIN E B	3010000758		17725	66
4	FORMERS F F	3010001152		10664	18
100	FORMERS C F	3010001254		27824	37
	FORMERS D B	3010001356		7491	53
	LIGHT FORMERS E B	3010001458		13501	66
72	HEAVY FORMERS E B	3010001558		21890	66
	LOWER LONGERONS F F	3010001652		6846	18
	LONGITUDINAL MEMBERS E B	3010001758		11067	0
75	LOWER LONGERON E B	3010001858		6842	65
	TOP LONGERONS E B	3010001958		6386	6
	LOWER SHEAR PANEL F F	3010002052		2940	23
	TOP WING LONGERONS D B	3010002156		4985	3
	LONGERONS C F	3010002252		5325	
	LONGERONS C F	3010002354		13813	41
43	LONGERONS F D B	3010002454		1258	48
43	LONGERONS A D B	3010002556		8655	52
	ELECTRONICS BAY STRUCTURE	3010002654		3570	27
59	LONGITUDINAL BEAMS D B	3010002756		6570	52
	RADAR ACCESS DOORS C F	3010002854		2138	27
72	MAIN FRAME AT STN 538 77	3010002956		5980	53
	DIVE BRAKE ACCOM STRUCTURE	3010003056		3634	50
48	TOP LONGERONS F F	3010003152		18866	19
100	DUCT C F	3010003254		33368	37
97	DUCT D B	3010003356		31633	54
22	CANOPY ARCHES	3010003452		8461	22
4	ACCESS PANEL STIFFENERS	3010003656		3954	54
66	NOSE U C SUPPORT STRUCTURE	3010003752		3343	21
3	CREW BULKHEADS	3010003852		12718	20
51	EQUIPMENT BAY STRUCTURE	3010003954		6150	28
86	WINDSCREEN	3010004152		13003	13
33	SERVICE ACCESS DOORS	3010004258		6704	66
	TORSION BOX E B	3010004358		6042	61
	DORSAL FAIRING AIR OUTLET	3010004454		2143	29
66	INTERMEDIATE FORMERS	3010004558		5154	69
	ENGINE ACCESS DOORS	3010004658		14659	62
	SEALING MISSILE BAY	3010004754		6973	32
100	MISCELLANEOUS ITEM C F	3010004854		3923	37
98	ARMAMENT BAY ROOF	3010004954		13216	38
	BULKHEAD AT STA 120	3010005052		3060	12
	BULKHEAD AT STA 255	3010005152		10429	25
100	BULKHEAD AT STA 485	3010005254		11245	48
13	ENGINE TUNNEL	3010005458		47572	66

AVRO AIRCRAFT LTD.
MALTON, ONT.

WEIGHT AND C. OF G BY FUNCTIONAL COMPONENT

PROJECT_____

[illegible]

WEIGHT AND C. OF G BY FUNCTIONAL GROUP COMPONENT

REPORT NO. _____

SHEET _____

UNCLASSIFIED / NON CLASSIFIÉ

REFERENCE NO.	COMP. NO.	WEIGHT	H. ARM	V. ARM	H. MOMENT	V. MOMENT
5080001	54	13474	40781	14045	5494832	1892423
5080002	56	16857	53575	11233	9031138	1893547
5080003	58	3592	66531	12549	2389794	450760
5080004	62	53997	55804	14420	30132486	7786367
5080005		626	65901	9594	412540	60058
5080006		754	61525	9658	463899	72821
		89300			47924689	12155976



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MALTON, ONT.

WEIGHT AND C. OF G BY FUNCTIONAL COMPONENT

PROJECT _____

DESCRIPTION		REFERENCE NO.				COMP. NO.	WEIGHT	H. A.
FIXED EQUIPMENT GROUP		7000000						
INSTRUMENTS		7010000						
INSTRUMENTS F F		7010001	52				440716	
NAVIG TABLE AND STOWAGE		7010004	52				20022	
							4607	
COCKPIT PRESSURE SEALING		7020000	52				50018	
							500	
OXYGEN SYSTEM		7030000						
OXYGEN SYSTEM		7030001	52				260724	
							2607	
AIR CONDITIONING SYSTEM		7040000						
54	AIRCONDITIONING F F	7040001	52				354917	
54	AIRCONDITIONING C F	7040002	54				4721229	
54	AIRCONDITIONING D B	7040003	56				114851	
54	AIRCONDITIONING C A	7040005					2736339	
54	AIRCONDITIONING ENG	7040006					285564	
54	AIRCONDITIONING I W	7040007	62				80515	
							82207	
HYDRAULICS MAIN SYSTEM		7050000						
32	UTILITY HYDRAULICS F F	7050001	52				841820	
31	UTILITY HYDRAULICS C F	7050002	54				427243	
20	UTILITY HYDRAULICS D B	7050003	56				2733855	
66	UTILUTY HYDRAULICS E B	7050004	58				735360	
24	ITILITY HYDRAULICS I W	7050005	62				1351155	
32	UTILITY HYDR NOSE U C	7050006	91				325190	
24	UTILITY HYDR MAIN U C	7050007	92				298054	
28	EMERGENCY LOWERING M U C	7050008	62				853584	
35	EMERGENCY LOWERING N U C	7050009	52				438214	
							65488	
CABIE INSULATION		7070000	52				1431187	
							1431	
BRAKE PARACHUTE		7080000						

WEIGHT AND C. OF G BY FUNCTIONAL COMPONENT

PROJECT _____

[illegible]

WEIGHT AND C. OF G BY FUNCTIONAL COMPONENT

PROJECT_____

DESCRIPTION	REFERENCE NO.	COMP. NO.	WEIGHT	H.
REMOVABLE EQUIPMENT GROUP	8000000			
77 EJECTOR SEATS	801010052		3390620	
			33906	
RADAI REMOV GROUP	8020000			
DAMPING SYSTEM	8030000			
DAMPING SYSTEM F F	803010152		78417	
DAMPING SYSTEM C F	803010254		230332	
DAMPING SYSTEM E B	803010358		36963	
DAMPING SYSTEM I W	803010462		607052	
DAMPING SYSTEM O W	803010564		9574	
DAMPING SYSTEM R N	803010651		2877	
			9908	
98 INSTIUMENT PACK	805080054		6868038	
			68680	
INSTIUMENTATION	805090054		30480039	
			304800	
FIRE PREVENT FIRST A C CF	805100054		1637938	
FIRE PREVENT FIRST A C DB	805100156		80654	
FIRE PREVENT FIRST A C EB	805100258		58262	
			17767	

WEIGHT AND C. OF G BY FUNCTIONAL COMPONENT

PROJECT_____

DESCRIPTION	REFERENCE NO.	COMP. NO.	WEIGHT	H. A.
OPERATIONAL LOAD	9000000			
CREW MEMBERS	9010000	52	39000	19
			39000	
ENGINEE OIL	9020000			
ENGINEE OIL USABLE	9020001		88166	61
ENGINEE OIL TRAPPED ENG	9020002		17736	2
ENGINEE OIL TRAPPED D B	9020003	56	19255	8
ENGINEE OIL TRAPPED E B	9020004	58	90959	
			13423	
OXYGEN CHARGE	9040000			
OXYGEN CHARGE F F	9040001	52	7220	
OXYGEN CHARGE C F	9040002	54	12672	6
			1339	
100 ENGINEE FIRE EXT FLUID	9060000		25007	3
			2500	
RESIDUAL FUEL	9070000			
RESIDUAL FUEL C F	9070001	54	46803	9
RESIDUAL FUEL I W	9070002	62	17160	59
			21840	
WATER FOR AIR CONDITIONING	9100000	54	12500	26
UNUSABLE WATER FOR AIRCOND	9100001	54	15002	6
			14000	

