QCX
Avro
CF105
R-7-0574-1

AVRO AIRCRAFT

TECHNICAL REPORT

J Thurston

A. V ROE CANADA LIMITED
MALTON · ONTARIO

ANALYZED

TECHNICAL DEPARTMENT (Aircraft)

AIRCRAFT: C102

REPORT NO: [illegible]

FILE NO:

NO OF SHEETS:

TITLE: Aileron Loads & Rudder Stability Check

~~CONFIDENTIAL~~

Classification cancelled / Changed to UNCLASS
By authority of AVRO
Date 30 Sept 58
Signature [illegible]
Unit / Rank / Appointment AVRO

NRC - CISTI
AERO / M.E.
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CNRC - ICIST

PREPARED BY E. Gaukers DATE 12 Jan 55

CHECKED BY DATE

SUPERVISED BY DATE

APPROVED BY DATE

ISSUE No.	REVISION No.	REVISED BY	APPROVED BY	DATE	REMARKS

FORM 1316A

15867319

A. V ROE CANADA LIMITED
MALTON - ONTARIO
TECHNICAL DEPARTMENT (Aircraft)

REPORT No. 7-0579-1
SHEET No. 2 A

AIRCRAFT:		PREPARED BY	DATE
C105	AILERON	R. GAVALIS	
		CHECKED BY	DATE

CONFIDENTIAL

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RJ.

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ORM 1119A

A. V ROE CANADA LIMITED
MALTON - ONTARIO
TECHNICAL DEPARTMENT (Aircraft)

REPORT No. 7-0574-1
SHEET No. 8

AIRCRAFT:		PREPARED BY	DATE
C 105	AILERON	R GAVALIS	
		CHECKED BY	DATE

SYMBOLS

F - ANY ALLOWABLE STRESS
F_S - ALLOWABLE SHEAR STRESS
F_c - " COLUMN " (FOR COMPRESSION)
F_{CR} - " CRIPPLING "
F_b - " BEARING "
F_{CR} - " INTER-RIVET BUCKLING STRESS

f_{scc} - INITIAL BUCKLING SHEAR FLOW

f_{su} - ULTIMATE SHEAR FLOW - ALLOWABLE
ALL

f - ANY WORKING STRESS (SUBSCRIPTS SAME AS ABOVE)

ϵ - UNIT STRAIN
σ_{cc} - INITIAL BUCKLING STRESS
R - STRESS RATIO
M - MOMENT
P - AXIAL LOAD
V - VERTICAL SHEAR
q_s - DESIGN SHEAR FLOW
q_r - DESIGN SHEAR FLOW FOR RIVETS
T - TORQUE
A - AREA
I - MOMENT OF INERTIA
Q - FIRST MOMENT OF AREA
K - REDUCTION FACTOR
b - PANEL WIDTH, FLANGE WIDTH
b_m OR W - EFFECTIVE WIDTH OF SECTION
C - EDGE DISTANCE, ECCENTRICITY
S - RIVET SPACING

SUB-SUBSCRIPTS

U - ULTIMATE
Y - YIELD
ALL - ALLOWABLE
TR - TRANSVERSE
A - AXIAL

FORM 1319A

A. V. ROE CANADA LIMITED
MALTON - ONTARIO
TECHNICAL DEPARTMENT (Aircraft)

REPORT No. 7-0579-1
SHEET No. 00

AIRCRAFT:		PREPARED BY	DATE
C105	AILERON	R. GAVALIS	12-29-54
		CHECKED BY	DATE

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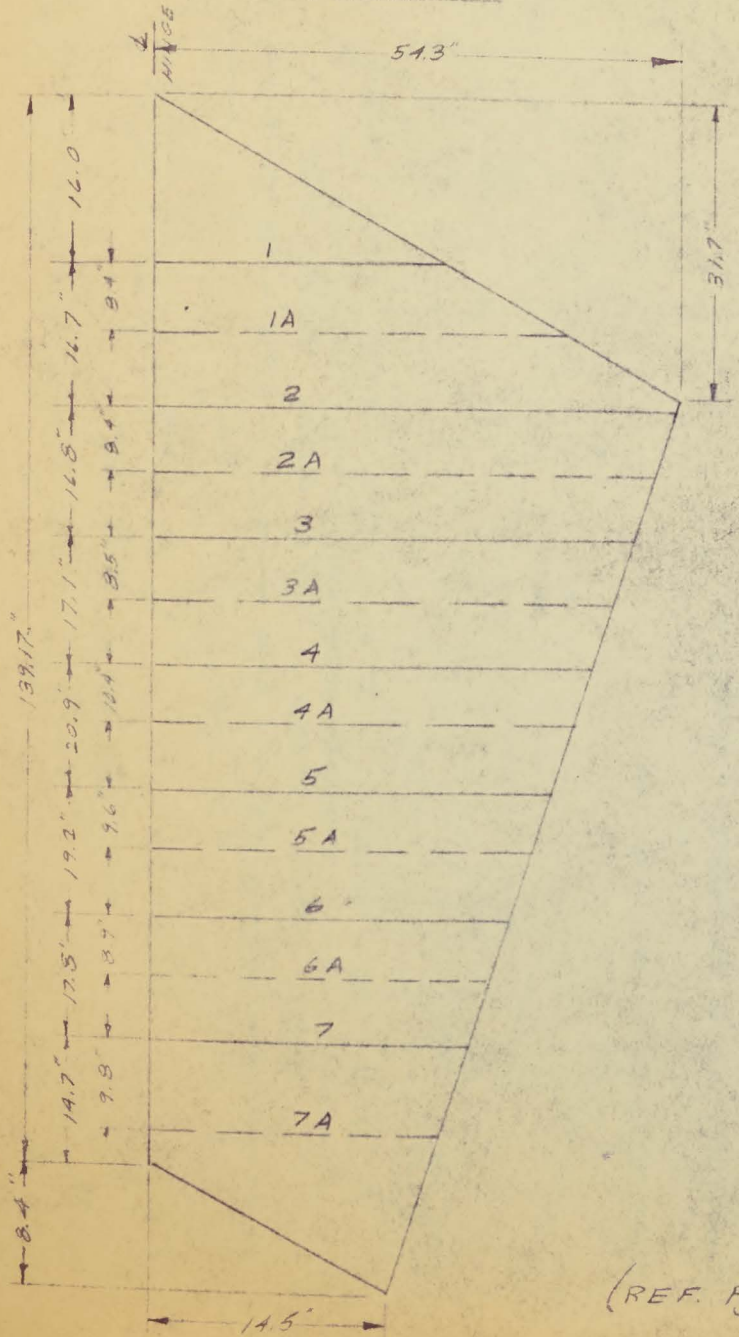
FORM 1319A

A. V. ROE CANADA LIMITED
MALTON - ONTARIO
TECHNICAL DEPARTMENT (Aircraft)

REPORT NO. 7-0574-1
SHEET NO. 000

AIRCRAFT:		PREPARED BY	DATE
C 105	AILERON	R. GAVALIS	
		CHECKED BY	DATE

SKETCH OF AILERON



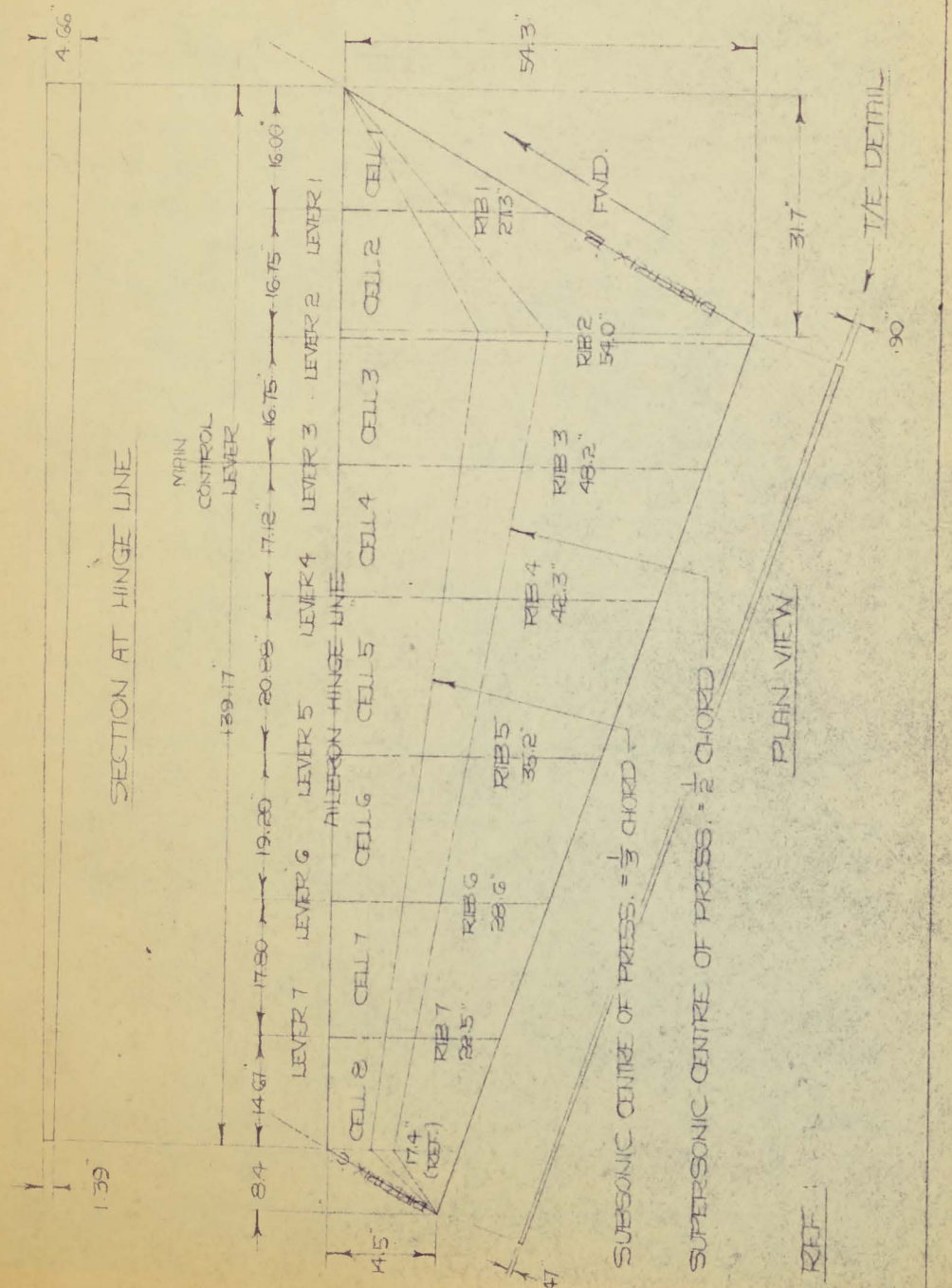
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A. V. ROE CANADA LIMITED
MALTON - ONTARIO
TECHNICAL DEPARTMENT (Aircraft)

REPORT No. 7-0679-1
SHEET No. 1

AIRCRAFT:		PREPARED BY	DATE
C 105	AILERON	T. HAYMAN	MARCH 25/57
		CHECKED BY	DATE

AILERON GEOMETRY



FORM 1319A

RCRAFT C 105 COMPONENT AILERON SHEET No. 2. REPORT No. I-0574-1

U. W. DATE MARCH 26/54 PREP. BY T. HAYMAN

AILERON CHORD LENGTHS & C.P. POSITIONS

SUBSONIC CASE
(C.P. AT 1/3 CHORD)
& SUPERSONIC CASE
(C.P. AT 1/2 CHORD)

KEY-SIGNS

CHORD LENGTH, C, & C.P. POSITION, Q, AFT FROM HL - inches

C.P. POSITION, Q, AFT FROM HL - inches (@ 1/3 CHORD)

C.P. POSITION, Q, AFT FROM HL - inches (@ 1/2 CHORD)

AILERON SPAN - inches (ALONG HL)

MAX CHORD

RIB 1

RIB 2

RIB 3

RIB 4

RIB 5

RIB 6

END HL

TRAILING EDGE

LEADING EDGE

PERPENDICULAR TO HL

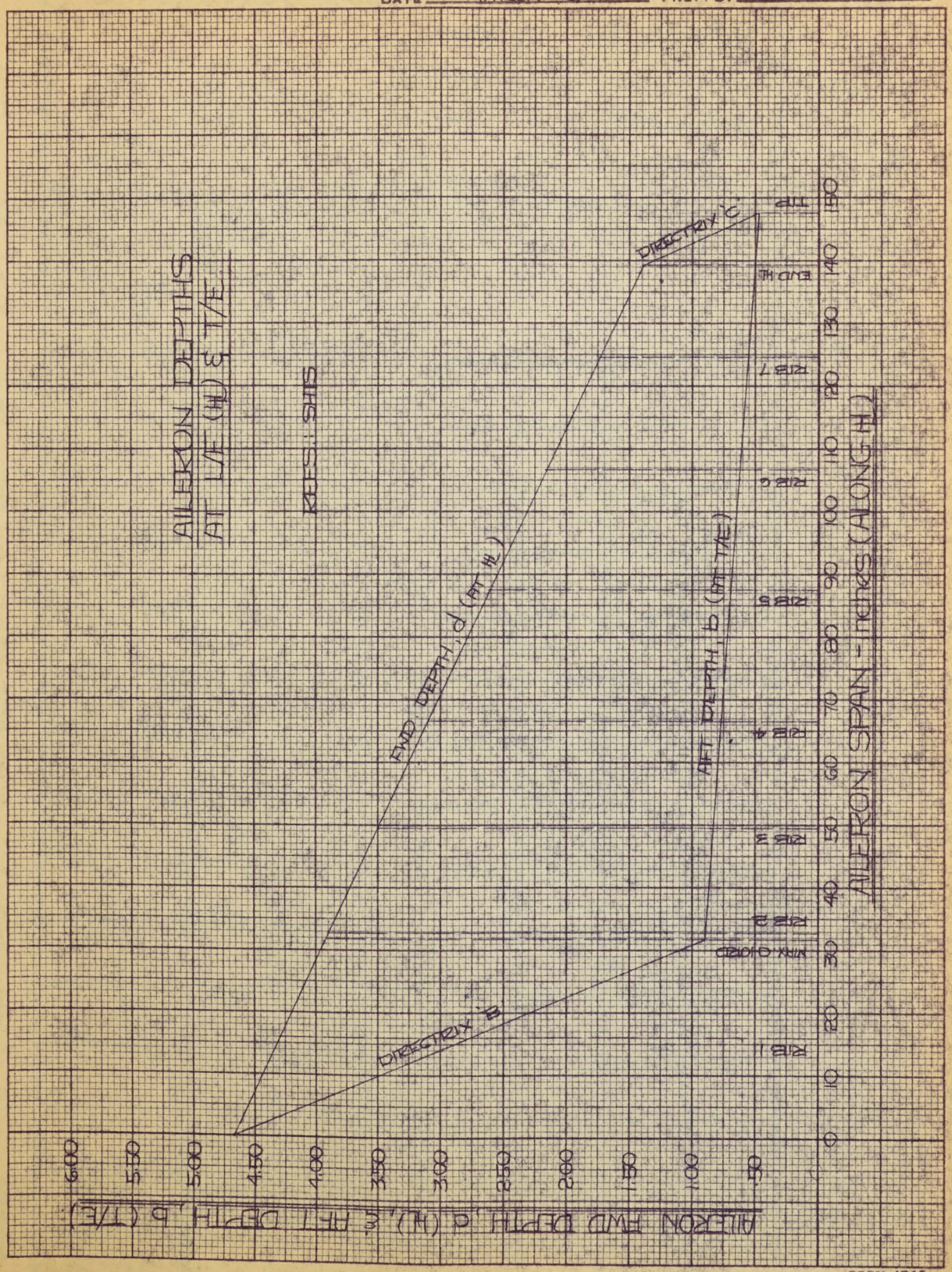
TRAILING EDGE (TAPER)

CHORD LENGTH, C & C.P. POSITION, Q, AFT HL - inches

FORM 1748

10" X 10 to the inch, 5th lines accented.
MADE IN U.S.A.

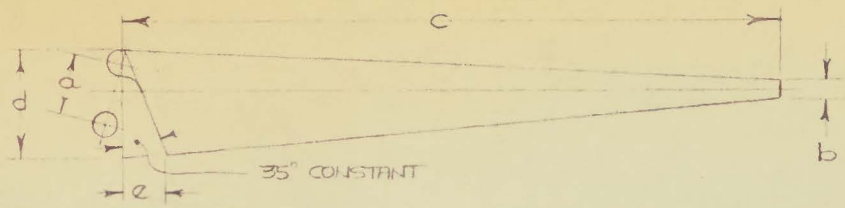
RCRAFT C 105 COMPONENT AILERON SHEET NO. 3 REPORT NO. 7-0671-1
U. W. DATE MARCH 26/54 PREP. BY J. HAYMAN



FORM 1746

10 × 10 to the inch, 5th lines accented.
MADE IN U. S. A.

AILERON RIB GEOMETRY



A. V. RC

TE

AIRCRAFT

WEIGHT

C. G. POSIT

STATION - DIST. FROM DIRECTRIX 'B' ALONG AILERON HINGE LINE	1	2	3	4	5	6	7	8	9	10	11
	RIB NO.	CHORD c INCHES	FWD DEPTH d INCHES	AFT DEPTH b INCHES	CUTOUT e = .700 d INCHES	HINGE-LEVER ARM a INCHES	PERIMETER = b+d+2c b+d = ④+③ INCHES	2c = 2×② INCHES	PERIMETER S = ⑦+⑧ INCHES	AREA = c/2 c/2 = ②/2 INCHES	c/2 (b+ = ⑩ × IN 2
Y											
16.00	1	27.3	4.30	2.76	3.01	2.20	7.06	54.60	61.66	13.65	96.4
32.75	2	54.0	3.90	.90	2.73	2.20	4.80	108.00	112.80	27.00	129.6
49.50	3	48.2	3.50	.83	2.45	2.20	4.33	96.20	100.53	24.10	104.3
66.62	4	42.3	3.10	.77	2.17	2.08	3.87	84.60	88.47	21.15	81.8
87.50	5	35.2	2.61	.69	1.83	1.94	3.30	70.20	73.50	17.60	58.0
106.70	6	28.6	2.16	.62	1.51	1.80	2.78	57.20	59.98	14.30	39.75
124.50	7	22.5	1.74	.55	1.23	1.63	2.29	45.00	47.29	11.25	25.7
	RIBS: 9115										

FORM 1543

A. V. ROE CANADA LIMITED

MALTON, ONTARIO

TECHNICAL DEPT. (AIRFRAME)

REPORT NO. . 7-0579-1

SHEET . . 9

DATE . . MARCH 26/54

AIRCRAFT . . C 105

WEIGHT . .

C. G. POSITION . .

PREPARED BY . I. HAYMAN

10	11	12	13	14	15	16	17	18	19
AREA = $\frac{c}{2}(b+d)-.35d^2$ *									
$\frac{c}{2}$ = ②/2 INCHES	$\frac{c}{2}(b+d)$ = ⑩ × ⑦ IN.^{2}	$.35d^2$ = 35 ③^2 IN.^{2}	AREA, A = ① − ⑫ IN.^{2}						
13.65	96.40	5.77	90.63						
27.00	129.60	5.32	124.28	*	AREA = $c \times b + \frac{1}{2}(d-b) \times c - \frac{1}{2}d \times e$				
24.10	104.35	4.29	100.06		$= c(b - \frac{1}{2}b + \frac{1}{2}d) - \frac{1}{2}d \times e$				
21.15	81.85	3.36	78.49		BUT, $e = d \cdot \tan 135^\circ = .700d$				
17.60	58.08	2.38	55.70		AREA = $\frac{c}{2}(b+d) - \frac{1}{2}d \times .700d$				
14.30	39.75	1.63	38.12		$= \frac{c}{2}(b+d) - .35d^2$				
11.25	25.76	1.06	21.70						

A. V. RO

TE

AIRCRAFT

WEIGHT

C. G. POSIT

AILERON LIMIT LOAD DISTRIBUTION (AIR LOAD)

SUBSONIC CASE - C.P. AT 1/3 CHORD

25,000 FT. LB LIMIT HG. MOM. REF: AERO. INTO. SHT 85 ; SHT.

	STATION - DIST. FROM DIRECTRIX "B" ALONG AILERON HINGE LINE	1	2	3	4	5	6	7	8	9	10	11
		0 (ROOT)	8.00"	16.00" (RIB 1)	31.70 (MAX. CHORD)	32.75" (RIB 2)	49.50" (RIB 3)	66.62" (RIB 4)	87.50" (RIB 5)	106.70" (RIB 6)	124.50" (RIB 7)	133.1 (FWD TIP
①	LIMIT HINGE MOM FT LB/IN / 1000 FT LBS LIMIT HG. MOM.	0	.80	3.00	16.00	15.80	13.00	10.00	7.12	4.94	3.20	2.4
②	LIMIT HINGE MOM FT LBS/IN = ① × 25	0	20.0	75.0	400.0	395.0	325.0	250.0	178.0	123.5	80.0	61.5
③	LIMIT HINGE MOM IN-LBS/IN = ② × 12	0	240	900	4800	4740	3900	3000	2136	1482	960	738
④	CHORD IN FT (DIS OF II L TO RIB)	0	13.1	27.3	54.3	54.0	48.2	42.3	35.2	28.0	22.5	17.4
⑤	LOAD MOM ARM, IN INCHES = 1/3 × C = 1/3 × ④	0	4.37	9.10	18.10	18.00	16.07	14.10	11.73	9.53	7.50	5.8
⑥	AILERON LIMIT LOAD LBS/IN = ②/⑤	0	53	99	265	264	243	213	182	156	128	12

FORM 1543

A. V. ROE CANADA LIMITED

MALTON, ONTARIO

TECHNICAL DEPT. (AIRFRAME)

REPORT NO. . 7-0574-1

SHEET . . 5

DATE . . MARCH 26/54

AIRCRAFT . . C 105

WEIGHT . .

C. G. POSITION . .

PREPARED BY . T HAYMAN

10	11	12	13	14	15	16	17	18	19
124.50" (RIB 1)	139.17" (FWD TIP)	147.6" (AFT TIP)							
3.20	2.46	0	- AERO INFO., SHT 8.5						
80.0	61.5	0							
960	738	0	- PLOTTED ON SHT						
22.5	17.4	0	- SHT						
7.50	5.80	0	- SHT						
128	127	0	- PLOTTED ON SHT						

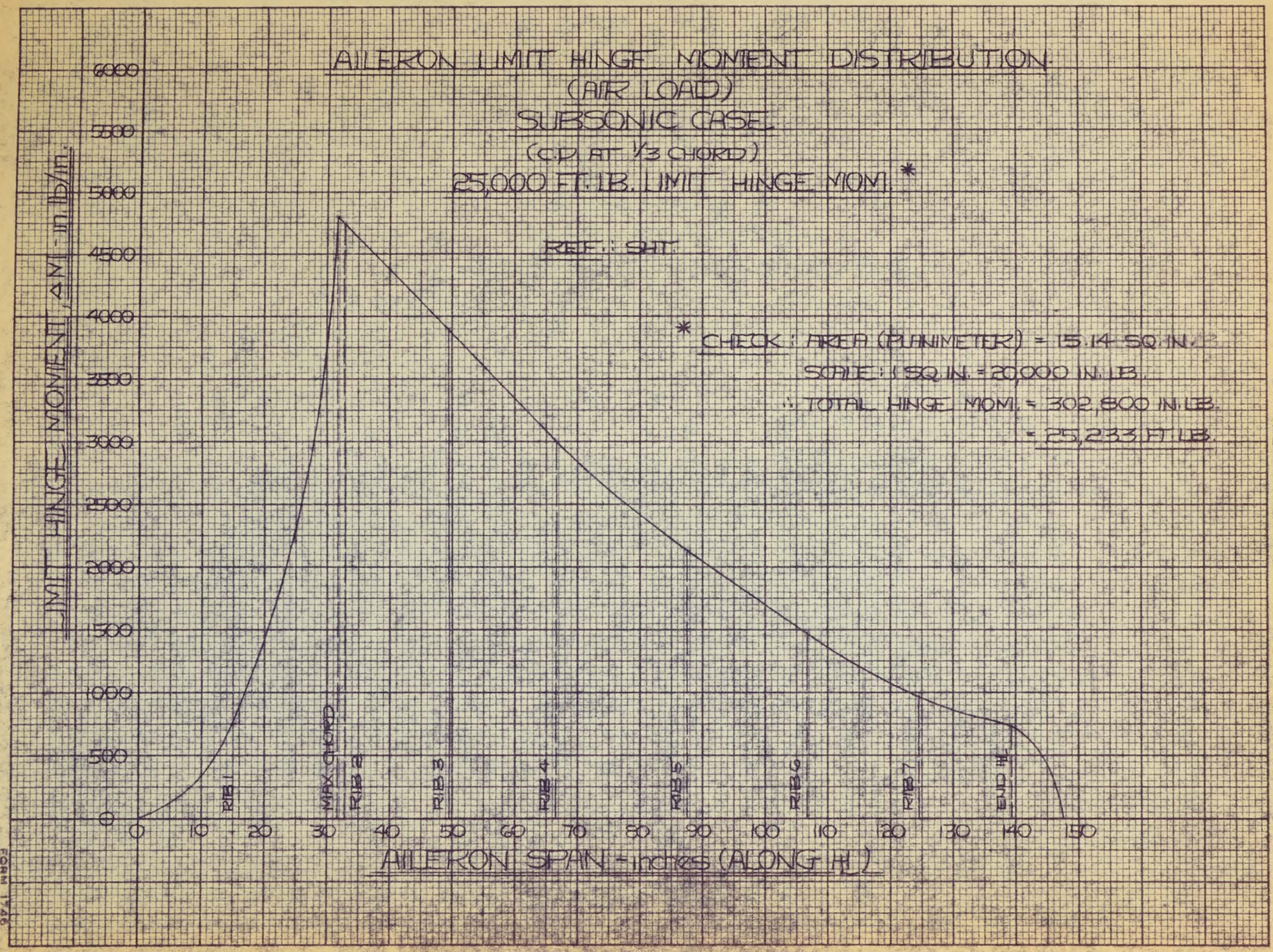
10 × 10 to the ½ inch. 5th lines accented.
MADE IN U. S. A.

AIRCRAFT C105 COMPONENT AILERON
S. U. W.
SHEET NO. 6
DATE MARCH 29/54 REPORT NO. 2-3-72-1
PREP. BY T. HAYMAN

AILERON LIMIT HINGE MOMENT DISTRIBUTION
(AIR LOAD)
SUBSONIC CASE
(C.P. AT 1/3 CHORD)
25,000 FT. LB. LIMIT HINGE MOM. *

REF: SHT

* CHECK: AREA (PLANIMETER) = 15.14 SQ. IN.
SCALE: 1 SQ. IN. = 20,000 IN. LB.
∴ TOTAL HINGE MOM. = 302,800 IN. LB.
= 25,233 FT. LB.



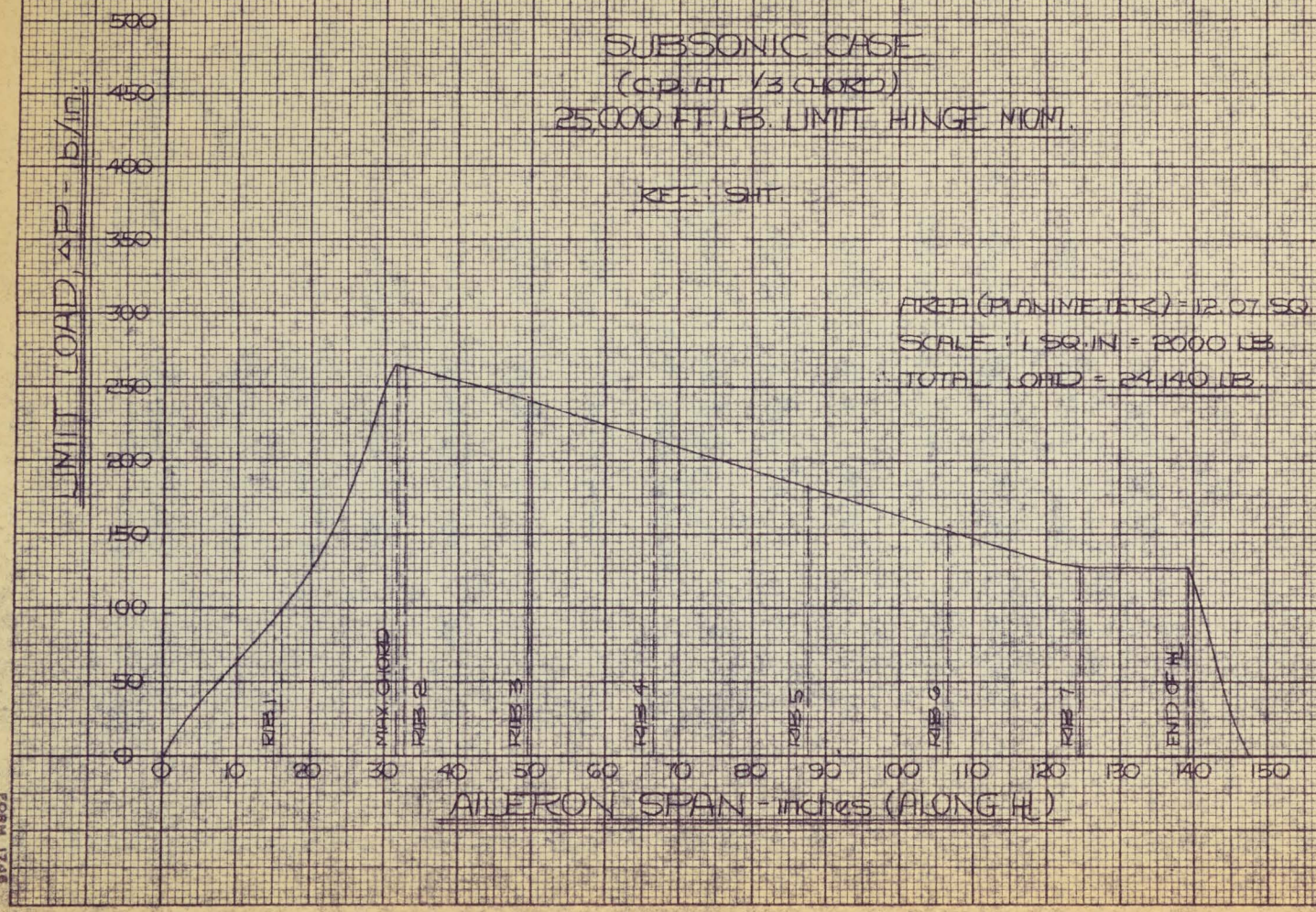
FORM 1746

AILERON LIMIT LOAD DISTRIBUTION
(AIR LOAD)

SUBSONIC CASE
(C.P. AT 1/3 CHORD)
25,000 FT. LB. LIMIT HINGE MOM.

REF: SHT.

AREA (PLANIMETER) = 12.07 SQ. IN.
SCALE: 1 SQ. IN = 2000 LB.
TOTAL LOAD = 24,140 LB.



AIRCRAFT C 105 COMPONENT AILERON SHEET NO. 7
U. W. DATE MARCH 30/54 REPORT NO. Z-0574-1
PREP BY T. HAYMAN

FORM 1746

A. V. ROE CANADA LIMITED
MALTON - ONTARIO
TECHNICAL DEPARTMENT (Aircraft)

REPORT NO. T-0579-1
SHEET NO. 8

AIRCRAFT:		PREPARED BY	DATE
C 105	AILERON	T. HAYMAN	MARCH 29/54
		CHECKED BY	DATE

ELEMENTAL HINGE MOMENTS (AIR LOAD): SUBSONIC CASE

CELL 1: $\Delta M = .24 \times 20{,}000 = 4800$ IN. LB

CELL 2: $\Delta M = 2.05 \times 20{,}000 = 41{,}000$ IN LB.

CELL 3: $\Delta M = 3.57 \times 20{,}000 = 71{,}400$ IN. LB.

CELL 4: $\Delta M = 2.95 \times 20{,}000 = 59{,}000$ IN. LB. SEE SHT.

CELL 5: $\Delta M = 2.66 \times 20{,}000 = 53{,}200$ IN. LB.

CELL 6: $\Delta M = 1.73 \times 20{,}000 = 34{,}600$ IN. LB.

CELL 7: $\Delta M = 1.07 \times 20{,}000 = 21{,}400$ IN. LB.

CELL 8: $\Delta M = .81 \times 20{,}000 = 17{,}400$ IN. LB.
$\Sigma = 15.14$ SQ IN. $\Sigma = 302{,}800$ IN. LB.

RIB 1: $\Delta M = .87 \times 20{,}000 = 17{,}400$ IN. LB.

RIB 2: $\Delta M = 3.32 \times 20{,}000 = 66{,}400$ IN. LB.

RIB 3: $\Delta M = 3.19 \times 20{,}000 = 63{,}800$ IN LB. SEE SHT.

RIB 4: $\Delta M = 2.85 \times 20{,}000 = 57{,}000$ IN LB.

RIB 5: $\Delta M = 2.18 \times 20{,}000 = 43{,}600$ IN LB.

RIB 6: $\Delta M = 1.39 \times 20{,}000 = 27{,}800$ IN. LB.

RIB 7: $\Delta M = 1.34 \times 20{,}000 = 26{,}800$ IN. LB.
$\Sigma = 15.14$ SQ IN. $\Sigma = 302{,}800$ IN LB.

REF SHT.

FORM 1118A

A. V. ROE CANADA LIMITED
MALTON - ONTARIO
TECHNICAL DEPARTMENT (Aircraft)

REPORT No. 7-0579-1
SHEET No. 9

AIRCRAFT:		PREPARED BY	DATE
C 105	AILERON	T. HAYMAN	MARCH 30/54
		CHECKED BY	DATE

ELEMENTAL LIMIT LOADS (AIR LOAD): SUBSONIC CASE

CELL 1 : $\Delta M/\frac{1}{3}C^{*}$ = 4800/4.57 = 1050 LB.

CELL 2 : $\Delta M/\frac{1}{3}C$ = 41,000/13.90 = 2950 LB.

CELL 3 : $\Delta M/\frac{1}{3}C$ = 71,400/17.04 = 4190 LB.

CELL 4 : $\Delta M/\frac{1}{3}C$ = 59,000/15.08 = 3910 LB. SEE SHT.

CELL 5 : $\Delta M/\frac{1}{3}C$ = 53,200/12.91 = 4120 LB.

CELL 6 : $\Delta M/\frac{1}{3}C$ = 34,600/10.63 = 3255 LB.

CELL 7 : $\Delta M/\frac{1}{3}C$ = 21,400/8.51 = 2515 LB.

CELL 8 : $\Delta M/\frac{1}{3}C$ = 17,400/6.65 = 2620 LB.

RIB 1 : $\Delta M/\frac{1}{3}C^{*}$ = 17,400/9.10 = 1910 LB.

RIB 2 : $\Delta M/\frac{1}{3}C$ = 66,400/18.00 = 3690 LB.

RIB 3 : $\Delta M/\frac{1}{3}C$ = 63,800/16.07 = 3970 LB. SEE SHT.

RIB 4 : $\Delta M/\frac{1}{3}C$ = 57,000/14.10 = 4040 LB.

RIB 5 : $\Delta M/\frac{1}{3}C$ = 43,600/11.73 = 3720 LB

RIB 6 : $\Delta M/\frac{1}{3}C$ = 27,800/9.53 = 2920 LB.

RIB 7 : $\Delta M/\frac{1}{3}C$ = 26,800/7.50 = 3570 LB.

REF: SHTS.

*CHDWISE LOAD DISTRIB. IS CONSIDERED Δ FOR SUBSONIC CASE; LOAD C.G. (OR C.P.) IS THEREFORE 1/3 C (SEE SHT.)

FORM 1319A

A. V. ROE CANADA LIMITED
MALTON · ONTARIO
TECHNICAL DEPARTMENT (Aircraft)

REPORT No. 7-0574-1
SHEET No. 10

AIRCRAFT:		PREPARED BY	DATE
C105	AILERON	T. HAYMAN	MARCH 30/54
		CHECKED BY	DATE

ELEMENTAL LIMIT LOADS (AIR LOAD): SUBSONIC CASE

CELL 1: $\Delta P = .43 \times 2000 = 860$ LB; ARM = 4800/860 = 5.58"

CELL 2: $\Delta P = 1.45 \times 2000 = 2900$ LB; ARM = 41,000/2900 = 14.14"

CELL 3: $\Delta P = 2.11 \times 2000 = 4220$ LB; ARM = 71,400/4220 = 16.92"

CELL 4: $\Delta P = 1.95 \times 2000 = 3900$ LB; ARM = 59,000/3900 = 15.13"

CELL 5: $\Delta P = 2.07 \times 2000 = 4140$ LB; ARM = 53,200/4140 = 12.85"

CELL 6: $\Delta P = 1.61 \times 2000 = 3220$ LB; ARM = 34,600/3220 = 10.75"

CELL 7: $\Delta P = 1.25 \times 2000 = 2500$ LB; ARM = 21,400/2500 = 8.56"

CELL 8: $\Delta P = 1.20 \times 2000 = 2400$ LB; ARM = 17,400/2400 = 7.25"

Σ = 12.07 SQ IN. Σ = 24,140 LB.

RIB 1: $\Delta P = .97 \times 2000 = 1940$ LB; ARM = 17,400/1940 = 8.97"

RIB 2: $\Delta P = 2.02 \times 2000 = 4040$ LB; ARM = 66,100/4040 = 16.44"

RIB 3: $\Delta P = 2.04 \times 2000 = 4080$ LB; ARM = 63,800/4080 = 15.64"

RIB 4: $\Delta P = 2.04 \times 2000 = 4080$ LB; ARM = 57,000/4080 = 13.97"

RIB 5: $\Delta P = 1.82 \times 2000 = 3640$ LB; ARM = 43,600/3640 = 11.98"

RIB 6: $\Delta P = 1.41 \times 2000 = 2820$ LB; ARM = 27,800/2820 = 9.86"

RIB 7: $\Delta P = 1.77 \times 2000 = 3540$ LB; ARM = 26,800/3540 = 7.57"

Σ = 12.07 SQ. IN. Σ = 24,140 LB.

RIT SHTS.

FORM 1319A

AILERON RIBS - LIMIT SHEARS & BENDING MOMENTS (A

SUBSONIC CASE - C.P. AT 1/3 CHORD

25,000 FT LB. LIMIT HINGE MOMENT

REF: SHTS

RIB	1	2	3	4	5	6	7	8	9	10
	STATION		$C-x$	$(C-x)^2$	$(C-x)^3$	SHEAR	BEND. MOM.		RIB	
	%C	x IN.	$=C-②$ IN.	$=③^2$ IN^2	$=③^3$ IN^3	$V=\frac{W(C-x)^2}{C^2}=\frac{W}{C^2}\times④$ LB.	$M=\frac{W(C-x)^3}{3.C^2}=\frac{W}{3C^2}\times⑤$ IN.LB.			
	1.00	27.30	0	0	0	0	0			
RIB 1 (STA. 16.00)	.75	20.48	6.82	46.5	317	119	271		RIB 4 (STA. 66.62)	
C = 27.3" C/3 = 9.10" C^2 = 745 in^2	.50	13.65	13.65	186	2540	477	2170		C = 42.3" C/3 = 14.10 C^2 = 1789 in^2	
W = 1910 LB. W/C^2 = 2.564 W/$3C^2$ = .855	.25	6.83	20.47	419	8580	1074	7340		W = 4040 LB. W/C^2 = 2.258 W/$3C^2$ = .753	
	0	0	27.30	745	20,300	1910	17,400			
	1.00	54.00	0	0	0	0	0			
RIB 2 (STA. 32.75)	.75	40.50	13.50	182	2460	230	1040		RIB 5 (STA. 87.50)	
C = 54.0" C/3 = 18.00" C^2 = 2916 in^2	.50	27.00	27.00	729	19,700	922	8310		C = 35.2" C/3 = 11.73" C^2 = 1239 in^2	
W = 3690 LB. W/C^2 = 1.265 W/$3C^2$ = .422	.25	13.50	40.50	1640	66,400	2070	28,000		W = 3720 LB W/C^2 = 3.002 W/$3C^2$ = 1.001	
	0	0	54.00	2920	157,700	3690	66,400			
	1.00	48.20	0	0	0	0	0			
RIB 3 (STA. 49.50)	.75	36.15	12.05	145	1750	248	998		RIB 6 (STA. 106.70)	
C = 48.2" C/3 = 16.07" C^2 = 2323 in^2	.50	24.10	24.10	581	14,000	993	7980		C = 28.6" C/3 = 9.53" C^2 = 818 in^2	
W = 3970 LB W/C^2 = 1.709 W/$3C^2$ = .570	.25	12.05	36.15	1310	47,400	2240	27,000		W = 2920 LB W/C^2 = 3.570 W/$3C^2$ = 1.190	
	0	0	48.20	2320	111,800	3970	63,800			

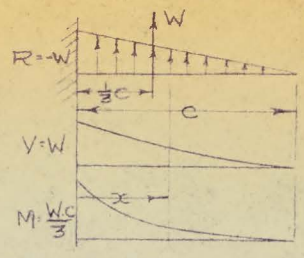
FORM 1544

S & BENDING MOMENTS (AIR LOAD):

CHORD

MENT

REF: SHTS.



$R = -W$

$V_x = W\frac{(C-x)^2}{C^2}$

$M_x = \frac{W}{3}\frac{(C-x)^3}{C^2}$

7	8	9	10	11	12	13	14	15	16	17	18	19	20
TIR $\frac{(C-x)^2}{C^2}\times④$	BEND. MOM M $=\frac{W(C-x)^3}{3.C^2}$ $=\frac{W}{3C^2}\times⑤$ IN.LB.		RIB	STATION %C	 x IN.	C-x $=C-⑫$ IN.	$(C-x)^2$ $=⑬^2$ IN^2	$(C-x)^3$ $=⑬^3$ $IN.^3$	SHEAR V $=\frac{W(C-x)^2}{C^2}$ $=\frac{W}{C^2}\times⑭$ LB.	BEND. MOM M $=\frac{W(C-x)^3}{3C^2}$ $=\frac{W}{3C^2}\times⑮$ IN. LB.		RIB	
0	0			1.00	42.30	0	0	0	0	0			
9	271		RIB 4 (STA. 66.62)	.75	31.73	10.57	112	1180	253	889		RIB 7 (STA 24.5	
17	2170		C = 42.3" C/3 = 14.10 C^2 = 1789 "	.50	21.15	21.15	447	9450	1010	7120		C = 22.5 C/3 = 7.50 C^2 = 506	
74	7340		W = 4040LB W/C^2 = 2.258 $W/3C^2$ = .753	.25	10.58	31.72	1010	32,000	2280	24,100		W = 3570 L W/C^2 = 7.05 $W/3C^2$ = 2.3	
10	17,400			0	0	42.30	1790	75,700	4040	57,000			
0	0			1.00	35.20	0	0	0	0	0			
30	1040		RIB 5 (STA. 87.50)	.75	26.40	8.80	77.4	681	232	682			
22	8310		C = 35.2" C/3 = 11.73" C^2 = 1239 "	.50	17.60	17.60	310	5460	931	5470			
70	28,000		W = 3720 LB W/C^2 = 3.002 $W/3C^2$ = 1.001	.25	8.80	26.40	697	18,400	2090	18,420			
80	66,400			0	0	35.20	1240	43,600	3720	43,600			
0	0			1.00	28.60	0	0	0	0	0			
8	998		RIB 6 (STA. 106.70)	.75	21.45	7.15	51.1	365	182	434			
3	7980		C = 28.6" C/3 = 9.53" C^2 = 818 "	.50	14.30	14.30	204	2920	728	3470			
0	27,000		W = 2920LB W/C^2 = 3.570 $W/3C^2$ = 1.190	.25	7.15	21.45	460	9870	1640	11,700			
0	63,800			0	0	28.60	818	23,400	2920	27,800			

$R = -W$

$x = W\frac{(c-x)^2}{c^2}$

$x = \frac{W}{3}\frac{(c-x)^3}{c^2}$

A. V. ROE CANADA LIMITED

MALTON, ONTARIO

ENGINEERING DIVISION - AIRCRAFT

AIRCRAFT - - C.105

WEIGHT - -

C. G. POSITION -

REPORT NO. - 7-0574-1

SHEET 11

DATE - - MARCH 31/54

PREPARED BY - T. HAYMAN

17	18	19	20	21	22	23	24	25	26	27	28	29
BEND. MOM. $M = \frac{W(c-x)^3}{3c^2} = \frac{W}{3c^2} \times (15)$ IN. LB.		RIB		STATION %c	STATION x IN.	$c-x = c-(22)$ IN.	$(c-x)^2 = (23)^2$ IN^2	$(c-x)^3 = (23)^3$ IN^3	SHEAR $V = \frac{W(c-x)^2}{c^2} = \frac{W}{c^2} \times (24)$ LB.	BEND. MOM. $M = \frac{W(c-x)^3}{3c^2} = \frac{W}{3c^2} \times (25)$ IN. LB.		
0				1.00	22.50	0	0	0	0	0		
889		RIB 7 (STA 24.50)		.75	16.88	5.62	31.6	178	223	419		
7120		$C = 22.5$ $C/3 = 7.50$ $C^2 = 506''^2$		.50	11.25	11.25	127	1430	896	3360		
24,100		$W = 3570$ LB $W/C^2 = 7.035$ $W/3C^2 = 2.352$		.25	5.63	16.87	285	4810	2010	11,300		
57,000				0	0	22.50	506	11,400	3570	26,800		
0												
682												
5470												
18,420												
43,600												
0												
434												
3470												
11,700												
27,800												

CRAFT C105 COMPONENT AILERON SHEET No. 12 REPORT No. 7-0574-1

I. W. 4040 DATE MARCH 31/54 PREP. BY T. HAYMAN

AILERON RIB LIMIT SHEARS (AIR LOAD)

SUBSONIC CASE (C.P. AT 1/3 CHORD) 25,000 FT. LB. LIMIT HINGE MOM.

RIB NO.	CHORD IN.	MAX. V LB.
1	27.3	1910
2	54.0	3690
3	48.2	3970
4	42.3	4040
5	35.2	3720
6	28.6	2920
7	22.5	3570

REF: SHT.

LIMIT SHEAR, V - LB.

4000 3800 3600 3400 3200 3000 2800 2600 2400 2200 2000 1800 1600 1400 1200 1000 800 600 400 200 0

0 .10 .20 .30 .40 .50 .60 .70 .80 .90 1.00

STATION FROM AILERON H.L. - % CHORD

FORM 1746

MADE IN U.S.A.

CRAFT C105 COMPONENT AILERON SHEET NO. 13 REPORT NO. T-1674-1

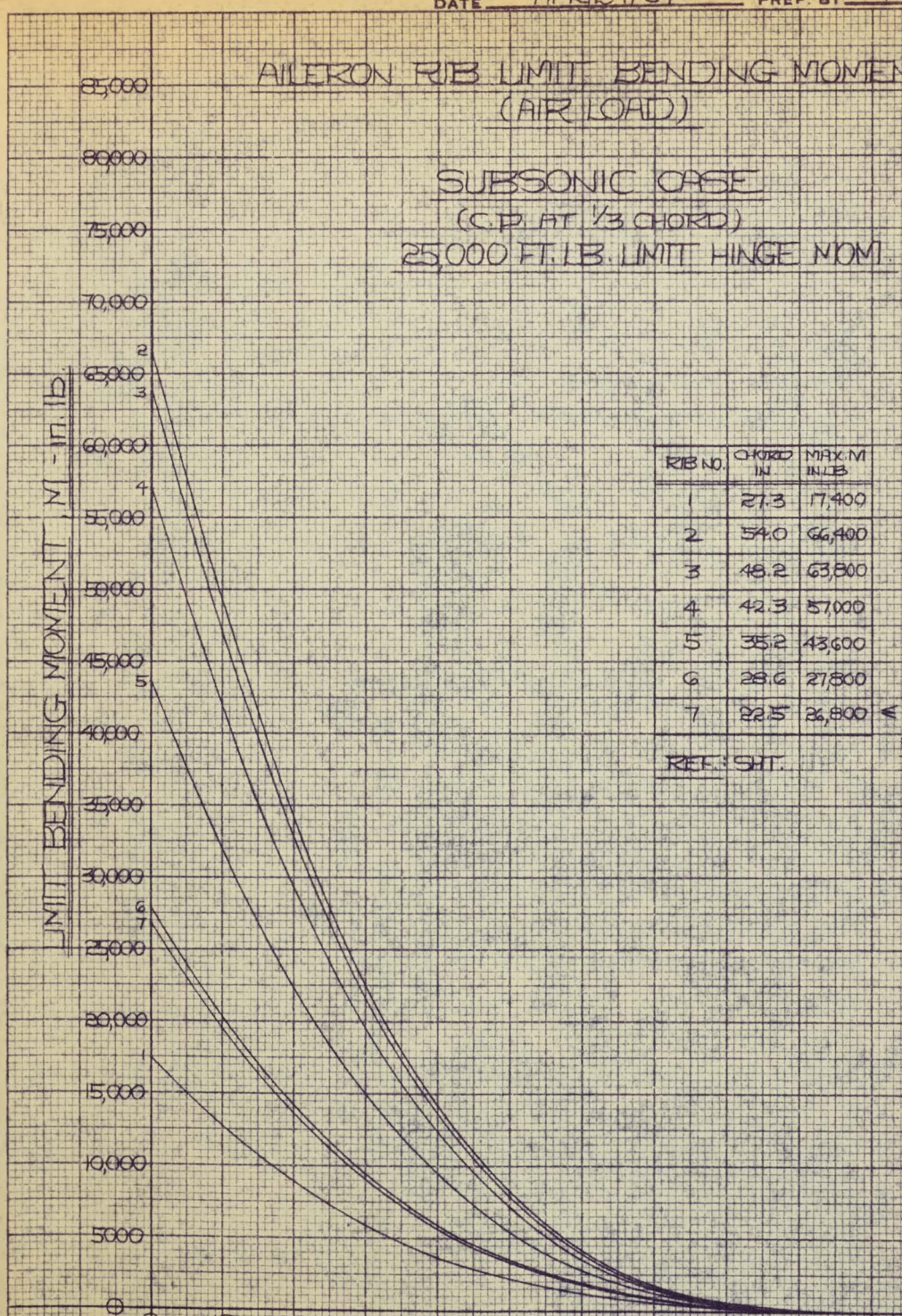
W. DATE APRIL 1/54 PREP. BY T. HAYMAN

AILERON RIB LIMIT BENDING MOMENTS (AIR LOAD)

SUBSONIC CASE

(C.P. AT 1/3 CHORD)

25,000 FT. LB. LIMIT HINGE MOM.

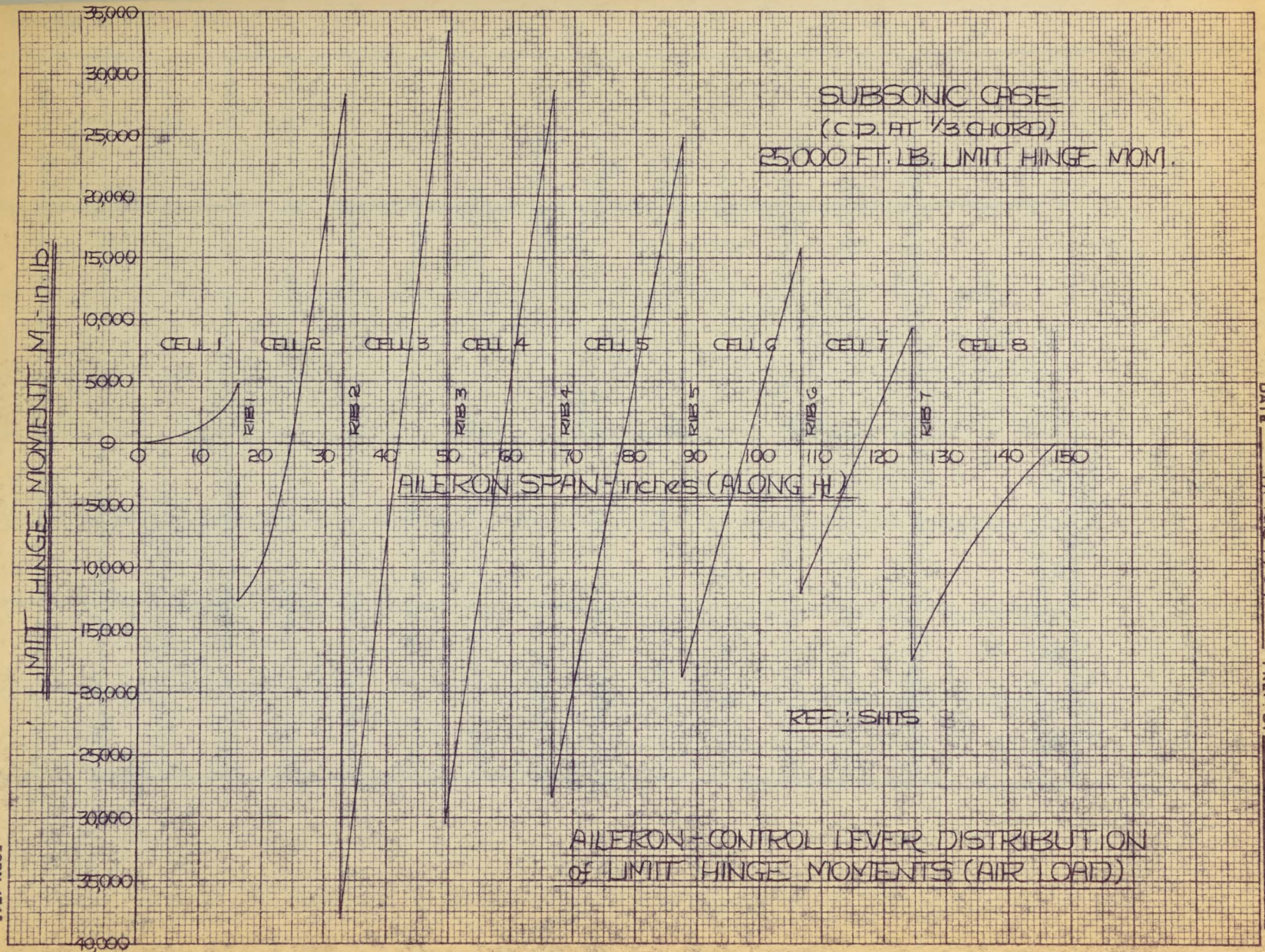


RIB NO.	CHORD IN.	MAX. M IN. LB.
1	27.3	17,400
2	54.0	66,400
3	48.2	63,800
4	42.3	57,000
5	35.2	43,600
6	28.6	27,800
7	22.5	26,800

REF.: SHT.

∴ = 392,800 IN LB.
= 25,233 FT. LB.

FORM 1746



CRAFT C 105 COMPONENT AILERON SHEET NO. 14 REPORT NO. 26579-1
DATE APRIL 1/54 PREP. BY T. HAYMAN

FORM 1746

AILERON LIMIT LOAD DISTRIBUTION (AIR LOAD)

SUPERSONIC CASE - C P AT 1/2 CHORD

25,000 FT LB. LIMIT HG. MOM. REF.: AERO. INFO. SHT. 85 ; SHT.

A. V.

AIRCRA

WEIGHT

C. G. P

	STATION - DIST FROM DIRECTRIX 'B' ALONG AILERON HINGE LINE →	1	2	3	4	5	6	7	8	9	10
		O (ROOT)	8.00"	16.00" (RIB 1)	31.70" (MAX. CHORD)	32.75" (RIB 2)	49.50" (RIB 3)	66.62" (RIB 4)	87.50" (RIB 5)	106.70" (RIB 6)	124.50" (RIB 7)
①	LIMIT HINGE MOM. FT. LB/IN/1000 FT. LB. LIM. HG. MOM.	O	1.34	3.80	16.00	15.80	13.00	10.00	7.00	4.76	2.92
②	LIMIT HINGE MOM. FT. LB /IN. = ① × 25	O	33.5	95.0	400.0	395.0	325.0	250.0	175.0	119.0	73.0
③	LIMIT HINGE MOM. IN. LB/IN. = ② × 12	O	402	1140	4800	4740	3900	3000	2100	1428	876
④	CHORD INCHES (RIB OR TIP TO RIB)	O	13.7	27.3	54.3	54.0	48.2	42.3	35.2	28.6	22.5
⑤	LOAD MOM. ARM, INCHES = ½ × C · ½ × ④	O	6.85	13.65	27.15	27.00	24.10	21.15	17.60	14.30	11.25
⑥	AILERON LIMIT LOAD LB/IN. = ③/⑤	O	59	84	177	176	162	142	119	100	78

FORM 1543

A. V. ROE CANADA LIMITED

MALTON, ONTARIO

TECHNICAL DEPT. (AIRFRAME)

REPORT NO. . Z-0574-1

SHEET . . 15

DATE . . MARCH 26/54

AIRCRAFT . . C105

WEIGHT . .

C. G. POSITION .

PREPARED BY . T. HAYMAN

9	10	11	12	13	14	15	16	17	18	19
106.70 (RIB 6)	124.50 (RIB 7)	139.17 (FWD. TIP)	147.6 (AFT TIP)							
4.76	2.92	1.83	0	- AIRCO. INTO., SHT			8-5			
11.90	7.30	4.57	0							
14.28	8.76	5.49	0	- PLOTTED ON SHT.						
2.86	2.25	1.74	0	- SHT.						
14.30	11.25	8.70	0	- SHT						
10.00	7.8	6.3	0	- PLOTTED ON SHT.						

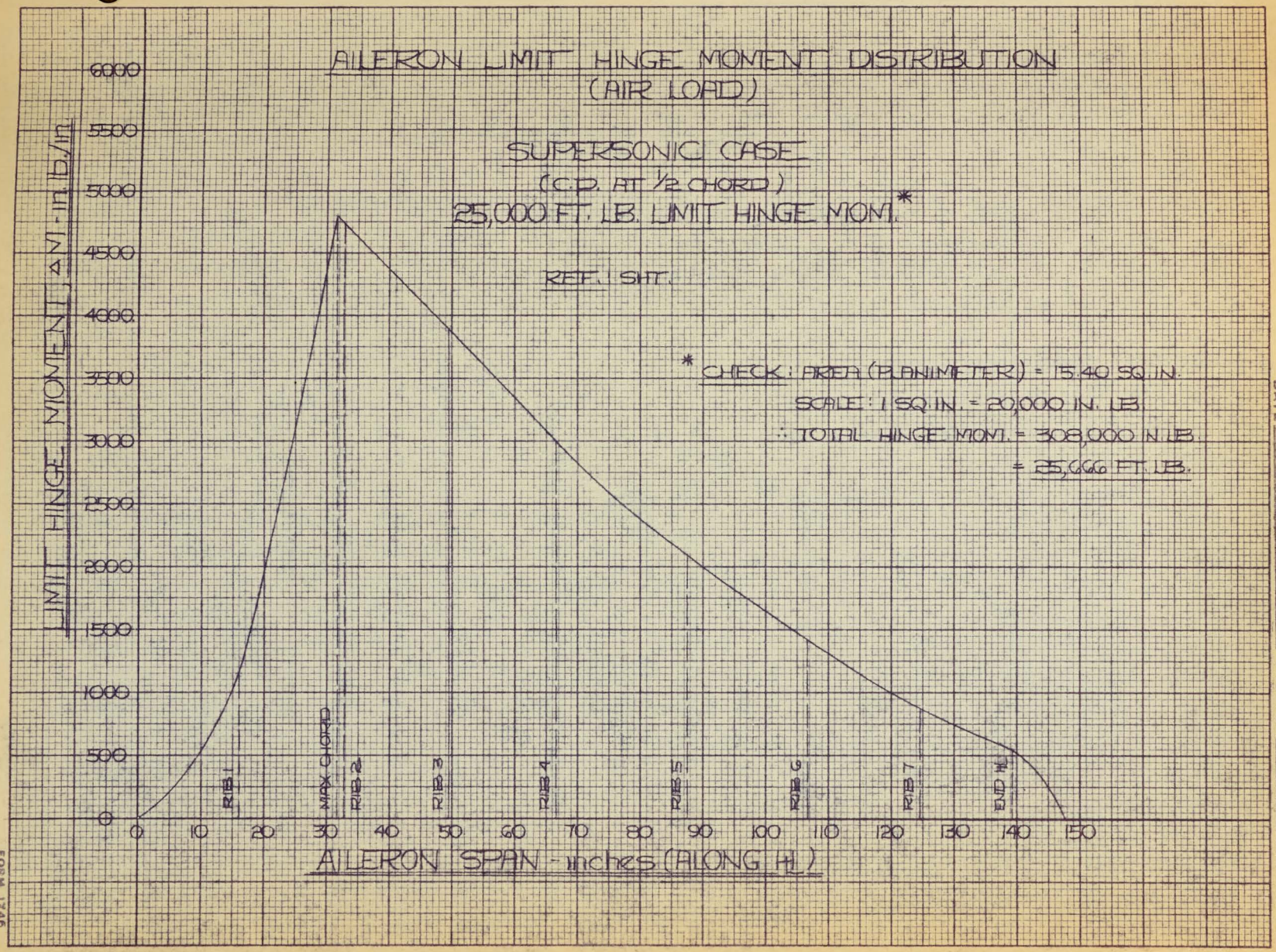
10 × 10 to the inch, 5th lines accented.
MADE IN U. S. A.

AILERON LIMIT HINGE MOMENT DISTRIBUTION
(AIR LOAD)

SUPERSONIC CASE
(C.P. AT ½ CHORD)

25,000 FT. LB. LIMIT HINGE MOM.*

REF. 1 SHT.



* CHECK: AREA (PLANIMETER) = 15.40 SQ. IN.
SCALE: 1 SQ. IN. = 20,000 IN. LB.
∴ TOTAL HINGE MOM. = 308,000 IN LB.
= 25,666 FT. LB.

AIRCRAFT C105 COMPONENT AILERON
A. U. W.
SHEET NO. 16 REPORT NO. 7-05-24-1
DATE MARCH 29/54 PREP. BY T. HAYMAN

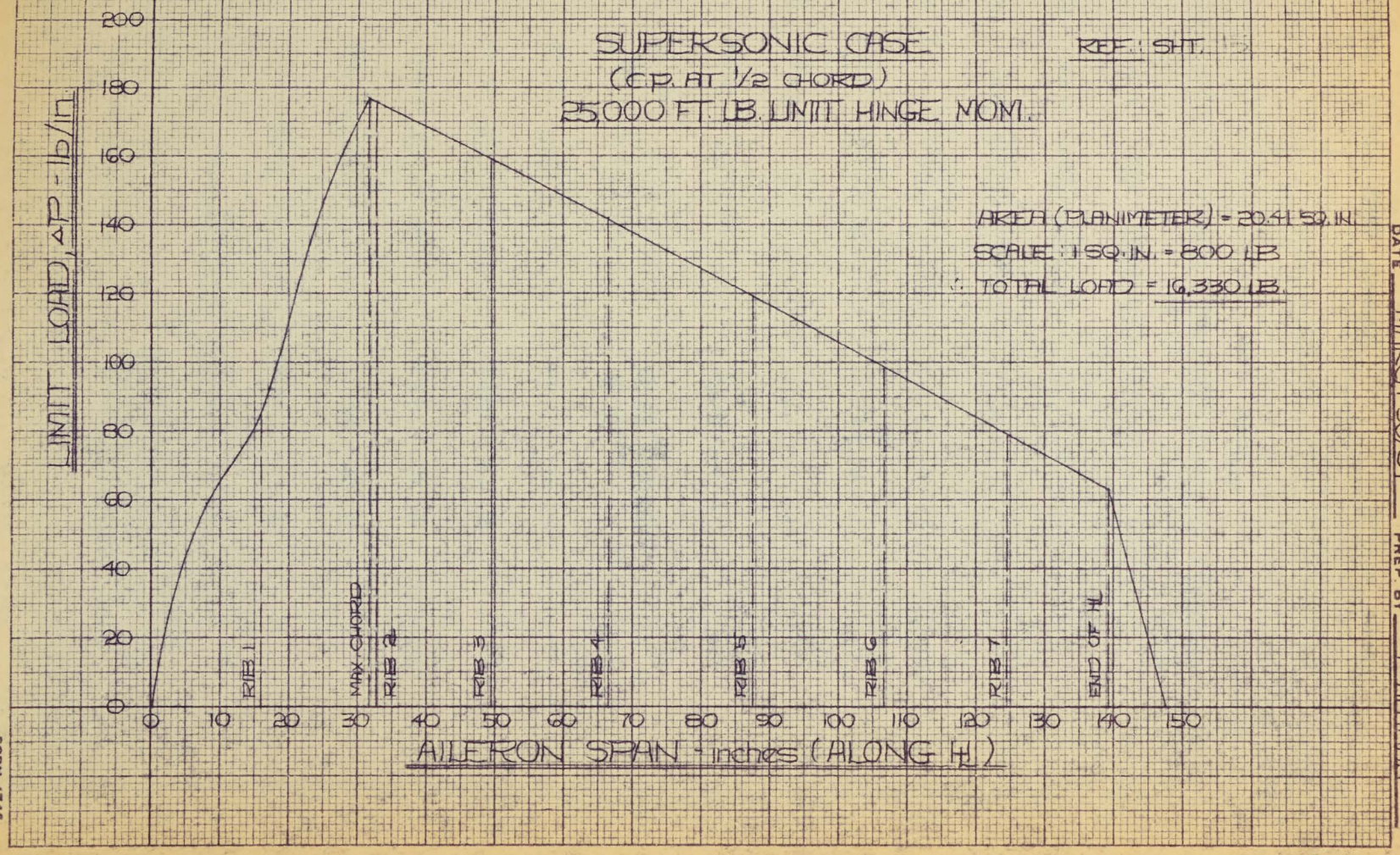
FORM 1246

10 × 10 to the ½ inch, 5th lines accented.
MADE IN U.S.A.

AILERON LIMIT LOAD DISTRIBUTION
(AIR LOAD)

SUPERSONIC CASE
(C.P. AT ½ CHORD)
25,000 FT. LB. LIMIT HINGE MOM.

REF: SHT.



AREA (PLANIMETER) = 20.41 SQ. IN.
SCALE: 1 SQ. IN. = 800 LB
∴ TOTAL LOAD = 16,330 LB.

AIRCRAFT U.W. C-105 COMPONENT AILERON SHEET No. 17 REPORT No. Z-05279-1
DATE MARCH 30/54 PREP. BY T. HAYMAN

FORM 1746

A. V ROE CANADA LIMITED
MALTON - ONTARIO
TECHNICAL DEPARTMENT (Aircraft)

REPORT No. 7-0574-1
SHEET No 18

AIRCRAFT:		PREPARED BY	DATE
C 105	AILERON	T. HAYMAN	MARCH 29/54
		CHECKED BY	DATE

ELEMENTAL HINGE MOMENTS (AIR LOAD): SUPERSONIC CASE

CELL 1 : $\Delta M = .35 \times 20{,}000 = 7000$ IN. LB.

CELL 2 : $\Delta M = 2.49 \times 20{,}000 = 48{,}800$ IN. LB.

CELL 3 : $\Delta M = 3.57 \times 20{,}000 = 71{,}400$ IN. LB.

CELL 4 : $\Delta M = 2.95 \times 20{,}000 = 59{,}000$ IN. LB. SEE SHT.

CELL 5 : $\Delta M = 2.66 \times 20{,}000 = 53{,}200$ IN. LB.

CELL 6 : $\Delta M = 1.68 \times 20{,}000 = 33{,}600$ IN. LB.

CELL 7 : $\Delta M = 1.03 \times 20{,}000 = 20{,}600$ IN. LB.

CELL 8 : $\Delta M = .68 \times 20{,}000 = 13{,}400$ IN. LB.
$\Sigma = 15.40$ SQ IN. $\Sigma = 308{,}000$ IN. LB.

RIB 1 : $\Delta M = 1.20 \times 20{,}000 = 24{,}000$ IN. LB.

RIB 2 : $\Delta M = 3.54 \times 20{,}000 = 70{,}800$ IN. LB.

RIB 3 : $\Delta M = 3.19 \times 20{,}000 = 63{,}800$ IN. LB. SEE SHT.

RIB 4 : $\Delta M = 2.85 \times 20{,}000 = 57{,}000$ IN. LB.

RIB 5 : $\Delta M = 2.16 \times 20{,}000 = 43{,}200$ IN. LB.

RIB 6 : $\Delta M = 1.34 \times 20{,}000 = 26{,}800$ IN. LB.

RIB 7 : $\Delta M = 1.12 \times 20{,}000 = 22{,}400$ IN. LB.
$\Sigma = 15.40$ SQ. IN. $\Sigma = 308{,}000$ IN. LB.

REF SHT. 12

FORM 1319A

A. V. ROE CANADA LIMITED
MALTON · ONTARIO
TECHNICAL DEPARTMENT (Aircraft)

REPORT No. 7-0574-1
SHEET No. 19

AIRCRAFT:		PREPARED BY	DATE
C 105	AILERON	T. HAYMAN	MARCH 30/54
		CHECKED BY	DATE

ELEMENTAL UNIT LOADS (AIR LOAD): SUPERSONIC CASE

CELL 1: $\Delta M/\frac{1}{2}C^{*}$ = 7000/6.85 = 1020 LB.

CELL 2: $\Delta M/\frac{1}{2}C$ = 48,800/20.85 = 2340 LB.

CELL 3: $\Delta M/\frac{1}{2}C$ = 71,400/25.55 = 2795 LB.

CELL 4: $\Delta M/\frac{1}{2}C$ = 59,000/22.62 = 2610 LB. SEE SHT.

CELL 5: $\Delta M/\frac{1}{2}C$ = 53,200/19.37 = 2750 LB.

CELL 6: $\Delta M/\frac{1}{2}C$ = 33,600/15.95 = 2110 LB.

CELL 7: $\Delta M/\frac{1}{2}C$ = 20,600/12.77 = 1610 LB.

CELL 8: $\Delta M/\frac{1}{2}C$ = 13,400/9.98 = 1340 LB.

RIB 1: $\Delta M/\frac{1}{2}C^{*}$ = 24,000/13.65 = 1760 LB.

RIB 2: $\Delta M/\frac{1}{2}C$ = 70,800/27.00 = 2620 LB.

RIB 3: $\Delta M/\frac{1}{2}C$ = 63,800/24.10 = 2650 LB. SEE SHT.

RIB 4: $\Delta M/\frac{1}{2}C$ = 51,000/21.15 = 2695 LB.

RIB 5: $\Delta M/\frac{1}{2}C$ = 43,200/17.60 = 2455 LB.

RIB 6: $\Delta M/\frac{1}{2}C$ = 26,800/14.30 = 1870 LB.

RIB 7: $\Delta M/\frac{1}{2}C$ = 22,400/11.25 = 1990 LB.

REF.: SHTS

* CHDWISE LOAD DISTRIB. IS CONSIDERED U.D.L. FOR SUPERSONIC CASE; LOAD c.g. (OR C.P.) IS THEREFORE ½C (SEE SHT. 2)

FORM 1319A

A. V. ROE CANADA LIMITED
MALTON · ONTARIO
TECHNICAL DEPARTMENT (Aircraft)

REPORT No. 7-0574-1
SHEET No 20

AIRCRAFT:		PREPARED BY	DATE
C 105	AILERON	T. HAYMAN	MARCH 30/54
		CHECKED BY	DATE

ELEMENTAL LIMIT LOADS (AIR LOAD): SUPERSONIC CASE

CELL 1 : $\Delta P = 1.05 \times 800 = 840$ LB, ARM = 7000/840 = 8.33"

CELL 2 : $\Delta P = 2.86 \times 800 = 2290$ LB, ARM = 48,800/2290 = 21.31"

CELL 3 : $\Delta P = 3.55 \times 800 = 2840$ LB, ARM = 71,400/2840 = 25.14"

CELL 4 : $\Delta P = 3.25 \times 800 = 2600$ LB, ARM = 59,000/2600 = 22.69"

CELL 5 : $\Delta P = 3.43 \times 800 = 2740$ LB, ARM = 53,200/2740 = 19.42"

CELL 6 : $\Delta P = 2.65 \times 800 = 2120$ LB, ARM = 33,600/2120 = 15.85"

CELL 7 : $\Delta P = 1.97 \times 800 = 1580$ LB, ARM = 20,600/1580 = 13.04"

CELL 8 : $\Delta P = 1.65 \times 800 = 1320$ LB, ARM = 13,400/1320 = 10.15"

Σ = 20.41 SQ IN. Σ = 16,330 LB.

RIB 1 : $\Delta P = 2.25 \times 800 = 1800$ LB, ARM = 24,000/1800 = 13.33"

RIB 2 : $\Delta P = 3.47 \times 800 = 2780$ LB, ARM = 70,800/2780 = 25.47"

RIB 3 : $\Delta P = 3.39 \times 800 = 2710$ LB, ARM = 63,800/2710 = 23.54"

RIB 4 : $\Delta P = 3.40 \times 800 = 2720$ LB, ARM = 57,000/2720 = 20.96"

RIB 5 : $\Delta P = 3.01 \times 800 = 2410$ LB, ARM = 43,200/2410 = 17.93"

RIB 6 : $\Delta P = 2.31 \times 800 = 1850$ LB, ARM = 26,800/1850 = 14.49"

RIB 7 : $\Delta P = 2.58 \times 800 = 2060$ LB, ARM = 22,400/2060 = 10.87"

Σ = 20.41 SQ IN. Σ = 16,330 LB.

REF. : SHT. 17 - 19

FORM 1316A

AILERON RIBS - LIMIT SHEARS & BENDING MOMENTS (

SUPERSONIC CASE - C.P. AT ½ CHORD

25,000 FT. LB. LIMIT HINGE MOMENT

REF: S

RIB	1	2	3	4	5	6	7	8	9	10
	STATION		C-X = C-②	(C-X)/2 = ③/2	SHEAR V = W(C-X) = W × ③	BEND. MOM. M = W(C × (C-X)/2) = ⑤ × ④				RIB
	%C	X IN.	IN.	IN.	LB.	IN. LB.				
	1.00	27.30	0	0	0	0				
RIB 1 (STA. 16.00)	.75	20.48	6.82	3.41	440	1500				RIB 4 (STA. 66.62)
C = 27.3" W = 1760 LB.	.50	13.65	13.65	6.82	880	6000				C = 42.3 W = 2695 LB
W = W/C = 64.47 #/"	.25	6.83	20.47	10.24	1320	13,500				W = W/C = 63.71 #/"
	0	0	27.30	13.65	1760	24,000				
	1.00	54.00	0	0	0	0				
RIB 2 (STA. 32.75)	.75	40.50	13.50	6.75	655	4430				RIB 5 (STA. 87.50)
C = 54.0" W = 2620 LB.	.50	27.00	27.00	13.50	1310	17,700				C = 35.2" W = 2455 LB.
W = W/C = 48.52 #/"	.25	13.50	40.50	20.25	1965	39,800				W = W/C = 69.74 #/"
	0	0	54.00	27.00	2620	70,800				
	1.00	48.20	0	0	0	0				
RIB 3 (STA. 49.50)	.75	36.15	12.05	6.02	662	3990				RIB 6 (STA. 106.70)
C = 48.2" W = 2650 LB.	.50	24.10	24.10	12.05	1325	15,950				C = 28.6" W = 1870 LB.
W = W/C = 54.97 #/"	.25	12.05	36.15	18.08	1983	35,900				W = W/C = 65.38
	0	0	48.20	24.10	2650	63,800				

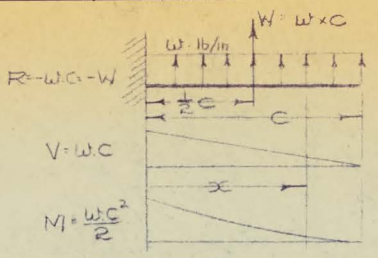
FORM 1544

SHEARS & BENDING MOMENTS (AIR LOAD)

C.P. AT $\frac{1}{2}$ CHORD

REF: SHTS.

UGE MOMENT



5	6	7	8	9	10	11	12	13	14	15	16	17	18	19
HEAR V w(c-x) w×③ LB.	BEND. MOM. M = w(c-x)((c-x)/2) = ⑤×④ IN. LB.			RIB		STATION %c	STATION x IN.	c-x = c-⑫ IN.	(c-x)/2 = ⑬/2 IN.	SHEAR V = w(c-x) = w×⑬ LB.	BEND. MOM. M = w(c-x)((c-x)/2) = ⑮×⑭ IN. LB.			
0	0					1.00	42.30	0	0	0	0			
440	1500			RIB 4 (STA. 66.62)		.75	31.73	10.57	5.29	674	3560			
880	6000			C = 42.3" W = 2695 LB		.50	21.15	21.15	10.58	1348	14,250			
1320	13,500			w = W/C = 63.71 #/in		.25	10.58	31.72	15.86	2022	32,060			
1760	24,000					0	0	42.30	21.15	2695	57,000			
0	0					1.00	35.20	0	0	0	0			
655	4430			RIB 5 (STA. 87.50)		.75	26.40	8.80	4.40	614	2700			
1310	17,700			C = 35.2" W = 2455 LB.		.50	17.60	17.60	8.80	1228	10,800			
1965	39,800			w = W/C = 69.74 #/in		.25	8.80	26.40	13.20	1842	24,300			
2620	70,800					0	0	35.20	17.60	2455	43,200			
0	0					1.00	28.60	0	0	0	0			
662	3990			RIB 6 (STA. 106.70)		.75	21.45	7.15	3.57	467	1675			
1325	15,950			C = 28.6" W = 1870 LB.		.50	14.30	14.30	7.15	935	6700			
1983	35,900			w = W/C = 65.38		.25	7.15	21.45	10.73	1403	15,080			
2650	63,800					0	0	28.60	14.30	1870	26,800			

R = W

V = w(c-x)

M = w(c-x)$\left(\frac{c-x}{2}\right)$

A. V. ROE CANADA LIMITED

MALTON, ONTARIO

ENGINEERING DIVISION - AIRCRAFT

AIRCRAFT - - C 105

WEIGHT - -

C. G. POSITION -

REPORT NO. - 7-0579-1

SHEET 21

DATE - - MARCH 31/54

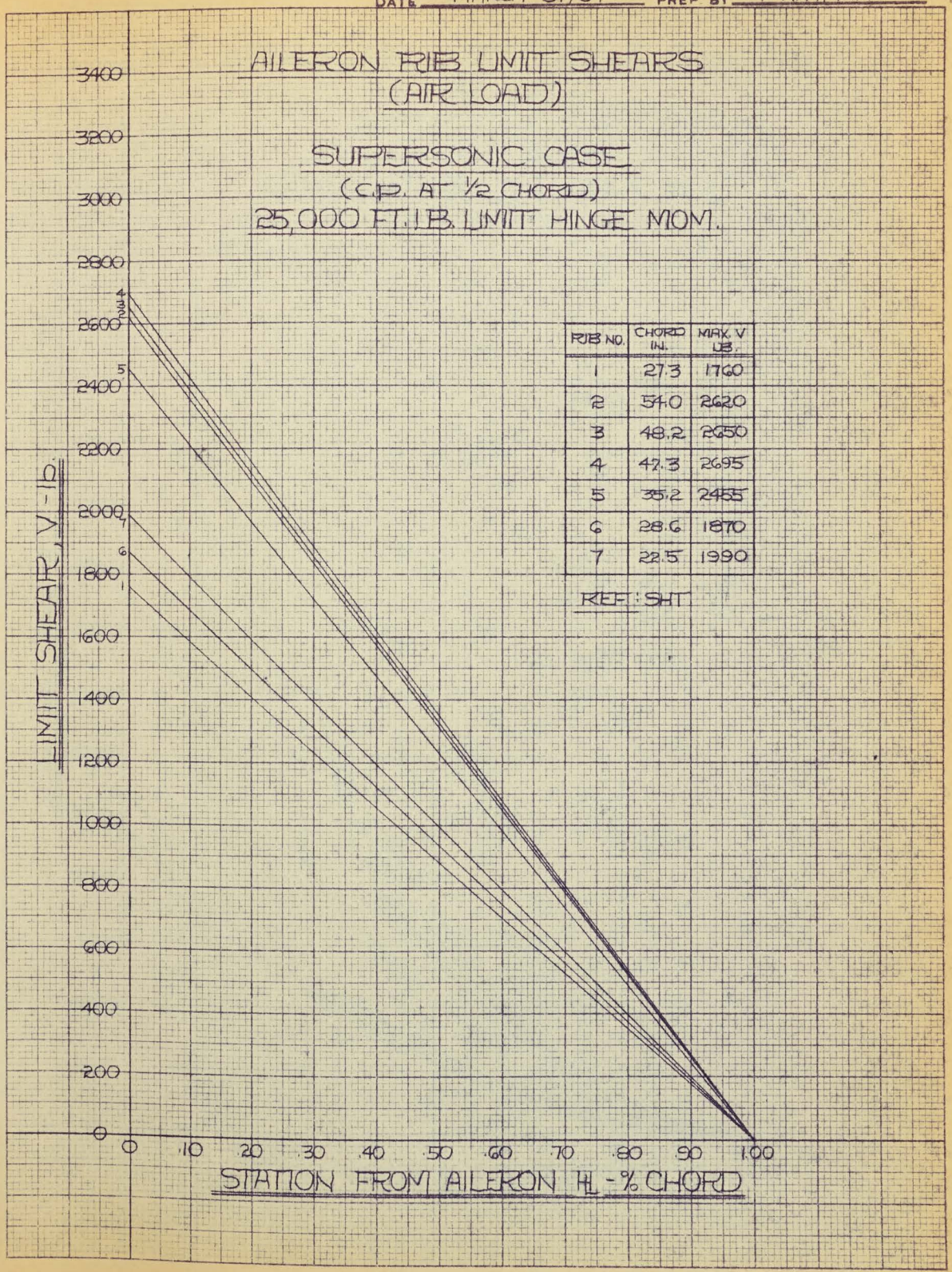
PREPARED BY - I. HAYMAN

17	18	19	20	21	22	23	24	25	26	27	28	29
		RIB		STATION		$c-x$	$\frac{c-x}{2}$	SHEAR	BEND. MOM			
				%C	x	$=c-(22)$	$=(23)/2$	V $=w(c-x)$ $=w\times(23)$	M $=w(c-x)\left(\frac{c-x}{2}\right)$ $=(25)\times(24)$			
					IN.	IN.	IN.	LB.	IN. LB.			
				1.00	22.50	0	0	0	0			
		RIB 7 (STA. 124.50)		.75	16.88	5.62	2.81	497	1400			
		$c = 22.5"$ $w = 1990$ LB		.50	11.25	11.25	5.63	995	5600			
		$w = w/c$ $= 88.44$ #/"		.25	5.63	16.87	8.44	1493	12,600			
				0	0	22.50	11.25	1990	22,400			

AIRCRAFT C 105 COMPONENT AILERON SHEET No. 22 REPORT No. Z-0579-1
U. W. DATE MARCH 31/54 PREP BY T. HAYMAN

AILERON RIB LIMIT SHEARS
(AIR LOAD)

SUPERSONIC CASE
(C.P. AT ½ CHORD)
25,000 FT. LB. LIMIT HINGE MOM.



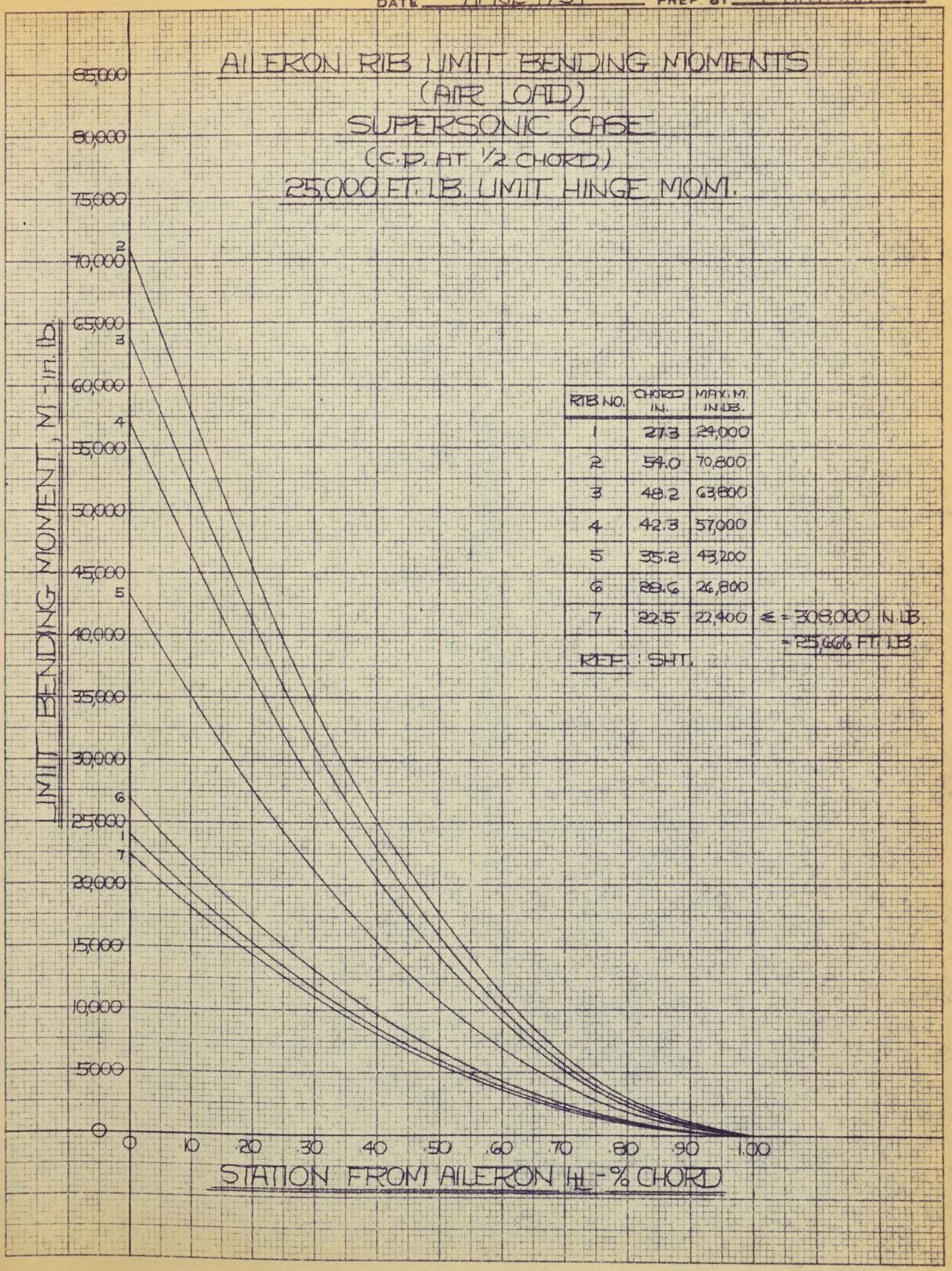
RIB NO.	CHORD IN.	MAX. V LB.
1	27.3	1760
2	54.0	2620
3	48.2	2650
4	42.3	2695
5	35.2	2455
6	28.6	1870
7	22.5	1990

REF: SHT

FORM 1746

CRAFT C 105 COMPONENT AILERON SHEET No. 23 REPORT No. Z-0574-1
W. DATE APRIL 1/54 PREP. BY T. HAYMAN

AILERON RIB LIMIT BENDING MOMENTS
(AIR LOAD)
SUPERSONIC CASE
(C.P. AT 1/2 CHORD)
25,000 FT. LB. LIMIT HINGE MOM.

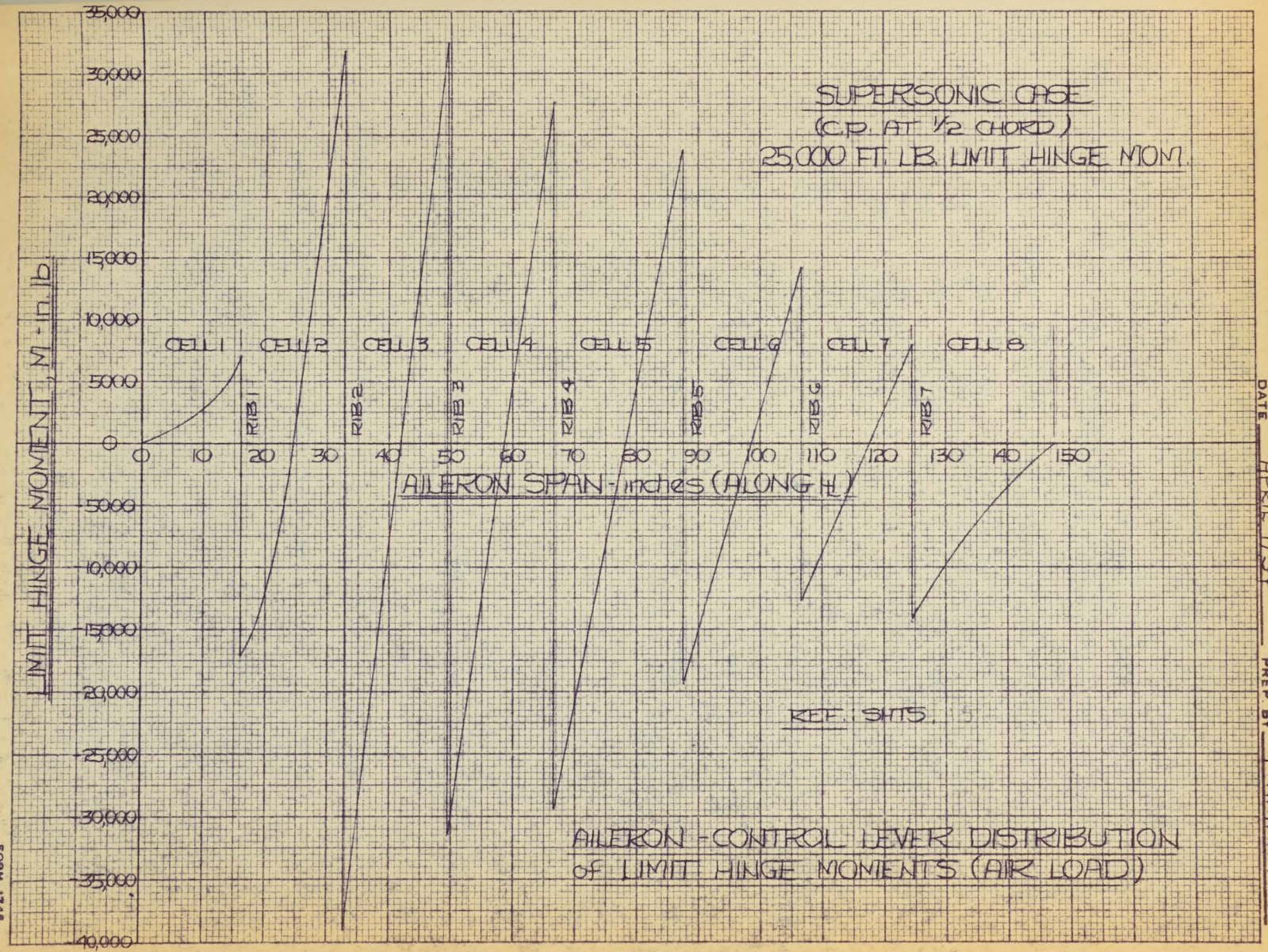


RIB NO.	CHORD IN.	MAXIMUM IN LB.	
1	27.3	29,000	
2	54.0	70,800	
3	48.2	63,800	
4	42.3	57,000	
5	35.2	43,200	
6	28.6	26,800	
7	22.5	22,400	Σ = 308,000 IN. LB. = 25,666 FT. LB.

REF: SHT.

FORM 1746

CRAFT C 105 COMPONENT AILERON SHEET NO. 24 REPORT NO. 7-26529-1
W.
DATE APRIL 1954 PREP. BY T. HAYMAN



AILERON - CONTROL LEVER DISTRIBUTION
of LIMIT HINGE MOMENTS (AIR LOAD)

FORM 1746

A. V. ROE CANADA LIMITED
MALTON - ONTARIO
TECHNICAL DEPARTMENT (Aircraft)

REPORT No. T-0579-1
SHEET No. 25

AIRCRAFT:		PREPARED BY	DATE
C105	AILERON	T. HAYMAN	APRIL 1/54
		CHECKED BY	DATE

LINK & TIE ROD LIMIT LOADS (AIR LOAD):

* MAIN CONTROL LEVER IS AT RIB 3.

	RIB NO	① LIMIT HINGE MOMENT M IN LB	② LINK ARM a IN.	③ LINK LOAD M/a = ①/② LB.	④ CONTROL LEVER GEOM. DIMN. q IN.	⑤ CONTROL LEVER GEOM. DIMN. h IN.	⑥ TIE ROD TO LINK LOAD R/P_L = q/h = ④/⑤	⑦ Δ TIE ROD LOAD R_1 R_2 = ③ × ⑥ LB	⑧ TIE ROD LOAD = Σ R_1 = Σ ⑦ LB
SUBSONIC	1	17,400	2.20	7910	4.45	8.50	.524	4140	4140
	2	66,400	2.20	30,180	4.45		.524	15,810	19,950
	3	63,800	2.20	29,000	4.45		.524	15,200	35,150 — RIB 3
	4	57,000	2.08	27,400	4.21		.495	13,560	36,930
	5	43,600	1.94	22,470	3.93		.462	10,380	23,370
	6	27,800	1.80	15,440	3.64		.428	6610	12,990
	7	26,800	1.63	16,440	3.30	8.50	.388	6380	6380
SUPERSONIC	1	24,000	2.20	10,910	4.45	8.50	.524	5720	5720
	2	70,800	2.20	32,180	4.45		.524	16860	22,580
	3	63,800	2.20	29,000	4.45		.524	15,200	38,550 — RIB 3
	4	57,000	2.08	27,400	4.21		.495	13,560	21,990
	5	43,200	1.94	22,270	3.93		.462	10,290	11,700
	6	26,800	1.80	14,890	3.64		.428	6370	5330
	7	22,400	1.63	13,740	3.30	8.50	.388	5330	

SHT. 3 SHT. 4 SHT. 5

SUBSONIC CASE: C.P. AT 1/3 CHORD (◺ DISTRIB.)

SUPERSONIC CASE: C.P. AT 1/2 CHORD (U.D.L.)

BOTH CASES: TOTAL HINGE MOM. = 25,000 FT. LB.

FORM 1319A

A. V. ROE CANADA LIMITED
MALTON - ONTARIO
TECHNICAL DEPARTMENT (Aircraft)

REPORT No. T-0579-1
SHEET No. 26

AIRCRAFT:		PREPARED BY	DATE
C105	AILERON	T. HAYMAN	APRIL 1/54
		CHECKED BY	DATE

LINK LOADS (EXTERNAL + UNIT REDUNDANT):

- MAIN CONTROL LEVER IS AT RIB 3 (LINK 3).

	LINK NO.	ZERO LOAD, P_0 LB. ①	LOAD DUE TO: P_1 LB. ②	P_2 LB. ③	P_4 LB. ④	P_5 LB. ⑤	P_6 LB. ⑥	P_7 LB. ⑦	
SUBSONIC	1	7310	1.00						
	2	30,180		1.00					
	3	29,000	-1.00	-1.00	-.945	-.882	-.818	-.741	REACTION
	4	27,400			1.00				
	5	22,470				1.00			
	6	15,440					1.00		
	7	16,440						1.00	
SUPERSONIC	1	10,910	1.00						
	2	32,180		1.00					
	3	29,000	-1.00	-1.00	-.945	-.882	-.818	-.741	REACTION
	4	27,400			1.00				
	5	22,270				1.00			
	6	14,890					1.00		
	7	13,740						1.00	

ZERO LINK LOADS - SHT. 1

P_1 - P_7 = 1.00# ARE UNIT TENSION LOADS APPLIED TO EACH LINK SEPERATELY, THE REMAINDER (EXCEPT FOR LINK 3) BEING 'CUT'.

LOADS AT LINK 3 DUE TO P_1 - P_9 = $\frac{P_i(-1.00) \times \text{LINK ARM @ } i}{\text{LINK ARM @ 3 } (-2.20)}$ $i = 1\text{-}7$

(SEE SHT. 2)

FORM 1319A

A. V. ROE CANADA LIMITED
MALTON - ONTARIO
TECHNICAL DEPARTMENT (Aircraft)

REPORT NO. 7-0579-1
SHEET NO. 27

AIRCRAFT:		PREPARED BY	DATE
C105	AILERON	T. HAYMAN	APRIL 2/54
		CHECKED BY	DATE

TIE ROD LOADS (EXTERNAL + UNIT REDUNDANT):

- MAIN CONTROL LEVER IS AT RIB 3.

	TIE ROD	ZERO LOAD P_0' LB ①	LOAD DUE TO: $P_1 = P_1'$ LB ②	$P_2 = P_2'$ LB ③	$P_4 = P_4'$ LB ④	$P_5 = P_5'$ LB ⑤	$P_6 = P_6'$ LB ⑥	$P_7 = P_7'$ LB ⑦	
SUBSONIC	1-2	-4140	-.524						
	2-3	-19,950	-.524	-.524					REACTION = -(2-3) + (3-4) (INBD.)
	3-4	36,930			.495	.462	.428	.388	
	4-5	23,310				.462	.428	.388	
	5-6	12,990					.428	.388	
	6-7	6380						.388	
SUPERSONIC	1-2	-5720	-.524						
	2-3	-22,580	-.524	-.524					REACTION = -(2-3) + (3-4) (INBD.)
	3-4	35,550			.495	.462	.428	.388	
	4-5	21,990				.462	.428	.388	
	5-6	11,700					.428	.388	
	6-7	5330						.388	

ZERO TIE ROD LOADS - SHT. 25

$P_1 - P_7 = 1.00$ ARE UNIT TENSION LOADS APPLIED TO EACH LINK SEPERATELY, THE REMAINDER (EXCEPT FOR LINK 3) BEING 'CUT'.

TIE ROD LOADS DUE TO $P_1 - P_7$, $P_i' = P_i(=1.00) \times \frac{g}{h}$, WHERE g, h ARE LEVER DIMNS. (SEE SHT. 25) $i = 1-7$

FORM 1319A

A. V. ROE CANADA LIMITED
MALTON - ONTARIO
TECHNICAL DEPARTMENT (Aircraft)

REPORT No. 7-0579-1
SHEET No. 28

AIRCRAFT:		PREPARED BY	DATE
C105	AILERON	T. HAYMAN	APRIL 2/54
		CHECKED BY	DATE

CRANK LOADS (EXTERNAL + UNIT REDUNDANT):

- MAIN CONTROL LEVER IS AT RIB 3 (CRANK 3)

	CRANK NO	ZERO LOAD P_i'' LB. (1)	LOAD DUE TO: $P_1 = P_1''$ LB. (2)	P_2 P_2'' LB. (3)	P_4 P_4'' LB (4)	P_5 P_5'' LB (5)	P_6 P_6'' LB. (6)	P_7 P_7'' LB. (7)	
SUBSONIC	1	4140	.524						
	2	15,810		.524					
	3	15,200	-.524	-.524	-.495	-.462	-.428	-.388	REACTION
	4	13,560			.495				
	5	10,380				.462			
	6	6610					.428		
	7	6380						.388	
SUPERSONIC	1	5720	.524						
	2	16,860		.524					
	3	15,200	-.524	-.524	-.495	-.462	-.428	-.388	REACTION
	4	13,560			.495				
	5	10,290				.462			
	6	6370					.428		
	7	5330						.388	

ZERO CRANK LOADS - SHT. 25

$P_1 - P_9 = 1.00$ ARE UNIT TENSION LOADS APPLIED TO EACH LINK SEPERATELY, THE REMAINDER (EXCEPT FOR LINK 3) BEING 'CUT'

CRANK LOADS DUE TO $P_1 - P_7$, $P_i'' = P_i (=1.00) \times \frac{q}{h}$, WHERE q, h ARE CRANK DIMNS. (SEE SHT. 2)
$i = 1 - 7$

A. V. ROE CANADA LIMITED
MALTON - ONTARIO
TECHNICAL DEPARTMENT (Aircraft)

REPORT No. 7-0574-1
SHEET No. 29

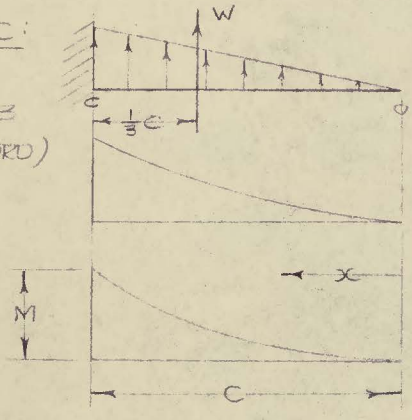
AIRCRAFT:		PREPARED BY	DATE
C105	AILERON	T. HAYMAN	APRIL 2/54
		CHECKED BY	DATE

RIB BENDING MOMENTS (EXTERNAL + UNIT REDUNDANT):

FOR ZERO (EXTERNAL) LOADS:

SUBSONIC:

(△ DISTRIB
- C.P. AT ⅓ CHORD)



$V = \frac{W x^2}{C^2}$

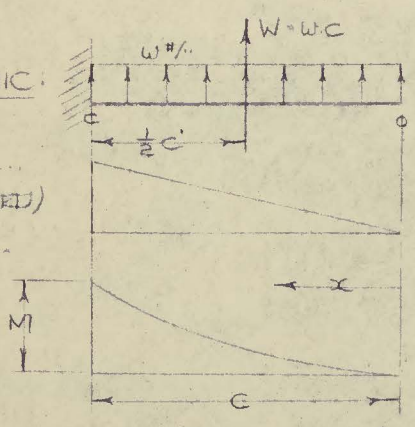
$B.M._x = \frac{W x^3}{3C^2} = k.x^3$

$B.M._{x=C} = k.C^3 = M$

i.e. $k = \frac{M}{C^3}$ OR, $B.M._x = \frac{M.x^3}{C^3}$

SUPERSONIC:

(▭ U.D.L.
- C.P. AT ½ CHORD)



$V = w.x$

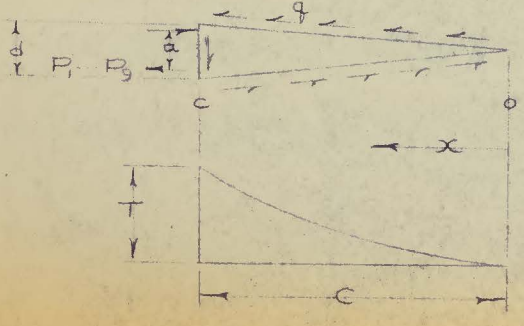
$B.M._x = w.x.\frac{x}{2} = \frac{wx^2}{2} = kx^2$

$B.M._{x=C} = k.C^2 = M$

i.e. $k = \frac{M}{C^2}$ OR, $B.M._x = \frac{M.x^2}{C^2}$

FOR REDUNDANT LOADS:

($P_1 - P_2 = 1.00$ - UNIT TENSION LOAD APPLIED TO LINKS)



$q = \frac{T}{2A} = \frac{T}{d.C} = \frac{M.C}{d.x^2}$

$A_x = h_x.\frac{x}{2} = \frac{dx}{C}.\frac{x}{2} = \frac{dx^2}{2C}$

$M_x = 2.q.A_x = \frac{2.T}{dC}.\frac{dx^2}{2C} = \frac{T.x^2}{C^2}$

$M_{x=C} = T = P_1 \times a$, $\ell = 1.7$

CRM 1319A

A. V. ROE CANADA LIMITED
MALTON - ONTARIO
TECHNICAL DEPARTMENT (Aircraft)

REPORT No. 7-0579-1
SHEET No. 30

AIRCRAFT:		PREPARED BY	DATE
C105	AILERON	T. HAYMAN	APRIL 2/54
		CHECKED BY	DATE

RIB BENDING MOMENTS (EXTERNAL + UNIT REDUNDANT) (CONT.):

- MAIN CONTROL LEVER IS AT RIB 3.

	RIB NO.	ZERO MOMENT M_0 IN. LB. ①	MOMENT DUE TO: $P_1 = m_1$ IN. LB. ②	$P_2 = m_2$ IN. LB. ③	$P_4 = m_4$ IN. LB. ④	$P_5 = m_5$ IN. LB. ⑤	$P_6 = m_6$ IN. LB. ⑥	$P_7 = m_7$ IN. LB. ⑦	
SUBSONIC	1	17,400	2.20						
	2	66,400		2.20					
	3	63,800	-2.20	-2.20	-2.08	-1.94	-1.80	-1.63	REACTION
	4	57,000			2.08				
	5	43,600				1.94			
	6	27,800					1.80		
	7	26,800						1.63	
SUPERSONIC	1	24,000	2.20						
	2	70,800		2.20					
	3	63,800	-2.20	-2.20	-2.08	-1.94	-1.80	-1.63	REACTION
	4	57,000			2.08				
	5	43,200				1.94			
	6	26,800					1.80		
	7	22,400						1.63	

ZERO BENDING MOMENTS - SHT. 28

$P_1 - P_7 = 1.00$ ARE UNIT TENSION LOADS APPLIED TO EACH LINK SEPERATELY, THE REMAINDER (EXCEPT FOR LINK 3) BEING 'CUT'.

RIB B.M.'S DUE TO $P_1 - P_3 = P_i\,(=1.00) \times$ LINK ARM, a (SEE SHT. 28) $\quad i = 1-7$

SHEAR DUE TO STRAIN ENERGY IS NEGLECTED.

CRM 1316A

A. V. ROE CANADA LIMITED
MALTON - ONTARIO
TECHNICAL DEPARTMENT (Aircraft)

REPORT No. 7-0579-1
SHEET No. 31

AIRCRAFT		PREPARED BY	DATE
C 105	AILERON	T. HAYMAN	APRIL 2/54
		CHECKED BY	DATE

AILERON HINGE MOMENTS (EXTERNAL + UNIT REDUNDANT):

- MAIN CONTROL LEVER IS AT RIB 3.

	CELL	ZERO TORSION T_o IN. LB ①	TORSION DUE TO: $P_1 = t_1$ IN LB ②	$P_2 = t_2$ IN. LB ③	$P_4 = t_4$ IN LB ④	$P_5 = t_5$ IN LB ⑤	$P_6 = t_6$ IN. LB ⑥	$P_7 = t_7$ IN LB ⑦	
SUBSONIC	0-1	0							
	1-2	7900	-2.20						
	2-3	-2300	-2.20	-2.20					REDUNDANT @ RIB 3 IS -VE
	3-4	-900			2.08	1.94	1.80	1.63	
	4-5	-1800				1.94	1.80	1.63	
	5-6	-1500					1.80	1.63	
	6-7	-1300						1.63	
	7-0	0							
SUPERSONIC	0-1	0							
	1-2	7400	-2.20						
	2-3	-3300	-2.20	-2.20					REACTION @ RIB 3 IS -VE
	3-4	-1900			2.08	1.94	1.80	1.63	
	4-5	-2800				1.94	1.80	1.63	
	5-6	-2600					1.80	1.63	
	6-7	-2300						1.63	
	7-0								

ZERO HINGE MOMENTS - SHTS. [illegible] (AVERAGE)

$P_1 - P_7 = 100$ ARE UNIT TENSION LOADS APPLIED TO EACH LINK SEPERATELY, THE REMAINDER (EXCEPT FOR LINK 3) BEING 'CUT'.

AILERON HINGE MOMS. DUE TO $P_1 - P_7$ | CELL $i-(i+1) = P_i(100) \times$ LINK ARM ℓ
$i = 1-7$ (SEE SHT. [illegible])

POSITIVE TORQUE IS CLOCKWISE WHEN LOOKING INBOARD.

AVRO FORM 1319A

A. V. ROE CANADA LIMITED
MALTON - ONTARIO
TECHNICAL DEPARTMENT (Aircraft)

REPORT No. 7-0574-1
SHEET No. 31.1

AIRCRAFT:		PREPARED BY	DATE
C 105	AILERON	R. GAVALIS	JULY 19/54
		CHECKED BY	DATE

REDUNDANT LOADS

SECTION PROPERTIES

LINKS

(FINAL CONFIGURATION NOT AVAILABLE)

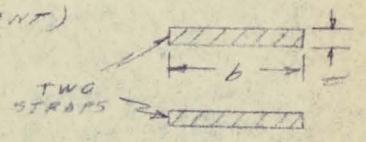
$L = 5.55"$ (ASSUMED LENGTH - CONSTANT)

$E = 29 \times 10^6$ p.s.i.

$F_{cu} = 160{,}000$ psi

$F_{cal.} = 82000$ psi

CRITICAL SECTION



LEVER →	1	2	3	4	5	6	7	REF. ↓
t	.20						.20	
P_{LINK}	16910	32180	29000	27400	22470	16440	16440	B.25
$A_{REQ'D}$	.226	.666	.601	.567	.466	.320	.340	$\frac{P_{LINK}}{F_{CAL.}} \times 1.7$
$b_{REQ'D}$	.565	1.67	1.51	1.42	1.17	.80	.85	
$L/AE \times 10^6$	.847	.287	.318	.338	.410	.599	.562	$\frac{5.55}{A(29\times10^6)}$

TIE-RODS

TIE-ROD →	1-2	2-3	3-4	4-5	5-6	6-7		REF. ↓
L	16.73	16.73	17.34	21.15	19.47	18.15		FORMULAE R.13.6-20
A	.240	.538	.905	.596	.380	.2005		
$S = L/AE$	2.4×10^{-6}	1.07×10^{-6}	$.661\times10^{-6}$	1.22×10^{-6}	1.77×10^{-6}	3.12×10^{-6}		

$E = 29 \times 10^6$ p.s.i.

AILERONS

$$\text{STIFFNESS} = R_L = \frac{Li}{GJ_L}, \quad \text{WHERE } L = \text{CELL LENGTH}$$

$G_{SUB.} = 3.9 \times 10^6$ p.s.i.

$G_{UPPER} = 3.5 \times 10^6$ p.s.i.

$$J = \frac{4A^2 t}{p} = \frac{4A^2(.051)}{p}$$

$$\therefore R_L = \frac{Li\,p}{G(4)(.051)A^2} = 4.9\frac{Li\,p}{GA^2}, \quad \text{WHERE } A = \text{CELL AREA}$$

p = CELL PERIMETER

A. V. ROE CANADA LIMITED
MALTON · ONTARIO
TECHNICAL DEPARTMENT (Aircraft)

REPORT No. 7-0579-1
SHEET No 31a

AIRCRAFT:		PREPARED BY	DATE
C 105	AILERON	R GAVALIS	JULY 19/59
		CHECKED BY	DATE

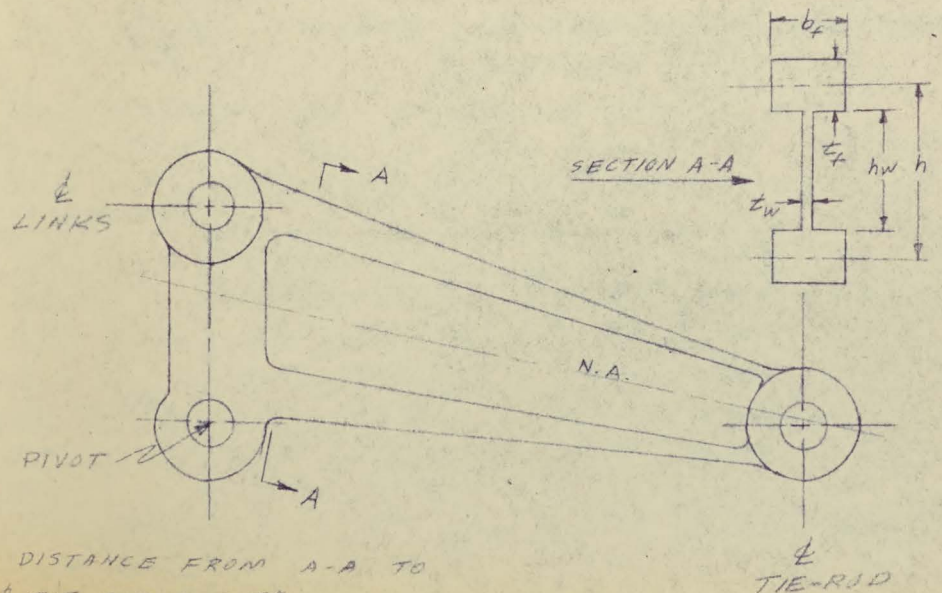
REDUNDANT LOADS

SECTION PROPERTIES

CELL →	1-2	2-3	3-4	4-5	5-6	6-7	REF ↓
L	16.75	16.75	17.12	20.88	19.20	17.80	
P	89.26	106.56	94.50	80.78	66.64	53.54	
A	116.30	111.47	88.85	61.26	46.36	31.06	
A^2	13,560	12,410	7890	4390	2148	965	
$1.9 \frac{L}{A^2} P$	.540	.705	1.019	1.881	2.92	4.85	
$R_{G\ SUB} \times 10^6$	.1382	.1809	.261	.482	.748	1.242	
$K_{G\ SUPER} \times 10^6$	.1542	.2018	.291	.538	.835	1.387	

CRANKS

BELOW IS A TYPICAL SKETCH OF CRANKS 1, 2, & 4 TO 6.



DISTANCE FROM A-A TO ℄ TIE ROD = 7.5"

FORM 1319A

A. V. ROE CANADA LIMITED
MALTON - ONTARIO
TECHNICAL DEPARTMENT (Aircraft)

REPORT NO. 7-0579-1
SHEET NO. 315

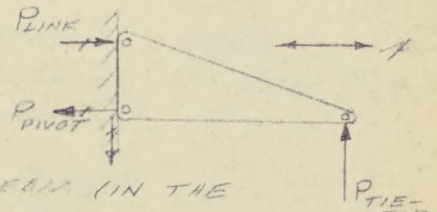
AIRCRAFT		PREPARED BY	DATE
C105	AILERON	R. GAVALIS	JULY 19/57
		CHECKED BY	DATE

REDUNDANT LOADS

SECTION PROPERTIES

STIFFNESS OF CRANKS (CONT.)

THE CRANKS MAY BE CONSIDERED TO BE CANTILEVER BEAMS AS SHOWN. IF THE MOMENT OF INERTIA WAS CONSTANT ALONG THE BEAM (IN THE ↑ DIRECTION), AN INDICATION OF THE CRANK'S STIFFNESS WOULD BE,



$$S = \frac{L^3}{3EI}$$

CONSIDERING A VARIABLE MOMENT OF INERTIA, IT WAS FOUND THAT THE STIFFNESS WOULD BE,

$$S = \frac{.81 L^3}{E I_{A-A}}$$ WHERE: L = LENGTH OF BEAM (8.5")

$E_{SUB} = 10.3 \times 10^6$ p.s.i.

$E_{SUPER.} = 9.5 \times 10^6$ p.s.i.

I_{A-A} = MOMENT OF INERTIA AT A-A (SEE Pg 414)

$\therefore S_{SUB} = 48.2 \times 10^{-6} / I_{AA}$

$S_{SUPER} = 52.3 \times 10^{-6} / I_{AA}$

(REF DWG 7-011K-0004 FOR ALL DIMENSIONS)

CRANK →	REF.	1	2	3	4	5	6	7
b_f		1.1	1.0		1.2	.855	.78	.82
t_f		.60	1.0		.55	.855	.62	.60
A_f	$b_f t_f$	.55	1.0		.66	.730	.484	.492
h		4.40	4.40		4.5	3.40	3.25	3.22
I_f	$h^2 A_f/2$	5.31	9.67		6.68	4.22	2.55	2.56
h_w	$h - t_f$	3.80	3.40		3.95	2.54	2.63	2.62
t_w		.25	.25		.25	.20	.20	.20
I_w	$t_w h_w^3/12$	1.23	.816	(SEE Pg 414)	1.29	.273	.303	.300
I_{TOT}	$I_f + I_w$	6.54	10.49		7.97	4.49	2.85	2.86
S_{SUB}	$\frac{48.2 \times 10^{-6}}{I_{TOT}}$	7.4×10^{-6}	4.6×10^{-6}	3.12×10^{-6}	6.1×10^{-6}	10.7×10^{-6}	16.9×10^{-6}	16.9×10^{-6}
$S_{SUPER.}$	$\frac{52.3 \times 10^{-6}}{I_{TOT}}$	8.0×10^{-6}	5.0×10^{-6}	3.38×10^{-6}	6.6×10^{-6}	11.6×10^{-6}	18.3×10^{-6}	19.3×10^{-6}

A. V. ROE CANADA LIMITED
MALTON - ONTARIO
TECHNICAL DEPARTMENT (Aircraft)

REPORT No. 7-0574-1
SHEET No. 310

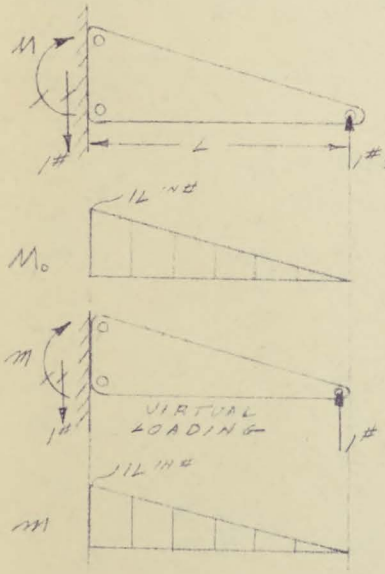
AIRCRAFT:		PREPARED BY	DATE
C105	AILERON	R. GAVALIS	JULY 14/59
		CHECKED BY	DATE

REDUNDANT LOADS

SECTION PROPERTIES

CRANKS - DETERMINATION OF .81 FACTOR

DETERMINE THE DEFLECTION OF THE CRANK DUE TO A TIE-ROD LOAD OF $R_T = 1\#$.



$$\delta = \int \frac{M m \, dx}{EI}$$

$M = 1(x)$

$m = 1(x)$

$I = f(x)$

$$\therefore \delta = \int \frac{x^2 \, dx}{EI} = \sum \frac{x^2 \Delta x}{EI}$$

THE DEFLECTION OF CRANK #5 FOR A UNIT APPLIED LOAD WILL BE CALCULATED.

MOMENT OF INERTIA (I)

STATION, ↓ REFERENCE	t_f DWG. 7-0115-0004 # Pg. 11C	t_f	A_f $b_f t_f$	h REF. DWG. 7-0115-0004 # Pg. 11C	h_w	I_f $A_f h^2/2$	I_w $t_w h_w^3/12$	$I_{TOT.}$ $I_f + I_w$
0	.60	.08	.048	.90	.82	.0194	.00917	.0286
1.5"	.66	.24	.158	1.42	1.18	.159	.0273	.1863
3.5"	.73	.45	.328	2.12	1.67	.735	.0776	.813
5.5"	.80	.65	.520	2.80	2.15	2.04	.166	2.21
7.5"	.855	.855	.730	3.40	2.54	4.22	.223	4.443
8.7"	.90	1.0	.900	4.00	3.00	7.20	.450	7.650
$t_w = .20"$								

NOTE: STATIONS ARE MEASURED ALONG NEUTRAL AXIS OF BEAM.

OPM 13194

A. V. ROE CANADA LIMITED
MALTON - ONTARIO
TECHNICAL DEPARTMENT (Aircraft)

REPORT No. 7-0579-1 31d
SHEET No. 31d

AIRCRAFT:		PREPARED BY	DATE
C105	AILERONS	R. GAVALIS	JULY 19/59
		CHECKED BY	DATE

REDUNDANT LOADS

SECTION PROPERTIES

CRANKS (CONT'D.)

DEFLECTION OF CRANK #5:

STATION (#)	ΔC	M = m	I	M m ΔC / I	
REF. →		#	Pg.		
.75	1.5	.75	.09	9.35	
2.0	1.0	2.0	.25	16.00	
3.0	1.0	3.0	.60	15.00	
4.0	1.0	4.0	1.10	14.52	
5.0	1.0	5.0	1.80	13.70	
6.0	1.0	6.0	2.70	13.34	
7.0	1.0	7.0	3.80	12.70	
8.0	1.2	8.0	5.80	13.22	
Σ	9.7			108.23	

$$\delta = \sum \frac{M m \Delta C}{EI} = \frac{108.23}{10.3 \times 10^{6}} = 10.5 \times 10^{-6} \text{ in}$$

FOR AN APPLIED TIE-ROD LOAD (P):

$$\delta = 10.5 \times 10^{-6}(P) = S P_{T.R}$$

CONSIDER THE STIFFNESS FACTOR (S) TO BE A FUNCTION OF $I_{y=7.5"}$, THEN

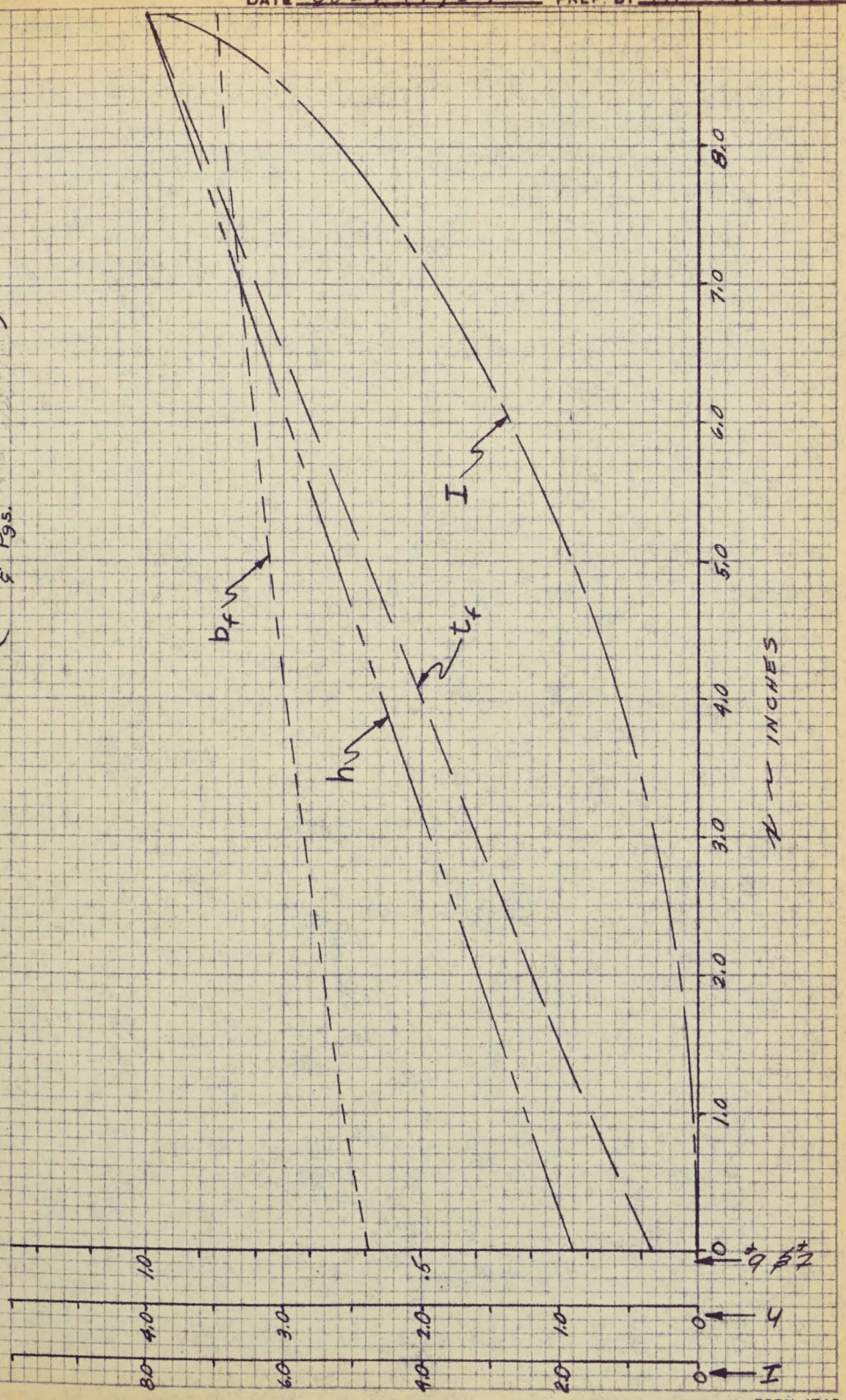
$$S = K/I_{7.5} \quad \text{OR} \quad K_5 = S I_{7.5} = 10.5 \times 10^{-6}(4.443)$$

$$K_5 = 46.6 \times 10^{-6} \quad \text{(SEE Pg. 31)}$$

FORM 1319A

CRAFT C105 COMPONENT AILERON SHEET No. 31e REPORT No. 7-0579-1
I. W. DATE JULY 14/54 PREP. BY R. GAVALIS

SECTION PROPERTIES
OF CRANK #5
(REF. DWG. 7-0115-0004
& Pgs.



FORM 1746

A. V ROE CANADA LIMITED
MALTON - ONTARIO
TECHNICAL DEPARTMENT (Aircraft)

REPORT NO. 7-0579-1
SHEET NO. 31f

AIRCRAFT:		PREPARED BY	DATE
C 105	AILERON	R. GAVALIS	JULY 14/59
		CHECKED BY	DATE

REDUNDANT LOADS

SECTION PROPERTIES

CRANKS (CONT'D.)

CRANK #7 WILL BE NOW BE CONSIDERED:

MOMENT OF INERTIA (I):

STATION	b_f	t_f	A_f	h	h_w	I_f	I_w	$I_{TOT.}$
REF. →	DWG. 7-0115-00048 Pg. 318		$b_f t_f$	DWG. 7-0115-00048 Pg. 318		$A_f h^2/2$	$t_w h_w^3/12$	$I_f + I_w$
1.5	.55	.15	.0825	1.5	1.35	.0926	.041	.1336
3.5	.64	.30	.192	2.08	1.78	.415	.094	.509
5.5	.73	.45	.328	2.65	2.20	1.152	.177	1.329
7.5	.82	.60	.492	3.22	2.62	2.55	.300	2.85
8.7	.88	.70	.616	3.62	2.92	4.03	.416	4.446

$t_w = .20"$ (CONSTANT)

DEFLECTION OF CRANK #7

STATION (R)	ΔC	$M = m$	I	$\frac{M m \Delta C}{I}$		
REF. →		1	Pg. 317			
.75	1.5	.75	.046	18.3		
2.0	1.0	2.0	.18	22.2		
3.0	1.0	3.0	.39	23.1		
4.0	1.0	4.0	.70	22.8		
5.0	1.0	5.0	1.09	28.4		
6.0	1.0	6.0	1.60	22.5		
7.0	1.0	7.0	2.37	20.6		
8.0	1.2	8.0	3.40	22.6		
Σ	8.7			180.5		

$$\delta = \sum \frac{M m \Delta C}{E I} = \frac{180.6}{10.3 \times 10^{-6}} = 17.5 \times 10^{-6} \quad \text{OR}$$

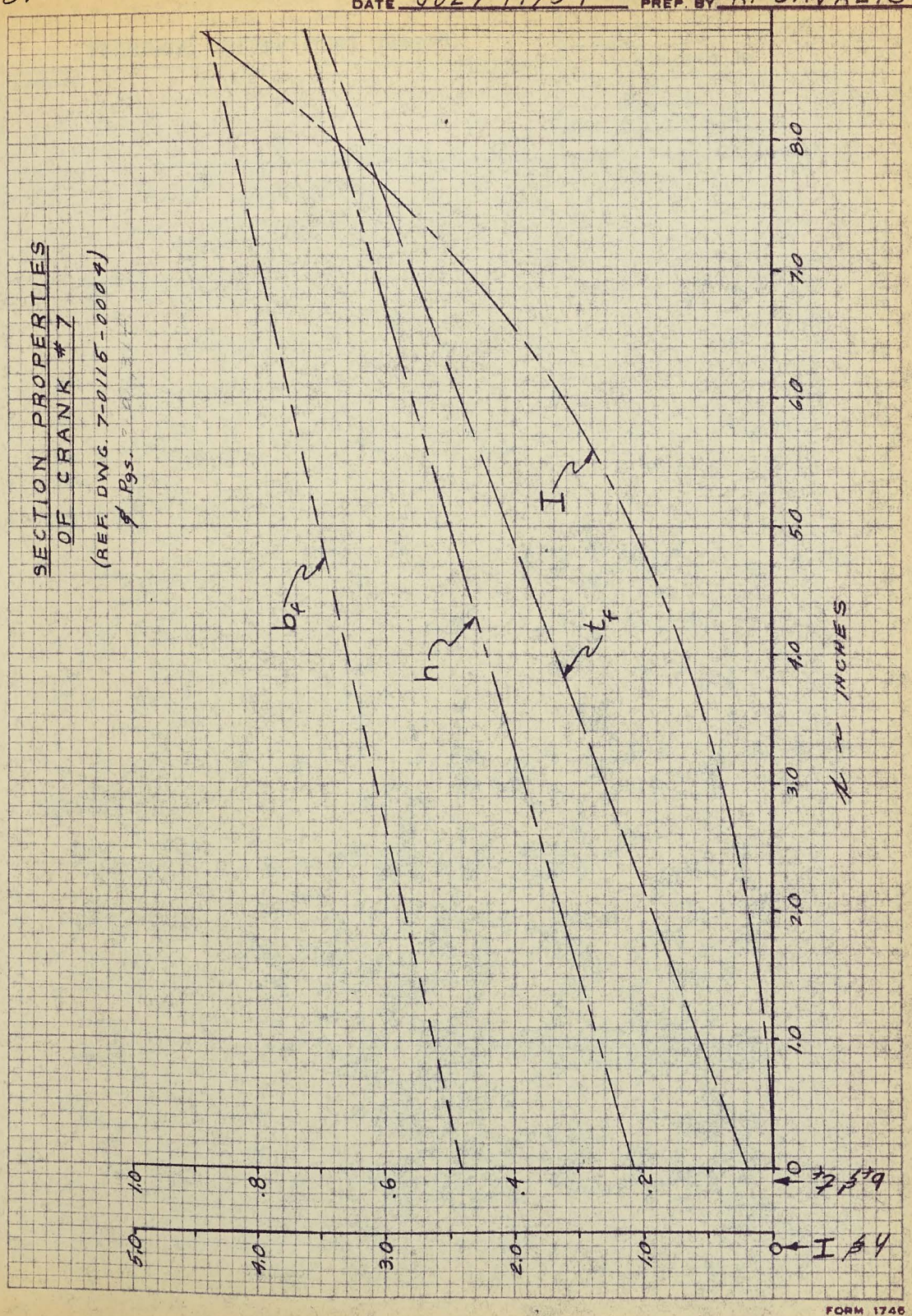
$\delta = 17.5 \times 10^{-6} (P_{TR})$ FOR ANY APPLIED LOAD (P_{TR}).

FORM 1319A

AIRCRAFT C105 COMPONENT AILERON SHEET No. 319 REPORT No. 7-0579-1
A. U. W. DATE JULY 19/54 PREP. BY R. GAVALIS

SECTION PROPERTIES OF CRANK #7

(REF. DWG. 7-0116-0004)
6 Pgs.



FORM 1746

REDUNDANT LOADS

SECTION PROPERTIES

CRANKS (CONT'D.)

THE STIFFNESS FACTOR (S) IN TERMS OF $I_{4-7.5"}$ IS,

$S = K/I_{7.5}$ OR $K_7 = 5I_{7.5} = 17.5(2.85)(10^{-6})$

$K_7 = 49.9 \times 10^{-6}$

$\therefore K_{AVERAGE} = \frac{K_5 + K_7}{2} = \frac{46.6 + 49.9}{2} = 48.2 \times 10^{-6}$

THEN IN GENERAL FOR ANY CRANK,

$S = 48.2 \times 10^{-6} / I_{4-7.5"}$

ALSO, FOR A BEAM WITH CONSTANT SECTION PROPERTIES,

$\delta = \frac{PL^3}{3EI} = SP$ OR $S = \frac{L^3}{3EI}$

FOR THE CRANKS, CONSIDERING THE VARYING MOMENT OF INERTIA, THE STIFFNESS (S) IN TERMS OF L^3/EI IS

$S_{\#5} = \frac{K_2 L^3}{EI} = 10.5 \times 10^{-6} = \frac{K_2 (8.5)^3}{(10.3 \times 10^6 \times 4.443)}$

$K_{2\#5} = .78$ AND

$S_{\#7} = \frac{K_{2\#7} L^3}{EI} = \frac{K_{2\#7}(8.5)^3}{(10.3)(10^6)(2.85)}$, $K_{2\#7} = .839$

THEN, K_2 FOR ANY CRANK IS,

$K_{2\,AVERAGE} = \frac{.78 + .839}{2} = .81$ & $S = \frac{.81 L^3}{EI}$

FORM 1319A

A. V. ROE CANADA LIMITED
MALTON - ONTARIO
TECHNICAL DEPARTMENT (Aircraft)

REPORT No. 7-0574-1
SHEET No. 31C

AIRCRAFT:		PREPARED BY	DATE
C105	AILERON	R. CAVALIS	JULY 19/54
		CHECKED BY	DATE

REDUNDANT LOADS

SECTION PROPERTIES

STIFFNESS OF CRANKS (CONT.)

CRANK #3

THE PRELIMINARY LAYOUT OF CRANK #3 INDICATES THAT THIS CRANK APPROXIMATES A CANTILEVER BEAM WITH A CONSTANT MOMENT OF INERTIA, THEN

$$S = \frac{L^3}{3EI}$$

FROM THE LAYOUT:

$L = 8.5"$, $h = 3.1$, $b_f = 2.3$, $t_f = .55$, $t_w = .20$

THEN,

$$I = \frac{A_f h^2}{2} + \frac{t_w h_w^3}{12} = \frac{2.3(.55)(3.1)^2}{2} + \frac{.20(3.1-.55)^3}{12}$$

$$I = 6.08 + .276 = 6.36 \text{ IN}^4$$

$$\therefore S_{\text{SUB-SONIC}} = \frac{(8.5)^3}{3(10.3)(10^6)(6.36)} = 3.12 \times 10^{-6}$$

$$S_{\text{SUPER-SONIC}} = \frac{(8.5)^3}{3(9.5)(10^6)(6.36)} = 3.38 \times 10^{-6}$$

FORM 1319A

A. V. ROE CANADA LIMITED
MALTON - ONTARIO
TECHNICAL DEPARTMENT (Aircraft)

REPORT No. 7-0574-1
SHEET No. 31 J

AIRCRAFT:		PREPARED BY	DATE
C105	AILERON	R. GAVALIS	JULY 19/54
		CHECKED BY	DATE

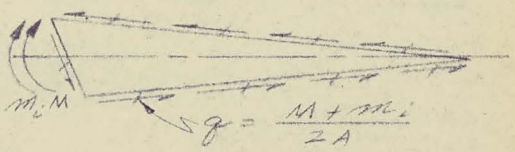
REDUNDANT LOADS

SECTION PROPERTIES

STIFFNESS OF RIBS

THE LOADING ON THE RIBS IS AS SHOWN IN THE DIAGRAM. THEN THE BENDING MOMENT ALONG THE RIB DUE TO THE RIB MOMENT (M_x) IS,

$$M_x = M\left(\frac{x}{c}\right)^2$$



WHERE: M_x = MOMENT AT ANY POINT

M = APPLIED MOMENT OR LEADING EDGE MOMENT = M_{LE}

$$q' \quad m_x = m_i\left(\frac{x}{c}\right)^2$$

THE DEFLECTION OF THE RIB IS,

$$\delta = \frac{\partial U}{\partial X} = \int_0^c \frac{M\, m_i}{EI}\, dy$$

THE MOMENT OF INERTIA VARIES ALONG THE RIB & IS UNAVAILABLE AT THIS TIME. THE MOMENT OF INERTIA REQUIRED ($I_{REQ'D}$) WILL BE USED. RECALL THAT,

$$F_b = \frac{My}{I} \quad \text{OR} \quad I = \frac{My}{F_b} \quad \text{THEN,}$$

$$I_{REQ'D} = \frac{M_{DESIGN}\, y}{F_b} \quad \& \quad M_{DESIGN} = M_{L.E.\ DESIGN}\left(\frac{x}{c}\right)^2$$

A. V. ROE CANADA LIMITED
MALTON - ONTARIO
TECHNICAL DEPARTMENT (Aircraft)

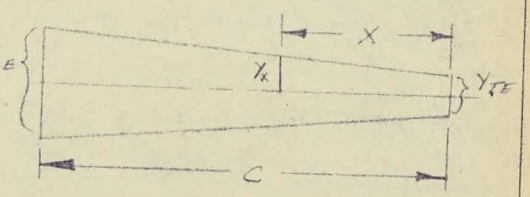
REPORT NO. 7-0579-1
SHEET NO. 31K

AIRCRAFT:		PREPARED BY	DATE
C 105	AILERON	R. GAVALIS	JULY 14/54
		CHECKED BY	DATE

REDUNDANT LOADS
SECTION PROPERTIES
STIFFNESS OF RIBS (CONT.)

$$I_{REQ'D} = \frac{M_{LE_{DESIGN}} \left(\frac{X}{C}\right)^2 Y_X}{F_b}$$

Y_X FROM THE DIAGRAM.



$$Y_X = \frac{Y_{TE}}{2} + \frac{Y_{LE} - Y_{TE}}{2}\left(\frac{X}{C}\right)$$

THEN,

$$I_{REQ'D} = \frac{M_{LE}\, Y_{TE}}{2F_b}\left(\frac{X}{C}\right)^2 + \frac{M_{LE}\,\Delta Y}{2F_b}\left(\frac{X}{C}\right)^3$$

WHERE $\Delta Y = Y_{LE} - Y_{TE}$

LET,

$$I_{REQ'D} = K_1\left(\frac{X}{C}\right)^2 + K_2\left(\frac{X}{C}\right)^3$$

WHERE, $K_1 = \frac{M_{LE}\, Y_{TE}}{2F_b}$, $K_2 = \frac{M_{LE}\,\Delta Y}{2F_b}$

THEN,

$$\delta' = \int_0^C \frac{M \cdot m_L}{EI}\, dX = \int_0^C \frac{\left(\frac{X}{C}\right)^2 \left(\frac{X}{C}\right)^2 M_{LE} m_{LE}}{F\left[K_1\left(\frac{X}{C}\right)^2 + K_2\left(\frac{X}{C}\right)^3\right]}\, dX$$

$$\delta' = \int_0^C \frac{M_{LE}\, m_{LE}}{EC^2}\left(\frac{X^2}{[K_3 X + K_1]}\right) dX \quad \text{WHERE } K_3 = \frac{K_2}{C}$$

$$\delta' = \frac{M_{LE}\, m_{LE}}{EC^2}\left[\frac{1}{K_3^3}\left\{\frac{1}{2}(K_3 X + K_1)^2 - 2K_1(K_3 X + K_1) + K_1^2 \ln(K_3 X + K_1)\right\}\right]_0^C$$

$$\delta' = \frac{M_{LE}\, m_{LE}\, C}{E K_2^3}\left[\frac{K_2^2}{2} - K_1 K_2 + K_1^2 \ln(K_3 + K_1) - K_1^2 \ln K_1\right]$$

DEFLECTION FOR ANY GIVEN LEADING EDGE MOMENTS $M_{LE} \neq m_{LE}$

FORM 1319A

A. V. ROE CANADA LIMITED
MALTON · ONTARIO
TECHNICAL DEPARTMENT (Aircraft)

REPORT No. 7-0579-1
SHEET No 311

AIRCRAFT:		PREPARED BY	DATE
C 105	AILERON	R. GAVALIS	JULY 14/59
		CHECKED BY	DATE

REDUNDANT LOADS

SECTION PROPERTIES

STIFFNESS OF RIBS (CONT.)

LET $M_{LE} = -M_{LE} = 1$ IN # & SOLVE FOR δ_i

$\delta_{M=1}^{i} = S\, M_{LE} M_{LE} = S(1)(1) = S =$ COEFFICIENT OF STIFFNESS

RIB	M_{LE} # ULTIMATE	Y_{TE}	F_b	K_1	Y_{LE}	ΔY	K_2	C	$S_{SUB.} \times 10^6$	$S_{SUPER.} \times 10^6$
REF →	Pg. 23	Pg. 4	TABLE BELOW	$\frac{M_{LE} Y_{TE}}{2F_b}$	Pg. 4	$Y_{LE} - Y_{TE}$	$\frac{M_{LE}\Delta Y}{2F_b}$	Pg. 4		*
1	32800	2.76	34200	1.322	4.30	1.54	.738	27.3	.472	.511
2	16500	.90	34200	.270	3.90	3.00	4.23	54.0	.404	.436
3	87000	.83	34200	1.055	2.50	2.67	3.39	48.2	.449	.480
4	77800	.77	34200	.876	2.10	2.33	2.65	42.3	.487	.527
5	59200	.64	34200	.595	2.61	1.92	1.66	35.2	.631	.683
6	36600	.62	51300	.221	2.16	1.54	.55	28.6	1.49	1.61
7	30600	.55	51300	.164	1.74	1.19	.355	22.5	1.71	1.85

$M_{LE_{ULT.}} = 1.364 \times M_{LE_{LIMIT}}$ (Pg. 23) $E_{SUBSONIC} = 10.5 \times 10^6$ psi

$E_{SUPERSONIC} = 9.7 \times 10^6$ psi

* $S_{SUPER} = \frac{E_{SUB}}{E_{SUPER}} (S_{SUBSONIC}) = 1.081\, S_{SUB}$

BENDING MODULUS (F_b):

RIB	$F_{b_{T=250°}}$ @	$F_{b_{T=0°}}$	SECTION	BASIS FOR ALLOWABLE
1	34200	38000	24S-T4 ALCLAD BENT-UP SHEET	CRIPPLING
2	34200			
3	34200			
4	34200			
5	34200	38000	24S-T4 ALCLAD BENT-UP SHEET	CRIPPLING
6	51300	57000	14S-T6 FORGING I-SECTION	PLASTIC BENDING $K=1.3$, $F_{cy}=50,000$ psi
7	51300	57000	14S-T6 FORGING I-SECTION	PLASTIC BENDING $K=1.3$, $F_{cy}=50,000$ psi

@ $F_{b_{T=250°}} = .9\, F_{b_{T=0°}}$

ORM 1319A

A. V. ROE CANADA LIMITED
MALTON - ONTARIO
TECHNICAL DEPARTMENT (Aircraft)

REPORT NO. 7-0579-1
SHEET NO. 32

AIRCRAFT:		PREPARED BY	DATE
C 105	AILERON	R. GAVALIS	JULY 19/54
		CHECKED BY	DATE

REDUNDANT LOADS - LINKS

SUBSONIC CASE

THE FINAL LINK LOADS WILL BE:

$P_1 = 7710 + X_1 \beta_1 = 7710 + X_1$

$P_2 = 30180 + X_2 \beta_2 = 30180 + X_2$

$P_3 = 29000 + X_3 = 29000 - X_1 \beta_1 - X_2 \beta_2 - X_4 \beta_4 - X_5 \beta_5 - X_6 \beta_6 - X_7 \beta_7$

$P_3 = 29000 - X_1 - X_2 - .945 X_4 - .882 X_5 - .818 X_6 - .741 X_7$

$P_4 = 27400 + X_4 \beta_4 = 27400 + X_4$

$P_5 = 22470 + X_5 \beta_5 = 22470 + X_5$

$P_6 = 15440 + X_6 \beta_6 = 15440 + X_6$

$P_7 = 16440 + X_7 \beta_7 = 16440 + X_7$

(REF. P9. 20

A. V. ROE CANADA LIMITED
MALTON - ONTARIO
TECHNICAL DEPARTMENT (Aircraft)

REPORT NO. 7-0574-1
SHEET NO. 33

AIRCRAFT:		PREPARED BY	DATE
C105	AILERON	R. GAVALIS	JULY 14/54
		CHECKED BY	DATE

REDUNDANT LOADS - LINKS

SUBSONIC CASE

FOR AN AXIAL LOADED MEMBER, THE STRAIN ENERGY IS,

$$U_L = \frac{P_L^2 L}{2AE} \qquad (L \text{ MAY BE ANY LINK})$$

THEN

$$\frac{\partial U_L}{\partial X_L} = \delta_{1L} = \sum \frac{P_L \beta_L L_L}{A_L E} = \sum (\beta_0 + X_1\beta_1 + X_2\beta_2 \cdots X_7\beta_7)(\beta_L)\left(\frac{L_L}{A_L E}\right)$$

S_{1L}

FOR THE LINKS,

$$\delta_{1L} = (7710 + X_1)\beta_1 S_{1L} - (\ ^{*}\ )\beta_1 S_{3L}, \quad \beta_1 = 1.00\ (\text{LINK 1})\ \S\ 1.00\ (\text{LINK 3})\ \#$$

$$\delta_{1L} = (4700 + .847X_1)10^{-6} - (9210 - .318X_1 - .318X_2 - .300X_4 - .281X_5 - .260X_6 - .236X_7)10^{-6}$$

$$\delta_{1L} = (-2510 + 1.165X_1 + .318X_2 + .300X_4 + .281X_5 + .260X_6 + .236X_7)10^{-6}$$

$$\delta_{2L} = (30180 + X_2)\beta_2 S_{2L} - (\quad)\beta_2 S_{3L}, \quad \beta_2 = 1.00\ (\text{LINK 2})\ \S\ 1.00\ (\text{LINK 3})$$

$$\delta_{2L} = (8650 + .287X_2)10^{-6} - (9210 - .318X_1 - .318X_2 - .300X_4 - .281X_5 - .260X_6 - .236X_7)10^{-6}$$

$$\delta_{2L} = (-560 + .318X_1 + .605X_2 + .300X_4 + .281X_5 + .260X_6 + .236X_7)10^{-6}$$

$$\delta_{4L} = (27400 + X_4)\beta_4 S_{4L} - (\quad)\beta_4 S_{3L}, \quad \beta_4 = 1.00\ (\text{LINK 4})\ \S\ .945\ (\text{LINK 5})$$

$$(\ ^{*}\ ) = (29000 - X_1\beta_1 - X_2\beta_2 - X_4\beta_4 - X_6\beta_6 - X_4\beta_4 - X_7\beta_7)$$
$$= (29000 - X_1 - X_2 - .945X_4 - .882X_5 - .818X_6 - .741X_7)$$

§ REF. PG 32, # REF PG 26, @ REF. PG. 21

FORM 1319A

A. V. ROE CANADA LIMITED
MALTON - ONTARIO
TECHNICAL DEPARTMENT (Aircraft)

REPORT No. 7-0574-1
SHEET No. 34

AIRCRAFT:		PREPARED BY	DATE
C105	AILERON	R. GAVALIS	JULY 14/54
		CHECKED BY	DATE

REDUNDANT LOADS - LINKS

SUBSONIC CASE (CONT.)

$$\delta_{4L} = (9250 + .338X_4)10^{-6} - (9700 - .300X_1 - .300X_2 - .284X_4 - .266X_5 - .246X_6 - .223X_7)10^{-6}$$

$$\delta_{4L} = (550 + .300X_1 + .300X_2 + .422X_4 + .266X_5 + .246X_6 + .223X_7)10^{-6}$$

$$\delta_{5L} = (22470 + X_5)\beta_5 S_{5L} - (\quad)\beta_5 S_{4L},\ \beta_5 = 1.00_{(LINK 5)},\ \beta = .982_{(LINK 3)}$$

$$\delta_{5L} = (9220 + .410X_5)10^{-6} - (8130 - .280X_1 - .280X_2 - .265X_4 - .248X_5 - .230X_6 - .208X_7)10^{-6}$$

$$\delta_{5L} = (1090 + .280X_1 + .280X_2 + .265X_4 + .658X_5 + .230X_6 + .208X_7)10^{-6}$$

$$\delta_{6L} = (11643 + X_6)\beta_6 S_{6L} - (\quad)\beta_6 S_{5L},\ \beta_6 = 1.00_{(LINK 6)},\ \beta = .815_{(LINK 5)}$$

$$\delta_{6L} = (9250 + .5991_6)10^{-6} - (7550 - .260X_1 - .260X_2 - .246X_4 - .230X_5 - .212X_6 - .193X_7)10^{-6}$$

$$\delta_{6L} = (1700 + .260X_1 + .260X_2 + .246X_4 + .230X_5 + .811X_6 + .193X_7)10^{-6}$$

$$\delta_{7L} = (16440 + X_7)\beta_7 S_{7L} - (\quad)\beta_7 S_{6L},\ \beta_7 = 1.00_{(LINK 7)},\ \beta = .741_{(LINK 5)}$$

$$\delta_{7L} = (9250 + .562X_7)10^{-6} - (6940 - .236X_1 - .236X_2 - .222X_4 - .208X_5 - .193X_6 - .175X_7)10^{-6}$$

$$\delta_{7L} = (2310 + .236X_1 + .236X_2 + .222X_4 + .208X_5 + .193X_6 + .737X_7)10^{-6}$$

ORM 1316A

A. V. ROE CANADA LIMITED
MALTON - ONTARIO
TECHNICAL DEPARTMENT (Aircraft)

REPORT No. Z-0579-1
SHEET No. 34a

AIRCRAFT:		PREPARED BY	DATE
C 105	AILERON	R. GAVALIS	JULY 14/54
		CHECKED BY	DATE

REDUNDANT LOADS - LINKS

SUBSONIC CASE (CONT.)

SUMMARY:

δ^0_{1L}	-2510	$+1.106X_1$	$+.319X_2$	$+.300X_3$	$+.281X_5$	$+.260X_6$	$+.236X_7$	$\times 10^{-6}$
δ^0_{2L}	-560	$+.318X_1$	$+1.605X_2$	$+.300X_4$	$+.281X_5$	$+.260X_6$	$+.236X_7$	$\times 10^{-6}$
δ^0_{4L}	540	$+.300X_1$	$+.300X_2$	$+1.622X_4$	$+.266X_5$	$+.246X_6$	$+.223X_7$	$\times 10^{-6}$
δ^0_{5L}	1040	$+.280X_1$	$+.280X_2$	$+.265X_4$	$+1.658X_5$	$+.230X_6$	$+.208X_7$	$\times 10^{-6}$
δ^0_{6L}	1700	$+.260X_1$	$+.260X_2$	$+.246X_4$	$+.230X_5$	$+.811X_6$	$+.193X_7$	$\times 10^{-6}$
δ^0_{7L}	2410	$+.236X_1$	$+.236X_2$	$+.222X_4$	$+.208X_5$	$+.193X_6$	$+.737X_7$	$\times 10^{-6}$

ORM 1316A

A. V. ROE CANADA LIMITED
MALTON - ONTARIO
TECHNICAL DEPARTMENT (Aircraft)

REPORT NO. T-0579-1
SHEET NO. 35

AIRCRAFT:		PREPARED BY	DATE
C 105	AILERON	R. GAVALIS	JULY 19/54
		CHECKED BY	DATE

REDUNDANT LOADS - LINKS

SUPERSONIC CASE

THE SUPERSONIC CASE IS IDENTICAL TO THE SUBSONIC EXCEPT FOR P_3 (REF. Pg. 26).

$$\delta_{1L} = (10910 + X_1)\beta_1 S_{1L} - (\ ^{*}\ )\beta_3 S_{3L},\ \beta_1 = 1.00 \text{ (LINK 1)},\ \beta_3 = 1.00 \text{ (LINK 3)}$$

$$\delta_{1L} = (9250 + .847X_1)10^{-6} - (9210 - .318X_1 - .318X_2 - .300X_4 - .281X_5 - .260X_6 - .236X_7)10^{-6}$$

$$\delta_{1L} = 40 + 1.165X_1 + .318X_2 + .300X_4 + .281X_5 + .260X_6 + .236X_7)10^{-6}$$

$$\delta_{2L} = (32180 + X_2)\beta_2 S_{2L} - (\ )\beta_3 S_{3L},\ \beta_3 = 1.00 \text{ (LINK 3)}$$

$$\delta_{2L} = (20 + .318X_1 + .682X_2 + .300X_4 + .281X_5 + .260X_6 + .236X_7)10^{-6}$$

$$\delta_{4L} = (27400 + X_4)\beta_4 S_{4L} - (\ )\beta_3 S_{3L},\ \beta_4 = 1.00 \text{ (LINK 4)},\ \beta_3 = .945 \text{ (LINK 3)}$$

$$\delta_{4L} = (4550 + .300X_1 + .300X_2 + .632X_4 + .266X_5 + .246X_6 + .223X_7)10^{-6}$$

$$\delta_{5L} = (22270 + X_5)\beta_5 S_{5L} - (\ )\beta_3 S_{3L},\ \beta_5 = 1.00 \text{ (LINK 5)},\ \beta_3 = .882 \text{ (LINK 3)}$$

$$\delta_{5L} = (1010 + .280X_1 + .280X_2 + .265X_4 + .659X_5 + .230X_6 + .208X_7)10^{-6}$$

$$\delta_{6L} = (14890 + X_6)\beta_6 S_{6L} - (\ )\beta_3 S_{3L},\ \beta_6 = 1.00 \text{ (LINK 6)},\ \beta_3 = .818 \text{ (LINK 3)}$$

$$\delta_{6L} = (1360 + .260X_1 + .260X_2 + .246X_4 + .230X_5 + .811X_6 + .193X_7)10^{-6}$$

$$^{*}\ (\ ) = (29000 - X_1 - X_2 - .945X_4 - .882X_5 - .818X_6 - .741X_7)$$

REF. Pg. 26 ¶ 33

A. V. ROE CANADA LIMITED
MALTON - ONTARIO
TECHNICAL DEPARTMENT (Aircraft)

REPORT No. 7-0579-1
SHEET No. 36

AIRCRAFT:		PREPARED BY	DATE
C105	AILERON	R. GAVALIS	JULY 19/59
		CHECKED BY	DATE

REDUNDANT LOADS - 4 LINES

SUPERSONIC CASE

$$\delta_{7L} = (13740 + X_7)\beta_7 S_{7L} - (\quad)\beta_7 S_{8L}, \quad \beta_7 = \frac{1.00}{(1+m_7)}, \quad \beta_7 = \frac{.741}{(1+m_3)}$$

$$\delta'_{7L} = (890 + .236X_1 + .236X_2 + .222X_4 + .208X_5 + .193X_6 + .737X_7)\,10^{-6}$$

SUMMARY :

δ'_{1L}	40	$+1.164X_1$	$+.318X_2$	$+.300X_4$	$+.281X_5$	$+.260X_6$	$+.236X_7$	$\times 10^{-6}$
δ'_{2L}	20	$+.318X_1$	$+1.605X_2$	$+.300X_4$	$+.281X_5$	$+.260X_6$	$+.236X_7$	$\times 10^{-6}$
δ'_{4L}	550	$+.300X_1$	$+.300X_2$	$+.622X_4$	$+.266X_5$	$+.246X_6$	$+.223X_7$	$\times 10^{-6}$
δ'_{5L}	1010	$+.258X_1$	$+.280X_2$	$+.266X_4$	$+.668X_5$	$+.230X_6$	$+.208X_7$	$\times 10^{-6}$
δ'_{6L}	1360	$+.260X_1$	$+.260X_2$	$+.246X_4$	$+.230X_5$	$+.811X_6$	$+.193X_7$	$\times 10^{-6}$
δ'_{7L}	890	$+.236X_1$	$+.236X_2$	$+.222X_4$	$+.208X_5$	$+.193X_6$	$+.737X_7$	$\times 10^{-6}$

FORM 1319A

A. V. ROE CANADA LIMITED
MALTON - ONTARIO
TECHNICAL DEPARTMENT (Aircraft)

REPORT No. T-0574-1
SHEET No. 37

AIRCRAFT:		PREPARED BY	DATE
C105	AILERON	T. HAYMAN	APRIL 5/54
		CHECKED BY	DATE

REDUNDANT LOADS - TIE-RODS :

FOR AXIALLY LOADED MEMBER, STRAIN ENERGY $U = \frac{P'^2 L}{2AE}$

WHERE : $P' = (P_0' + X_1 P_1' + X_2 P_2' + \cdots X_7 P_7')$; X_i = REDUND. LOAD, $i = 1 \cdots 7$
P_i' = UNIT REDUND. LOAD

STRAIN IS GIVEN BY : $\left(\frac{\partial U}{\partial X_i}\right)_T \cdot \delta_{iT} = \Sigma \frac{P' P_i' L_i}{A_i E} = \Sigma \frac{(P_0' + X_1 P_1' \cdots X_7 P_7') P_i' L_i}{A_i E}$

SUBSONIC CASE :

SEE SHT. 27 FOR P_i' VALUES

TIE-ROD	LOAD, P' LBS.
1-2	$-4140 + X_1 P_1' = -4140 - .524 X_1$
2-3	$-19{,}950 + X_1 P_1' + X_2 P_2' = -19{,}950 - .524 X_1 - .524 X_2$
3-4	$36{,}930 + X_4 P_4' + X_5 P_5' + X_6 P_6' + X_7 P_7'$
	$= 36{,}930 + .495 X_4 + .462 X_5 + .428 X_6 + .388 X_7$
4-5	$23{,}370 + X_5 P_5' + X_6 P_6' + X_7 P_7'$
	$= 23{,}370 + .462 X_5 + .428 X_6 + .388 X_7$
5-6	$12{,}990 + X_6 P_6' + X_7 P_7' = 12{,}990 + .428 X_6 + .388 X_7$
6-7	$6380 + X_7 P_7' = 6380 + .388 X_7$

REF. : SECHLER & DUNN, PGS. 190-147, & SHT 27

FORM 1319A

A. V. ROE CANADA LIMITED
MALTON - ONTARIO
TECHNICAL DEPARTMENT (Aircraft)

REPORT No. 7-0579-1
SHEET No. 38

AIRCRAFT:		PREPARED BY	DATE
C105	AILERON	R. GAVALIS	JULY 14/54
		CHECKED BY	DATE

REDUNDANT LOADS - TIE RODS

SUBSONIC CASE (CONT.)

FOR THE TIE-RODS,

$$\delta_{1T} = (-4140 - .524 X_1)\beta_1 \overset{\phi}{\overset{*}{S}}_{1-2T} + (-19950 - .524 X_1 - .524 X_2)\beta_1 S_{2-3T}$$

$$\delta_{1T} = (5190 + .656 X_1)10^{-6} + (11200 + .294 X_1 + .294 X_2)10^{-6}$$

$$\delta_{1T} = (16390 + .950 X_1 + .294 X_2)10^{-6}$$

$$\delta_{2T} = (-19950 - .524 X_1 - .524 X_2)\beta_2 S_{2-3T}$$

$$\delta_{2T} = (+11200 + .294 X_1 + .294 X_2)10^{-6}$$

$$\delta_{4T} = (36930 + .495 X_4 + .462 X_5 + .428 X_6 + .388 X_7)\beta_4 S_{3-4T}$$

$$\delta_{4T} = (12080 + .162 X_4 + .151 X_5 + .140 X_6 + .127 X_7)10^{-6}$$

$$\delta_{5T} = (23370 + .462 X_5 + .428 X_6 + .388 X_7)\beta_5 S_{4-5T} + (36930 + .495 X_4 + .462 X_5 + .428 X_6 + .388 X_7)\beta_5 S_{3-4T}$$

$$\delta_{5T} = (13160 + .260 X_5 + .242 X_6 + .218 X_7)10^{-6} + (11240 + .151 X_4 + .141 X_5 + .131 X_6 + .118 X_7)10^{-6}$$

$$\delta_{5T} = (24470 + .151 X_4 + .401 X_5 + .372 X_6 + .336 X_7)10^{-6}$$

$$\delta_{6T} = (12990 + .428 X_6 + .388 X_7)\beta_6 S_{5-6T} + (23370 + .462 X_5 + .428 X_6 + .388 X_7)\beta_6 S_{4-5T} + (36930 + .495 X_4 + .462 X_5 + .428 X_6 + .388 X_7)\beta_6 S_{3-4T}$$

* REF P. [illegible] # REF Pg 37

AVRO FORM 1319A

A. V. ROE CANADA LIMITED
MALTON - ONTARIO
TECHNICAL DEPARTMENT (Aircraft)

REPORT No. 7-0579-1
SHEET No. 39

AIRCRAFT:		PREPARED BY	DATE
C 105	AILERON	R. GAVALIS	JULY 19/54
		CHECKED BY	DATE

REDUNDANT LOADS - TIE RODS

SUBSONIC CASE (CONT.)

$$\delta_{6T} = (1840 + .324X_6 + .294X_7)10^{-6} + (12190 + .241X_5 + .223X_6 + .202X_7)10^{-6} + (10400 + .140X_4 + .131X_5 + .121X_6 + .110X_7)10^{-6}$$

$$\delta_{6T} = (32490 + .140X_4 + .372X_5 + .663X_6 + .606X_7)10^{-6}$$

$$\delta_{7T} = (6380 + .388X_7)\beta_7 S_{6-7T} + (12990 + .428X_6 + .388X_7)\beta_7 S_{5-6T} + (23370 + .462X_5 + .428X_6 + .388X_7)\beta_7 S_{4-5T} + (36930 + .495X_4 + .462X_5 + .428X_6 + .388X_7)\beta_7 S_{3-4T}$$

$$\delta_{7T} = (7710 + .467X_7)10^{-6} + (18910 + .294X_6 + .266X_7)10^{-6} + (11030 + .218X_5 + .202X_6 + .184X_7)10^{-6} + (9450 + .127X_4 + .118X_5 + .109X_6 + .099X_7)10^{-6}$$

$$\delta_{7T} = (37100 + .127X_4 + .336X_5 + .606X_6 + 1.018X_7)10^{-6}$$

SUMMARY (SUBSONIC):

δ_{1T}	16370	+.960X_1	+.214X_2					$\times 10^{-6}$
δ_{2T}	11200	+.294X_1	+.294X_2					$\times 10^{-6}$
δ_{4T}	12080			+.162X_4	+.151X_5	+.140X_6	+.127X_7	$\times 10^{-6}$
δ_{5T}	29470			+.151X_4	+.401X_5	+.372X_6	+.336X_7	$\times 10^{-6}$
δ_{6T}	32490			+.140X_4	+.372X_5	+.663X_6	+.606X_7	$\times 10^{-6}$
δ_{7T}	37100			+.127X_4	+.336X_5	+.606X_6	+1.018X_7	$\times 10^{-6}$

FORM 1319A

REDUNDANT LOADS - TIE RODS

SUPERSONIC CASE

THIS CASE IS IDENTICAL TO THE SUBSONIC EXCEPT FOR P_6 (REF. P_3)[2]

$$\delta'_{1T} = (-5720 - .524X_1)\beta_1 S^{*}_{1-2T} + (-22580 - .524X_1 - .524X_2)\beta_1 S_{2-3T}$$

$$\delta_{1T} = (14300 + .750X_1 + .294X_2)10^{-6}$$

$$\delta'_{2T} = (-22580 - .524X_1 - .524X_2)\beta_2 S_{2-3T}$$

$$\delta_{2T} = (12600 + .294X_1 + .294X_2)10^{-6}$$

$$\delta'_{4T} = (35550 + .495X_4 + .462X_5 + .428X_6 + .388X_7)\beta_4 S_{3-4T}$$

$$\delta_{4T} = (11660 + .162X_4 + .151X_5 + .140X_6 + .127X_7)10^{-6}$$

$$\delta'_{5T} = (21990 + .462X_5 + .428X_6 + .388X_7)\beta_5 S_{4-5T} + (35550 + .495X_4 + .462X_5 + .428X_6 + .388X_7)\beta_5 S_{3-4T}$$

$$\delta'_{6T} = (23210 + .151X_4 + .401X_5 + .372X_6 + .336X_7)10^{-6}$$

$$\delta'_{6T} = (11700 + .428X_6 + .388X_7)\beta_6 S_{5-6T} + (21990 + .462X_5 + .428X_6 + .388X_7)\beta_6 S_{4-5T} + (35550 + .495X_4 + .462X_5 + .428X_6 + .388X_7)\beta_6 S_{3-4T}$$

$$\delta'_{6T} = (30390 + .140X_4 + .372X_5 + .668X_6 + .606X_7)10^{-6}$$

* REF. P_3, 27 * REF. P_3, 41

FORM 1319A

A. V. ROE CANADA LIMITED
MALTON - ONTARIO
TECHNICAL DEPARTMENT (Aircraft)

REPORT No. 7-0579-1
SHEET No. 91

AIRCRAFT:		PREPARED BY	DATE
C 105	AILERON	R. GAVALIS	JULY 19/54
		CHECKED BY	DATE

REDUNDANT LOADS — TIE-RODS

SUPERSONIC CASE (CONT.)

$$\delta^{\circ}_{7T} = (.5330 + .335X_3)\beta_7 S_{6-7T} + (.111700 + .428X_6 + .388X_7)\beta_7 S_{6-6T} + (.21790 + .462X_5 + .428X_6 + .388X_7)\beta_7 S_{5-5T} + (.35,550 + .495X_4 + .462X_5 + .428X_6 + .388X_7)\beta_7 S_{3-4T}$$

$$\delta_{7T} = (.33980 + .127X_4 + .336X_5 + .606X_6 + 1.018X_7)10^{-6}$$

SUMMARY:

δ°_{1T}	19800	$+.960X_1$	$+.294X_2$					$\times 10^{-6}$
δ°_{2T}	12600	$+.294X_1$	$+.294X_2$					$\times 10^{-6}$
δ°_{4T}	11600			$+.162X_4$	$+.151X_5$	$+.140X_6$	$+.127X_7$	$\times 10^{-6}$
δ°_{5T}	23210			$+.151X_4$	$+.401X_5$	$+.372X_6$	$+.336X_7$	$\times 10^{-6}$
δ°_{6T}	30390			$+.140X_4$	$+.372X_5$	$+.668X_6$	$+.606X_7$	$\times 10^{-6}$
δ_{7T}	33980			$+.127X_4$	$+.336X_5$	$+.606X_6$	$+1.018X_7$	$\times 10^{-6}$

FORM 1319A

A. V. ROE CANADA LIMITED
MALTON - ONTARIO
TECHNICAL DEPARTMENT (Aircraft)

REPORT No. 7-0579-1
SHEET No. 42

AIRCRAFT:		PREPARED BY	DATE
C105	AILERON	R. GAVALIS	JULY 14/54
		CHECKED BY	DATE

REDUNDANT LOADS - CRANKS

SUBSONIC CASE

THE FINAL LOADS IN THE CRANKS WILL BE:

$P_1 = 4140 + X_1 \quad p_1 = 4140 + .524 X_1$

$P_2 = 15810 + X_2 \quad p_2 = 15810 + .524 X_2$

$P_3 = 15200 - X_1 p_1 - X_2 p_2 - X_4 p_4 - X_5 p_5 - X_6 p_6 - X_7 p_7$

$P_3 = 15200 - .524 X_1 - .524 X_2 - .495 X_4 - .462 X_5 - .428 X_6 - .388 X_7$

$P_4 = 13560 + X_4 \quad p_4 = 13560 + .495 X_4$

$P_5 = 10380 + X_5 \quad p_5 = 10380 + .462 X_5$

$P_6 = 6610 + X_6 \quad p_6 = 6610 + .428 X_6$

$P_7 = 6380 + X_7 \quad p_7 = 6380 + .388 X_7$

(REF. P3, 28)

FORM 1318A

A. V. ROE CANADA LIMITED
MALTON - ONTARIO
TECHNICAL DEPARTMENT (Aircraft)

REPORT No. 2-0579-1
SHEET No. 43

AIRCRAFT:		PREPARED BY	DATE
C105	AILERON	R. GAVALIS	JULY 14/54
		CHECKED BY	DATE

REDUNDANT LOADS - CRANKS

SUBSONIC CASE

THE STRAIN ENERGY DUE TO BENDING IS,

$$U_a = \int_0^L \frac{M_a^2 dy}{2EI} \quad , \text{LET } M_a = (M_0 + m_1 X_1 + m_2 X_2 + \dots)$$

a = ANY CRANK

THEN,

$$M_a^2 = (M_0^2 + 2M_0 m_1 X_1 + 2M_0 m_2 X_2 + m_1^2 X_1^2 + 2 m_1 X_1 m_2 X_2 + m_2^2 X_2^2 + \dots)$$

SO,

$$U_a = \int_0^L \frac{(M_0^2 + 2M_0 m_1 X_1 + 2M_0 m_2 X_2 + \dots)}{2EI} dy$$

THE DEFLECTION IS,

$$\delta_a = \frac{\partial U_a}{\partial X_1} = \int_0^L \frac{(M_0 + m_1 X_1 + m_2 X_2 + \dots) m_1}{EI} dy$$

OR

$$\delta_a = \int_0^L \frac{M_a m_1}{EI} dy = S P_a \beta_1$$

WHERE P_a = CRANK LOAD (REF. Pg. 42
β_1 = UNIT REDUNDANT (REF. Pg. 28

THEN FOR THE CRANKS,

$$\delta_{1c} = (4140 + .524 X_1) \beta_1 S_{1c} - (\ * \ ) \beta_1 S_{3c}$$

(REF P_{3_1} = [illegible])

$\beta_1 = .524$, $S_{1c} = 7.4 \times 10^{-6}$, $S_{3c} = 8.12 \times 10^{-6}$

$$\delta_{1c} = (16000 + 2.02 X_1) 10^{-6} - (24800 - .855 X_1 - .855 X_2 - .808 X_4 - .766 X_5 - .698 X_6 - .634 X_7) 10^{-6}$$

$$(\ * \ ) = 15200 - .524 X_1 - .524 X_2 - .495 X_3 - .467 X_5 - .428 X_6 - .389 X_7$$

FORM 1319A

A. V. ROE CANADA LIMITED
MALTON - ONTARIO
TECHNICAL DEPARTMENT (Aircraft)

REPORT No. 7-9579-1
SHEET No. 44

AIRCRAFT:		PREPARED BY	DATE
C 105	ARROW	R. GAVALIS	JULY 19/59
		CHECKED BY	DATE

REDUNDANT LOADS - CRANKS

SUBSONIC CASE

$$\delta_{1c} = -3800 + 2.875X_1 + .855X_2 + .809X_4 + .755X_5 + .698X_6 + .634X_7)10^{-6}$$

$$\delta'_{1c} = (15810 + .524X_2)\beta_1 S_{1c} - (\quad)\beta_2 S_{3c}$$

$$\delta'_{2c} = (3100 + 1.26X_2)10^{-6} - (24800 - .855X_1 - .855X_2 - .809X_4 - .755X_5 - .698X_6 - .634X_7)10^{-6}$$

$$\delta''_{2c} = (13300 + .855X_1 + 2.115X_2 + .809X_4 + .755X_5 + .698X_6 + .634X_7)10^{-6}$$

$$\delta'_{4c} = (13560 + .495X_4)\beta_4 S_{4c} - (\quad)\beta_3 S_{3c}$$

$$\delta'_{4c} = (4070 + 1.495X_4)10^{-6} - (23450 - .808X_1 - .808X_2 - .765X_4 - .715X_5 - .661X_6 - .599X_7)10^{-6}$$

$$\delta''_{4c} = (17420 + .808X_1 + .808X_2 + 2.260X_4 + .715X_5 + .661X_6 + .599X_7)10^{-6}$$

$$\delta'_{5c} = (10380 + .462X_5)\beta_5 S_{5c} - (\quad)\beta_5 S_{3c}$$

$$\delta'_{5c} = (5130 + 2.285X_5)10^{-6} - (21900 - .755X_1 - .755X_2 - .715X_4 - .667X_5 - .617X_6 - .560X_7)10^{-6}$$

$$\delta''_{5c} = (21400 + .755X_1 + .755X_2 + .715X_4 + 2.952X_5 + .617X_6 + .560X_7)10^{-6}$$

$$\delta'_{6c} = (6610 + .428X_6)\beta_6 S_{6c} - (\quad)\beta_6 S_{3c}$$

$$\delta'_{6c} = (4790 + 3.10X_6)10^{-6} - (20220 - .698X_1 - .698X_2 - .660X_4 - .616X_5 - .570X_6 - .517X_7)10^{-6}$$

FORM 1319A

A. V. ROE CANADA LIMITED
MALTON · ONTARIO
TECHNICAL DEPARTMENT (Aircraft)

REPORT No. 7-0579-1
SHEET No. 45

AIRCRAFT:		PREPARED BY	DATE
C105	AILERON	R. GAVALIS	JULY 19/59
		CHECKED BY	DATE

REDUNDANT LOADS - CRANKS

SUBSONIC CASE

$$\delta_{6c} = (27620 + .698X_1 + .698X_2 + .660X_4 + .616X_5 + 3.670X_6 + .517X_7)10^{-6}$$

$$\delta_{7c} = (6380 + .383X_7)\beta_7 S_{7c} - (\quad)\beta_7 S_{5c}$$

$$\delta_{7c} = (42500 + 2.58X_7)10^{-6} - (18400 - .634X_1 - .634X_2 - .600X_4 - .560X_5 - .517X_6 - .470X_7)10^{-6}$$

$$\delta_{7c} = (24100 + .634X_1 + .634X_2 + .600X_4 + .560X_5 + .517X_6 + 3.050X_7)10^{-6}$$

SUMMARY

δ_{1c}	-8800	+2.875X_1	+.855X_2	+.805X_4	+.755X_5	+.698X_6	+.634X_7	$\times 10^{-6}$
δ_{2c}	13300	+.855X_1	+2.115X_2	+.805X_4	+.755X_5	+.698X_6	+.634X_7	$\times 10^{-6}$
δ_{4c}	17420	+.808X_1	+.808X_2	+2.260X_4	+.715X_5	+.661X_6	+.599X_7	$\times 10^{-6}$
δ_{5c}	29400	+.755X_1	+.755X_2	+.715X_4	+2.952X_5	+.617X_6	+.560X_7	$\times 10^{-6}$
δ_{6c}	27620	+.698X_1	+.698X_2	+.660X_4	+.616X_5	+3.670X_6	+.517X_7	$\times 10^{-6}$
δ_{7c}	24100	+.634X_1	+.634X_2	+.600X_4	+.560X_5	+.517X_6	+3.050X_7	$\times 10^{-6}$

FORM 1319A

A. V. ROE CANADA LIMITED
MALTON · ONTARIO
TECHNICAL DEPARTMENT (Aircraft)

REPORT No. 7-0579-1
SHEET No. 96

AIRCRAFT:		PREPARED BY	DATE
C105	AILERON	R. GAVALIS	JULY 19/54
		CHECKED BY	DATE

REDUNDANT LOADS - CRANKS

SUPERSONIC CASE

THIS CASE IS SIMILIAR TO SUBSONIC EXCEPT FOR P_0 & S (REF. P95. 28 & 91b).

$$\delta_{1c} = (5720^{\ddagger} + .524X_1)\beta_1 S_{1c} - (\ \ ^{*}\ \ )\beta_1 S_{3c}$$

$$\delta_{1c} = (23900 + 2.19X_1)10^{-6} - (26900 - .927X_1 - .927X_2 - .875X_4 - .819X_5 - .757X_6 - .686X_7)10^{-6}$$

$$\delta_{1c} = (-3000 + 3.117X_1 + .927X_2 + .875X_4 + .819X_5 + .757X_6 + .686X_7)10^{-6}$$

$$\delta_{2c} = (16860 + .524X_2)\beta_2 S_{2c} - (\ \ )\beta_2 S_{3c}$$

$$\delta_{2c} = (44100 + 1.37X_2)10^{-6} - (26900 - .927X_1 - .927X_2 - .875X_4 - .819X_5 - .757X_6 - .686X_7)10^{-6}$$

$$\delta_{2c} = (17200 + .927X_1 + 2.297X_2 + .875X_4 + .819X_5 + .757X_6 + .686X_7)10^{-6}$$

$$\delta_{4c} = (13500 + .495X_4)\beta_4 S_{4c} - (\ \ )\beta_4 S_{3c}$$

$$\delta_{4c} = (44300 + 1.62X_4)10^{-6} - (25400 - .875X_1 - .875X_2 - .829X_4 - .774X_5 - .716X_6 - .650X_7)10^{-6}$$

$$\delta_{4c} = (18900 + .875X_1 + .875X_2 + 2.449X_4 + .774X_5 + .716X_6 + .650X_7)10^{-6}$$

$$\delta_{5c} = (10290 + .462X_5)\beta_5 S_{5c} - (\ \ )\beta_5 S_{3c}$$

$$(\ ^{*}\ ) = 15200 - .524X_1 - .524X_2 - .495X_4 - .462X_5 - .428X_6 - .388X_7$$

‡ REF. P9.28

FORM 1319A

A. V. ROE CANADA LIMITED
MALTON - ONTARIO
TECHNICAL DEPARTMENT (Aircraft)

REPORT No. 7-0579-1
SHEET No. 47

AIRCRAFT:		PREPARED BY	DATE
C 105	AILERON	R. GAVALIS	JULY 14/59
		CHECKED BY	DATE

REDUNDANT LOADS - CRANKS

SUPERSONIC CASE

$$\delta'_{5c} = (55000 + 2.47X_5)10^{-6} - (23800 - .819X_1 - .819X_2 - .775X_4 - .723X_5 - .670X_6 - .606X_7)10^{-6}$$

$$\delta'_{5c} = (31200 + .819X_1 + .819X_2 + .775X_4 + 3.193X_5 + .670X_6 + .606X_7)10^{-6}$$

$$\delta'_{6c} = (6370 + .428X_6)\beta_6 S_{6c} - (\quad)\beta_6 S_{3c}$$

$$\delta'_{6c} = (49100 + 3.35X_6)10^{-6} - (22000 - .757X_1 - .757X_2 - .715X_4 - .669X_5 - .619X_6 - .561X_7)10^{-6}$$

$$\delta'_{6c} = (27900 + .757X_1 + .757X_2 + .715X_4 + .669X_5 + 3.969X_6 + .561X_7)10^{-6}$$

$$\delta'_{7c} = (5330 + .388X_7)\beta_7 S_{7c} - (\quad)\beta_7 S_{3c}$$

$$\delta'_{7c} = (37800 + 2.74X_7) - (19930 - .686X_1 - .686X_2 - .650X_4 - .606X_5 - .561X_6 - .509X_7)10^{-6}$$

$$\delta'_{7c} = (17870 + .686X_1 + .686X_2 + .650X_4 + .606X_5 + .561X_6 + 3.269X_7)10^{-6}$$

SUMMARY:

δ'_{1c}	-3000	+3.117X_1	+.927X_2	+.875X_4	+.819X_5	+.757X_6	+.686X_7	$\times 10^{-6}$
δ'_{2c}	17200	+.927X_1	+3.197X_2	+.875X_4	+.819X_5	+.757X_6	+.686X_7	$\times 10^{-6}$
δ'_{4c}	18700	+.875X_1	+.875X_2	+2.449X_4	+.774X_5	+.716X_6	+.650X_7	$\times 10^{-6}$
δ'_{5c}	31200	+.819X_1	+.819X_2	+.775X_4	+3.193X_5	+.670X_6	+.606X_7	$\times 10^{-6}$
δ'_{6c}	27900	+.757X_1	+.757X_2	+.715X_4	+.669X_5	+3.969X_6	+.561X_7	$\times 10^{-6}$
δ'_{7c}	17870	+.686X_1	+.686X_2	+.650X_4	+.606X_5	+.561X_6	+3.269X_7	$\times 10^{-6}$

FORM 1319A

REDUNDANT LOADS - AILERON

SUBSONIC CASE

THE TORQUE IN THE CELLS IS,

$T_{1-2} = 7900 + X_1 t_1 = 7900 - 2.20 X_1$

$T_{2-3} = -2300 + X_1 t_1 + X_2 t_2 = -2300 - 2.20 X_1 - 2.20 X_2$

$T_{3-4} = -900 + X_4 t_4 + X_5 t_5 + X_6 t_6 + X_7 t_7$

$T_{3-4} = -900 + 2.08 X_4 + 1.94 X_5 + 1.80 X_6 + 1.63 X_7$

$T_{4-5} = -1800 + X_5 t_5 + X_6 t_6 + X_7 t_7 = -1800 + 1.94 X_5 + 1.80 X_6 + 1.63 X_7$

$T_{5-6} = -1500 + X_6 t_6 + X_7 t_7 = -1500 + 1.80 X_6 + 1.63 X_7$

$T_{6-7} = -1300 + X_7 t_7 = -1300 + 1.63 X_7$

(REF. Pg. 31)

STRAIN ENERGY OF TORSION:

THE STRAIN ENERGY IS,

$$U_a = \int_0^L \frac{T_a^2 \, d\ell}{2GJ}$$

ASSUME AVERAGE J OVER CELL LENGTH &

$T_a = (T_0 + X_1 t_1 + X_2 t_2 + \dots)$, IT FOLLOWS THAT

$T_a^2 = (T_0^2 + 2T_0 t_1 X_1 + 2T_0 X_2 t_2 + X_1^2 t_1^2 + 2X_1 t_1 X_2 t_2 + \dots)$

THEN,

$$\frac{\partial U_a}{\partial X_1} = \int_0^L \frac{(T_0 t_1 + X_1 t_1^2 + X_2 t_2 t_1 + \dots)}{GJ} d\ell$$

FORM 1319A

A. V. ROE CANADA LIMITED
MALTON · ONTARIO
TECHNICAL DEPARTMENT (Aircraft)

REPORT No. 49
SHEET No. T-0579-1

AIRCRAFT:		PREPARED BY	DATE
C105	AILERON	R. GAVALIS	JULY 19/59
		CHECKED BY	DATE

REDUNDANT LOADS - AILERON

SUBSONIC CASE

OR $$\frac{\partial U_a}{\partial X_1} = \int_0^L \frac{T_a t_1}{GJ}\, dy$$

FOR AN AVERAGE TORQUE OVER THE CELL LENGTH,

$$\delta_1 = \frac{\partial U_a}{\partial X_1} = \frac{T_a t_1 y}{GJ}\Bigg]_0^L = \frac{T_a t_1 L}{GJ} = R\, T_a t_1$$

WHERE: $R = \frac{L}{GJ}\left(\frac{SFE}{Pg.}\right)$

THEN FOR THE CELLS:

$$\delta_{1A} = (7900 - 2.20X_1)t_1 R_{1-2} + (-2300 - 2.20X_1 - 2.20X_2)t_1 R_{2-3}$$

$t_1 = -2.20$, $R_{1-2} = .1382 \times 10^{-6}$, $R_{2-3} = .1809 \times 10^{-6}$ (REF. Pgs. 31 & 32A)

$$\delta_{1A} = (-2400 + .670X_1)10^{-6} + (915 + .875X_1 + .875X_2)10^{-6}$$

$$\delta_{1A} = (-1485 + 1.545X_1 + .875X_2)10^{-6}$$

$$\delta_{2A} = (-2300 - 2.20X_1 - 2.20X_2)t_2 R_{2-3}$$

$$\delta_{2A} = (915 + .875X_1 + .875X_2)10^{-6}$$

$$\delta_{4A} = (-900 + 2.08X_4 + 1.94X_5 + 1.80X_6 + 1.63X_7)t_4 R_{3-4}$$

$$\delta_{4A} = (-489 + 1.13X_4 + 1.053X_5 + .978X_6 + .885X_7)10^{-6}$$

$$\delta_{5A} = (-1800 + 1.94X_5 + 1.80X_6 + 1.63X_7)t_5 R_{4-5} + (-900 + 2.08X_4 + 1.94X_5 + 1.80X_6 + 1.63X_7)t_5 R_{3-4}$$

$$\delta_{5A} = (-1682 + 1.812X_5 + 1.682X_6 + 1.522X_7)10^{-6} + (-455 + 1.052X_4 + .983X_5 + .911X_6 + .825X_7)10^{-6}$$

A. V. ROE CANADA LIMITED
MALTON · ONTARIO
TECHNICAL DEPARTMENT (Aircraft)

REPORT No. 7-0574-1
SHEET NO. 50

AIRCRAFT:		PREPARED BY	DATE
C105	AILERON	R. GAVALIS	JULY 14/59
		CHECKED BY	DATE

REDUNDANT LOADS - AILERON

SUBSONIC CASE

$$\delta_{5A} = (-2137 + 1.052X_4 + 2.795X_5 + 2.593X_6 + 2.347X_7)10^{-6}$$

$$\delta_{6A} = (-1500 + 1.80X_6 + 1.63X_7)t_6R_{5-6} + (-1800 + 1.94X_5 + 1.80X_6 + 1.63X_7)t_6R_{4-5} + (-900 + 2.08X_4 + 1.94X_5 + 1.80X_6 + 1.63X_7)t_6R_{3-4}$$

$$\delta_{6A} = (-2020 + 2.42X_6 + 2.20X_7)10^{-6} + (-1560 + 1.68X_5 + 1.56X_6 + 1.41X_7)10^{-6} + (-423 + .977X_4 + .912X_5 + .846X_6 + .766X_7)10^{-6}$$

$$\delta_{6A} = (-4003 + .977X_4 + 2.592X_5 + 4.826X_6 + 4.376X_7)10^{-6}$$

$$\delta_{7A} = (-1300 + 1.63X_7)t_7R_{6-7} + (-1500 + 1.80X_6 + 1.63X_7)t_7R_{5-6} + (-1800 + 1.94X_5 + 1.80X_6 + 1.63X_7)t_7R_{4-5} + (-900 + 2.08X_4 + 1.94X_5 + 1.80X_6 + 1.63X_7)t_7R_{3-4}$$

$$\delta_{7A} = (-2640 + 3.30X_7)10^{-6} + (-1830 + 2.20X_6 + 1.99X_7)10^{-6} + (-1426 + 1.528X_5 + 1.418X_6 + 1.281X_7)10^{-6} + (-382 + .885X_4 + .825X_5 + .765X_6 + .694X_7)10^{-6}$$

$$\delta_{7A} = (-6270 + .885X_4 + 2.353X_5 + 4.383X_6 + 7.265X_7)10^{-6}$$

ORM 1394

A. V. ROE CANADA LIMITED
MALTON - ONTARIO
TECHNICAL DEPARTMENT (Aircraft)

REPORT NO. 7-0579-1
SHEET NO. 51

AIRCRAFT:		PREPARED BY	DATE
C105	AILERON	R. GAVALIS	JULY 14/59
		CHECKED BY	DATE

REDUNDANT LOADS - AILERON

SUBSONIC CASE

SUMMARY:

δ_{1A}	-1435	+1.545X_1	+.375X_2					$\times 10^{-6}$
δ_{2A}	915	+.875X_1	+.875X_2					$\times 10^{-6}$
δ_{4A}	-487			+1.13X_4	+1.053X_5	+.778X_6	+.885X_7	$\times 10^{-6}$
δ_{5A}	-2137			+1.052X_4	+2.798X_5	+2.593X_6	+2.347X_7	$\times 10^{-6}$
δ_{6A}	-4003			+.979X_4	+2.592X_5	+4.826X_6	+4.376X_7	$\times 10^{-6}$
δ_{7A}	-6270			+.885X_4	+2.353X_5	+4.383X_6	+7.265X_7	$\times 10^{-6}$

SUPERSONIC CASE

THIS CASE IS SIMILAR TO SUBSONIC EXCEPT FOR τ_0 & R ($P_{REF.}$ P85, 913 21a)
THEN,

$$\delta_{1A} = (7400 - 2.20X_1)\tau_0 R_{1-2} + (-3300 - 2.20X_1 - 2.20X_2)\tau_0 R_{2-3}$$

$$\delta_{1A} = [(-2520 + .748X_1) + (1460 + .976X_1 + .976X_2)]10^{-6}$$

$$\delta_{1A} = (-1060 + 1.724X_1 + .976X_2)10^{-6}$$

$$\delta_{2A} = (-3300 - 2.20X_1 - 2.20X_2)\tau_0 R_{2-3}$$

$$\delta_{2A} = (1460 + .976X_1 + .976X_2)10^{-6}$$

A. V. ROE CANADA LIMITED
MALTON · ONTARIO
TECHNICAL DEPARTMENT (Aircraft)

REPORT No. 7-0674-1
SHEET No. 52

AIRCRAFT:		PREPARED BY	DATE
C 105	AILERON	R. CAVALIS	JULY 19/54
		CHECKED BY	DATE

REDUNDANT LOADS - AILERON

SUPERSONIC CASE

$$\delta^{2}_{4A} = (-1700 + 2.08 X_4 + 1.94 X_5 + 1.80 X_6 + 1.63 X_7)\, t_4 R_{3-4}$$

$$\delta^{2}_{4A} = (-1150 + 1.26 X_4 + 1.171 X_5 + 1.09 X_6 + .986 X_7)\, 10^{-6}$$

$$\delta^{2}_{5A} = (-2800 + 1.94 X_5 + 1.80 X_6 + 1.63 X_7)\, t_5 R_{4-5} + (-1900 + 2.08 X_4 + 1.94 X_5 + 1.80 X_6 + 1.63 X_7)\, t_5 R_{3-4}$$

$$\delta^{2}_{5A} = (-2920 + 2.022 X_5 + 1.880 X_6 + 1.70 X_7)\, 10^{-6} + (-1370 + 1.171 X_4 + 1.098 X_5 + 1.018 X_6 + .921 X_7)\, 10^{-6}$$

$$\delta^{2}_{5A} = (-3990 + 1.171 X_4 + 3.120 X_5 + 2.898 X_6 + 2.621 X_7)\, 10^{-6}$$

$$\delta^{2}_{6A} = (-2600 + 1.80 X_6 + 1.63 X_7)\, t_6 R_{5-6} + (-2800 + 1.94 X_5 + 1.80 X_6 + 1.63 X_7)\, t_6 R_{4-5} + (-1900 + 2.08 X_4 + 1.94 X_5 + 1.80 X_6 + 1.63 X_7)\, t_6 R_{3-4}$$

$$\delta^{2}_{6A} = (-3700 + 2.71 X_6 + 2.44 X_7)\, 10^{-6} + (-2710 + 1.88 X_5 + 1.74 X_6 + 1.579 X_7)\, 10^{-6} + (-995 + 1.09 X_4 + 1.018 X_5 + .942 X_6 + .854 X_7)\, 10^{-6}$$

$$\delta^{2}_{6A} = (-7000 + 1.09 X_4 + 2.898 X_5 + 5.392 X_6 + 4.873 X_7)\, 10^{-6}$$

$$\delta^{2}_{7A} = (-2300 + 1.63 X_7)\, t_7 R_{6-7} + (-2600 + 1.80 X_6 + 1.63 X_7)\, t_7 R_{5-6} + (-2800 + 1.94 X_5 + 1.80 X_6 + 1.63 X_7)\, t_7 R_{4-5} + (-1900 + 2.08 X_4 + 1.94 X_5 + 1.80 X_6 + 1.63 X_7)\, t_7 R_{3-4}$$

ORM 1319A

A. V. ROE CANADA LIMITED
MALTON - ONTARIO
TECHNICAL DEPARTMENT (Aircraft)

REPORT No. 7-0674-1
SHEET No. 53

AIRCRAFT:		PREPARED BY	DATE
C 100	AILERON	R. GAVALIS	JULY 14/54
		CHECKED BY	DATE

REDUNDANT LOADS - AILERON

SUPERSONIC CASE

$$\delta_{7A} = (-5200 + 3.68X_1)10^{-6} + (-3540 + 2.95X_6 + 2.22X_7)10^{-6} + (-2460 + 1.70X_5 + 1.58X_6 + 1.43X_7)10^{-6} + (-900 + .985X_4 + .920X_5 + .853X_6 + .773X_7)10^{-6}$$

$$\delta_{7A} = (-12100 + .985X_4 + 2.620X_5 + 4.883X_6 + 8.10X_7)10^{-6}$$

SUMMARY:

δ_{1A}	-1060	$+1.724X_1$	$+.976X_2$					$\times 10^{-6}$
δ_{2A}	1460	$+.976X_1$	$+.976X_2$					$\times 10^{-6}$
δ_{4A}	-1150			$+1.26X_4$	$+1.171X_5$	$+1.09X_6$	$+.986X_7$	$\times 10^{-6}$
δ_{5A}	-3990			$+1.171X_4$	$+3.12X_5$	$+2.898X_6$	$+2.621X_7$	$\times 10^{-6}$
δ_{6A}	-7600			$+1.09X_4$	$+2.898X_5$	$+5.392X_6$	$+4.883X_7$	$\times 10^{-6}$
δ_{7A}	-12100			$+.985X_4$	$+2.621X_5$	$+4.883X_6$	$+8.10X_7$	$\times 10^{-6}$

FORM 1319A

A. V. ROE CANADA LIMITED
MALTON - ONTARIO
TECHNICAL DEPARTMENT (Aircraft)

REPORT No. 7-0579-1
SHEET No. 54

AIRCRAFT:		PREPARED BY	DATE
C 105	AILERON	R. GAVALIS	JULY 17/59
		CHECKED BY	DATE

REDUNDANT LOADS - RIBS

SUBSONIC CASE

THE STRAIN ENERGY OF BENDING IS,

$$U = \int_0^c \frac{M^2}{2EI}\, dy$$

$$M = (M_0 + m_1 X_1 + m_2 X_2 + \dots + m_n X_n)$$

THEN $M^2 = M_0^2 + 2M_0 m_1 X_1 + 2M_0 m_2 X_2 + m_1^2 X_1^2 + 2M_1 X_1 m_2 X_2 + m_2^2 + X_2^2 + \dots$

$$\therefore U = \int_0^c \frac{(M_0^2 + 2M_0 m_1 X_1 + 2M_0 m_2 X_2 + \dots)}{2EI}\, dy$$

AND $$\delta_1 = \frac{\partial U}{\partial X_1} = \int_0^c \frac{(2M_0 m_1 + 2m_1^2 X_1 + 2m_1 m_2 X_2 + \dots)}{2EI}\, dy$$

$$\delta_1 = \int_0^c \frac{(M_0 + m_1 X_1 + m_2 X_2 + \dots) m_1}{EI}\, dy$$

$$\delta_1 = \int_0^c \frac{M m_1}{EI}\, dy$$

OR IN GENERAL,

$$\delta_{UR} = \int_0^c \frac{M_i M_c}{EI}\, dy \qquad \text{WHERE: } c \text{ IS ANY RIB}$$

RIB MOMENT:

$M_1 = 17400 + 2.20 X_1$
(REF. Pg. 50)

FORM 1319A

A. V. ROE CANADA LIMITED
MALTON · ONTARIO
TECHNICAL DEPARTMENT (Aircraft)

REPORT No. 7-0579-1
SHEET No. 55

AIRCRAFT:		PREPARED BY	DATE
C105	AILERON	R. GAVANIS	JULY 14/54
		CHECKED BY	DATE

REDUNDANT LOADS - RIBS

SUBSONIC CASE. (CONT.)

$M_2 = 66400 + X_2 m_2 = 66400 + 2.20 X_2$

$M_3 = 63800 + X_1 m_1 + X_2 m_2 + X_4 m_4 + X_5 m_5 + X_6 m_6 + X_7 m_7$

$M_3 = 63800 - 2.20 X_1 - 2.20 X_2 - 2.08 X_4 - 1.94 X_5 - 1.80 X_6 - 1.63 X_7 = (*)$

$M_4 = 57000 + X_4 m_4 = 57000 + 2.08 X_4$

$M_5 = 43600 + X_5 m_5 = 43600 + 1.94 X_5$

$M_6 = 27800 + X_6 m_6 = 27800 + 1.80 X_6$

$M_7 = 26800 + X_7 m_7 = 26800 + 1.63 X_7$

FOR THE RIBS,

$\delta'_{1R} = (17400 + 2.20 X_1) m_1 S_1 - (*) m_1 S_3$

$m_1 = 2.20 \quad S_1 = .472 \times 10^{-6}$ (REF. Rys 304 #1)
$S_3 = .444 \times 10^{-6}$

$\delta'_{1R} = [(8100 + 2.28 X_1) - (62300 - 2.14 X_1 - 2.14 X_2 - 2.03 X_4 - 1.89 X_5 - 1.76 X_6 - 1.59 X_7)] 10^{-6}$

$\delta'_{1R} = (-44200 + 4.42 X_1 + 2.14 X_2 + 2.03 X_4 + 1.89 X_5 + 1.76 X_6 + 1.59 X_7) 10^{-6}$

$\delta'_{2R} = (66400 + 2.20 X_2) m_2 S_2 - (*) m_2 S_3$

(*) SEE M_3 ABOVE

FORM 1319A

A. V. ROE CANADA LIMITED
MALTON - ONTARIO
TECHNICAL DEPARTMENT (Aircraft)

REPORT NO. 7-0574-1
SHEET NO. 56

AIRCRAFT:		PREPARED BY	DATE
C 105	AILERON	R. GAVALIS	JULY 19/54
		CHECKED BY	DATE

REDUNDANT LOADS - RIBS
SYMMETRICAL CASE (CONT.)

$$\delta_{2R} = (59700 + 1.752 X_2)10^{-6} - (62300 - 2.14X_1 - 2.14X_2 - 2.03X_3 - 1.89X_5 - 1.76X_6 - 1.59X_7)10^{-6}$$

$$\delta'_{2R} = (-3400 + 2.14X_1 + 4.09X_2 + 2.03X_3 + 1.89X_5 + 1.76X_6 + 1.59X_7)10^{-6}$$

$$\delta'_{3R} = (57000 + 2.08X_3)m_3 S_3 - (\ ^*\ )m_3 S_3$$

$$\delta'_{4R} = (57200 + 2.11X_4)10^{-6} - (58700 - 2.02X_1 - 2.02X_2 - 1.91X_4 - 1.79X_5 - 1.66X_6 - 1.50X_7)10^{-6}$$

$$\delta'_{4R} = (-1000 + 2.02X_1 + 2.02X_2 + 4.52X_4 + 1.79X_5 + 1.66X_6 + 1.50X_7)10^{-6}$$

$$\delta'_{5R} = (-4360 + 1.94X_5)m_5 S_5 - (\ ^*\ )m_5 S_3$$

$$\delta_{5R} = (53500 + 2.38X_5)10^{-6} - (54900 - 1.89X_1 - 1.89X_2 - 1.79X_4 - 1.67X_5 - 1.55X_6 - 1.40X_7)10^{-6}$$

$$\delta'_{5R} = (-1400 + 1.89X_1 + 1.89X_2 + 1.79X_4 + 4.05X_5 + 1.55X_6 + 1.40X_7)10^{-6}$$

$$\delta'_{6R} = (27800 + 1.80X_6)m_6 S_6 - (\ ^*\ )m_6 S_3$$

$$\delta_{6R} = (44500 + 4.69X_6)10^{-6} - (51000 - 1.76X_1 - 1.76X_2 - 1.66X_4 - 1.55X_5 - 1.44X_6 - 1.30X_7)10^{-6}$$

$$\delta'_{6R} = (23500 + 1.76X_1 + 1.76X_2 + 1.66X_4 + 1.55X_5 + 6.27X_6 + 1.30X_7)10^{-6}$$

$$\delta'_{7R} = (26800 + 1.63X_7)m_7 S_7 - (\ ^*\ )m_7 S_3$$

FORM 1319A

A. V ROE CANADA LIMITED
MALTON - ONTARIO
TECHNICAL DEPARTMENT (Aircraft)

REPORT No. 7-0574-1
SHEET No. 57

AIRCRAFT:		PREPARED BY	DATE
C105	AILERON	R. GAVALIS	JULY 19/59
		CHECKED BY	DATE

REDUNDANT LOADS - RIBS

SUBSONIC CASE (CONT.)

$$\delta_{7R} = (74600 + 4.59X_7)10^{-6} - (46080 - 1.59X_1 - 1.59X_2 - 1.50X_4 - 1.40X_5 - 1.30X_6 - 1.18X_7)10^{-6}$$

$$\delta_{7R} = (28600 + 1.59X_1 + 1.59X_2 + 1.50X_4 + 1.40X_5 + 1.30X_6 + 5.72X_7)10^{-6}$$

SUMMARY:

δ_{1R}	-44200	+4.42X_1	+2.14X_2	+2.03X_4	+1.89X_5	+1.76X_6	+1.59X_7	$\times 10^{-6}$
δ_{2R}	-3400	+2.14X_1	+4.09X_2	+2.03X_4	+1.89X_5	+1.76X_6	+1.59X_7	$\times 10^{-6}$
δ_{4R}	-1000	+2.03X_1	+2.03X_2	+4.02X_4	+1.79X_5	+1.66X_6	+1.50X_7	$\times 10^{-6}$
δ_{5R}	-1490	+1.89X_1	+1.89X_2	+1.79X_4	+4.05X_5	+1.55X_6	+1.40X_7	$\times 10^{-6}$
δ_{6R}	23500	+1.76X_1	+1.76X_2	+1.66X_4	+1.55X_5	+4.27X_6	+1.30X_7	$\times 10^{-6}$
δ_{7R}	28600	+1.59X_1	+1.59X_2	+1.50X_4	+1.40X_5	+1.30X_6	+5.72X_7	$\times 10^{-6}$

SUPERSONIC CASE

THIS CASE IS SIMILAR TO SUBSONIC EXCEPT FOR M_0 & S (SEE Pgs 30 & 31)

$$\delta_{1R} = (24000 + 2.20X_1)m_1 S_1 - (\ *\ )m_1 S_3$$

$m_1 = 2.20$, $S_1 = .511 \times 10^{-6}$, $S_3 = .480 \times 10^{-6}$
(REF. Pgs. 30 & 31)

$$(\ *\ ) = (43800 - 2.20X_1 - 2.20X_2 - 2.08X_4 - 1.94X_5 - 1.80X_6 - 1.63X_7$$
(REF. Pg 30)

FORM 1319A

A. V. ROE CANADA LIMITED
MALTON - ONTARIO
TECHNICAL DEPARTMENT (Aircraft)

REPORT No. 7-0579-1
SHEET No. 58

AIRCRAFT:		PREPARED BY	DATE
C 105	AILERON	R. GAVALIS	JULY 14/54
		CHECKED BY	DATE

REDUNDANT LOADS - RIBS

SUPERSONIC CASE (CONT.)

$$\delta_{1R} = (27000 + 2.48X_1)10^{-6} - (17400 - 2.32X_1 - 2.32X_2 - 2.20X_4 - 2.05X_5 - 1.90X_6 - 1.72X_7)10^{-6}$$

$$\delta_{1R} = (-40400 + 4.80X_1 + 2.32X_2 + 2.20X_4 + 2.05X_5 + 1.90X_6 + 1.72X_7)10^{-6}$$

$$\delta_{2R} = (70800 + 2.20X_2)m_2 S_2 - (\ *\ )m_2 S_3$$

$$\delta_{2R} = (17900 + 2.11X_2)10^{-6} - (17500 - 2.32X_1 - 2.32X_2 - 2.20X_4 - 2.05X_5 - 1.90X_6 - 1.72X_7)10^{-6}$$

$$\delta_{2R} = (400 + 2.32X_1 + 4.43X_2 + 2.20X_4 + 2.05X_5 + 1.90X_6 + 1.72X_7)10^{-6}$$

$$\delta_{4R} = (57000 + 2.08X_4)m_4 S_4 - (\ *\ )m_4 S_3$$

$$\delta_{4R} = (62500 + 2.28X_4)10^{-6} - (63600 - 2.20X_1 - 2.20X_2 - 2.08X_4 - 1.94X_5 - 1.80X_6 - 1.63X_7)10^{-6}$$

$$\delta_{4R} = (-1100 + 2.20X_1 + 2.20X_2 + 4.36X_4 + 1.94X_5 + 1.80X_6 + 1.63X_7)10^{-6}$$

$$\delta_{5R} = (43200 + 1.94X_5)m_5 S_5 - (\ *\ )m_5 S_3.$$

$$\delta_{5R} = (57200 + 2.56X_5)10^{-6} - (58500 - 2.05X_1 - 2.05X_2 - 1.94X_4 - 1.81X_5 - 1.68X_6 - 1.52X_7)10^{-6}$$

$$\delta_{5R} = (-1300 + 2.05X_1 + 2.05X_2 + 1.94X_4 + 4.37X_5 + 1.68X_6 + 1.52X_7)10^{-6}$$

$$\delta_{6R} = (26800 + 1.80X_6)m_6 S_6 - (\ *\ )m_6 S_3$$

FORM 1319A

A. V. ROE CANADA LIMITED
MALTON - ONTARIO
TECHNICAL DEPARTMENT (Aircraft)

REPORT No. T-0579-1
SHEET No. 59

AIRCRAFT:		PREPARED BY	DATE
C 105	AILERON	R. GAVALIS	JULY 19/54
		CHECKED BY	DATE

REDUNDANT LOADS - RIBS

SUPERSONIC CASE (CONT.)

$$\delta_{6R} = (77600 + 5.21X_6)10^{-6} - (55100 - 1.90X_1 - 1.90X_2 - 1.80X_4 - 1.67X_5 - 1.55X_6 - 1.41X_7)10^{-6}$$

$$\delta_{6R} = (22500 + 1.90X_1 + 1.90X_2 + 1.80X_4 + 1.67X_5 + 6.76X_6 + 1.41X_7)10^{-6}$$

$$\delta_{7R} = (22400 + 1.63X_7)m_7 S_7 - (\ *\ )m_7 S_3$$

$$\delta_{7R} = (67600 + 4.92X_7)10^{-6} - (50,000 - 1.72X_1 - 1.72X_2 - 1.63X_4 - 1.52X_5 - 1.41X_6 - 1.28X_7)10^{-6}$$

$$\delta_{7R} = (17600 + 1.72X_1 + 1.72X_2 + 1.63X_4 + 1.52X_5 + 1.41X_6 + 6.20X_7)10^{-6}$$

SUMMARY:

δ_{1R}	-40400	+4.80X_1	+2.32X_2	+2.20X_4	+2.05X_5	+1.90X_6	+1.72X_7	$\times 10^{-6}$
δ_{2R}	400.	+2.32X_1	+4.43X_2	+2.20X_4	+2.05X_5	+1.90X_6	+1.72X_7	$\times 10^{-6}$
δ_{4R}	-1100	+2.20X_1	+2.20X_2	+4.36X_4	+1.99X_5	+1.80X_6	+1.63X_7	$\times 10^{-6}$
δ_{5R}	-1300	+2.05X_1	+2.05X_2	+1.99X_4	+4.37X_5	+1.67X_6	+1.52X_7	$\times 10^{-6}$
δ_{6R}	22500	+1.90X_1	+1.90X_2	+1.80X_4	+1.67X_5	+6.76X_6	+1.41X_7	$\times 10^{-6}$
δ_{7R}	17600	+1.72X_1	+1.72X_2	+1.63X_4	+1.52X_5	+1.41X_6	+6.20X_7	$\times 10^{-6}$

FORM 1318A

A. V. ROE CANADA LIMITED
MALTON · ONTARIO
TECHNICAL DEPARTMENT (Aircraft)

REPORT No. 7-0579-1
SHEET No. 60

AIRCRAFT:		PREPARED BY	DATE
C 105	AILERON	R. GAVALIS	JULY 19/57
		CHECKED BY	DATE

REDUNDANT LOADS

DETERMINANT SUMMARY

THE EQUATIONS FROM WHICH THE REDUNDANTS ARE FOUND ARE OBTAINED BY SUMMING ALL THE DERIVATIVES OF THE STRAIN ENERGY FOR THE FIVE ELEMENTS MAKING UP THE SYSTEM.

$$\Delta_i = \Sigma\left(\frac{2U}{2X_i}\right) = \left(\frac{2U}{2X_i}\right)_L + \left(\frac{2U}{2X_i}\right)_T + \left(\frac{2U}{2X_i}\right)_C + \left(\frac{2U}{2X_i}\right)_R + \left(\frac{2U}{2X_i}\right)_A$$

SUBSONIC CASE

$\Delta_1 =$	-40605	$+10.756X_1$	$4.482X_2$	$3.138X_4$	$2.925X_5$	$2.718X_6$	$2.460X_7$	$\times 10^{-6} = 0$
$\Delta_2 =$	21446	$4.482X_1$	$7.977X_2$	$3.138X_4$	$2.925X_5$	$2.718X_6$	$2.460X_7$	$\times 10^{-6} = 0$
$\Delta_4 =$	28561	$3.138X_1$	$3.138X_2$	$8.174X_4$	$3.975X_5$	$3.685X_6$	$3.334X_7$	$\times 10^{-6} = 0$
$\Delta_5 =$	51423	$2.925X_1$	$2.925X_2$	$3.975X_4$	$10.956X_5$	$5.360X_6$	$4.857X_7$	$\times 10^{-6} = 0$
$\Delta_6 =$	81367	$2.718X_1$	$2.718X_2$	$3.685X_4$	$5.360X_5$	$16.245X_6$	$6.999X_7$	$\times 10^{-6} = 0$
$\Delta_7 =$	35940	$2.460X_1$	$2.460X_2$	$3.334X_4$	$4.857X_5$	$6.999X_6$	$17.790X_7$	$\times 10^{-6} = 0$

REF. Pgs. [illegible]

FORM 1319A

A. V. ROE CANADA LIMITED
MALTON - ONTARIO
TECHNICAL DEPARTMENT (Aircraft)

REPORT No. 7-0579-1
SHEET No. 61

AIRCRAFT:		PREPARED BY	DATE
C105	AILERON	R. GAVALIS	JULY 19/54
		CHECKED BY	DATE

REDUNDANT LOADS

DETERMINANT SOLUTION - SUBSONIC CASE

AUXILIARY MATRIX

A_1 12.755	$B_1 = \frac{B_2}{A_1}$ .410	$m_1 = \frac{C_1}{A_1}$ .286	n_1 .263	p_1 .253	q_1 .229	O_1 3700
A_2 4.482	$k_2 = S_2 - (A_1 \cdot B_1^2)$ 6.15	$m_2 = \frac{C_2 - A_2 m_1^2}{k_2}$ .302	n_2 .280	p_2 .261	q_2 .237	O_2 -6170
A_3 3.139	k_3 1.856	m_3 6.739	n_3 .377	p_3 .360	q_3 .326	O_3 -4260
A_4 2.725	k_4 1.725	m_4 2.619	n_4 0.598	p_4 .378	q_4 .342	O_4 -4700
A_5 2.718	k_5 1.607	m_5 2.424	n_5 3.263	p_5 13.05	q_5 .315	O_5 -4270
A_6 2.420	k_6 1.455	m_6 2.172	n_6 2.961	p_6 4.10	q_6 13.879	O_6 -3260

FORM 1319A

A. V. ROE CANADA LIMITED
MALTON - ONTARIO
TECHNICAL DEPARTMENT (Aircraft)

REPORT No. 7-0579-1
SHEET No. 62

AIRCRAFT:		PREPARED BY	DATE
C105	AILERON	R. GAVALIS	JULY 14/59
		CHECKED BY	DATE

REDUNDANT LOADS

SUBSONIC CASE

REDUNDANTS

$X_7 = O_6 = -3260^{\#}$

$X_6 = O_5 - X_7 f_6 = -4270 - (-3260)(.315) = -3242^{\#}$

$X_5 = O_4 - X_7 f_4 - X_6 f_4 = -4700 - (-3260)(.342)$
$-(-3242)(.378) = -2360^{\#}$

$X_4 = O_3 - X_7 f_3 - X_6 f_3 - X_5 m_3 = -4260 - (-3260)(.326)$
$-(-3242)(.360) - (-2360)(.379)$

$X_4 = -1133^{\#}$

$X_2 = O_2 - X_7 f_2 - X_6 f_2 - X_5 m_2 - X_4 m_2$

$= -6190 - (-3260)(.237) - (-3242)(.261) - (-2360)(.280)$
$-(-1133)(.302)$

$X_2 = -3567^{\#}$

$X_1 = O_1 - X_7 f_1 - X_6 f_1 - X_5 m_1 - X_4 m_1 - X_2 l_1$

$= 3700 - (-3260)(.224) - (-3242)(.298) - (-2360)(.268)$
$-(-1133)(.286) - (-3567)(.410)$

$X_1 = 7653^{\#}$

$X_3 = -X_1 - X_2 - .945 X_4 - .882 X_5 - .818 X_6 - .741 X_7$
(REF. P3. 32)

$X_3 = -7653 + 3567 + 1071 + 2080 + 2655 + 2420$

$X_3 = 4140^{\#}$

A. V. ROE CANADA LIMITED
MALTON - ONTARIO
TECHNICAL DEPARTMENT (Aircraft)

REPORT No. 7-0579-1
SHEET No. 63

AIRCRAFT:		PREPARED BY	DATE
C 105	AILERON	R. GAVALIS	JULY 1954
		CHECKED BY	DATE

REDUNDANT LOADS

DETERMINANT SUMMARY - SUPERSONIC CASE

$\Delta_1 =$	-29620	$11.756X_1$	$4.835X_2$	$3.375X_4$	$3.149X_5$	$2.917X_6$	$2.642X_7$	$\times 10^{-6} = 0$
$\Delta_2 =$	31680	$4.835X_1$	$8.602X_2$	$3.375X_4$	$3.149X_5$	$2.917X_6$	$2.642X_7$	$\times 10^{-6} = 0$
$\Delta_4 =$	28800	$3.375X_1$	$3.375X_2$	$8.853X_4$	$4.302X_5$	$3.992X_6$	$3.616X_7$	$\times 10^{-6} = 0$
$\Delta_5 =$	50130	$3.149X_1$	$3.149X_2$	$4.302X_4$	$11.742X_5$	$5.839X_6$	$5.291X_7$	$\times 10^{-6} = 0$
$\Delta_6 =$	74550	$2.917X_1$	$2.917X_2$	$3.992X_4$	$5.839X_5$	$17.600X_6$	$7.653X_7$	$\times 10^{-6} = 0$
Δ_7	58240	$2.642X_1$	$2.642X_2$	$3.616X_4$	$5.291X_5$	$7.653X_6$	$19.324X_7$	$\times 10^{-6} = 0$

(REF. Pgs. 36, 41, 47, 53, 57)

FORM 1318A

A. V ROE CANADA LIMITED
MALTON · ONTARIO
TECHNICAL DEPARTMENT (Aircraft)

REPORT No. J-0579-1
SHEET No. 69

AIRCRAFT:		PREPARED BY	DATE
C105	AILERON	R. GAVALIS	JULY 14/54
		CHECKED BY	DATE

REDUNDANT LOADS
DETERMINANT SOLUTION - SUPERSONIC CASE
AUXILIARY MATRIX

D_1 2.100	D_2 -.6300	D_3 -.3200	D_4 -.3880	D_5 -.3370	D_6 -.1240
β_1 .225	β_2 .234	β_3 .326	β_4 .346	β_5 .518	β_6 15.039
μ_1 .295	μ_2 .259	μ_3 .362	μ_4 .382	μ_5 14.120	μ_6 4.50
μ_1' .266	μ_2' .291	μ_3' .370	μ_4' 9.273	μ_5' 3.550	μ_6' 3.218
μ_1'' .287	μ_2'' .300	μ_3'' 7.272	μ_4'' 2.840	μ_5'' 2.670	μ_6'' 2.370
λ_1 .411	λ_2 6.62	λ_3 1.971	λ_4 1.8357	λ_5 1.720	λ_6 1.559
A_1 11.766	A_2 4.8335	A_3 3.375	A_4 3.149	A_5 2.917	A_6 2.682

CRM 1319A

A. V. ROE CANADA LIMITED
MALTON - ONTARIO
TECHNICAL DEPARTMENT (Aircraft)

REPORT No. 7-0579-1
SHEET No. 65

AIRCRAFT:		PREPARED BY	DATE
C105	AILERON	R. GAVALIS	JULY 19/54
		CHECKED BY	DATE

REDUNDANT LOADS

SUPERSONIC CASE

REDUNDANTS

$X_7 = O_6 = -1240^{\#}$

$X_6 = O_5 - f_5 X_7 = -3370 - .318(-1240) = -2976^{\#}$

$X_5 = O_4 - f_4 X_7 - f_4 X_6 = -3890 - .346(-1240) - .382(-2976)$

$X_5 = -2314^{\#}$

$X_4 = O_3 - f_3 X_7 - f_3 X_6 - m_3 X_5$

$X_4 = -3200 - .328(-1240) - .362(-2976) - .390(-2314)$

$X_4 = -814^{\#}$

$X_2 = O_2 - f_2 X_7 - f_2 X_6 - m_2 X_5 - m_2 X_4$

$X_2 = -6300 - .234(-1240) - .259(-2976) - .281(-2314) - .300(-814)$

$X_2 = -4346^{\#}$

$X_1 = O_1 - f_1 X_7 - f_1 X_6 - m_1 X_5 - m_1 X_4 - l_1 X_2$

$X_1 = 2100 - .225(-1240) - .248(-2976) - .266(-2314) - .287(-814) - .411(-4346)$

$X_1 = 5751^{\#}$

FORM 1319A

A. V. ROE CANADA LIMITED
MALTON - ONTARIO
TECHNICAL DEPARTMENT (Aircraft)

REPORT No. 7-0579-1
SHEET No. 46

AIRCRAFT:		PREPARED BY	DATE
C105	AILERON	R. GAVALIS	JULY 14/54
		CHECKED BY	DATE

REDUNDANT LOADS

SUPERSONIC CASE

REDUNDANTS (CONT.)

$X_3 = -X_1 - X_2 - .945 X_4 - .882 X_5 - .818 X_6 - .741 X_7$

$X_3 = -5751 + 4346 + .945(814) + .882(2314)$
$+ .818(2976) + .741(1240)$

$X_3 = 4758\#$

A. V. ROE CANADA LIMITED
MALTON · ONTARIO
TECHNICAL DEPARTMENT (Aircraft)

REPORT No. 7-0579-1
SHEET No. 67

AIRCRAFT:		PREPARED BY	DATE
C105	AILERON	R. GAVALIS	JULY 14/59
		CHECKED BY	DATE

FINAL LIMIT LOADS - LIMIT

SUBSONIC CASE

$P_1 = 7910 + X_1 = 7910 + 7653 = 15,560\ \#$

$P_2 = 30180 + X_2 = 30180 - 3567 = 26,610\ \#$

$P_3 = 29000 - X_1 - X_2 - .945X_4 - .892X_5 - .918X_6 - .741X_7$

$P_3 = 21000 + X_3 = 21000 + 4140 = 33140\ \#$

$P_4 = 27400 + X_4 = 27400 - 1133 = 26270\ \#$

$P_5 = 22470 + X_5 = 22470 - 2360 = 20110\ \#$

$P_6 = 15440 + X_6 = 15440 - 3242 = 12200\ \#$

$P_7 = 16490 + X_7 = 16490 - 3360 = 13190\ \#$

SUPERSONIC CASE

$P_1 = 10910 + X_1 = 10910 + 5751 = 16660\ \#$

$P_2 = 32180 + X_2 = 32180 - 4346 = 27830\ \#$

$P_3 = 29000 + X_3 = 29000 + 4758 = 33760\ \#$

$P_4 = 27400 + X_4 = 27400 - 814 = 26590\ \#$

$P_5 = 22,270 + X_5 = 22270 - 2319 = 19960\ \#$

$P_6 = 14970 + X_6 = 14970 - 2976 = 11910\ \#$

$P_7 = 13740 + X_7 = 13740 - 1240 = 12500\ \#$

(REF. P_{03}, 24, 22 & 25)

FORM 1319A

A. V. ROE CANADA LIMITED
MALTON - ONTARIO
TECHNICAL DEPARTMENT (Aircraft)

REPORT NO. 7-0579-1
SHEET NO. 68

AIRCRAFT:		PREPARED BY	DATE
C105	AILERON	R. GAVALIS	JULY 14/54
		CHECKED BY	DATE

FINAL TIE-ROD LOADS - LIMIT

SUBSONIC CASE

$P_{1-2} = -4140 - .524X_1 = -4140 - .524(7653) = -8150\#$

$P_{2-3} = -19550 - .524X_1 - .524X_2 = -19550 - .524(7653-3567)$

$P_{2-3} = -21690\#$

$P_{3-4} = 36930 + .495X_4 + .462X_5 + .428X_6 + .388X_7$

$= 36930 + .495(-1133) + .462(-2360) + .428(-3242) + .388(-3260)$

$P_{3-4} = 32620\#$

$P_{4-5} = 23370 + .462X_5 + .428X_6 + .388X_7$

$P_{4-5} = 23370 - 3745 = 19630\#$

$P_{5-6} = 12990 + .428X_6 + .388X_7 = 12990 - 2655$

$P_{5-6} = 10340\#$

$P_{6-7} = 6380 + .388X_7 = 6380 - 1265 = 5120\#$

SUPERSONIC CASE

$P_{1-2} = -5730 - .524(5751) = -8740\#$

$P_{2-3} = -22580 - .524(5751) - .524(-4376) = -23330\#$

$P_{3-4} = 35550 + .495X_4 + .462X_5 + .428X_6 + .388X_7$

$P_{3-4} = 35550 + .495(-814) + .462(-2314) + .428(-2976) + .388(-1240)$

$P_{3-4} = 32330\#$

(SEE PAGE [illegible] OF

FORM 1319A

A. V. ROE CANADA LIMITED
MALTON · ONTARIO
TECHNICAL DEPARTMENT (Aircraft)

REPORT NO. 7-0579-1
SHEET NO. 69

AIRCRAFT:		PREPARED BY	DATE
C 105	AILERON	R. GAVALIS	JULY 1959
		CHECKED BY	DATE

FINAL TIE-ROD LOADS — LIMIT

SUPERSONIC CASE (CONT.)

$P_{4-5} = 21790 + .462X_5 + .428X_6 + .388X_7$

$P_{4-5} = 21790 - 1069 - 1272 - 480 = 19170\#$

$P_{5-6} = 11700 + .428X_6 + .388X_7$

$P_{5-6} = 11700 - 1272 - 480 = 9950\#$

$P_{6-7} = 5330 + .388X_7 = 5330 - 480 = 4850\#$

FINAL CRANK LOADS — LIMIT

SUBSONIC CASE

$P_1 = 4140 + .524X_1 = 4140 + .524(7653) = 8150\#$.

$P_2 = 15810 + .524X_2 = 15810 + .524(-3567) = 13940\#$

$P_3 = 15200 - .524X_1 - .524X_2 - .495X_4 - .462X_5 - .428X_6 - .388X_7$

$= 15200 - .524(7653) - .524(-3567) - .495(-1133) - .462(-2360) - .428(-3242) - .388(-3260)$

$P_3 = 17370\#$

$P_4 = 13560 + .495X_4 = 13560 - 560 = 13000\#$

$P_5 = 10380 + .462X_5 = 10380 - 1090 = 9290\#$

REF. P45 FOR [illegible]

FORM 1318A

A. V. ROE CANADA LIMITED
MALTON - ONTARIO
TECHNICAL DEPARTMENT (Aircraft)

REPORT No. 7-0574-1
SHEET No. 70

AIRCRAFT:		PREPARED BY	DATE
C105	AILERON	R. GAVALIS	JULY 14/59
		CHECKED BY	DATE

FINAL CRANK LOADS - LIMIT

SUBSONIC CASE (CONT.)

$P_6 = 6610 + .428 X_6 = 6610 - 1370 = 5220\#$

$P_7 = 6380 + .388 X_7 = 6380 - 1265 = 5115\#$

SUPERSONIC CASE

$P_1 = 5720 + .524(5751) = 8740\#$

$P_2 = 16860 + .524(-4346) = 14530\#$

$P_3 = 15200 - .524(5751) - .524(-4346) - .495(-814)$
$- .462(-2314) - .428(-2976) - .388(-1240)$

$P_3 = 12710\#$

$P_4 = 13560 + .495(-814) = 13160\#$

$P_5 = 10230 + .462(-2314) = 9220\#$

$P_6 = 6370 + .428(-2976) = 5160\#$

$P_7 = 5130 + .388(-1240) = 4850\#$

(REF P_{35} = 28,[illegible]05

FORM 1319A

A. V. ROE CANADA LIMITED
MALTON - ONTARIO
TECHNICAL DEPARTMENT (Aircraft)

REPORT No. 7-0574-1
SHEET No. 71

AIRCRAFT:		PREPARED BY	DATE
C105	AILERON	R. GAVALIS	JULY 19/54
		CHECKED BY	DATE

FINAL RIB BENDING MOMENT - LIMIT

SUBSONIC CASE

$M_1 = 17400 + 2.20X_1 = 17400 + 2.20(7653) = 34220^{IN\#}$

$M_2 = 66400 + 2.20X_2 = 66400 + 2.20(-3567) = 58550^{IN\#}$

$M_3 = 63300 - 2.20X_1 - 2.20X_2 - 2.08X_4 - 1.94X_5 - 1.80X_6 - 1.63X_7$

$M_3 = 63300 - 2.20(7653) - 2.20(-3567) - 2.08(-1133) - 1.94(-2360) - 1.80(-3242) - 1.63(-3260)$

$M_3 = 72150^{IN\#}$

$M_4 = 57700 + 2.08X_4 = 57700 - 2360 = 54640^{IN\#}$

$M_5 = 43600 - 1.94X_5 = 43600 - 4550 = 39020^{IN\#}$

$M_6 = 27800 + 1.80X_6 = 27800 - 5850 = 21950^{IN\#}$

$M_7 = 26800 + 1.63X_7 = 26800 - 5310 = 21490^{IN\#}$

SUPERSONIC CASE

$M_1 = 24000 + 2.20(5751) = 36660^{IN\#}$

$M_2 = 70800 + 2.20(-4326) = 61250^{IN\#}$

$M_3 = 63300 - 2.20(5751) - 2.20(-4326) - 2.08(-814) - 1.94(-2314) - 1.80(-2976) - 1.63(-1240)$

$M_3 = 74240^{IN\#}$

$M_4 = 57700 + 2.08(-814) = 55310^{IN\#}$

FORM 1319A

A. V. ROE CANADA LIMITED
MALTON · ONTARIO
TECHNICAL DEPARTMENT (Aircraft)

REPORT No. 7-0574-1
SHEET No. 72

AIRCRAFT:		PREPARED BY	DATE
C 105	AILERON	R. GAVALIS	JULY 19/54
		CHECKED BY	DATE

FINAL RIB BENDING MOMENT - LIMIT

SUPERSONIC CASE (CONT.)

$M_6 = 43200 + 1.74(-2314) = 38710$ IN #

$M_6 = 26800 + 1.60(-2976) = 21450$ IN #

$M_7 = 22400 + 1.63(-1200) = 20380$ IN #

FORM 1316A

A. V. ROE CANADA LIMITED
MALTON - ONTARIO
TECHNICAL DEPARTMENT (Aircraft)

REPORT No. 7-0574-1
SHEET No. 73

AIRCRAFT:		PREPARED BY	DATE
C 105	AILERON	R. GAVALIS	JUNE 21/54
		CHECKED BY	DATE

AILERON LOADS SUMMARY - SUBSONIC (LIMIT)

UP AILERON

FINAL TORQUE DISTRIBUTION - LIMIT

(POSITIVE TORQUE IS CLOCKWISE WHEN VIEWED LOOKING INBOARD)

$T_{RIB\#7\ OUTB'D} = +17400$ IN #

$T_{RIB\#7\ INB'D} = +17400 - 21490 = -4090$ IN #

$T_{RIB\#6\ OUTB'D} = -4090 + 21400 = 17310$ IN #

$T_{RIB\#6\ INB'D} = 17310 - 21950 = -4640$ IN #

$T_{RIB\#5\ OUTB'D} = -4640 + 34600 = 29960$ IN #

$T_{RIB\#5\ INB'D} = 29960 - 39020 = -9060$ IN #

$T_{RIB\#4\ OUTB'D} = -9060 + 53,200 = 44140$ IN #

$T_{RIB\#4\ INB'D} = 44140 - 54640 = -10500$ IN #

$T_{RIB\#3\ OUTB'D} = -10500 + 59000 = 48500$ IN #

$T_{RIB\#3\ INB'D} = 48500 - 72930 = -24430$ IN #

$T_{RIB\#2\ OUTB'D} = -24430 + 71400 = 46970$ IN #

$T_{RIB\#2\ INB'D} = 46970 - 58550 = -11580$ IN #

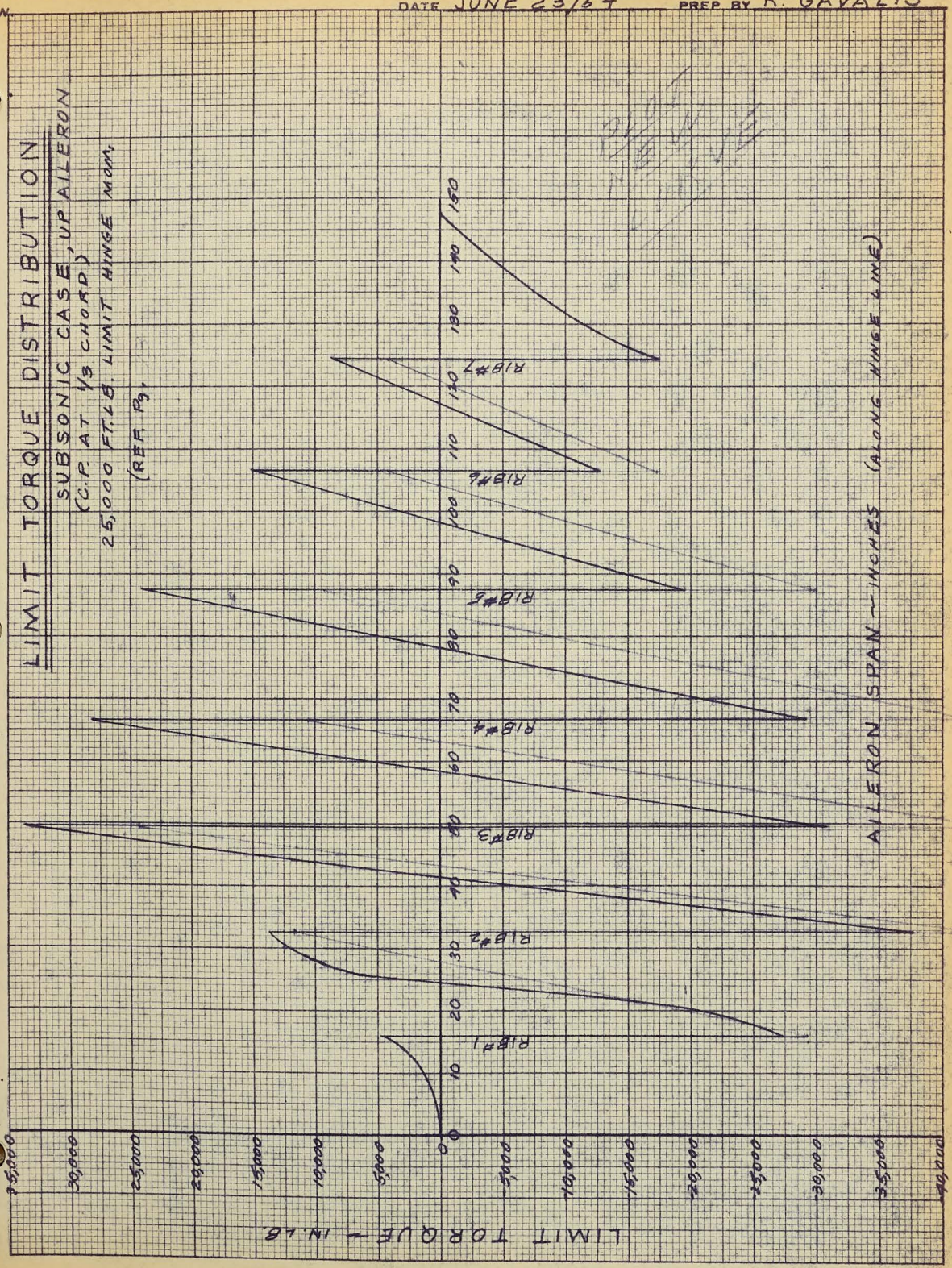
$T_{RIB\#1\ OUTB'D} = -11580 + 41000 = 29420$ IN #

$T_{RIB\#1\ INB'D} = 29420 - 34220 = -4800 = -T_{CELL\#1}$ CHECK

(REF. 95 B # 71)

FORM 1319A

AIRCRAFT C105 COMPONENT AILERON SHEET NO. 130 REPORT NO. T-0579-1
A. U. W. DATE JUNE 23/54 PREP BY R. GAVALIS



MADE IN U.S.A.

FORM 1746

AIRCRAFT
A.U.W.

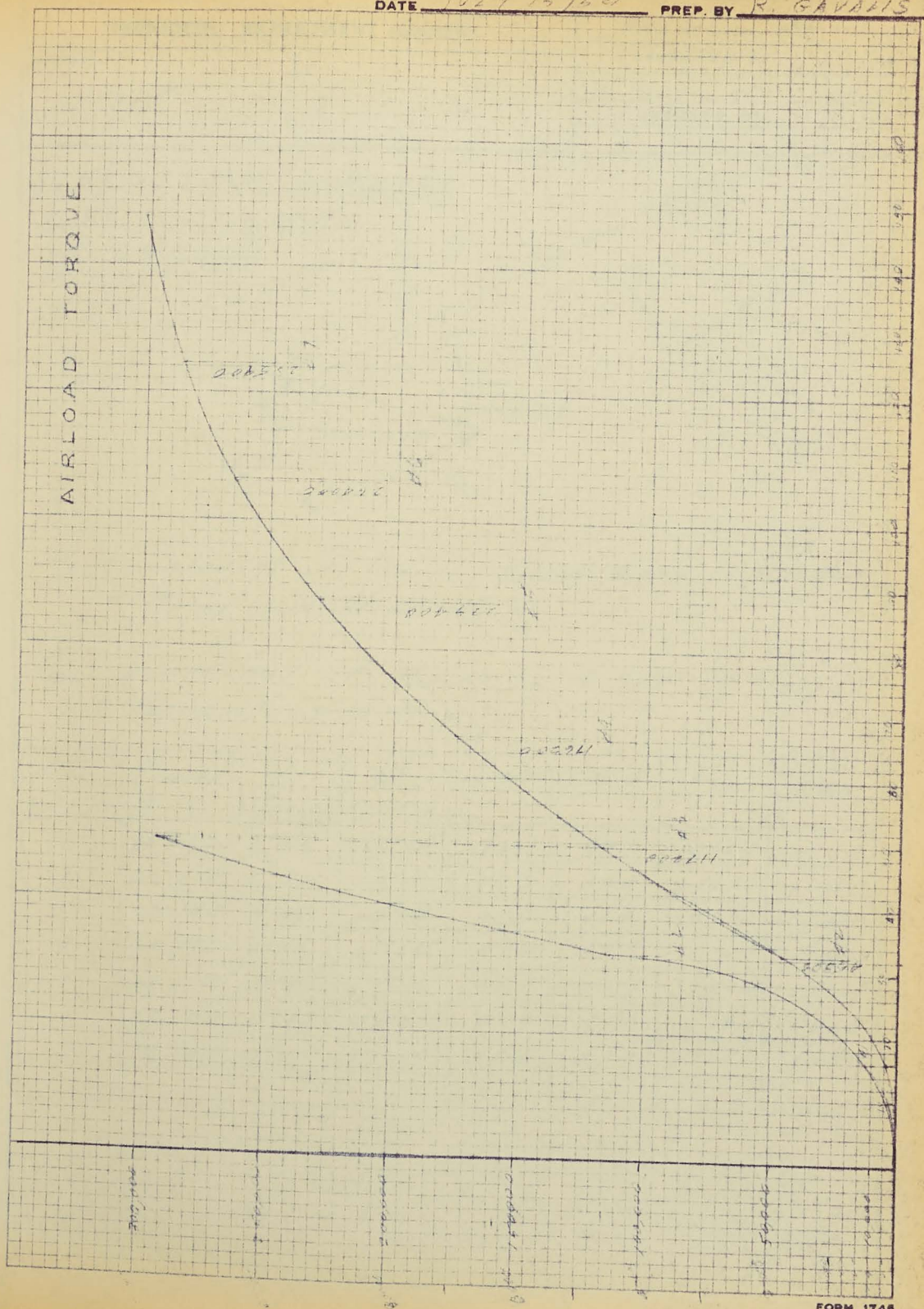
COMPONENT

SHEET No. 736

REPORT No. 7-0579-1

DATE JULY 15/54

PREP. BY R. GAVAIS



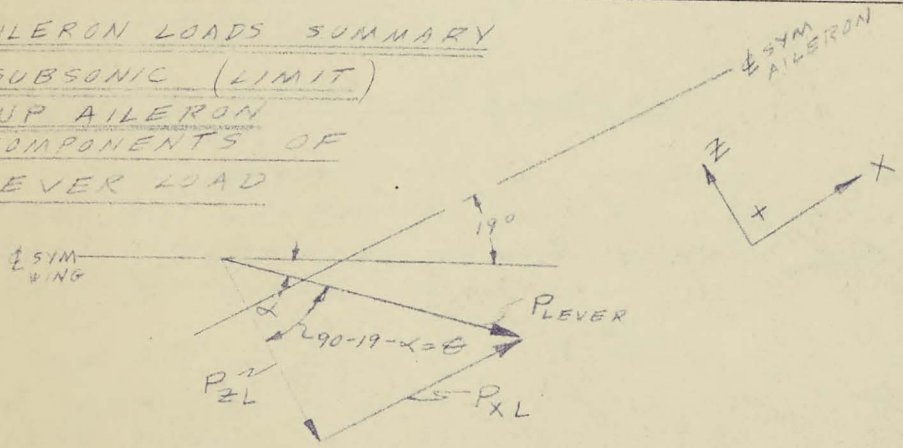
FORM 1746

A. V. ROE CANADA LIMITED
MALTON - ONTARIO
TECHNICAL DEPARTMENT (Aircraft)

REPORT No. 7-0579-1
SHEET No. 74

AIRCRAFT:		PREPARED BY	DATE
C 105	AILERON	R. GAVALIS	JUNE 22/59
		CHECKED BY	DATE

AILERON LOADS SUMMARY
SUBSONIC (LIMIT)
UP AILERON
COMPONENTS OF
LEVER LOAD



P_{XL} = COMPONENT OF P_{LEVER} ALONG ℄ SYM. OF AILERON
= P_{LEVER} (SIN 90-19-α)

P_{ZL} = COMPONENT OF P_{LEVER} ⊥ ℄ SYM. OF AILERON
= $-P_{LEVER}$ (COS 90-19-α)

RIB REF. →	P_{LEVER} Pg. 67	α DWG. 7-0115-001	θ 90°-19°-α	SIN θ	-COS θ	P_{XL}	P_{ZL}
1	15,560	3°56'	67°05'	.921	-.389	14320	-6060
2	26,610	6°10'	64°50'	.903	-.430	24000	-11460
3	33,140	8°45'	62°15'	.885	-.465	29300	-15400
4	26,270	9°35'	61°25'	.876	-.477	23000	-12540
5	20,110	10°55'	60°05'	.867	-.498	17410	-10,000
6	12,200	11°40'	59°20'	.859	-.510	10490	-6210
7	13,130	11°55'	59°05'	.858	-.514	11300	-6750

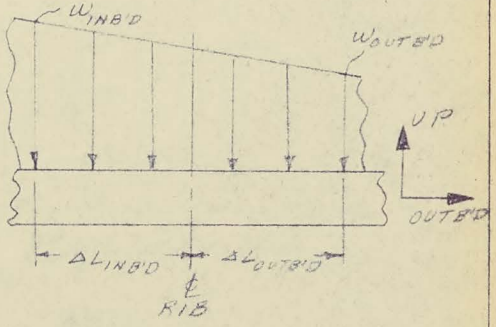
FORM 1319A

RIB LOADING (LIMIT)

SUBSONIC CASE - UP AILERON

THE LOADS ON A TYPICAL RIB ARE AS GIVEN BELOW & CONSIST OF LOCAL AIRLOADING, SKIN SHEARS, LEVER LOADS & HINGE REACTIONS.

THE RIB IS ASSUMED TO CARRY LOCAL AIR-LOADS ACTING OVER AN INCREMENT OF SPAN ΔL THEN,



$$P_{AIR} = \left(\frac{W_{INB'D} + W_{OUTB'D}}{2}\right) \Delta L$$

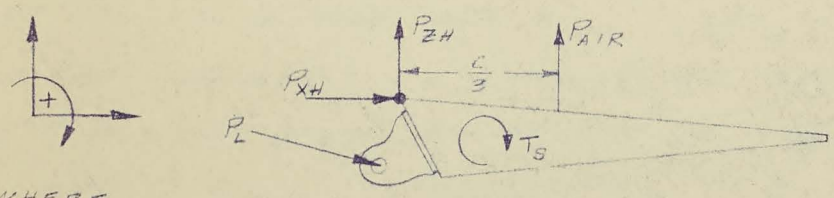
WHERE

P_{AIR} = LOCAL AIRLOAD ON RIB. (LBS.)

W = RUNNING LOAD (LBS/IN.)

$\Delta L = \Delta L_{INB'D} + \Delta L_{OUTB'D}$ = INCREMENT OF SPAN (IN.)

THEN FOR THE RIB THE LOADING IS,



WHERE,

$P_{XH} = -P_{XL}$

$P_{ZH} = -P_{AIR} - P_{ZL}$

P_L = LEVER LOAD

P_{XH} & P_{ZH} = COMPONENTS OF HINGE REACTIONS

T_S = SKIN TORQUE = $T_{OUTB'D} - T_{INB'D}$

ALSO

T_A = AIRLOAD TORQUE = $P_{AIR}\left(\frac{C}{3}\right)$

A. V. ROE CANADA LIMITED
MALTON - ONTARIO
TECHNICAL DEPARTMENT (Aircraft)

REPORT No. 7-0574-1
SHEET No. 76

AIRCRAFT:		PREPARED BY	DATE
C 105	AILERON	R. GAVALIS	JULY 15/54
		CHECKED BY	DATE

RIB LOADING (LIMIT)

SUBSONIC CASE - UP AILERON

OR

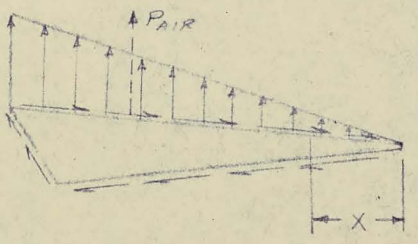
$T_A = T_{AIRLOAD\ OUTBD} - T_{AIRLOAD\ INBD}$ (REF. P3 [illegible])

M_{LE} = LEADING EDGE MOMENT (REF. P3 71 & 72)

THEN

$$T_S = -M_{LE} - T_A \quad , \quad q_S = \frac{T_S}{2A}$$

FOR THE PURPOSE OF OBTAINING THE VERTICAL SHEAR DISTRIBUTION ALONG THE RIB THE CONCENTRATED P_{AIR} MAY BE DISTRIBUTED AS SHOWN.



THE SHEAR AT ANY POINT ALONG THE RIB IS,

$$V = P_{AIR}\left(\frac{X}{C}\right)^2 - q\,h_x$$

h_x = HEIGHT OF RIB AT X

$$h_x = b\left(1-\frac{X}{C}\right) + d\left(\frac{X}{C}\right)$$, d = HEIGHT AT LEADING EDGE

$(h_x \rightarrow d\left(\frac{X}{C}\right)$ AS $b \rightarrow 0)$ b = HEIGHT AT TRAILING EDGE

C = CHORD

$$V_x = P_{AIR}\left(\frac{X}{C}\right)^2 - q\left[b\left(1-\frac{X}{C}\right) + d\left(\frac{X}{C}\right)\right]$$

THE MOMENT AT ANY RIB STATION WILL BE

$$M_x = -T_A\left(\frac{X}{C}\right)^3 - T_S\left(\frac{X}{C}\right)^2$$

(POSITIVE M_x GIVES COMPRESSION IN UPPER FIBER)

FORM 1319A

A. V. ROE CANADA LIMITED
MALTON - ONTARIO
TECHNICAL DEPARTMENT (Aircraft)

REPORT No. J-0579-1
SHEET No. 77

AIRCRAFT:		PREPARED BY	DATE
C105	AILERON	R. GAVALIS	JULY 15/59
		CHECKED BY	DATE

RIB LOADING (LIMIT)

SUBSONIC CASE - UP AILERON

LOADS ON MAIN RIBS:

RIB → / REF. ↓	1 ΔL_{INSID}	2 ΔL_{OUTSID}	3 ΔL ① + ②	4 W_{INSID} P_3	5 W_{OUTSID} P_3	P_{AIR} $\frac{④+⑤}{2} \times ③$	P_{ZL} P_3	P_{ZH} ⑥ − ⑦
1	9,000	4,173	13,173	-522	-127	-1100	-6050	7150
2	4,173	4,173	8,346	-255	-255	-2150	-11460	13610
3	4,173	4,229	8,397	-241	-234	-2040	-15400	17440
4	4,229	5,221	9,450	-220	-206	-2020	-12540	14560
5	5,221	4,800	10,021	-190	-174	-1830	-10,000	11830
6	4,800	4,345	9,145	-160	-146	-1410	-8210	9620
7	4,345	4,537	8,934	-132	-125	-1200	-6750	7950

RIB → / REF. ↓	1 P_{XH} $-\frac{P_{XH}}{P_3}$	2 M_{LE} P_3	11 $T_{AOUTSID}$ P_3	12 T_{AINSID} P_3	13 T_A ⑪ − ⑫	14 T_S ⑩ − ⑬	15 $2A$ P_3	16 ⑭/⑮
1	-14320	-34220	1,300	800	10500	23720	181.3	131
2	-24000	-59550	63,000	24,000	39,000	19550	249.6	79
3	-33300	-77990	132,000	101,000	31,000	41490	200.1	207
4	-23000	-57640	191,000	162,000	29,000	25640	157.0	164
5	-17710	-39020	240,000	218,000	22,000	17020	111.4	153
6	-10490	-21990	272,000	252,000	19,000	7950	76.2	104
7	-11500	-21490	291,000	282,000	9000	12490	47.4	253

FORM 1319A

A. V. ROE CANADA LIMITED
MALTON · ONTARIO
TECHNICAL DEPARTMENT (Aircraft)

REPORT No. 7-0579-1
SHEET No. 78

AIRCRAFT:		PREPARED BY	DATE
C105	AILERON	R. CAVALIS	JULY 15/59
		CHECKED BY	DATE

RIB LOADING (LIMIT)

SUBSONIC CASE - UP AILERON

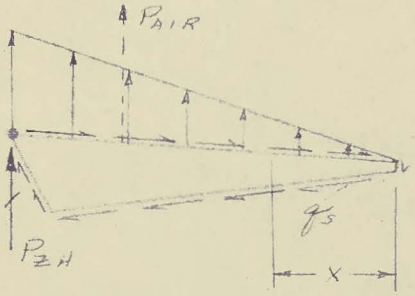
INTERMEDIATE RIBS

THE INTERMEDIATE RIBS ARE LOADED BY LOCAL AIRLOAD ONLY.

P_{AIR} = LOCAL AIRLOAD

P_{ZH} = HINGE REACTION TO P_{AIR}

q_s = SKIN SHEAR FLOW



THE MOMENT ALONG THE RIB DUE TO THE AIRLOAD IS,

$$M_{X_{AIR}} = M_{LE}\left(\frac{X}{C}\right)^3 = \frac{C P_{AIR}}{3}\left(\frac{X}{C}\right)^3$$ & DUE TO SHEAR FLOW

$$M_{X_{q_s}} = T\left(\frac{X}{C}\right)^2 = \frac{C P_{AIR}}{3}\left(\frac{X}{C}\right)^2$$ THEN,

$$M_X = \frac{C P_{AIR}}{3}\left[\left(\frac{X}{C}\right)^3 - \left(\frac{X}{C}\right)^2\right]$$

LIKEWISE THE SHEAR AT ANY RIB STATION IS

$$V_X = P_{AIR}\left(\frac{X}{C}\right)^2 - \frac{P_{AIR}C}{6A}\left[b(1-\frac{X}{C}) + d\left(\frac{X}{C}\right)\right]$$ (REF. R_y 76,1)

$$V_X = P_{AIR}\left[\left(\frac{X}{C}\right)^2 - \frac{1}{3(b+d)}\left\{b - (b-d)\left(\frac{X}{C}\right)\right\}\right]$$

P_{AIR}, P_{ZH} & q_s ARE TABULATED

ON THE NEXT PAGE.

FORM 1319A

A. V. ROE CANADA LIMITED
MALTON - ONTARIO
TECHNICAL DEPARTMENT (Aircraft)

REPORT No. 7-0579-1
SHEET No. 79

AIRCRAFT:		PREPARED BY	DATE
C105	AILERON	R. GAVALIS	JULY 15/54
		CHECKED BY	DATE

RIB LOADING (LIMIT)
SUBSONIC CASE - UP AILERON

LOADS ON INTERMEDIATE RIBS:

	1	2	3	4	5	6	7	8
RIB →	ΔL	W_{INRD}	W_{OUTRD}	$P_{AIR} = \frac{(2)+(3)}{2} \times (1)$	$\frac{1}{X}$	T_S	Q_S	$M_{X_{MAX}}$
REF. ←		P_3 ♯	P_3 ♯	$-P_{2H}$	$C/3$ P_{2H}^2	④ × ⑤	⑥/2 A^Φ	-.0473 × ④ × C
1A	9.37	-129	-225	-1980	14.0	-20,700	- 89	+ 3040
2A	9.37	-265	-247	-2110	17.0	-35520	-161	5300
3A	9.56	-234	-220	-1940	15.1	-29300	-165	4320
4A	10.44	-206	-190	-2020	13.0	-26,200	-195	3860
5A	9.60	-174	-160	-1600	18.6	-16,980	-193	2510
6A	8.90	-145	-132	-1240	8.5	-10,520	-170	1560
7A				-1750*	6.4	-11,200	-301	16550

* READJUSTED TO FIT CURVE ON P3

* $P_{AIR_{7A}} = \frac{-127(9.79) + -127(8.90)}{2} = -1750\#$ (REF. P3

♦ REF. P3 SYS FOR A, $A_{RIBTA} = 19.1\left(\frac{(15.52)}{2}\right) - \frac{.902(1.5)}{2} = 12.6\ FT^2$

⊖ POSITIVE VALUES INDICATES COMPRESSION IN UPPER FLGR

ORM 1319A

A. V. ROE CANADA LIMITED
MALTON - ONTARIO
TECHNICAL DEPARTMENT (Aircraft)

REPORT No. 7-0529-1
SHEET No. 80

AIRCRAFT:		PREPARED BY	DATE
C105	AILERON	R. GAVALIS	JULY 16/54
		CHECKED BY	DATE

AILERON LOADS SUMMARY - SUBSONIC (LIMIT)

DOWN AILERON

THE AIRLOADS & LEVER LOADS FOR "DOWN" AILERON WILL BE OF THE SAME MAGNITUDE AS THE "UP" AILERON LOADS BUT OPPOSITE IN SIGN.

FINAL TORQUE DISTRIBUTION

THE TORQUE CALCULATIONS ON P_{93}, [illegible] APPLY EXCEPT THAT ALL SIGNS WILL BE REVERSED.

RIB LOADING (LIMIT) - MAIN RIBS

	1	2	3	4	5	6
RIB ↓	P_{AIR}	P_{2L}	P_{2H}	P_{XH}	q_s	
REF. →	- col. 6, P_3. 11	P_3. 91	- ① - ②	$-P_{XL}$, P_3. 91	- col. 16, P_3. 11	
1	1100	-4150	3050	14980	-131	
2	2150	-6450	4300	25810	-179	
3	2040	-7080	5020	32400	-207	
4	2020	-5240	3220	25900	-164	
5	1830	-3640	1810	19790	-153	
6	1410	-2040	630	12020	-104	
7	1200	-2050	860	13810	-253	

THE MOMENT & SHEAR ALONG THE RIB IS OF THE SAME MAGNITUDE AS FOR THE "UP AILERON" CASE EXCEPT FOR A CHANGE IN THE DIRECTIONS: I.E.

$$(M_x)_{\substack{\text{DOWN}\\\text{AILERON}}} = -(M_x)_{\substack{\text{UP}\\\text{AILERON}}}$$

$$(V_x)_{\substack{\text{DOWN}\\\text{AILERON}}} = -(V_x)_{\substack{\text{UP}\\\text{AILERON}}}$$

FORM 1319A

A. V. ROE CANADA LIMITED
MALTON - ONTARIO
TECHNICAL DEPARTMENT (Aircraft)

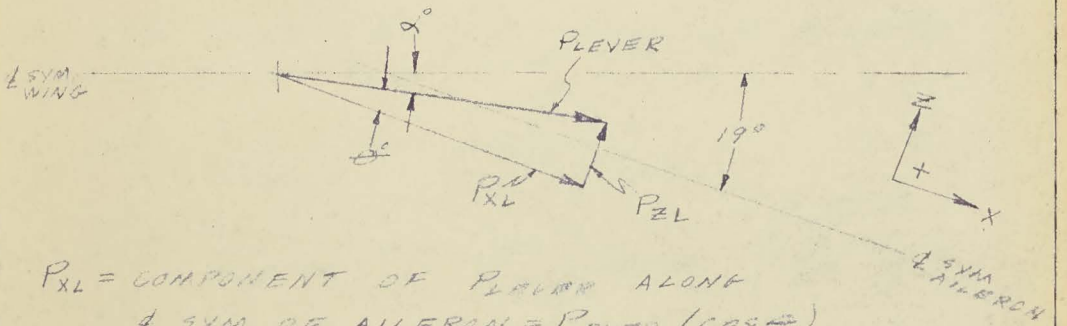
REPORT NO. 7-0579-1
SHEET NO. 81

AIRCRAFT:		PREPARED BY	DATE
C105	AILERON	R. GAVALIS	JULY 16/54
		CHECKED BY	DATE

AILERON LOADS SUMMARY-SUBSONIC (LIMIT)

DOWN AILERON

COMPONENTS OF LEVER LOADS



P_{XL} = COMPONENT OF P_{LEVER} ALONG ℄ SYM. OF AILERON = P_{LEVER} $(\cos\theta)$

P_{ZL} = COMPONENT OF P_{LEVER} PERPENDICULAR TO ℄ SYM. OF AILERON = P_{LEVER} $(\sin\theta)$

$\theta^\circ = 19^\circ - \alpha^\circ$

RIB REF →	α DWG. 7-0115-0017	θ 19°−α	P_{LEVER} Fig. 17	SINθ	COSθ	P_{ZL}	P_{XL}
1	4.4	15.5	-15560	.267	.964	-4150	-14980
2	5.0	14.0	-26610	.242	.970	-6450	-25810
3	6.7	12.3	-33140	.213	.977	-7060	-32400
4	7.5	11.5	-26270	.199	.980	-5240	-25800
5	8.6	10.4	-20110	.181	.984	-3640	-19790
6	9.4	9.6	-12200	.167	.986	-2040	-12020
7	10.0	9.0	-13180	.156	.988	-2060	-13010

FORM 1198A

A. V ROE CANADA LIMITED
MALTON - ONTARIO
TECHNICAL DEPARTMENT (Aircraft)

REPORT NO. 7-0579-1
SHEET NO. 82

AIRCRAFT:		PREPARED BY	DATE
C105	AILERON	R. GAVALIS	JULY 16/54
		CHECKED BY	DATE

RIB LOADING (LIMIT)

SUBSONIC CASE - DOWN AILERON

INTERMEDIATE RIB LOADING (LIMIT)

THE CALCULATIONS FOR "UP AILERON" APPLY EXCEPT THAT,

$$(P_{AIR})_{\substack{DOWN \\ AILERON}} = -(P_{AIR})_{\substack{UP \\ AILERON}}$$

$$(q_s)_{\substack{DOWN \\ AILERON}} = -(q_s)_{\substack{UP \\ AILERON}} \quad \left(\begin{matrix} REF \\ \beta_{SS} \end{matrix}\right)$$

$$(M_{x_{MAX}})_{\substack{DOWN \\ AILERON}} = -(M_{x_{MAX}})_{\substack{UP \\ AILERON}}$$

A. V. ROE CANADA LIMITED
MALTON - ONTARIO
TECHNICAL DEPARTMENT (Aircraft)

REPORT No. 7-0574-1
SHEET No. 83

AIRCRAFT:		PREPARED BY	DATE
C 105	AILERON	R. GAVALIS	JULY 16/54
		CHECKED BY	DATE

AILERON LOADS SUMMARY - SUPERSONIC CASE

UP AILERON - LIMIT

FINAL TORQUE DISTRIBUTION
(POSITIVE TORQUE IS CLOCKWISE LOOKING INBOARD)

TRIB #7 OUTB'D = 13400 IN #

TRIB #7 INB'D = 13400 − 20380 = −6980 IN #

TRIB #6 OUTB'D = −6980 + 20600 = 13620 IN #

TRIB #6 INB'D = 13620 − 21450 = −7830 IN #

TRIB #5 OUTB'D = −7830 + 33600 = 25770 IN #

TRIB #5 INB'D = 25770 − 38710 = −12940 IN #

TRIB #4 OUTB'D = −12940 + 53200 = 40260 IN #

TRIB #4 INB'D = 40260 − 55310 = −15050 IN #

TRIB #3 OUTB'D = −15050 + 59000 = 43950 IN #

TRIB #3 INB'D = 43950 − 74240 = −30290 IN #

TRIB #2 OUTB'D = −30290 + 71400 = 41110 IN #

TRIB #2 INB'D = 41110 − 61250 = −20140 IN #

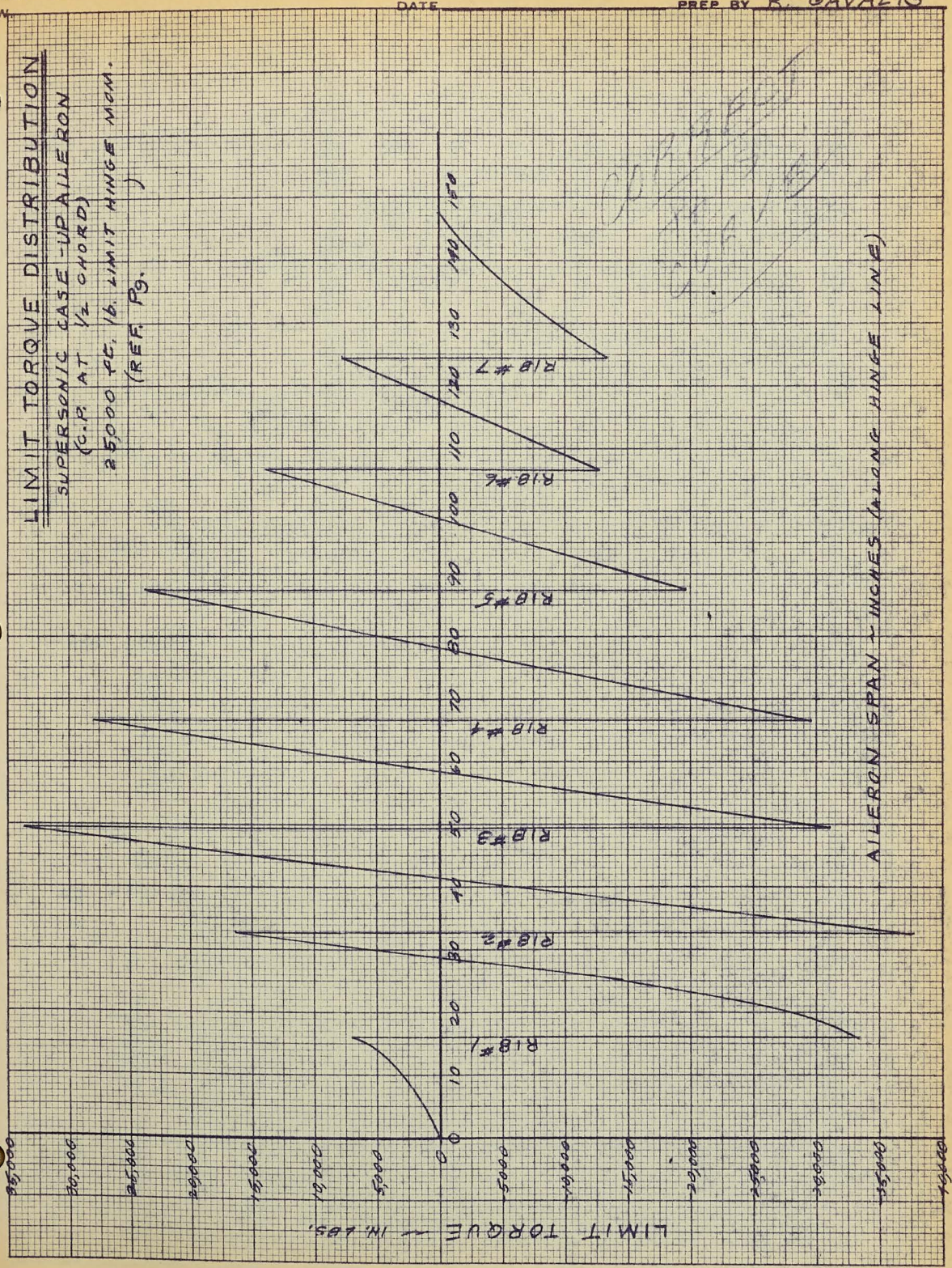
TRIB #1 OUTB'D = −20140 + 47800 = 27660 IN #

TRIB #1 INB'D = 29660 − 36660 = 7000 IN # = T CELL #1 (CHECK)

REF Dyn. Rpt.

FORM 1319A

AIRCRAFT C 105 COMPONENT AILERON SHEET No. 94 REPORT No. I-0577-1
A. U. W. DATE PREP BY R. GAVALIS



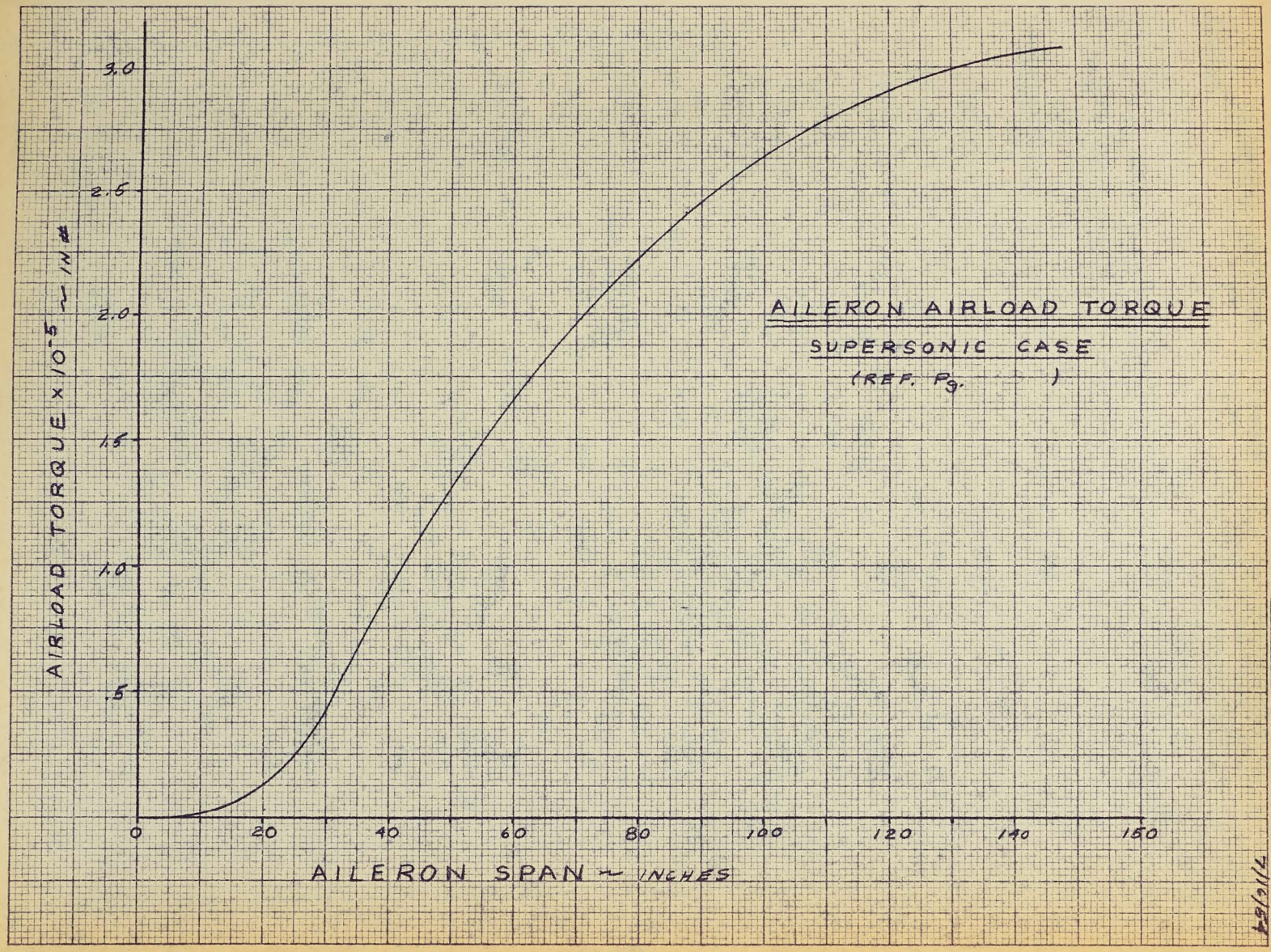
FORM 1746

MADE IN U.S.A.

KEUFFEL & ESSER CO.
10 × 10 to the ½ inch, 5th lines accented.
MADE IN U.S.A.

AIRCRAFT C105 COMPONENT AILERON SHEET NO. 35 REP. NO. NR 52H1

DATE _____ PRE. BY GAVALLS 7/16/54



A. V. ROE CANADA LIMITED
MALTON · ONTARIO
TECHNICAL DEPARTMENT (Aircraft)

REPORT No. 7-0579-1
SHEET No. 86

AIRCRAFT:		PREPARED BY	DATE
C105	AILERON	R. GAVALIS	JULY 16/59
		CHECKED BY	DATE

AILERON LOADS SUMMARY (LIMIT)

SUPERSONIC CASE - UP AILERON

COMPONENTS OF LEVER LOADS

RIB ↓	P_{LEVER}	λ	θ	SIN θ	COS θ	P_{XL}	P_{ZL}
REF. →	P_3	P_3			P_3		
1	16660	3°55'	67°05'	.921	-.389	15320	-6480
2	27830	6°10'	64°50'	.903	-.430	25200	-12000
3	33760	8°45'	62°15'	.885	-.465	29800	-15700
4	26590	9°35'	61°25'	.876	-.477	23200	-12680
5	19760	10°55'	60°05'	.867	-.498	17300	-9950
6	11910	11°40'	59°20'	.859	-.510	11220	-6080
7	12500	11°55'	59°05'	.858	-.514	10700	-6420

THE GEOMETRY FOR THE SUBSONIC UP-AILERON CASE APPLIES (SEE Pg. ~~7~~).

RIB LOADING (LIMIT)

THE METHOD FOR OBTAINING THE RIB LOADING IS GIVEN ON Pg. ~~7~~ 5. THE CALCULATIONS ARE SHOWN ON THE NEXT PAGE.

THE VERTICAL SHEAR AT ANY STATION:

$$V_x = P_{AIR}\left(\frac{X}{C}\right) - \frac{g}{g} h_x$$

AND THE MOMENT IS,

$$M_x = M_{LE}\left(\frac{X}{C}\right)^2$$

FORM 1319A

A. V. ROE CANADA LIMITED
MALTON - ONTARIO
TECHNICAL DEPARTMENT (Aircraft)

REPORT No. Z-0579-1
SHEET No. 87

AIRCRAFT:		PREPARED BY	DATE
C105	AILERON	R. GAVALIS	JULY 16/59
		CHECKED BY	DATE

RIB LOADING (LIMIT)

SUPERSONIC CASE - UP AILERON

LOADS ON MAIN RIBS:

RIB →	1	2	3	4	5	6	7	8
REF. →	ΔL_{INBD}	ΔL_{OUTBD}	ΔL	WINGID	W_{OUTBD}	P_{AIR} $\frac{⑦+⑥}{2}\times③$	P_{ZL}	P_{ZH} ⑥ − ①
	P_B →		P_B	P_B	P_B	#	P_B 8.96	
1	8.00	4.19	12.19	-556	-110	-1009	-6490	7490
2	4.19	4.19	8.38	-170	-175	-1470	-12000	13470
3	4.19	4.28	8.47	-164	-156	-1350	-15100	16450
4	4.28	5.22	9.50	-146	-136	-1370	-12680	14120
5	5.22	4.80	10.02	-125	-114	-1200	-7760	11160
6	4.80	4.445	9.225	-104	-94	-915	-6090	6995
7	4.445	4.889	9.334	-94	-63	-686	-6420	7110
	9	10	11	12	13	14 #	15	16 KIPS
RIB →	P_{XH} #	N_{LE} IN.#	T_{AOUTBD}	T_{AINBD}	T_A IN.#	T_S	2A	P_S ⑭ / ⑮
REF. →	$-P_{X2}$ P_B	P_B	P_B	P_B	⑪ − ⑫	− ⑩ − ⑬	P_B	
1	-15320	-36680	9008	7.0	9000	27660	184.3	153
2	-26700	-61360	25010	33,000	37000	22250	248.6	90
3	-27800	-79240	146,000	112,000	32000	42240	200.1	211
4	-23200	-55310	201,006	173,000	29000	27310	157.0	174
5	-17300	-39710	249200	228,000	21200	17510	111.4	157
6	-11220	-21450	266800	299,000	18200	8250	76.2	108
7	-10100	-20380	299,000	299,000	8000	12390	49.4	250

DRM 1319A

A. V. ROE CANADA LIMITED
MALTON - ONTARIO
TECHNICAL DEPARTMENT (Aircraft)

REPORT No. 7-0579-1
SHEET No. 88

AIRCRAFT:		PREPARED BY	DATE
C105	AILERON	R. GAVALIS	JULY 16/54
		CHECKED BY	DATE

RIB LOADING (LIMIT)

SUPERSONIC CAMBER-UP AILERON

INTERMEDIATE RIBS

LOADS ON INTERMEDIATE RIBS, #

	1	2	3	4	5	6	7	8
RIB REF.	ΔL P_3 =	W_{1200} P_3	W_{BOOM} P_3	PAIR* $\frac{②+③}{2} \times ①$ P_{3A}	$\overline{X}$ C/2 P_3	$\overline{T_3}$ ④ × ⑤	q_3 ⑥ × 1/2A*	
1A	8,37	-110	-170	-1170	20.8	-24300	-164	
2A	8,37	-175	-169	-1920	28.5	-36200	-163	
3A	8,56	-155	-146	-1290	22.6	-28200	-159	
4A	10,94	-136	-125	-1360	19.4	-26400	-200	
5A	9,60	-114	-104	-1050	15.7	-16700	-180	
6A	8,10	-94	-84	-790	12.3	-10100	-163	
7A				-132 *	9.6	-9150	-241	

* REF. P_3 318 FOR A, $A_{RIB\#7A} = 19.6\ in^2$ (REF. PG 77).

** $PAIR_{RIB\#7A} = \left(\frac{7846.3}{2}\right)(9.78) + \frac{63(8.3)}{2} = 932\ \#$ (REF. PG. 77)

† REF. PG 78 FOR METHOD.

A. V. ROE CANADA LIMITED
MALTON - ONTARIO
TECHNICAL DEPARTMENT (Aircraft)

REPORT No. 2-0529-1
SHEET No. 89

AIRCRAFT:		PREPARED BY	DATE
C 105	AILERON	R. GAVALIS	JULY 16/54
		CHECKED BY	DATE

AILERON LOADS SUMMARY - LIMIT

SUPERSONIC CASE - DOWN AILERON

THE AIRLOADS & LEVER LOADS FOR "DOWN AILERON" WILL BE OF THE SAME MAGNITUDE AS THE "UP AILERON" LOADS BUT OPPOSITE IN SIGN.

FINAL TORQUE DISTRIBUTION

SEE Pgs 83 & 84 & REVERSE ALL SIGNS.

COMPONENTS OF LEVER LOADS

	1	2	3	4	5
RIB REF.	P_{LEVER} Pg. 86	SIN θ Pg. 81	COS θ Pg. 81	P_{ZL} ① × ②	P_{XL} ① × ③
1	-16660	.267	.964	-4450	-16020
2	-27830	.242	.970	-6750	-27000
3	-33760	.213	.977	-7190	-33000
4	-26590	.199	.980	-5290	-26000
5	-19960	.181	.984	-3610	-19620
6	-11710	.167	.986	-1990	-11750
7	-12500	.156	.988	-1950	-12320

RIB LOADING (LIMIT)

THE MOMENT & SHEAR ALONG THE RIB IS OF THE SAME MAGNITUDE AS FOR THE "UP AILERON" CASE BUT THE DIRECTIONS ARE OPPOSITE, i.e.,

$$(M_x)_{\substack{\text{DOWN}\\\text{AILERON}}} = -(M_x)_{\substack{\text{UP}\\\text{AILERON}}}$$

$$(V_x)_{\substack{\text{DOWN}\\\text{AILERON}}} = -(V_x)_{\substack{\text{UP}\\\text{AILERON}}}$$

FORM 1319A

A. V. ROE CANADA LIMITED
MALTON - ONTARIO
TECHNICAL DEPARTMENT (Aircraft)

REPORT NO. 7-0579-1
SHEET NO. 90

AIRCRAFT:		PREPARED BY	DATE
C105	AILERON	R. GAVALIS	JULY 19/59
		CHECKED BY	DATE

AILERON LOADS SUMMARY - LIMIT

SUPERSONIC CASE - DOWN AILERON

	1	2	3	4	5
RIB ↓	P_{AIR}	P_{2L}	P_{2H}	P_{XH}	q_s
REF. →	$-P_{COL}$ [6] Pg. 57	P_{3} Pg. 58	-① - ②	$\bar{P}_{3}^{P_{XL}}$ Pg. 57	$\bar{P}_{COL}$ [16] Pg. 57
1	1004	-4450	+3446	16020	-153
2	1440	-6750	+5310	27000	-90
3	1350	-7190	+5840	33000	-211
4	1340	-5290	+3950	26000	-174
5	1200	-3610	+2410	19620	-157
6	915	-1970	+1075	11780	-108
7	686	-1950	+1264	12320	-250

INTERMEDIATE RIB LOADING

THE CALCULATIONS FOR "UP AILERON" APPLY EXCEPT THAT,

$$(P_{AIR})_{\substack{DOWN \\ AILERON}} = -(P_{AIR})_{\substack{UP \\ AILERON}}$$

$$(q_s)_{\substack{DOWN \\ AILERON}} = -(q_s)_{\substack{UP \\ AILERON}}$$

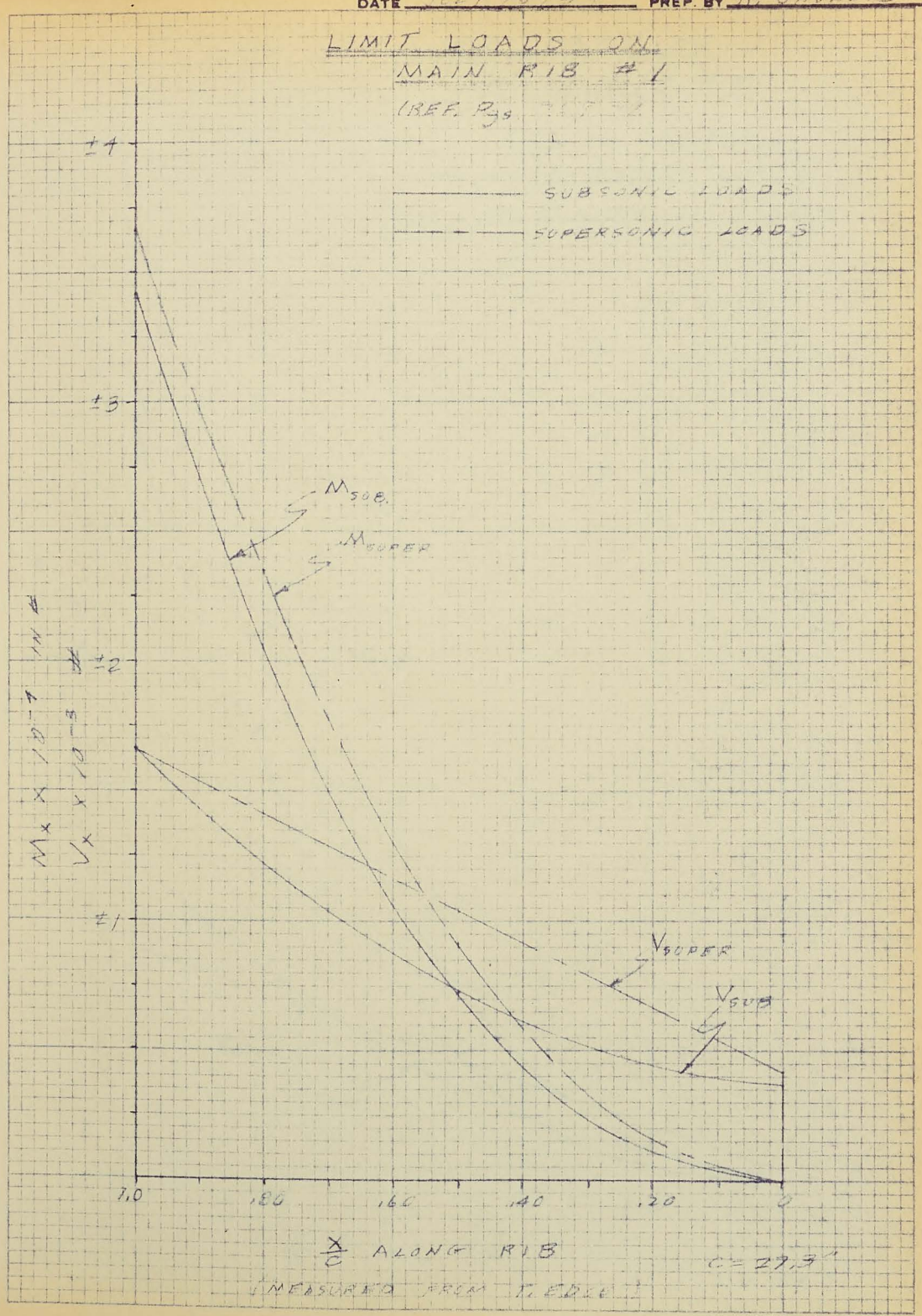
DRM 1319A

AIRCRAFT
A. U. W.

COMPONENT

SHEET No. 90a REPORT No. Z-0579-1

DATE JULY 1949 PREP. BY R. GAVALIS



FORM 1746

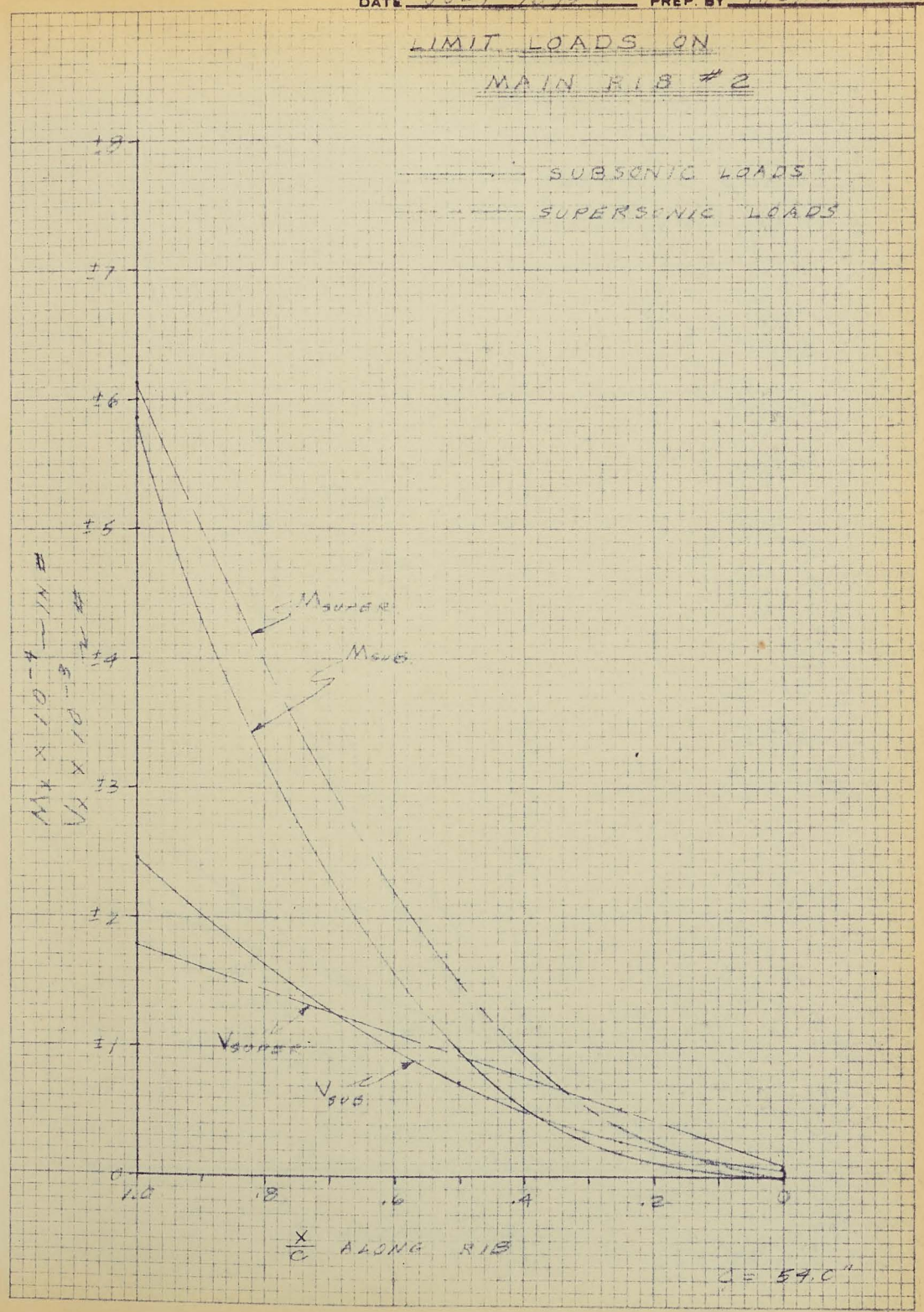
AIRCRAFT
A. U. W.

COMPONENT

SHEET No. 906 REPORT No. Z-0579-1

DATE JULY 18/54 PREP. BY R. GAVALIS

LIMIT LOADS ON MAIN RIB #2



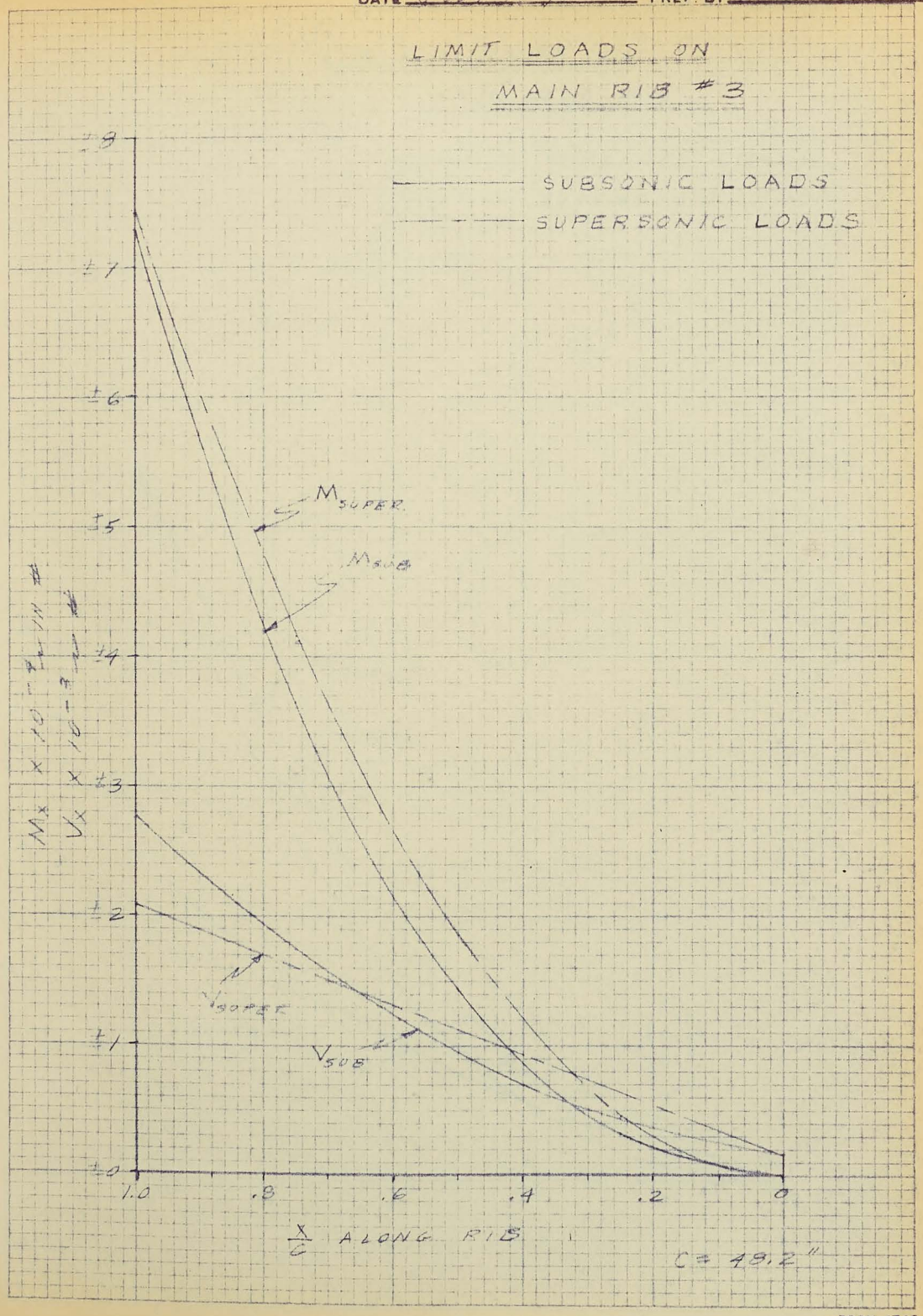
FORM 1746

AIRCRAFT
A. U. W.

COMPONENT

SHEET No. 90 C REPORT No. Z-0523-1

DATE JULY 19/54 PREP. BY R. GAVALIS



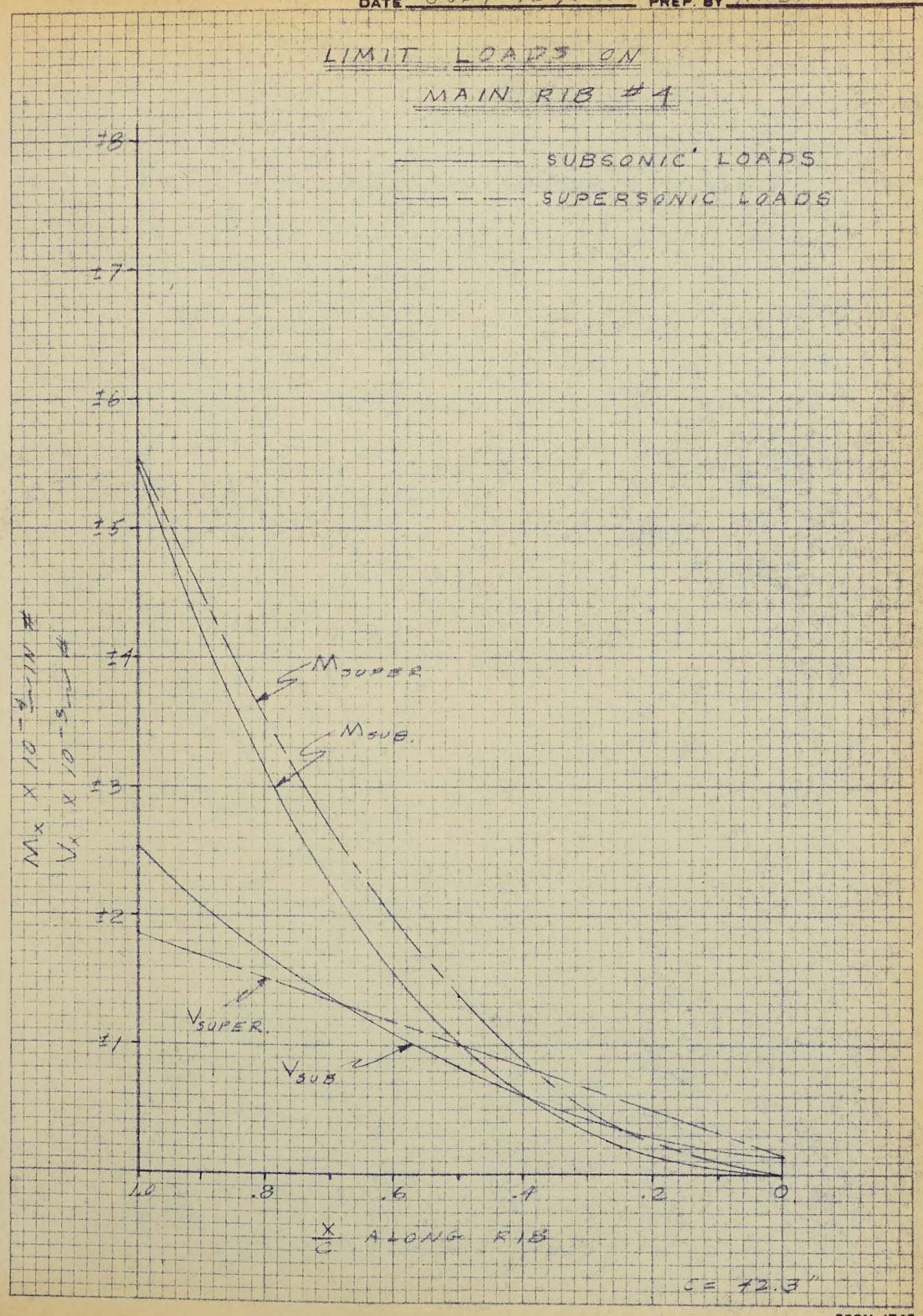
FORM 1746

AIRCRAFT
A. U. W.

COMPONENT

SHEET No. 90d REPORT No. 7-0571-1

DATE JULY 18/54 PREP. BY R. GAVALIS



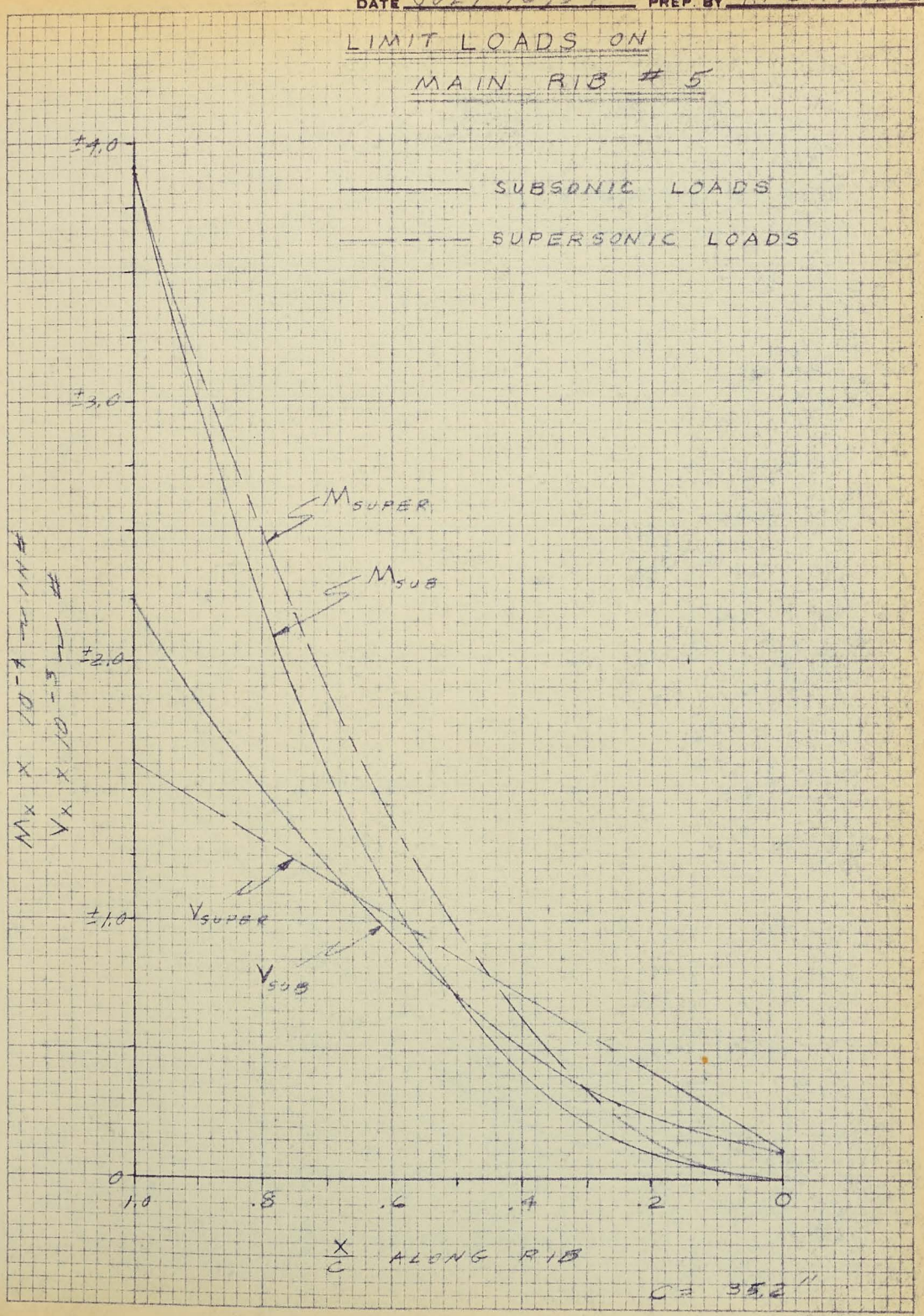
FORM 1746

AIRCRAFT
A. U. W.

COMPONENT

SHEET NO. 90 C REPORT NO. 2-0574-1

DATE JULY 18/54 PREP. BY R. GAVALIS



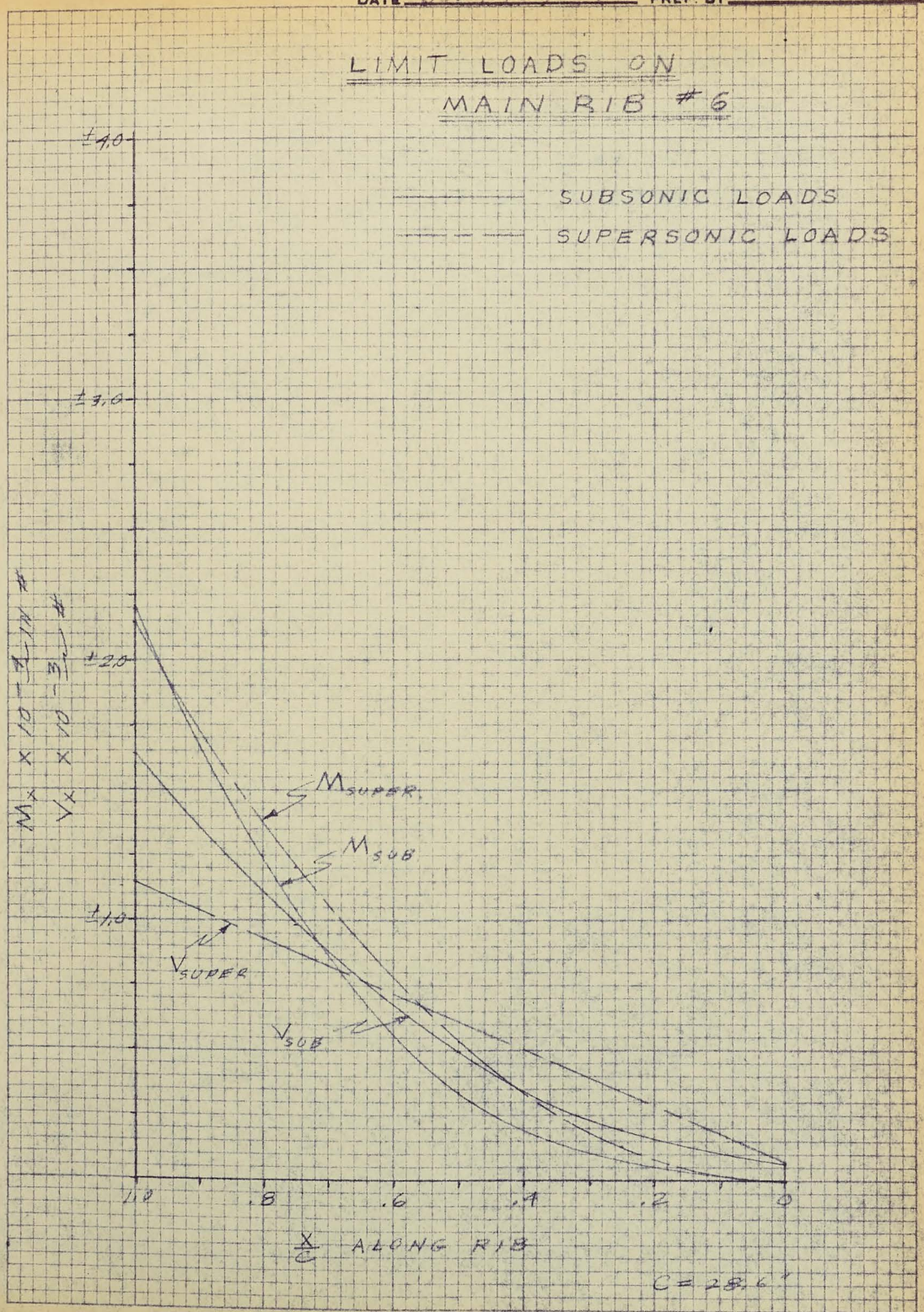
FORM 1746

AIRCRAFT
A. U. W.

COMPONENT

SHEET No. 90 f REPORT No. T-0574-1

DATE JULY 18/51 PREP. BY R. GAVALIS



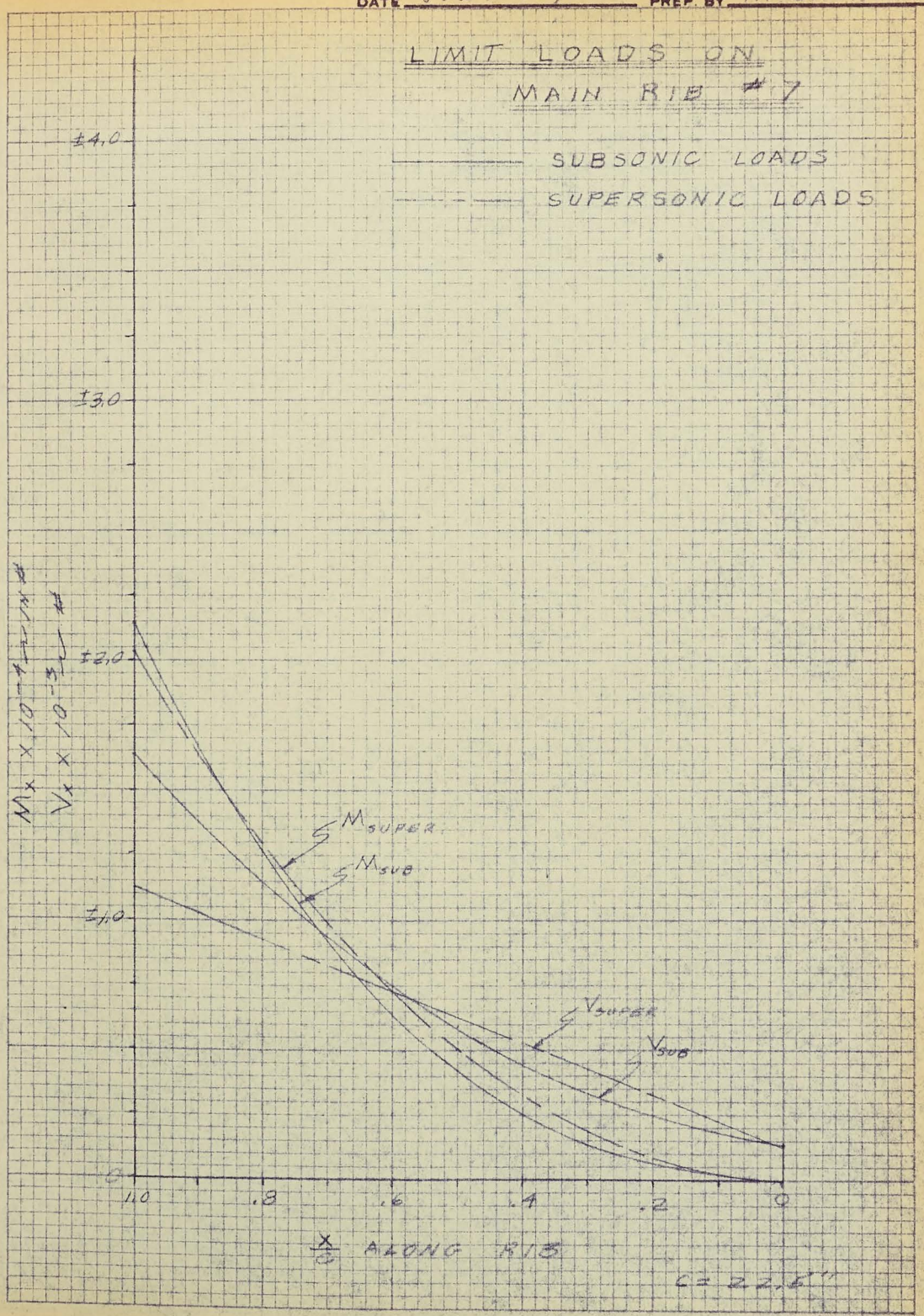
FORM 1746

AIRCRAFT
A. U. W.

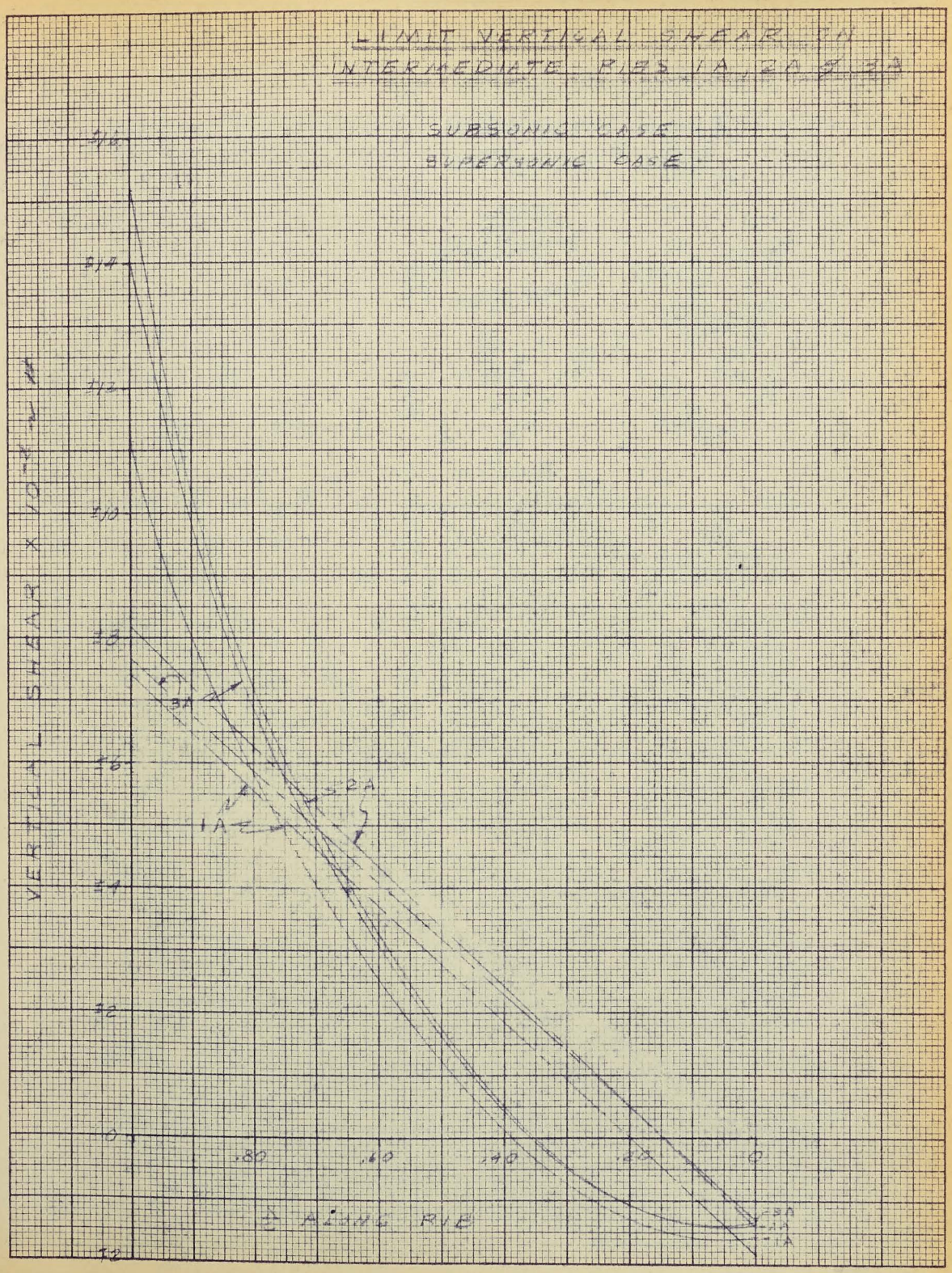
COMPONENT

SHEET No. 909 REPORT No. 7-0574-1

DATE JULY 18/54 PREP. BY R. GAVALIS



FORM 1746



10 X 10 TO THE ½ INCH 359-12
KEUFFEL & ESSER CO. MADE IN U.S.A.

AIRCRAFT
A. U. W.

COMPONENT

SHEET No. 90h REPORT No. 7-0574-1

DATE JULY 19/54 PREP. BY R. GAVALIS

LIMIT VERTICAL SHEAR ON INTERMEDIATE RIBS 1A, 2A & 3A

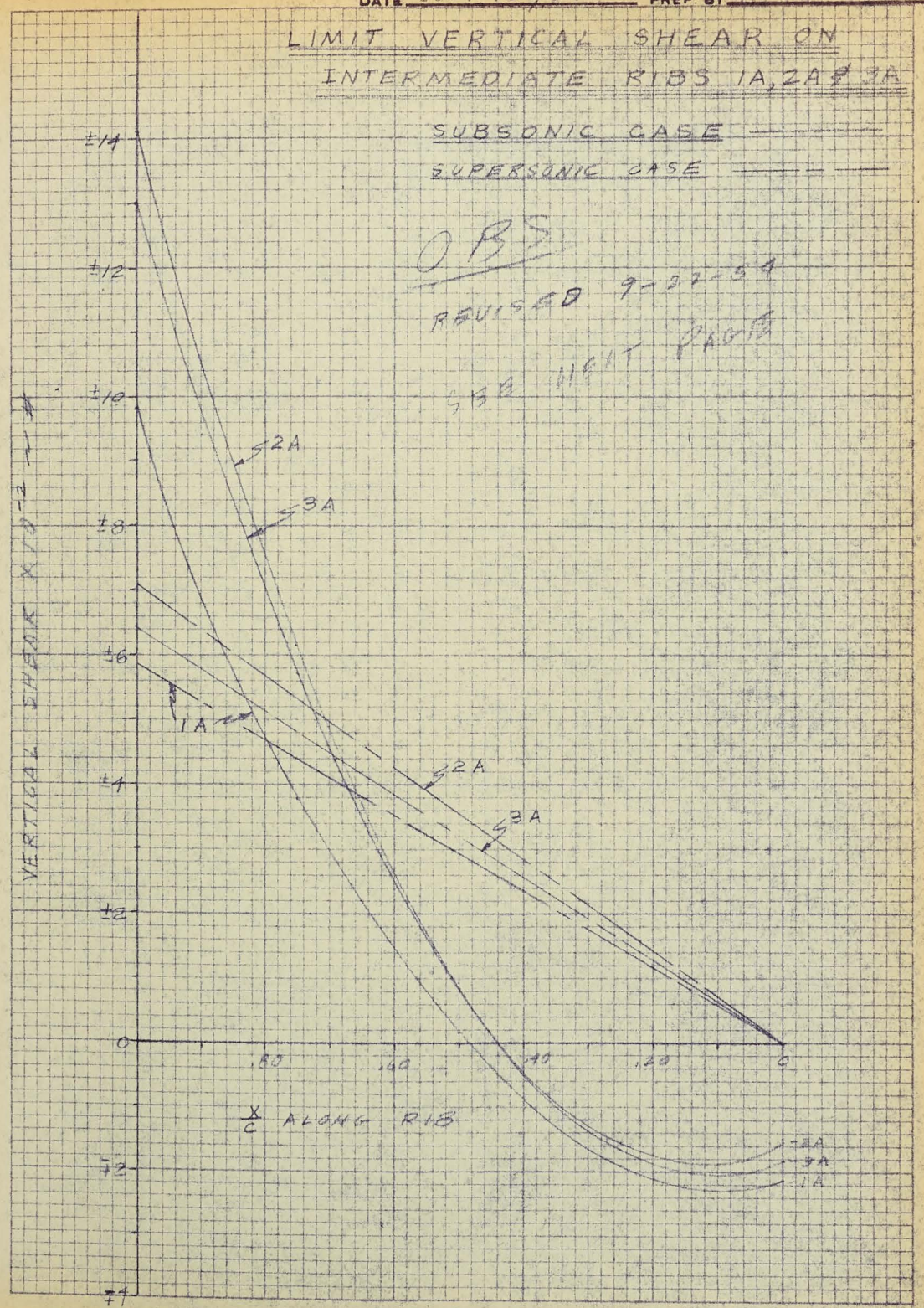
SUBSONIC CASE ———

SUPERSONIC CASE — — —

OBS

REVISED 9-22-54

SEE LIFT PAGES



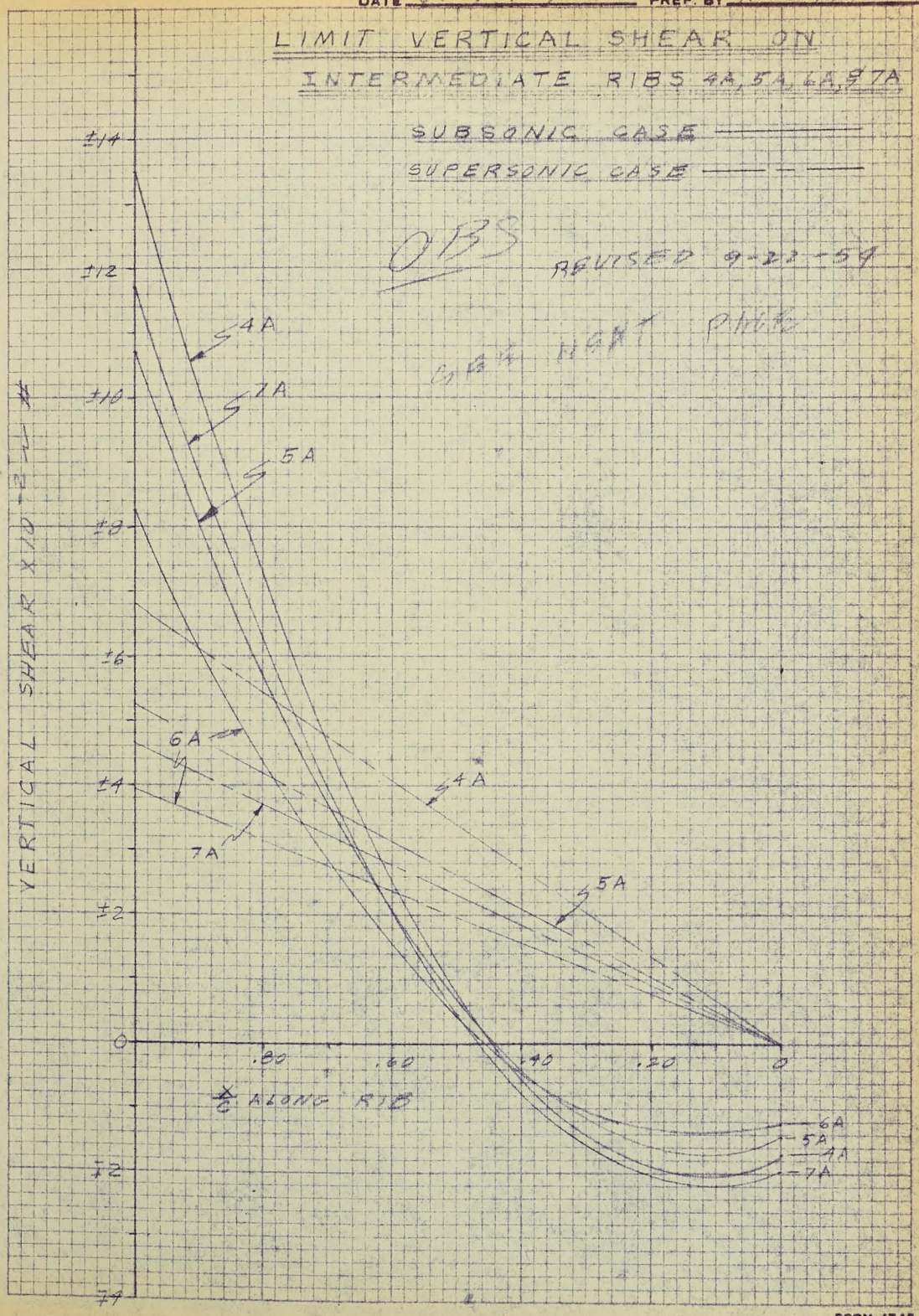
FORM 1746

AIRCRAFT
A. U. W.

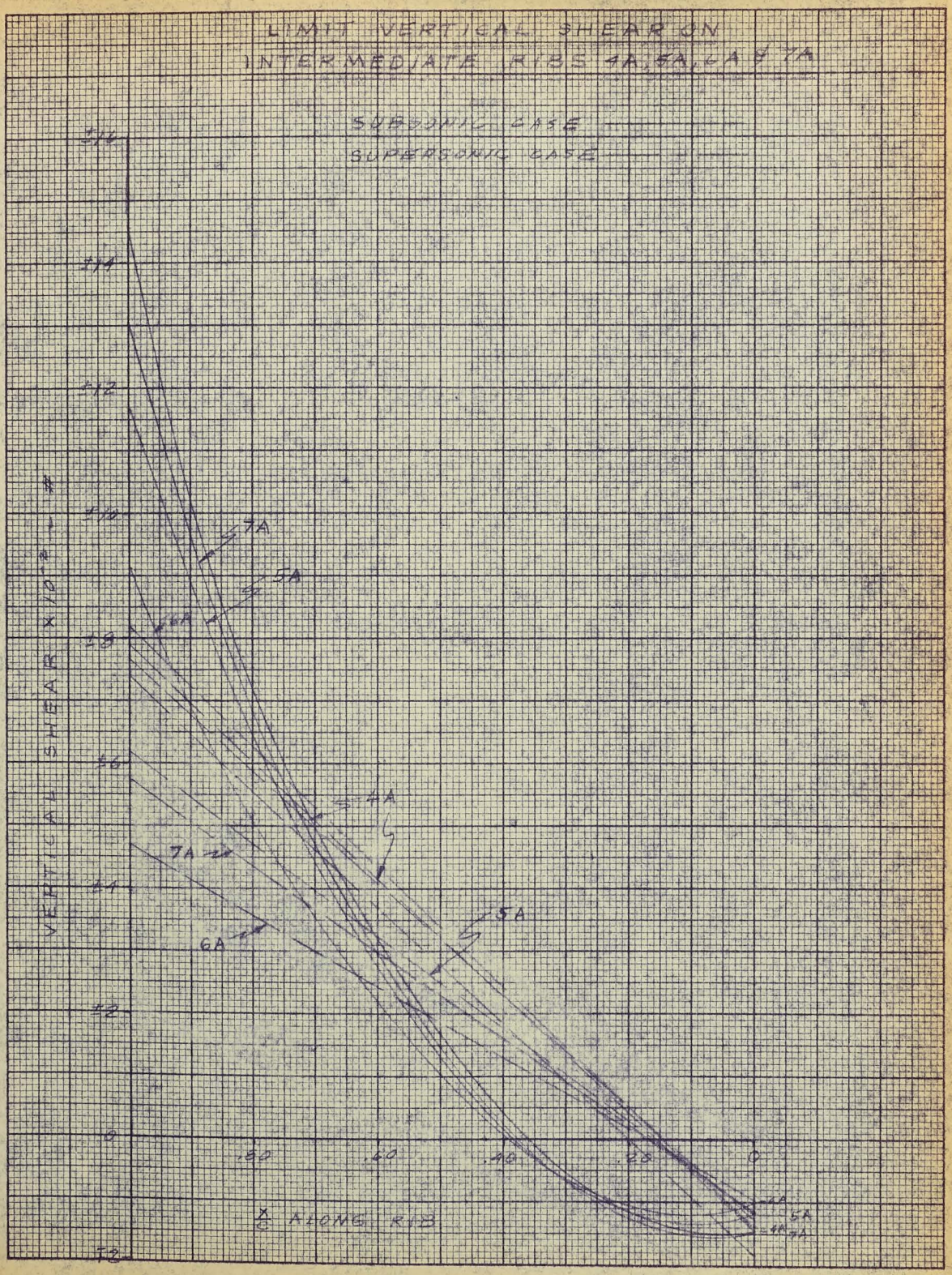
COMPONENT

SHEET No. 90C REPORT No. 7-0524-1

DATE JULY 18/54 PREP. BY R. GAVALIS



FORM 1746



K&E 10 X 10 TO THE ½ INCH 359-12
KEUFFEL & ESSER CO. MADE IN U.S.A.

AIRCRAFT
A.U.W.

COMPONENT

SHEET NO. 90K REPORT NO. Z-0574-1

DATE JULY 18/54 PREP. BY R. GAVALIS

DESIGN RIB MOMENT (LIMIT) FOR INTERMEDIATE RIBS

THE MOMENT AT ANY RIB STATION IS,

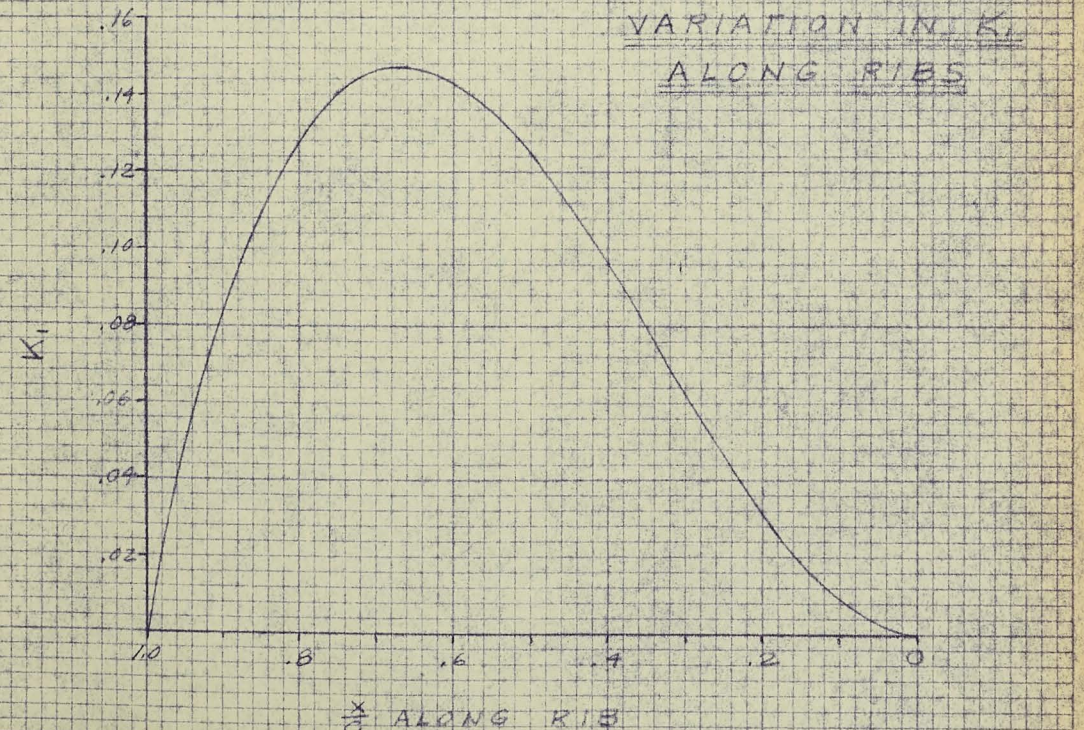
$M_x = \frac{C P_{AIR}}{3} K_1$ WHERE: $K_1 = \left[\left(\frac{x}{c}\right)^3 - \left(\frac{x}{c}\right)^4 \right]$

$M_x = K_2 K_1$ $\qquad K_2 = \frac{C P_{AIR}}{3}$

SUBSONIC CASE

RIB	M_x
1A	± 20,700 K,
2A	± 35,820 K,
3A	± 29,300 K,
4A	± 26,200 K,
5A	± 16,950 K,
6A	± 10,520 K,
7A	± 11,200 K,

VARIATION IN K_1 ALONG RIBS

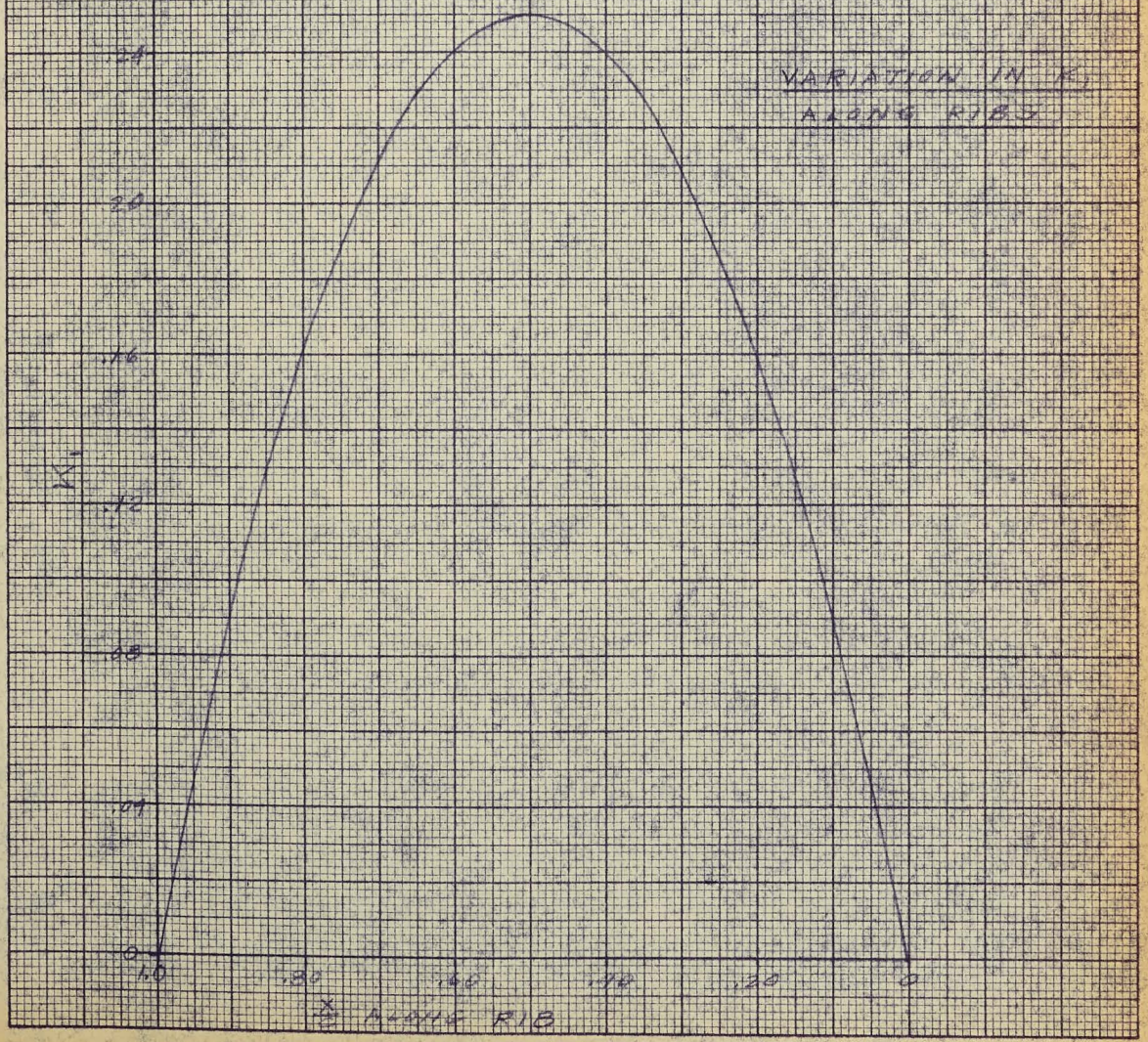


FORM 1746

DESIGN M_x MOMENT LIMITS FOR INTERMEDIATE RIBS

SUPERSONIC CASE

RIB	M_x
1A	± 14600 K,
2A	± 13600 K,
3A	± 11000 K,
4A	± 10200 K,
5A	± 7160 K,
6A	± 4700 K,
7A	± 1450 K,



K+E 10 X 10 TO THE ½ INCH 359-12 KEUFFEL & ESSER CO. MADE IN U.S.A.

A. V. ROE CANADA LIMITED
MALTON · ONTARIO
TECHNICAL DEPARTMENT (Aircraft)

REPORT No. 7-0579-1
SHEET No. 91

AIRCRAFT:		PREPARED BY	DATE
C105	AILERON	R. CAVALIS	JULY 13/54
		CHECKED BY	DATE

AILERON LOADS SUMMARY - LIMIT

SKIN SHEAR FLOWS DUE TO TORSUE
(SHEAR FLOW DUE TO P_{LH} NOT INCLUDED)

	1	2
RIB ↓	$q_{s\,SUB.}$	$q_{s\,SUPER}$
REF. →	P_9	P_3
1	± 131	± 153
1A	± 89	± 104
2	± 79	± 90
2A	± 161	± 163
3	± 207	± 211
3A	± 165	± 159
4	± 164	± 174
4A	± 198	± 200
5	± 153	± 157
5A	± 183	± 190
6	± 104	± 105
6A	± 170	± 163
7	± 253	± 250
7A	± 301	± 241

DESIGN SHEAR FLOWS FOR RIB-TO-SKIN ATTACHMENTS NOT IN REGION OF HINGE.

FORM 1319A

A. V. ROE CANADA LIMITED
MALTON · ONTARIO
TECHNICAL DEPARTMENT (Aircraft)

REPORT No. 7-0574-1
SHEET No. 92

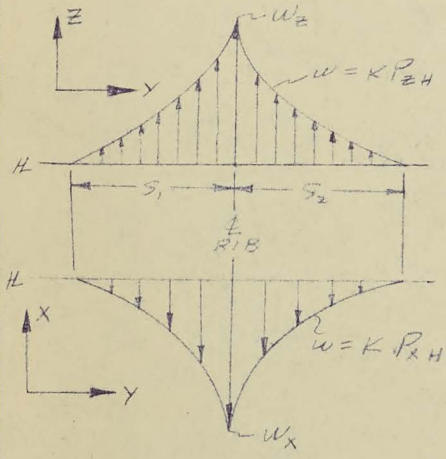
AIRCRAFT:		PREPARED BY	DATE
C105	AILERON	R. GAVALIS	JULY 19/54
		CHECKED BY	DATE

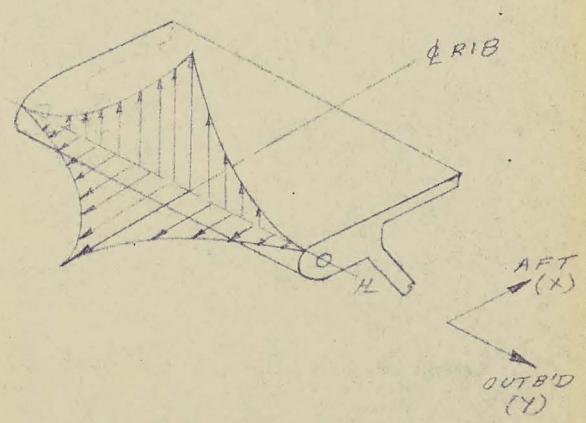
AILERON LOADS SUMMARY

OBJ

HINGE LOADS

ASSUME THAT THE COMPONENTS OF THE HINGE LOADS (P_{XH} & P_{ZH}) ARE DISTRIBUTED AS SHOWN. *





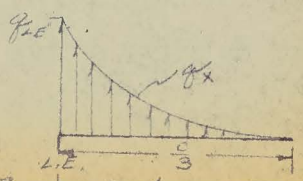
ASSUMING PARABOLIC DISTRIBUTION,

$$W_Z = \frac{3P_{ZH}}{S_1+S_2} \quad \& \quad W_X = \frac{3P_{XH}}{S_1+S_2}$$

P_{ZH} IS TRANSFERRED FROM THE HINGE INTO THE LEADING EDGE SPAR OF THE AILERON. P_{XH} IS TRANSFERRED INTO THE UPPER SKIN & THEN INTO THE RIB. ASSUMING THE SKIN SHEAR TO LAG OUT PARABOLICALLY IN ONE-THIRD OF THE RIB CHORD, THE SHEAR FLOW AT ANY RIB STATION IS:

$$q_{LE} = \frac{3W_X}{c/3} = \frac{3P_{XH}}{c}$$

$$\& \quad q_X = \left[1 - 6\left(\frac{X}{c}\right) + 9\left(\frac{X}{c}\right)^2\right] q_{LE}$$



* BACK-UP STRUCTURE MAY DICTATE OTHERWISE LATER

FORM 1319A

A. V. ROE CANADA LIMITED
MALTON - ONTARIO
TECHNICAL DEPARTMENT (Aircraft)

REPORT No. 7-0574-1
SHEET No 93

AIRCRAFT:		PREPARED BY	DATE
C105	AILERON	R. GAVALIS	JULY
		CHECKED BY	DATE

AILERON LOADS SUMMARY

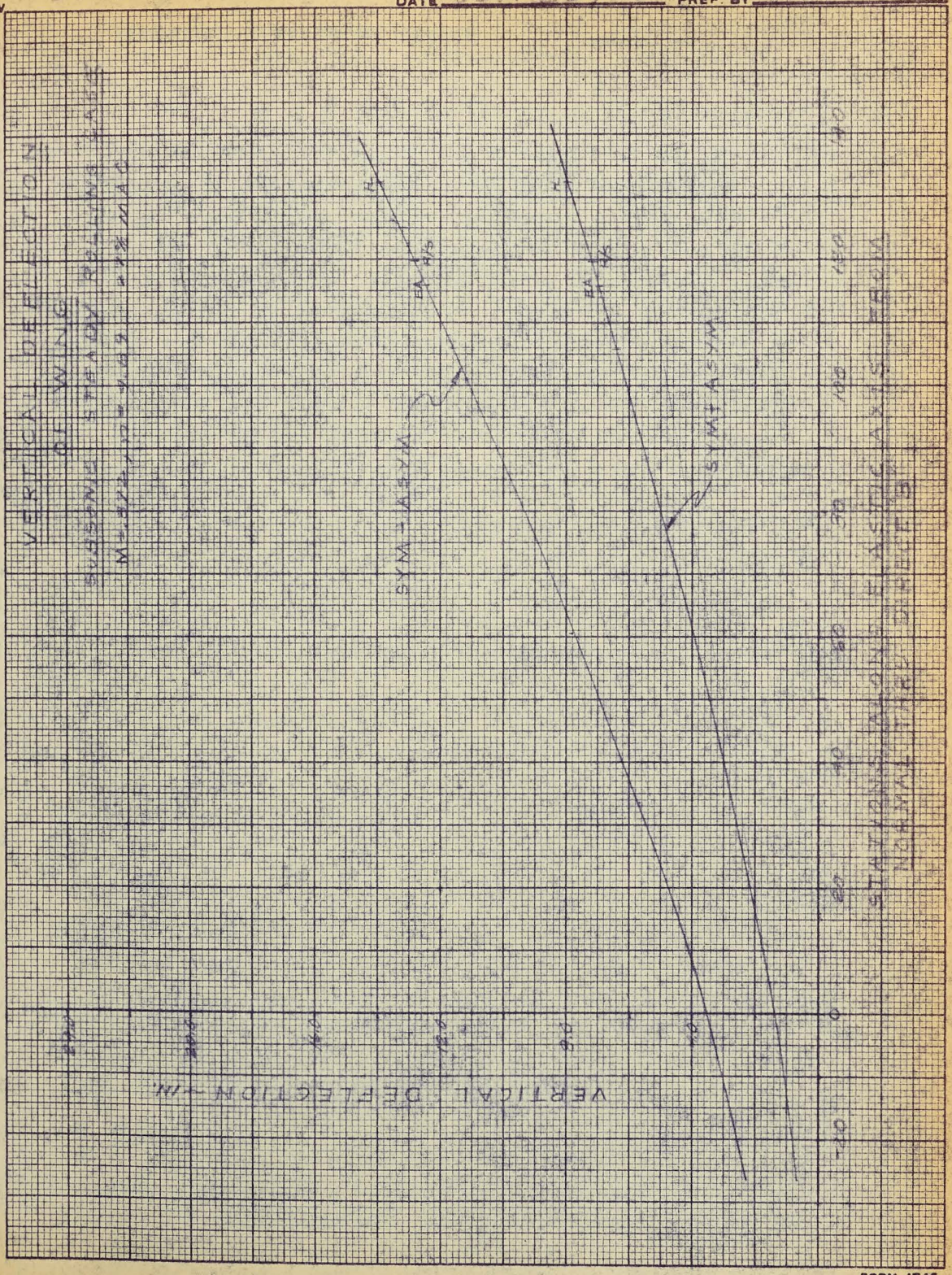
HINGE LOADS (LIMIT) - SUBSONIC CASE - UP AILERON

SKIN SHEAR FLOWS AT SPAR LOADING (W_2):

1	2	3	4	5	6	7	8	9	10	11
RIB	P_{2H} (#)	S_1 (IN.)	S_2 (IN.)	W_X (#/IN.)	W_2 (#/IN.)	P_{2V} (#)	$\frac{P_{2H}}{S_2}$ (#/IN.)	$\frac{P_{2V}}{S_2}$ (#/IN.)	C (IN.)	
REF→	B.77 B.77	#	#	$\frac{3\times②}{③+④}$	$\frac{3\times①}{③+④}$	$\frac{9\times②}{⑫}$	①	$.945\times.1111\times①$	B.T.	
1	7150 -1320	8.00	8.33	-2630	1310	-1730	-	-	27.3	
2	13610 -2900	8.38	8.33	-4500	2440	-	-	-	54.0	
3	17440 -2900	8.39	8.56	-5190	3080	-3480	-	-	68.2	
4	19560 -3000	8.56	10.44	-3630	2300	-	-	-	92.3	
5	11890 -1740	10.44	9.60	-2600	1770	-	-	-	35.2	
6	1620 -1040	9.60	8.70	-1700	1240	-	-	-	25.6	
7	7950 -1500	8.90	7.33	-2090	1470	-	-	-	22.5	
#	S_1 & S_2 ARE ONE-HALF OF THE ACTUAL VALUE									

FORM 1319A

AIRCRAFT C105 COMPONENT AILERON SHEET No. 99 REPORT No. 7-0514-1
A. U. W. DATE OCT. 22/54 PREP. BY S. GAULIN



K&E 10 X 10 TO THE ½ INCH 359-12 KEUFFEL & ESSER CO. MADE IN U.S.A.

FORM 1746

A. V. ROE CANADA LIMITED
MALTON - ONTARIO
TECHNICAL DEPARTMENT (Aircraft)

REPORT No. 7-0579-1
SHEET No. 95

AIRCRAFT:		PREPARED BY	DATE
C105	AILERON	R. GAVALIS	
		CHECKED BY	DATE

DEFLECTION LOADS SUBSONIC CASE
ESTIMATION OF SPAR MOMENT OF INERTIA DOWN AILERON #

AS THE WING DEFLECTS VERTICAL & HORIZONALLY, & TWISTS ABOUT THE Y-AXIS, THE AILERON HINGE LINE WILL VARY FROM A STRAIGHT LINE, THE DEFLECTION OF THE HINGE LINE DUE TO NORMAL BENDING & TORQUE IS GIVEN ON Pg 24. THE LOADS INDUCED IN THE AILERON WILL BE CALCULATED.

A PRELIMINARY VALUE OF THE BENDING STRESS WILL BE OBTAINED FROM THE RELATIONSHIPS;

$$\frac{1}{\rho} = \frac{M}{EI}$$ WHERE: M = BENDING MOMENT IN SPAR
I = MOMENT OF INERTIA OF SPAR
ρ = RADIUS OF CURVATURE OF THE ELASTIC AXIS

$$f_b = \frac{M}{EI}(E)(c) = \frac{Ec}{\rho}$$ c = CENTROIDAL HEIGHT OF L.E. SPAR

THE BENDING STRESSES ALONG THE AILERON SPAR IS SHOWN ON Pg 16
THE BENDING MOMENT WILL BE CARRIED BY THE LEADING EDGE SPAR, ITS SECTION PROPERTIES BEING UNKNOWN, AN ESTIMATE OF THE MOMENT OF INERTIA WAS MADE ON Pg 17.

WORK ON FOLLOWING PAGES WAS DONE TO OBTAIN AN ESTIMATE OF THE SPAR MOMENT OF INERTIA. ACCURACY DEPENDS ON THE MEASUREMENT OF THE RADIUS OF CURVATURE.

FORM 1319A

A. V. ROE CANADA LIMITED
MALTON - ONTARIO
TECHNICAL DEPARTMENT (Aircraft)

REPORT No. J-0579-1
SHEET No. 96

AIRCRAFT:		PREPARED BY	DATE
C105	AILERON	R. GAVALIS	
		CHECKED BY	DATE

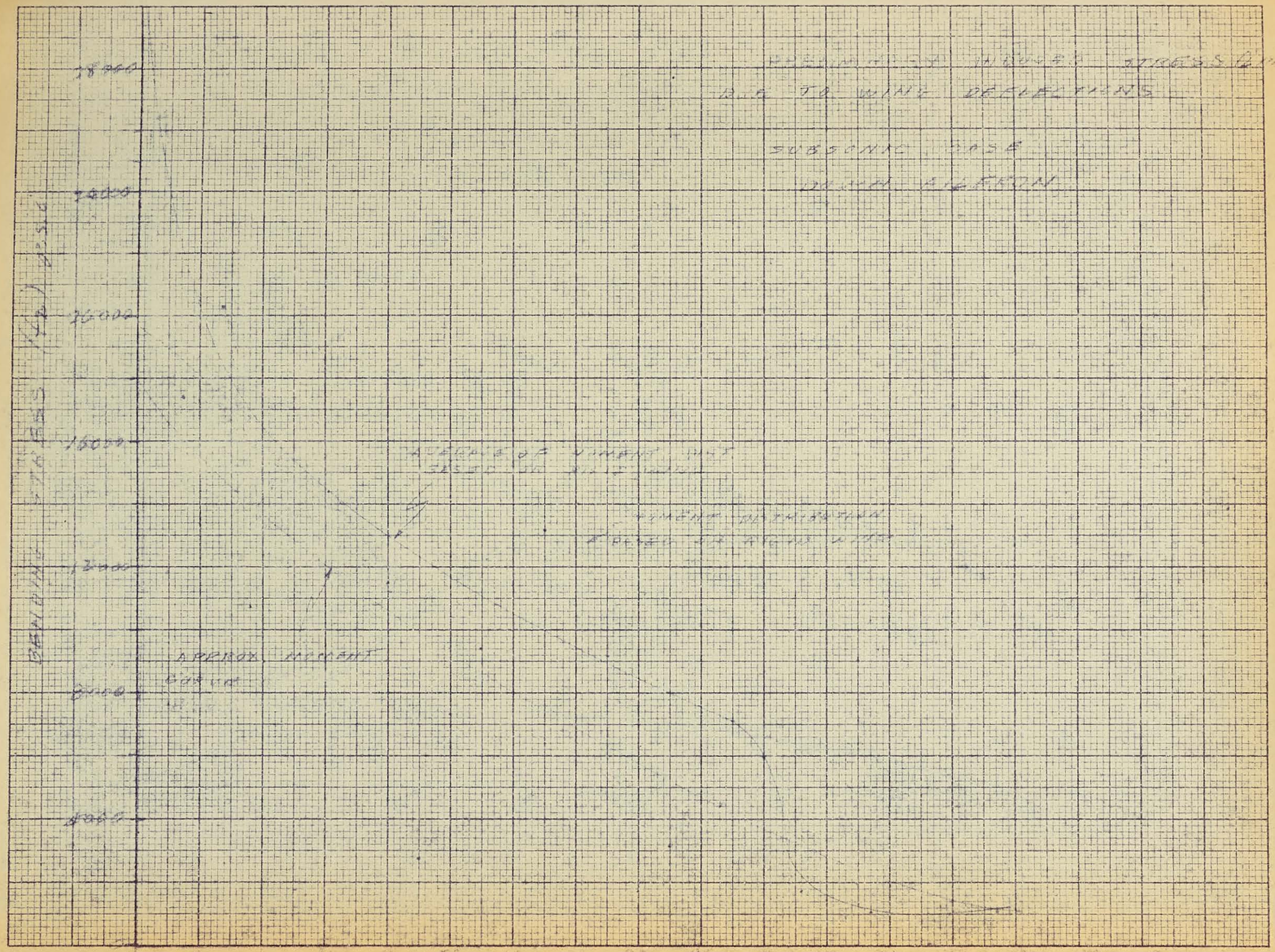
DEFLECTION LOADS (CONT.) SUBSONIC CASE
DOWN AILERON

BENDING STRESS:

	1	2	3	4	5	6	7	8
ELEMENT	$\bar{x}$ IN.	l IN.	h IN.	ℓ^2	δh	λ $\frac{4h^2+\ell^2}{\delta h}$	$\frac{M}{EI} \times 10^6$ 1/©	f_b #/in² $\frac{M}{EI}(E)(c)$
REF. →		Fig	Fig					
1	2.5	7.4	.007	54.6	.072	760	1318	31800
2	7.4	6.6	.004	43.5	.032	1360	735	17380
3	13.5	8.5	.008	72.2	.064	1128	887	20300
4	21.5	10.4	.009	108.1	.072	1502	665	14500
5	30.5	9.6	.008	92.1	.064	1440	695	14400
6	40.0	10.4	.008	108.1	.064	1690	591	11500
7	45.0	10.5	.002	110.1	.016	6870	145	2750
8	54.5	10.1	.009	102.0	.054	1890	530	9400
9	65.0	10.0	.010	100.0	.080	1250	900	13150
10	75.0	10.2	.008	104.0	.064	1623	615	7200
11	85.0	10.3	.003	106.1	.024	4430	226	3160
12	95.0	10.7	.008	114.3	.064	1790	559	7100
13	106	12.5	.003	156.2	.024	6510	153	1740
14	117	12.5	.002	156.2	.016	9780	102	1030
15	126	8.8	=00	77.4	=0	=00	=0	0
16	135	10.8	.002	116.8	.016	7300	137	1040
17	18	10	.006	100	.048	2080	480	10700
18	50	10	.005	100	.040	2500	400	7360
19	80	10	.0015	100	.012	8330	112	1760
20	100	10	.006	100	.048	2040	492	5990
-1	130	10	0	—	—	—	—	=0

FORM 1319A

10 × 10 to the ½ inch. 5th lines accented
MADE IN U. S. A.



AIRCRAFT
A. U. W.

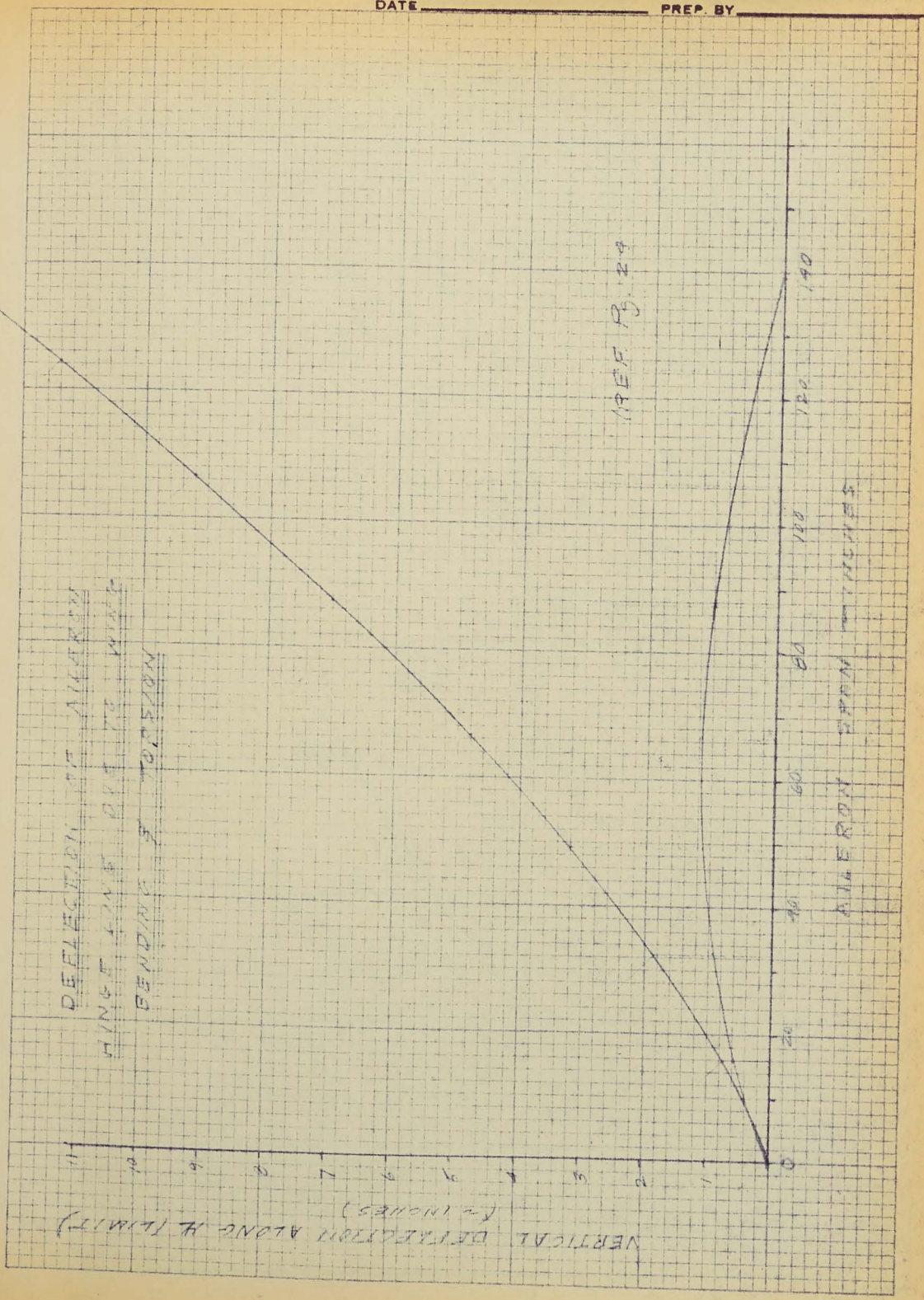
COMPONENT

SHEET No. 96 b

REPORT No. 1-0579-1

DATE

PREP. BY



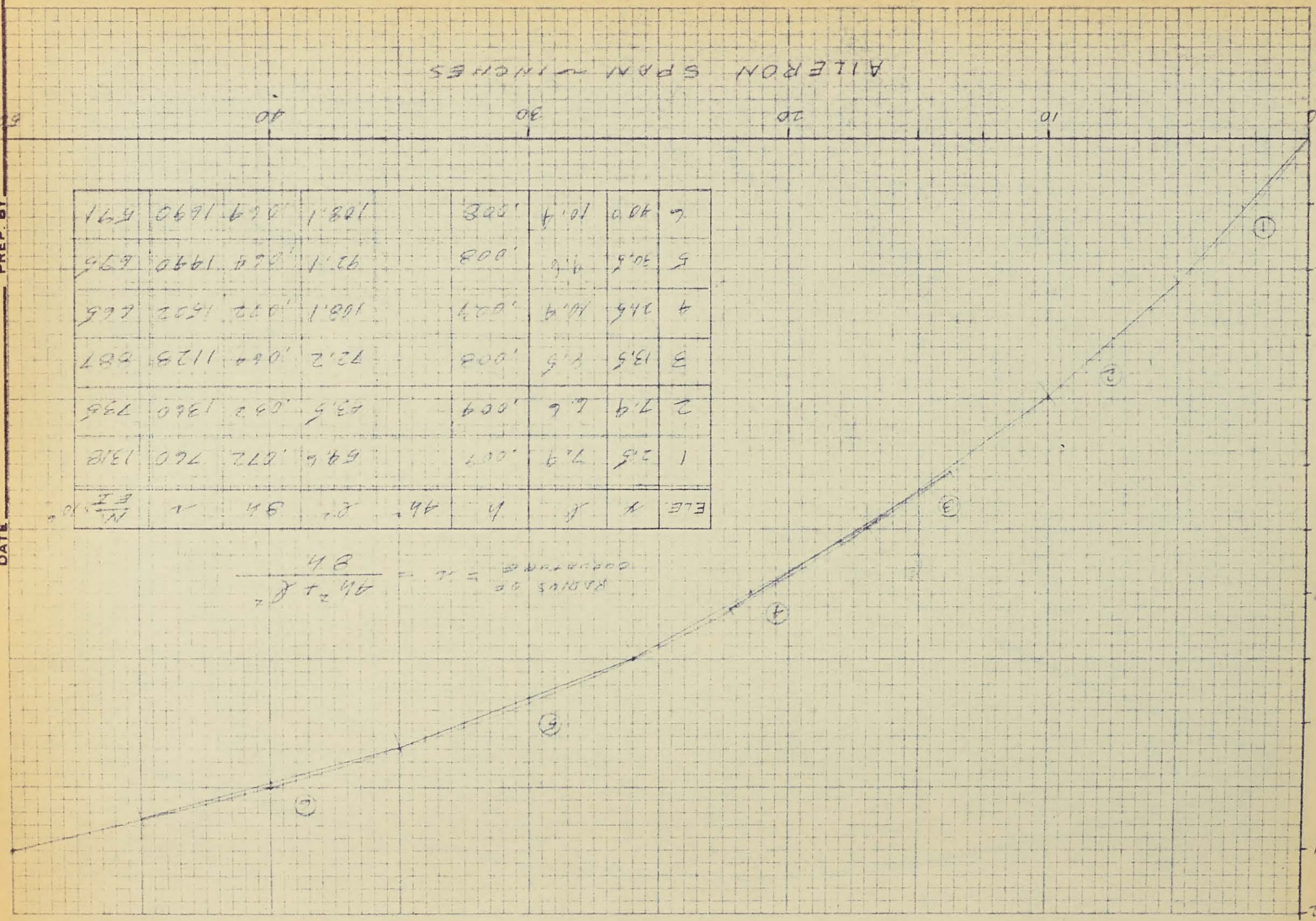
FORM 1746

COMPONENT _____ SHEET NO. _____

AIRCRAFT _____ DATE _____

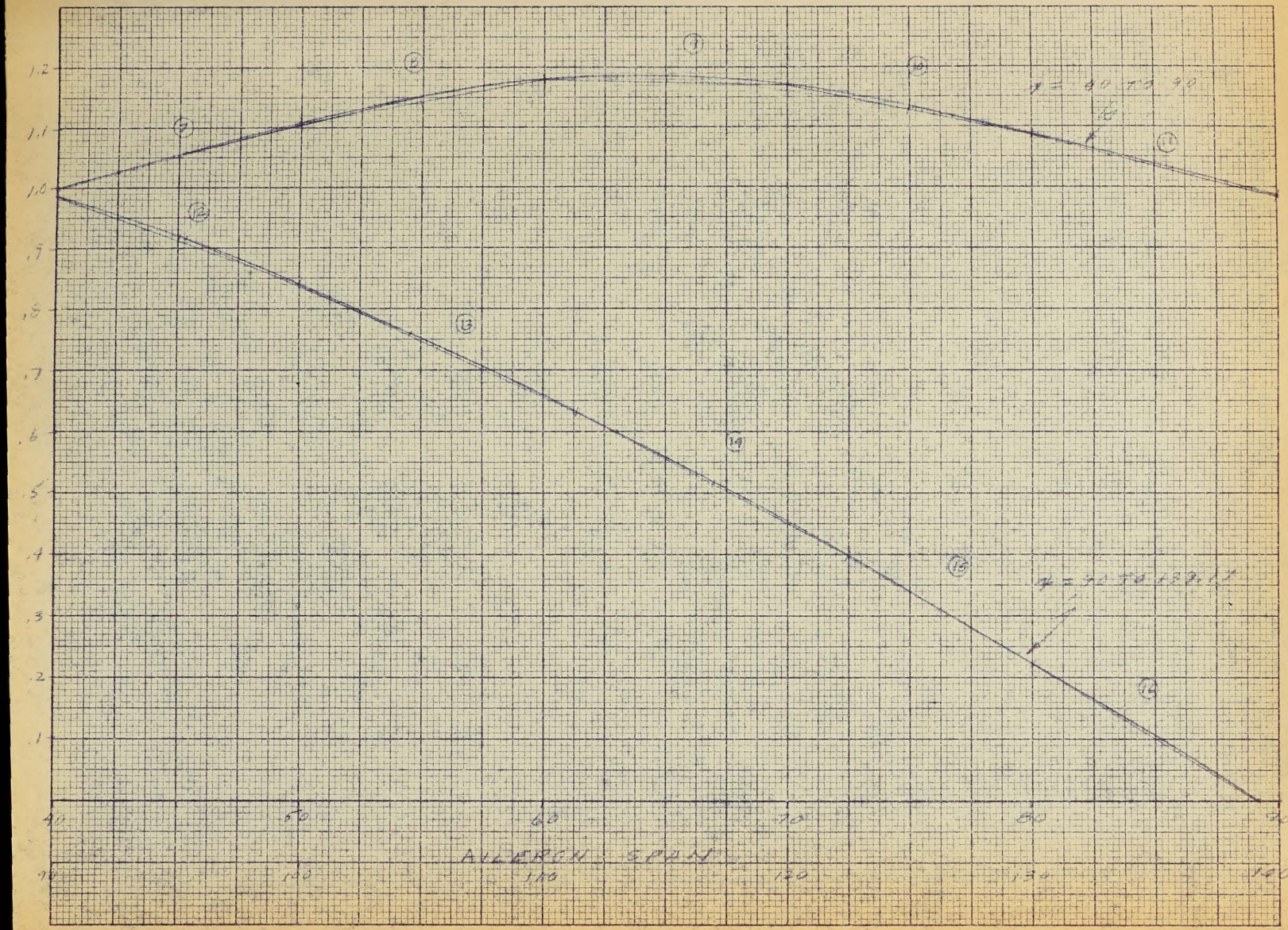
U. W. _____ PREP. BY _____

FORM 1746



ELE	x	$\frac{dy}{dx}$	h	$\frac{dy}{dx}h$	$\frac{M}{EI}h^2$
1	2.5	7.9	.007	.055	138
2	7.4	6.6	.009	.059	795
3	13.5	5.5	.008	.044	687
4	24.5	4.4	.017	.075	665
5	30.5	4.0	.008	.032	675
6	48.0	10.4	.028	.291	691

$$\text{SLOPES OF CONNECTING LINES} = \frac{dy}{dx} = \frac{dy_2 + dy_1}{2h}$$


1.2
1.1
1.0
.9
.8
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.6
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ALLERON SPAN
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A. V. ROE CANADA LIMITED
MALTON - ONTARIO
TECHNICAL DEPARTMENT (Aircraft)

REPORT No. T-0574-1
SHEET No. 97

AIRCRAFT:		PREPARED BY	DATE
C105	AILERON	R. GAVALIS	
		CHECKED BY	DATE

DEFLECTION LOADS (CONT.) SUBSONIC CASE
DOWN AILERON

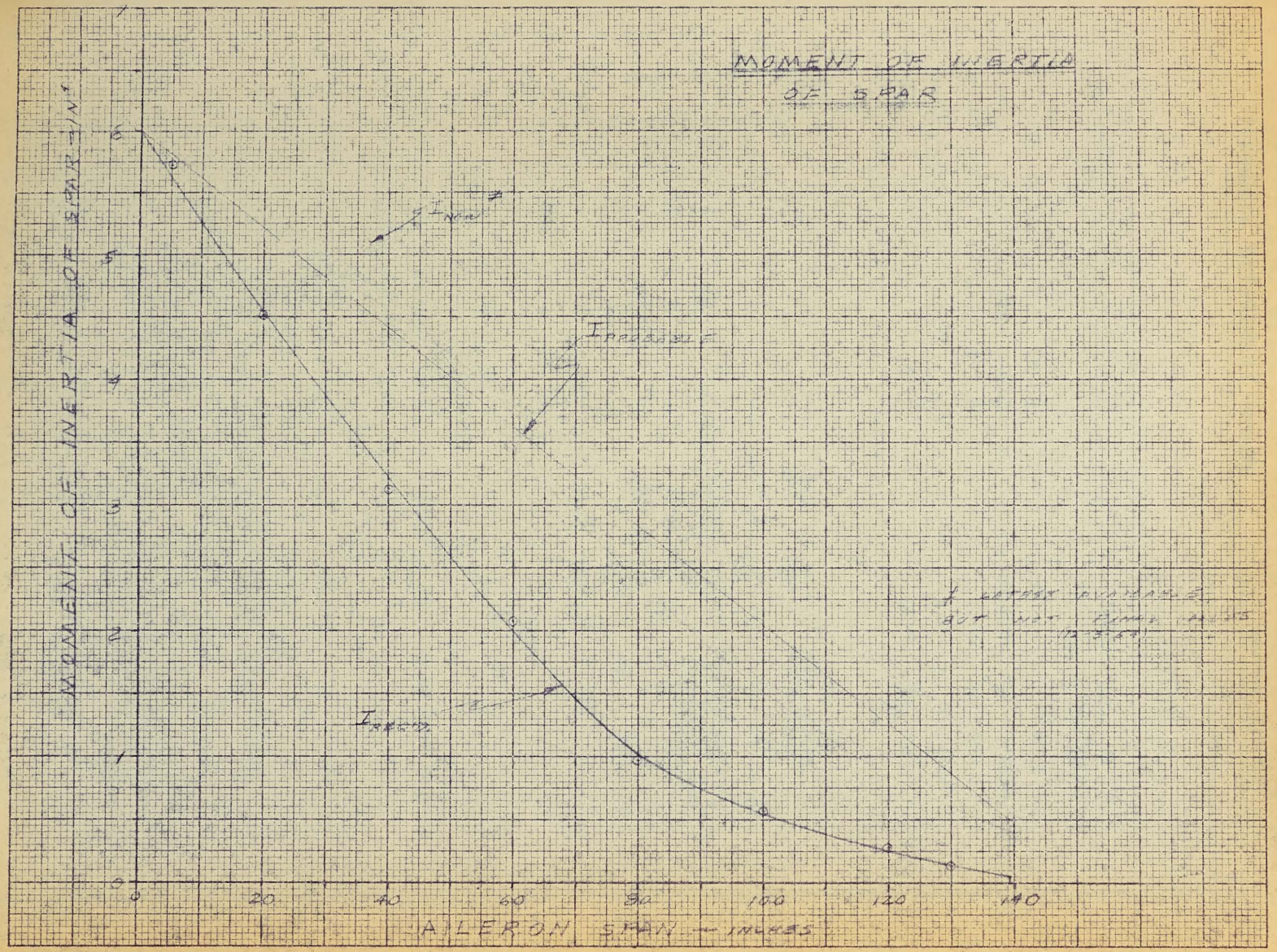
MOMENT OF INERTIA OF SPAR (ESTIMATE)

	1	2	3	4	5	6	7	8
#	$f_{b_{ULT.}}$ #	C	b	t	A_f	$\frac{AC^2}{2}$	$\frac{C^3t}{12}$	I
REF. →	P_3 ×1.4	P_3 ×			b×t			⑥+⑦
5	34000	4.65	2.0	.20	.400	4.15	1.67	5.72
20	28000	4.20	1.85	.20	.370	3.26	1.24	4.50
40	23000	3.72	1.64	.20	.328	2.27	.862	3.13
60	18600	3.25	1.43	.20	.286	1.51	.567	2.08
80	15000	2.78	1.22	.15	.183	.706	.268	.974
100	10500	2.32	1.02	.15	.153	.411	.156	.567
120	3540	1.86	.81	.15	.1212	.207	.079	.286
130	2650	1.60	.71	.10	.0711	.0906	.034	.125

$f_{b_{ULT.}} = f_{b_{LIMIT}} \times 1.364 \times 1.30$ ← FACTOR OF SAFETY

FORM 1319A

10 × 10 to the ½ inch, 5th lines accented.
MADE IN U.S.A.



972

7-15-42-1

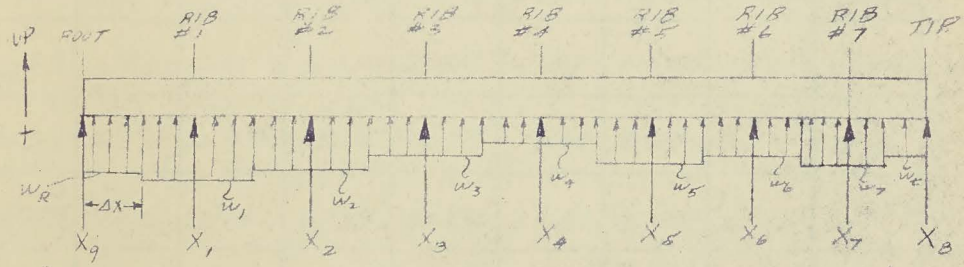
A. V. ROE CANADA LIMITED
MALTON · ONTARIO
TECHNICAL DEPARTMENT (Aircraft)

REPORT No. 7-0574-1
SHEET No. 98

AIRCRAFT:		PREPARED BY	DATE
C105	AILERON	R. GAVALIS	
		CHECKED BY	DATE

DEFLECTION LOADS (CONT.) SUBSONIC CASE
DOWN AILERON

IT WILL BE ASSUMED THAT THE WING TRAILING EDGE IN DEFLECTING UPWARD WILL LOAD THE HINGE WITH INCREMENTS OF UNIFORM LOADING ≠ THAT MAY BE CONSIDERED CONCENTRATED AT THE POINTS SHOWN.



(ALL LOADS ARE NORMAL TO WING CHORD)

FOR ANY STATION,

$$X_N = W_N \Delta X_m$$

X_1 TO X_8 ARE CALCULATED ON THE FOLLOWING PAGES.

APPLY UNIT LOADS AT RIBS 1 TO 7 & REACT AT ROOT (X_0) & TIP (X_8):

DUE TO A UNIT LOAD AT ↓	REACTION AT X_0 IS (LBS)	REACTION AT X_8 IS (LBS)
X_1	- .885	- .115
X_2	- .766	- .234
X_3	- .645	- .355
X_4	- .522	- .478
X_5	- .373	- .627
X_6	- .235	- .765
X_7	- .107	- .893

≠ LOADS WERE DISTRIBUTED TRIANGULARLY LATER (R 103

FORM 1319A

DEFLECTION LOADS

SUBSONIC CASE - DOWN AILERON

# SPAR STATION (ALONG EL. IN.)	1	2	3	4	5	6	7	8	9	10	
	$\frac{\neq}{EI_{(\times 10^{+6})}}$	$\frac{\Delta X^*}{EI}$ $(\times 10^{-5})$	m_1	m_2	m_3	m_4	m_5	m_6	m_7	$\delta_{11} = \frac{m_1 m_1 \Delta x}{EI}$ $(\times 10^{-5})$	$\delta_{21} = \frac{m_2 m_1 \Delta x}{EI}$ $(\times$
REF. →	Fig. 44a	$\Delta X/$①	Fig. 46							③²× ②	②×
10	55.1	.0272	-8.85	-7.66	-6.45	-5.22	-3.73	-2.35	-1.07	2.130	1.6
20	47.5	.0210	-13.70	-15.31	-12.90	-10.44	-7.46	-4.70	-2.14	3.941	4.
30	40.7	.0246	-12.56	-23.00	-19.32	-15.68	-11.20	-7.05	-3.21	3.881	7.
40	33.8	.0296	-11.40	-23.37	-25.80	-20.96	-14.91	-9.40	-4.28	3.847	7.
50	27.1	.0369	-10.25	-21.03	-31.77	-26.10	-18.62	-11.76	-5.35	3.877	7.
60	20.9	.0479	-9.10	-18.66	-28.20	-31.33	-22.40	-14.10	-6.42	3.758	8.
70	15.3	.0654	-7.95	-16.34	-24.68	-33.05	-26.10	-16.46	-7.49	4.133	8.
80	10.7	.0935	-6.80	-13.96	-21.10	-28.25	-29.82	-18.80	-8.56	4.323	8.
90	7.87	.127	-5.67	-11.63	-17.52	-23.48	-30.80	-21.19	-9.63	4.083	8.
100	5.77	.173	-4.50	-10.35	-14.0	-18.69	-24.54	-23.60	-10.7	3.503	8.
110	3.98	.251	-3.37	-6.95	-10.4	-13.91	-18.25	-22.25	-11.78	2.8606	5.
120	2.62	.382	-2.20	-4.55	-6.9	-9.16	-12.02	-14.62	-12.82	1.849	3.
130	1.58	.890	-1.06	-2.25	-3.4	-4.37	-5.75	-7.02	-8.18	1.000	2.
Σ										43.376	8

≠ E = 10.5 X 10⁶ P.S.I. * ΔX FOR X = 10 IS 15', ΔX FOR X = 130 IS 14.17"

FORM 1544

DS

DOWN AILERON

5	6	7	8	9	10	11	12	13	14	15	16	17	18	19
M_3	M_4	M_5	M_6	M_7	$\delta_{11} = \frac{M_1 M_1 \Delta x}{EI}$ (x 10^{-5})	$\delta_{12} = \frac{M_1 M_2 \Delta x}{EI}$ (x 10^{-5})	$\delta_{13} = \frac{M_1 M_3 \Delta x}{EI}$ (x 10^{-5})	$\delta_{14} = \frac{M_1 M_4 \Delta x}{EI}$ (x 10^{-5})	$\delta_{16} = \frac{M_1 M_6 \Delta x}{EI}$ (x 10^{-5})	$\delta_{17} = \frac{M_1 M_7 \Delta x}{EI}$ (x 10^{-5})	$\delta_{22} = \frac{M_2 M_2 \Delta x}{EI}$ (x 10^{-5})	$\delta_{23} = \frac{M_2 M_3 \Delta x}{EI}$ (x 10^{-5})	$\delta_{24} = \frac{M_2 M_4 \Delta x}{EI}$ (x 10^{-5})	
					③^2 × ②	② × ③ × ④	② × ③ × ⑤	② × ③ × ⑥	② × ③ × ⑦	② × ③ × ⑧	② × ③ × ⑨	② × ④ × ④	② × ④ × ⑤	② × ④ ×
-.46	-5.22	-3.73	-2.35	-1.07	2.130	1.844	1.553	1.258	.977	.565	.2578	1.577	1.343	1.08
-2.90	-10.44	-7.46	-4.70	-2.14	3.941	4.405	3.711	3.005	2.148	1.351	.615	4.93	4.16	3.36
-9.32	-15.68	-11.20	-7.05	-3.21	3.881	7.107	5.969	4.845	3.46	2.178	.991	13.0	10.91	8.85
-15.80	-20.86	-14.91	-9.40	-4.28	3.847	7.686	8.706	7.05	5.03	3.162	1.441	16.13	17.82	14.92
-21.77	-26.10	-18.62	-11.76	-5.35	3.871	7.954	12.016	9.87	7.05	4.45	2.022	16.33	24.61	20.24
-28.20	-31.38	-22.40	-14.10	-6.42	3.758	8.112	12.266	13.61	9.75	6.135	2.795	16.62	25.18	27.98
-34.68	-33.05	-26.10	-16.46	-7.49	4.133	8.496	12.832	17.18	13.56	8.55	3.898	17.47	26.40	35.35
-41.10	-28.35	-29.82	-18.80	-8.56	4.323	8.376	13.415	17.97	18.97	11.84	5.45	18.20	27.53	36.83
-47.52	-23.48	-30.80	-21.19	-9.63	4.083	8.375	12.616	16.91	22.20	15.24	6.94	17.20	25.88	34.69
-54.0	-18.69	-24.54	-23.60	-10.7	3.503	8.057	10.859	14.52	19.10	18.30	8.34	15.53	25.05	33.46
-61.4	-13.71	-18.25	-22.25	-11.78	2.8606	5.879	8.797	11.77	15.42	18.82	9.97	12.11	18.11	24.22
-68.9	-9.16	-12.02	-14.62	-12.82	1.849	3.824	5.797	7.71	10.11	12.31	10.80	7.91	12.00	15.91
-74	-4.37	-5.75	-7.02	-8.18	1.050	2.123	3.208	4.145	5.43	6.62	7.72	4.51	6.81	8.86
					43.376	82.938	111.787	129.848	133.145	109.52	61.24	164.54	225.79	266.14
10	15	15	ΔX FOR X = 130 IS 14.17"		ΔX FOR ALL OTHERS IS 10"									

A. V. ROE CANADA LIMITED

MALTON, ONTARIO

TECHNICAL DEPT. (AIRFRAME)

REPORT NO. 7-0579-1

SHEET 99

DATE

AIRCRAFT C105

WEIGHT

C. G. POSITION

PREPARED BY R. GAVALIS

16	17	18	19	20	21	22	23	24	25	26	27	28	29
$\delta_{12} = \frac{M_1 M_2 \Delta x}{EI}$ (×10⁻⁵)	$\delta_{22} = \frac{M_2 M_2 \Delta x}{EI}$ (×10⁻⁵)	$\delta_{23} = \frac{M_2 M_3 \Delta x}{EI}$ (×10⁻⁵)	$\delta_{24} = \frac{M_2 M_4 \Delta x}{EI}$ (×10⁻⁵)	$\delta_{25} = \frac{M_2 M_5 \Delta x}{EI}$ (×10⁻⁵)	$\delta_{26} = \frac{M_2 M_6 \Delta x}{EI}$ (×10⁻⁵)	$\delta_{27} = \frac{M_2 M_7 \Delta x}{EI}$ (×10⁻⁵)	$\delta_{33} = \frac{M_3 M_3 \Delta x}{EI}$ (×10⁻⁵)	$\delta_{34} = \frac{M_3 M_4 \Delta x}{EI}$ (×10⁻⁵)	$\delta_{35} = \frac{M_3 M_5 \Delta x}{EI}$ (×10⁻⁵)	$\delta_{36} = \frac{M_3 M_6 \Delta x}{EI}$ (×10⁻⁵)	$\delta_{37} = \frac{M_3 M_7 \Delta x}{EI}$ (×10⁻⁵)	$\delta_{44} = \frac{M_4 M_4 \Delta x}{EI}$ (×10⁻⁵)	$\delta_{45} = \frac{M_4 M_5 \Delta x}{EI}$ (×10⁻⁵)
(2)×(3)×(4)	(2)×(4)×(4)	(2)×(4)×(5)	(2)×(4)×(6)	(2)×(4)×(7)	(2)×(4)×(8)	(2)×(4)×(9)	(2)×(5)×(5)	(2)×(5)×(6)	(2)×(5)×(7)	(2)×(5)×(8)	(2)×(5)×(9)	(2)×(6)×(6)	(2)×(6)×(7)
2578	1.577	1.343	1.089	.777	.490	.223	1.131	.915	.654	.412	.1878	.741	.530
6.15	4.93	4.16	3.36	2.40	1.512	.689	3.498	2.828	2.021	1.271	.580	2.288	1.636
991	13.0	10.91	8.85	6.33	3.981	1.817	9.200	7.450	5.34	3.358	1.528	6.045	9.310
1.441	16.13	17.82	14.92	10.31	6.50	2.96	19.700	15.99	11.40	7.18	3.265	12.90	9.21
2.022	16.33	24.61	20.24	14.48	9.14	4.16	37.20	30.58	21.81	13.78	6.26	25.17	17.94
2.795	16.62	25.18	27.98	19.98	12.58	5.72	38.00	42.30	30.20	19.00	8.65	46.94	33.58
3.898	17.47	26.40	35.35	27.88	17.60	8.00	39.80	53.40	42.10	26.58	12.09	71.40	56.40
5.46	18.20	27.53	36.83	38.98	24.50	11.18	41.60	55.80	58.90	37.08	16.90	74.70	79.90
6.94	17.20	25.88	34.69	45.50	31.25	14.21	39.00	52.30	68.55	47.10	21.40	70.05	91.90
8.34	18.53	26.05	33.40	43.90	42.10	19.18	33.88	45.20	59.40	56.90	25.9	60.40	79.40
9.97	12.11	13.11	24.22	31.80	38.80	20.48	27.19	36.40	47.60	58.2	30.78	48.70	63.80
10.80	7.91	12.00	15.91	20.88	25.41	22.32	18.20	24.18	31.74	38.60	33.82	32.01	42.10
7.72	4.51	6.81	8.80	11.50	14.07	16.39	10.29	13.29	17.40	21.22	24.78	17.12	22.41
61.24	164.54	225.79	266.14	274.72	227.93	127.32	318.69	380.58	397.12	330.68	186.14	468.52	502.12
5 10"													

A. V. ROE CANADA LIMITED
MALTON - ONTARIO
TECHNICAL DEPARTMENT (Aircraft)

REPORT No. 7-0574-1
SHEET No. 100

AIRCRAFT:		PREPARED BY	DATE
C105	AILERON	R. GAVALIS	
		CHECKED BY	DATE

DEFLECTION LOADS (CONT.) SUBSONIC CASE
DOWN AILERON

4 SPAR STATION	30 $\delta'_{46} = \frac{M_4 M_6 \Delta x}{EI\ (\times 10^{-5})}$	31 $\delta'_{47} = \frac{M_4 M_7 \Delta x}{EI\ (\times 10^{-5})}$	32 $\delta'_{55} = \frac{M_5 M_5 \Delta x}{EI\ (\times 10^{-5})}$	33 $\delta'_{56} = \frac{M_5 M_6 \Delta x}{EI\ (\times 10^{-5})}$	34 $\delta'_{57} = \frac{M_5 M_7 \Delta x}{EI\ (\times 10^{-5})}$	35 $\delta'_{66} = \frac{M_6 M_6 \Delta x}{EI\ (\times 10^{-5})}$	36 $\delta'_{67} = \frac{M_6 M_7 \Delta x}{EI\ (\times 10^{-5})}$	37 $\delta'_{77} = \frac{M_7 M_7 \Delta x}{EI\ (\times 10^{-5})}$
REF. →	②×⑥×⑧	②×⑥×⑨	②×⑦×⑦	②×⑦×⑧	②×⑦×⑨	②×⑧×⑧	②×⑧×⑨	②×⑨×⑨
10	.334	.152	.378	.238	.1084	.1602	.068	.0311
20	1.030	.469	1.170	.737	336	.464	.211	.0962
30	2.719	1.238	3.084	1.941	.885	1.221	.556	.254
40	5.80	2.640	6.600	4.156	1.891	2.62	1.191	.541
50	11.31	5.15	12.81	8.09	3.68	5.09	2.320	1.057
65	21.12	7.61	23.94	15.09	6.87	9.50	4.32	1.968
75	35.58	16.17	44.60	28.00	12.78	17.68	8.05	3.66
80	49.60	22.60	83.40	52.50	23.88	30.30	14.41	6.85
90	63.1	28.68	120.6	82.75	37.62	56.90	25.82	11.78
100	76.0	34.60	104.1	99.70	45.46	95.60	43.50	19.80
110	77.90	41.10	83.50	104.0	53.90	124.3	65.70	34.78
120	51.15	44.90	55.30	67.30	59.00	81.9	71.80	63.00
130	27.40	31.75	29.41	35.75	41.90	43.8	51.10	59.50
Σ	423.04	239.26	568.84	500.45	288.30	469.52	276.08	203.32

FORM 1319A

A. V. ROE CANADA LIMITED
MALTON - ONTARIO
TECHNICAL DEPARTMENT (Aircraft)

REPORT NO. 7-0579-1
SHEET NO. 101

AIRCRAFT:		PREPARED BY	DATE
C105	AILERON	R. GAVALIS	
		CHECKED BY	DATE

DEFLECTION LOADS — SUBSONIC CASE
DOWN AILERON

DEFLECTION EQUATIONS

THE EQUATION FOR THE DEFLECTION AT X_1 (IT IS TYPICAL FOR ALL OTHER DEFLECTIONS) IS,

$$\delta_1' = \delta_{10}' + \delta_{11}' X_1 + \delta_{12}' X_2 + \delta_{13}' X_3 + \delta_{14}' X_4 + \delta_{15}' X_5 + \delta_{16}' X_6 + \delta_{17}' X_7$$

THEN THE EQUATIONS IN TABULAR FORM ARE:

δ_m	δX_1	δX_2	δX_3	δX_4	δX_5	δX_6	δX_7	$\times 10^5 =$	δ_{m1}
δ_1'	43.32	82.94	111.79	129.96	133.14	109.52	61.24	=	+57,500 *
δ_2'	82.94	164.64	225.79	265.14	274.72	227.93	127.32	=	+91,000
δ_3'	111.79	225.79	318.67	380.58	397.12	330.68	186.14	=	+116,000
δ_4'	129.86	265.14	380.58	469.52	502.12	423.04	239.26	=	+118,200
δ_5'	133.14	274.72	397.12	502.12	568.84	500.45	288.30	=	+101,100
δ_6'	109.52	227.93	330.68	423.04	500.45	469.52	276.08	=	+72,000
δ_7'	61.24	127.32	186.14	239.26	288.30	276.08	203.32	=	+35100

* $\delta_1' \times 10^5 = .575 \times 10^5 = 57{,}500$ (REF. R_3 9[illegible] c.4)

FORM 1319A

A. V. ROE CANADA LIMITED
MALTON - ONTARIO
TECHNICAL DEPARTMENT (Aircraft)

REPORT No. 7-0574-1
SHEET No. 102

AIRCRAFT:		PREPARED BY	DATE
C105	AILERON	R. GAVALIS	
		CHECKED BY	DATE

DEFLECTION LOADS (CONT.) SUBSONIC CASE
DOWN AILERON

SIMPLIFYING THE EQUATIONS.

X_1	X_2	X_3	X_4	X_5	X_6	X_7	K
1.00	1.912	2.577	2.993	3.069	2.529	1.412	-1325
1.00	1.783	2.721	3.195	3.310	2.747	1.534	-1097
1.00	2.020	2.851	3.404	3.552	2.958	1.665	-984
1.00	2.042	2.931	3.608	3.867	3.258	1.842	-910
1.00	2.063	2.983	3.771	4.272	3.759	2.165	-759
1.00	2.051	3.019	3.863	4.569	4.287	2.521	-657
1.00	2.079	3.040	3.907	4.708	4.508	3.320	-573

FORM 1319A

A. V. ROE CANADA LIMITED
MALTON · ONTARIO
TECHNICAL DEPARTMENT (Aircraft)

REPORT No. Z-0579-1
SHEET No. 103

AIRCRAFT:		PREPARED BY	DATE
C105	AILERON	R. GAVALIS	
		CHECKED BY	DATE

DEFLECTION LOADS (CONT.) SUBSONIC CASE
DOWN AILERON

AUXILIARY MATRIX

1.00	1.912	2.577	2.933	3.959	2.624	1.412	-1326
1.00	.071	2.128	2.643	3.375	3.140	1.719	3213
1.00	.103	.044	2.390	2.660	2.160	1.544	-1139
1.00	.130	.077	.065	2.339	2.442	1.339	1047
1.00	.151	.084	.153	.109	1.890	1.468	694
1.00	.169	.082	.197	.243	.104	.615	-536
1.00	.167	.107	.188	.350	.108	.624	43

FORM 1319A

A. V. ROE CANADA LIMITED
MALTON · ONTARIO
TECHNICAL DEPARTMENT (Aircraft)

REPORT No. 7-0579-1
SHEET No. 109

AIRCRAFT:		PREPARED BY	DATE
C105	AILERON	R. GAVALIS	
		CHECKED BY	DATE

DEFLECTION LOADS (CONT.) SUBSONIC CASE
DOWN AILERON

REDUNDANTS (LIMIT)

$X_7 = 43^{\#}$

$X_6 = -535^{\#} - 43(.615) = -561.4^{\#}$

$X_5 = 699 + 561.4(1.890) - 43(1.968) = 1682^{\#}$

$X_4 = 104.7 - 1682(2.339) + 561.4(2.442) - 43(1.339) = -2512^{\#}$

$X_3 = -113.8 - 1.544(43) - 2.160(-561.4) - 2.660(1682) - 2.340(-2512)$

$X_3 = 2421^{\#}$

$X_2 = 3213 - 1.719(43) - 3.140(-561.4) - 3.395(1682) - 2.843(-2512) - 2.128(2421)$

$X_2 = 1171^{\#}$

$X_1 = -1325 - 1.412(43) - 2.524(-561.4) - 3.069(1682) - 2.993(-2512) - 2.577(2421) - 1.912(1171)$

$X_1 = -6097^{\#}$

$X_8 = -.115(-6097) - .234(1171) - .356(2421) - .478(-2512) - .627(1682) - .765(-561.4) - .893(43)$

$X_8 = 98^{\#}$

FORM 1319A

A. V. ROE CANADA LIMITED
MALTON - ONTARIO
TECHNICAL DEPARTMENT (Aircraft)

REPORT No. 7-0579-1
SHEET No 105

AIRCRAFT:		PREPARED BY	DATE
C105	AILERON	R. GAVALIS	
		CHECKED BY	DATE

DEFLECTION LOADS (CONT.) SUBSONIC CASE
DOWN AILERON

$X_9 = -.885(-6097) - .766(1171) - .645(2421)$
$- .522(-2512) - .373(1682)$
$- .235(-561) - .107(43)$

$X_9 = 3740\ \#$

MATH. CHECK:

$\delta_1' = [93.38(-6097) + 82.94(1171) + 111.79(2421)$
$+ 122.86(-2512) + 133.14(1682)$
$+ 109.62(-561) + 61.24(43)]10^{-5} \stackrel{?}{=} -.575$
(REF. Pgs 101 of 104

$\delta_1' = (-56900)(10^{-5}) \stackrel{?}{=} -.575$

$\delta_1' = -.567 \stackrel{?}{=} -.575$ (ERROR = 1.09%)

CHECK OF EQUATIONS:

THE ENTIRE DEFLECTION STUDY CAN BE CHECKED WITH REASONABLE ACCURACY BY TAKING THE SPAR, LOADING IT WITH THE REDUNDANTS, SOLVING FOR THE DEFLECTION AT ANY RIB, & COMPARING THIS DEFLECTION WITH THAT OBTAINED FROM THE DEFLECTION CURVE ON PAGE 96 L.

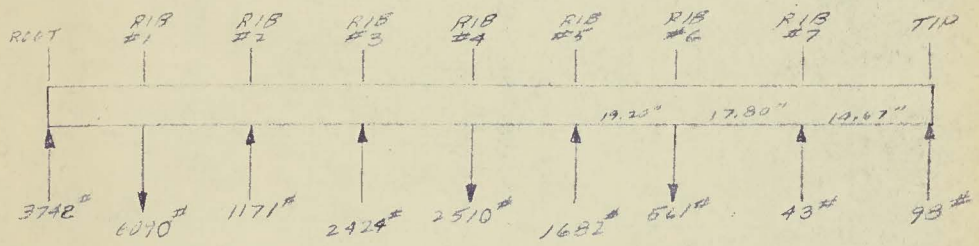
FORM 1319A

A. V. ROE CANADA LIMITED
MALTON - ONTARIO
TECHNICAL DEPARTMENT (Aircraft)

REPORT No. Z-0579-1
SHEET No. 106

AIRCRAFT:		PREPARED BY	DATE
C 105	AILERON	R. GAVALIS	
		CHECKED BY	DATE

DEFLECTION LOADS (CONT.) — LIMIT — SUBSONIC — DOWN AILERON



FOR RIB # 4

$$\delta_4 = \int_0^t \frac{M m_4 dx}{EI} = \sum \frac{M m_4 \Delta x}{EI}$$

STATION (IN.)	1 I (IN⁴)	2 Δx (IN.)	3 $\frac{\Delta x}{EI} \times 10^6$ # ②/①×E	4 M (IN-#)	5 m_4 (IN.)	6 $\frac{M m_4 \Delta x}{EI}$ ③×④×⑤
REF →	Pg. 97a			Pg. 107		
10	5.25	15	.272	37600	-5.21	-.05310
20	4.53	10	.210	50300	-10.42	-.1102
30	3.86	10	.246	27000	-15.62	-.1037
40	3.22	10	.296	11800	-20.82	-.0728
50	2.58	10	.369	2600	-26.20	-.02418
60	1.99	10	.478	13700	-31.25	-.2047
70	1.46	10	.652	17200	-33.10	-.3705
80	1.02	10	.933	4700	-28.32	-.1240
90	.75	10	1.270	-3500	-23.55	+.1047
100	.55	10	1.731	0	-18.72	0
110	.38	10	2.50	2200	-13.92	-.0766
120	.25	10	3.81	800	-9.16	-.0279
130	.15	14.14	9.00	80	-4.39	-.0316
					Σ	-1.095

E = 10.5 X 10⁶ P.S.I.

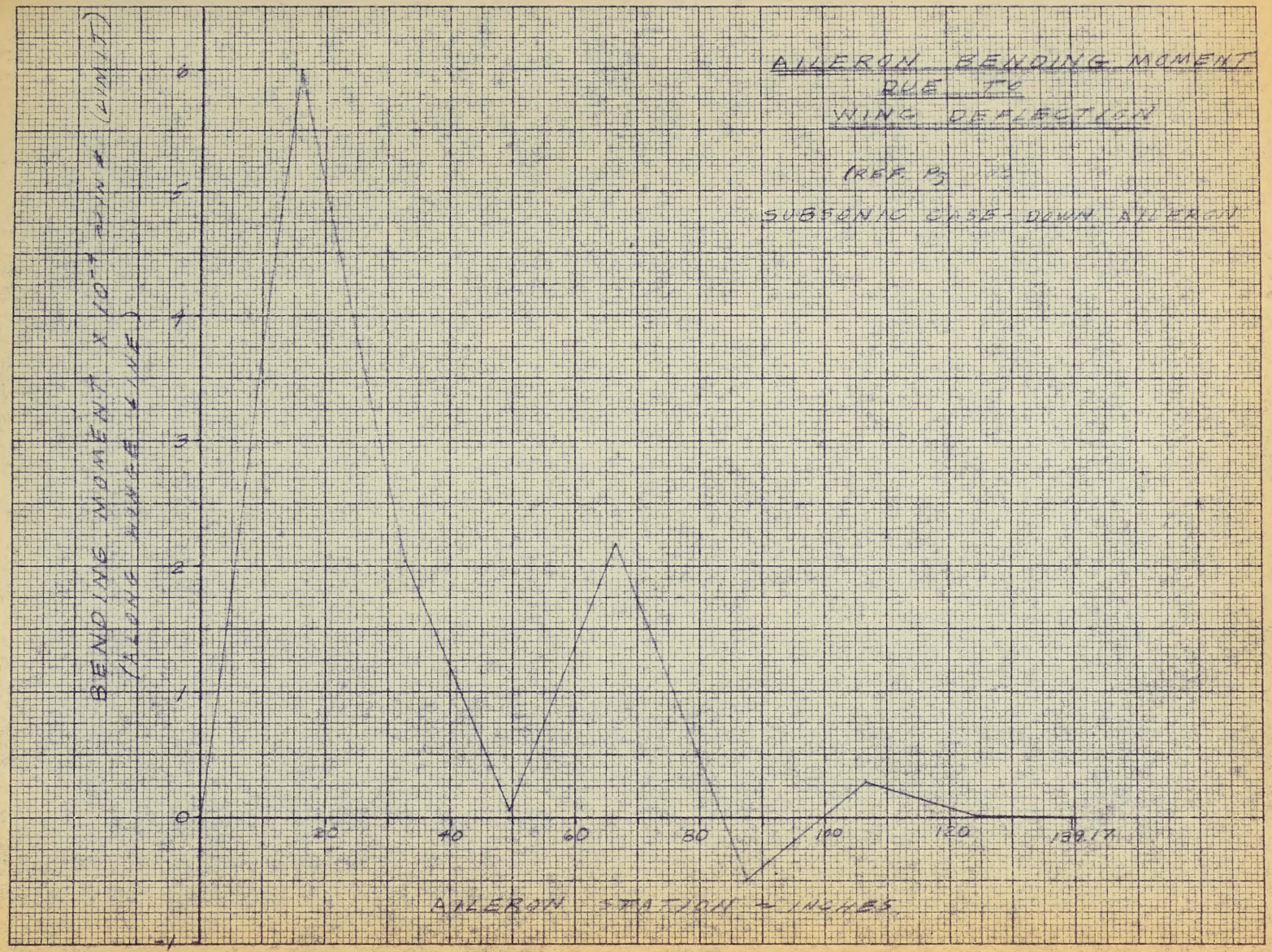
φ M ADJUSTED TO REPRESENT AVERAGE MOMENT OVER Δx

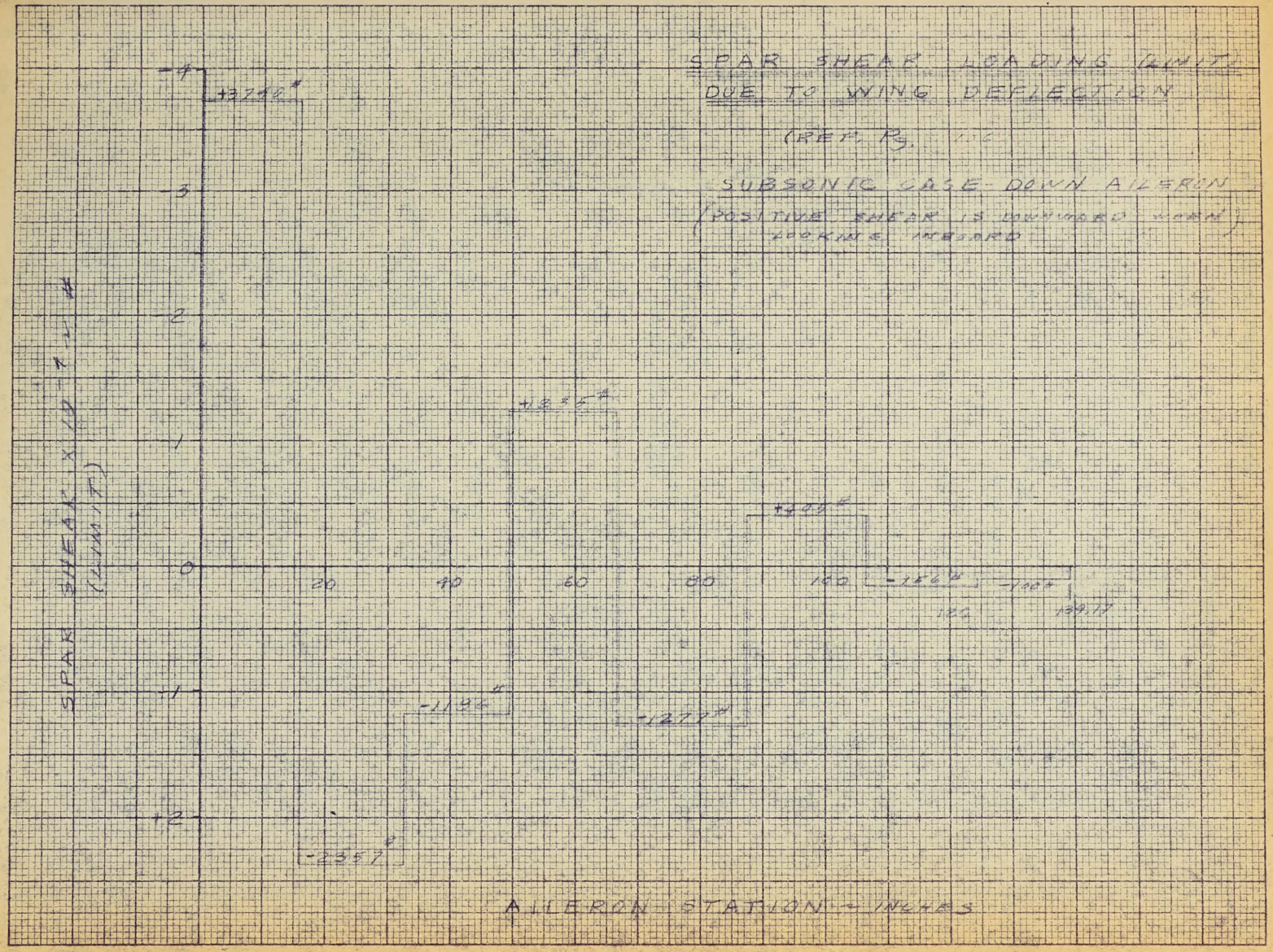
θ m_4 = MOMENT DUE TO UNIT LOAD ACTING UPWARD AT RIB #4.

$$\delta_4 = \sum \frac{M m_4 \Delta x}{EI} = -1.095 \approx -1.18 \text{ (REF. Pg 96)}$$

ERROR = 7% → WITHIN ACCURACY OF ASSUMPTIONS. ERROR AT RIB #1 FOUND TO BE 82.

FORM 1319A


AILERON BENDING MOMENT
DUE TO
WING DEFLECTION
REF. 3
SUBSONIC CASE - DOWN AILERON
BENDING MOMENT x 10-4 in-lb (LIMIT)
(ALONG AXIS OF AILERON)
6
5
4
3
2
1
0
-1
20
40
60
80
100
120
139.17
AILERON STATION - INCHES


SPAR SHEAR LOADING UNIT DUE TO WING DEFLECTION
(REF. R5)
SUBSONIC CASE - DOWN AILERON
(POSITIVE SHEAR IS UPWARD ON RIGHT HAND LOOKING INBOARD)
SPAR SHEAR X 10 - 4 = #
(LINK-FT)
-4
-3
-2
-1
0
+1
+2
+3246#
+1855#
+1009#
-1196#
-1277#
-2357#
-1266#
-1005#
20
40
60
80
100
120
139.77
AILERON STATION - INCHES

A. V. ROE CANADA LIMITED
MALTON · ONTARIO
TECHNICAL DEPARTMENT (Aircraft)

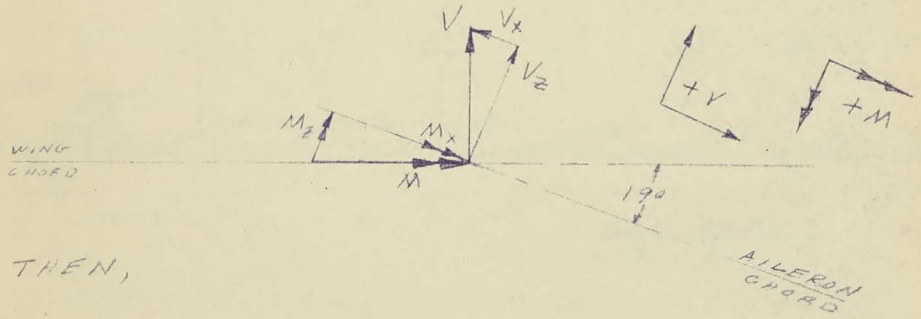
REPORT No. 7-0579-1
SHEET No. 1076

AIRCRAFT:		PREPARED BY	DATE
C 105	AILERON	R. GAVALIS	
		CHECKED BY	DATE

DEFLECTION LOADS (CONT.) SUBSONIC CASE
DOWN AILERON

SPAR LOADING DUE TO WING
DEFLECTION (SUMMARY) - LIMIT

THE BENDING MOMENT & SHEAR GIVEN ON P9 & 10 ARE WITH RESPECT TO THE WING CHORD LINE. RESOLVING THESE LOADS INTO THE PLANE OF THE AILERON CHORD GIVES:



THEN,

$M_x = M \cos 19° = .945\,M$

$M_z = -M \sin 19° = -.326\,M$

$V_z = V \cos 19° = .945\,V$

$V_x = -V \sin 19° = -.326\,V$

A. V. ROE CANADA LIMITED
MALTON - ONTARIO
TECHNICAL DEPARTMENT (Aircraft)

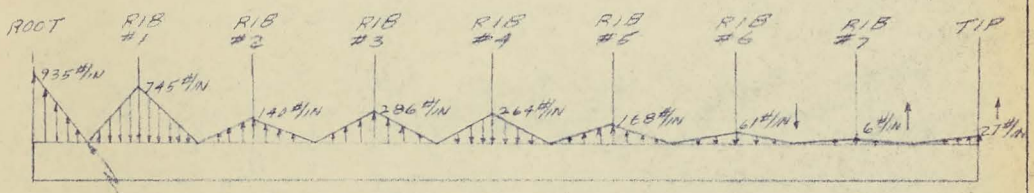
REPORT No. Z-0579-1
SHEET No. 108

AIRCRAFT:		PREPARED BY	DATE
C 105	AILERON	R. GAVALIS	
		CHECKED BY	DATE

DEFLECTION LOADS (CONT) SUBSONIC CASE
DOWN AILERON

SPAR LOADING DUE TO WING DEFLECTION (SUMMARY) — LIMIT

THE CONCENTRATED REDUNDANTS WILL BE TRIANGULARLY DISTRIBUTED AS SHOWN BELOW. ALL LOADS SHOWN ARE NORMAL TO WING CHORD LINE.



ALL LOADS ARE LIMIT

THE ABOVE LOADS ARE FOR AN ENVELOPE CONDITION CONSISTING OF AILERON LOADS FOR THE SUBSONIC CASE, & WING LOADS FOR SUPERSONIC (M = 1.6) CASE (REF. R&S DEFLECTION S.P.E. HAYMAN). THEY WILL BE COMBINED DIRECTLY WITH AILERON LOADS FOR SUBSONIC & SUPERSONIC CASES (CONSERVATIVE).

OBS

FORM 1319A

A. V. ROE CANADA LIMITED
MALTON · ONTARIO
TECHNICAL DEPARTMENT (Aircraft)

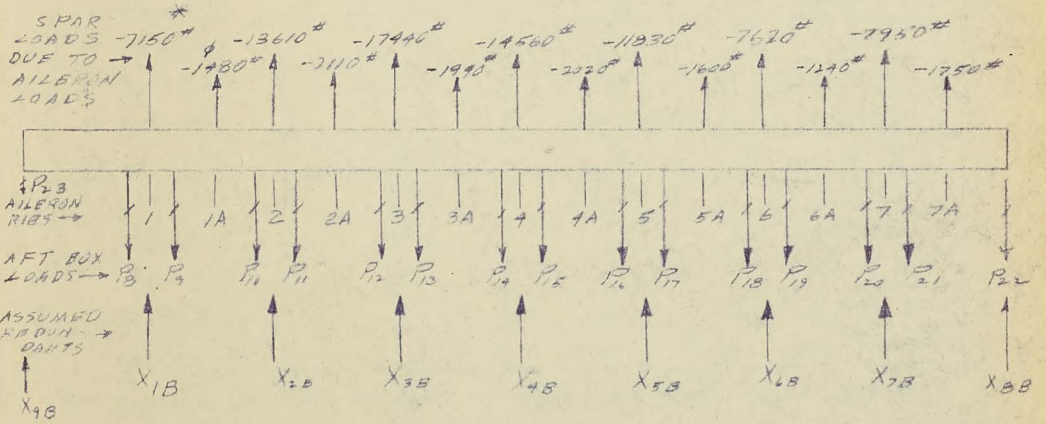
REPORT No. 7-0579-1
SHEET No. 109

AIRCRAFT:		PREPARED BY	DATE
C 105	AILERON	R. GAVALIS	
		CHECKED BY	DATE

SPAR LOADING

LOADS DUE TO RIBS & LEVERS
SUBSONIC CASE - UP AILERON

THE SPAR IS LOADED BY THE AILERON RIBS & LEVER FITTINGS. THE LOAD IS TRANSMITTED THROUGH THE HINGES TO THE BACK-UP STRUCTURE. IF THE RIGIDITY OF THE BACK-UP STRUCTURE IS RELATIVELY CONSTANT,† THE REACTIONS ARE AS SHOWN BELOW.



THE AFT BOX LOADS P_8 TO P_{23} DUE TO THE LOADS SHOWN ABOVE ARE CALCULATED ON THE FOLLOWING PAGES, USING THE HARDY-CROSS METHOD.

* REF. P_9 77 , † REF. P_3 74

† i.e. IF THE DEFLECTION AT ONE RIB DUE TO ITS LOADS IS EQUAL TO THE DEFLECTION AT ANOTHER RIB DUE TO ITS LOADS.

FORM 1319A

A. V. ROE CANADA LIMITED
MALTON - ONTARIO
TECHNICAL DEPARTMENT (Aircraft)

REPORT No. 7-0579-1
SHEET No. 110

AIRCRAFT:		PREPARED BY	DATE
C105	AILERON	R. GAVALIS	
		CHECKED BY	DATE

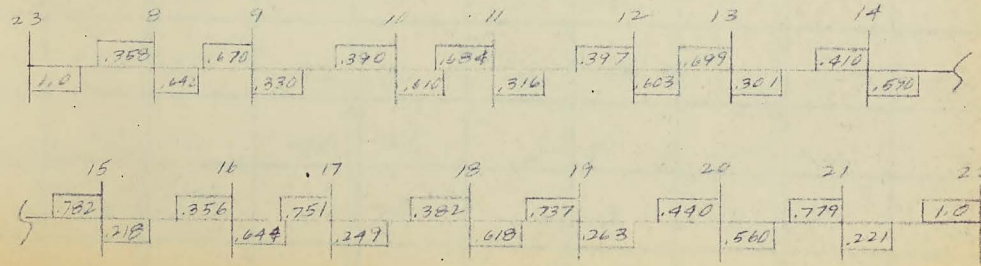
SPAR LOADING

STIFFNESS FACTORS

MEMBER	I^{*} IN⁴	$L^{\neq}$ IN.	$\frac{I}{L}$
REFERENCE → P_3 97.2			
23-8	5.5	13	.445
8-9	4.8	6	.800
9-10	4.25	10.74	.396
10-11	3.70	6	.617
11-12	3.08	10.74	.287
12-13	2.62	6	.436
13-14	2.10	11.12	.189
14-15	1.63	6	.272
15-16	1.13	14.88	.076
16-17	.82	6	.137
17-18	.60	13.20	.04455
18-19	.44	6	.0735
19-20	.31	11.80	.0262
20-21	.20	6	.0333
21-22	.11	11.67	.00945

* AVERAGE I OVER LENGTH OF MEMBER
≠ AFT BOX RIBS (8 TO 23) ASSUMED TO BE LOCATED 3" ON EITHER SIDE OF AILERON MAIN RIBS.

DISTRIBUTION FACTORS



FORM 1319-A

SPAR LOADING

MOMENT DISTRIBUTION (LIMIT)

SUBSONIC CASE - UP AILERON

		1	2	3	4	5	6	7	8	9	10	11
RIB →	23		8		9		10		11		12	
CARRY-OVER FACTOR →	.10	.358	.642	.670	.330	.390	.610	.684	.316	.397	.603	.69
FIXED-END MOMENT	0	0	5360	-5350	1985	-1905	10200	-10200	2830	-2830	13080	-13080
BALANCE (BAL.)	0	-1920	-3440	2260	1110	-3200	-5010	5040	3330	-4070	-6180	7250
CARRY OVER (C.O.)	-960	0	1130	-1720	-1600	550	2520	-2505	-2035	1165	3625	-3090
BAL.	960	-405	-725	2230	1100	-1200	-1872	3100	1435	-1900	-2880	3340
C.O	-202	480	1115	-362	-600	550	1550	-936	-950	717	1670	-1440
BAL.	202	-575	-1030	645	318	-819	-1281	1291	595	-949	-1438	1629
C.O.	-288	101	322	-515	-410	159	645	-640	-474	279	814	-719
BAL.	288	-151	-272	619	305	-313	-490	762	352	-441	-670	792
C.O.	-75	144	320	-136	-156.	152	381	-245	-220	176	396	-335
BAL.	75	-166	-278	196	97	-208	-326	318	147	-227	-344	396
C.O.	-83	38	98	-149	-164	49	159	-163	-113	73	193	-173
BAL.	83	-49	-87	169	84	-81	-127	189	87	-105	-160	190
C.O	-25	42	84	-43	-40	42	95	-63	-52	43	75	-80
BAL.	25	-45	-81	56	27	-54	-84	79	39	-55	-83	92
TOTAL	0	-2506	2486	-2110	2116	-6353	6355	-3973	3971	-8105	8118	-5237

FORM 1544

A. V

AIRCH
WEIG
C. G.

N (LIMIT)
AILERON

	7	8	9	10	11	12	13	14	15	16	17	18	19	20
		11		12		13		14		15		16		17
	.084	.316	.397	.603	.699	.301	.410	.590	.792	.218	.356	.644	.751	.249
0	-10260	2830	-2830	13080	-13080	2700	-2700	10900	-10900	3760	-3760	8880	-8880	2640
0	5040	2330	-4670	-6180	7250	3120	-3360	-4840	5570	1553	-1828	-3290	4280	1550
0	-2505	-2035	1165	3625	-3090	1680	1560	2785	-2420	-914	776	2340	-1645	-595
2	3100	1435	-1700	-2880	3340	1436	-1780	-2560	2600	734	-1110	-2010	1675	556
	-936	-950	717	1670	-1440	-890	717	1300	-1280	-550	367	937	-1105	-422
1	1231	595	-949	-1438	1629	701	-826	-1189	1430	400	-429	-775	1071	356
	-640	-474	298	814	-719	-413	350	715	-595	-215	200	536	-388	-184
	762	352	-441	-670	792	341	-436	-629	634	176	-262	-474	430	143
	-245	-220	176	376	-335	-218	170	317	-315	-131	88	215	-237	-113
	318	147	-227	-344	386	166	-200	-288	349	97	-108	-195	262	88
	-163	-113	73	193	-172	-100	83	174	-144	-54	49	132	-97	-36
	189	87	-105	-160	190	82	-105	-152	155	43	-65	-116	100	33
	-63	-52	43	96	-80	-52	41	77	-76	-32	21	50	-58	-28
	79	39	-55	-83	92	40	-49	-70	84	24	-25	-46	65	21
	-3973	3971	-8105	8118	-5237	5232	-6534	6540	-4908	4891	-6086	6084	-4827	4019

A. V. ROE CANADA LIMITED

MALTON, ONTARIO

ENGINEERING DIVISION - AIRCRAFT

AIRCRAFT - - C105

WEIGHT - -

C. G. POSITION -

REPORT NO. - T-0579-1

SHEET 111

DATE - -

PREPARED BY - R. GAWLIS

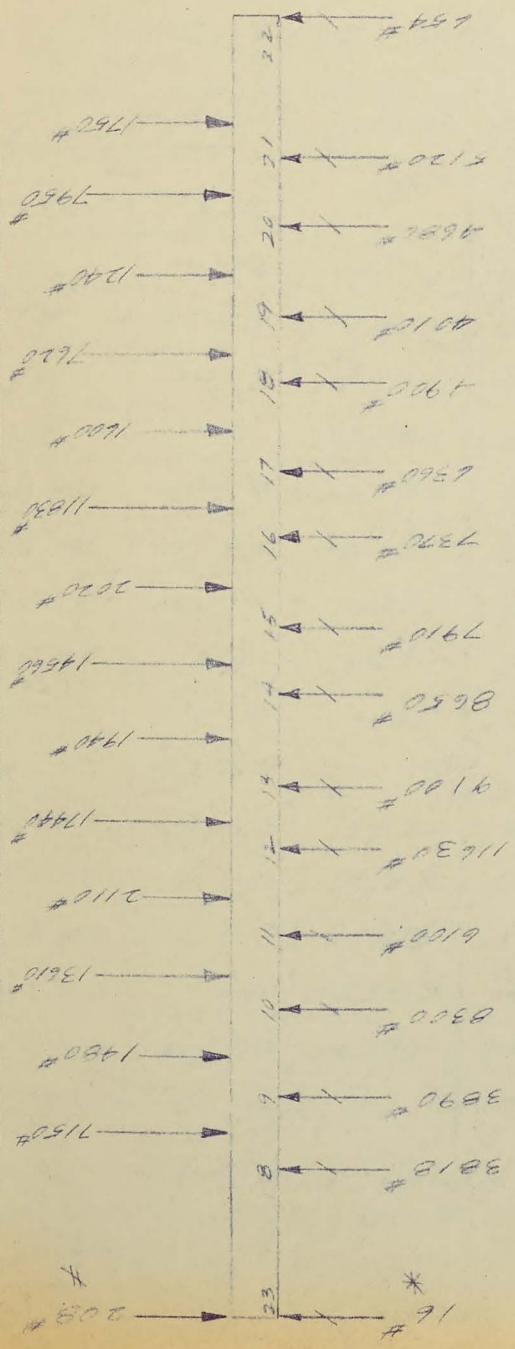
17	18	19	20	21	22	23	24	25	26	27	28	29
	16		17		18		19		20		21	22
.356	.644	.751	.249	.382	.618	.737	.263	.440	.560	.779	.221	.110
3760	8880	-8880	2640	-2640	5710	-5710	1830	-1830	5960	-5960	2085	-2880
1828	-3290	4480	1550	-1171	-1895	2860	1020	-1315	-2310	3020	856	2880
776	2340	-1695	-585	775	1430	-947	-907	510	1510	-1155	1440	427
1110	-2010	1675	556	-844	-1363	1367	487	-890	-1136	-222	-63	-427
367	937	-1105	-422	278	683	-681	-445	243	-111	-565	-213	-31
429	-775	1071	356	-367	-594	829	297	-58	-74	605	173	31
200	536	-388	-184	178	419	-297	-29	149	302	-37	15	87
262	-474	436	143	-226	-366	240	86	-177	-253	17	5	-87
38	215	-237	-113	71	120	-183	-77	43	9	-126	-44	2
108	-195	262	88	-73	-118	308	74	-22	-29	132	38	-2
49	132	-97	-36	44	104	-59	-11	37	66	-15	-1	19
65	-116	180	33	-56	-92	52	18	-45	-53	12	4	-19
21	50	-58	-28	17	26	-46	-23	9	6	-29	-10	2
25	-46	66	21	-16	-27	51	19	-7	-8	30	9	-2
086	6084	-4027	4019	-4030	4032	-2316	2316	-3875	3879	-4293	4294	0

A. V. ROE CANADA LIMITED
MALTON - ONTARIO
TECHNICAL DEPARTMENT (Aircraft)

REPORT No. 7-0579-1
SHEET No. 112

AIRCRAFT:		PREPARED BY	DATE
C105	AILERON	R. GAVALIS	
		CHECKED BY	DATE

SPAR LOADING



$$\# \frac{W_{UP\,WING} - W_{DOWN}}{2}(\Delta L) = \frac{SZ - 0}{2}(\theta) = 205\ \#/\text{RAD/FT} \quad \text{(REF 185 - 71)}$$

* 16 = 208 - 192 LOAD OBTAINED FROM HARDY-CROSS METHOD

* ALL OTHER REACTIONS OBTAINED FROM HARDY-CROSS DISTRIBUTION.

ALL LOADS ARE NORMAL TO AILERON CHORD LINE.

CRN 3184

A. V. ROE CANADA LIMITED
MALTON - ONTARIO
TECHNICAL DEPARTMENT (Aircraft)

REPORT No. 7-0579-1
SHEET No. 112a

AIRCRAFT:		PREPARED BY	DATE
C105	AILERON	R. CAVALIS	
		CHECKED BY	DATE

SPAR LOADING

SUBSONIC CASE - UP AILERON (LIMIT)

SPAR SHEAR & MOMENT (NORMAL TO AILERON CHORD)
(LOADS DUE TO WING DEFLECTION NOT INCLUDED)

SPAR STATION	V_{INTBD} #	M IN#	SPAR STATION	V_{OUTBD} #	M
0	-192	0	69.62	916	-4683
13	3656	-7500	77.06	-1104	2127
16	-3474	8960	84.50	6266	-6083
19	346	-2030	87.50	-5564	12697
24.37	-1134	-170	90.50	796	-4013
29.75	7196	-6260	97.10	-804	1337
32.75	-6414	15320	103.70	4996	-4063
35.75	706	-3590	106.70	-3524	8217
41.12	-1404	-100	109.70	486	-2373
46.50	9226	-7650	115.60	-754	470
49.50	-8214	19970	121.50	3726	-3960
52.50	866	-5103	124.60	-4024	7830
53.06	-1084	-343	127.50	1096	-4250
63.62	7566	-6383	134.28	-654	3200
66.62	-6974	16297	139.17	0	0
ABOVE VALUES OBTAINED FROM LOADING ON					Pg. 12

NOTE: SHEAR (V) SHOWN IS SHEAR ON OUTBOARD SIDE OF SPAR STATION

CRM 1319A

A V ROE CANADA LIMITED
MALTON - ONTARIO
TECHNICAL DEPARTMENT (Aircraft)

REPORT NO. 7-0579-1
SHEET NO. 1126

AIRCRAFT:		PREPARED BY	DATE
2105	AILERON	R. GAVALIS	
		CHECKED BY	DATE

SPAR LOADING - SUMMARY (LIMIT)

SUBSONIC CASE - UP AILERON

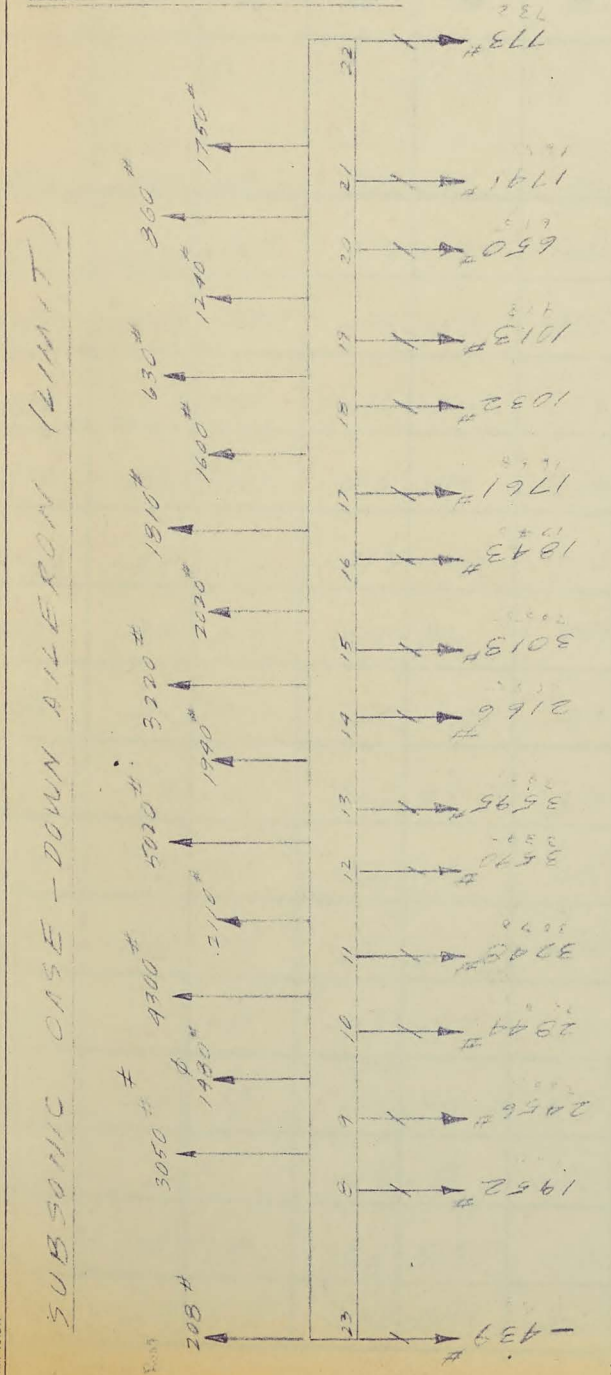
SPAR STATION ↓	RIB ↓ REF →	DEFLECTION LOADS V_{CRIT} # R_2	DEFLECTION LOADS M_x in# R_2	RIB LOADS V_{RIB} # R_3	RIB LOADS M_x in# R_3	TOTAL SPAR LOADS $V_{Z_{MAX}}$ #	TOTAL SPAR LOADS M_x in#
0	23	3540	0	0	0	3540	0
13	8	3540	46000	-192	-2500	3348	43500
16	1	3540	56500	3656	8460	7196	64960
19	9	-2220	47800	-3474	-1030	-5714	47570
24.37	1A	-2220	37900	346	-170	-1874	37730
28.75	10	-2220	26200	-1134	-6260	-3354	19940
32.75	2	-1120	14200	7196	15320	6076	34520
33.75	11	-1120	10110	-6414	-3830	-7534	12220
41.12	2A	-1120	9740	706	-100	-414	9640
46.50	12	-1120	3960	-1404	-7650	-2624	-3690
49.50	3	-1120	566	9226	19970	8106	20536
52.50	13	1168	4060	-5214	-5103	-7046	-1043
58.06	3A	1168	10640	866	-343	2034	10347
63.62	14	1168	17100	-1084	-6783	84	10717
66.62	9	1168	20600	7566	16297	8734	36897
[illegible]	15	-1204	16800	-6994	-4685	-8198	12120
77.06	4A	-1204	-940	916	2127	-288	10970
84.50	16	-1204	-550	-1104	-6083	-2308	-6930
87.50	5	-1204	-4420	6266	12697	5062	8080
90.50	17	382	-3500	-5564	-4013	-5182	-7513
97.10	5A	382	-945	796	1337	1179	392
103.70	18	382	1420	-804	-4063	-422	-2643
106.70	6	382	2700	4096	8217	4478	10920
109.70	19	382	2260	-3524	-2373	-3142	-110
115.60	6A	-147	1718	486	490	339	2210
121.50	20	-147	1478	-754	-3960	-901	-2480
124.50	7	-147	1356	3926	7530	3779	9186
127.50	21	-95	1080	-4024	-4250	-4119	-3170
134.25	7A	-95	452	1096	3200	1001	3650
137.17	22	-95	0	-654	0	-749	0

A. V. ROE CANADA LIMITED
MALTON - ONTARIO
TECHNICAL DEPARTMENT (Aircraft)

REPORT No. T-0579-1
SHEET No 113

AIRCRAFT:		PREPARED BY	DATE
C105	AILERON	R. GAVALIS	
		CHECKED BY	DATE

SPAR LOADING



MOMENT DISTRIBUTION WAS CALCULATED ON THE FOLLOWING PAGE.

REACTIONS WERE OBTAINED FROM LOADS SHOWN ABOVE & MOMENT DISTRIBUTION.

REF PG 80 & REF PG 79, 82 & 83

ORM. 1319A

SPAR LOADING

MOMENT DISTRIBUTION (LIMIT)

SUBSONIC CASE - DOWN AILERON

		1	2	3	4	5	6	7	8	9	10	11
RIB →	23		8		9		10		11		12	
	1.0	.358	.642	.670	.330	.390	.610	.684	.316	.397	.603	.6
FIXED-END MOMENTS	0	0	-2285	2285	-1985	1985	-3221	3221	-2830	2830	-3760	376
BALANCE (BAL.)	0	819	1469	-201	-99	481	765	-267	-124	369	560	-74
CARRY OVER (C.O.)	409	0	-100	735	240	-50	-133	377	185	-62	-370	29
BAL.	-409	36	64	-653	-322	71	112	-384	-178	172	261	-15
C.O	18	-204	-326	32	35	-161	-192	56	86	-89	-78	13
BAL.	-18	190	340	-45	-22	188	215	-97	-45	65	102	-3
C.O.	95	-7	-23	170	69	-11	-49	108	33	-23	-19	5
BAL.	-95	11	21	-160	-79	23	36	-96	-45	17	25	-1
C.O	5	-48	-80	10	12	-40	-48	18	9	-23	-6	1
BAL	-5	46	82	-15	-7	34	54	-18	-9	12	17	
C.O	23	-2	-8	41	17	-3	-9	27	6	-4	2	8
BAL	-23	4	6	-39	-19	5	7	-23	-10	1	1	
C.O	2	-11	-20	3	2	-9	-12	3	1.5	-5	1.5	
BAL	-2	+11	20	-3	-2	8	13	-2	-1.5	2	2.5	2
TOTAL MOMS.	0	843	-840	2160	-2160	2471	-2472	2923	-2923	3262	-3262	33

FORM 1344

(LIMIT)
AILERON

A.

AIR
WE
C.

	7	8	9	10	11	12	13	14	15	16	17	18	19	20
		11		12		13		14		15		16		17
	.684	.316	.397	.603	.699	.301	.410	.590	.782	.218	.356	.644	.751	.249
1	3221	-2830	2830	-3760	3760	-2700	2700	-2418	2418	-3760	3760	-1359	1359	-2640
	-267	-124	369	560	-740	-319	-116	-166	1049	293	-855	-1547	963	319
	377	185	-62	-370	280	-58	-159	525	-83	-427	147	486	-773	-414
	-384	-178	172	261	-155	-67	-150	-216	398	111	-225	-406	870	296
2	56	86	-89	-78	130	-75	-33	199	-108	-112	56	445	-203	-126
	-97	-45	65	102	-38	-17	-68	-93	172	48	-178	-322	247	82
	108	33	-23	-19	51	-34	-8	86	-99	-89	24	123	-161	-93
	-96	-45	17	25	-12	-5	-32	-46	108	30	-52	-95	191	63
	18	9	-23	-6	12	-16	-2	54	-23	-26	15	96	-47	-35
	-18	-9	12	17	3	1	-21	-31	38	11	-40	-71	62	20
	27	6	-4	2	8	-10	.5	19	-15	-20	5	31	-35	-29
	-23	-10	1	1	1	1	-8	-11	27	8	-13	-23	48	16
	3	.5	-5	.5	.5	-4	.5	13	-6	-6	4	24	-12	-8
	-2	-1.5	2	2.5	2.5	1	-5.5	-8	9.5	2.5	-10	-18	15	5
2	2923	-2923	3262	-3262	3303	-3302	2099	-2099	3435	-3937	2638	-2636	2544	-2544

A. V. ROE CANADA LIMITED

MALTON, ONTARIO

ENGINEERING DIVISION - AIRCRAFT

AIRCRAFT - - C105

WEIGHT - -

C. G. POSITION -

REPORT NO. - 7-0579-1

SHEET 114

DATE - -

PREPARED BY - R. GAVALIS

	17	18	19	20	21	22	23	24	25	26	27	28	29
		16		17		18		19		20		21	22
	.356	.644	.751	.249	.382	.618	.737	.263	.440	.560	.779	.221	1.0
0	3760	-1359	1359	-2640	2640	-472	472	-1830	1830	-645	645	-2085	2880
3	-855	-1547	963	319	-929	-1340	1600	358	-521	-664	1122	318	-2880
7	147	486	-773	-414	159	500	-670	-260	179	561	-332	-1440	159
	-225	-406	670	296	-252	-407	686	244	-326	-414	1381	391	-154
2	56	445	-203	-126	148	342	-203	-163	122	690	-207	-79	196
3	-178	-322	247	82	-187	-303	280	86	-357	-456	222	64	-175
9	29	123	-161	-93	41	140	-151	-178	43	111	-227	-98	32
	-52	-95	191	63	-69	-112	242	87	-68	-86	253	72	-32
	15	96	-47	-35	32	121	-56	-34	43	126	-43	-16	36
	-40	-71	62	20	-58	-95	66	29	-74	-95	46	13	-36
	5	31	-35	-29	10	33	-47	-37	12	23	-47	-18	6
	-13	-23	48	16	-16	-27	62	22	-15	-20	50	15	-6
	4	24	-12	-8	8	31	-13	-8	11	25	-10	-3	7
5	-10	-18	15	5	-15	-24	15.5	5.5	-16	-20	10	3	-7
37	2638	-2636	2544	-2541	1612	-1613	1682	-1684	863	-863	2823	-2863	0

A. V. ROE CANADA LIMITED
MALTON - ONTARIO
TECHNICAL DEPARTMENT (Aircraft)

REPORT No. 7-0579-1
SHEET No. 115

AIRCRAFT:		PREPARED BY	DATE
0105.	AILERON	R. GAVALIS	
		CHECKED BY	DATE

SPAR LOADING

SUBSONIC CASE - DOWN AILERON (LIMIT)

SPAR SHEAR (NORMAL TO AILERON CHORD)
& MOMENT (LOADS DUE TO WING DEFLECTION NOT INCLUDED)

SPAR STATION	$V_{INB'D}$ #	M IN #	SPAR STATION	$V_{INB'D}$ #	M IN #
0	0	0	69.62	1916	3936
13	647	842	77.06	-1097	-4213
16	-1305	-3070	84.50	923	2637
19	1745	2160	87.50	-920	-126
24.37	-711	-1669	90.50	890	2544
29.75	769	2471	97.10	-871	-3198
32.75	-2075	-3747	103.70	729	1612
35.75	2225	2923	106.70	-303	703
41.12	-1023	-2578	109.70	327	1683
46.50	1087	3262	115.60	-686	-2397
49.50	-2503	-4238	121.50	554	863
52.50	2517	3302	124.50	-96	573
58.06	-1078	-2701	127.50	764	2963
63.62	862	2077	134.28	-977	-3780
66.62	-1304	-1814	139.17	773	0

ABOVE VALUES WERE OBTAINED FROM LOADS SHOWN ON Pg 113

NOTE: SHEAR (V) SHOWN IS SHEAR ON INBOARD SIDE OF SPAR STATION.

FORM 1319A

A. V. ROE CANADA LIMITED
MALTON - ONTARIO
TECHNICAL DEPARTMENT (Aircraft)

REPORT No. 2-0578-1 116
SHEET No. 116

AIRCRAFT:		PREPARED BY	DATE
C105	AILERON	R GAVARIS	
		CHECKED BY	DATE

SPAR LOADING - SUMMARY

SUBSONIC CASE - DOWN AILERON (LIMIT)

SPAR STATION	RIB REF.	DEFLECTION LOADS V_{GRIP} lbs	DEFLECTION LOADS M_x in-lbs	RIB LOADS V_{INBD} lbs	RIB LOADS M_x in-lbs	TOTAL SPAR LOAD V lbs INBD OF STATION	TOTAL SPAR LOAD M in-lbs
0	23	+3540	0		0	+4187	0
13	8	+3540	46000	647	842	4187	46800
16	1	+3540	56500	-1305	-3070	2235	53400
19	9	-2220	49600	1745	2160	-475	51500
24.37	1A	-2220	37900	-711	-1659	-2930	36200
29.75	10	-2220	26200	769	2471	-1450	28700
32.75	2	-2220	19200	-2075	-3747	-4295	15500
35.75	11	-1120	16116	2725	2923	1105	19030
41.12	2A	-1120	9740	-1023	-2578	-2145	7160
46.50	12	-1120	3960	1087	3262	-33	7220
49.50	3	+1168	566	-2503	-4238	-1330	-3670
52.50	13	+1169	4060	2517	3302	3685	7360
58.06	3A	+1168	10610	-1078	-2701	90	7990
63.62	14	+1168	17100	962	2099	2030	19200
66.62	4	-1204	20600	-1304	-1814	-2510	18900
69.62	15	-1204	16800	1916	3936	712	20700
77.06	4A	-1204	7940	-1097	-4213	-2300	3730
84.50	16	-1204	-850	923	2637	-281	1787
87.50	5	-1204	-4620	-920	-126	-2125	-4746
90.50	17	+382	-3500	890	2544	+1270	-960
97.10	5A	+382	-945	-871	-3195	-490	-4140
103.70	18	+382	1420	729	1612	+110	3030
106.70	6	-147	2700	-303	703	-450	3400
109.70	19	-147	2260	327	1683	+180	3940
115.60	6A	-147	1713	-686	-2397	-830	-680
121.50	20	-141	1473	554	863	+405	2346
124.50	7	-95	1356	-96	573	-190	1930
127.50	21	-95	1080	764	2863	+670	3940
134.28	7A	-95	452	-977	-3780	-1070	-3330
137.17	22	-95	0	773	0	+680	0

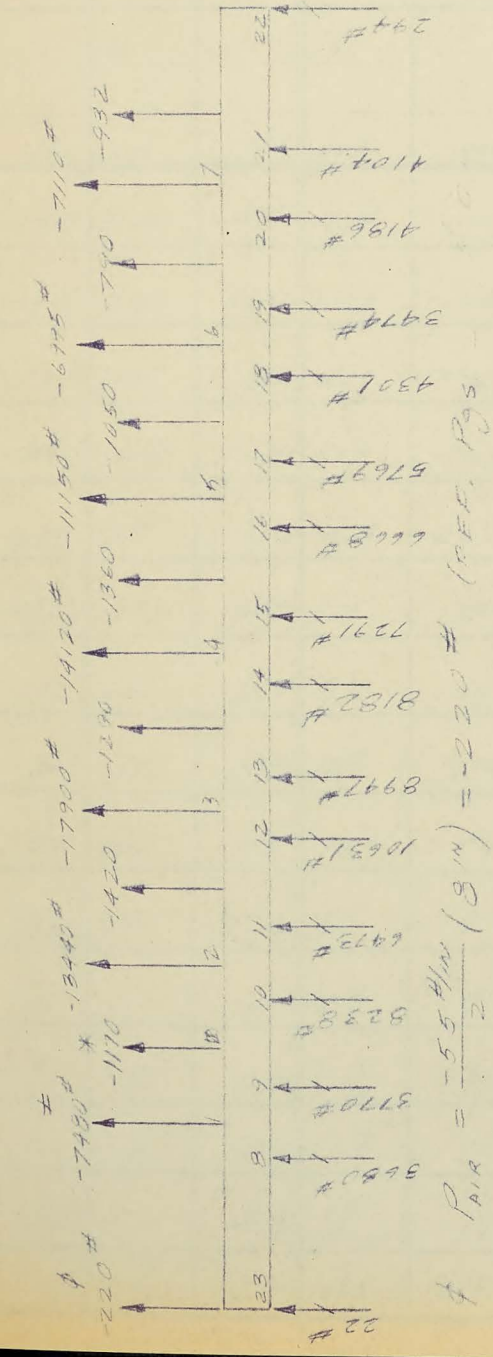
FORM 1194

A. V. ROE CANADA LIMITED
MALTON - ONTARIO
TECHNICAL DEPARTMENT (Aircraft)

REPORT No. 7-0579-1
SHEET No. 117

AIRCRAFT:		PREPARED BY	DATE
C105	AILERON	R. GAVALIS	
		CHECKED BY	DATE

SPAR LOADING



$P_{AIR} = \frac{-55\ \#/in\ (8\ in)}{2} = -220\ \#$ (REF. P3)

MOMENT DISTRIBUTION WAS CALCULATED ON THE FOLLOWING PAGE.

REACTIONS WERE OBTAINED FROM MOMENT DISTRIBUTION ABOVE & REF. P3.

* REF. P3.

#REF. P3.

SPAR LOADING

MOMENT DISTRIBUTION (LIMIT)

SUPERSONIC CASE - UP AILERON

		1	2	3	4	5	6	7	8	9	10	11
RIB	23		8		9		10		11		12	
	1.0	.358	.642	.670	.330	.390	.610	.684	.316	.397	.603	.69
FIXED END MOMENT	0	0	5350	-5350	1570	-1570	10100	-10100	1910	-1910	13910	-1341
BALANCE (BAL.)	0	-1915	-3435	2530	1250	-3320	-5200	5810	2580	-4560	-6940	8140
CARRY-OVER (C.O.)	-957	0	1265	-1717	-1660	625	2795	-2610	-2280	1290	4070	-348
BAL.	957	-453	-812	2280	1110	-1330	-2070	3330	1540	-2130	-3290	3680
C.O.	-226	478	1140	-406	-665	555	1665	-1045	-1065	770	1840	-1620
BAL.	226	-579	-1090	719	354	-865	-1350	1444	666	-1040	-1570	1840
C.O.	-289	113	360	-520	-432	177	722	-675	-520	333	920	-785
BAL.	289	-169	-304	637	314	-350	-547	817	378	-497	-755	864
C.O.	-84	144	318	-152	-175	157	408	-273	-245	189	432	-277
BAL.	84	-166	-297	219	108	-220	-344	356	165	-246	-374	365
C.O.	-33	42	110	-148	-110	54	178	-172	-123	83	182	-181
BAL.	83	-55	-96	173	85	-90	-142	202	93	-105	-160	206
C.O.	-28	41	86	-48	-45	42	101	-71	-52	46	103	-80
BAL.	23	-45	-81	62	31	-56	-87	94	39	-59	-90	95
TOTAL MOMENT	0	-2564	2564	-1721	1735	-6191	6209	-3113	3083	-7836	7828	-4637

FORM 1544

...TION (LIMIT)
...D ALLEGED

6	7	8	9	10	11	12	13	14	15	16	17	18	19	
		11		12		13		14		15		16		17
10	.684	.316	.397	.603	.699	.301	.410	.590	.782	.218	.356	.644	.751	.24
6100	-10100	1910	-1910	13910	-13410	1790	-1790	13600	-10600	2520	-2520	8350	-8350	17
5200	5640	2530	-4560	-6940	8140	3500	-3610	-5190	6310	1760	-2080	-3760	4770	163
795	-2600	-2280	290	4070	-3470	-1805	1750	3155	-2595	-1040	880	2485	-1875	-6
2090	3330	1540	-2130	-3290	3680	1588	-2010	-2890	2840	791	-1200	-2170	1910	65
465	-1045	-1065	770	1840	-1620	-1005	794	1420	-1445	-600	395	955	-1085	-4
1350	1477	666	-1040	-1570	1940	735	-904	-1310	1600	446	-480	-870	1150	33
22	-675	-520	333	920	-785	-452	392	800	-655	-240	223	575	-435	-20
547	817	378	-497	-755	864	372	-490	-705	690	192	-284	-514	477	15
85	-273	-248	189	432	-277	-245	186	345	-352	-142	96	239	-257	-12
44	356	165	-246	-374	365	157	-213	-314	386	108	-115	-208	283	94
78	-172	-123	83	182	-181	-109	78	193	-157	-57	54	141	-104	-4
42	202	93	-105	-160	206	90	-111	-160	167	47	-70	-125	110	37
1	-71	-52	26	103	-80	-55	45	83	-80	-35	23	55	-60	-30
7	94	39	-59	-90	95	41	-52	-75	90	25	-28	-50	69	23
99	-3113	3083	-7836	7828	-4637	4652	-5940	5962	-3801	3775	-5106	5113	-3199	320

A. V. ROE CANADA LIMITED

MALTON, ONTARIO

ENGINEERING DIVISION - AIRCRAFT

AIRCRAFT - - C 105

WEIGHT - -

C. G. POSITION -

REPORT NO. - 7-0574-1

SHEET 118

DATE - -

PREPARED BY - R. GAVALIS

18	19	20	21	22	23	24	25	26	27	28	29
6		17		18		19		20		21	22
644	,751	,249	,382	,618	,737	,263	,440	,560	,779	,221	1,0
3350	-3350	1730	-1730	5240	-5240	1165	-1165	5340	-5340	1109	-1540
3760	-4170	1650	-1340	-2170	3000	1075	-1840	-2390	3290	935	1540
2485	-1875	-610	825	1500	-1086	-920	538	1645	-1170	770	467
2170	1910	635	-890	-1440	1480	525	-958	-1226	312	88	-467
965	-1085	-445	317	740	-720	-479	262	156	-612	-233	44
970	1150	331	-403	-651	883	315	-184	-234	658	187	-44
475	-435	-201	191	441	-325	-92	157	329	-117	-22	93
514	477	159	-241	-390	303	108	-214	-272	108	31	-93
39	-257	-120	75	151	-195	-107	54	54	-136	-46	15
208	283	94	-86	-140	222	80	-47	-61	142	40	-15
41	-104	-43	47	111	-70	-23	40	71	-30	-7	20
125	110	37	-61	-98	68	24	-49	-62	29	8	-20
75	-65	-30	18	34	-49	-25	12	15	-31	-10	4
50	69	23	-20	-32	54	19	-12	-15	32	9	-2
113	-3199	3200	-3298	3296	-1674	1665	-3369	3400	-2866	2859	0

A. V ROE CANADA LIMITED
MALTON - ONTARIO
TECHNICAL DEPARTMENT (Aircraft)

REPORT NO. Z-0574-1
SHEET NO. 119

AIRCRAFT:		PREPARED BY	DATE
C105	AILERON	R. CAVALIS	
		CHECKED BY	DATE

SPAR LOADING - SUMMARY (LIMIT)

SUPERSONIC CASE - UP AILERON

M_x IS ABOUT LOCAL IN BOARD

SPAR STATION	RIB ↓ REF →	DEFLECTION* LOADS $V_{CRIT.}$ # (Pg 116)	DEFLECTION* LOADS M_x in-# (Pg 116)	RIB LOADS V_{RIB} # (Pg 115)	RIB LOADS M_x in-# (Pg 115)	TOTAL SPAR LOAD $V_{MAX.}$ #	TOTAL SPAR LOAD M_x in-#
0	23	3540	0	0	0	3540	0
13	8	3540	46000	-198	-2560	3342	43440
16	1	3540	56560	3879	9080	7419	65580
19	9	-2220	49600	-3601	-1730	-5821	47870
24.37	1A	-2220	37900	169	-825	-2051	37075
29.75	10	-2220	26200	-1001	-6200	-3221	20000
32.75	2	-1120	19200	7237	15540	6117	34740
35.75	11	-1120	16110	-6203	-3100	-7323	13010
41.12	2A	-1120	7740	270	-1650	-850	6090
46.50	12	-1120	3960	-1150	-7890	-2270	-3870
49.50	3	-1120	566	9481	20555	8361	21121
52.50	13	1168	4060	-9419	-4645	-7251	-585
58.06	3A	1168	10670	528	-1710	1696	8960
63.62	14	1169	17130	-762	-5950	406	11150
66.62	4	1168	20600	7420	16310	8588	36910
69.62	15	-1204	16300	-6710	-3790	-7914	13010
77.06	4A	-1204	7740	641	400	-613	8540
84.50	16	-1204	-860	-769	-5110	-1973	-5960
87.50	5	-1204	-4620	5274	12600	4695	7980
90.50	17	382	-2700	-5251	-5200	-4869	-5900
97.10	5A	382	-145	518	203	900	+58
103.70	18	382	2420	-632	-3290	-132	-870
106.70	6	382	3720	3769	8020	4151	11720
109.70	19	-133	3321	-3226	-1670	-3359	1651
115.60	6A	-133	2536	248	-200	115	2336
121.50	20	-133	1755	-542	-3400	-675	-1645
124.50	7	-133	1356	3644	7535	3511	8890
127.50	21	-95	1080	-3466	-2865	-3561	-1785
132.28	7A	-95	452	638	1437	543	1891
137.17	22	-95	0	-294	0	-387	0

A. V ROE CANADA LIMITED
MALTON - ONTARIO
TECHNICAL DEPARTMENT (Aircraft)

REPORT NO. 7-0579-1
SHEET NO. 120

AIRCRAFT:		PREPARED BY	DATE
C 105	AILERON	R. GAVALIS	
		CHECKED BY	DATE

SPAR LOADING - SUMMARY (LIMIT)

DESIGN MOMENT (M_x)

(+ = COMPRESSION IN UPPER FIBER)
(+V_z IS DOWN WHEN LOOKING INB'D)

SPAR STATION	RIB	V_z #	$M_{x_{MAX}}$ IN#	SPAR STATION	RIB	V_z #	$M_{x_{MAX}}$ IN#
0	E3	3540	0	69.62	15	-4685	21800
13	9	4733	44200	77.06	4A	-2280	11800
16	1	7419	65380‡	89.50	16	-4400 -2308	3200 -6930
19	1	-3730	54300	97.50	5	-4400 5062	-10220 8080
24.37	1A	-3210	41700	90.50	17	-5182	-7513
29.75	10	-3110	30700	97.10	5A	1220 1110	1300 -4140
32.75	2	6117	30750‡	103.70	18	2590	4400 -1400
35.75	11	-3830	19750	106.70	6	2590 4151	-800 11720‡
41.12	2A	-2371	12300	109.70	19	-2040	4400
46.50	12	-2371	3500	115.60	6A	-798	3400
49.50	3	5120 8360	-6700 21120‡	121.50	20	-2010 -901	3800 -2450
52.50	13	4845	7900	129.50	7	-2440 3779	-2000 *9186
58.06	3A	2196	13200	127.50	21	-2384	4600 -2400
63.62	14	2215	21700	134.28	7A	-1131	4000 -3100
66.62	4	8598	36910‡	139.17	22	-819	0

NOTE: $M_{x_{MAX}}$ GIVEN IS HIGHEST NUMERICAL VALUE OF MOMENTS GIVEN ON R/S 1 TO 11, 19, 18.
V_z IS SHEAR COMPATIBLE WITH $M_{x_{MAX}}$ BUT IS NOT NECESSARILY THE HIGHEST POSSIBLE SHEAR.

‡ SUPERSONIC CASE
* SUPERSONIC CASE GIVES M_x = 8890 IN#, V = 3497 #

A V ROE CANADA LIMITED
MALTON - ONTARIO
TECHNICAL DEPARTMENT (Aircraft)

REPORT NO. 7-0574-1
SHEET NO 121

AIRCRAFT:		PREPARED BY	DATE
C105	AILERON	R. CAVALIS	
		CHECKED BY	DATE

SPAR LOADING - SUMMARY (DEFLECTION LOADS ONLY)

CHORDWISE BENDING MOMENT & SHEAR

(POSITIVE SHEAR IS AFT, POSITIVE MOM. IS COMPRESSION IN T. EDGE)

RIB	SUBSONIC - UP AILERON		SUBSONIC - DOWN AILERON		SUPERSONIC - UP AILERON		SUPERSONIC - DOWN AILERON	
	V_x	M_z	V_x	M_z	V_x	M_z	V_x	M_z
REF. →			[illegible]					
23			-1220	0				
8			-1210	-5900				
1			-1220	-19500				
1			+760	-17100				
1A			+760	-13100				
10			+760	-9050				
2			+760	-6620				
11			+386	-5360				
2A			+386	-3360				
12			+386	-1370				
3			-402	-195				
13			-402	-1400				
3A			-402	-3680				
14			-402	-5900				
4			+415	-7110				
15			+415	-5800				
4A			+415	-2700				
16			+415	294				
5			+415	1590				
17			-132	1210				
5A			-132	526				
18			-132	-490				
6			+51	-782				
19			+51	-780				
6A			+51	-642				
20			+51	-510				
7			+33	-468				
21			+33	-378				
7A			+33	-156				
22			+33	0				

A. V ROE CANADA LIMITED
MALTON · ONTARIO
TECHNICAL DEPARTMENT (Aircraft)

REPORT NO. 7-0579-1
SHEET NO. 122

AIRCRAFT:		PREPARED BY	DATE
C105	AILERON	R. GAVALIS	
		CHECKED BY	DATE

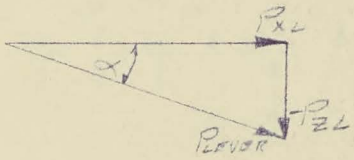
AILERON LOADS SUMMARY - SUBSONIC (LIMIT)

NEUTRAL AILERON *

COMPONENTS OF LEVER LOADS

$P_{XL} = P_{LEVER} \cos\alpha$

$P_{ZL} = -P_{LEVER} \sin\alpha$



RIB ↓ REF. →	α	P_{LEVER}	SIN α	COS α	P_{ZL} #	P_{XL} #
1	4°58'	±14600	.0865	.9963	∓ 1260	±14580
2	7°20'	±25000	.1276	.9921	∓ 3180	±24800
3	10°06'	±31100	.1754	.985	∓ 5450	±30600
4	10°56'	±24500	.1900	.981	∓ 4650	±24000
5	12°25'	±18800	.216	.975	∓ 4060	±18300
6	13°27'	±11420	.233	.972	∓ 2660	±11200
7	13°46'	±12360	.238	.971	∓ 2940	±12000

RIB LOADING (LIMIT) - MAIN RIBS

RIB ↓ REF. →	1 P_{AIR} B	2 P_{ZL}	3 P_{ZH} -① − ②	4 P_{XH} $-P_{XL}$	5
1	∓ 1100	∓ 1260	± 2360	∓ 14580	
2	∓ 2150	∓ 3180	± 5330	∓ 24800	
3	∓ 2940	∓ 5450	± 7490	∓ 30600	
4	∓ 2020	∓ 4650	± 6670	∓ 24000	
5	∓ 1830	∓ 4060	± 5890	∓ 18300	
6	∓ 1410	∓ 2660	± 4070	∓ 11200	
7	∓ 1200	∓ 2940	± 4140	∓ 12000	

DESIGN MOMENT FOR AILERON NEUTRAL POSITION RECEIVED 8-27-54.

A V ROE CANADA LIMITED
MALTON · ONTARIO
TECHNICAL DEPARTMENT (Aircraft)

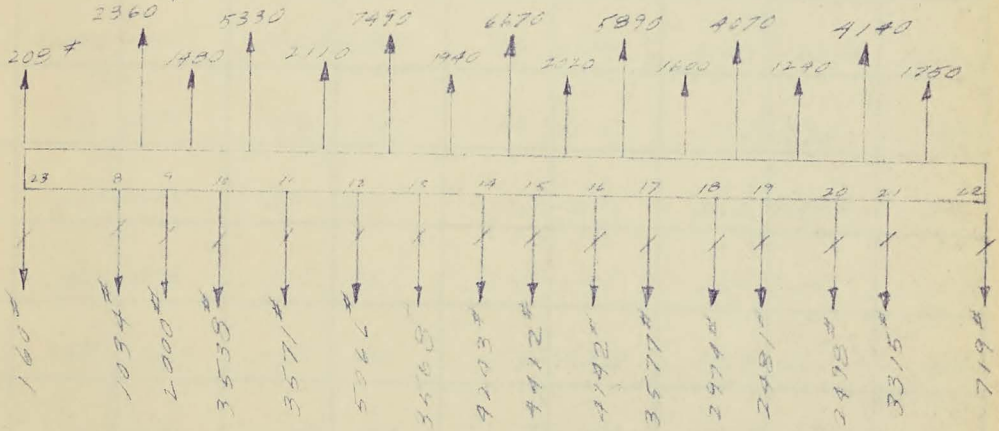
REPORT No. T-0579-1
SHEET No. 123

AIRCRAFT:		PREPARED BY	DATE
C105	AILERON	R. GAVALIS	
		CHECKED BY	DATE

SPAR LOADING (LIMIT)

LOADS DUE TO RIBS & LEVERS

SUBSONIC CASE - NEUTRAL AILERON ϕ



ϕ ALL LOADS ARE REVERSIBLE

THE MOMENT DISTRIBUTION WAS CALCULATED ON THE FOLLOWING PAGE.

REACTIONS WERE OBTAINED FROM LOADS SHOWN ABOVE & MOMENT DISTRIBUTION.

THE SPAR SHEAR & MOMENT IS GIVEN ON P. 124

* FREE R.
* REF PREVIOUS PAGE

SPAR LOADING

MOMENT DISTRIBUTION (LIMIT)

SUBSONIC CASE - NEUTRAL AILERON

		1	2	3	4	5	6	7	8	9	10	11
RIB →	23		8		9		10		11		12	
DIST. FACTOR	1.0	.358	.642	.670	.330	.390	.610	.684	.316	.397	.603	.69
FIXED END MOM.	0	0	-1770	1770	-1985	1985	-4000	4000	-2830	2830	-5600	560
BALANCE	0	634	1138	144	71	785	1230	-800	-370	1100	1670	-202
CARRY-OVER (C.O.)	317	0	72	569	392	35	-400	615	550	-135	-1010	83
BAL.	-317	-26	-46	-644	-317	142	223	-795	-368	475	720	-91
C.O.	-13	-158	-322	-23	71	-158	-397	112	237	-184	-456	360
BAL.	13	172	308	-32	-16	216	338	-230	-110	254	386	-38
USE AS NOM.	0	621	-621	1784	-1784							
NOM. TOTAL	0	622	-620	1784	-1784	3005	-3006	2844	-2891	3291	-4290	347

FORM 1544

LIMIT)

L AILERON

A. V.

EI

AIRCRAI

WEIGHT

C. G. P

7	8	9	10	11	12	13	14	15	16	17	18	19	20
	11		12		13		14		15		16		17
.684	.316	.397	.603	.699	.301	.410	.590	.782	.218	.356	.644	.751	.249
-4000	-2830	2930	-5600	5600	-2700	2700	-5000	5000	-3760	3760	-4410	4410	-2690
-800	-370	1100	1670	-2020	-871	744	1360	-970	-270	231	413	-1830	-491
615	552	-135	-1010	835	472	-435	-485	690	115	-135	-665	209	78
-795	-368	475	720	-913	-393	377	542	-621	-173	285	515	-216	-71
112	237	-189	-456	360	189	-196	-310	271	142	-86	-108	251	128
-238	-110	254	386	-389	-165	208	298	-322	-90	69	125	-289	-96
2894	-3391	4230	-4290	3478	-3783	3598	-3595	4038	-4036	4124	-4125	3091	-3042

A. V. ROE CANADA LIMITED

MALTON, ONTARIO

ENGINEERING DIVISION - AIRCRAFT

REPORT NO. - 7-0579-1

SHEET - 129

AIRCRAFT - - C 105

WEIGHT - -

C. G. POSITION -

DATE - -

PREPARED BY - R. GAVALIS

17	18	19	20	21	22	23	24	25	26	27	28	29
	16		17		18		19		20		21	22
.356	.644	.751	.249	.382	.618	.737	.263	.440	.560	.779	.221	1.0
3760	-4410	4410	-2690	2640	-3050	3050	-1830	1880	-3100	3100	-2065	2890
231	413	-1330	-441	156	254	-900	-321	560	712	-790	-225	-2890
-135	-665	209	79	-220	-456	127	280	-160	-295	356	-1440	-112
285	515	-216	-71	156	414	-300	-107	200	255	845	240	112
-86	-108	257	128	-35	-160	207	100	-53	422	127	56	120
69	125	-289	-96	71	114	-226	-81	-163	-206	-143	-40	-120
4124	-4125	3041	-3042	2860	-2860	1958	-1959	3214	-2212	3495	-3494	0

A. V. ROE CANADA LIMITED
MALTON - ONTARIO
TECHNICAL DEPARTMENT (Aircraft)

REPORT NO. 7-0579-1
SHEET NO. 125

AIRCRAFT:		PREPARED BY	DATE
C 105	AILERON	R. GAVALIS	
		CHECKED BY	DATE

SPAR LOADING - SUMMARY (LIMIT)

SUBSONIC CASE - NEUTRAL AILERON

SPAR STATION	RIB ↓ REF. →	DEFLECTION ± LOADS V_{SPLIT} #	DEFLECTION ± LOADS M_x IN#	RIB LOADS $\pm V_{RIB\,\Delta}$ #	RIB LOADS $\pm M_x$ IN#	TOTAL SPAR LOAD $V_{\#\,MAX}$ #	TOTAL SPAR LOAD M_x IN#
		β_3 [illegible]	β_3 [illegible]	β_3 [illegible]	[illegible]		
0	23	3740	0	0	0	3790	0
13	9	3740	43600	43	621	4730	49200
16	1	3740	57700	-986	-2336	4730	62000
19	9	-2357	52500	1374	1794	-3730	54300
24.37	1A	-2357	40100	-626	-1570	-3210	41700
29.75	10	-2357	27700	854	3006	-3210	30700
32.75	2	-2357	20300	-2684	-5057	-5040	15400
35.75	11	-1186	17050	2646	2893	-3830	19950
41.12	2A	-1186	10300	-925	-2070	-2371	12300
46.50	12	-1186	4200	1185	4290	-2371	8500
49.50	3	1235	600	-3881	-7337	5120	7900 -6700
52.50	13	1235	4300	3609	3473	4845	7800
58.06	3A	1235	11300	-959	-1855	2195	13200
63.62	14	1235	18100	981	3593	2215	21700
66.62	4	-1277	21800	-3262	-6183	-4540	28000
69.62	15	-1277	17800	3405	4037	-4685	21800
77.06	4A	-1277	8400	-1004	-3475	-2290	11800
84.50	16	-1277	-900	1016	4125	-4400	3200 -5000
87.50	5	-1277	-4395	-3125	-5259	-4400	400 -10200
90.56	17	405	-3700	3764	3041	3170	-6700
97.10	5A	405	-1000	-813	-2332	1220	1300 -3300
103.70	18	405	1500	757	2868	2590	4400 -1400
106.70	6	405	2860	-2187	-3691	2540	6600 800
109.70	19	-156	2370	1893	1959	-2040	4400
115.60	6A	-156	1820	-598	-1577	-798	3400
121.50	20	-156	1560	642	2213	-2010	3800
124.50	7	-156	1937	-1856	-3365	-2440	1800 -2000
127.50	21	-100	1141	2284	3495	-2334	4600 -2400
134.28	7A	-100	478	-1031	-3510	-1131	4000 -7100
139.17	22	-100	0	719	0	-819	0

A. V. ROE CANADA LIMITED
MALTON - ONTARIO
TECHNICAL DEPARTMENT (Aircraft)

REPORT No. 7-0579-1
SHEET No. 126

AIRCRAFT		PREPARED BY	DATE
C 105	AILERON	R. GAVALIS	12-3-54
		CHECKED BY	DATE

SPAR LOADING

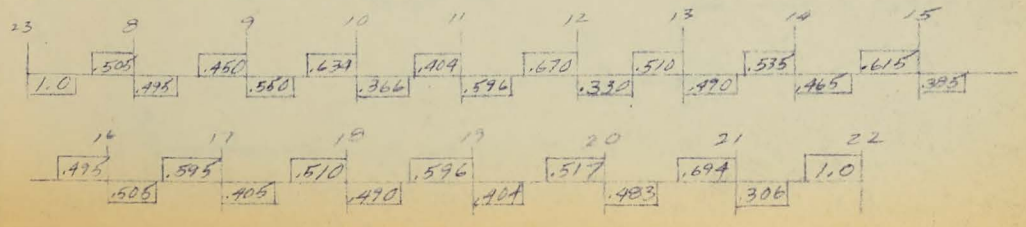
LOADS DUE TO RIBS & LEVERS

THE SPAR MOMENT OF INERTIA AND BACK-UP RIB LOCATIONS ARE CONSIDERABLY DIFFERENT THAN ASSUMED. THE EFFECT OF THESE DIFFERENCES WILL BE CALCULATED.

STIFFNESS FACTORS:

MEMBER	I IN.^{4}	L IN.	$K=\frac{I}{L}$ IN.^{3}
REFERENCE →	Rg 47a	DRAWINGS	
23-8	7.0	10.30	.873
8-9	8.2	9.60	.855
9-10	7.1	6.85	1.036
10-11	6.0	10.00	.600
11-12	5.1	5.75	.888
12-13	4.5	10.30	.436
13-14	3.7	8.82	.420
14-15	3.1	8.50	.365
15-16	2.6	11.38	.229
16-17	2.1	9.00	.233
17-18	1.7	10.70	.159
18-19	1.3	8.50	.153
19-20	1.0	9.60	.104
20-21	.80	8.20	.0975
21-22	.50	11.67	.0430

DISTRIBUTION FACTORS:



FORM 1319A

A. V ROE CANADA LIMITED
MALTON - ONTARIO
TECHNICAL DEPARTMENT (Aircraft)

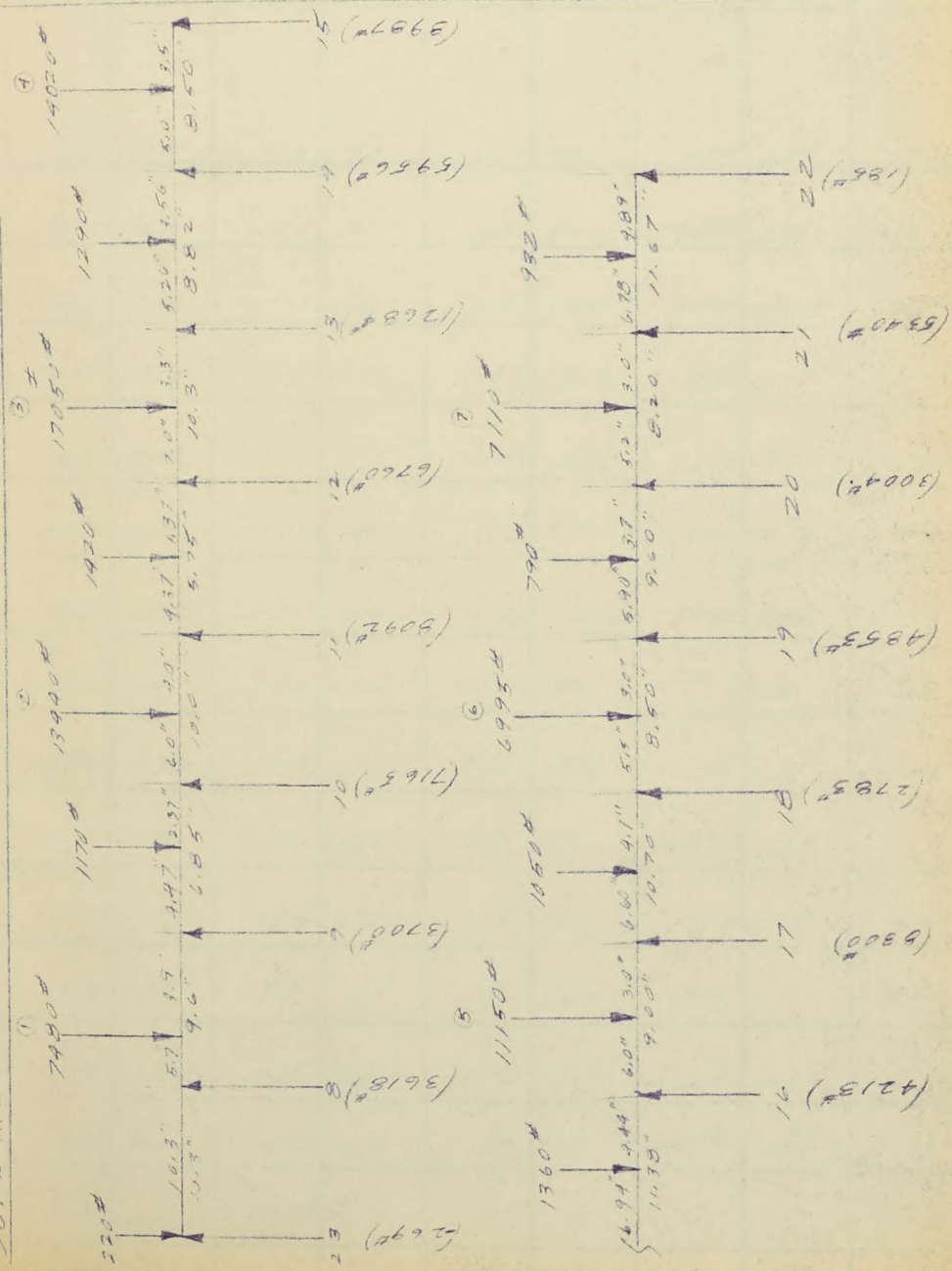
REPORT No. 2-0579-1
SHEET No. 127

AIRCRAFT:		PREPARED BY	DATE
C105	AILERON	R. GAVALIS	12-3-59
		CHECKED BY	DATE

SPAR LOADS

LOADS DUE TO RIBS & LEVERS

SUPERSONIC CASE - UP AILERON (LIMIT)



FORM 1319A

SPAR LOADING

MOMENT DISTRIBUTION (LBS-FT)

SUPERSONIC CASE - UP AILERON

		1	2	3	4	5	6	7	8	9	10	11
RIB →	23	8		9		10		11		12		
DIST. FACTOR	1.0	.505	.496	.1450	.550	.639	.366	.404	.596	.670	.330	.151
FIXED END MOMENT	0	0	7030	-10300	626	-1180	12900	-19300	352	-1121	12210	-266
BALANCE	0	-3550	-3490	4350	5310	-7490	-4300	7650	11300	-7410	-3650	1261
CARRY OVER	-1775	0	2175	-1740	-3720	2655	3825	-2150	-3705	5650	6305	-192
BAL.	1775	-1100	-1078	2460	3000	-4100	-2370	2360	3470	-2080	-3940	234
C.O.	-550	888	1230	-539	-2050	1500	1180	-1185	-4060	1745	1165	-19
BAL.	550	-1069	-1048	1120	1370	-1700	-980	2090	3090	-1950	-960	245
C.O	-534	275	560	-524	-850	685	1045	-490	-975	1545	1240	-48
BAL.	534	-421	-414	619	756	-1096	-634	590	976	-1870	-915	55
C.O	-210	267	309	-207	-545	278	295	-317	-935	437	276	-45
BAL	210	-291	-285	340	415	-363	-210	506	746	-477	-235	57
C.O	-145	185	170	-142	-181	207	253	-185	-230	373	297	-11
BAL	145	-139	-136	185	175	-291	-168	138	205	-442	-218	13
C.O	-69	72	72	-68	-195	89	69	-84	-221	102	66	-10
BAL	69	-73	-71	96	117	-100	-68	123	182	-113	-55	13
TOTAL MOMENT	0	-5036	5039	-4390	4278	-10856	10847	-10174	10166	11531	11575	-121
	0		5035		4330		10850		10170		11550	

FORM 1544

OTION (6-10-57)

- UP AILERON

6	7	8	9	10	11	12	13	14	15	16	17	18	19	
	11		12		13		14		15		16		17	
.366	.404	.596	.670	.330	.1510	.470	.535	.485	.615	.385	.495	.505	.595	.5
12900	-19300	352	-1121	12210	-26000	1108	-1631	11900	-16780	1440	-2240	7440	-14830	14
-4300	7650	11300	-7410	-3650	12610	12110	-5490	-4760	9550	5980	-2580	-2620	8230	5
3815	-2150	-3705	5650	6305	-1825	-2745	6055	4775	-2380	-1270	2770	4115	-1310	-8
-2370	2360	3470	-8000	-3940	2330	2240	-5800	-5050	2260	1410	-3520	-3590	1260	8
1180	-1185	-4000	1745	1165	-1970	-2300	1120	1130	-2525	-1760	705	630	-1795	-1
-930	2070	3090	-1750	-960	2430	2380	-1203	-1049	2640	1650	-660	-675	1860	1
1045	-490	-775	1545	1240	-480	-601	1190	1320	-625	-330	825	930	-337	-2
-634	590	875	-1870	-915	551	530	-1341	-1169	525	330	-870	-886	394	2
295	-317	-935	437	275	-457	-670	265	262	-589	-435	165	172	-493	-3
-210	506	746	-477	-235	575	551	-282	-245	626	392	-117	-120	467	3
253	-105	-238	373	287	-117	-141	276	313	-122	-58	196	233	-60	-3
-168	138	205	-492	-218	132	127	-314	-274	111	69	-212	-216	68	4
69	-84	-221	102	66	-109	-157	63	55	-137	-106	35	34	-163	-2
-63	123	182	-113	-55	136	130	-63	-55	150	93	-34	-35	115	7
9847	-10174	10166	11531	11576	-12134	11962	-7156	7153	-7391	7396	-5317	5412	-6537	4
50	10170		11550		12050		7155		7340		5365		6054	

A. V. ROE CANADA LIMITED

MALTON, ONTARIO

ENGINEERING DIVISION — AIRCRAFT

AIRCRAFT - - C105

WEIGHT - -

C. G. POSITION -

REPORT NO. - 7-0574-1

SHEET - - 128

DATE - - - 12-3-59

PREPARED BY - R. SAVARIS

18	19	20	21	22	23	24	25	26	27	28	29
	17		18		19		20		21		22
.505	.595	.405	.510	.490	.596	.404	.517	.483	.694	.306	1.0
7440	-14830	1020	-1690	4790	-8770	692	-1102	4950	-8590	1115	-1598
-2620	8230	5600	-1610	-1595	4810	3260	-1996	-1860	5180	2280	1598
4115	-1310	-805	2800	2405	-772	-995	1630	2590	-930	774	1140
-3590	1260	855	-2660	-2560	1051	714	-2180	-2040	108	93	-1140
630	-1795	-1330	427	525	-1275	-1090	357	54	-1020	-570	24
-675	1860	1269	-435	-466	1910	955	-212	-198	1105	485	-24
930	-337	-242	635	705	-233	-106	477	552	-99	-12	242
-886	344	234	-684	-656	202	137	-531	-496	77	34	-242
172	-443	-342	117	101	-323	-265	68	38	-243	-121	17
-120	467	318	-110	-107	354	239	-55	-51	256	113	-17
233	-60	-55	159	177	-53	-27	119	128	-25	-9	56
-216	68	47	-172	-165	48	32	-128	-119	24	16	-56
34	-103	-86	23	24	-82	-64	16	12	-59	-28	5
-35	115	79	-24	-23	87	59	-14	14	60	27	-5
5412	-6537	6563	-3224	3215	-3551	3541	-3545	3579	-4161	4146	0
605	6550		3220		3545		3560		4155		6

A. V. ROE CANADA LIMITED
MALTON, ONTARIO
TECHNICAL DEPARTMENT (Aircraft)

REPORT No. 7-0579-1
SHEET No. 129

AIRCRAFT:		PREPARED BY	DATE
C105	AILERON	R. GAVALIS	12-6-59
		CHECKED BY	DATE

SPAR LOADS

LOADS DUE TO WING DEFLECTION

THE SPAR LOADING DUE TO WING DEFLECTION WILL BE CALCULATED (FOR THE NEW SECTION PROPERTIES & RIB LOCATIONS) BY THE HARDY-CROSS METHOD.

THE FIXED-END MOMENT IS

$M = \frac{6KE\Delta}{L}$ WHERE $E = 9.7 \times 10^6$ psi

$K = \frac{I}{L}$ (Pg 126)

Δ = DEFLECTION (Pg. 466)

MEMBER	K IN^3	Δ IN	L IN	M $\times 10^{-6}$ IN.LB
REF. →	Pg. 126	Pg 466-470	Pg. 126	
23-8	.073	.409	10.30	2.0199
8-9	.255	.261	9.60	1.3526
9-10	1.036	.145	6.85	1.2763
10-11	.600	.145	10.00	.5063
11-12	.988	.068	5.75	.6112
12-13	.436	.107	10.30	.2636
13-14	.420	.050	3.82	.1386
14-15	.366	-.015	3.50	-.03749
15-16	.229	-.098	11.38	-.11477
16-17	.233	-.092	9.00	-.13856
17-18	.157	-.160	10.70	-.13837
18-19	.153	-.150	8.50	-.15714
19-20	.104	-.200	9.60	-.12606
20-21	.0776	-.190	8.20	-.13148
21-22	.0430	-.230	11.67	-.06004
		Σ =	139.17	

FORM 1519A

SPAR LOADING

MOMENT DISTRIBUTION DUE TO WING DEF.

SUPERSONIC CASE - UP AILERON

		1	2	3	4	5	6	7	8	9	10	
	23	8		9		10		11		12		
DIST. FACTOR	1.0	.605	.495	.450	.550	.634	.366	.404	.596	.670	.330	
$\times 10^{-6}$ FEM.	2.0199	2.0199	1.3526	1.3526	1.2763	1.2763	.5063	.5063	.6112	.6112	.2636	.2
BAL	-2.0199	-1.7031	-1.6694	-1.1830	-1.4457	-1.1302	-.6524	-.4515 -.6984	-.6660 -1.0303	-.5861	-.2527	-.1
C.O.	-.85155	-1.0079	-.5915	-.5347	-.5651	-.7229	-	-.3262	-.2930		-.1025	-.14
BAL	.85155	.8087	.79269	.6297	.76959		.3924	.2502	.3690	.4138		.08
C.O.	.40956	.42583	.31495	.39635		.38494	.1251	.1962	.2069	.1845	.04369	
BAL	-.40956	-.37407	-.3666		-.40488	-.3234	-.1867	-.16285	-.2402	-.1529	-.0753	-.04
C.O.	-.18703	-.20217		-.1833	-.1617	-.20244	-.08142	-.0933	-.0764	-.1201	-.02951	-.03
BAL	+.18703		+.18206	.1553	.1897	.1799	.1039	.0686	.1011	.1002	.0494	.02
C.O.		.09351	.07765	.09103	.0899	.0948	.0343	.0519	.0501	.0505	.01163	.02
BAL	-.09277	-.08644	-.08972	-.08192	-.09952	-.08184	-.04725	-.04121	-.04677	-.04163	-.02050	-.01
C.O.	-.04322	-.04633	-.04171	-.04236	-.04092	-.04976	-.02065	-.023676	-.02081	-.03039	-.007905	-.01
BAL	.04322	.04313	.04311	.03749	.04590	.04461	.02575	.01797	.02651	.02566	.01269	.006
C.O	+.02199	+.02161	.01874	.02155	.02230	.02290	.008985	.012376	.01283	.013255	.003268	.006
BAL	-.02199	-.02038	-.01997	-.01973	-.02412	-.02022	-.01167	-.010385	-.015320	-.01107	-.005453	-.00
TOTAL MOMENT	0	156,800	-156,700	8,490	-8450	152,400	-152,500	-252,000	H	1 6 4	MOMENT	

FORM 1544

UE TO WING DEFLECTION

AILERON

A.

AIR
WE
C.

	7	8	9	10	11	12	13	14	15	16	17	18	19	20
	11		12		13		14		15		16		17	
	.404	.596	.670	.330	.510	.490	.535	.465	.615	.385	.495	.505	.595	.405
	.5063	.6112	.6112	.2636	.2636	.1386	.1386	-.03749	-.03749	-.11477	-.11477	-.13856	-.13856	-.1353
7	-.4515 -.6984	-.6660 -1.0303	-.5861	-.2957	-.2051	-.1971	-.03409	-.04701	.09364	.05862	.12540	.12793	.16477	.11216
	-.3262	-.2930		-.1025	-.1443	-.02704	-.0785	-.04682	-.02350	.06270	.02931	.08238	.06376	.07535
7	.2502	.3690	.4138		.08738	.08376	.02765	.02483	-.0241	-.01607	-.05529	-.05640	-.08389	-.05642
	.1962	.2069	.1845	.04369		.01382	.04193	-.11200	.01201	-.02764	-.00754	-.04144	-.02920	-.0353
7	-.16285	-.2402	-.1529	-.0753	-.05402		-.016137	-.01397	.003612	.006018	.02425	.02974	.03309	.02595
2	-.0933	-.0764	-.1201	-.02951	-.0376	-.008019		.004806	-.00677	.01212	.003009	.01904	.01237	.01775
	.0686	.1011	.1002	.0494	.02327	.02235	.01259		-.003167	-.001783	-.01091	-.01114	-.01772	-.0122
	.0519	.0501	.0505	.01163	.02470	.006225	.011175	-.001583		-.005953	-.00771	-.00376	-.00557	-.00835
	-.09121	-.06077	-.09163	-.02050	-.01581	-.01519	-.005133	-.004420	-.000123		.007726	-.005015	.008732	.005632
5	-.023675	-.02081	-.03039	-.007905	-.01025	-.002565	-.007595	-.0060615	-.002230	+.002465		.004141	.002512	.004034
	.01797	.02651	.02566	.01264	.006536	.006279	.004067	.003634	-.0001453	-.0000397	-.002093		-.003893	-.00265
5	.012976	.01283	.013255	.003263	.00632	.002033	.0031376	-.000716	.001767	-.001024	-.0000493	-.001746		-.00189
	-.010385	-.015320	-.01107	-.005453	-.004260	-.004093	-.00164	-.001426	.000457	-.000286	.000185	.001005	.001749	
0	-.252000	HIGH	MOMENTS		INDICATE		THAT	AILERON		WILL		NOT		DE

A. V. ROE CANADA LIMITED

MALTON, ONTARIO
ENGINEERING DIVISION — AIRCRAFT

AIRCRAFT - - C105
WEIGHT - -
C. G. POSITION -

REPORT NO. - 7-0574-1
SHEET - - 1292
DATE - - 12-6-54
PREPARED BY - R. GAVALIS

17	18	19	20	21	22	23	24	25	26	27	28	29
16		17		18		19		20		21		22
495	.505	.595	405	.510	.490	.596	.404	.517	.483	.694	.306	1.10
1477	-.13856	-.13856	-.13837	-.13837	-.15714	-.15714	-.12606	-.12606	-.13148	-.13148	-.06004	-.06004
2540	.12793	.16477	.11216	.15071	.1448	.16879	.11441	.13315	.12439	.13291	.05861	.06009
2931	.08238	.06876	.07535	.05608	.08737	.07240	.06657	.05720	.06645	.06219	.03002	.02930
5529	-.05640	-.08289	-.05642	-.07164	-.06883	-.08283	-.05614	-.06393	-.05972	-.06379	-.02822	-.02930
0754	-.04144	-.02920	-.03532	-.02821	-.04141	-.03441	-.03196	-.02307	-.03199	-.02986	-.01465	-.01411
2425	.02474	.03809	.01593	.03551	.03911	.03756	.02681	.03105	.02901	.03089	.01362	.01411
3009	.01904	.01237	.01775	.01296	.01772	.01705	.01552	.01340	.01545	.01450	.00705	.00681
1691	-.01114	-.01772	-.01220	-.01670	-.01604	-.01941	-.01316	-.01492	-.01393	-.01976	-.006594	-.00681
0791	-.00896	-.00557	-.00835	-.00610	-.009706	-.00862	-.00746	-.00658	-.00798	-.006746	-.003905	-.003297
7726	-.005015	.008932	.005633	.006861	.007744	.009226	.006254	.007269	.006791	.007197	.003173	.003297
	.004141	.002512	.0040306	.002819	.004613	.003872	.003634	.003127	.003598	.003395	.001648	.001536
2048		-.003813	-.002650	-.003790	-.003642	-.007474	-.003032	-.003477	-.003248	-.003500	-.001543	-.001586
0493	-.001746		-.001896	-.001325	-.002237	-.001821	-.001738	-.001516	-.001760	-.001624	-.000773	-.000771
0785	.001005	.001749		.001817	.001746	.002121	.001439	.001689	.001577	.001674	.000740	+.000771
Y WILL		NOT	DEFLECT		AS		SHOWN		ON	PG. 29		

A. V. ROE CANADA LIMITED
MALTON - ONTARIO
TECHNICAL DEPARTMENT (Aircraft)

REPORT No. 7-0579-1
SHEET No. 130

AIRCRAFT:		PREPARED BY	DATE
C 105	AILERON	R. GAVALIS	12-3-54
		CHECKED BY	DATE

SPAR LOADS

LOADS DUE TO RIBS & LEVERS (LIMIT)

SUPERSONIC CASE -UP AILERON ($+V_z$ IS UP WHEN LOOKING INBOARD)

SPAR STATION ↓	RIB REF → ↓	DEFLECTION LOADS V_z #	DEFLECTION LOADS M_x IN#	RIB LOADS V_z IN B/O # $B_{3.127}$	RIB LOADS M_x IN# $B_{3.127+128}$	TOTAL SPAR LOAD V_z #	TOTAL SPAR LOAD M_x IN#
0	23			0	0		
10.3	8			489	-5035		
16.0	1			-3130	12670		
19.9	9			4350	-4330		
24.37	1A			547	-6790		
26.74	10			1717	-10850		
32.75	2			-5448	21780		
36.75	11			7992	-10170		
41.12	2A			-100	-9745		
42.50	12			1320	-11550		
49.50	3			-5440	26330		
52.30	13			11610	-12050		
58.06	3A			-1074	-6385		
61.62	14			216	-7155		
66.62	4			-5740	21610		
70.12	15			8280	-7390		
77.06	4A			-707	-2465		
81.50	16			653	-5365		
87.50	5			-3560	16240		
90.50	17			7590	-6550		
97.10	5A			-712	-1836		
101.20	18			338	-3220		
106.70	6			-2445	10130		
109.70	19			4550	-3550		
115.60	6A			-303	-1760		
119.30	20			487	-3560		
124.50	7			-2517	9645		
127.50	21			4593	-4155		
134.28	7A			-747	905		
139.17	22			185	0		

FORM 1319A

IRCRAFT
. U. W.

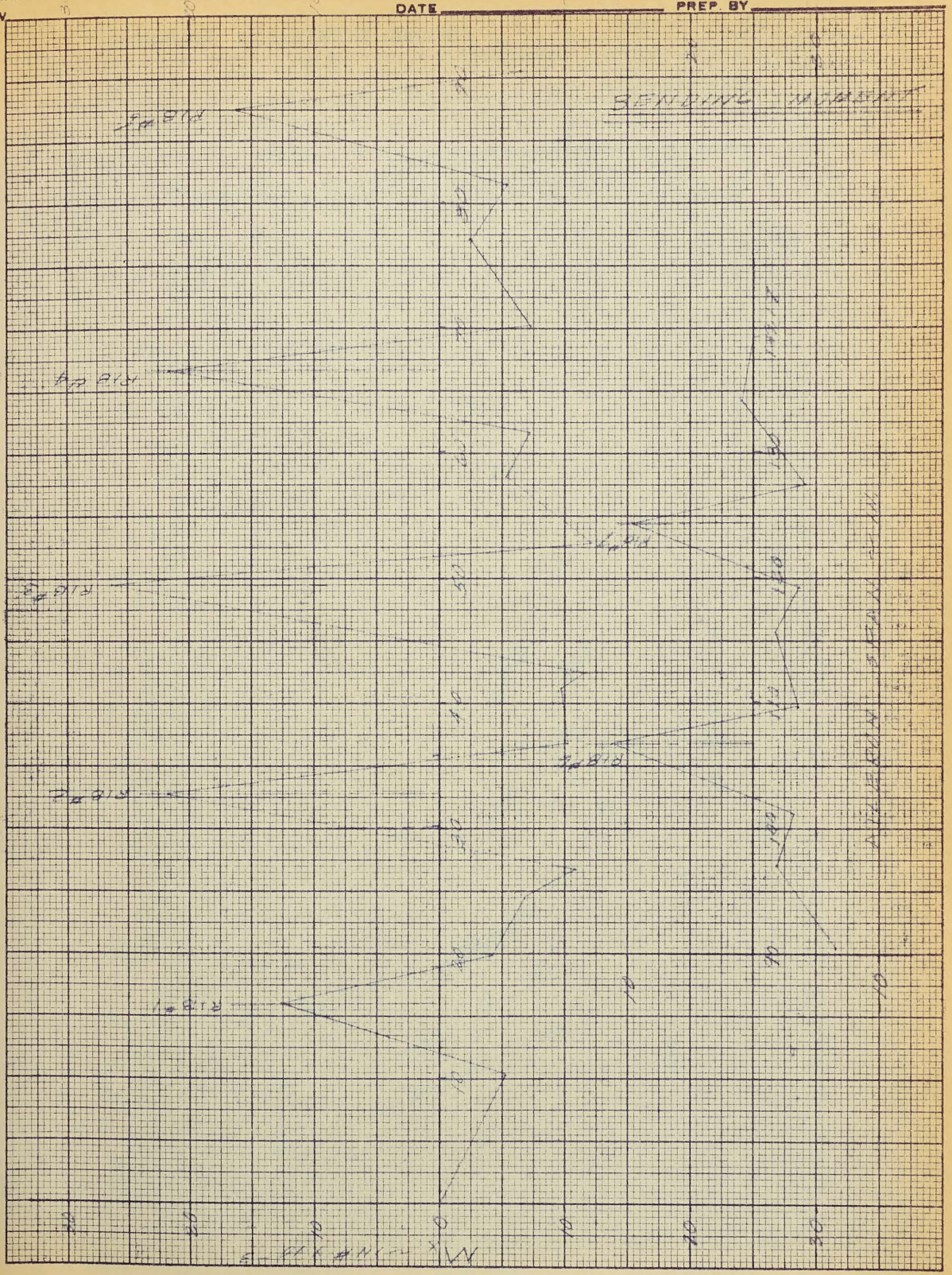
COMPONENT

SHEET No. 132

REPORT No. 1-0674-1

DATE

PREP. BY



FORM 1746

A. V. ROE CANADA LIMITED
MALTON · ONTARIO
TECHNICAL DEPARTMENT (Aircraft)

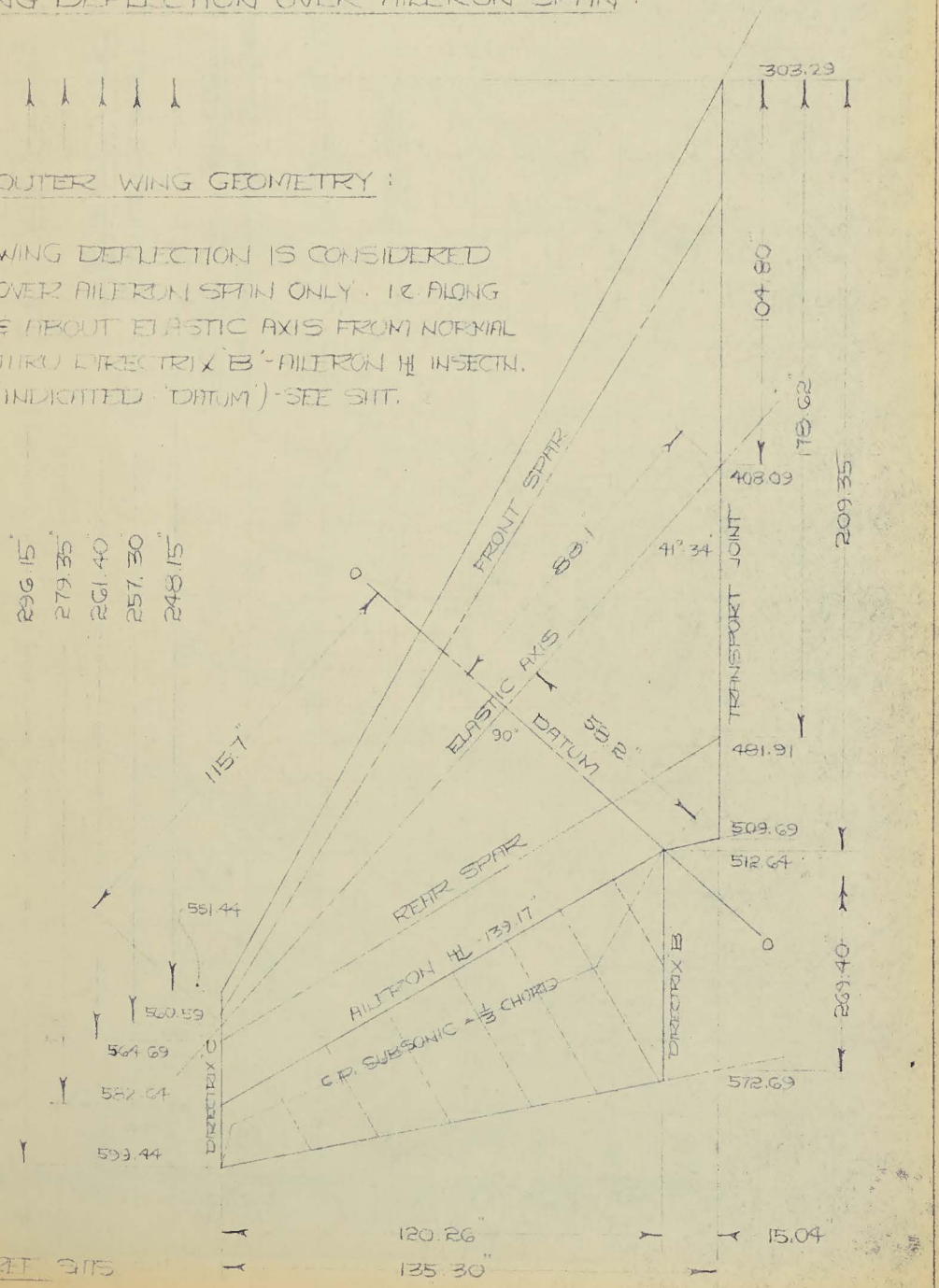
REPORT No 7-0579-1
SHEET No D1

AIRCRAFT:		PREPARED BY	DATE
C105	AILERON	T. HAYMAN	APRIL 22/54
		CHECKED BY	DATE

WING DEFLECTION OVER AILERON SPAN :

OUTER WING GEOMETRY :

WING DEFLECTION IS CONSIDERED OVER AILERON SPAN ONLY - IE ALONG ℄ ABOUT ELASTIC AXIS FROM NORMAL THRU DIRECTRIX 'B' - AILERON HL INSECTN. (INDICATED 'DATUM') - SEE SHT.



REF 3115

FORM 1319A

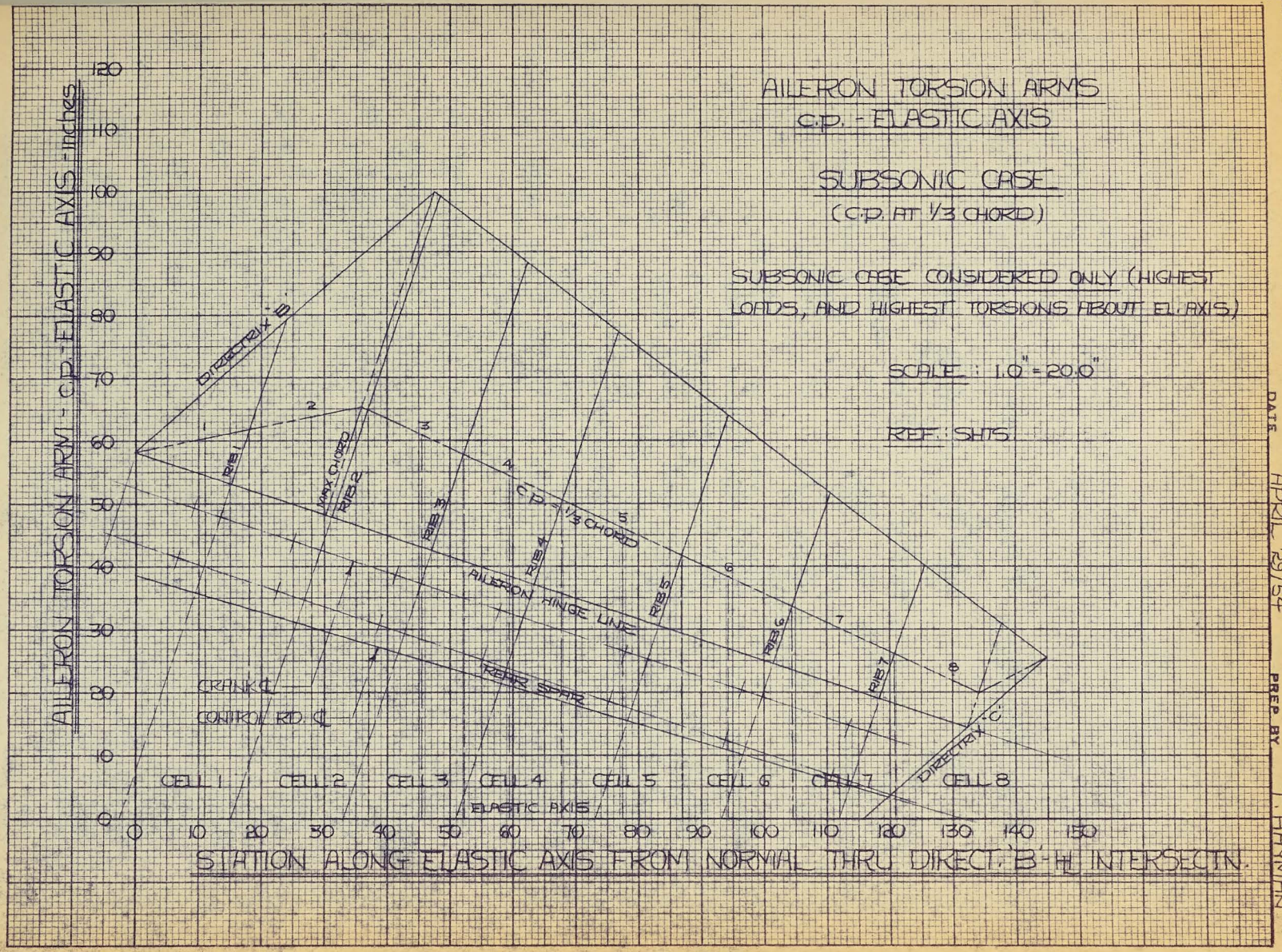
AILERON TORSION ARMS
C.P. - ELASTIC AXIS

SUBSONIC CASE
(C.P. AT 1/3 CHORD)

SUBSONIC CASE CONSIDERED ONLY (HIGHEST LOADS, AND HIGHEST TORSIONS ABOUT EL. AXIS)

SCALE : 1.0" = 20.0"

REF : SHTS



CRAFT C105 COMPONENT AILERON SHEET NO. B-2 REPORT NO. 7-6624-1

DATE APRIL 29/54 PREP BY T. HAYMAN

FORM 1746

A. V. ROE CANADA LIMITED
MALTON - ONTARIO
TECHNICAL DEPARTMENT (Aircraft)

REPORT No. 7-0574-1
SHEET No. D 3

AIRCRAFT:		PREPARED BY	DATE
C 105	AILERON	T. HAYMAN	APRIL 23/54
		CHECKED BY	DATE

WING DEFLECTION OVER AILERON SPAN (CONT): LIMIT

B.M. & TORQUE AT ELASTIC AXIS DUE TO AILERON LIMIT AIR LOAD:

BENDING MOMENT - SUBSONIC CASE:

CELL	STATION ALONG AILERON HL IN.	STATION ALONG ELAST. AXIS FROM DATUM IN.	ΔX ALONG AILERON HL IN. ①	ΔP LIMIT LOAD LB/IN ②	W = STRIP LD = ① × ② LB ③	SHEAR V_z = ≤ W LB ④	$V_z \Delta X$ = ④ × ① IN LB ⑤	$W \cdot \Delta X/2$ = ③ × ①/2 IN LB ⑥	B.M. M_y = ≤⑤ + ⑥ IN LB ⑦
	152.5	145.0				0	0	0	0
8			23.07	104	2400				
	127.1	120.7				2400	0	27,680	27,680
7			17.80	141	2500				
	110.0	104.5				4900	42,120	22,250	92,050
6			19.20	168	3220				
	91.4	86.9				8120	94,080	30,910	217,040
5			20.88	198	4140				
	71.3	67.8				12,260	169,550	43,220	430,410
4			17.12	228	3900				
	55.0	52.2				16,160	209,890	33,380	673,680
3			16.75	252	4220				
	39.0	37.0				20,380	270,680	35,340	979,700
2			16.75	173	2900				
	19.0	18.0				23,280	341,370	24,290	1,345,360
1			16.00	53.7	860				
	0	0				24,140	372,480	6880	1,724,720

RIB - RIB

TORQUE - SUBSONIC CASE:

CELL	STATION ALONG AILERON HL IN.	STATION ALONG ELAST AXIS FROM DATUM IN.	W = STRIP LOAD = ③ ABOVE LB ①	y = ARM FROM C.P. - ELASTIC AXIS IN. ②	W·y = ① × ② IN. LB. ③	TORQUE M_x = ≤ W y = ≤ ③ IN. LB. ④
	152.5	145.0				0
8			2400	22.7	54,480	
	127.1	120.7				54,480
7			2500	30.1	75,250	
	110.0	104.5				129,730
6			3220	38.3	123,330	
	91.4	86.9				253,060
5			4140	46.1	190,850	
	71.3	67.8				443,910
4			3900	54.4	212,160	
	55.0	52.2				656,070
3			4220	60.9	257,000	
	39.0	37.0				913,070
2			2900	63.7	184,730	
	19.0	18.0				1,097,800
1			860	60.3	51,860	
	0	0				1,149,660

REF.: SHTS. 12 [illegible]

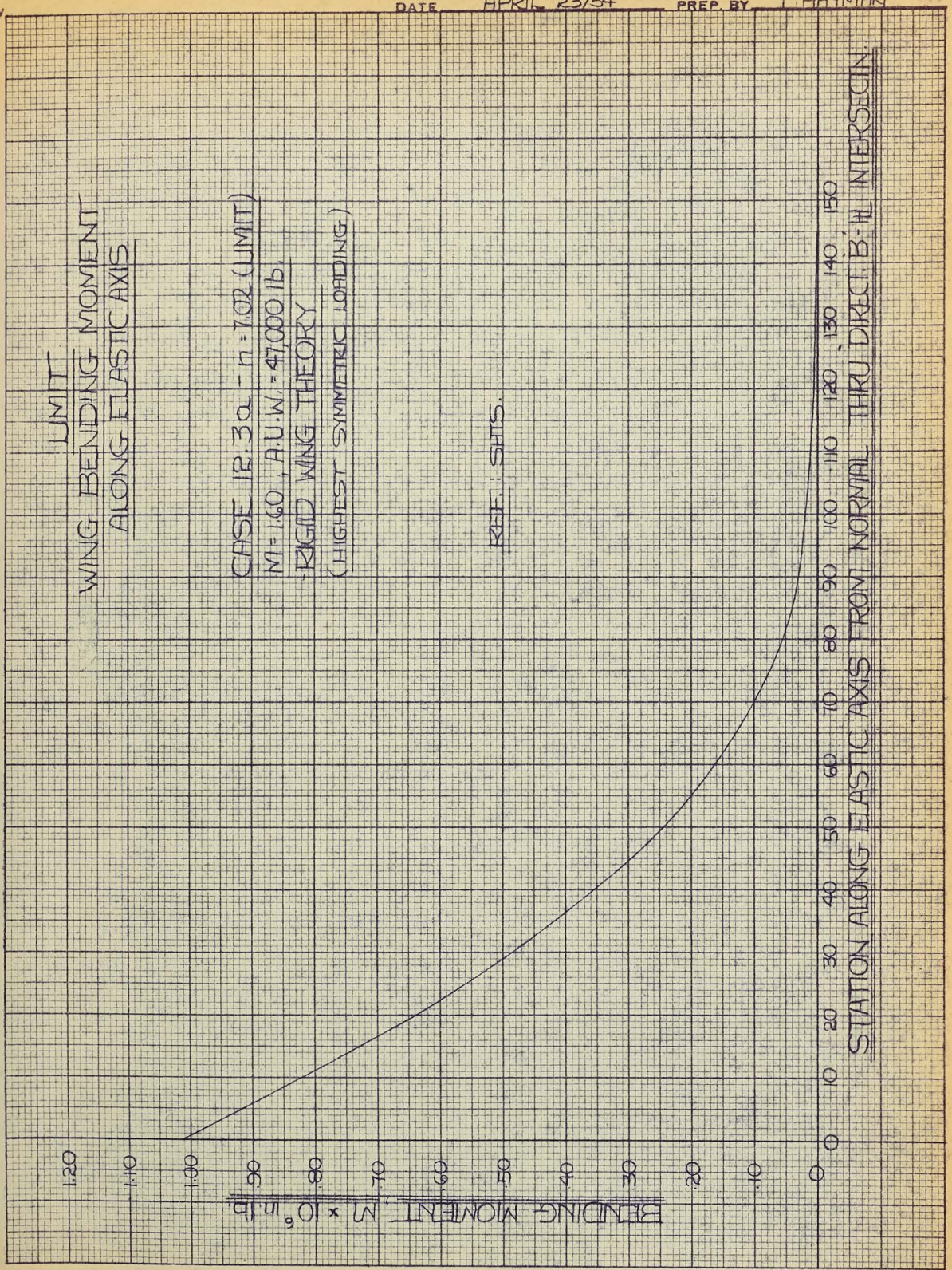
FORM 1319A

CRAFT C105 COMPONENT AILERON SHEET No. 04 REPORT No. Z-05741
W DATE APRIL 23/54 PREP. BY T. HAYMAN

UNIT
WING BENDING MOMENT
ALONG ELASTIC AXIS

CASE 1B 30 - n = 7.02 (LIMIT)
M = 1.60, A.U.W. = 47,000 lb.
RIGID WING THEORY
(HIGHEST SYMMETRIC LOADING)

REF.: SHTS.



FORM 1746

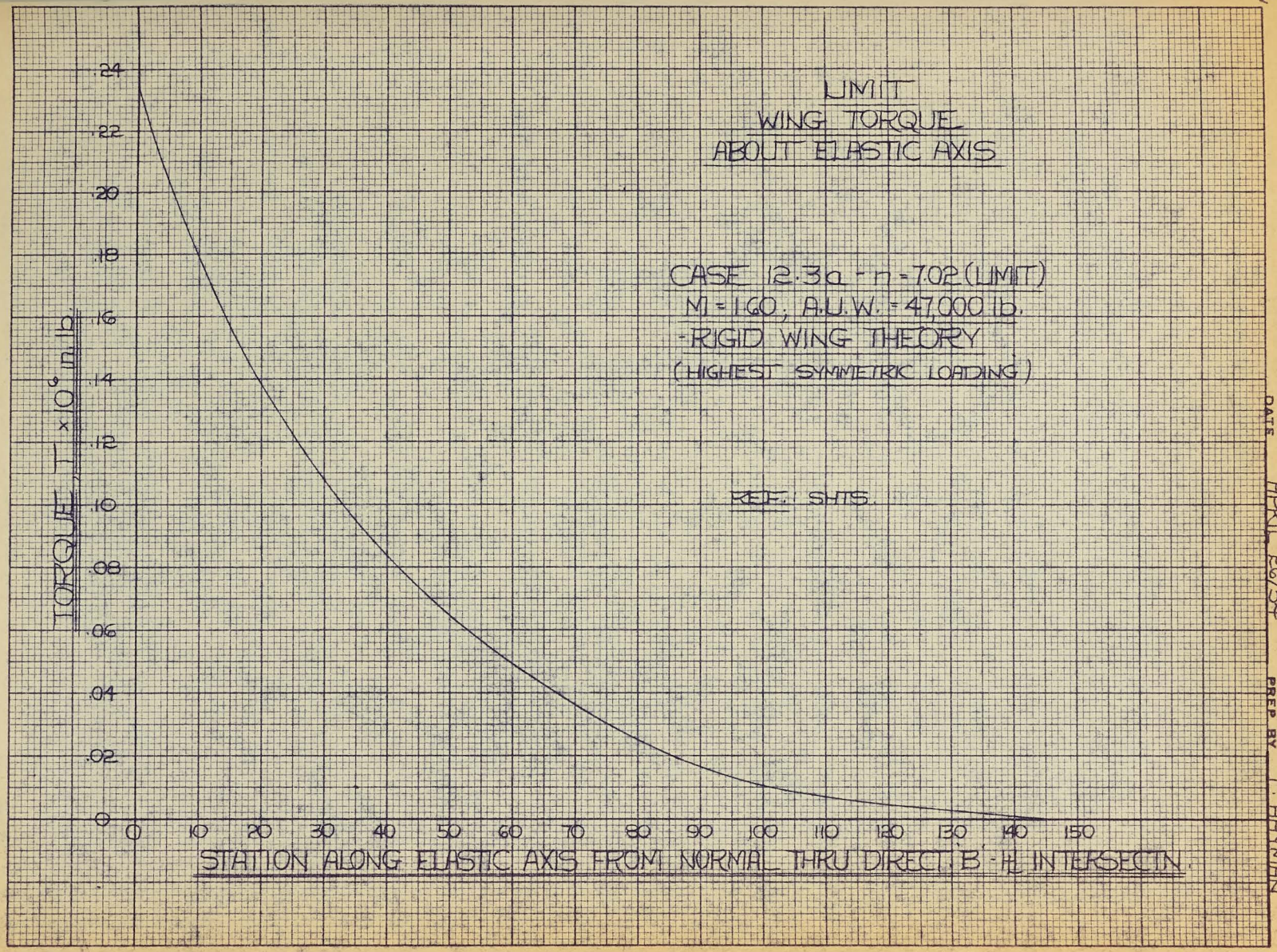
CRAFT C 105 COMPONENT AILERON SHEET NO. 105 REPORT NO. Z-05779-1

DATE APRIL 26/54 PREP BY T. HAYMAN

LIMIT WING TORQUE ABOUT ELASTIC AXIS

CASE 12·3a - n = 7.02 (LIMIT)
M = 1.60, A.U.W. = 47,000 lb.
- RIGID WING THEORY
(HIGHEST SYMMETRIC LOADING)

REF: SHTS.



FORM 1746

A. V. ROE CANADA LIMITED
MALTON - ONTARIO
TECHNICAL DEPARTMENT (Aircraft)

REPORT No. 7-0574-1
SHEET No. 106

AIRCRAFT:		PREPARED BY	DATE
C105	AILERON	T. HAYMAN	APRIL 30/54
		CHECKED BY	DATE

WING DEFLECTION OVER AILERON SPAN (CONT.): LIMIT

B.M. & TORQUE AT ELASTIC AXIS - AILERON & WING COMBINED:

CELL	STATION ALONG AILERON H.L. IN.	STATION ALONG ELAST. AXIS FROM DATUM IN.	WING B.M. - LIMIT IN. LB. ①	WING B.M. + ASSYMETRIC = 2/3 x ① IN. LB. ②	AILERON B.M. - LIMIT IN. LB. ③	NET WING B.M. - LIMIT = ② + ③ IN. LB. ④	WING TORQUE - LIMIT IN. LB. ⑤	WING * TORQUE - ASSYMETRIC = 2/3 x ⑤ IN. LB. ⑥	AILERON TORQUE - LIMIT IN. LB. ⑦	NET WING TORQUE - LIMIT = ⑥ + ⑦ IN. LB. ⑧
8	152.5	145.0	0	0	0	0	0	0	0	0
7	127.1	120.7	5000	3300	27,700	31,000	4200	2800	54,500	57,300
6	110.0	104.5	14,000	9300	92,700	102,000	8600	5700	129,700	135,400
5	91.4	86.9	36,000	24,000	217,600	241,600	18,800	12,500	253,100	265,600
4	71.3	67.8	111,500	74,300	430,400	504,700	31,200	26,100	443,900	470,000
3	55.0	52.2	224,000	149,300	673,700	823,000	61,000	40,700	656,100	696,800
2	39.0	37.0	393,000	262,000	979,100	1,241,700	90,200	60,100	913,100	973,200
1	19.0	18.0	670,500	447,000	1,345,400	1,792,400	144,600	96,400	1,037,800	1,134,200
	0	0	1,011,500	674,400	1,724,700	2,399,100	234,600	156,400	1,149,700	1,306,100
			SHT. 1		SHT. 4		SHT. 5		SHT. 8	

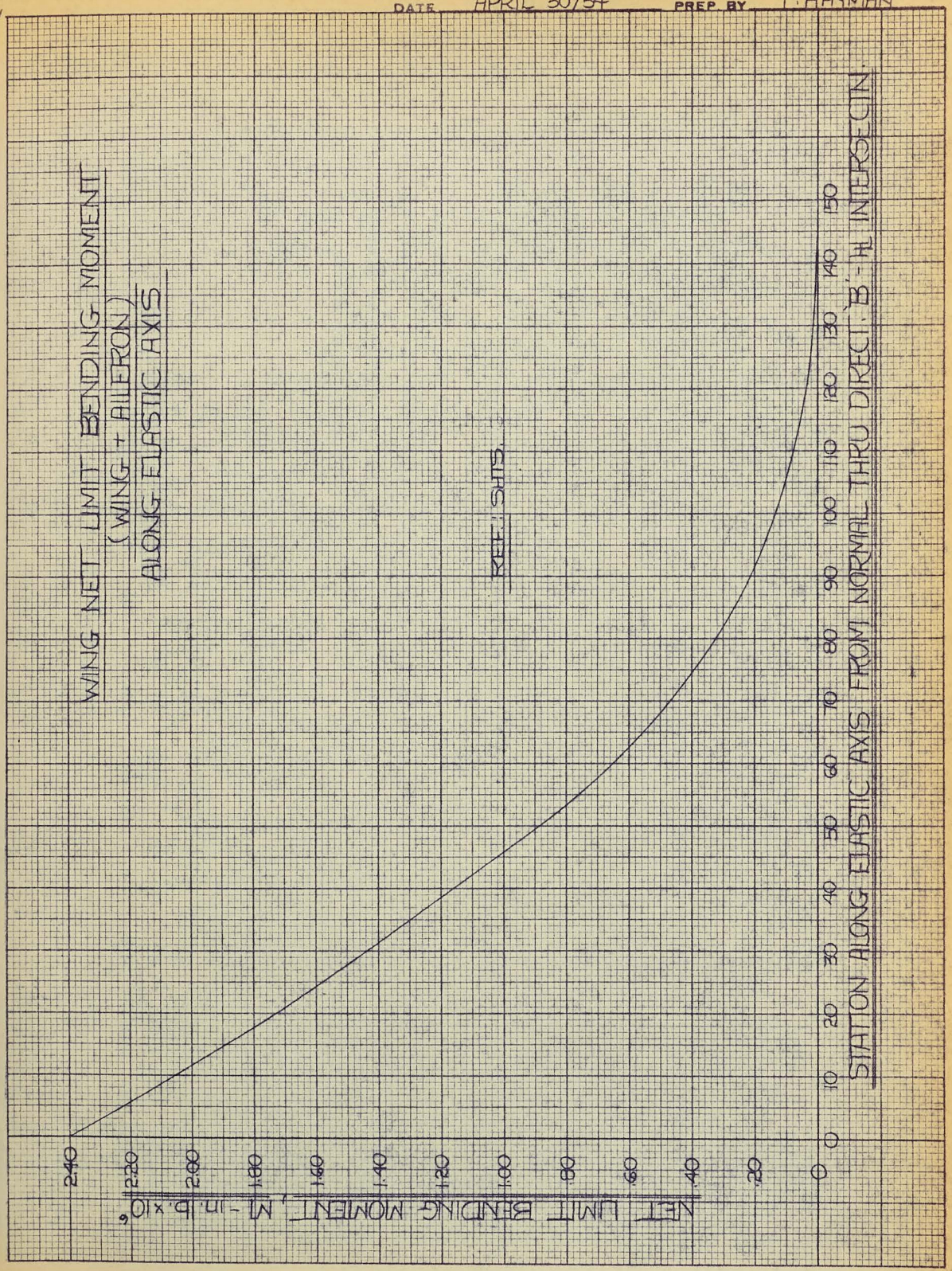
- AILERON B.M.'s & TORQUES - SUBSONIC CASE - SHT. 2

- WING B.M.'s & TORQUES - CASE 12.3a - n = 7.02 LIMIT, M = 1.60 (HIGHEST SYMMITRIC LOADING) - SHTS. 4 & 5

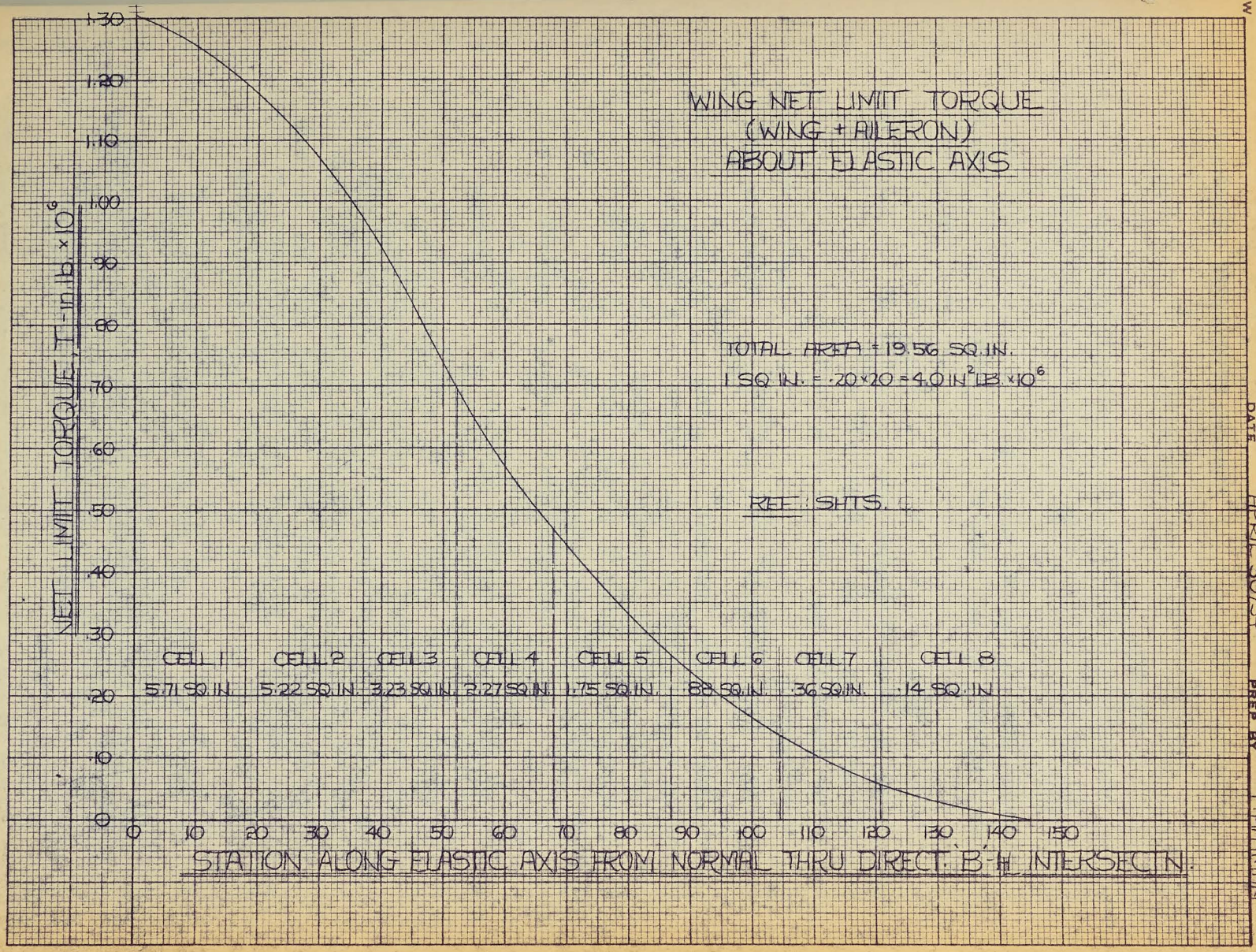
* - FOR ASSYMETRIC CASE, A.P. 970 ( ) SPECIFIES LOADING TO BE 2/3 SYMMETRIC LOAD + ASSYMETRIC CONTROL LOADS.

DRM 1191A

CRAFT C105 COMPONENT AILERON SHEET No. 27 REPORT No. Z-0579-1
J. W. DATE APRIL 30/54 PREP. BY T. HAYMAN



FORM 1746



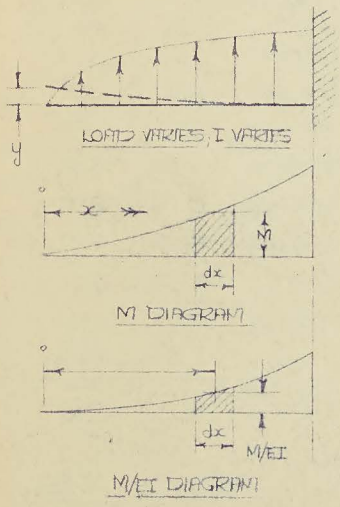
AIRCRAFT C 105 COMPONENT AILERON SHEET NO. 25 REPORT NO. Z-1522-1
J. W. DATE APRIL 30/54 PREP BY T. HAYMAN

FORM 1746

WING DEFLECTION OVER AILERON SPAN (CONT.): LIMIT

TOTAL DEFLECTION WILL BE DUE TO BENDING & TORSION, BENDING TAKEN ALONG THE ELASTIC AXIS & TORSION ABOUT THE ELASTIC AXIS.

BENDING:



SINCE THE BENDING LOAD IS NON-UNIFORM & THE WING I VARIES, DEFLECTION DUE TO BENDING WILL BE FOUND BY GRAPHICAL (MEHNS.

MOMENT-AREA METHOD: REF: SEELY

WHEN A STRAIGHT BEAM IS SUBJECTED TO BENDING, THE DIFFERENCE IN THE SLOPES OF THE ELASTIC CURVE AT ANY TWO POINTS IS EQUAL IN MAGNITUDE TO THE AREA OF THE M/EI DIAGRAM BETWEEN THE TWO POINTS.

$$\text{i.e.: } d\theta = \frac{M}{EI}dx \text{ \& } \Delta\theta = \int \frac{M}{EI}dx$$

FURTHER, THE DISTANCE OF ANY POINT ON THE ELASTIC CURVE, MEASURED NORMAL TO THE ORIGINAL POSITION OF THE BEAM, FROM A TANGENT DRAWN TO THE ELASTIC CURVE AT ANY OTHER POINT, IS EQUAL IN MAGNITUDE TO THE MOMENT OF THE AREA OF THE M/EI DIAGRAM BETWEEN THE TWO POINTS ABOUT AN ORDINATE THROUGH THE POINT OF DEFLECTION.

$$\text{i.e.: } y = \int dy = \int x \cdot d\theta \text{ ; } d\theta = \frac{M}{EI}dx \text{ OR, } y = \int \frac{M.x}{EI}\cdot dx$$

WHERE: $\frac{M.dx}{EI}$ = ELEMENTARY AREA FROM $\frac{M}{EI}$ DIAG. &

$\frac{M.x}{EI}dx$ = MOMENT OF THAT AREA.

- RESULTS ARE TABULATED ON SHT. 10 & PLOTTED ON SHTS. 11 & 12

A. V. ROE CANADA LIMITED
MALTON - ONTARIO
TECHNICAL DEPARTMENT (Aircraft)

REPORT No. Z-0579-1
SHEET No. D 10

AIRCRAFT:		PREPARED BY	DATE
C105	AILERON	T. HAYMAN	APRIL 30/54
		CHECKED BY	DATE

WING DEFLECTION OVER AILERON SPAN (CONT.): UNIT

BENDING (CONT.):

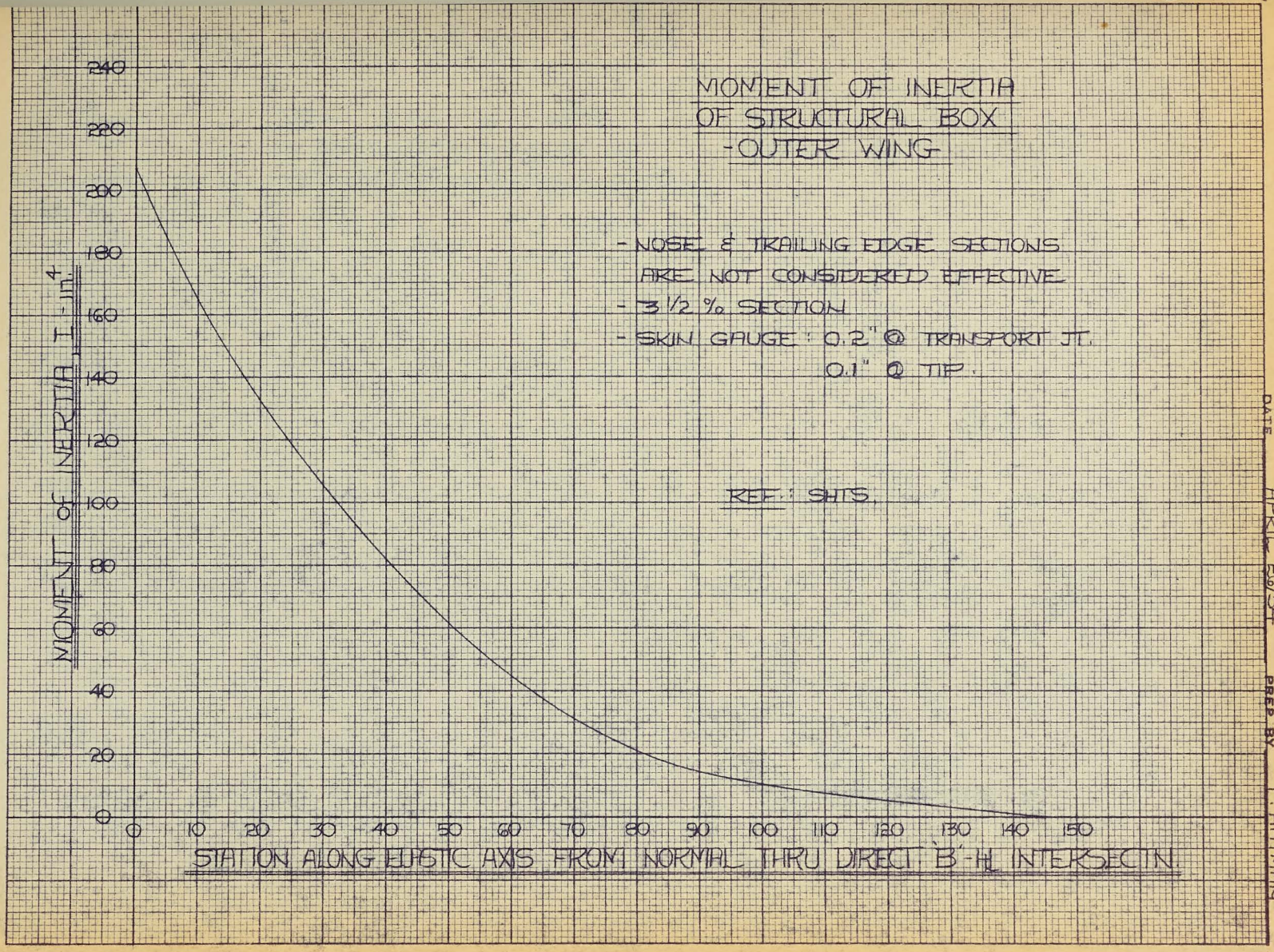
CELL	STATION ALONG AILERON HL IN.	STATION ALONG ELAST. AXIS FROM DATUM IN.	M (WING & AILERON) IN LB ①	I (STRUCT BOX) IN^4 ②	E.I (E=10.3×10⁶ P.S.I. CONSTANT) $LB.IN^2 \times 10^6$ ③	M/EI = ①/③ $IN^{-1} \times 10^{-3}$ ④	ANG. DEFLN. $d\theta$ = M/EI · dx (AREA M/EI DIAGRAM) $RAD. \times 10^{-3}$ ⑤	TOTAL ANG. DEFLN. $\Sigma d\theta$ = Σ⑤ $RAD. \times 10^{-3}$ ⑥	X (AREA CNTD. FROM DEFLN. POINT) IN. ⑦	VERTICAL DISPLACE y_b = Σdθ.X = ⑥×⑦ IN. ⑧
	0	0	2,393,100	207	2132	1.125		0	0	0
1							21.84			
	19.0	18.0	1,792,400	137	1411	1.270		21.84	8.9	.194
2							25.12			
	39.0	37.0	1,241,700	89	917	1.354		46.96	17.8	.836
3							20.96			
	55.0	52.2	823,000	58	597	1.379		67.92	25.2	1.712
4							21.84			
	71.3	67.8	504,700	34	350	1.442		89.76	32.3	2.899
5							28.48			
	91.4	86.9	241,600	16	165	1.464		118.24	40.9	4.836
6							24.08			
	110.0	104.5	102,000	9	92.7	1.100		142.32	49.6	7.059
7							14.24			
	127.1	120.7	31,000	5	51.5	.602		156.56	61.0	9.550
8							6.80			
	152.5	145.0	0	0	0	0		163.36	82.7	13.510
			SHT. 6	SHT. 11		SHT. 2	SHT. 12		SHT. 3	SHT. 1

REF: SHTS. 6, 11, 12, 13

FORM 1191A

DATE APRIL 26/54 PREP BY T. HAYMAN

MOMENT OF INERTIA OF STRUCTURAL BOX -OUTER WING



- NOSE & TRAILING EDGE SECTIONS ARE NOT CONSIDERED EFFECTIVE
- 3 1/2 % SECTION
- SKIN GAUGE : 0.2" @ TRANSPORT JT.
  0.1" @ TIP.

REF : SHTS.

MADE IN U.S.A.

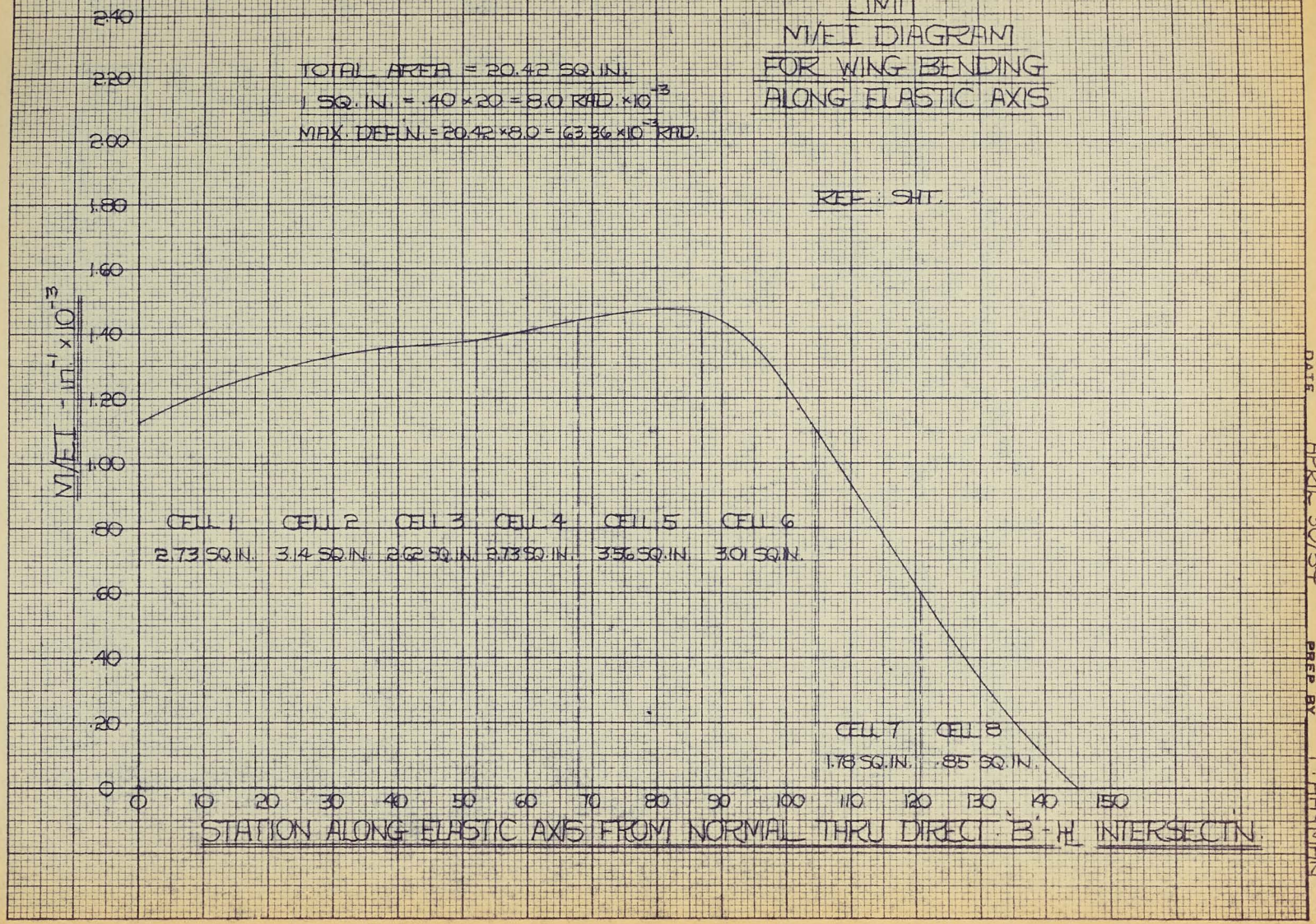
LIMIT M/EI DIAGRAM FOR WING BENDING ALONG ELASTIC AXIS

TOTAL AREA = 20.42 SQ. IN.

1 SQ. IN. = .40 × 20 = 8.0 RAD. × 10^{-3}

MAX. DEFLN. = 20.42 × 8.0 = 163.36 × 10^{-3} RAD.

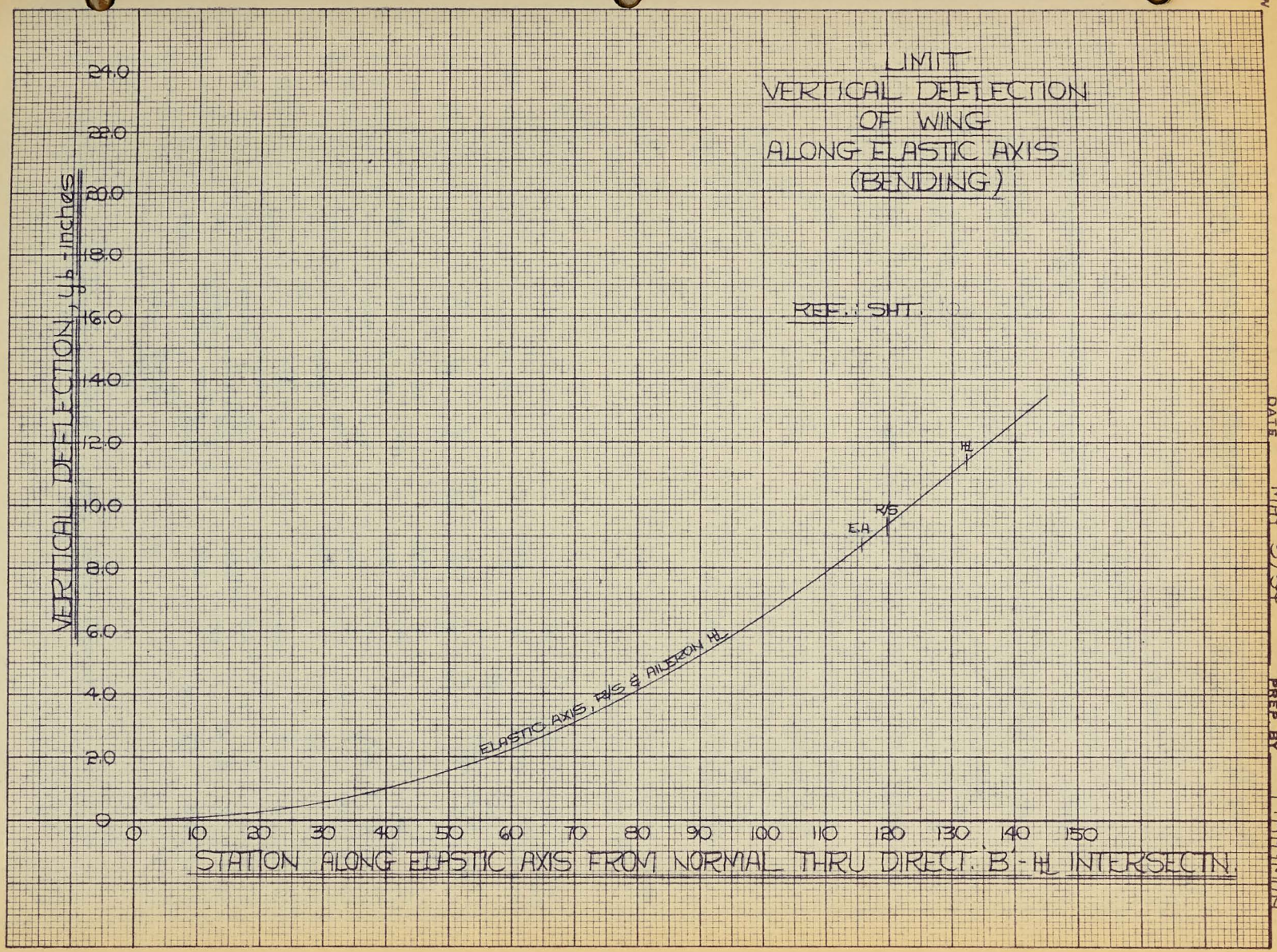
REF: SHT.



FORM 1746

LIMIT
VERTICAL DEFLECTION OF WING ALONG ELASTIC AXIS (BENDING)

REF.: SHT. 2



AIRCRAFT C/05 COMPONENT AILERON SHEET NO. 213 REPORT NO. 7-0529-1

U. W. DATE MAY 3/54 PREP. BY T. HAYMAN

FORM 1746

A. V. ROE CANADA LIMITED
MALTON · ONTARIO
TECHNICAL DEPARTMENT (Aircraft)

REPORT No. 7-0579-1
SHEET No. D 19

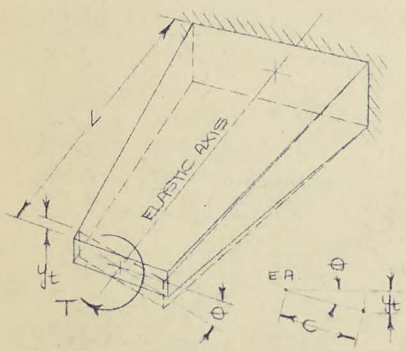
AIRCRAFT:		PREPARED BY	DATE
C 105	AILERON	T. HAYMAN	MAY 3/54
		CHECKED BY	DATE

WING DEFLECTION OVER AILERON SPAN (CONT.): LIMIT

TORSION:

TWIST OF A BOX BEAM IS GIVEN BY:

$$\theta = \frac{T.L}{G.J}, \quad J = \frac{4A^2.t}{S}$$



WHERE: T = TORQUE, IN LB @ L FROM DATUM
L = CELL LENGTH, IN.
G = SHEAR MOD. = 3.9×10^6 p.s.i. (75S-T6)
J = TORSION CONSTANT, $IN.^4$
(A = CELL SECTN. AREA, $IN.^2$
t = SKIN THICKNESS, IN.
S = CELL SECTN. PERIMETER, IN

REF: PEERY 16:11

& $y_t = C.\sin\theta$; C = CHORD - FROM ELASTIC AXIS TO REF. PT.

CELL	STATION ALONG AILERON HL IN.	STATION ALONG ELAST. AXIS FROM DATUM IN.	T (WING + AILERON) IN LB. ①	T L (AREA T DIAGRAM) $IN^2 LB \times 10^6$ ②	ΣT.L = Σ② $IN^2 LB \times 10^6$ ③	G (75S-T6) p.s.i $\times 10^6$ ④	J.L (AREA J DIAGRAM) IN^5 ⑤	ΣJ.L = Σ⑤ IN^5 ⑥	AVG. J = ΣT.L/L = ⑥/L E.A. IN^4 ⑦	G J = ④×⑦ $IN^2 LB \times 10^6$ ⑧	Σθ = ΣT.L / G J = ③/⑧ RADIANS ⑨	Σθ DEGREES = ⑨/57.296 DEGREES ⑩
	0	0	1,306,100		0	3.9		0	0	0	0	0
1	19.0	18.0	1,194,200	22.64	22.84		7540	7540	419	1634	.01398	.801
2	39.0	37.0	973,200	20.88	43.72		5360	12,900	349	1361	.03212	1.840
3	55.0	52.2	691,800	12.92	56.64		2680	15,580	298	1162	.04874	2.793
4	71.3	67.8	470,000	9.08	65.72		1580	17,160	253	987	.06659	3.815
5	91.4	86.9	265,600	7.00	72.72		1160	18,320	211	823	.08836	5.063
6	110.0	104.5	135,400	3.52	76.24		660	18980	182	710	.10738	6.152
7	127.1	120.7	57,300	1.44	77.68		400	19,380	161	628	.12369	7.087
8	152.5	145.0	0	.56	78.24	3.9	220	19,600	135	527	.14846	8.506

SHT. 5 SHT. 6 SHT. 15 SHT. 15

VERTICAL DISPLACEMENT - SEE NEXT SHEET.

FORM 1394A

A. V. ROE CANADA LIMITED
MALTON - ONTARIO
TECHNICAL DEPARTMENT (Aircraft)

REPORT No. 7-0579-1
SHEET No. D 15

AIRCRAFT:		PREPARED BY	DATE
C105	AILERON	T. HAYMAN	MAY 3/54
		CHECKED BY	DATE

WING DEFLECTION OVER AILERON SPAN (CONT.): UNIT

TORSION (CONT.):

VERTICAL DEFLECTION DUE TO TORSIONAL TWIST:

CELL	STATION ALONG AILERON H.L. IN.	STATION ALONG ELAST AXIS FROM DATUM IN.	∈θ DEGREES ①	SIN θ ②	AT REAR SPAR: C ELASTIC AXIS - REAR SPAR IN. ③	AT REAR SPAR: $y_{t_{R/S}}$ = C SIN θ = ③ x ② IN. ④	AT AILERON H.L.: C ELASTIC AXIS - AILERON H.L. IN. ⑤	AT AILERON H.L.: $y_{t_{HL}}$ C SIN θ = ⑤ x ② IN. ⑥
1	0	0	.0	0	38.7	0	58.2	0
2	19.0	18.0	.801	.0140	33.4	.468	52.3	.732
3	39.0	37.0	1.840	.0321	27.6	.886	46.0	1.477
4	55.0	52.2	2.793	.0488	23.2	1.132	40.8	1.991
5	71.3	67.8	3.815	.0665	18.6	1.237	35.7	2.374
6	91.4	86.9	5.063	.0883	13.0	1.148	29.4	2.596
7	110.0	104.5	6.152	.1071	7.8	.835	23.6	2.527
8	127.1	120.7	7.087	.1233	3.0	.370	18.2	2.244
	152.5	145.0	8.506	.1480	—	—	10.2	1.510
			SHT. 4		SHT.	SHT. 1	SHT. 2	SHT. 17

- TWIST IS ABOUT ELASTIC AXIS ($y_{t_{EA}} = 0$)

REF.: SHTS. 2, 14 & 17

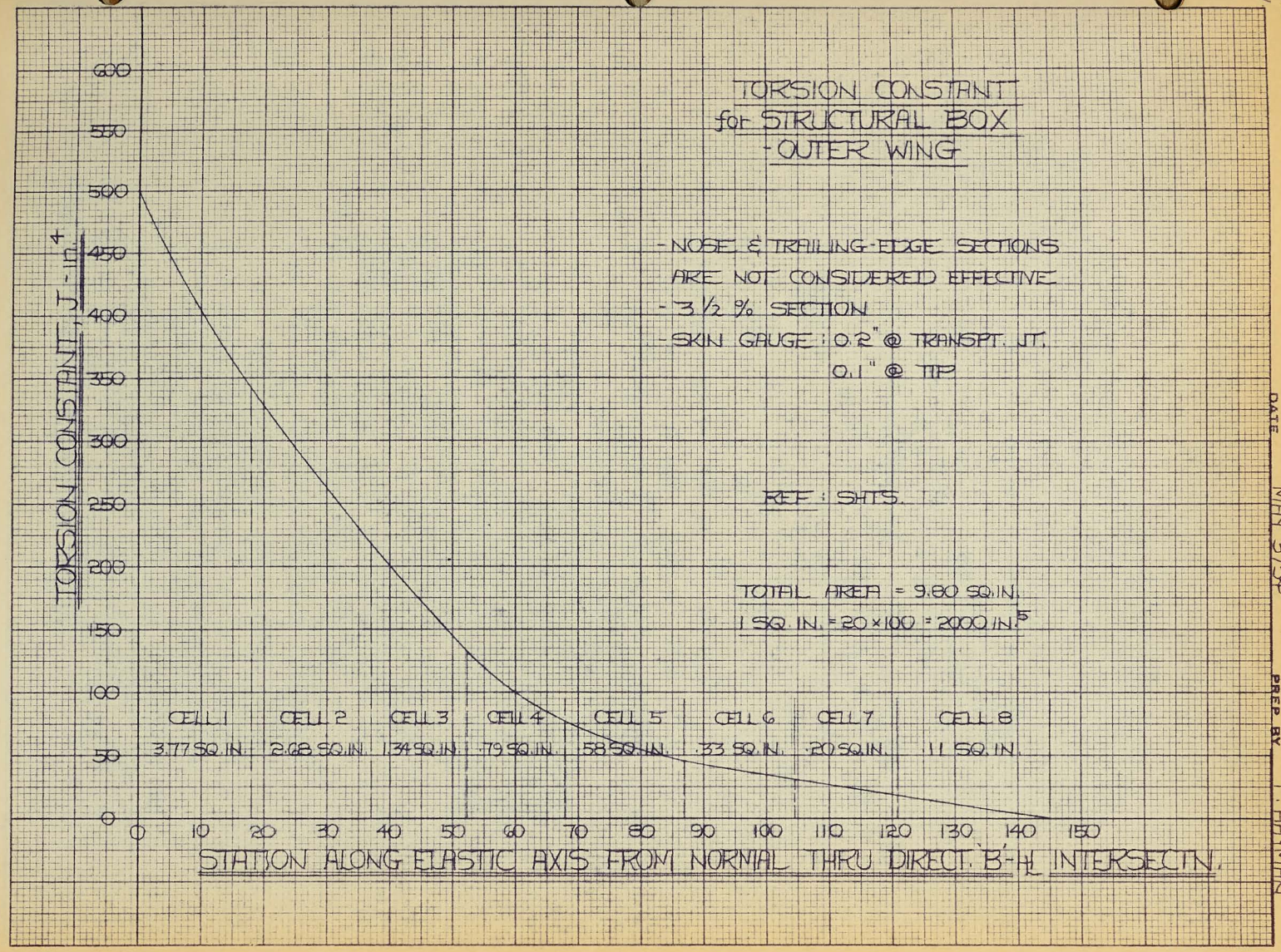
FORM 1319A

TORSION CONSTANT for STRUCTURAL BOX - OUTER WING

- NOSE & TRAILING-EDGE SECTIONS ARE NOT CONSIDERED EFFECTIVE
- 3 ½ % SECTION
- SKIN GAUGE : 0.2" @ TRANSPT. JT.
  0.1" @ TIP

REF : SHTS.

TOTAL AREA = 9.80 SQ.IN.
1 SQ. IN. = 20 × 100 = 2000 IN.^{5}

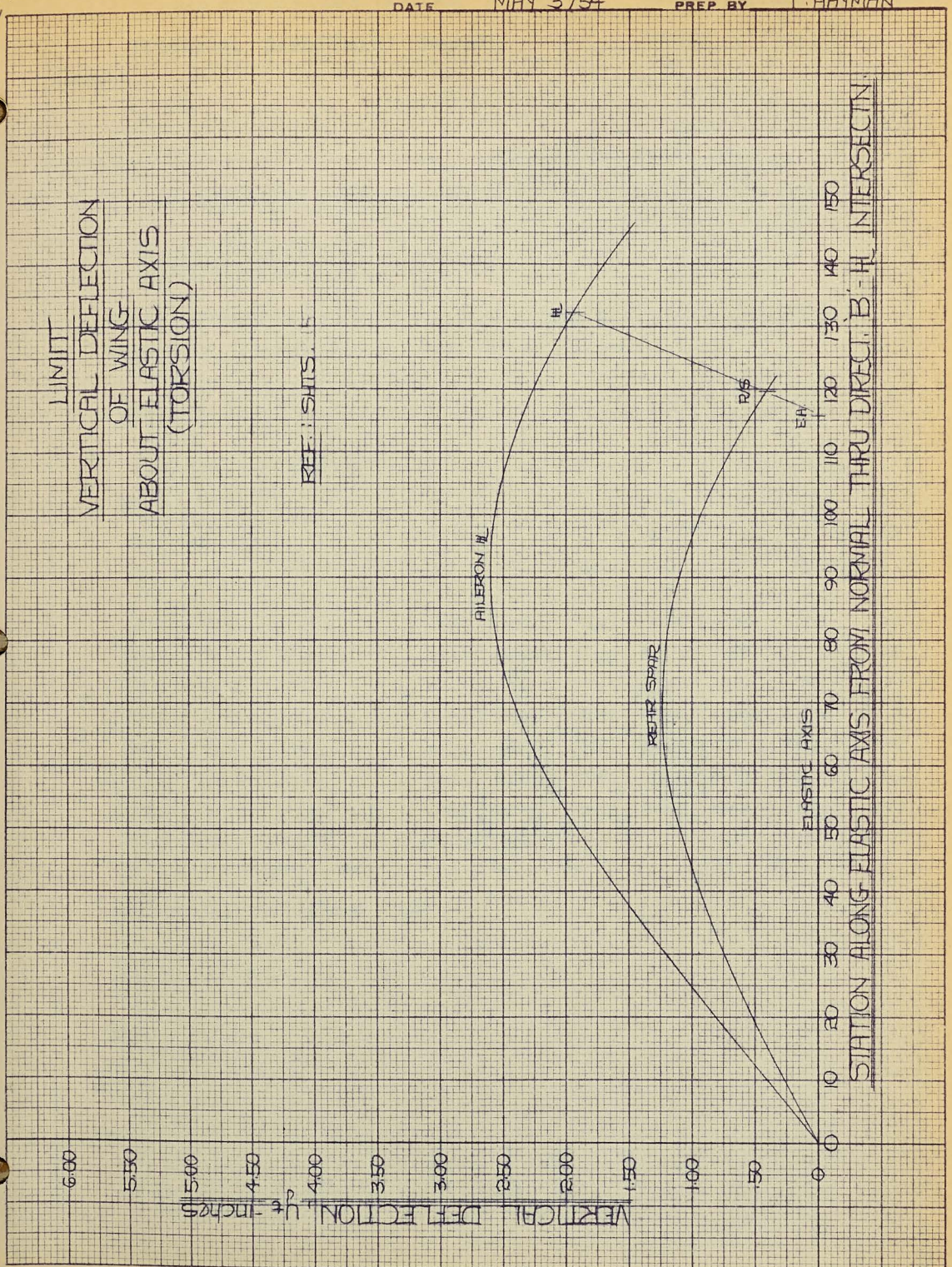


FORM 1746

AIRCRAFT C105 U.W. COMPONENT AILERON SHEET No. D-17 REPORT No. 7-2524-1
DATE MAY 3/54 PREP BY T. HAYMAN

LIMIT VERTICAL DEFLECTION OF WING ABOUT ELASTIC AXIS (TORSION)

REF: SHTS. 5



FORM 1746

A. V. ROE CANADA LIMITED
MALTON - ONTARIO
TECHNICAL DEPARTMENT (Aircraft)

REPORT No. 7-0579-1
SHEET No. D 13

AIRCRAFT:		PREPARED BY	DATE
C105	AILERON	T. HAYMAN	MAY 3/54
		CHECKED BY	DATE

WING DEFLECTION OVER AILERON SPAN (CONT.): LIMIT

COMBINED BENDING & TORSION:

TOTAL VERTICAL DEFLECTION IS GIVEN BY COMBINING THE BENDING & TORSIONAL DEFLECTIONS OF SHTS

RESULTS ARE TABULATED BELOW & PLOTTED ON SHTS. *

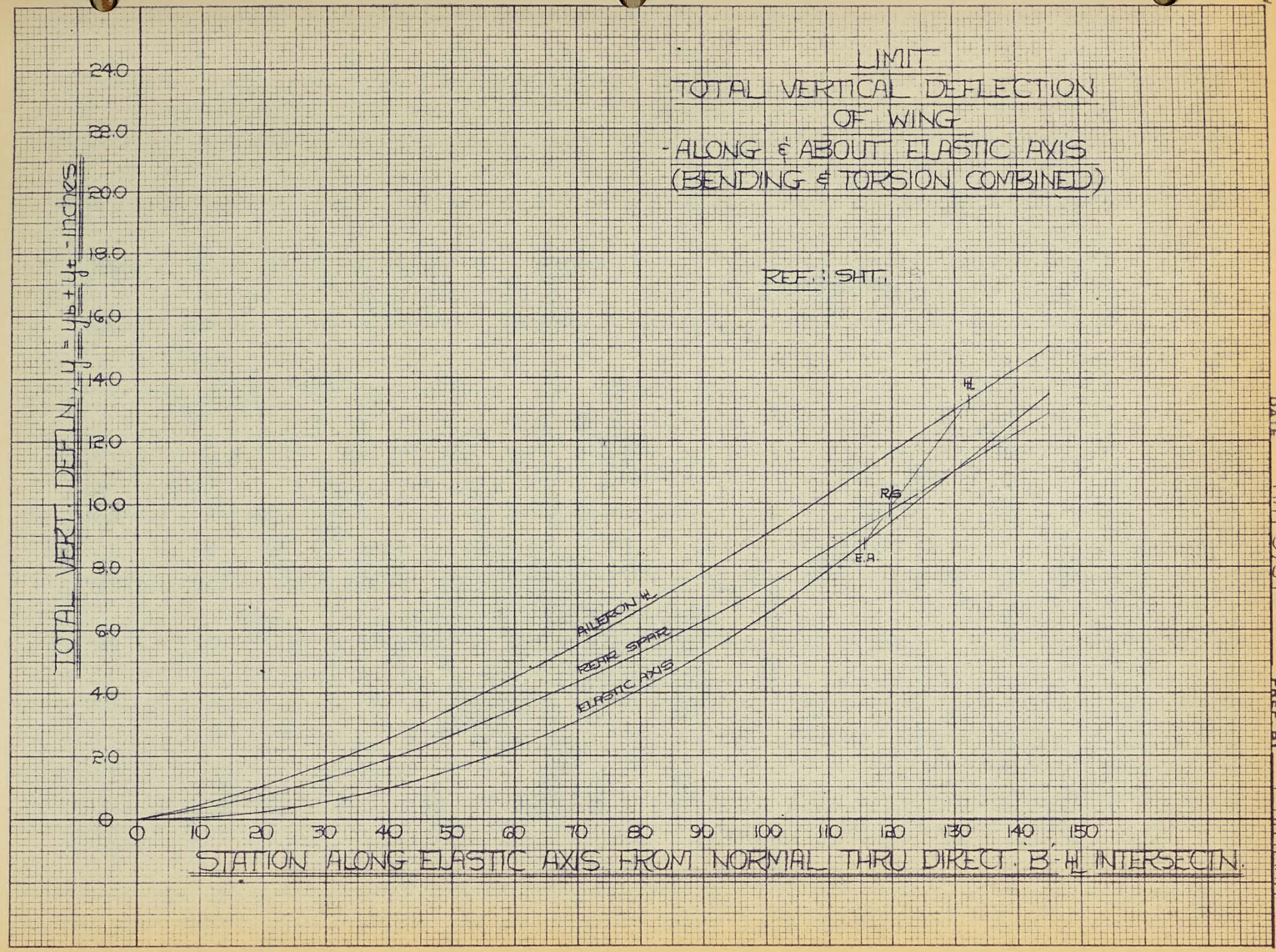
CELL	STATION		ELASTIC AXIS			REAR SPAR			AILERON HL		
	ALONG AILERON HL IN.	ALONG ELAST. AXIS FROM DATUM IN.	y_b IN. ①	$y_{t\,EA}$ IN. ②	y_{EA} = ①+② IN. ③	y_b ④	$y_{t\,R/S}$ IN. ⑤	$y_{R/S}$ = ④+⑤ IN. ⑥	y_b IN ⑦	$y_{t\,HL}$ IN ⑧	y_{HL} = ⑦+⑧ IN. ⑨
1	0	0	0	0	0	0	0	0	0	0	0
2	19.0	18.0	.194	↓	.194	.194	.468	.662	.194	.732	.926
3	39.0	37.0	.836		.836	.836	.886	1.722	.836	1.477	2.313
4	55.0	52.2	1.712		1.712	1.712	1.132	2.844	1.712	1.991	3.703
5	71.3	67.8	2.899		2.899	2.899	1.237	4.136	2.899	2.374	5.273
6	91.4	86.9	4.836		4.836	4.836	1.148	5.984	4.836	2.596	7.432
7	110.0	104.5	7.059		7.059	7.059	.835	7.894	7.059	2.527	9.586
8	127.1	120.7	9.550	↓	9.550	9.550	.370	9.920	9.550	2.244	11.794
	152.5	145.0	13.510	0	13.510	13.510	—	—	13.510	1.510	15.020
			SHT.	SHT.		SHT. 10	SHT. 15		SHT.	SHT.	

* ALONG ELASTIC AXIS - SHT.

ALONG AILERON HL - SHT.

REF: SHTS. 12 & 15

ORM 1194



AIRCRAFT C-105 COMPONENT AILERON SHEET NO. 42 REPORT NO. 7-42529-1
U.W. DATE MAY 3/54 PREP BY T. HAYMAN

FORM 1745

AIRCRAFT C105 COMPONENT AILERON SHEET No. U 20 REPORT No. Z-0524-1
A. U. W. DATE MAY 3/54 PREP BY T. HAYMAN

LIMIT
TOTAL VERTICAL DEFLECTION
OF WING
ALONG AILERON HINGE LINE
(BENDING & TORSION COMBINED)

REF: SHTS.

TOTAL VERT. DEFLN. $y = y_b + y_t$ - inches

AILERON SPAN - inches (ALONG HL)

FORM 1746

A. V. ROE CANADA LIMITED
MALTON - ONTARIO
TECHNICAL DEPARTMENT (Aircraft)

REPORT No. 7-0574-1
SHEET No. D 21

AIRCRAFT:		PREPARED BY	DATE
C105	AILERON	T. HAYMAN	MAY 6/54
		CHECKED BY	DATE

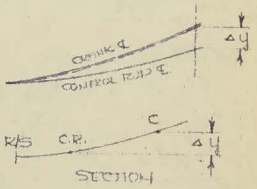
LINKAGE SYSTEM - FOULING CHECK : LIMIT

CONSIDERING THAT WING FLEXURE MAY BE SUCH THAT ELEMENTS OF THE AILERON CONTROL SYSTEM WILL FOUL THE WING STRUCTURE, A REASONABLY DETAILED STUDY OF THE WING STRUCTURE - CONTROL LINKAGE GEOMETRY IS IN ORDER.

THE MOST PROBABLE PT. AT WHICH FOULING MAY OCCUR IS AT THE CRANK-CONTROL ROD CONNECTION, CONSIDERING THAT TWIST ABOUT THE ELASTIC AXIS GIVES DIFFERENT DEFLECTIONS AT THE RESPECTIVE ℄'s (i.e. CRANK ℄ & CONTROL ROD ℄) WHICH MAY RESULT IN THE CONTOUR OF THE DEFLECTED WING @ CONTROL ROD ℄ DIFFERING SUFFICIENTLY FROM THE CONTOUR OF THE DEFLECTED WING @ CRANK ℄ TO CAUSE FOULING (ASSUMING THAT THE CRANKS ARE PART OF THE WING STRUCTURE & IMPART CRANK ℄ CONTOUR TO CONTROL ROD). ALSO, IF THERE IS EXTREME ARCHING OF THE WING NORMAL TO THE ELASTIC AXIS, THE CRANK ARM & CONTROL ROD MAY 'RISE' ENOUGH TO FOUL THE STRUCTURE. THESE FACTORS ARE CHECKED BELOW:

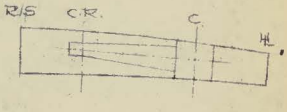
CRANK ℄ CONTOUR vs CONTROL ROD ℄ CONTOUR (SHTS. [illegible]):

SHT. [illegible] COMPARES ℄ CONTOURS &, BY BRINGING THE CURVES TOGETHER, INDICATES THAT THEIR CURVATURE IS ALMOST IDENTICAL (NEGLIGIBLE DIFF)



ARCHING NORMAL TO ELASTIC AXIS (SHTS 2, 12, [illegible]):

SHT [illegible], IN PLANE OF AILERON RIBS (EXTENDED), INDICATES LITTLE OR NO ARCHING SO THAT THE RIGID ATTACH. OF CRANK @ CRANK ℄ WILL IMPART LITTLE OR NO DISPLACEMENT OF CONTROL ROD FROM CR ℄ (NEGLIGIBLE DISPLACE)



CHECK INDICATES NO FOULING IF CRANK ℄ CONTOUR IMPARTED TO CONT. ROD

ORM 1394

A. V ROE CANADA LIMITED
MALTON · ONTARIO
TECHNICAL DEPARTMENT (Aircraft)

REPORT No. 7-0574-1
SHEET No. D 22

AIRCRAFT:		PREPARED BY	DATE
C105	AILERON	T. HAYMAN	MAY 4/54
		CHECKED BY	DATE

LINKAGE SYSTEM - TOWING CHECK (CONT.). LIMIT

VERTICAL DEFLECTION - COMBINED BENDING & TORSION:

CTL	STATION ALONG AILERON H/L * IN.	STATION ALONG ELAST AXIS FROM DATUM IN.	∠θ DEGREES ①	SIN θ ②	AT CONTROL ROD ℄ y_b IN. ③	C ELASTIC AXIS - CONTROL ℄ IN. ④	y_{tcr} C.SIN θ = ④ × ② IN. ⑤	y_{cr} = ③ + ⑤ IN. ⑥	AT CRANK ℄ y_b IN. ⑦	C ELASTIC AXIS - CRANK ℄ IN. ⑧	y_{tc} C.SIN θ = ⑧ × ② IN. ⑨	y_c = ⑦ + ⑨ IN. ⑩
	0	0	0	0	0	43.7	0	0	0	52.4	0	0
1	19.0	18.0	.801	.0140	.194	37.6	.526	.720	.194	46.3	.648	.842
2	39.0	37.0	1.840	.0321	.836	31.3	1.005	1.841	.836	40.0	1.284	2.120
3	55.0	52.2	2.793	.0488	1.712	26.2	1.279	2.991	1.712	35.0	1.708	3.420
4	71.3	67.8	3.815	.0665	2.899	21.0	1.397	4.296	2.899	29.9	1.988	4.887
5	91.4	86.9	5.063	.0883	4.836	14.8	1.307	6.143	4.836	23.6	2.084	6.920
6	110.0	104.5	6.152	.1071	7.059	9.0	.964	8.023	7.059	17.8	1.906	8.965
7	127.1	120.7	7.087	.1233	9.550	35	.432	9.982	9.550	12.4	1.529	11.079
8	152.5	145.0	8.506	.1480	13.510	—	—	—	13.510	—	—	—

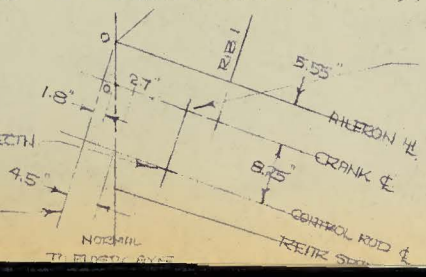
SHT. 1 SHT. 2 SHT. 2

REF: SHTS. 2, 10, 11

* ALSO APPLIES TO REAR SPAR (APPROX. PARALLEL TO H/L), & TO CONTROL ROD ℄ & CRANK ℄ (PARALLEL TO AILERON H/L).

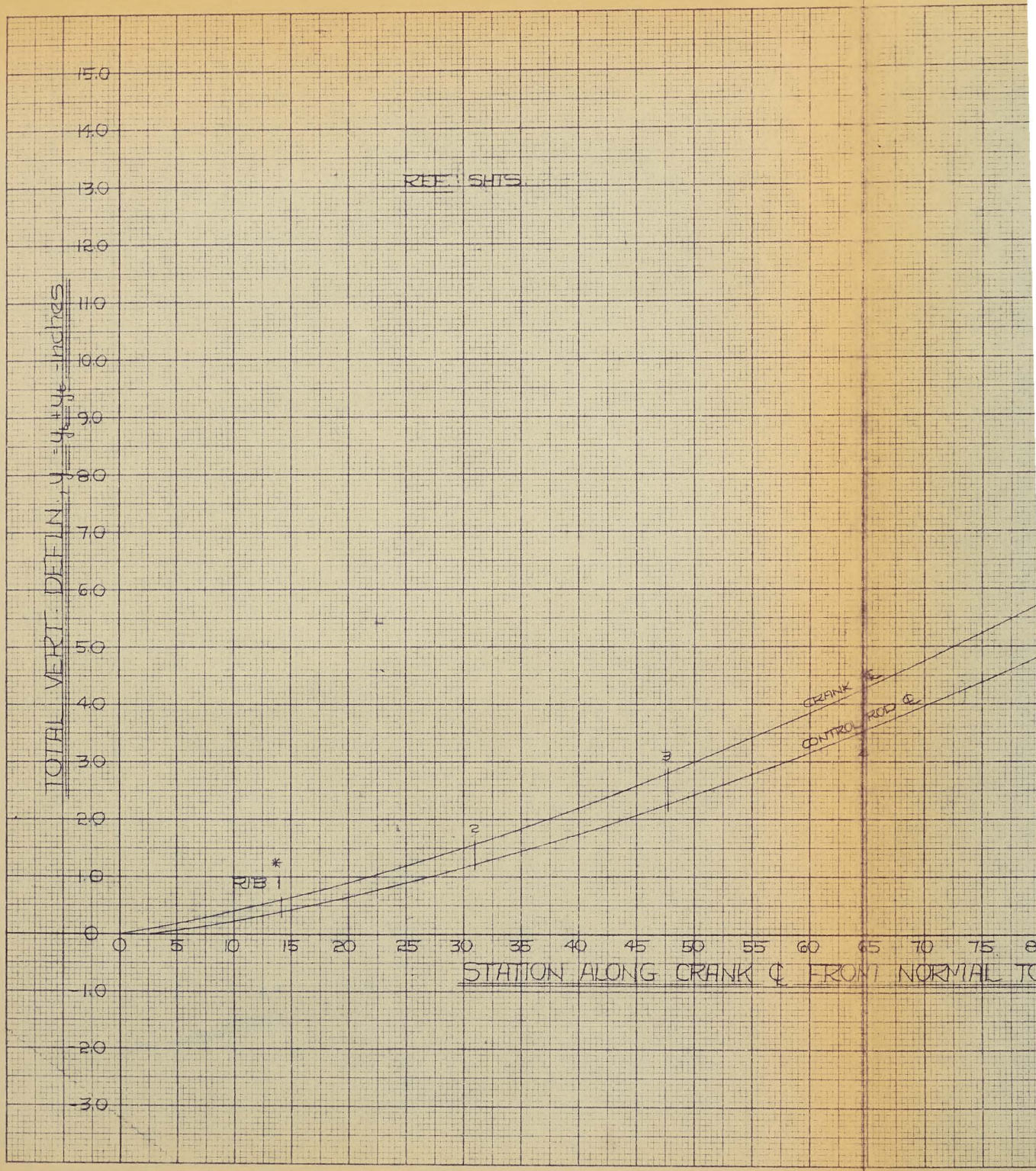
TAKING NORMAL TO AILERON H/L AT '0' ON H/L AS A DATUM, THE ZEROS FOR THE CRANK ℄ & CONTROL ROD ℄ ARE 1.8" & 4.5" RESPECTIVELY.

PLOTTING CRANK ℄ DEFLECTION VS CONTROL ROD ℄ DEFLECTN, 'ZERO' FOR CONTROL ROD EQUALS (4.5 - 1.8) = 2.7" FOR CRANK, USING CRANK ℄ AS BASE (SEE SHT. 8).



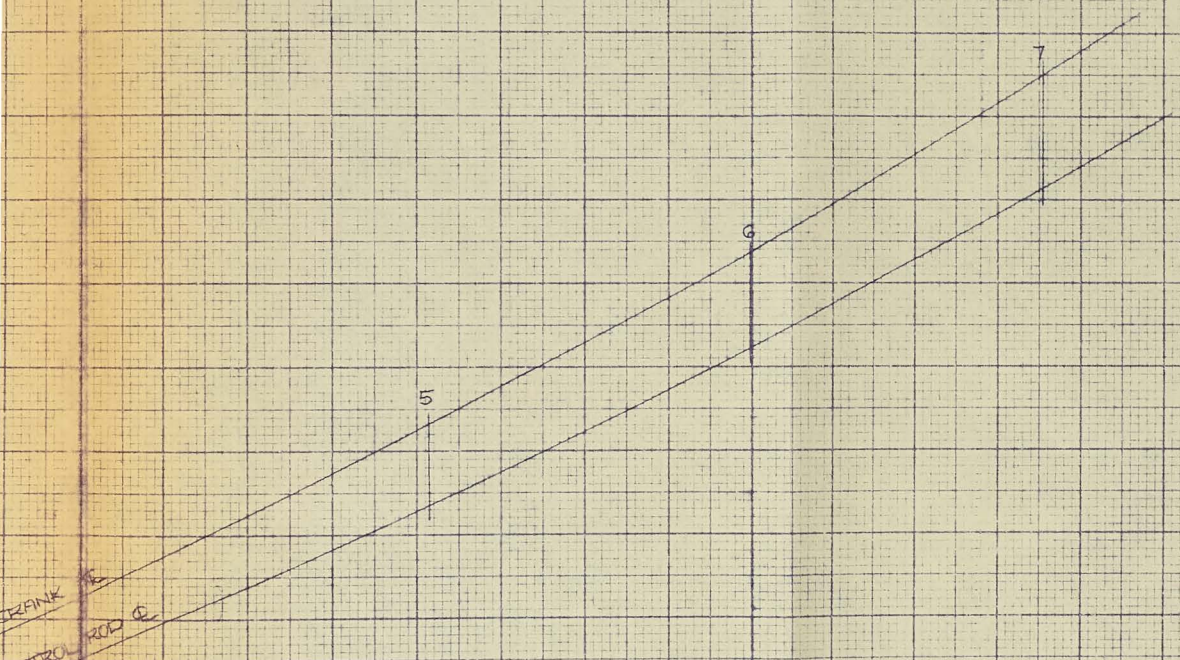
REF: SHT. 2

FORM 1319A


REF SHTS.
TOTAL VERT. DEFLN, $y = y_c + y_c$ - inches
15.0
14.0
13.0
12.0
11.0
10.0
9.0
8.0
7.0
6.0
5.0
4.0
3.0
2.0
1.0
0
-1.0
-2.0
-3.0
0 5 10 15 20 25 30 35 40 45 50 55 60 65 70 75
STATION ALONG CRANK ℄ FROM NORMAL TO
CRANK ℄
CONTROL ROD ℄
RIB 1
1
2
3

LIMIT

TOTAL VERTICAL DEFLECTION OF WING ALONG CRANK CENTERLINE & CONTROL-ROD CENTERLINE (BENDING & TORSION COMBINED)



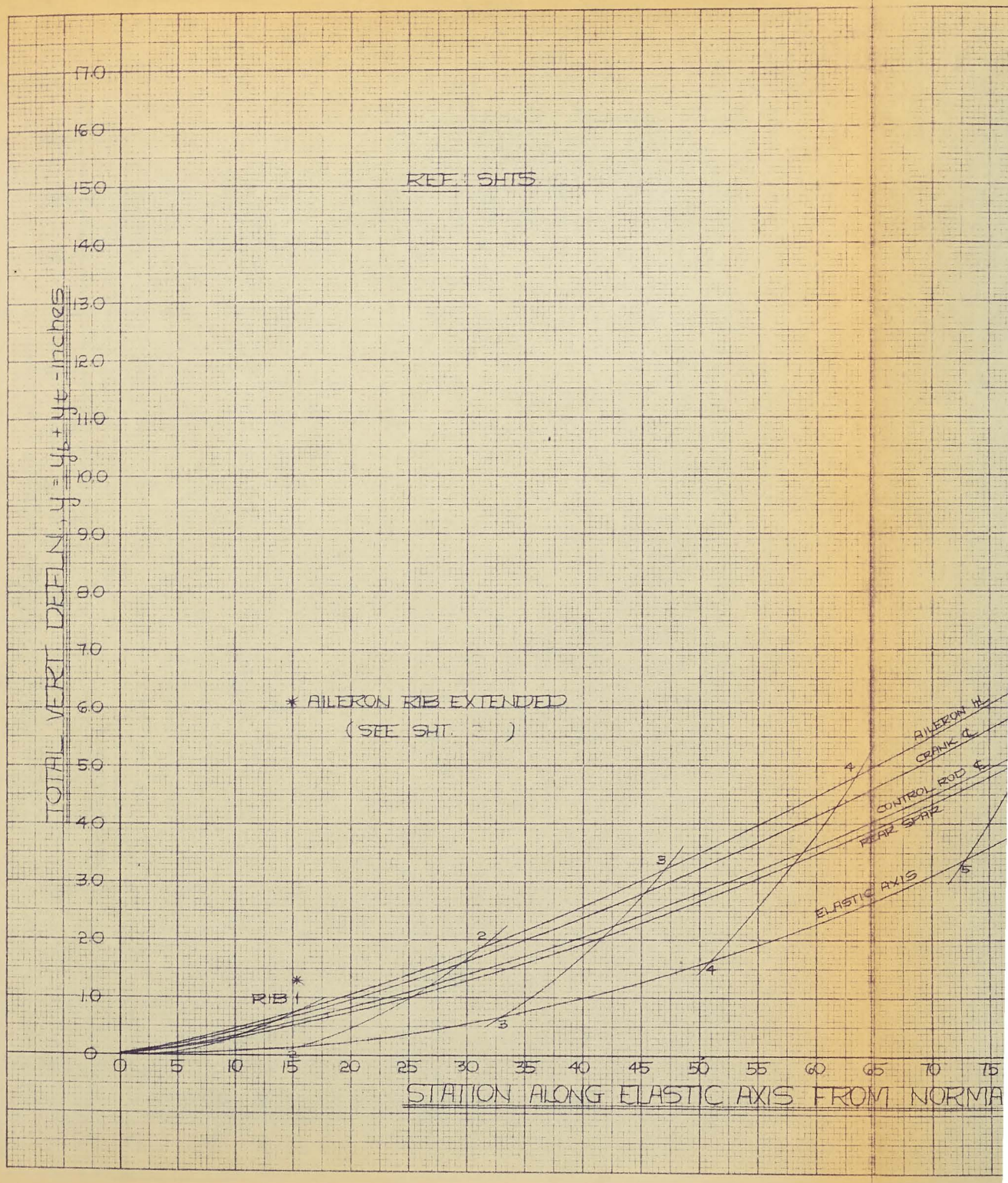
* AILERON RIB EXTENDED (SEE SHT.)

65 70 75 80 85 90 95 100 105 110 115 120 125 130 135

FROM NORMAL TO ELASTIC AXIS (SEE SHT.)

C105 AILERON

T. HAYMAN MAY 5/54


REF SHTS
TOTAL VERT DEFLN, $y = y_b + y_e$ - inches
17.0
16.0
15.0
14.0
13.0
12.0
11.0
10.0
9.0
8.0
7.0
6.0
5.0
4.0
3.0
2.0
1.0
0
* AILERON RIB EXTENDED
(SEE SHT)
AILERON H
CRANK
CONTROL ROD
REAR SPAR
ELASTIC AXIS
RIB 1
2
3
4
5
0 5 10 15 20 25 30 35 40 45 50 55 60 65 70 75
STATION ALONG ELASTIC AXIS FROM NORMA

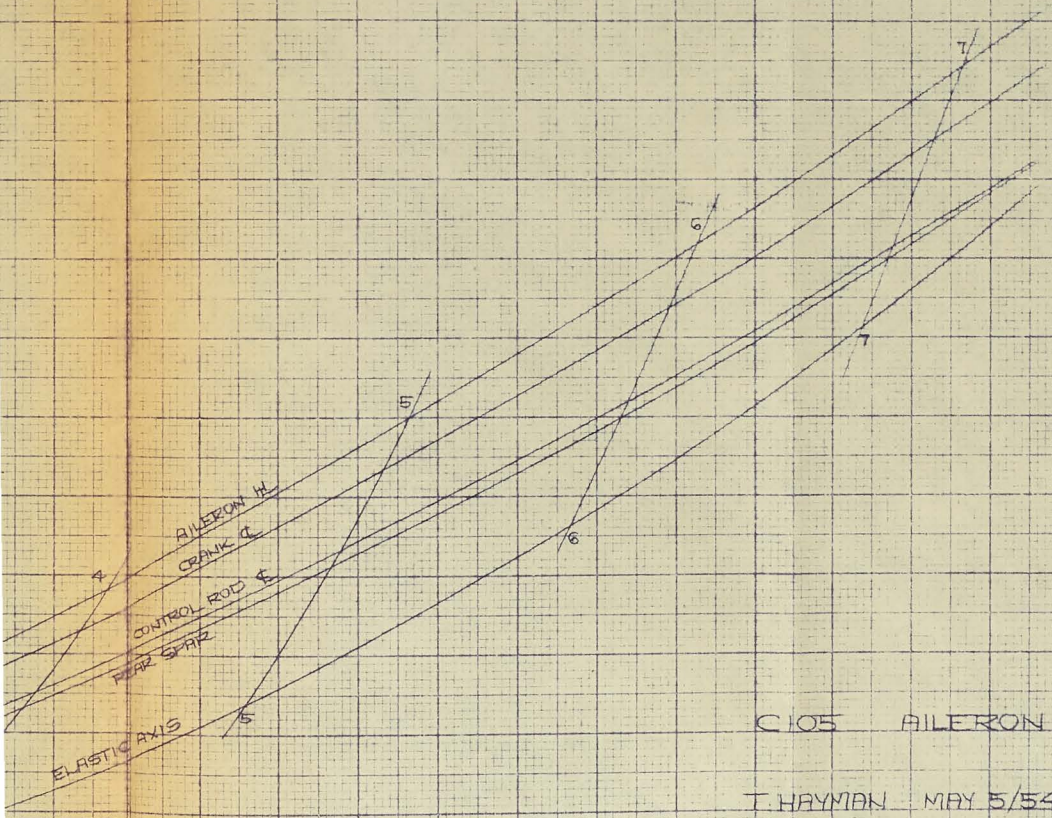
LIMIT

TOTAL VERTICAL DEFLECTION

OF WING

ALONG & ABOUT ELASTIC AXIS

(BENDING & TORSION COMBINED)



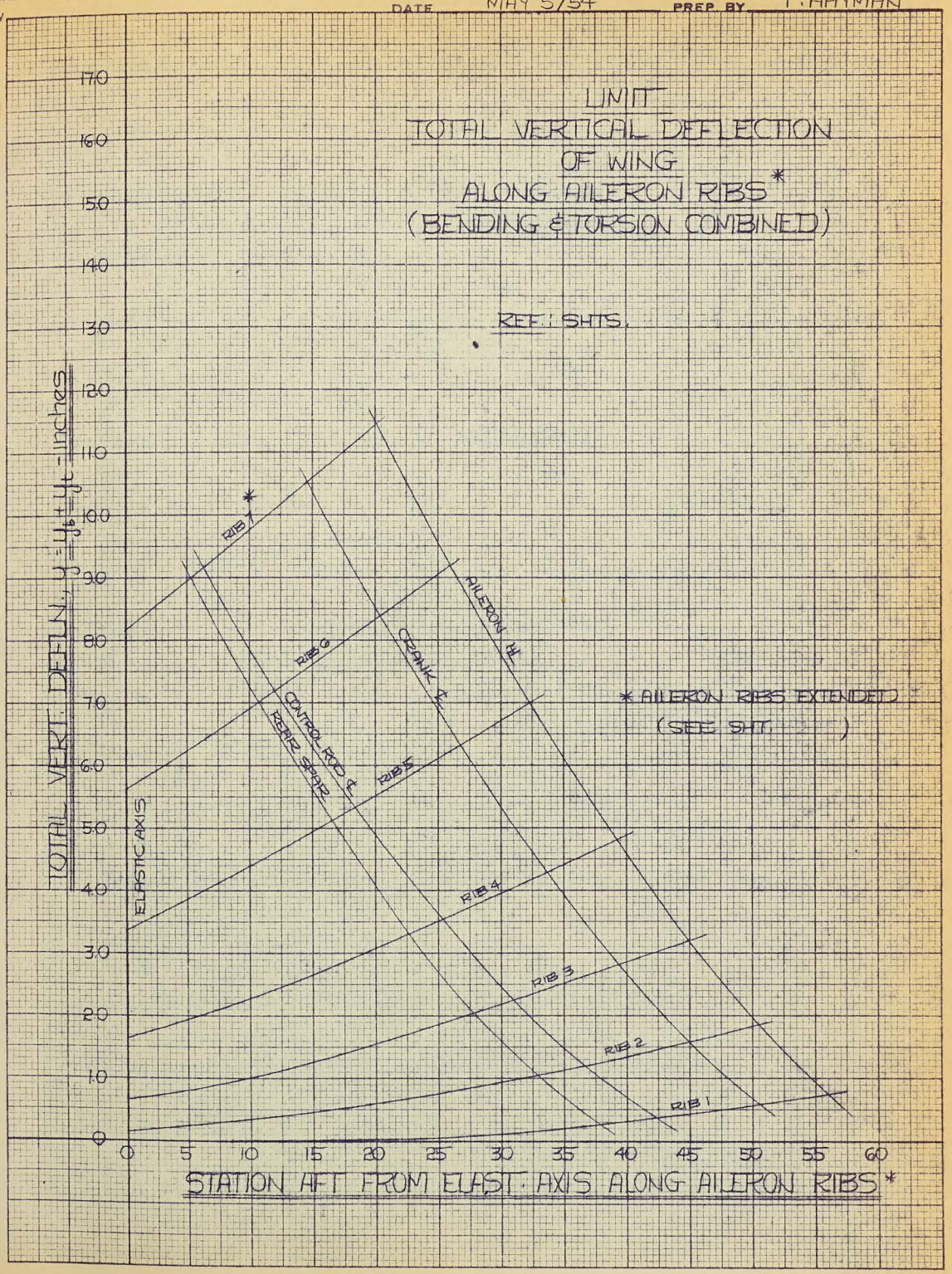
60 65 70 75 80 85 90 95 100 105 110 115 120 125 130 135

S FROM NORMAL THRU DIRECT 'B' - H INTERSECTN

AIRCRAFT C105 COMPONENT AILERON SHEET No. U25 REPORT No. Z-0574-1
A. U. W. DATE MAY 5/54 PREP. BY T. HAYMAN

LIMIT TOTAL VERTICAL DEFLECTION OF WING ALONG AILERON RIBS* (BENDING & TORSION COMBINED)

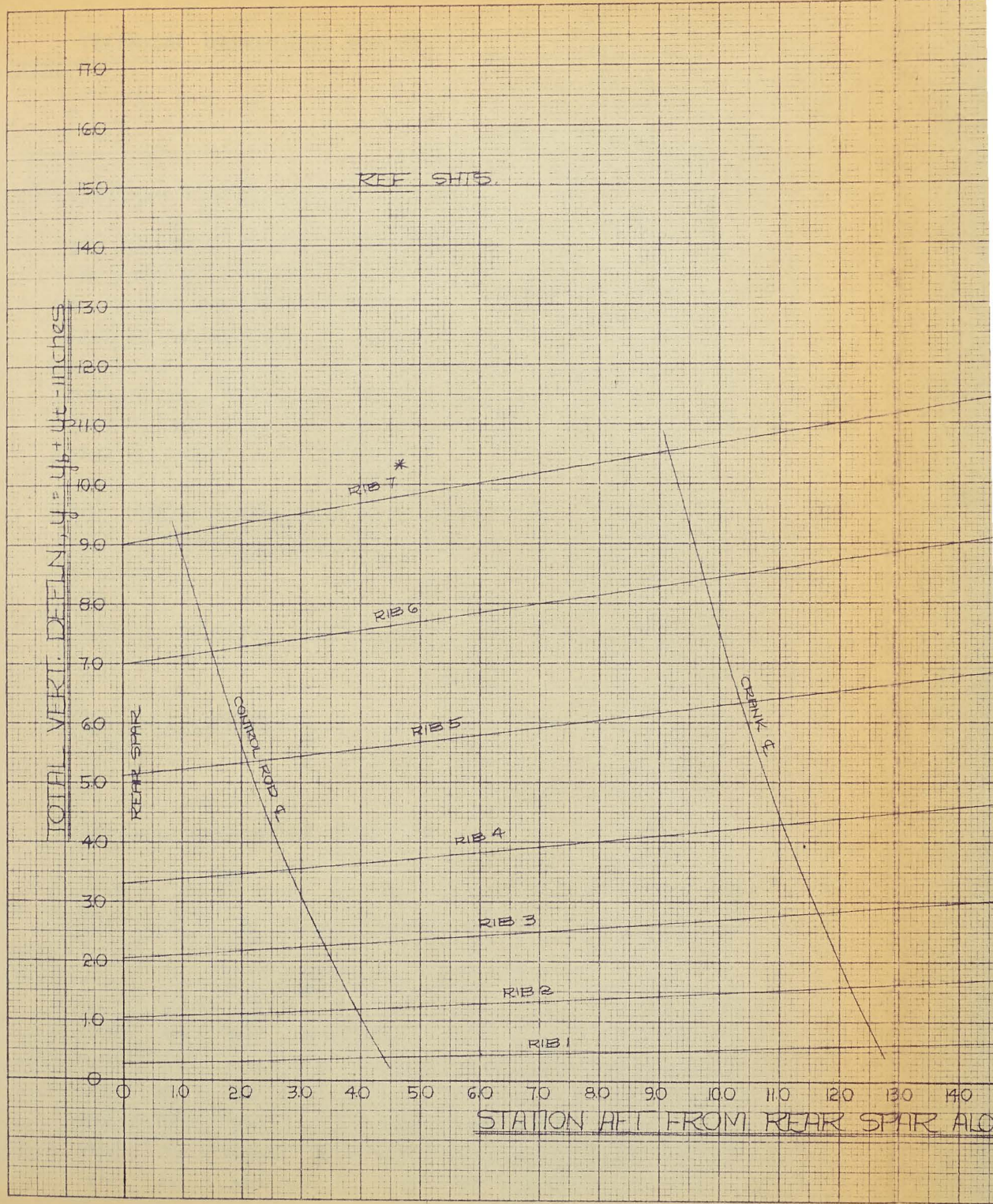
REF: SHTS.



* AILERON RIBS EXTENDED (SEE SHT.)

FORM 1746

10 × 10 to the ½ inch, 200 lines accented
MADE IN U.S.A.



10 × 10 to the ½ inch, 5th lines accented
MADE IN U.S.A.

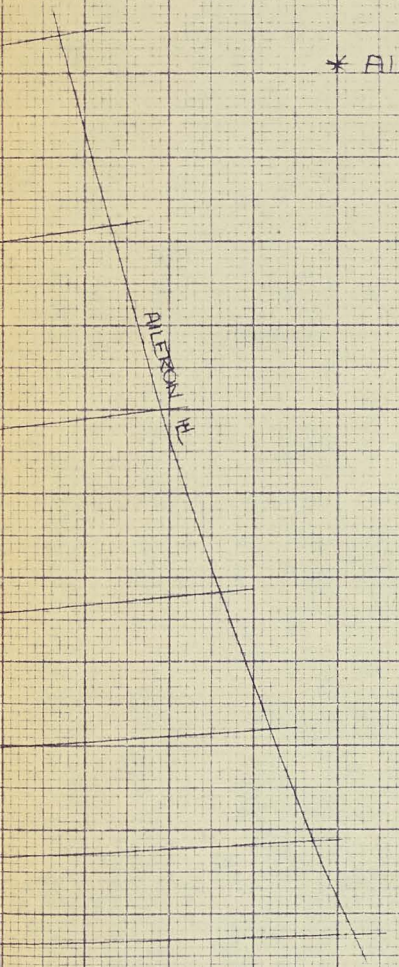
LIMIT

TOTAL VERTICAL DEFLECTION OF WING ALONG AILERON RIBS*

(BENDING & TORSION COMBINED)

* AILERON RIBS EXTENDED

(SEE SHT.)



C105 AILERON

J. HAYMAN MAY 6/54

0 15.0 16.0 17.0 18.0 19.0 20.0 21.0 22.0 23.0 24.0 25.0 26.0 27.0

ALONG AILERON RIBS*

A. V. ROE CANADA LIMITED
MALTON - ONTARIO
TECHNICAL DEPARTMENT (Aircraft)

REPORT No. 7-0574-1
SHEET No. D 27

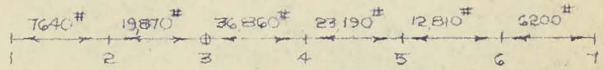
AIRCRAFT:		PREPARED BY	DATE
C105	AILERON	T. HAYMAN	MAY 7/54
		CHECKED BY	DATE

AILERON CONTROL ROD LOADING: — LIMIT

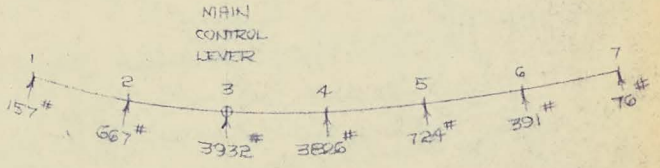
THE AILERON CONTROL LEVER SYSTEM IS SUCH THAT THE CRANKS, BEING ATTACHED TO THE WING STRUCTURE, WILL MOVE AS PART OF THE WING STRUCTURE WHEN THE WING FLEXES DUE TO AIR LOADS. THIS WILL INDUCE BENDING INTO THE CONTROL ROD APPROXIMATING THE DEFLECTION EXPERIENCED BY THE WING, & HENCE, ADDITIONAL LOADS DUE TO BENDING AT THE CONTROL-ROD - CRANK CONNECTIONS.

THE MAGNITUDE OF THESE LOADS, COUPLED WITH THE NORMAL OPERATING LOADS (AXIAL), ARE INDICATED BELOW:

NORMAL LOADS: (SHT. 30)



BENDING LOADS: (SHT. 30)

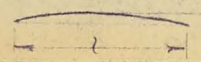


- CONSIDER RADIUS OF CURVE, TO FIND M AT SUPPORTS (ATTACH. TO CRANKS)

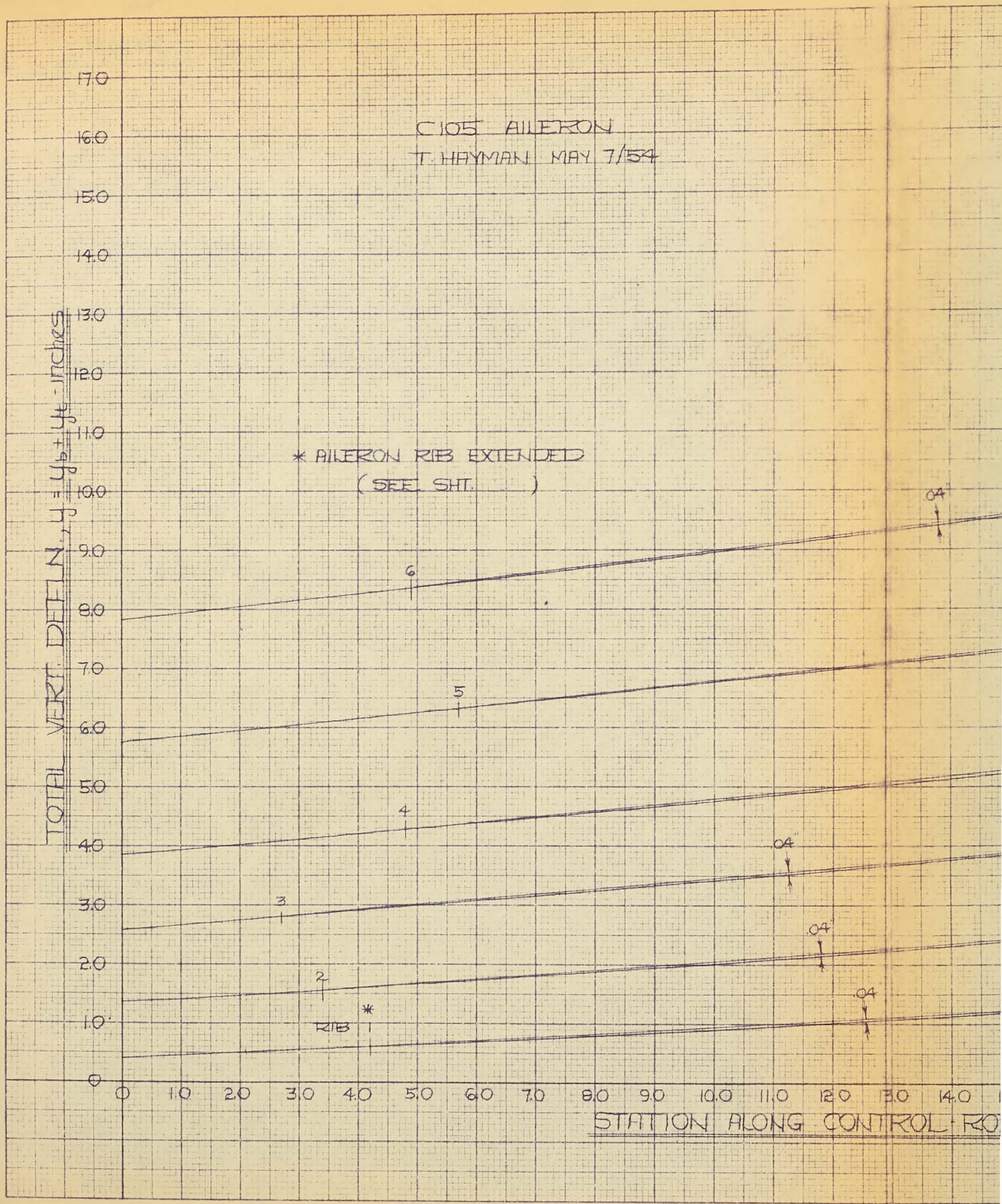
HAVE: $\rho = \frac{EI}{M}$ OR, $M = \frac{EI}{\rho}$ WHERE ρ = RAD OF CURVE (SEELY PG 122)

ROD ELEMENT	① l IN.	② h IN.	③ ρ = RAD CURVE = $\frac{4h^2+l^2}{8h}$ IN.	④ E = 29×10⁶ (STEEL) P.S.I.	⑤ r_o IN.	⑥ r_i IN.	⑦ $(r_o^4 - r_i^4)$ IN.⁴	⑧ $I = \frac{\pi}{4}(r_o^4 - r_i^4)$ IN.⁴	⑨ EI ×10⁻⁶ IN²LB	⑩ $M = EI/\rho = ⑨/③$ IN.LB
1-2	16.75	.04	877	29×10⁶	.500	.417	.0323 (.0625-.0302)	.0254	.737	840
2-3	16.75	.04	877	↓	.625	.469	.1042 (.1526-.0484)	.0818	2.372	2705
3-4	17.12	.04	916		1.000	.844	.4926 (1.0000-.5074)	.3867	11.214	12,242
4-5	20.88	.05	1090		.688	.532	.1440 (.2241-.0801)	.1130	3.277	3006
5-6	19.20	.04	1152	↓	.562	.442	.0616 (.0998-.0382)	.0484	1.404	1218
6-7	17.80	.04	990	29×10⁶	.438	.357	.0206 (.0368-.0162)	.0162	.470	475

SHT. 1 SHT. 20 DWG. 7.0115.0029 SHT. 29

$\rho = \frac{4h^2+l^2}{8h}$  (ESPATCH), $I = \frac{\pi}{4}(r_o^4 - r_i^4)$ (BROHN)

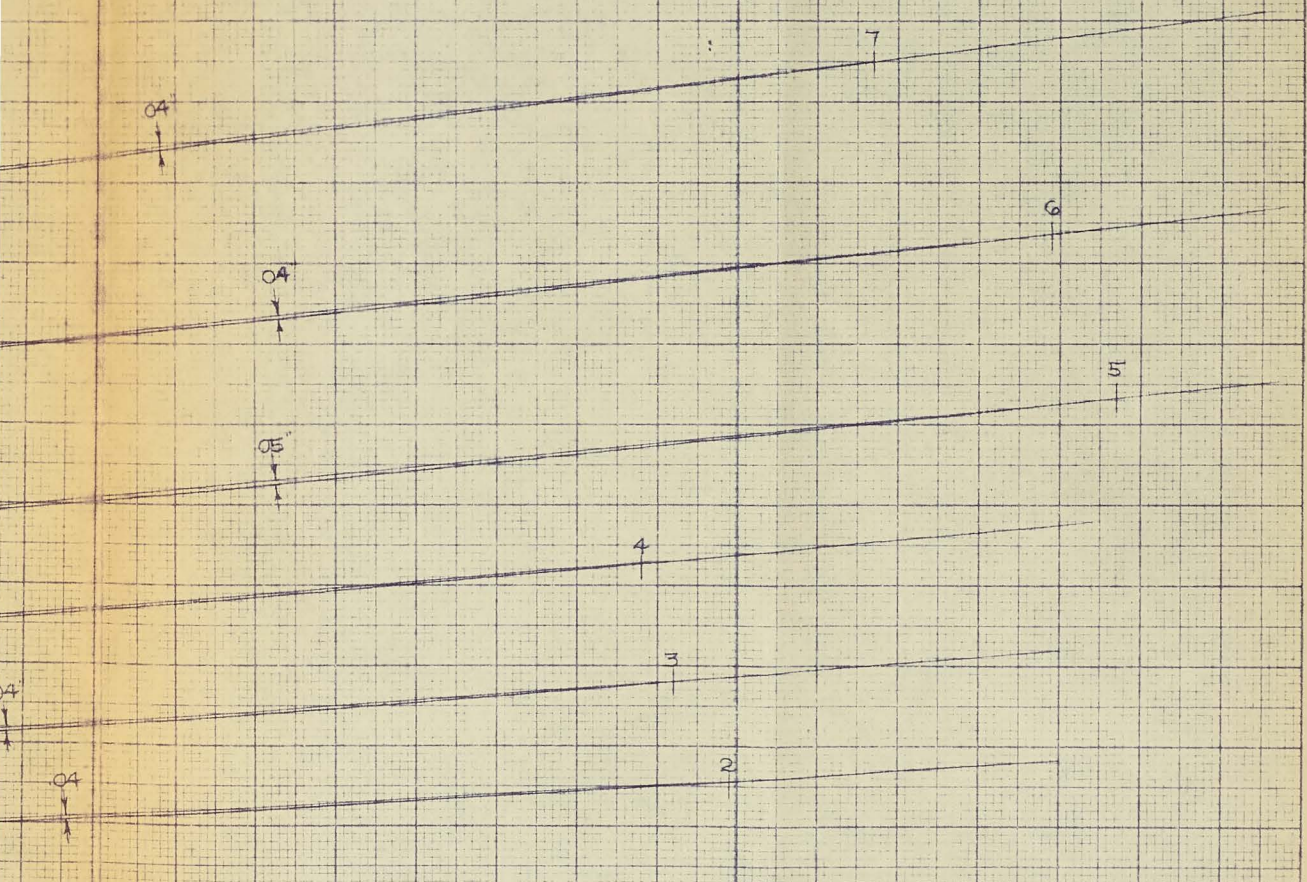
DRM 1319A


C105 AILERON
T. HAYMAN MAY 7/54
* AILERON RIB EXTENDED
(SEE SHT.)
TOTAL VERT. DEFLN. $y, y_b + y_d = y_b + y_d$ - Inches
STATION ALONG CONTROL RO
RIB
.04"
.04"
.04"
.04"
17.0
16.0
15.0
14.0
13.0
12.0
11.0
10.0
9.0
8.0
7.0
6.0
5.0
4.0
3.0
2.0
1.0
0
1.0
2.0
3.0
4.0
5.0
6.0
7.0
8.0
9.0
10.0
11.0
12.0
13.0
14.0

D 23 7-0370-1

LIMIT TOTAL VERTICAL DEFLECTION OF AILERON CONTROL ROD (ASSUMED SAME AS WING DEFLN. ALONG CRANK ℄)

REF SHT



12.0 13.0 14.0 15.0 16.0 17.0 18.0 19.0 20.0 21.0 22.0 23.0 24.0 25.0 26.0 27.0

CONTROL ROD ℄

A. V. ROE CANADA LIMITED
MALTON - ONTARIO
TECHNICAL DEPARTMENT (Aircraft)

REPORT No. 7-0574-1
SHEET No. D29

AIRCRAFT:		PREPARED BY	DATE
C105	AILERON	T. HAYMAN	MAY 11/54
		CHECKED BY	DATE

AILERON CONTROL-ROD LOADING (CONT.): LIMIT

BENDING LOADS (CONT.)

SINCE THE AILERON CONTROL-ROD IS SUBJECTED TO AXIAL TENSION &/OR COMPRESSION LOADS COMBINED WITH BENDING, EXAMINATION OF THE ROD AS A BEAM-COLUMN IS IN ORDER:

MOMENT DISTRIBUTION FOR AXIALLY LOADED MEMBERS:

REF: PEERY 18.11, PG. 549-553 (OR TN 534 - B.W. JAMES)

- FIXED-END MOMENTS, CARRY-OVER FACTORS & STIFFNESS FACTORS DEPEND ON THE VALUE OF L/j; $j = \sqrt{\frac{EI}{P}}$

ROD ELEMENT	P AXIAL LOAD LB (1)	L IN (2)	EI $\times 10^6$ $IN^2 LB$ (3)	$j = \sqrt{EI/P}$ IN (4)	$L/j = \Theta/\Phi$ (5)	$C_M = C_2$ PEERY PG. 550 (6)	$M = \frac{WL}{8}$ (FIXED ENDS - NO AXIAL LD) IN LB. (7)	$M' = \frac{WL}{C_M} = \frac{8M}{C_M}$ (AXIAL LD) IN LB. (8)	STIFFNESS FACTOR, K: $C_K = C$ PEERY PG 551 (9)	$\frac{4EI}{L} \times 10^6$ IN LB (10)	$K = \frac{4EI}{L} C_K \times 10^6$ IN LB. (11)	DISTRIB. FACTOR $D = \frac{K}{\Sigma K}$ (12)	CARRY-OVER FACTOR $C = M_B/M_A$ PEERY PG 551 (13)
1-2	7640	16.75	.737	9.83	1.70	7.45	840 840	902 902	.892	.176	.157	0 .234	.586
2-3	19,870	16.75	2.372	10.69	1.57	7.50	2705 2705	2885 2885	.906	.566	.513	.766 .170	.575
3-4	36,560	17.12	11.214	17.44	.98	7.72	12,242 12,242	12,687 12,687	.958	2.620	2.510	.830 .813	.534
4-5	23,190	20.88	3.277	11.89	1.76	7.40	3006 3006	3251 3251	.884	.628	.555	.181 .684	.592
5-6	12,810	19.20	1.404	10.47	1.83	7.36	1218 1218	13325 13325	.874	.293	.256	.316 .742	.602
6-7	6200	17.80	.470	8.71	2.04	7.25	475 475	525 525	.842	.106	.089	.258 0	.634

SHT. 27 — SHT. 27 SHT. 32 — SHT. 32

- MOMENT DISTRIBUTION & REACTIONS ARE GIVEN ON SHT.

- FIXED-ENDS HAVE BEEN ASSUMED THROUGHOUT (i.e. IT IS ASSUMED THAT THE CRANK-CONTROL ROD CONNECTIONS ARE SUFFICIENTLY RIGID TO ASSUME FIXED-ENDS). THIS ASSUMPTN. INDICATES HIGHEST LOADS AT CONTROL-ROD ENDS WHERE, AT OUTBD. END, AXIAL BEARING CAPACITY (THRUST) IS MOST LIMITED.

FORM 3194

A. V. ROE CANADA LIMITED
MALTON - ONTARIO
TECHNICAL DEPARTMENT (Aircraft)

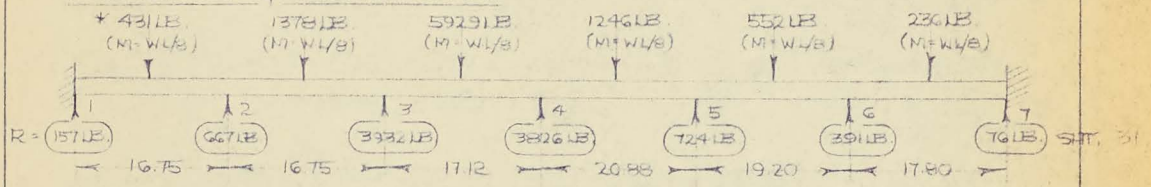
REPORT No. 7-0579-1
SHEET No. D30

AIRCRAFT:		PREPARED BY	DATE
C105	AILERON	T. HAYMAN	MAY 12/54
		CHECKED BY	DATE

AILERON CONTROL - ROD LOADING (CONT.): LIMIT

BENDING LOADS (CONT.): METHOD: HARDY CROSS - BRUHN A11.

MOMENTS & REACTIONS:



K	$\frac{4EI}{L}C_k$ = .157		$\frac{4EI}{L}C_k$ = .573		$\frac{4EI}{L}C_k$ = 2.510		$\frac{4EI}{L}C_k$ = .555		$\frac{4EI}{L}C_k$ = .256		$\frac{4EI}{L}C_k$ = .089		$\times 10^6$
D	0	.234	.766	.170	.830	.819	.181	.684	.316	.742	.258	0	
C	.586		.575		.534		.592		.602		.634		
M	−902	+902	−2885	+2885	−12,687	+12,687	−3251	+3251	−1325	+1325	−525	+525	
B_1	0	+464	+1519	+1666	+8136	−7728	−1708	−1317	−609	−594	−206	0	
C_1	+272	0	+958	+873	+427	+4345	−780	−1011	−356	−367	0	−131	
B_2	0	−229	−734	+553	+2101	−2920	−645	−935	+432	+212	+95	0	
C_2	−131	0	+378	−422	−1559	+1442	+554	−382	+164	+260	0	+60	
B_3	0	−74	−244	+337	+1644	−1635	−361	−149	+69	−193	−67	0	
C_3	−43	0	+194	−140	−673	+678	+88	−214	−116	+42	0	−42	
B_4	0	−45	−149	+172	+841	−791	−175	+226	+104	−31	−11	0	
C_4	−26	0	+99	−86	−422	+449	+134	−104	−19	+63	0	−7	
B_5	0	−23	−76	+86	+422	−477	−106	+84	+39	−47	−16	0	
C_5	−13	0	+49	−44	−255	+225	+50	−63	−28	+23	0	−10	
B_6	0	−11	−38	+51	+248	−225	−50	+62	+29	−17	−6	0	
C_6	−6	0	+29	−22	−120	+132	+37	−30	−10	+17	0	−4	
B_7	0	−7	−22	+24	+118	−138	−31	+27	+13	−13	−4	0	
C_7	−4	0	+14	−13	−74	+63	+16	−18	−8	+8	0	−3	
B_8	0	−3	−11	+15	+72	−65	−14	+18	+8	−6	−2	0	
C_8	−2	0	+9	−6	−35	+38	+11	−8	−4	+5	0	−1	
B_9	0	−2	−7	+7	+34	−40	−9	+8	+4	−4	−1	0	
C_9	−1	0	+4	−4	−21	+18	+5	−5	−2	+2	0	−1	
B_{10}	0	−1	−3	+4	+21	−19	−4	+5	+2	−1	−1	0	
M	−856	+976	−976	+5936	−5936	+6239	−6239	+1613	−1613	+744	−744	+386	
B.M.	−856	−976		−5936		−6239		−1613		−744		+386	

* IMAGINARY LOADS WHICH GIVE M INDICATED FROM RAD. OF CURVE (SHT. 29) & AXIAL LOAD CONSIDERATIONS.

ORM 1198

AILERON CONTROL ROD LOADING (CONT.): LIMIT

BENDING LOADS (CONT.): - REACTIONS:

M_2: $16.75\,R_1 = -976 + (431 \times 8.375) = -976 + 3610 = 2634$; $R_1 = 157$ LB.

M_3: $16.75\,R_2 = -5936 - (157 \times 33.50) + (431 \times 25.125) + (1378 \times 8.375)$
$= -5936 - 5260 + 10,829 + 11,541 = 11,174$; $R_2 = 667$ LB.

M_4: $17.12\,R_3 = -6239 - (157 \times 50.62) - (667 \times 33.87)$
$+ (431 \times 42.245) + (1378 \times 25.495) + (5929 \times 8.56)$
$= -6239 - 7947 - 22,591 + 18,208 + 35,132 + 50,752$
$= -36,777 + 104,092 = 67,315$; $R_3 = 3932$ LB.

M_5 (LEFT): $20.88\,R_4 = -1613 - (157 \times 71.50) - (667 \times 54.75) - (3932 \times 38.00)$
$+ (431 \times 63.125) + (1378 \times 46.375) + (5929 \times 29.44) + (1246 \times 10.44)$
$= -1613 - 11,226 - 36,518 - 149,416 + 27,207 + 63,905 + 174,550$
$+ 13,008 = 198,173 + 278,670 = 79,897$; $R_4 = 3826$ LB.

M_6 (LEFT): $19.20\,R_5 = -744 - (157 \times 90.70) - (667 \times 73.95) - (3932 \times 57.20) - (3826 \times 40.08)$
$+ (431 \times 82.325) + (1378 \times 65.575) + (5929 \times 48.64) + (1246 \times 29.64)$
$+ (552 \times 9.60)$
$= -744 - 14,240 - 49,325 - 224,910 - 153,346$
$+ 35,482 + 90,362 + 288,387 + 36,931 + 5299$
$= 442,535 + 456,461 = 13,896$; $R_5 = 724$ LB.

M_6 (RIGHT): $17.80\,R_7 = -744 + (236 \times 8.90) = -744 + 2100 = 1356$; $R_7 = 76$ LB.

M_5 (RIGHT): $19.20\,R_6 = -1613 - (76 \times 37.00) + (236 \times 28.10) + (552 \times 9.60)$
$= -1613 - 2812 + 6632 + 5299 = 7506$; $R_6 = 391$ LB.

CHECK: Σ REACTIONS = 9773 LB. ; Σ LOADS = 9772 LB.

ETC: SHT.

A. V. ROE CANADA LIMITED
MALTON - ONTARIO
TECHNICAL DEPARTMENT (Aircraft)

REPORT NO. J-0579-1
SHEET NO. I. 1

AIRCRAFT:		PREPARED BY	DATE
C105	AILERON	R. CAVALIS	
		CHECKED BY	DATE

MOMENT OF INERTIA - REQUIRED

MAIN RIBS

$$I_{REQ'D} = K_1\left(\frac{X}{C}\right)^2 + K_2\left(\frac{X}{C}\right)^3$$

(β REF.)

WHERE, $K_1 = \frac{M_{LE}\, Y_{TE}}{2F_b}$, $K_2 = \frac{M_{LE}\, \Delta Y}{2F_b}$

LET, $F_b = 25{,}000$ PSI , $\Delta Y = Y_{LE} - Y_{TE}$

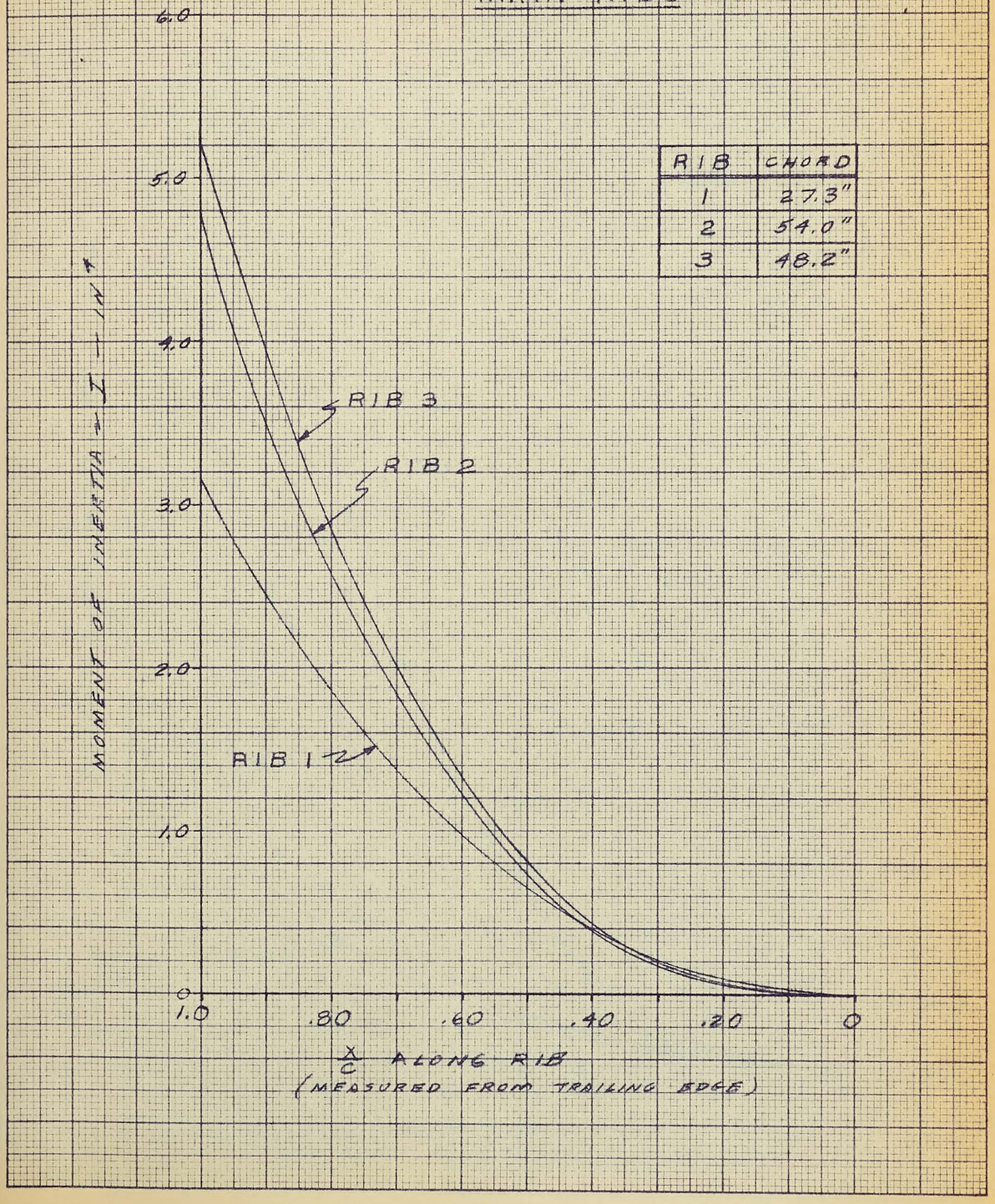
RIB	M_{LE}	Y_{LE}	Y_{TE}	ΔY	K_1	K_2	$I_{REQ'D}$
REF→	β REF	β REF	β REF				
1	36660	4.80	2.76	1.64	2.02	1.13	$2.02\left(\frac{X}{C}\right)^2 + 1.13\left(\frac{X}{C}\right)^3$
2	61250	3.70	.90	3.00	1.10	3.68	$1.10\left(\frac{X}{C}\right)^2 + 3.68\left(\frac{X}{C}\right)^3$
3	79240	3.50	.83	2.67	1.23	3.96	$1.23\left(\frac{X}{C}\right)^2 + 3.96\left(\frac{X}{C}\right)^3$
4	55310	3.10	.77	2.33	.85	2.58	$.85\left(\frac{X}{C}\right)^2 + 2.58\left(\frac{X}{C}\right)^3$
5	38710	2.61	.69	1.92	.534	1.49	$.534\left(\frac{X}{C}\right)^2 + 1.49\left(\frac{X}{C}\right)^3$
6	21450	2.16	.62	1.54	.266	.661	$.266\left(\frac{X}{C}\right)^2 + .661\left(\frac{X}{C}\right)^3$
7	20350	1.74	.55	1.19	.224	.485	$.224\left(\frac{X}{C}\right)^2 + .485\left(\frac{X}{C}\right)^3$

C105 AILERON

R. GAVALIS

MOMENT OF INERTIA (REQ'D.) OF MAIN RIBS

RIB	CHORD
1	27.3"
2	54.0"
3	48.2"

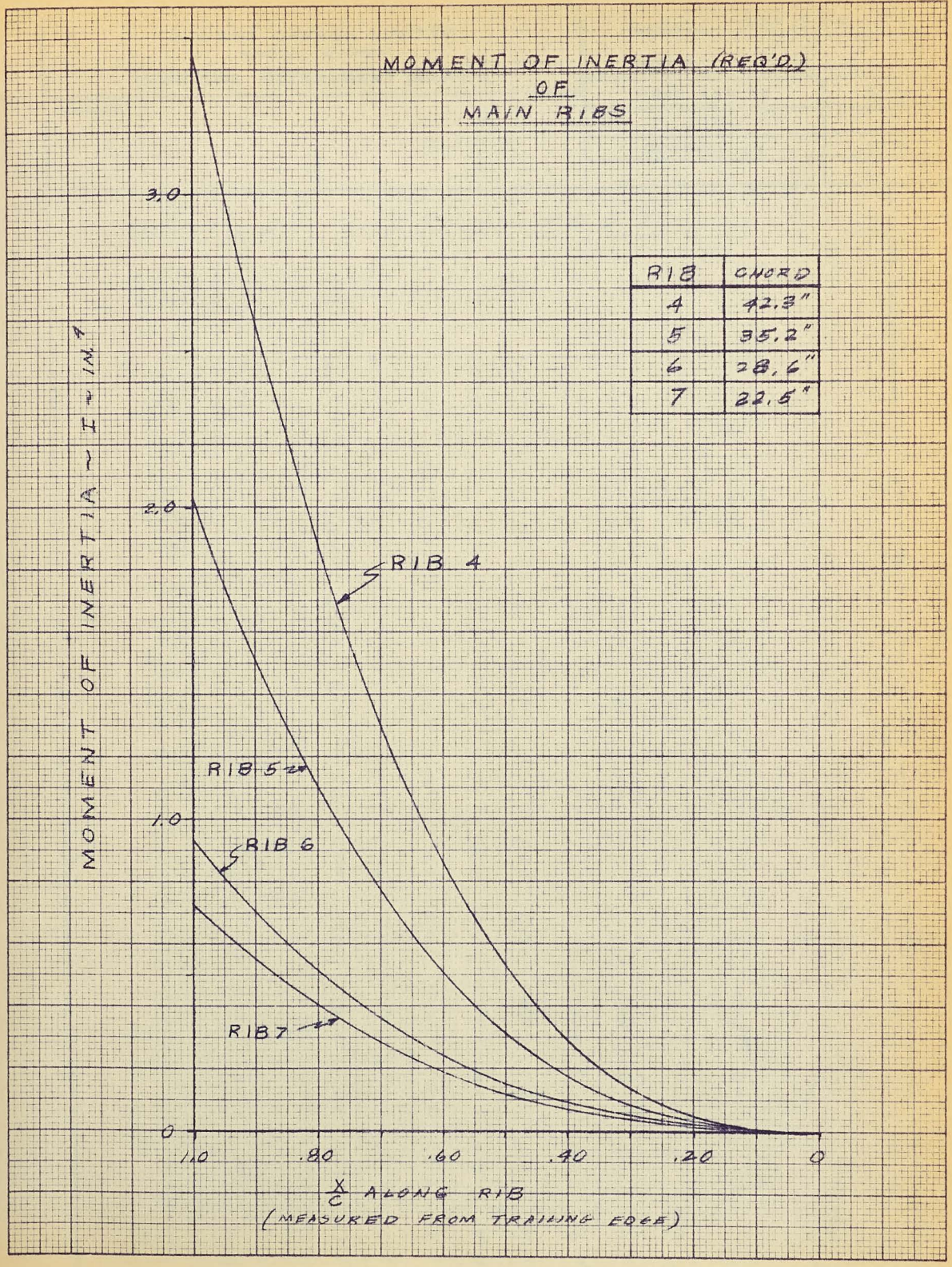


C105 AILERON I 3 7-0571-1

R. GAVALIS

MOMENT OF INERTIA (REQ'D.) OF MAIN RIBS

RIB	CHORD
4	42.3"
5	35.2"
6	28.6"
7	22.5"



A. V. ROE CANADA LIMITED
MALTON - ONTARIO
TECHNICAL DEPARTMENT (Aircraft)

REPORT NO. 7-0579-1
SHEET NO. I9

AIRCRAFT:		PREPARED BY	DATE
C105	AILERON	R. GAVALIS	
		CHECKED BY	DATE

MOMENT OF INERTIA - REQ'D.

INTERMEDIATE RIBS

	1	2	3	4	5	6	7	8	9	10	11
RIB	Y_{LE}*	$I_{1.666C}$	$M_{1.666C}$	$I_{1.666C}$	I_{LE}	$M_{1.48C}$	$Y_{1.48C}$	$I_{1.48C}$	$M_{1.28C}$	$Y_{1.28C}$	$I_{1.28C}$
REF →	B.L.		B		[1]² × ④ / [2]	B			B		
1A	4.1	3.33	4150	.276	.420	3130	2.83	.177	1550	2.43	.0754
2A	3.7	2.75	1200	.396	.717	5430	2.14	.232	2670	1655	.0870
3A	3.30	2.47	5890	.290	.516	4440	1.93	.171	2200	1.50	.0660
4A	2.85	2.14	5260	.224	.398	3960	1.68	.133	1960	1.32	.0519
5A	2.37	1.80	3400	.123	.214	2570	1.42	.073	1275	1.13	.0285
6A	1.95	1.495	2110	.063	.107	1591	1.20	.0382	790	.970	.0153
7A	1.50	1.173	2240	.0525	.086	1690	.961	.0326	840	.794	.0133

* Y_{LE} = TOTAL HEIGHT OF RIB AT LEADING EDGE

$$Y_x = Y_{TE} + (Y_{LE} - Y_{TE}) \frac{x}{c}$$

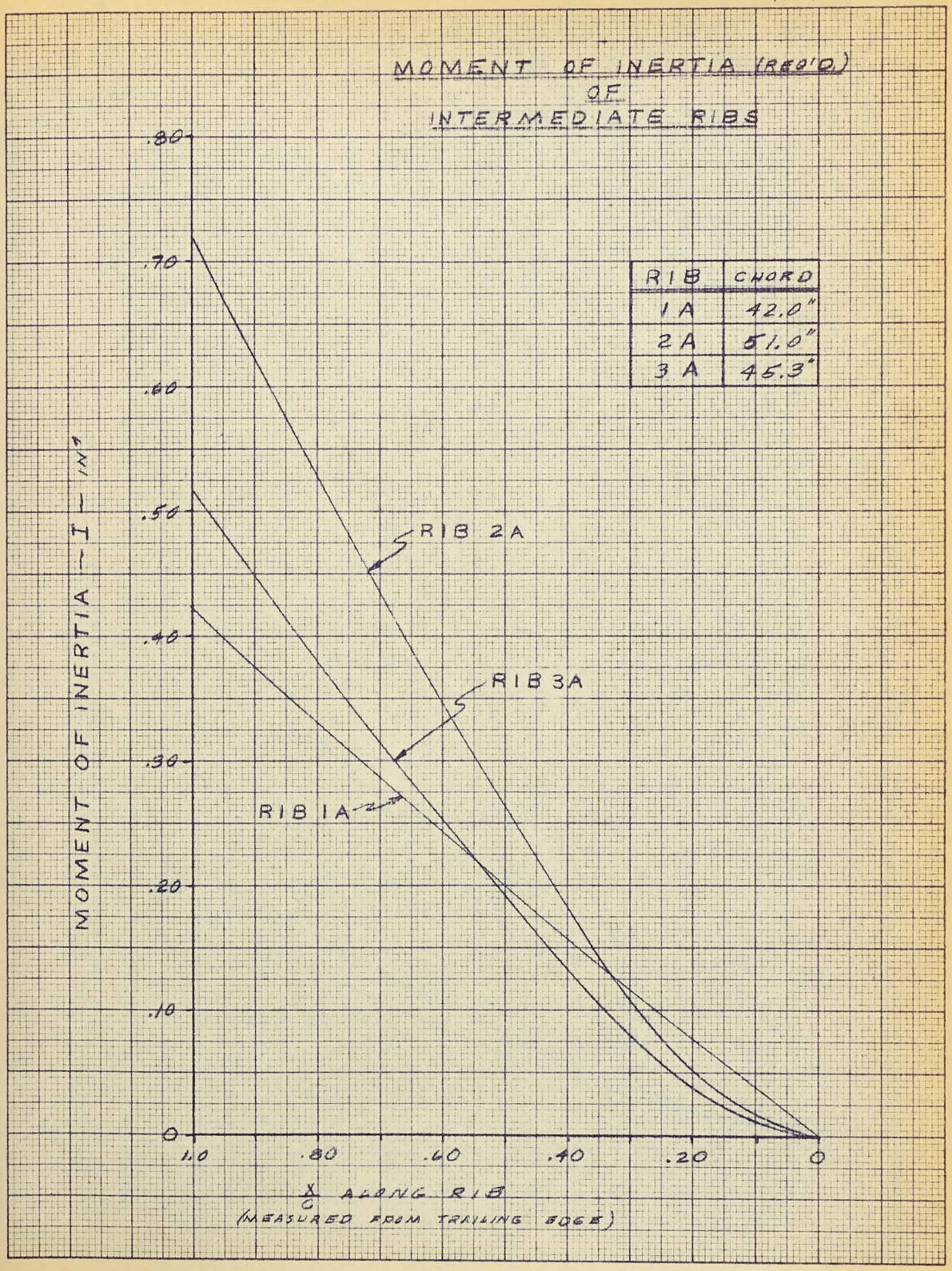
REF. P 9 3

$$\phi\ I_{REQ'D} = \frac{M_{ULT.}\ C}{F_b} = \frac{M\ Y}{2 F_b} \quad \text{LET} \quad F_b = 75{,}000 \text{ psi}$$

C105 AILERON I 5 40504-1 R. CAVALIS

MOMENT OF INERTIA (REQ'D) OF INTERMEDIATE RIBS

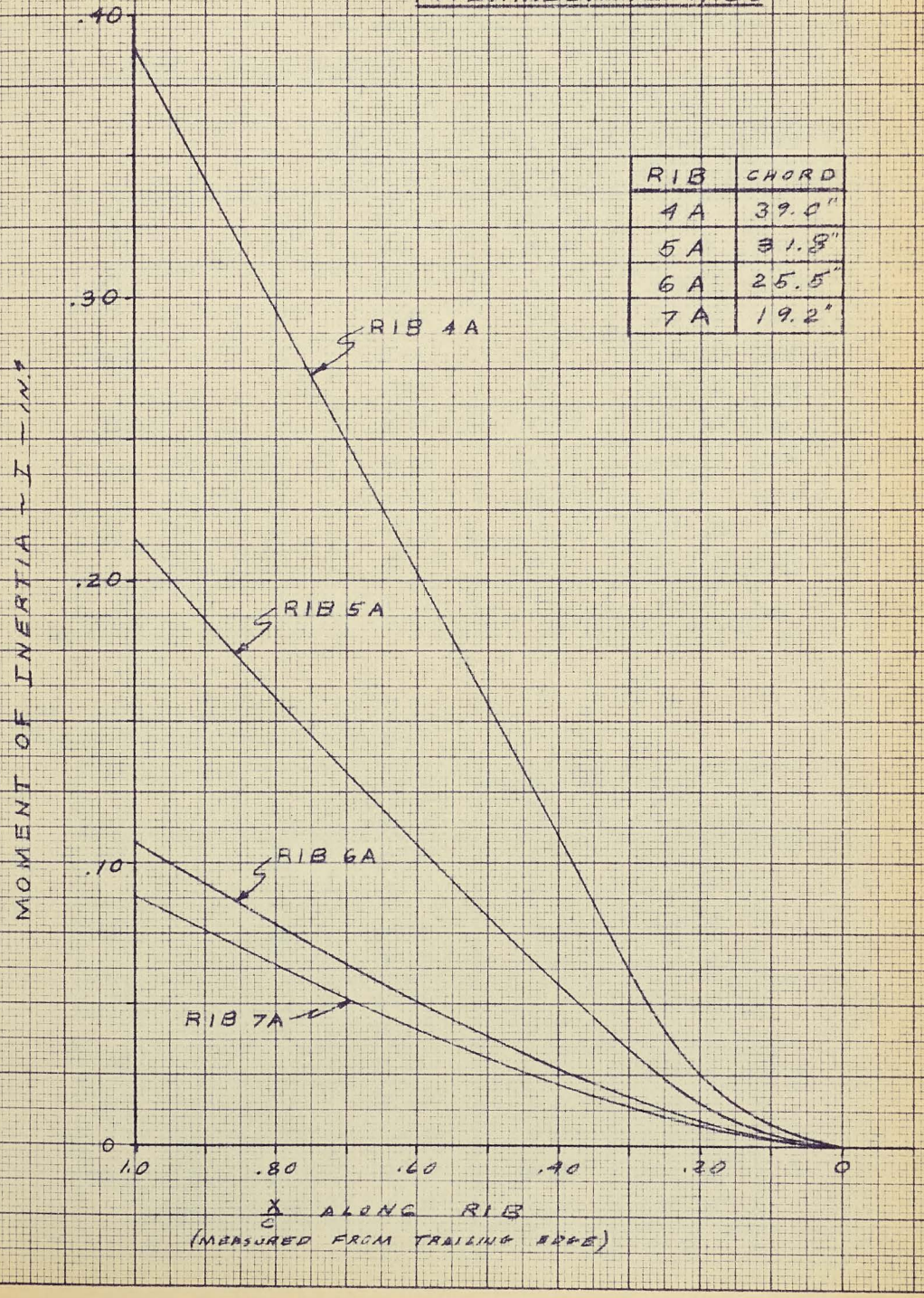
RIB	CHORD
1A	42.0"
2A	51.0"
3A	45.3"



C105 AILERON R. GAVALIS

MOMENT OF INERTIA (REQ'D.) OF INTERMEDIATE RIBS

RIB	CHORD
4A	39.0"
5A	31.8"
6A	25.5"
7A	19.2"



A. V ROE CANADA LIMITED
MALTON - ONTARIO
TECHNICAL DEPARTMENT (Aircraft)

REPORT No. 7-0574-1
SHEET No. 111

AIRCRAFT:		PREPARED BY	DATE
C105	WING	R. GAVALIS	
		CHECKED BY	DATE

245-T4 ALCLAD.

		ROOM TEMP PROP.	REDUCTION IN STRENGTH	PROP. * AT T=250°F	PROP AT # T=250°
F_{bu}	L	61	.87	53	50.5
	T	61	.87	53	50.5
F_{cy}	L	38	.91	34.6	33.6
	T	38	.91	34.6	33.6
F_{cy}	L	38	.91	34.6	33.6
	T	38	.91	34.6	33.6
F_{su}		37	.87	32.2	30.9
F_{bru}	$(\frac{e}{D}=1.5)$	92	.87	80.0	75.6
	$(\frac{e}{D}=2.0)$	116	.87	101.0	97.6
F_{bry}	$(\frac{e}{D}=1.5)$	53	.91	48.2	47.3
	$(\frac{e}{D}=2.0)$	61	.91	55.5	53.6
E		10.0		9.2	9.2

*THICKNESS .064" - .249" #THICKNESS <.064".

245-T4 EXTRUSION

		ROOM TEMP PROP.	REDUCTION IN STRENGTH	PROP AT T=250°F	
F_{bu}	L	57	.92	52.5	
	T	51	.92	46.9	
F_{by}	L	42	.95	39.9	
	T	36	.95	34.2	
F_{cy}	L	38	.95	36.1	
	T	38	.95	36.1	
F_{su}		30	.92	27.6	
F_{bru}	$(\frac{e}{D}=1.5)$	85	.92	78.1	
	$(\frac{e}{D}=2.0)$	108	.92	99.5	
F_{bry}	$(\frac{e}{D}=1.5)$	59	.95	56.0	
	$(\frac{e}{D}=2.0)$	67	.95	63.5	
E		10.5		9.7	

DRM 1319A

A. V ROE CANADA LIMITED
MALTON ONTARIO
TECHNICAL DEPARTMENT (Aircraft)

REPORT No 7-0529-1
SHEET No 11A

AIRCRAFT		PREPARED BY	DATE
C 105	AILERON	R. GAVALIS	9/9/59
		CHECKED BY	DATE
		-	

ELEVATED TEMPERATURE PROPERTIES

OF 14S-T6 FORGING* (4" THICK)

TEMPERATURE = 250°F (353 HOURS)

* HAND IN THE FORGING, AREA ≤ 46 IN²

REFERENCE →	ROOM TEMPERATURE PROPERTIES	% REDUCTION IN STRENGTH	PROPERTIES AT 250°F	
F_{tu} L	65 [illegible]	.91	59100	F_{tu}
T	62000	.91	56400	
F_{cy} L	63 [illegible]	.91	57600	F_{cy}
T	60 [illegible]	.90	54300	
F_{cy} L	52 [illegible]	.90	47600	F_{cy}
T	52 [illegible]	.90	46800	
F_{su}	39000	.91	35500	F_{su}
F_{br_u} ($e/D = 1.5$)	100 [illegible]	.91	89100	F_{br}
F_{br_u} ($e/D = 2.0$)	124000	.91	113000	
F_{br_y} ($e/D = 1.5$)	90 [illegible]	.91	63000	
F_{br_y} ($e/D = 2.0$)	70 [illegible]	.90	72000	
E	10.5×10^6		9.7×10^6	E

† ALLOWABLE FOR EITHER L OR T DIR. IN THE PLANE OF FORGING WHICH HAS LOWER.

A. V. ROE CANADA LIMITED
MALTON - ONTARIO
TECHNICAL DEPARTMENT (Aircraft)

REPORT No. 7-0574-1
SHEET No. M3

AIRCRAFT:		PREPARED BY	DATE
C105	AILERON	R GAVALIS	
		CHECKED BY	DATE

245-T42 PLATE

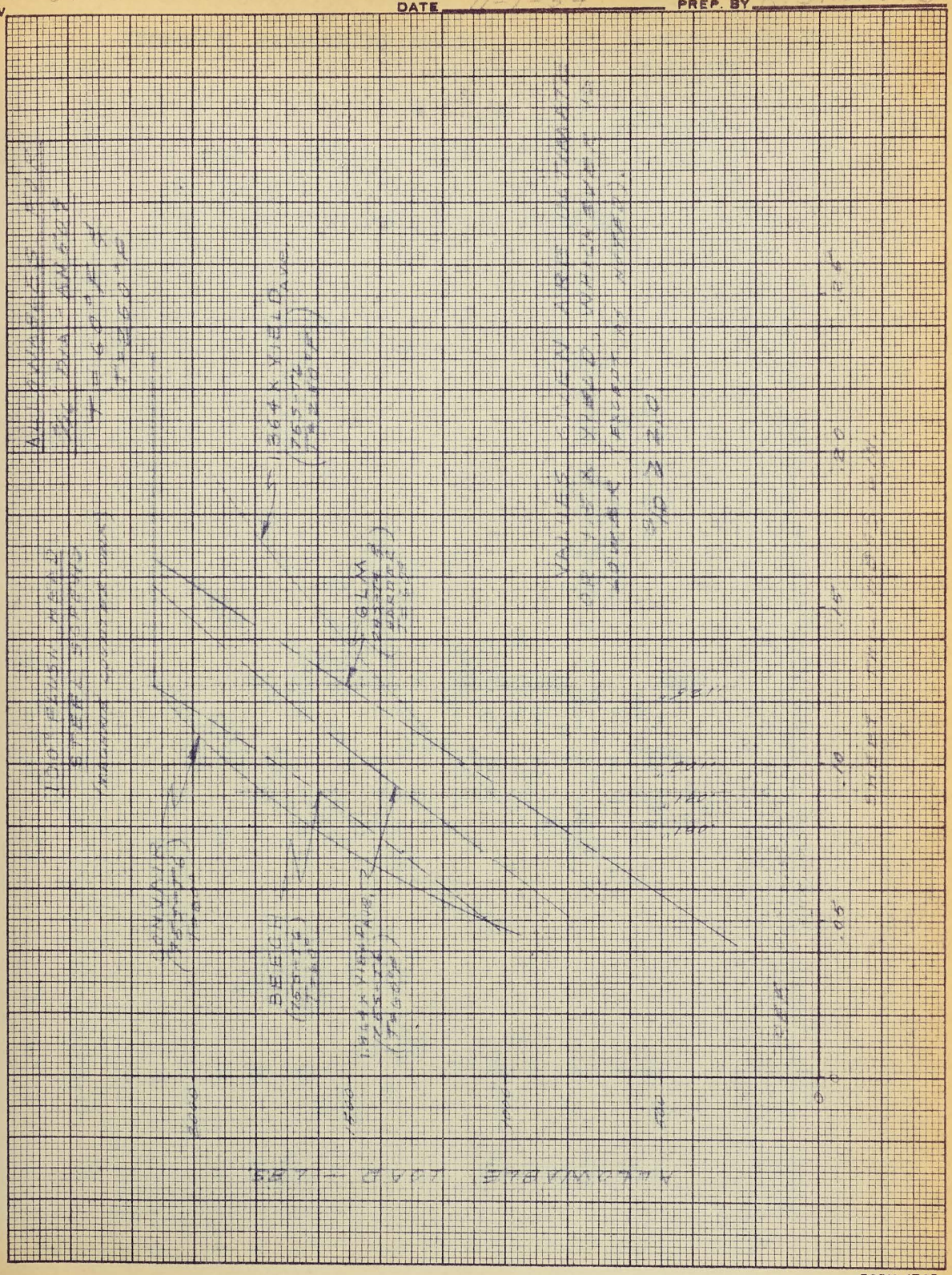
		ROOM TEMP PROP.	% REDUCTION STRENGTH	T=250° PROP
F_{cu}	L	62	87	54
	T	62		54
F_{cy}	L	38	91	34.6
	T	38		34.6
F_{cj}	L	38	91	34.6
	T	39		34.6
F_{su}		37	87	32.2
F_{bru} ($\frac{e}{D}$=1.5)		93	87	81.0
F_{bru} ($\frac{e}{D}$=2.0)		118	87	103.0
F_{bry} ($\frac{e}{D}$=1.5)		53	91	48.2
F_{bry} ($\frac{e}{D}$=2.0)		61	91	55.5
E				

255-T6 ALCLAD

		ROOM TEMP PROP.	% REDUCTION STRENGTH	PROP AT T=250°F
F_{cu}	L	72	79.5	57.2
	T	72	79.5	57.2
F_{cy}	L	63	79	49.7
	T	62	79	48.5
F_{cj}	L	60	79	47.7
	T	66	79	51.5
F_{su}		43	79.5	34.2
F_{bru} ($\frac{e}{D}$=1.5)		108	79.5	86
F_{bru} ($\frac{e}{D}$=2.0)		137	79.5	109
F_{bry} ($\frac{e}{D}$=1.5)		82	79	64.6
F_{bry} ($\frac{e}{D}$=2.0)		101	79	79.8
E		10.5		9.7

CRAFT 3105 COMPONENT AILERON SHEET No. M4 REPORT No. Z-0572-1

J. W DATE 11-1-54 PREP. BY S. SAVAGE



FORM 1746

A. V ROE CANADA LIMITED
MALTON - ONTARIO
TECHNICAL DEPARTMENT (Aircraft)

REPORT No. 7-0579-1
SHEET No. M 4a

AIRCRAFT:		PREPARED BY	DATE
C 105	AILERON	R. GAVALIS	
		CHECKED BY	DATE

RIVET ALLOWABLES

(ALL VALUES ARE ULTIMATE OR 1.364 x YIELD

	T = 60°F		T = 250°F	
RIVET	P_{SHEAR} #	P_{BR} # t=.051	P_{SHEAR} #	P_{BR} # t=.051
AN 470 AD 5	1) 575	570	1) 473	464
100° HI CSK AD 4	2) 373	340	2) 296	270
100° HI CSK AD 5	3) 576	433	3) 456	345
HUCK (P) 1/8"	4) 422	402	4) 334	317
HUCK (P) 5/32"	5) 478	604	5) 538	479
HUCK (100V) 1/8"	6) 277	268	6) 317	213
HUCK (100V) 5/32"	7) 460	302	7) 445	240
100° HI CSK AD 6	8) 553	530	8) 677	422
HUCK (100V) 3/16"	9) 969	232	9) 770	224
HUCK (100V) 3/16"	9) 969	t=.064 278	9) 770	t=.064 236
CHERRYLOCK 1/4"	10) 1487		10) 1180	
HUCK (P) 3/16"	11) 967	856	11) 770	680
AN 470 AD 6	12) 862	835	12) 685	665
AN 470 AD 8	13) 1550	1165	13) 1230	926
AN 509 3/8" *	8280		8280	
AN 509 5/16" *	5750	t=.132" 2510	5750	2301
AN 509 1/4" *	3680	t=.132" 2510	3680	t=.132 2010
AN 509 3/16"	2125		2125	t=.132 # 1440
REFERENCE	AND-5	AND-5	.775 x $P_{T=60°}$	.775 x $P_{T=60°}$

* COUNTERSUNK IN .132" REF. Pg M 4

1) t2 .064"
2) t2 .072"
3) t2 .091"
4) t2 .102"
5) t2 .102"
6) t2 .072"
7) t2 .091"
8) t2 .125"
9) t2 .125"
10) t2 .125"
11) t2 .091"
12) t2 .064
13) t2 .091

RCRAFT
U. W.

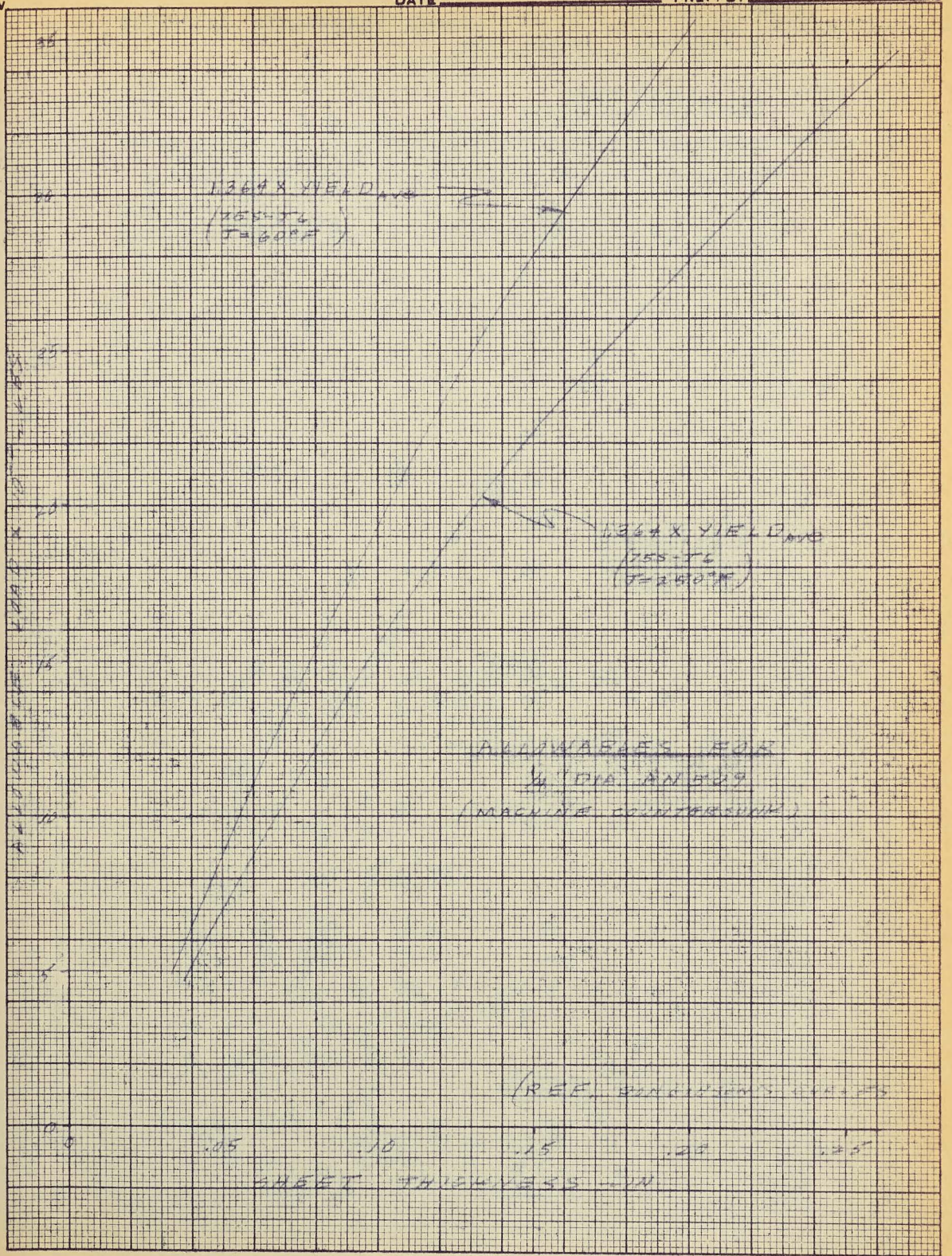
COMPONENT

SHEET No. M4b

REPORT No. 28574-1

DATE

PREP. BY



FORM 1746

A. V ROE CANADA LIMITED
MALTON - ONTARIO
TECHNICAL DEPARTMENT (Aircraft)

REPORT No. 7-0579-1
SHEET No. M5

AIRCRAFT:		PREPARED BY	DATE
C105	WING	R. GAVALIS	
		CHECKED BY	DATE

CRIPPLING CURVE

FOR 75S-T6 ALCLAD AT T=250°F

$F_{cy} = .78 (F_{cy})_{T=60°} = .78(64000) = 49900 psi$

$E_c = 9.7 \times 10^6 psi$ (REF. AVRO REP. 7/0500/2, P.11)

$n = 1 + .3851 / \log_{10} (F_{0.7}/F_{0.85})$

$F_{0.7} = 50,300 psi$, $F_{0.85} = 44600 psi$

$n = 8.5$

$K_{cc} = \left[\frac{(F_{0.7}/E)_{75S-T6}}{(F_{0.7}/E)_{24SRT}} \right]^{\frac{1}{2}} = \left[\frac{\left(\frac{50,300}{9.7\times10^6}\right)}{\left(\frac{46000}{9.7\times10^6}\right)} \right]^{\frac{1}{2}} = 1.095$

ASSUME $\frac{b}{t}$

CALCULATE: B_{24SRT} FROM FIG. 12 *

$B = K_{cc} B_{24SRT}$

$F/F_{0.7}$ FROM FIG. 9

$F_{CR} = F_{0.7} \left(\frac{F}{F_{0.7}} \right)$

* REF. NONDIMENSIONAL BUCKLING CURVES - COZZONE & MELLON - J.A.S., OCTOBER 1946 ISSUE.

FORM 1319A

RCRAFT
U. W

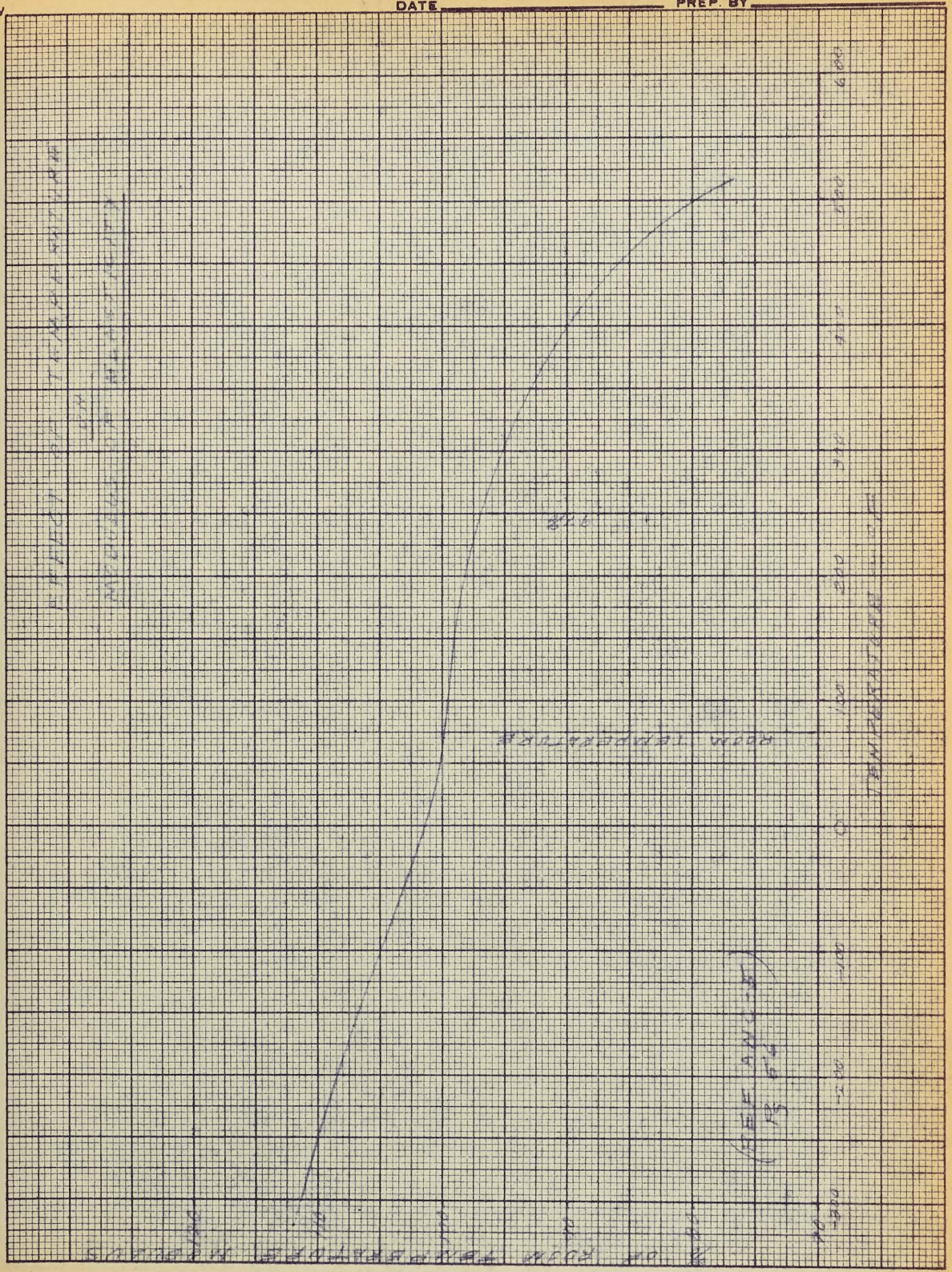
COMPONENT

SHEET No. M6

REPORT No. 2-6674-1

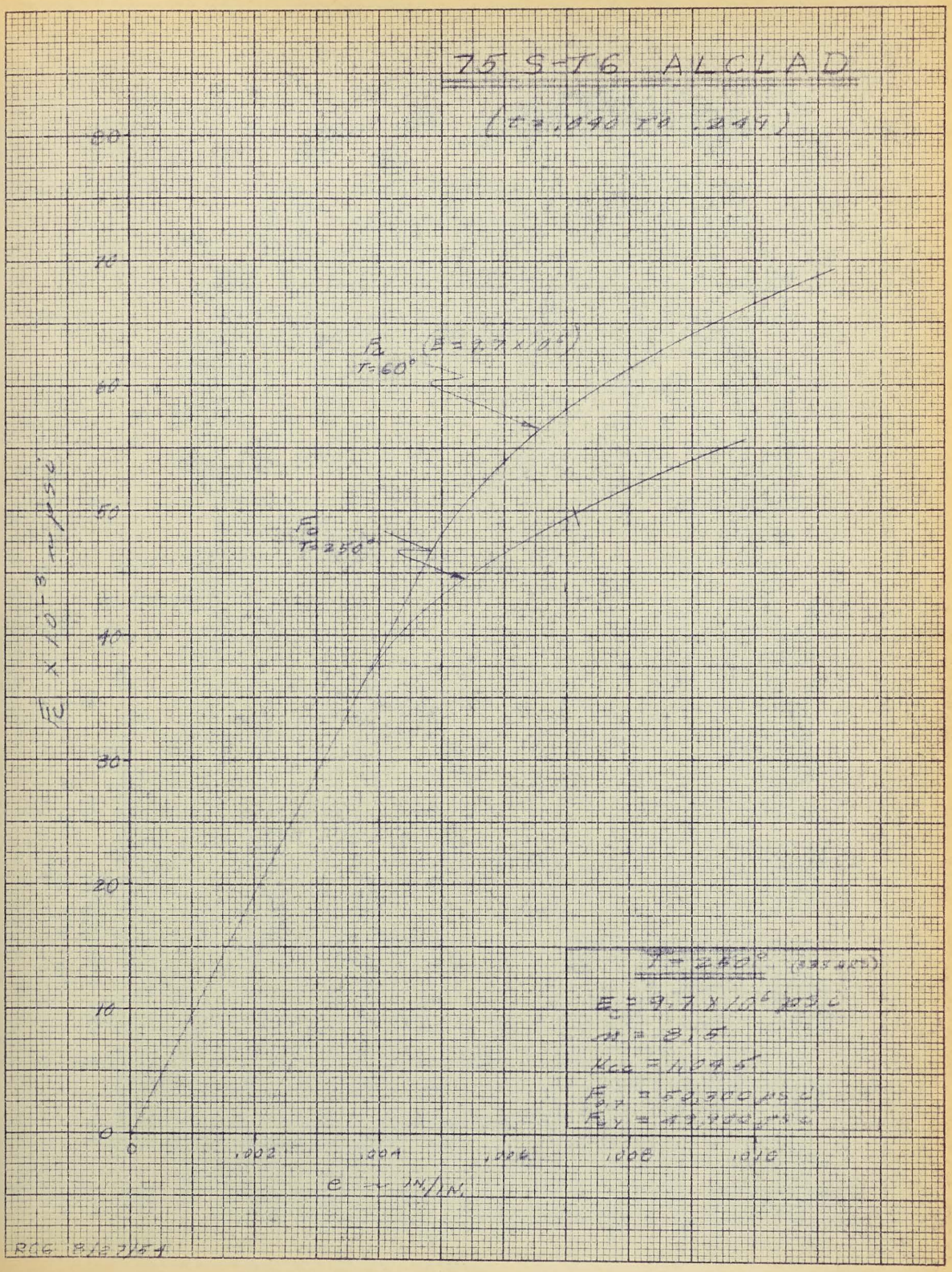
DATE

PREP. BY

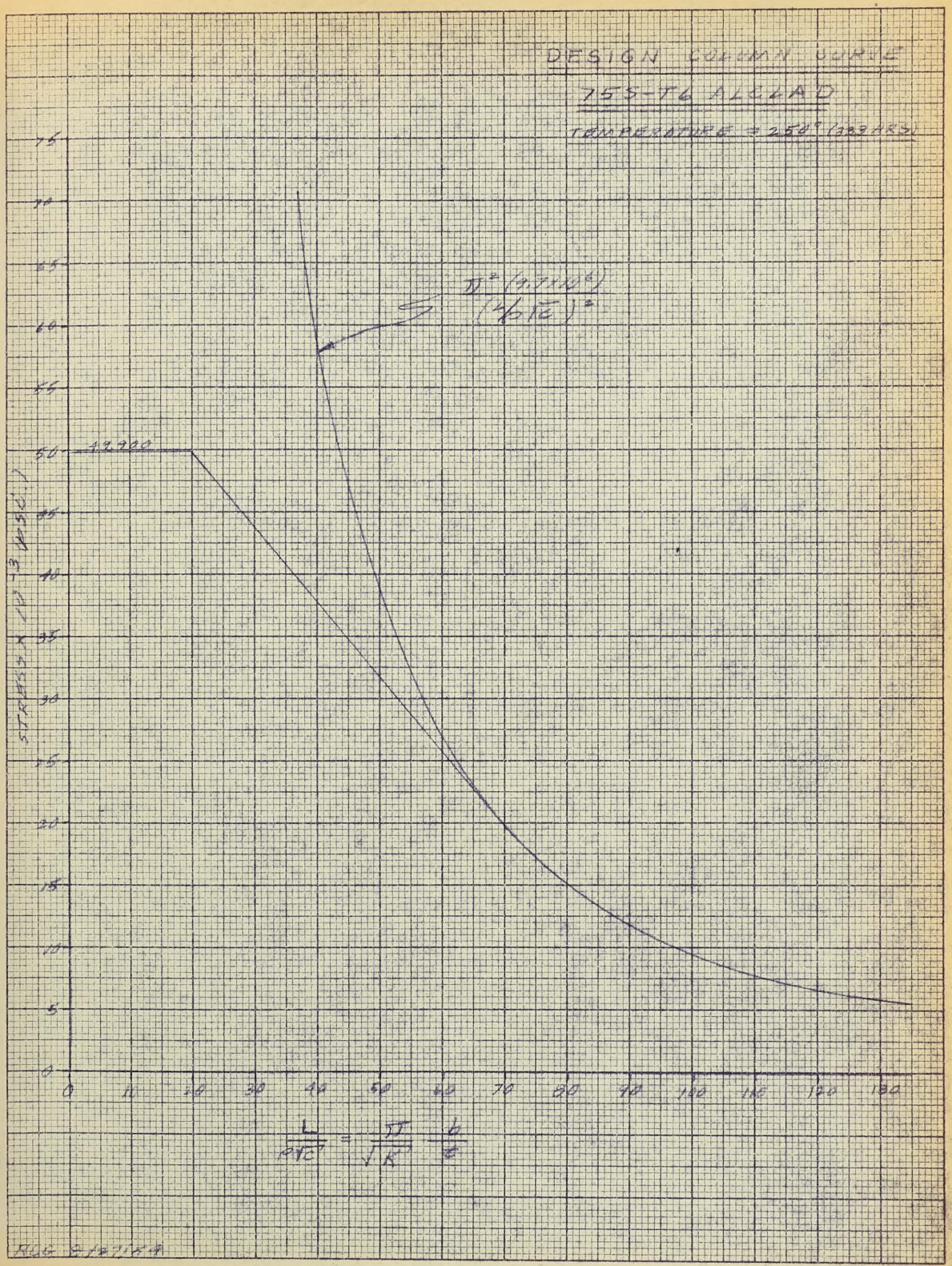


FORM 1746

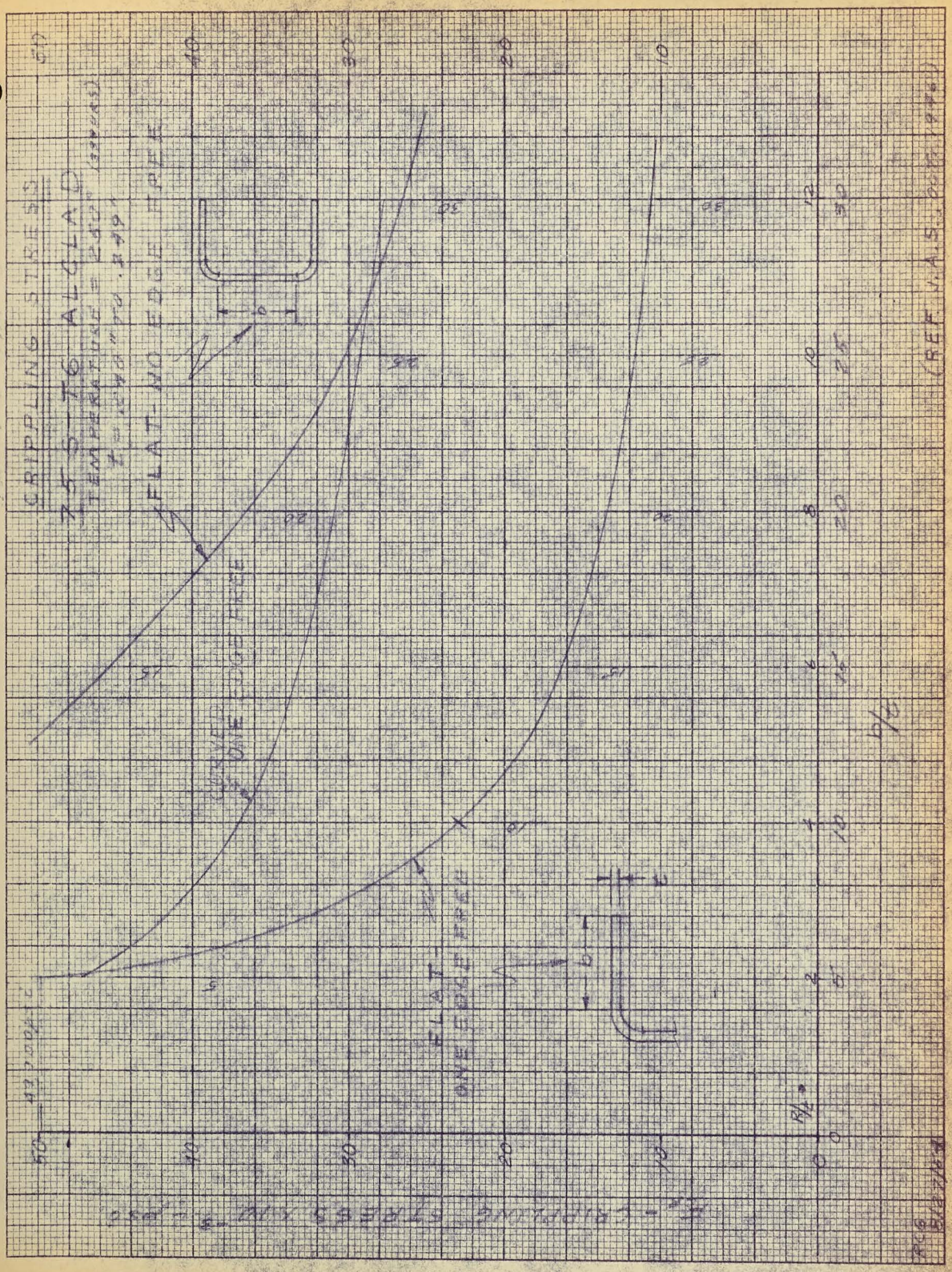
M7 7-0574-1


75 S-T6 ALCLAD
T=60°
T=250°
60
40
50
40
30
20
10
0
0
.002
.004
.006
.008
.010
ε = IN/IN

M8 7-0577-1


DESIGN COLUMN CURVE
75S-T6 ALCLAD
TEMPERATURE = 250° (121 HRS)
$\pi^2 (9.7 \times 10^6)$
$(L/\rho)^2$
12700
STRESS (10^-3 PSI)
0
5
10
15
20
25
30
35
40
45
50
55
60
65
70
75
0
10
20
30
40
50
60
70
80
90
100
110
120
130
$\frac{L}{\rho\sqrt{C}} = \frac{\pi}{\sqrt{K}} \frac{b}{t}$

M9 7-0579-1


GRIPPING STRESS
ALLOWABLE
FLAT NO EDGE FREE
ONE EDGE FREE
FLAT
ONE EDGE FREE
(REF. W.A.S.)

A V ROE CANADA LIMITED
MALTON - ONTARIO
TECHNICAL DEPARTMENT (Aircraft)

REPORT No. 2-0574-1
SHEET No. 110

AIRCRAFT:		PREPARED BY	DATE
C105	AILERON	R. G. AVALIS	9-30-57
		CHECKED BY	DATE

CRIPPLING CURVE FOR 75S-T6 ALCLAD
AT TEMPERATURE = 250° (333 HRS)

KNOWN:

1. COLUMN CURVE FOR MATERIAL AT TEMPERATURE = 60°F
2. CRIPPLING CURVE AT T = 60°F
3. COLUMN CURVE FOR MATERIAL AT T = 250°F

PROCEDURE:

1. FIND CRIPPLING STRESS FOR ANY b/t USING T=60°F CRIPPLING CURVE
2. FIND EQUIVALENT $\left(\frac{L}{\rho_{TC}}\right)$ FROM T=60°F COLUMN CURVE # FROM T=250°F COLUMN CURVE
3. THEN AT T=250°F, b/t FOR A CRIPPLING STRESS FOUND IN (1) IS,

$$\left(\frac{L}{\rho}\right)_{250°F} = \frac{\left(\frac{L}{\rho_{TC}}\right)_{250°F}}{\left(\frac{L}{\rho_{TC}}\right)_{60°F}} \left(\frac{L}{\rho}\right)_{60°F}$$

FROM MATERIALS DATA HAVE FOUND
[illegible] AT [illegible] = 250°F

A. V ROE CANADA LIMITED
MALTON · ONTARIO
TECHNICAL DEPARTMENT (Aircraft)

REPORT No 7-0579-1
SHEET No M 11

AIRCRAFT:		PREPARED BY	DATE
C 102	AILERON	R GAUDET	8-30-59
		CHECKED BY	DATE

CRIPPLING CURVE FOR 24S-T6 ALCLAD

AT T = 250°F (HOT)

EXAMPLE:

FOR $(b/t)_{T=80°F} = 12$

$F_{c_{T=80°F}} = 35000$ psi (FROM SHEET 30 FOR $E_c = 10.6$)

THEN

$\left(\frac{L}{\sqrt{Rt}}\right)_{T=80°F} = 51.5$ (FROM SHEET 30 FOR $E_c = 10.3$)

&

$\left(\frac{L}{\sqrt{Rt}}\right)_{T=250°F} = 44.3$ (FROM SHEET B)

$$\left(\frac{b}{t}\right)_{250°} = \frac{\left(\frac{L}{\sqrt{Rt}}\right)_{250°}}{\left(\frac{L}{\sqrt{Rt}}\right)_{80°}} \left(\frac{b}{t}\right)_{80°} = \frac{44.3}{51.5}(12) = 10.3$$

$\left(\frac{b}{t}\right)_{250°} = 10.3$ FOR $F_{c_{250°}} = 35000$ psi

A. V. ROE CANADA LIMITED
MALTON - ONTARIO
TECHNICAL DEPARTMENT (Aircraft)

REPORT NO. 7-0579-1
SHEET NO. M 12

AIRCRAFT:		PREPARED BY	DATE
C 105	AILERON	R. GAVALIS	
		CHECKED BY	DATE

INITIAL SHEAR BUCKLING - 75S-T6 ALCLAD

(REF. J.A.S. OCT. 1946) TEMPERATURE 250°F (333 HRS)

$n = 8.5$, $F_{0.7} = 50{,}300$ psi , $E = 9.7 \times 10^6$ psi

$$k_{s_{CR}} = \sqrt{\frac{.61\,F_{0.7}}{E}} \qquad (P_3\ 514)$$

$$k_{s_{CR}} = \sqrt{\frac{.61(50300)}{9.7\times10^6}} = .0563$$

$$\left(\frac{b}{t}\right)_e = \frac{b/t}{\sqrt{k_s}} = \frac{b/t}{\sqrt{5.0}} = .446\,\frac{b}{t}$$

$k_s = 5.0$ FOR $a/b = 4.5$ (REF. BOEING D-5000, P6.109 OR PEERY, P_3 394)

$$B = k_{s_{CR}}\left(\frac{b}{t}\right)_e = .0563(.446)\,\frac{b}{t} = .02515\,\frac{b}{t}$$

b/t	B	$F/F_{0.7}$	$F_{s_{CR}}$
REFERENCE →	.02515 b/t	FIG. 9 J.A.S. P_3 512	.61 $F_{0.7}$ ($F/F_{0.7}$)
10	.2515	1.2	36,800
20	.502	.995	30,580
30	.754	.860	26,400
40	1.003	.730	22,400
50	1.255	.600	18,410
60	1.508	.440	13,500
70	1.758	.330	10,100
80	2.02	.252	7,740
90	2.26	.200	6,140
100	2.515	.164	5,030
110	2.760	.138	4,230
120	3.018	.118	3,620

$F_{s_{CR}} = .446(43000) = 34206$ psi

A. V. ROE CANADA LIMITED
MALTON - ONTARIO
TECHNICAL DEPARTMENT (Aircraft)

REPORT NO. T-0579-1
SHEET NO. M 13

AIRCRAFT:		PREPARED BY	DATE
C 105	AILERON	R. GAVALIS	
		CHECKED BY	DATE

INITIAL SHEAR BUCKLING - 75S-T6 ALCLAD

(TEMP. = 250°F, 333 HRS.)

b/t	B	$F/F_{0.7}$	F_{SCR} (P.S.I.)
REFERENCE	$.02815\ b/t$	FIG. 9 J.A.S. Pa 512	$.61F_{0.7}\ (F/F_{0.7})$
139	3.5	.085	2600
159	4.0	.0625	1915
179	4.5	.0495	1518
199	5.0	.040	1228
219	5.5	.0333	1020
238	6.0	.0280	957
258	6.5	.0240	735
278	7.0	.0208	637
318	8.0	.0160	490
358	9.0	.0128	392
398	10.0	.0104	318
477	12.0	.0072	221
636	16.0	.0042	129
795	20.0	.0028	86

C105 AILERON M19 7-0579-1 3/31/43 R. GAUNTLETT

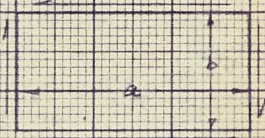
INITIAL SHEAR BUCKLING STRESS

75 ST6 ALCLAD

TEMPERATURE = 450°F, 8 HRS.

t = .040" TO .249"

SIMPLY SUPPORTED PANEL
(CLAMPING EFFECT OF RIVETS NEGLECTED)



a/b = 4.5
(CONSERVATIVE FOR a/b > 4.5
UNCONSERVATIVE FOR a/b < 4.5)

USE INSIDE SCALES

USE OUTSIDE SCALES

INITIAL BUCKLING STRESS (LBS/SQ IN) x 10³

2.0
1.5
1.0
.5
0

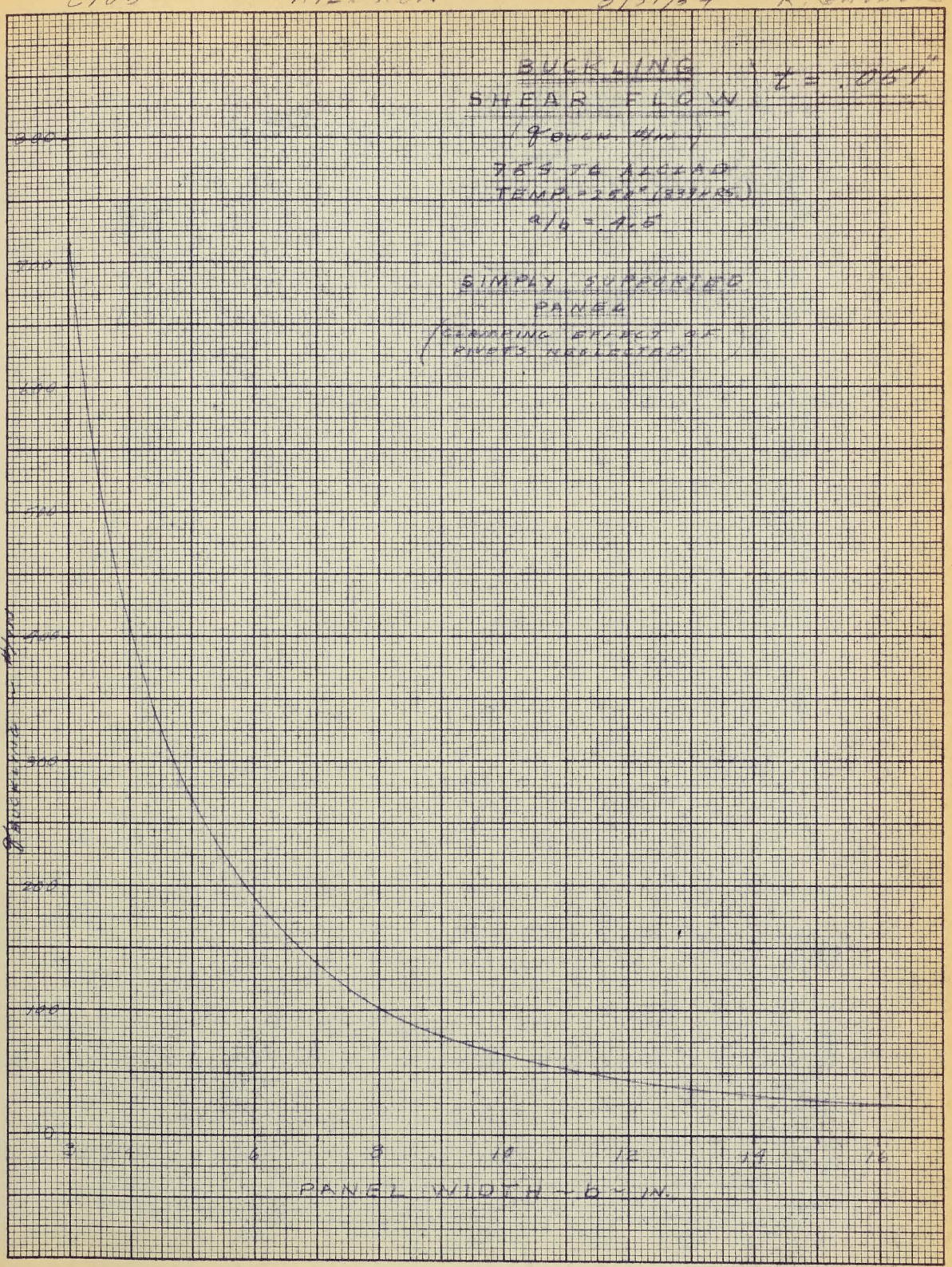
40
30
20
10

180 200 220 240 260 280 300 320 340

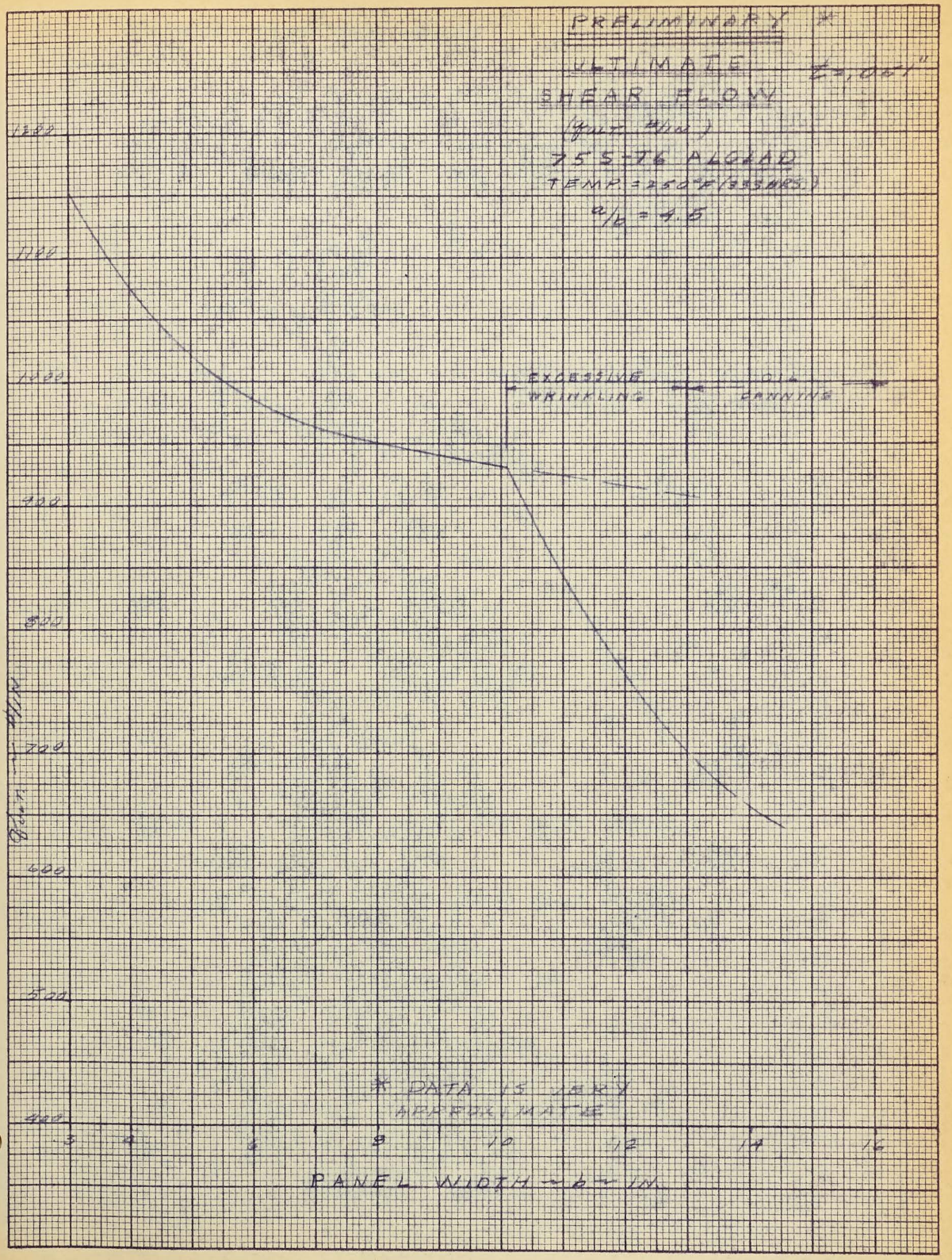
0 20 40 60 80 100 120 140 160 180

b/t

C105 AILERON M15 7-0574-1 9/31/54 R. GAVALAS



M16 7-0574-1


PRELIMINARY
ULTIMATE
SHEAR FLOW
(Ftu Allow)
7 5 S - T 6 ALCLAD
TEMP. = 250°F (325 HRS.)
a/b = 4.5
t = .001"
EXCESSIVE WRINKLING
DIA. CRIMPING
1200
1100
1000
900
800
700
600
500
400
SHEAR FLOW - Ftu
* DATA IS ONLY APPROXIMATE
3
4
6
8
10
12
14
16
PANEL WIDTH - b - IN.

A. V. ROE CANADA LIMITED
MALTON ONTARIO
TECHNICAL DEPARTMENT (Aircraft)

REPORT No. 7-0574-1
SHEET No 117

AIRCRAFT:		PREPARED BY	DATE
C105	AILERON	R. GAVALIS	
		CHECKED BY	DATE

INITIAL SHEAR BUCKLING — 75S-T6 ALCLAD

TEMPERATURE
250°F (333 HRS)

$m = 5.6$, $F_{cy} = 50300$ psi

$E = 9.7 \times 10^6$ psi, $K_{sa} = .0563$

THE DATA OBTAINED ON THE PRECEDING PAGES APPLIES FOR SIMPLY-SUPPORTED EDGE CONDITIONS. ACTUALLY, SHEET-TO-STRINGER RIVETS PROVIDE A FINITY SOMEWHERE BETWEEN SIMPLY-SUPPORTED AND CLAMPED. FOR A SINGLE ROW OF RIVETS AND AVERAGE PANEL PROPORTIONS, GLENN L. MARTIN USES A FINITY COEFFICIENT OF:

$$\sqrt{K_s} = 2.73 \quad , \quad \frac{b}{t} > 55 \quad , \quad \frac{a}{b} = 2.5$$

THEN,

$$\left(\frac{b}{t}\right)_e = \frac{b/t}{\sqrt{K_s}} = \frac{b/t}{2.73} = .366\,\frac{b}{t}$$

$$B = .0563\,(.366)\,\frac{b}{t} = .0206\,\frac{b}{t}$$

A. V ROE CANADA LIMITED
MALTON - ONTARIO
TECHNICAL DEPARTMENT (Aircraft)

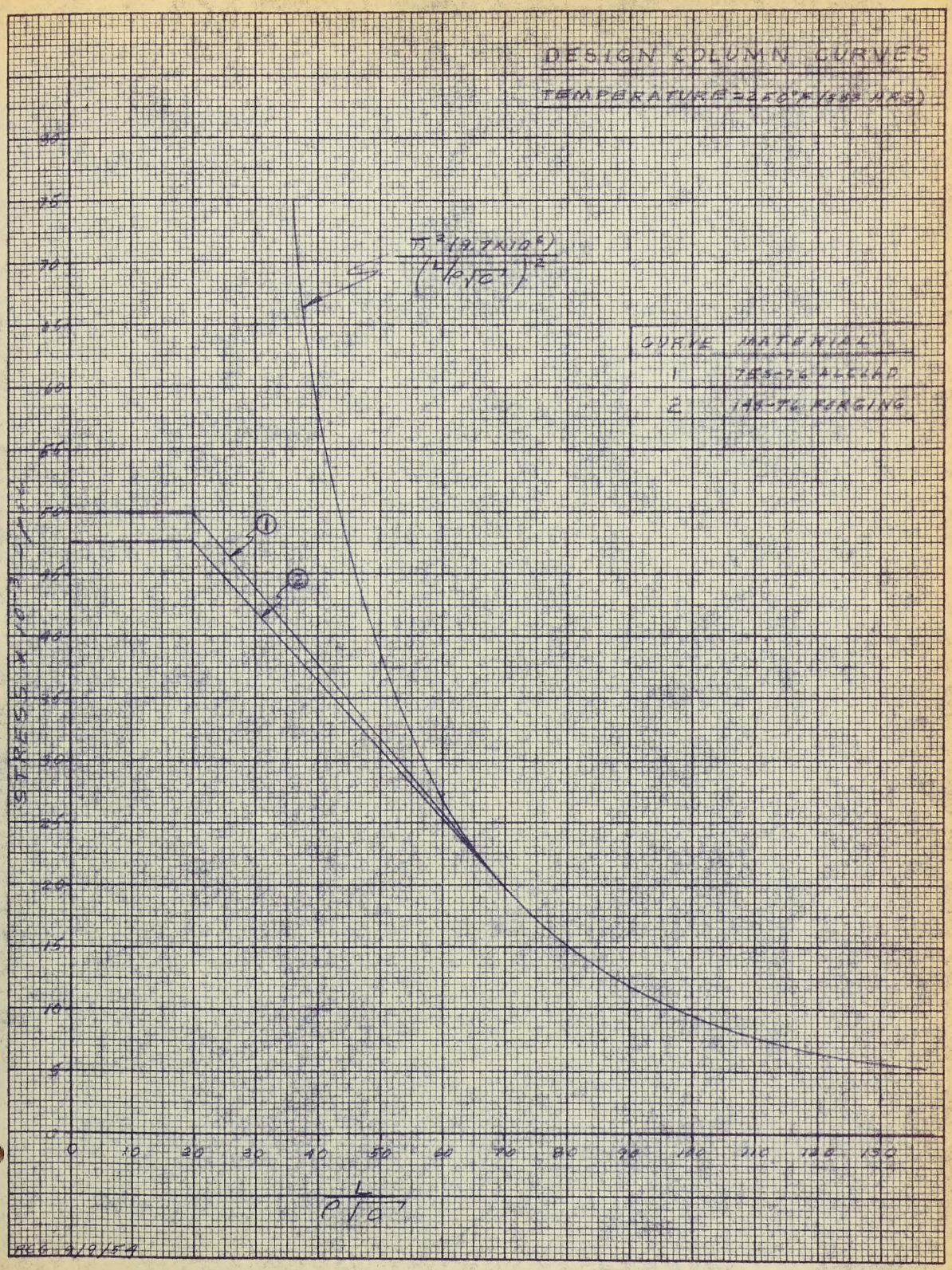
REPORT No. 7-0578-1
SHEET No. M 18

AIRCRAFT:		PREPARED BY	DATE
C105	AILERON	R. GAVALIS	
		CHECKED BY	DATE

INITIAL SHEAR BUCKLING - 75S-T6 ALCLAD

$F_{s_{cr}}$	$(b/t)_{\sqrt{K}=2.24}$	$(b/t)_{\sqrt{K}=2.73}$
$F_{s_{cr}} \frac{2.24}{2.73}$	F_{cs}	$\frac{2.73}{2.24}\left(b/t_{\sqrt{K}=2.24}\right)$

M19 7-0574-1


DESIGN COLUMN CURVES
TEMPERATURE = 250°F (121° MAX)
$\frac{\pi^2 (10.7 \times 10^6)}{(L/\rho)^2}$
CURVE | MATERIAL
1 | 7ES-T6 PLATE
2 | 14S-T6 FORGING
STRESS x 10³ PSI
0 10 20 30 40 50 60 70 80 90 100 110 120 130
$\frac{L}{\rho}$

AIRCRAFT
A. U. W.

COMPONENT

SHEET No. M 20

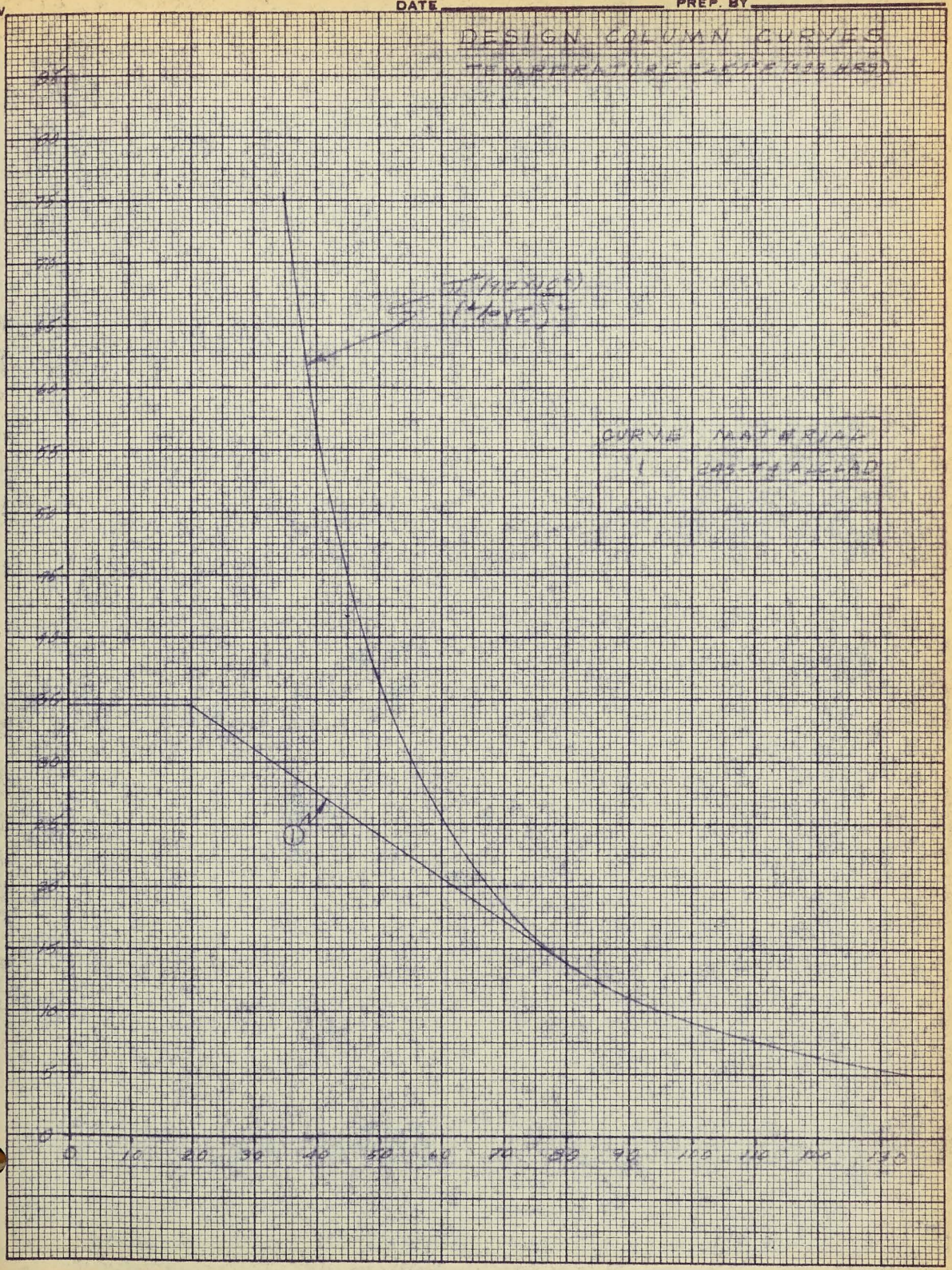
REPORT No. 7-0574-1

DATE

PREP. BY

DESIGN COLUMN CURVES

TEMPERATURE [illegible]



FORM 1746

MADE IN U.S.A.

CRIPPLING STRESS
7075-T6 ALCLAD
TEMPERATURE = 250° (393 °K)

FLAT
NO EDGE FREE

FLAT
ONE EDGE FREE

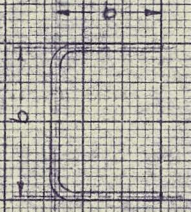
F_{cy} = 49,700 psi

F_{cr} - CRIPPLING STRESS - 1000 PSI

60
50
40
30
20
10
0

0 5 10 15 20 25 30

b/t



REF. GLN-30M-FIG 403.02
403.15, .10 F.S., # SHT. 5

REF. GLN-30-FIG 403.02

GLN-TR-FIG 403.02

M21W

1-6179-1

AIRCRAFT
A. U. W.

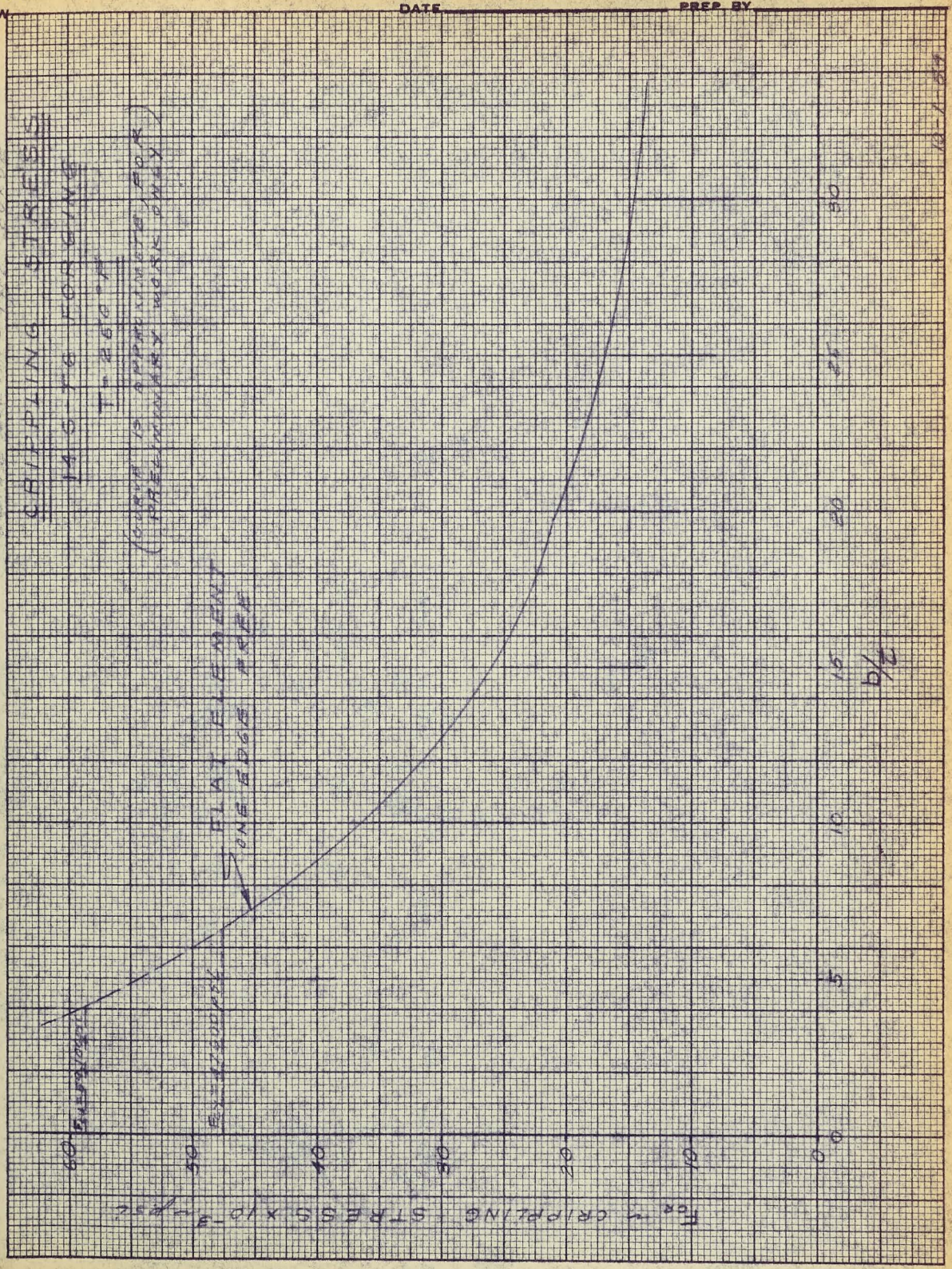
COMPONENT

SHEET No. M 22

REPORT No. 20578-1

DATE

PREP BY



FORM 1746

AIRCRAFT
A. U. W.

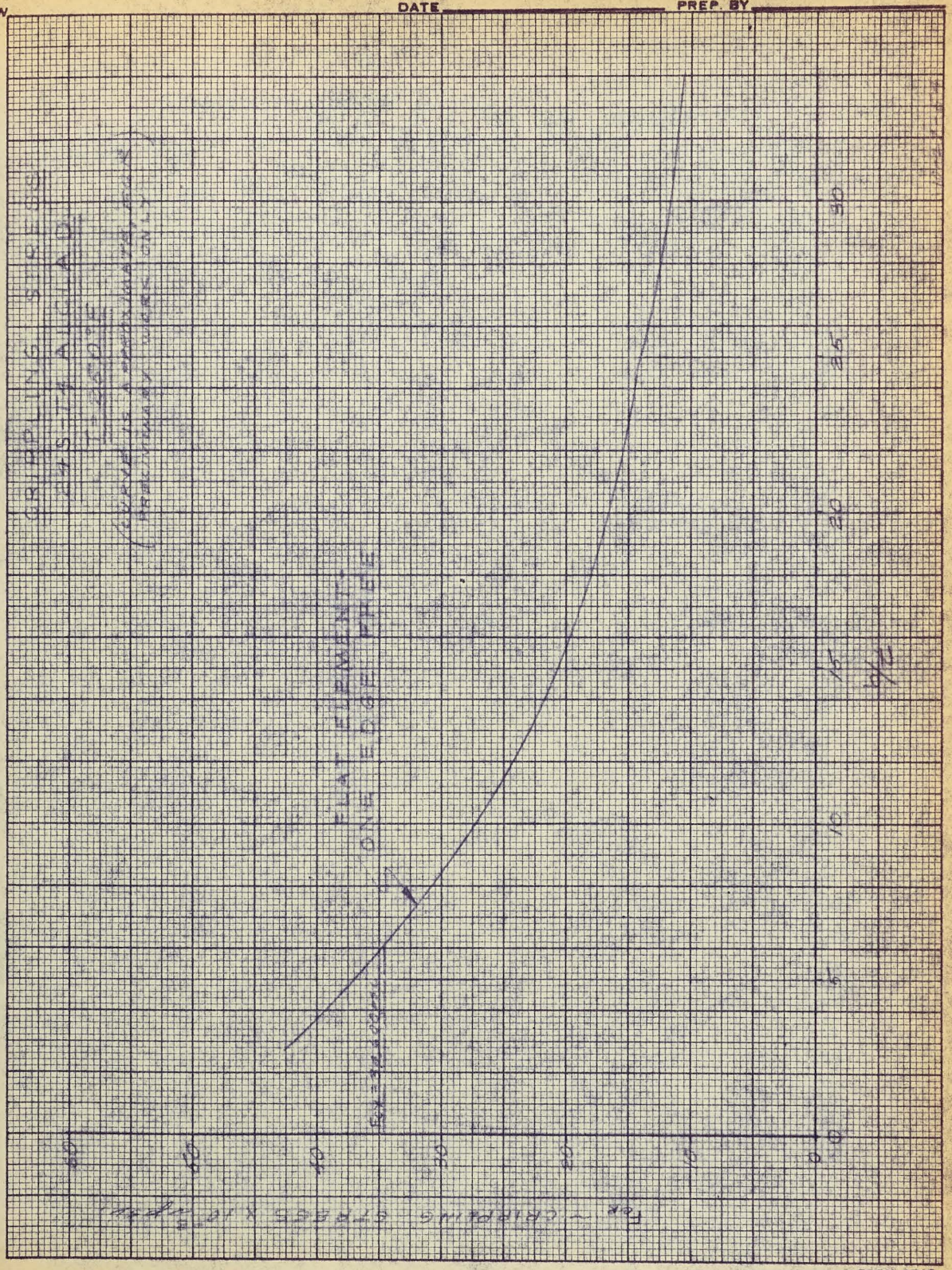
COMPONENT

SHEET No. M 23

REPORT No. Z-0529-1

DATE

PREP. BY



FORM 1746

A.V. ROE CANADA LIMITED
MALTON – ONTARIO

TECHNICAL DEPARTMENT (Aircraft)

REPORT NO. 7-0574-1
SHEET NO. R 0

AIRCRAFT		PREPARED BY: R. GAUZIS	DATE:
C105	AILERON	CHECKED BY:	DATE:

STRENGTH CHECK

THE FOLLOWING PAGES HAVE BEEN RECODED, THEREFORE ANY PAGE REFERENCED SHOULD BE TAKEN AS ±1 PAGE.

A SUMMARY OF THE ALLOWABLES USED ARE GIVEN ON PGS M1 TO M23.

A. V. ROE CANADA LIMITED
MALTON - ONTARIO
TECHNICAL DEPARTMENT (Aircraft)

REPORT No. Z-0574-1
SHEET No. P1

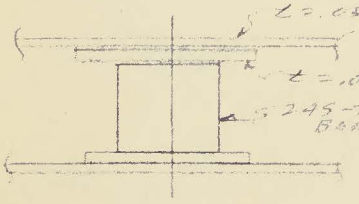
AIRCRAFT:	
C 102	AIRFRAME

PREPARED BY	DATE
R. GAVAN	
CHECKED BY	DATE

RIB 7A

M_{MAX} @ $T=0$ $= 11,100^{IN\#}$ (LOWER FLG), $V_{LOW} = 432^{\#}$ (LOWER FLG)
AT $\frac{x}{c} = .68$ (13.6")

M_{MAX} @ $T=20°$ $= 11,111^{IN\#}$ (LOWER FLG), $V_{UPPER} = 232^{\#}$ (UPPER FLG)
AT $\frac{x}{c} = .70$ (14.0")



AT $\frac{x}{c} = .50$

$I_{RIB} = \frac{.30(.051)^3}{12} = .0131\ IN^4$

$I_{STRIP} = 1.0(.051)(\frac{1}{2})(.35)^2 = .0156\ IN^4$

F_{TY} @ $T=0°$ $= 49,200\ PSI$, F_{TU} 245-T42 @ $T=0°$ $= 64,000\ PSI$

$\frac{L}{\rho_{LE}} = 1.0(\frac{9.9}{.051}) = 320$, σ_{cr} @ $T=0°$ $= \frac{\pi^2(9.7)(10^7)}{(320)^2} = 936\ PSI$

$\frac{\sigma_{cr}}{F_{TY}} = \frac{936}{49700} = .019$, $\frac{b_m}{b} = .23$, $b_m = .23(.79) = .18$

M_{ALL} SHEET $= 2.3\pi(.051)(\frac{1}{2})(.436)(49700) = 5060^{IN\#}$

M_{ALL} STRIP $= .75(.0131)(\frac{1}{2})(.38)(49700) = 2300^{IN\#}$

M_{ALL} RIB @ $T=20°$ $= \frac{34600(.0131)}{.34} = 1340^{IN\#}$, $M_{ALL} = 8700^{IN\#}$

$M.S. = \frac{8700}{1111(1.56)} - 1 = .472$

MARGIN OF SAFETY AT $\frac{x}{c} = .68$ WHERE SE LOWER SURFACE STRIP IS WIDEST NOT CRIT

$I = .0154 + .0234 + 2.78(.051)(\frac{1}{2})(.436)^2 = .0866\ IN^4$

$Q = 2.38(.051)(.436) + 1.0(.051)(\frac{1}{2})(.39) + .72(.051)^2(.5) = .0989\ IN^3$

$f_s = \frac{232(1.364)(.099)}{.0866(.38)} = 4960\ PSI$

FORM 1319A

A. V ROE CANADA LIMITED
MALTON - ONTARIO
TECHNICAL DEPARTMENT (Aircraft)

REPORT No. 7-0579-1
SHEET No. R2

AIRCRAFT:		PREPARED BY	DATE
C105	AILERON	R. GAUDAIS	
		CHECKED BY	DATE

RIB 7A (CONTD.)

$q_{MAX\ SUPER} = 241\ ^{\#}/_{IN}$ (LIMIT), $q_{MAX} = 1364(.241) = 329\ ^{\#}/_{IN}$

NOW 3/16" RIVETS @ 1.1" (ADS)

USE: 5/32" AN426 AD5 @ .625 PITCH

$P_{ALL} = .795(.675) = 456^{\#}$

$q_{ALL\ T=240°} = \frac{456}{.625} = 731\ ^{\#}/_{IN}$ @ .625"

$M.S. = \frac{731}{329} - 1 = \underline{1.21}$

FOR 5/32" HOOK (NOW) @ .625

$P_{ALL\ HOOK} = 410(1.564)(.795) = 442^{\#}$ (REF. R3, M4a)

$q_{ALL\ T=240°} = \frac{442}{.625} = 712\ ^{\#}/_{IN}$

$M.S. = \frac{712}{329} - 1 = \underline{1.16}$

FOR THIS RIB @ $e/D = 1.5$,

$P_{ALL\ BY\ T} = .432(1620) = 700^{\#} > P_{ALL\ SHEAR\ RIVET}$

∴ USE CAN WIDTH OF $30 = \frac{15}{D_2} = .50"$

ATTACHMENT - TO - SPAR

$V_{SUB} = 1300^{\#}$ (LIMIT), $V_{SUPER} = 572^{\#}$ (LIMIT) (REF. R3 90d)

$P_{SHEAR\ RIVET\ THRU\ WEB} = 1300(1.564)(1.414) = 2800^{\#}$ (ULT.)

$P_{SHEAR\ RIVET\ THRU\ FLANGE} = .707(2400) = 1770^{\#}$ (ULT.)

1/4" DEUTSCH RIVET WILL BE USED — WILL BE CHECKED LATER WHEN ALLOWABLES ARE AVAILABLE (REF. B WALL)

FORM 1194

A. V. ROE CANADA LIMITED
MALTON · ONTARIO
TECHNICAL DEPARTMENT (Aircraft)

REPORT No. 7-0579-1
SHEET No. R3

AIRCRAFT:		PREPARED BY	DATE
C 105	AILERON	R. GAVDAIS	
		CHECKED BY	DATE

RIB #7

AT $\frac{X}{C} = \frac{8}{22.5} = .356$ — 14S-T6 FORGING

$M_{x_{UPPER}} = 2600^{IN\#}$, $V_{y_{UPPER}} = 480^{\#}$

$b_{eff} = 2.28"$

$I = \frac{.60(.06)^3}{12} - \frac{.60(.3)^3}{12} + 2.28(.04)(2)(.406)^2 + 1.3(.05)(2)(.39)^2$

$I = .07215\ IN^4$

$M_{x_{LIM}} = \frac{47000(.07215)}{.432} = 7920^{IN\#}$

$M.S. = \frac{1950}{2600(1.569)} - 1 = 1.29$

$f_s = \frac{480(.6)(1.304)}{.60(.30)} = 5460\ PSI$ (SHEAR)

$q_{MAX} = 412\ \#/IN$ (LIMIT) — SEE NOTE-TO-R18

FOR 5/32" RIVETS @ .625" PITCH,

$q_{ALL_y} = \frac{410(.78)}{.625} = 511\ \#/IN$ (CRITICAL FOR HUCK 100°)

$M.S. = \frac{511}{412} - 1 = .24$

AT $\frac{X}{C} = \frac{13.1}{22.5} = .582$

$M_y = 6800^{IN\#}$ (UPPER), $V_z = 710^{\#}$

STRIP IS INEFFECTIVE

$\left(\frac{t}{b}\right)_{FLANGE} = \frac{1.0}{.11} = 9.1$, $F_{cc} = 38,000\ PSI$



CRM 1319A

A. V. ROE CANADA LIMITED
MALTON - ONTARIO
TECHNICAL DEPARTMENT (Aircraft)

REPORT No. 7-0579-1
SHEET No. R4

AIRCRAFT:		PREPARED BY	DATE
C105	AILERON	R. GAUDETTE	
		CHECKED BY	DATE

RIB 7

$I_{RIB} = \frac{.19(.63)^3}{12} + 2.0(.11)(.37)^2 = .0643 \text{ IN}^4$

$M^{ALL}_{RIB_U} = \frac{38000(.0643)}{.425} = 5750 \text{ IN-#}$

$e_{RIB} = \frac{38000}{9.7\times10^6} = .00392 \text{ IN/IN}$

$e_{SKIN} = \frac{.425}{.425}(.00392) = .00392 \text{ IN/IN}$

$F_{SKIN} = 44800 \text{ PSI}$

$b = 9.94$; $\left(\frac{t}{b}\right)_e = \frac{9.37(.065)}{.051} = 302$

$\sigma_{cc} = 3.62(9.7\times10^6)\left(\frac{.051}{9.94}\right)^2 = 10460 \text{ PSI}$

$\frac{\sigma_{cu}}{E} = \frac{1050}{44800} = .0234$, $\frac{b_m}{b} = .259$ (RAE EDITOR CURVE)

$b_m = .259(9.94) = 2.57''$

$M^{ALL}_{SKIN_U} = 2.37(.041)(.570)(44800) = 6170 \text{ IN-#}$

$M_{ALL_U} = 5750 + 6170 = 11920 \text{ IN-#}$

$I_{TOTAL} = .0643 + 2.37(.051)(2)(.570)^2 = .1429 \text{ IN}^4$

$Q = 2.37(.041)(.570) + .19(.63)^2(.4) - 2.0(.11)(.37) = .188$

$f_s = \frac{710(1.364)(.188)}{.1429(.19)} = 6720 \text{ PSI}$

$R_s = \frac{6720}{35500} = .189$, $R_b = \frac{6800(1.364)}{11920} = .777$

$M.S. = \frac{1}{\sqrt{(.777)^2 + (.189)^2}} - 1 = .25$

FORM 1319A

A. V. ROE CANADA LIMITED
MALTON - ONTARIO
TECHNICAL DEPARTMENT (Aircraft)
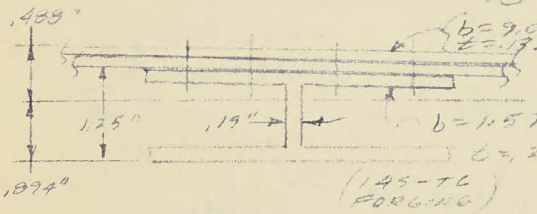
REPORT No. 7-0574-1
SHEET No. R5

AIRCRAFT:		PREPARED BY	DATE
C105	AILERON	R GAVALIS	
		CHECKED BY	DATE

RIB #7

LEVER BRACKET

FOR SECTION AT $\frac{Y}{C}$ = .911 (2nd SET OF H.E.)



$A = 9.0(.132) + 1.57(.275)(2) + .78(.25) = 3.083\ in^2$

$\frac{b}{t} = \frac{1.57}{.275} = 5.7$, $F_a = 47{,}600\ psi$

FOR COMPRESSION IN UPPER FIBER,

$I_{UPPER} = 9.0(.132)(.422)^2 + 1.57(2)(.274)(.219)^2 + \frac{.19(.0811)^3}{3}$

$I_{UPPER} = .253\ in^4$

$I_{LWR} = 1.57(2)(.275)(.74)^2 + (.603)^3(.19)(\frac{1}{3}) = .487\ in^4$

FOR $F_{UPR} = 59{,}100\ psi$, $F_{LWR} = 39{,}100\left(\frac{.489}{.894}\right) = 32{,}309\ psi$

$M_{B.L} = \frac{32{,}300(.263)}{.498} + \frac{39{,}100(.487)}{.894} = 42{,}920\ in\#$

$M = \frac{17{,}000\ in\#}{(LIMIT)} = \frac{23{,}200\ in\#}{(ULT.)}$ (SUPERSONIC REF. R. 909)

$M_{BEAM} = 9.0(.132)(32{,}300)(.422)\left(\frac{.422}{.498}\right) = 14{,}000\ in\#$

$M_{BEAM\ ULT} = \frac{14{,}000}{42{,}920}(23{,}200) = 6620\ in\#$

$P_{REAR} = \frac{6620}{.422} = 15{,}700\ \#$ (ULT) OR $11{,}500\ \#$ (LIMIT)

ORM 1318A

A. V ROE CANADA LIMITED
MALTON - ONTARIO
TECHNICAL DEPARTMENT (Aircraft)

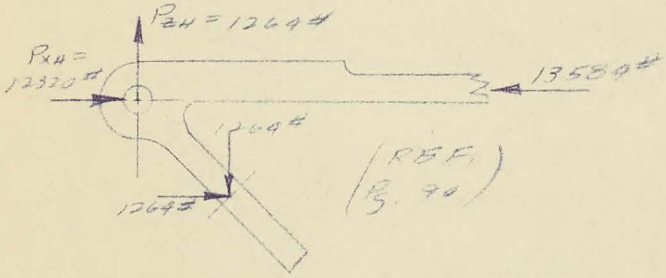
REPORT No. 7-0579-1
SHEET No. R6

AIRCRAFT:		PREPARED BY	DATE
C105	AILERON	R. GAVALIS	
		CHECKED BY	DATE

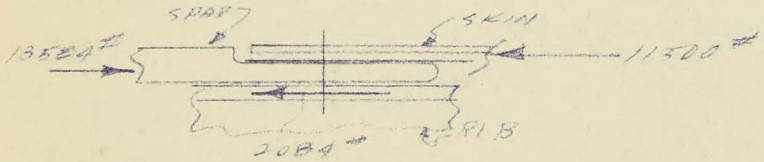
RIB #7 LEVER BRACKET

CONSIDER THE SPAR,

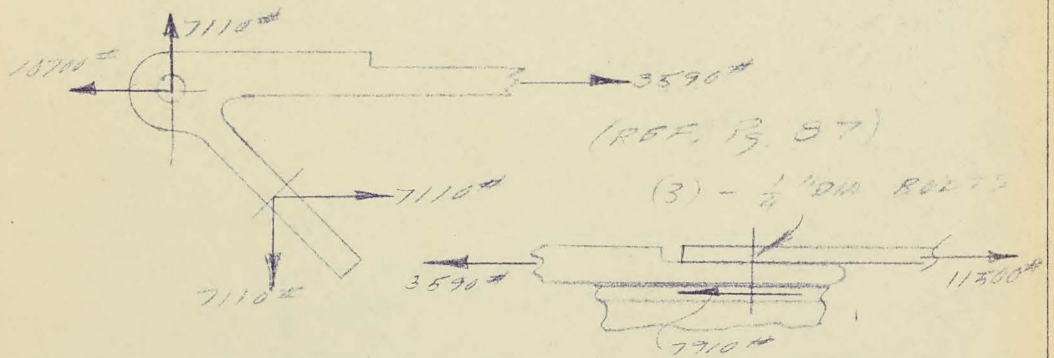
FOR COND. AIL. DOWN - SUPERSONIC



FOR THE UPPER FLANGE THEN



FOR AIL. UP - SUPERSONIC,



FOR RIB-TO- SPAR ATTACHMENTS :

$P_{SKIN} = 1090(3.75) = 4090\#$

$P_{SKIN/BOLT} = \frac{4090}{3} = 1363\#/BOLT$, $P_{ULT}_{SKIN} = 1940\#$

$P_{SPAR} = \frac{1.60(2084)(1900)}{3} + 1363 = 1853\#/BOLT$

$P_{BRACKET} = \frac{1.60(7110)(1324)}{3} = 2160\#/BOLT$

$P_{BOLT} = 4050\#$, $P_{BLT}_{ULT} = 2195$; $M.S. = \frac{+.01}{}$

CORN 1316A

A.V.ROE CANADA LIMITED
MALTON – ONTARIO

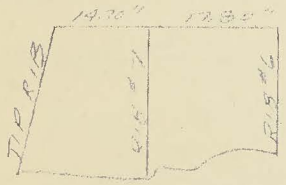
TECHNICAL DEPARTMENT (Aircraft)

REPORT NO. 7-0579-1
SHEET NO. R7

AIRCRAFT		PREPARED BY: R. GAVARIS	DATE:
C 105	AIRFRAME	CHECKED BY:	DATE:

R15 ± 7 LEVER BRACKET

FOR THE SKIN-TO-STRAP ATTACHMENT;



IF 18.7" OF SKIN & DOUBLER IS EFFECTIVE ALONG THE LOAD,

$$f_c = \frac{11500(1.80)(1.3)}{18.7} = 1440 \text{ #/in}$$

$$f_s = 7438(1.80)(1.3) = 17,400 \text{ #/in}$$

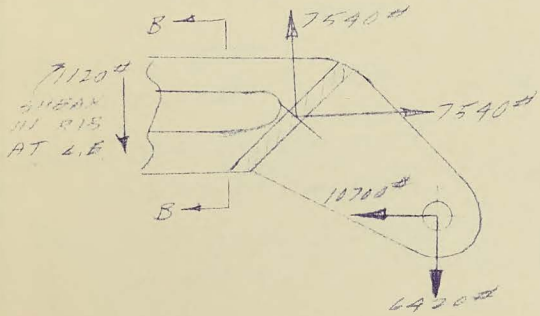
$$f_{cf} = \left[(1440)^2 + (1040)^2\right]^{\frac{1}{2}} = 1240 \text{ #/in}$$

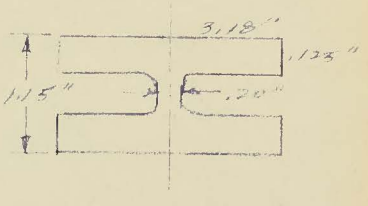
USE f_{su} = 1040 @ 1.10" PITCH

P_{su} = 1040#, $f_{su} = \frac{1040}{1.1} = 1310$ #/in

$$MS = \frac{312}{1240} - 1 = .06$$

FOR A SECTION THRU R15, JUST AFT OF EARS:





SECTION 5-B

A.V. ROE CANADA LIMITED
MALTON – ONTARIO

TECHNICAL DEPARTMENT (Aircraft)

REPORT NO. 7-0579-1
SHEET NO. R8

AIRCRAFT		PREPARED BY:	DATE:
C105	AILERON	R. GAVALIS	
		CHECKED BY:	DATE:

RIB #7 LEVER BRACKET

$M_{BS} = -6420(1.61) - 10200(1.1) + 7540(.4) = -17090^{\#}$ (LIMIT)

$V = 11270^{\#}$, $P_a = 3160^{\#}$

$I = 3.18(.125)(2)(1.512)^2 + \frac{.20(.90)^3}{12} = .2210 \text{ in}^4$

$f_{bu} = \frac{17090(.55)(1.204)}{.2210} = 63000 \text{ psi}$

$f_{cu} = \frac{3160(1.204)}{3.18(.125)(2) + 1.94(.20)} = 4420 \text{ psi}$

$f_{TOTAL} = 63000 + .3420 = 67420 \text{ psi}$

$\frac{L}{\rho} = \frac{3.18}{21.125} = 12.7$, $F_{cc} = 39,000 \text{ psi}$

$M.S. = \frac{39000}{67420} - 1 = -.57$ INADEQUATE STRAP

INCREASE WIDTH TO 3.5, $t = .25$"

$I = 3.0(.25)(2)(1.45)^2 + \frac{.25(.66)^3}{12} = .3601 \text{ in}^4$

$f_b = 45000\left(\frac{.220}{.360}\right) = 39900 \text{ psi}$

$\frac{L}{\rho} = \frac{3.50}{21.250} = 7.00$, $F_{cc} = 46,000 \text{ psi}$

$f_c = \frac{3160(1.363)}{3.5(.25)(2) + .65(.20)} = 2260 \text{ psi}$

$R = \frac{39900 + 2260}{46000} = .907$

$M.S. = \frac{1}{.907} - 1 = .09$ INADEQUATE STRAP

A.V.ROE CANADA LIMITED
MALTON – ONTARIO

TECHNICAL DEPARTMENT (Aircraft)

REPORT NO. 7-0574-1
SHEET NO. R8a

AIRCRAFT		PREPARED BY: R. GAVALIS	DATE:
C105	AILERON	CHECKED BY:	DATE:

RIB #7

USE $t_{RIB} = .275"$

$\frac{b}{t} = \frac{3.50}{2(.275)} = 6.36$, $F_{cc} = 47600$ psi

$I = 3.5(.275)(2)(.412)^2 + \frac{.25(.57)^3}{12} = .371$ in^4

$f_b = 45000\left(\frac{.220}{.371}\right) = 38600$ psi

$f_c = \frac{3160(1.369)}{3.47(.275)(2) + .57(.25)} = 2080$ psi

$R_c = \frac{38600 + 2080}{47600} = .866$

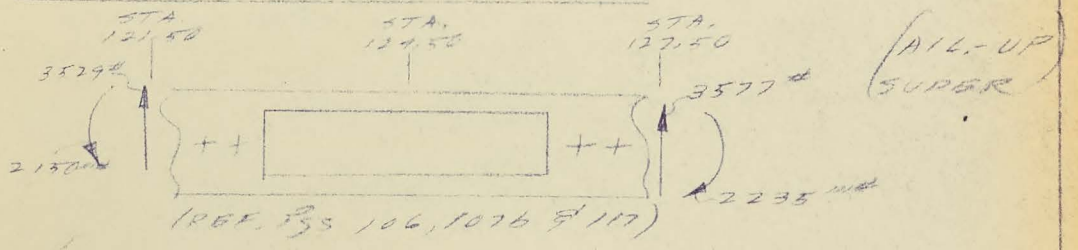
$Q = 3.5(.275)(.412)^2 + .25(.25)^2\left(\frac{.57}{2}\right) = .429$ in^3

$f_s = \frac{1120(1.369)(.429)}{.371(.25)} = 7040$ psi, $R_s = \frac{7040}{35500} = .198$

$M.S. = \frac{5.10}{4.40} - 1 = .16$

LOADINGS 5.1M @ 530, 516, 18

LOADS ON EARS OF RIB:



(ALL LOADS ARE LIMIT)

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MALTON – ONTARIO

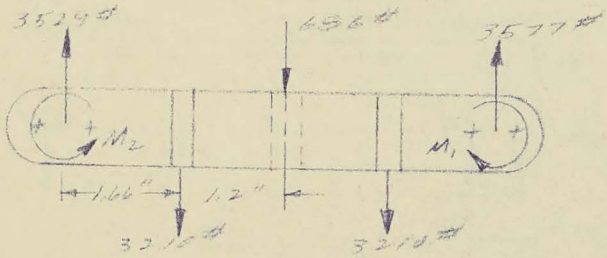
TECHNICAL DEPARTMENT (Aircraft)

REPORT NO. Z-0574-1
SHEET NO. R 96

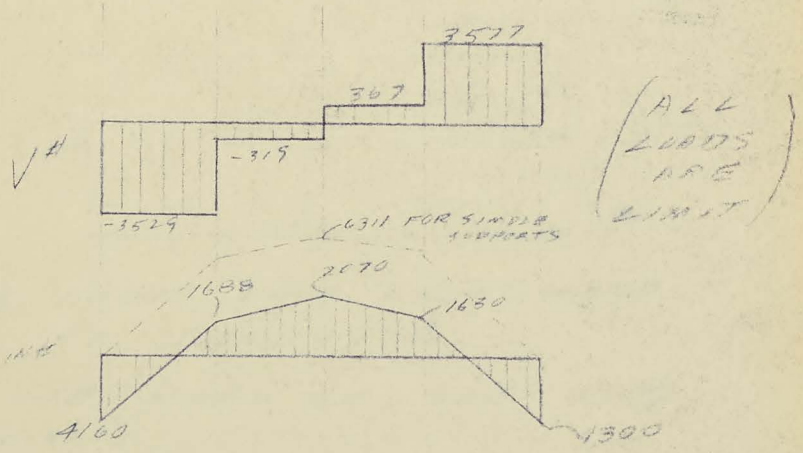
AIRCRAFT		PREPARED BY:	DATE:
C 105	AILERON	R. CAVALIS	
		CHECKED BY:	DATE:

RIB # 1

THE RIB LOADS FOR THIS CONDITION ARE:



FOR PERFECTLY RIGID SUPPORTS,
$M_1 = 4300$ in#, $M_2 = 4160$ in# & THE LOADING IS AS SHOWN.



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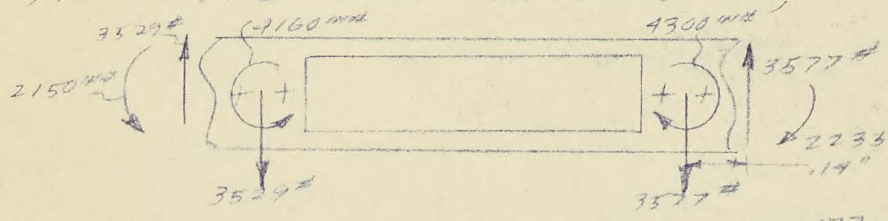
TECHNICAL DEPARTMENT (Aircraft)

REPORT NO. 7-0579-1
SHEET NO. R90

AIRCRAFT		PREPARED BY: R. GAVALIS	DATE:
C 105	AILERON	CHECKED BY:	DATE:

RIB #7

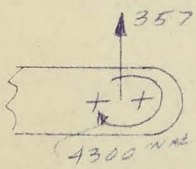
THEN THE SPAR LOADING IS,







ABOVE LOADS ARE CHORDWISE & NORMAL TO CHORDWISE FOR THE BARS OF THE RIB.



$M_{MAX} = 1.414\,(1.364)\,(4300) = 8300$ IN#
(REF, Pg. 22F)

$V_{SHEAR} = 1.364\,(1.414)\,(3577) = 6900$ #(ULT.)

$P_{BOLT} = \frac{8300}{.175} + \frac{6900}{2} = 15,050$ #

LOAD IS TOO HIGH, BOLTS SHOULD BE INCREASED IN SIZE & MOVED OUTBOARD.

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TECHNICAL DEPARTMENT (Aircraft)

REPORT NO. 7-0574-1
SHEET NO. R8d

AIRCRAFT		PREPARED BY: R. GAVALIS	DATE:
C 105	AILERON	CHECKED BY:	DATE:

RIB #7

USE 3/8" BOLTS @ 1.5" SPACING

$P_{BOLT} = \frac{9900}{1.5} + \frac{6400}{2} = 9400\#$

P_{ALL} THROAT = 10500# FOR MOS 1.46

$M.S. = \frac{10500}{7980} - 1 = .11$

MOMENT WILL INCREASE DUE TO MOVEMENT OF BOLT PATTERN CENTROID

P_{ALL} OF BAR = .20(3/8)(1.364)(72000) = 7360# (100 LOW)

LET $t_{BAR} = .30"$

P_{ALL} OF BAR = .30(3/8)(1.364)(72000) = 11,000# (O.K.)

P_{ALL} OF BAR = .325(3/8)(1.364)(63500) = 10550# (O.K.)

FOR THIS BAR

$I = \frac{.320(1.2)^3}{12} = .0460\ in^4$

$f_b = \frac{46801.60}{.0460} = 60,700\ psi$

$V = 48701b$, $f_s = \frac{48701(1.2)}{(.32)(1.2 - \frac{3}{8})} = 27700\ psi$

$R_b = \frac{60700}{54400} = 1.08$, $R_s = \frac{27700}{25600} = .750$

$M.S. = \frac{5.63}{6.70} - 1 = -.14$

USE $t_{BAR} = .350$, M.S. = .00

A.V. ROE CANADA LIMITED
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TECHNICAL DEPARTMENT (Aircraft)

REPORT NO. 7-0574-1
SHEET NO. R 8 C

AIRCRAFT		PREPARED BY: R. GAVALIS	DATE:
C 105	AILERON	CHECKED BY:	DATE:

RIB #7

FOR THE CENTER SECTION (BETWEEN LUGS)

$M = 8600$ IN-# (ULT.), $V = 500$ # (ULT.)

LET $t = .60$"

$I = \frac{.60(4.4)^3}{12} = .1372$ IN⁴

$f_b = \frac{8600(1.70)}{.1372} = 44000$ PSI, $R_b = \frac{44000}{56400} = .781$

$f_s = \frac{500(1.5)}{1.41(.6)} = 900$ PSI (SHEAR)

$M.S. = \frac{1}{.781} - 1 = .28$

BENDING OF SPAR:

$M_x = 6500$ IN-# (LIMIT)

$P = \frac{6500(11.64)}{1.3} = 58100$ #

$A_{2 \text{ IN. R}} = .677$ IN², $f_c = \frac{58100}{.5172} = 11700$ PSI

ADD TO OTHER SPAR LOADS LATER

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TECHNICAL DEPARTMENT (Aircraft)

REPORT NO. 7-0574-1
SHEET NO. R 9

AIRCRAFT		PREPARED BY: R. GAUAIS	DATE:
C 105	AILERON	CHECKED BY:	DATE:

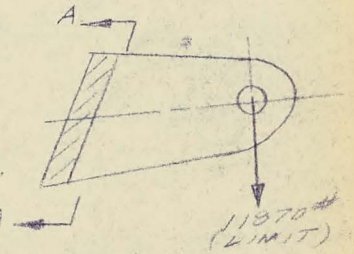
RIB #7

LUGS (SUPERSONIC CASE-UP AILERON)

$P_{TR} = 11870^{\#}$

$b_1 = b_4 = .51$, $b_2 = .43''$, $b_3 = .50''$

$$b_e = \frac{6}{\frac{4}{.51} + \frac{1}{.43} + \frac{1}{.50}} = .474$$



(REF. PBS 5-17-22 FOR LOADS)

$A_{AVG} = .474(.80) = .379\ IN^2$

$A_{BR} = .625(.80) = .500\ IN^2$

$\frac{A_{AVG}}{A_{BR}} = \frac{.379}{.500} = .758$, $K_{TRU} = .510$

$P'_{TRU} = .510(.500)(56900) = 14400^{\#}$

$$M.S. = \frac{14400(2)}{11870(1.369)} - 1 = .77$$

FOR BENDING @ A-A

$M = 12510^{\#}(1.54) = 19300\ IN^{\#}$

$I = \frac{.80(1.32)^3}{12} = .153\ IN^4$

$f_{b4} = \frac{19300(1.369)(.66)}{.153(2)} = 56800\ PSI$

$F_{TU_x} = 62,000\ PSI$, $R_b = \frac{56800}{62000} = .916$

$P_{c_1} = 4120^{\#}$, $f_c = \frac{4120(1.369)}{.80(1.32)(2)} = 2660\ PSI$

$R_c = \frac{2660}{62000} = .0429$, $R_t = .0429 + .916 = .959$

A.V. ROE CANADA LIMITED
MALTON – ONTARIO

TECHNICAL DEPARTMENT (Aircraft)

REPORT NO. 7-0579-1
SHEET NO. R 10

AIRCRAFT		PREPARED BY:	DATE:
C 105	AILERON	R. GAVALIS	
		CHECKED BY:	DATE:

RIB # 7

$$f_s = \frac{1.5(12510)(1364)}{21.80(1.32)} = 12150 \text{ psi}$$

$$R_s = \frac{12150}{39000} = .312 \qquad M.S. = \frac{10.35}{10.10} - 1 = .02$$

INCREASE WEB THICKNESS TO .85"

$$I = \frac{.85}{.80}(.153) = .1625 \text{ in}^4$$

$$R_b = .916\left(\frac{.153}{.1625}\right) = .901, \quad R_c = .0479\left(\frac{.80}{.85}\right) = .0407$$

$$R_T = .901, \quad R_s = .312\left(\frac{.80}{.85}\right) = .294$$

$$M.S. = \frac{5.10}{4.65} - 1 = .10$$

$t_{WEB} = .85$

SKIN-TO-RIB ATTACHMENTS

$q_{\substack{MAX \\ ULTIMATE}} = 412 \text{ #/in}$

5/32" A D @ .625" PITCH

$q_{ALL} = 731 \text{ #/in}$ (REF. P5, R2)

$$M.S. = \frac{731}{412(1.364)} - 1 = .30$$

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MALTON - ONTARIO

TECHNICAL DEPARTMENT (Aircraft)

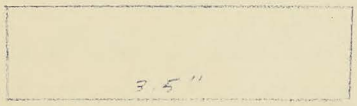
REPORT NO. J-0579-1
SHEET NO. R11

AIRCRAFT		PREPARED BY: R. GAVALIS	DATE:
C105	AILERON	CHECKED BY:	DATE:

RIB #7

LEADING EDGE OF RIB HAS BEEN MODIFIED AGAIN.

SECTION B-B (REF. TO R8)



$I = \frac{3.5(.90)^3}{12} = .212 \text{ in}^4$

$f_{by} = \frac{19090(.45)}{.212} = 40,500 \text{ psi}$

$f_{bx} = \frac{1,500(.90)}{.212} = 6,400 \text{ psi}$

$f_{cu} = \frac{3160(0.900)}{.70(3.5)(.90)} = 1620 \text{ psi}$, $f_{TOTAL} = 56,600 \text{ psi}$

$f_s = \frac{1120(0.900)(1.5)}{3.5(.90) - 4.71(.270)} = 839 \text{ psi}$

$M.S. = \frac{59100}{56600} - 1 = .05$

A.V.ROE CANADA LIMITED
MALTON – ONTARIO

TECHNICAL DEPARTMENT (Aircraft)

REPORT NO. 7-0574-1
SHEET NO. R 12

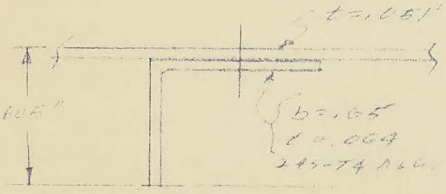
AIRCRAFT		PREPARED BY:	DATE:
C 105	AILERON	R. CAVALIS	
		CHECKED BY:	DATE:

RIB #64

$M_{\substack{MAX \\ LIMIT \\ UPPER}} = .25(4700) = 1174$ IN-#, $V = 194$ # (LIMIT AT $\frac{x}{c} = .50$)

$M_{\substack{MAX \\ LIMIT \\ LOWER}} = .147(10520) = 1550$ IN-#, $V = 100$ # (LIMIT AT $\frac{x}{c} = .48$)

AT 12.74" FROM T.E. ($\frac{x}{c} = .50$)



$I_{RIB} = .65(.064)(.520)^2 + \frac{.064(.780)^3}{12} = .0238$ IN⁴

$\frac{b}{t} = \frac{.65}{.064} = 10.16$, $F_{cu} = 27000$ PSI

$M_{\substack{I.L. \\ RIB}} = \frac{27000(.0238)}{.564} = 1139$ IN-#

FOR 24S-T4 ALC. ALCLAD,

$F_{cy} = 37,000$ PSI, $\left(\frac{t}{c}\right) = 1.64\left(\frac{13.70}{.021}\right) = 2.38$

$F_{cu} = 3.12(37,000)\left(\frac{.051}{13.70}\right)^{.6} = 11,520$ PSI

$\frac{F_{cu}}{E} = \frac{1150}{27000} = .0428$, $\frac{b_m}{b} = .311$

$b_m = .311(9.90) = 2.76$

$M_{\substack{ULT \\ RIB}} = 2.76(.051)(.52)\sqrt{2}(4,800) = 4400$ IN-#

$M_{ULT} = 5.2 + 4400 = 5745$ IN-#

A.V. ROE CANADA LIMITED
MALTON – ONTARIO

TECHNICAL DEPARTMENT (Aircraft)

REPORT NO. 7-0579-1
SHEET NO. R 13

AIRCRAFT		PREPARED BY: R. GAVALIS	DATE:
C105	AILERON	CHECKED BY:	DATE:

RIB #6A

$R_{bu} = \frac{.128(.254)^2}{5756} = .278$

$Q = 2.76(.051)(.580) + .65(.100)(.521) + (.430)^2(.069)(.5)$

$Q = .1109\ in^3$, $I_{min} = .0278 + 2.76(.051)(.580)^2 = .1149\ in^4$

$f_s = \frac{192(.254)(.580)}{.1149(.069)} = 3960\ psi$, $R_s = \frac{3960}{24000} = .116$

$M.S. = \frac{1}{\sqrt{(.278)^2 + (.116)^2}} - 1 = \frac{2.30}{4}$

USE $t_{RIB} = .051"$

SKIN - 7.8 - .218 RIVETS

$P_{SUPER} = 163\#/in$ (LIMIT)

NOW: $\frac{3}{8}$" HUCK (100V) @ 1.3" PITCH - UPPER

$\frac{1}{8}$" AD RIVETS @ 1.0" PITCH - LOWER

$P_{\substack{ALL \\ SKIN \\ HUCK}} = 269\#$, $P_{\substack{ALL \\ SKIN \\ AD}} = 340\#$

$q_{ALL} = \frac{269}{1.3} = 207\#/in$

$M.S._u = \frac{268}{163(1.369)} - 1 = .20$

ATTACHMENT TO FRONT SPAR

$V_{SUPER} = 393\#$ (LIMIT), $V_{SUB} = 913\#$ (LIMIT)

$P/RIV_u = \frac{913(1.369)}{3} = 415\#$

A.V. ROE CANADA LIMITED
MALTON – ONTARIO

TECHNICAL DEPARTMENT (Aircraft)

REPORT NO. Z-0574-1
SHEET NO. R 14

AIRCRAFT		PREPARED BY: R. GAVALIS	DATE:
C105	AILERON	CHECKED BY:	DATE:

RIB #6A

$M_{e_d} = 913(1.364)(1.6) = 1993$ IN #

$P_{RIV_{M_d}} = \frac{1993}{2.0} = 1000$ #

$P_V = 415 + 1000 = 1415$ #

$P_H = 415$ #, $P_{RES} = 1470$ #

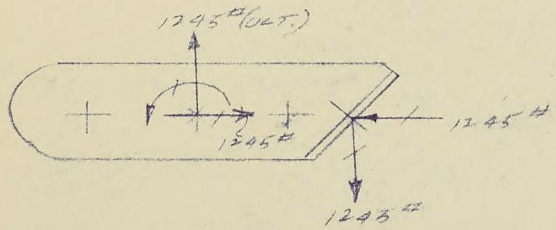
FOR ALL 3 - BOLTS

$P_{ALL\ SHEAR} = 2125$ #, $P_{ALL\ BY\ RIB} = .051(1.190)(1.364)(61000)(2) = 1610$ #

$P_{ALL\ BY\ CLIPS} = \frac{.081}{.051}(1610) = 2560$ #

$M.S. = \frac{1610}{1470} - 1 = .09$

FOR THE CLIP,



$M = 870$ IN #, $V = 1245$ #, $P = 1245$ #

LET $b = .80$", $t = 2(.081)$"

$I = \frac{.162(.80)^3}{12} = .0069$, $f_b = \frac{870(.40)}{.0069} = 50300$ PSI

$f_s = \frac{1245}{.162(.80-.190)} = 12,600$ PSI, $R_b = \frac{50300}{64000} = .786$

$R_s = \frac{12600}{43000} = .293$, $f_c = \frac{1245}{.162(.80)} = 9600$ PSI

A.V. ROE CANADA LIMITED
MALTON — ONTARIO

TECHNICAL DEPARTMENT (Aircraft)

REPORT NO. 7-0579-1
SHEET NO. R 14a

AIRCRAFT		PREPARED BY: R. GAVARIS	DATE:
C105	AILERON	CHECKED BY:	DATE:

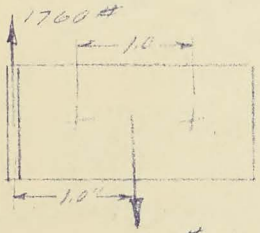
RIB #6A

$\frac{t}{c} = \frac{.48}{.081} = 5.9$, $F_{cu} = 64000$ psi

$R_c = \frac{9600}{64000} = .150$, $R_t = .796 + .150 = .936$

$M.S. = \frac{5.46}{4.91} - 1 = .05$

FOR THE CLIP-TO-SPAR ATTACHMENT:



$M = 1760(1.0) = 1760$ in-#

$P = \frac{1760}{2(2)} + \frac{1760}{1.0(2)} = 1320$ #

1760 # = 1345 (114.8) $P_{bl} = .081(\frac{3}{16})(132000)$ per clip

$= 2080$ #

$M.S. = \frac{2080}{1320} - 1 = .57$

M_{max} / clip $= 440$ in-#, V_{max} / clip $= 880$ #

$I = \frac{.081(1.0)^3}{12} = .00675$ in^4, $\frac{b}{2} = \frac{.50}{.081} = 6.2$

$f_b = \frac{440(.50)}{.00675} = 32600$ psi, $R_b = \frac{32600}{64000} = .510$

$f_s = \frac{1760}{(1.00 - \frac{3}{16})(.081)} = 13400$ psi, $R_s = \frac{13400}{43000} = .312$

$M.S. = \frac{1}{\sqrt{(.510)^2 + (.312)^2}} - 1 = .66$

A.V. ROE CANADA LIMITED
MALTON – ONTARIO

TECHNICAL DEPARTMENT (Aircraft)

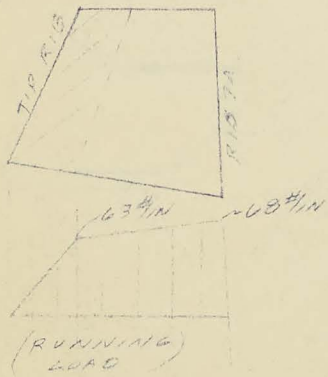
REPORT NO. 7-0579-1
SHEET NO. R 15

AIRCRAFT		PREPARED BY: R. GAVALIS	DATE:
C105	AILERON	CHECKED BY:	DATE:

TIP RIB

LOADING

(SUPERSONIC CASE)



$P_{AIR} = 63(2) + 8.6(65)(\frac{1}{2}) = 396^{\#}$

$M_{AIR}^{L.E.} = \frac{396(16.8)}{2} = 3330$ IN#

$\Sigma A = 10.85(2) = 21.7$ IN^2

$f = \frac{3330}{21.7} = 154$ #/IN

$f_{ULT} = 1.369(154) = 209$ #/IN

SKIN-TO-RIB RIVETING:

$\frac{1}{8}$" – 565 RIVETS @ 1.0" PITCH

$P_{ALL\ SHEAR\ U} = 340^{\#}$, $P_{ALL\ BRG\ U\ SKIN} = 340^{\#}$

$F_{cu} = 34000 psi$, $P_{ALL\ BRG\ U\ MAG.} = 1.14(34000)(.125)(.16) = 780^{\#}$

$f_{cu} = 60$ #/IN, $\frac{f_{cy}}{f_{cu}} = \frac{60}{209} = .287$, $f_{cy} = 1.23(209)$

$f_{cy} = 257$ #/IN $\qquad M.S. = \frac{340}{257} - 1 = .32$

USE RIB .80" U-CS

A.V. ROE CANADA LIMITED
MALTON – ONTARIO

TECHNICAL DEPARTMENT (Aircraft)

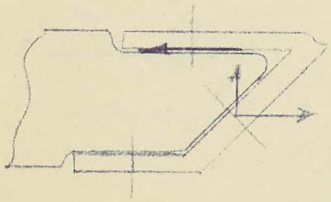
REPORT NO. J-0579-1

SHEET NO. R 16

AIRCRAFT		PREPARED BY:	DATE:
C 105	AILERON	R. GAUVAIS	
		CHECKED BY:	DATE:

TIP RIB

ATTACHMENT TO L.E.



$V = 396^{\#} - 1.3(159) = 196^{\#}$ (LIMIT)

$V_{ULT} = 1.5(196) = 294^{\#}$

$P_{RIVET} = 1.419(294) = 500^{\#}$ (ULT.)

USE 3/16" DEUTSCH RIVETS

A.V.RGE CANADA LIMITED
MALTON – ONTARIO

TECHNICAL DEPARTMENT (Aircraft)

REPORT NO. 7-6574-1

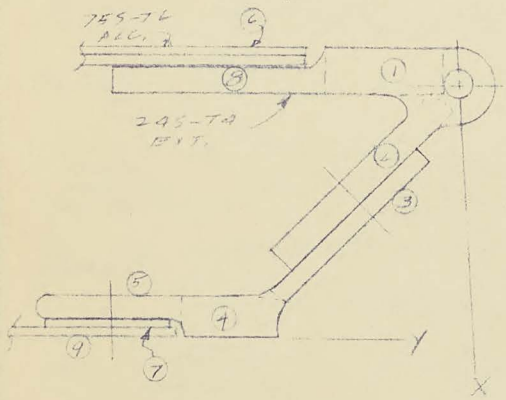
SHEET NO. R 17

AIRCRAFT		PREPARED BY:	DATE:
C105	AILERON	R GAUALIS	
		CHECKED BY:	DATE:

FRONT SPAR @ 115.90"

$M_{MAX} = 3900$ "#/(in.ft), $V_{MAX} = -778$ #

(REF FIG 120)



$\left(\frac{b}{t}\right)_{178} = \frac{1.97}{.18} = 8.16$ ← $A_{178}/1.47$

$F_{cu} = 35,000$ psi

$\left(\frac{b}{t}\right)_{487} = \frac{1.27}{.147} = 3.65$

$F_{cu} = 38,000$ psi

$\sigma_{cu} = 300$ TO 400 psi

USE $b_{MIN} = 2.0$"

WHEN SPAR STRESS IS 38,000 psi, SKIN STRESS = 55,000 psi

ITEM	b	t	A	x	Ax	Ax^2	I_o	I_{SPAR}	I_{SKIN}
1	.62	.25	.155	1.78	.276	.491	.0086	.0575	
2	1.42	.18	.256	.95	.243	.230	.0225	.00575	
3	1.00	.10	.100	.62	.062	.0384	.0044		
4	.40	.25	.100	.125	.0126	.00156			
5	.87	.10	.087	.134	.0118	.00158			
6	4.0	.132	.529	1.835	.969	1.778	.0003	.244	
7	2.0	.051	.102	.025	.00255	.00064			
8	.84	.13	.1092	1.78	.188	.3346		.0322	
9	.185	.081	.049	.091	.0063	.00057			
Σ			1.51		1.775	2.865	.0263	.2937	.4993

$\bar{x} = \frac{1.775}{1.51} = 1.179$

$I_y = 2.865 + .0263 - 1.51(1.179)^2 = .793$ in^3

FOR COMPRESSION IN SPAR CAP = 185 ksi,

$M_{ALL\ (COMP.\ IN\ SPAR\ CAP)} = \frac{35000(.2937)}{1.179} + \frac{41500(.4993)}{1.179} = 33,100$ in-#

$\epsilon_{SPAR} = .0056$ in/in, $\epsilon_{SKIN} = \frac{1.179}{1.72}(.0056) = .0046$ in/in

A.V. ROE CANADA LIMITED
MALTON – ONTARIO

TECHNICAL DEPARTMENT (Aircraft)

REPORT NO. 7-0529-1
SHEET NO. R 18

AIRCRAFT		PREPARED BY: R. GAVALIS	DATE:
C105	AILERON	CHECKED BY:	DATE:

FRONT SPAR @ 115.90

FOR COMPRESSION IN LOWER FIBRE;

$F_{LWR} = 38000$ psi, $\varepsilon_{LWR} = .0056$ in/in.

$\varepsilon_{UPR} = \frac{.72}{1.178}(.0056) = .00342$ in/in, $F_{UPR} = 32500$ psi

$M_{ALL} = \frac{38000(.4793)}{1.178} + \frac{32500(.2937)}{.72} = 23,390$ in-lbs
(COMP. IN LWR)

$Q_{MAX} = .180(.35) + .100(.42) + .10(1.06) + .087(.996)$
$+ .102(1.153) + .069(1.287) = .5036$ in^3.

$f_s = \frac{V(.5036)}{.793(.12)} = 5.52\ V$

$R_b = \frac{3400(1.364)}{33100} = .140$, $f_s = 3.52(.793)(1.364) = 3840$ psi

$R_s = \frac{3840}{30,000} = .128$

$M.S. = \frac{1}{\sqrt{(.128)^2 + (.140)^2}} - 1 = 4.25$

MOMENT WAS NOT RESOLVED INTO MOMENTS ABOUT THE PRINCIPAL AXES, BUT HIGH M.S. DOESN'T WARRANT THIS ADDITIONAL WORK.

A.V.ROE CANADA LIMITED
MALTON – ONTARIO

TECHNICAL DEPARTMENT (Aircraft)

REPORT NO. Z-0579-1
SHEET NO. R 19

AIRCRAFT		PREPARED BY: R GAVALIS	DATE:
C105	AILERON	CHECKED BY:	DATE:

RIB 6A

SECTION 3.1" FWD. OF T.E. ($\frac{t}{c}$ = .122)

$V_{SUB} = 120^{\#}$ (2 min) , $M_{SUB} = 10520(.013) = 137^{in\#}$ (2 min)

$V_{SUPER} = 30^{\#}$, $M_{SUPER} = .109(4700) = 508^{in\#}$

RIVETS @ 1.0" pitch

$M_A = \frac{Vp}{4} = \frac{120(1.0)(1.364)}{4} = 41^{in\#}$ EFFECTIVE SKIN = 30ϵ

$P = \frac{137(1.364)}{.60} = 312^{\#}$

$f_c = \frac{312}{30(.051)^2} = 4000 psi$, $\left(\frac{l}{D}\right) = 1.64\left(\frac{40}{.051}\right) = 32.4$

$F_{cu} = 42500 psi$, $R_c = \frac{4000}{42500} = .094$

$f_b = \frac{41(.025)}{.000017} = 60,500 psi$, $F_b = 72,000 psi$

$R_b = \frac{60500}{72000} = .840$, $I = \frac{30(.051)^4}{12} = .000017 in^4$

$f_s = \frac{120(1.364)}{2(.051)^2(30)} = 1050 psi$, $R_s = \frac{1050}{13000} = .0744$

$M.S. = \frac{1}{\sqrt{(.840+.094)^2+(.0744)^2}} - 1 = .07$

A.V. ROE CANADA LIMITED
MALTON – ONTARIO

TECHNICAL DEPARTMENT (Aircraft)

REPORT NO. 7-0579-1
SHEET NO. R 20

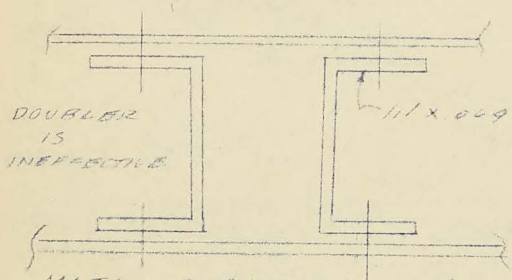
AIRCRAFT		PREPARED BY: R. GAVALIS	DATE:
C105	AILERON	CHECKED BY:	DATE:

RIB #6

SECTION AT 16.8" FWD. OF T.E. ($\frac{x}{c}$ = .582)

V_{SUB} = 650# (LIMIT), M_{SUB} = 5300 IN-# (LIMIT)

V_{UNBK} = 700# (ULTIMATE), M_{UNBK} = 7500 IN-# (ULTIMATE)
(PER FIG 907)



$\left(\frac{b}{t}\right) = \frac{1.1}{.064} = 17.2$

F_{cu} = 18,600 psi

$I_{RIB} = 1.1(.064)(4)\left(\frac{4.23}{2}\right)^2 + \frac{.064(4.17)^3}{12} = .1231$ IN⁴

$M_{ALL\ RIB} = \frac{18600(.1231)}{4.65} = 3520$ IN-#

$C_{RIB} = .0019$ IN/IN, $C_{SKIN} = .0019\left(\frac{.746}{.615}\right) = .00228$ IN/IN

$F_{SKIN} = 21700$ psi, $\sigma_{cu} = 3.62(9.7)(10^6)\left(\frac{.051}{8.34}\right)^2 = 1310$ psi

$\frac{\sigma_{cu}}{F_{cu}} = \frac{1310}{21700} = .0604$, $\frac{b_m}{b} = .952$

$b_m = .952(8.36) = 2.99$

$M_{ALL\ SKIN} = 21700\left[\left(\frac{4.29}{.051}\right).700\right](2) = 7750$ IN-# (.149 + 1.50 BETWEEN TWIN RIBS)

$M_{ALL} = 7750 + 3520 = 11,270$ IN-#

$M.S._{ULT} = \frac{11270}{7500(1.30)} - 1 = .10$

A.V. ROE CANADA LIMITED
MALTON – ONTARIO

TECHNICAL DEPARTMENT (Aircraft)

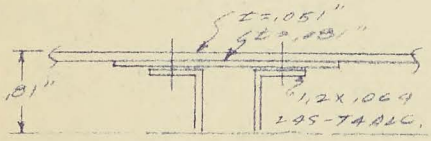
REPORT NO. 7-0579-1
SHEET NO. R 21

AIRCRAFT		PREPARED BY: R. GAVALIS	DATE:
C105	AILERON	CHECKED BY:	DATE:

RIB #6

SECTION AT $\frac{x}{c}$ = .710 (20.3" AWD. OF T.E. DGE)

$M_{SUPER\ (LIMIT)} = 10300$ IN#, $V_{SUPER\ (LIMIT)} = 840$# (REF. B 90F)



$\frac{b}{t} = \frac{1.2}{.069} = 18.75$

$F_{cr} = 17600$ psi

$I_{RIB} = \frac{.069(1.229)^3}{12}(2) + 1.2(.069)(4)(.410)^2 = .1479$ IN⁴

$M_{ALL\ RIB} = \frac{17500(.1479)}{.678} = 3820$ IN#

$f_{DOUBLER} = \frac{.717}{.636}(17500) = 19700$ psi

$M_{ALL\ DOUB} = 9.2(.081)(2)(.9580)(.719) = 9550$ IN#

$f_{SKIN} = \frac{.785}{.696}(17500) = 21200$ psi

$\frac{\sigma_{cc}}{f} = \frac{13100\ @\ P_3\ R21}{21200} = .0618$, $\frac{b_{eff}}{b} = .355$, $b_{eff} = .355(8.34) = 2.96$"

$b_{TOTAL} = 2.96 + 1.80 = 9.76$

$M_{ALL\ SKIN} = 9.76(.081)(2)(21200)(.785) = 8100$ IN#

$M_{ALL\ TOTAL} = 3820 + 9550 + 8100 = 21470$ IN#

$M.S. = \frac{21470}{1.369(10300)} - 1 = .49$

$M_{ALL\ SKIN} = 7750$ IN#, $M_{ALL\ W.DB} = 3520\left(\frac{.0171}{.123}\right)\left(\frac{1.65}{.59}\right) = 537$ IN#

$M_{ALL\ ODDS} = 29800$ IN#

A.V. ROE CANADA LIMITED
MALTON – ONTARIO

TECHNICAL DEPARTMENT (Aircraft)

REPORT NO. 7-0574-1

SHEET NO. R21a

AIRCRAFT		PREPARED BY:	DATE:
C105	AILERON	R. GAVARIS	
		CHECKED BY:	DATE:

RIB #6

$M_{\text{ACW DOUBLER}} = 21700(1.081)(6)(12)(1.670) = 11700$ IN-LBS

$\%MA_{\text{IN WEB OF RIB}} = \frac{537}{7750+7980+537+11700} \approx 2.3\%$

DESIGN BRACKET-TO-WEB RIVETS FOR 10% OF MOMENT

DESIGN BRACKET-TO-RIB FLANGE RIVETS FOR 100% OF MOMENT

A.V. ROE CANADA LIMITED
MALTON – ONTARIO

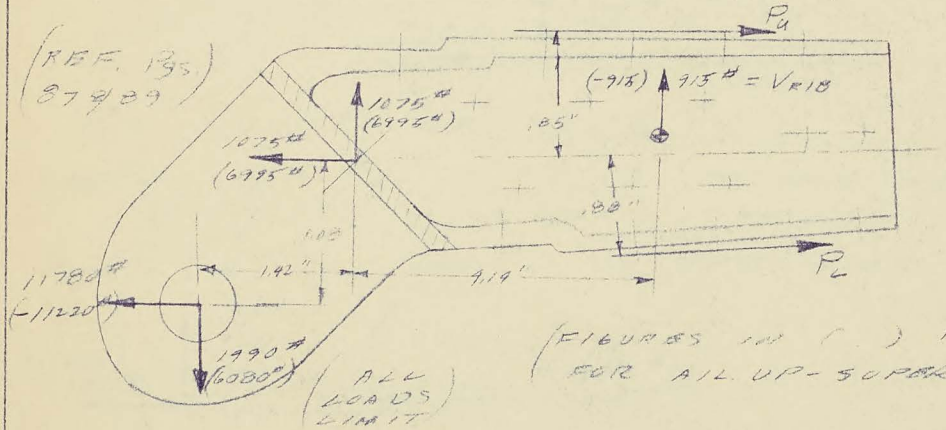
TECHNICAL DEPARTMENT (Aircraft)

REPORT NO. 7-0579-1
SHEET NO. R 22

AIRCRAFT		PREPARED BY:	DATE:
C105	AILERON	R. GAUDAIS	
		CHECKED BY:	DATE:

RIB #6 — LEVER BRACKET

(SUPERSONIC – AIL. DOWN)



(ALL LOADS LIMIT)

(FIGURES IN ( ) ARE FOR AIL UP – SUPERSONIC)

THE BRACKET-TO-SPAR WEB BOLTS MUST PICK-UP THE VERTICAL SHEAR OF 1990 – 915# ASSUMING THAT THE SPAR WEB CAN CARRY LOADS ONLY ALONG ITS AXIS, THE HORIZONTAL COMPONENT AT THIS BOLT IS ALSO 1990 – 915 = 1075# SINCE THE ANGLE OF THE SPAR WEB WITH VERTICAL IS 45°.

SOLVING FOR P_U & P_L

$$\Sigma M_A = 11780(.08) - 1990(1.42) - 915(9.19) + .85P_U - .80P_L = 0$$

$$\Sigma F_X = P_U + P_L - 1075 - 11780 = 0$$

$P_U = 9000\#$, $P_L = 9855\#$ FOR AIL. DOWN SUPER

$P_U = 7660\#$, $P_L = -11885\#$ FOR AIL UP – SUPER

FOR THE RIB,

$$\Sigma F_n = P_S - 3000 - 9855 = 0$$

$P_S = 12855\#$ FOR AIL DOWN SUPER (SEE ELEVATOR-MOMENT PAGE)

A. V. ROE CANADA LIMITED
MALTON - ONTARIO
TECHNICAL DEPARTMENT (Aircraft)

REPORT No. Z-0579-1
SHEET No. R22a

AIRCRAFT:		PREPARED BY	DATE
C105	AILERON	R. GAVALIS	
		CHECKED BY	DATE

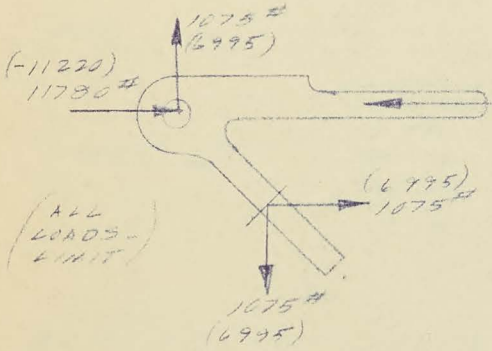
RIB #6



$P_S = -4225^{\#}$ FOR ALL-UP SUPER

NOTE. $P_S = P_{SU} + P_{SW}$ DUE TO THE FACT THAT SPAR WEB SLOPES AT 45°.

CHECKING EQUILIBRIUM OF THE SPAR:



$\Sigma F_V = 1075 - 1075 = 0$

$\Sigma F_H = 11780 + 1075 - 12855 = 0$

FOR LWR SKIN-TO-BRACKET ATTACHMENT:

$P = 11855^{\#}$ (LIMIT), $f_{SKIN\ SHEAR} = 461\ ^{\#}/_{IN}$ (ULT.) (REF. P_3, R24)

$P_{SKIN\ SHEAR} = 461(7.5) = 3460^{\#}$ (ULT.), $P_{TOT} = 3460 + 11855(1.364)$

$P_{TOT} = 17640^{\#}$

$P_{ALL\ SKIN} = 14(1440) = 20200^{\#}$

$P_{ALL\ BRACKET} = .12\left(\frac{3}{16}\right)(1.364)(72000)(14) = 89\,700^{\#}$ — $^{3}/_{16}$" DIA AN509

$M.S. = \frac{20200}{17640} - 1 = .03$

FORM 1319A

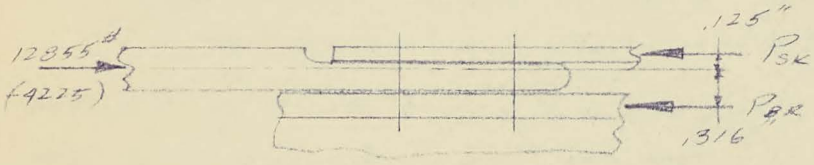
A. V. ROE CANADA LIMITED
MALTON - ONTARIO
TECHNICAL DEPARTMENT (Aircraft)

REPORT No. 7-0579-1
SHEET No. R 22a-1

AIRCRAFT:		PREPARED BY	DATE
C105	AILERON	R CAVALIS	
		CHECKED BY	DATE

RIB # 6
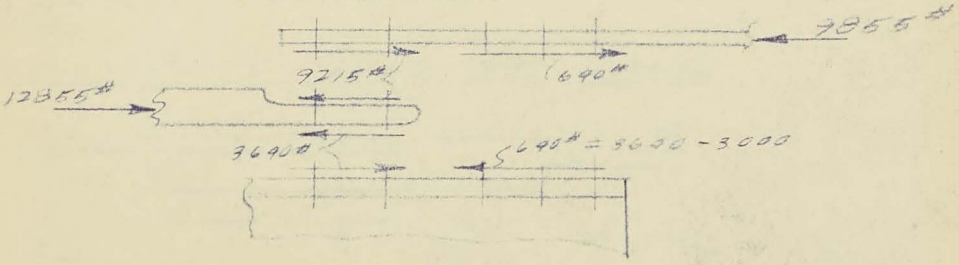
UPR. SKIN - TO - BRACKET ATTACHMENT:



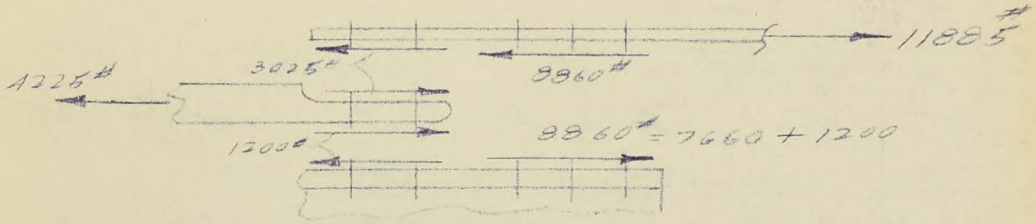
$P_{BR} = \frac{.125}{.441}(12855) = 3640^{\#}$ $(-1200^{\#})$

$P_{SK} = 9215^{\#}$ $(-3025^{\#})$

FOR AIL. DWN SUPER



FOR AIL. UP - SUPER



$P = 8860(1.364) = 12100^{\#}$

NOW: (16) - $\frac{3}{16}$ HUCK CRL 100 V

$P_{ALL} = 16(770) = 12320^{\#}$

$M.S. = \frac{12320}{12100} - 1 = .02$

A. V. ROE CANADA LIMITED
MALTON - ONTARIO
TECHNICAL DEPARTMENT (Aircraft)

REPORT No. 7-0579-1
SHEET No. R 226

AIRCRAFT:		PREPARED BY	DATE
C 105	AILERON	R. GAVALIS	
		CHECKED BY	DATE

RIB #6

FOR THE BRACKET-TO-RIB WEB RIVETS:

$\Sigma r^2 = 3.18^2 + 2.15^2 + 1.18^2 + .55^2 + .88^2 + 1.39^2 + .35^2 + 1.56^2 + 2.52^2 = 29.53$ IN^2

ASSUME $M = .10(21450)(1.364) = 2930$ IN-# (ULT.), $V = 1140$ # (LIMIT)

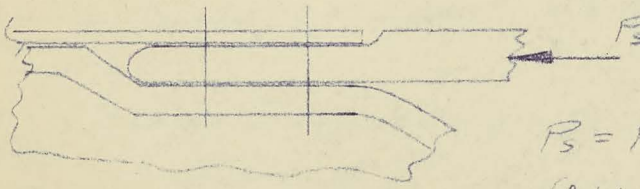
FOR THE MOST DET RIVET,

$P_M = \frac{2930(3.18)}{2(29.53)} = 158$ #, $P_{TOT} = 158 + \frac{1140(1.364)}{18} = 245$ #

USE 1/32" DIA HUCK (P) RIVETS

RIBS

CARRY-THRU LOAD AT SPAR



$P_S = P_{XH} + P_{ZH}$
(ALL LOADS LIMIT)

FOR AIL. DOWN:

	SUBSONIC			SUPERSONIC		
RIB #	P_{ZH}	P_{XH}	P_S	P_{ZH}	P_{XH}	P_S
1	3050	14980	18030	3446	16020	19470
2	4300	25810	30110	5310	27000	32310
3	5020	32400	37420	5840	33000	38840
4	3220	25900	29020	3950	26000	29950
5	1910	19790	21600	2410	19620	22030
6	630	12020	12650	1075	11780	12855
7	960	13010	13970	1264	12320	13580

FORM 1319A

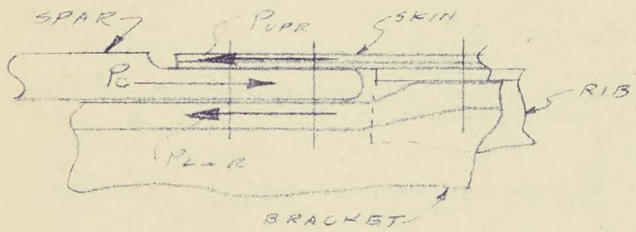
A. V ROE CANADA LIMITED
MALTON - ONTARIO
TECHNICAL DEPARTMENT (Aircraft)

REPORT No. 7-0574-1
SHEET No. R 22 C

AIRCRAFT:		PREPARED BY	DATE
C 105	AILERON	R GAVAIS	
		CHECKED BY	DATE

RIB #6

FOR SKIN-TO-SPAR-TO BRACKET ATTACHS:



$P_{UPR} = 693/(1.364)(2.5) = 2360^{\#}$ (REF P3, R23)

$P_{LWR} = 3640(1.364) = 4960^{\#}$

$P_C = 7330^{\#}$

FOR 1/4" SCREWS:

$P_{ALL\ BY\ SKIN} = 2(2010) = 4020^{\#}$, $M.S. = \frac{4020}{2360} - 1 = .70$

$P_{ALL\ BY\ BRACKET} = .25(\frac{1}{2})(1.364)(72000) = 6160^{\#}$

$P_{ALL\ BY\ SPAR} = .25(\frac{1}{2})(1.364)(63500) = 5410^{\#}$

$M.S. = \frac{5410(2)}{7330} - 1 = .48$

LEVER BRACKET

SPAR IS CUT AWAY IN REGION OF LEVER BRACKET, THEREFORE THERE WILL BE A REDISTRIBUTION OF SPAR LOADS. THE LEVER BRACKET MUST ALSO BEAR THE LEVER LOADS & THE RIB LOADS TO THE SPAR.

ORM 1319A

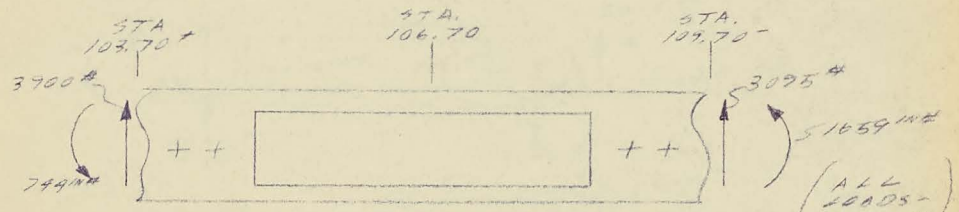
A. V. ROE CANADA LIMITED
MALTON · ONTARIO
TECHNICAL DEPARTMENT (Aircraft)

REPORT No. 7-0574-1
SHEET No. R22d

AIRCRAFT:		PREPARED BY	DATE
AILERON	C 105	R GAVALIS	
		CHECKED BY	DATE

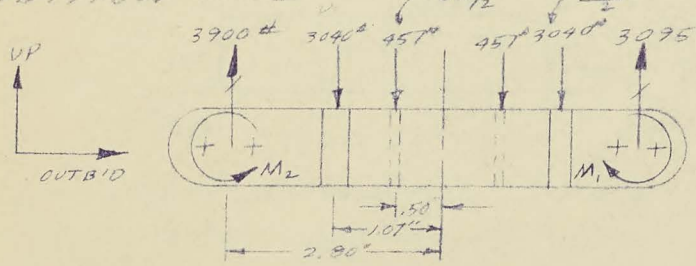
RIB #6

THE SPAR LOADING IN THIS REGION IS,



AIL. UP - SUPERSONIC (REF. BS 109, 117 & 1076)

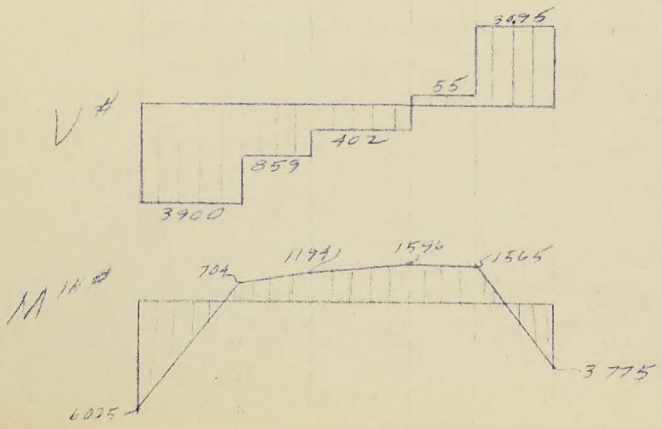
THE LEVER BRACKET LOADS FOR THIS CONDITION ARE, ($P_{6\,IR}/_2$) ($P_{24}/_2$)



FOR PERFECTLY RIGID SUPPORTS,

$M_1 = 3775$ IN#, $M_2 = 6025$ IN# (FROM LAST WORK)

THE BRACKET LOADING IS AS SHOWN



FORM 1319A

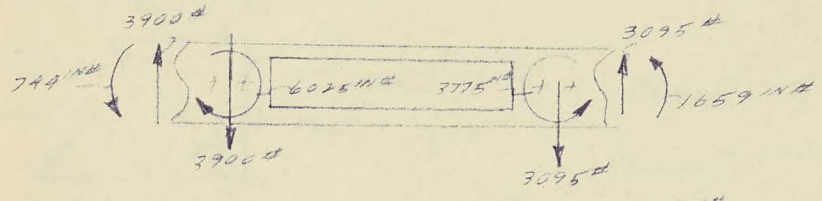
A. V. ROE CANADA LIMITED
MALTON - ONTARIO
TECHNICAL DEPARTMENT (Aircraft)

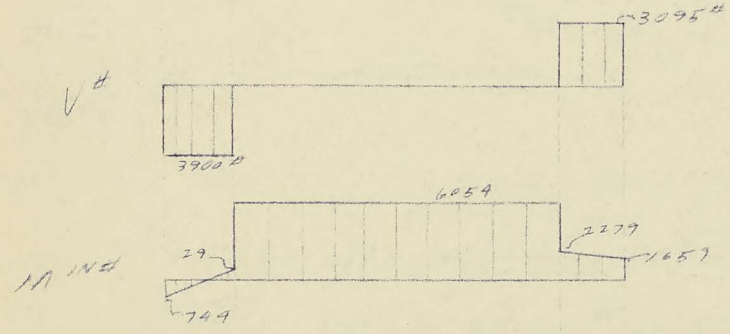
REPORT No. 7-0579-1
SHEET No. R 22 E

AIRCRAFT:		PREPARED BY	DATE
C105	AILERON	R. GAVALIS	
		CHECKED BY	DATE

RIB #6

THEN THE SPAR LOADING IS





IF THE SUPPORTS WERE CONSIDERED PINNED, THE MAXIMUM MOMENT IN THE REGION BETWEEN THE TWO LUGS WOULD BE 6310 IN#. THIS MOMENT WILL BE CONSERVATIVELY USED IN THE DESIGN OF THIS SECTION.

ALL THE ABOVE LOADS ARE CHORDWISE & NORMAL TO CHORDWISE. THEY WILL BE RESOLVED ALONG THE AXES OF THE SPAR WEB & FLANGES.

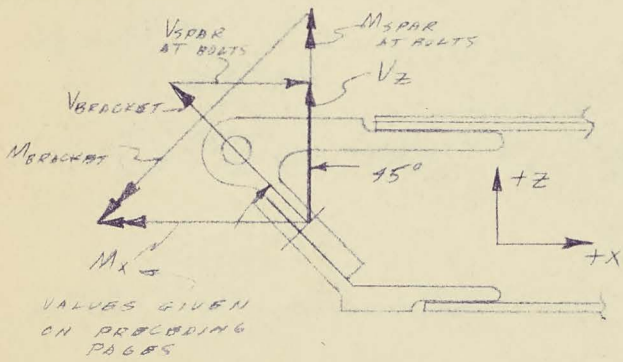
FORM 1319A

A. V. ROE CANADA LIMITED
MALTON - ONTARIO
TECHNICAL DEPARTMENT (Aircraft)

REPORT No. 7-0574-1
SHEET No. R 22 P

AIRCRAFT:		PREPARED BY	DATE
C 105	AILERON	R CAVALIS	
		CHECKED BY	DATE

RIB #6



$M_{BRACKET} = 1.414\, M_X$

$V_{BRACKET} = 1.414\, V_Z$

M_X SPAR = AS GIVEN ON PG 22e

FOR THE EARS OF THE BRACKET,

$M_{MAX} = 6025(1.414)(1.364)\left(\frac{3.25}{2.50}\right) = 13500$ IN #(ULT.) (3 ROW BOLT LOCATIONS)

$V = 3900(1.414)(1.364) = 7530$ # (ULT)

IF 7/16" NAS 147 BOLTS ARE USED @ 1.35"

$P_M = \frac{13500}{1.35} = 10,000$ #, $P_{TOTAL} = 13760$ #

$P_{ALL\ SHEAR} = 14300$ #, $P_{ALL\ BY\ EAR} = 15000$ # ($t_{EAR} = .550$)

$P_{ALL\ BY\ SPAR} = 14400$ # FOR $t = .380$"

$M.S. = \frac{14400}{13760} - 1 = .04$

FOR BENDING THRU INNER BOLT,

$M = 4300(1.364)(1.414) = 8290$ IN # (ULT)

$V = 7530$ # (ULT)

$I = \frac{.350(1.8)^3}{12} = .170$ IN⁴

$f_b = \frac{8290(.90)}{1.170} = 43700$ PSI, $F_{BU_y} = 56,000$ PSI

FORM 1319A

A. V. ROE CANADA LIMITED
MALTON - ONTARIO
TECHNICAL DEPARTMENT (Aircraft)

REPORT No. J-0574-1
SHEET No. R229

AIRCRAFT:		PREPARED BY	DATE
C105	AILERON	R. GAVALIS	
		CHECKED BY	DATE

RIB #6

$f_s = \frac{7540(1.5)}{(1.8-\frac{7}{16})(.350)} = 23800$, $F_{su} = 35500$ psi

$R_b = \frac{43900}{66400} = .777$, $R_s = \frac{23800}{35500} = .670$

$M.S. = \frac{5.75}{5.12} - 1 = .12$

FOR THE BRACKET THRU RIB ℄:

$M = 6310(1.364)(1.414) = 12200$ in-#

$V = 402(1.364)(1.414) = 777$ #

$I = \frac{.380(2.0)^3}{12} = .254$ in⁴

$f_b = \frac{12200(1.0)}{.254} = 48000$ psi, $R_b = \frac{48000}{66400} = .852$

$f_s = \frac{777(1.5)}{2.0(.38)} = 1530$ psi, $R_s = \frac{1530}{35500} = .043$

$M.S. = \frac{1}{\sqrt{(.852)^2+(.043)^2}} - 1 = .17$

CENTROID OF BOLT PATTERN HAS MOVED OUTWARD FROM ℄ BRACKET DUE TO INCREASE IN BOLT SIZE. LOADS WILL THEREFORE CHANGE, & WILL BE RECALCULATED LATER.

FORM 1319A

A. V. ROE CANADA LIMITED
MALTON · ONTARIO
TECHNICAL DEPARTMENT (Aircraft)

REPORT No. T-0579-1
SHEET No. R 23

AIRCRAFT:		PREPARED BY	DATE
C 105	AILERON	R. GAVALAS	
		CHECKED BY	DATE

RIB #6

SKIN-TO-SPAR ATTACHMENT (UPPER)

$P_{SKIN\ UPPER} = 9855\#$ (LIMIT) − COMPRESSION (REF. P_S, R_{L2})

$P_S - P_{AXIAL\ FLT} = 12855 - 3000$

ASSUME 18.50" OF SKIN IS EFFECTIVE,

$$f_c = \frac{1355(1.364)(1.3)}{18.5} = 795\ \#/in\ (ULT.),\quad f_s = 582\ \#/in\ (LIMIT)$$ (PEAKING FACTOR) (REF P_S, 91)

$$f_{sh_{ULT}} = \left[(795)^2 + (582 \times 1.364)^2\right]^{\frac{1}{2}} = 1020\ \#/in$$

FOR 3/16" SCREWS @ .90"

$$f_{ALL} = \frac{1440}{.90} = 1800\ \#/in$$

USE: 3/16" @ 1.3" M.S. = .09

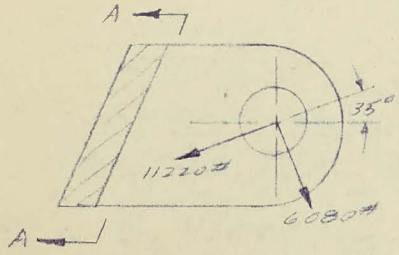
$$M.S. = \frac{1800}{1020} - 1 = .76$$

LEVER BRACKET - LUGS

FOR THE LUGS;

$P_{XL} = 11220\#$ (LIMIT), $P_{ZL} = -6080\#$ (LIMIT) (SUPERSONIC-UP REF. P_S, 86)

$P_{AXIAL} = 11220 \cos 35^\circ - 6080 \sin 35^\circ = 5710\#$ (LIMIT)



$P_{TR} = 11220 \sin 35^\circ + 6080 \cos 35^\circ$

$P_{TR} = 11430\#$ (LIMIT)

$$b_{AVE} = \frac{6}{\frac{2}{.150} + \frac{2}{.60}} = .563"$$

$A_{AVE} = .563(.62) = .349\ in^2$, $A_{BR} = .62(.62) = .384\ in^2$

FORM 1319A

A. V. ROE CANADA LIMITED
MALTON - ONTARIO
TECHNICAL DEPARTMENT (Aircraft)

REPORT No. T-0579-1
SHEET No. R 23a

AIRCRAFT:		PREPARED BY	DATE
C105	AILERON	R. GAVAZIS	
		CHECKED BY	DATE

RIB #6

$\frac{A_{DVC}}{A_{DT}} = \frac{.349}{.384} = .910$, $K_{TRU} = .52$, $K_{TR} = .78$

$P'_{TRU} = .52(.384)(56400)(2) = 22500\#$

$M.S. = \frac{22500}{11930(1.364)} - 1 = .44$

FOR BENDING AT A-A

$M = 11930(1.7) = 19950$ in-# (LIMIT)

$I = \frac{.75(1.3)^3}{12} = .212$ in^4

$f_{bu} = \frac{19950(.75)(1.3+.3)}{.212(2)} = 47000$ psi

$R_b = \frac{47000}{56400} = .835$, $f_c = \frac{5710(1.364)}{2(1.5)(.73)} = 3470$ psi

$R_c = \frac{3470}{56400} = .0615$, $f_s = \frac{11930(1.364)(1.5)}{2(1.7)(.63)} = 10400$ psi

$R_s = \frac{10400}{35500} = .295$, $R_c = .835 + .0615 = .8965$

$M.S. = \frac{10.35}{9.39} - 1 = .11$

PER LOCKHEED S.M. # 53C
FIG. 1B

FOR BENDING OF THE BRACKET JUST AFT OF THE EARS

$F_b = F_{bu} = 47600$ psi (REF. R.S. M2), $\frac{b}{t} = 6.5$

USE $b = 1.00"$, $t = .25"$

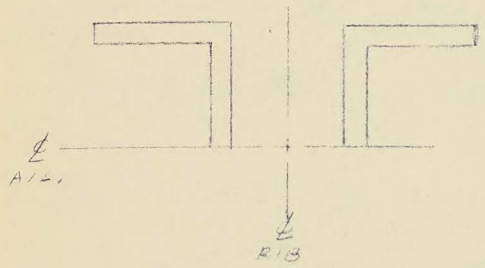
FORM 1319A

A. V. ROE CANADA LIMITED
MALTON - ONTARIO
TECHNICAL DEPARTMENT (Aircraft)

REPORT No. J-0574-1
SHEET No. R 236

AIRCRAFT:		PREPARED BY	DATE
C105	AILERON	R. GAVALIS	
		CHECKED BY	DATE

RIB #6



$$I = 2\left[1.0(.25)(.640)^2/2) + \frac{.25(1.03)^3}{12}\right] = .455\ IN^4$$

$$f_b = \frac{21720(1.364)(.765)}{.455} = 49700\ psi$$

$$R_b = \frac{49700}{47600} = 1.04,\ q = .383\ IN^3$$

TRY $b = 1.25''$, $t = .25''$

$$I = 2\left[1.25(.25)(.630)^2/2) + \frac{.25(1.01)^3}{12}\right] = .539\ IN^4$$

$$f_b = \frac{21720(1.364)(.755)}{.539} = 41500\ psi$$

$$A = 1.25(.25)(4) + 1.01(.25)(2) = 1.755\ IN^2$$

$$f_c = \frac{4225(1.364)}{1.755} = 3280\ psi,\ f_{TOT} = 41500 + 3280 = 44780\ psi$$

$$R_b = \frac{44780}{47600} = .940,\ q = .455\ IN^3$$

$$f_s = \frac{1145(1.364)(.455)}{.539(1.25)(2)} = 2640\ psi;\ R_s = \frac{2640}{35500} = .075$$

$$M.S. = \frac{1}{\sqrt{(1.030)^2 + (1.075)^2}} - 1 = .06$$

CRM 1319A

A. V. ROE CANADA LIMITED
MALTON - ONTARIO
TECHNICAL DEPARTMENT (Aircraft)

REPORT No. D-0579-1
SHEET No. R 24

AIRCRAFT:		PREPARED BY	DATE
C105	AILERON	R. GAVALIS	
		CHECKED BY	DATE

RIB #6

SKIN-TO-RIB ATTACHMENT (NOT IN REGION OF SPAR)

$q_d = 282$ #/in (LIMIT) (REF. B 91)

5/32" HUCKS @ .625", P_{all} (T>150°) = 445 #

$q_{all} = \frac{445}{.625} = 712$ #/in USE 1.0" SPACING

$q_{all} = 445$ #/in

$q_R = 1.2(282)(1.364) = 461$ #/in

$M.S. = \frac{2(445)}{461} - 1 = .93$

A. V. ROE CANADA LIMITED
MALTON - ONTARIO
TECHNICAL DEPARTMENT (Aircraft)

REPORT No. J-0574-1
SHEET No. R 25

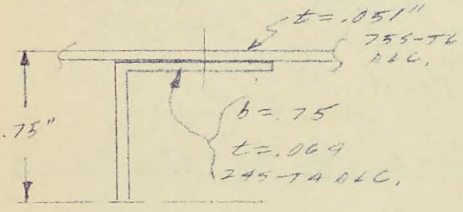
AIRCRAFT:		PREPARED BY	DATE
C105	AILERON	R. GAVAGIS	
		CHECKED BY	DATE

RIB 5A

$V_{SUB} = \frac{410\#}{(LIMIT)}$, $M_{SUB}{}_{(MAX.)} = .147(16780) = \underset{(LIMIT)}{2490''\#}$ AT $\frac{X}{C} = .68$

$V_{SUPER} = \frac{250\#}{(LIMIT)}$, $M_{SUPER}{}_{(MAX.)} = .25(7160) = \underset{(LIMIT)}{1790''\#}$ AT $\frac{X}{C} = .60$

AT 15.9" FWD. OF T.E. $\left(\frac{X}{C} = .50\right)$



$\frac{b}{t} = \frac{.75}{.064} = 11.7$

$F_{cu} = 24700 \text{ psi}$ (REF. RS M23)

$I_{RIB} = .75(.064)(.67)^2(2) + \frac{.064(1.22)^3}{12} = .0542 \text{ IN}^4$

$M_{ALL}{}_{RIB4} = \frac{24700(.0542)}{.70} = 1910''\#$

$C_{RIB} = .0026 \text{ IN/IN}$, $C_{SKIN} = .0026\left(\frac{.725}{.670}\right) = .0028 \text{ IN/IN}$

$F_{SKIN} = 27000 \text{ psi}$, $\sigma_{cu} = 3.62(9.7)(10^6)\left(\frac{.051}{9.60}\right)^2 = 992 \text{ psi}$

$\frac{\sigma_{cu}}{F} = \frac{992}{27000} = .0367$, $\frac{b_m}{b} = .296$, $b_m = .296(9.6) = 2.84"$

$M_{ALL}{}_{SKIN4} = 2.84(.051)(.723)(2)(27000) = 5680''\#$

$M_{ALL}{}_{TOTAL} = 5680 + 1910 = 7590''\#$

$M.S. = \frac{7590}{1.364(1790)} - 1 = \underline{2.10}$

IF $t_{RIB} = .051"$

$F_{cu} = 21000$, $b/t = 11.7$, $I = .0431 \text{ IN}^4$

$M_{ALL}{}_{RIB} = 1290''\#$, $b_m = .324(9.6) = 3.12$

$M_{ALL}{}_{SKIN} = 4840''\#$, $M_{ALL}{}_{TOTAL} = 6140''\#$

$t_{RIB} = .051"$ $M.S. = \frac{6140}{(1.364)(1790)} - 1 = \underline{1.51}$

RM 1319A

A. V. ROE CANADA LIMITED
MALTON - ONTARIO
TECHNICAL DEPARTMENT (Aircraft)

REPORT No. 7-0579-1
SHEET No. R 26

AIRCRAFT:		PREPARED BY	DATE
C105	AILERON	R GAVALIS	
		CHECKED BY	DATE

RIB #5A

FOR THE WEB,

$f_{su} = \frac{250(1.364)(1.5)}{.051(1.64)(2)} = 7840$ psi

$f_b = 21000$ psi $\quad R_b = \frac{21000}{50500} = .415$

$R_s = \frac{7840}{32200} = .244$

$M.S._{WEB} = \frac{1}{\sqrt{(.415)^2+(.244)^2}} - 1 = 1.08$

SKIN-TO-RIB ATTACHMENT

$q_{RIVET} = 180$ #/in (LIMIT) (REF. RS 91)

TOP SKIN: CKL 100V HUCK 1/8" DIA @ 1.0" PITCH
LWR SKIN: AD'S, 1/8" DIA. @ 1.0" PITCH

FOR HUCKS, P_{SLL} (T=60°) $= 196(1.364) = 268$ #

$q_{SLL} = 268$ #/in

$q_{BUCK.} = 110$ #/in, $\frac{f_a}{f_d} = \frac{110}{130(1.364)} = .45$

$q_{ult} = 1.16(130)(1.364) = 289$ #/in

USE 1/8" DIA. RIVETS @ .65" PITCH

q_{SLL} (T=60°) $= \frac{268}{.65} = 412$ #/in

q_{SLL} (T=93°) $= .795(412) = 328$ #/in

$M.S. = \frac{328}{289} - 1 = .15$

FORM 1319A

A. V. ROE CANADA LIMITED
MALTON - ONTARIO
TECHNICAL DEPARTMENT (Aircraft)

REPORT No. 7-0574-1
SHEET No. R 27

AIRCRAFT:		PREPARED BY	DATE
C105	AILERON	R. GAVALIS	
		CHECKED BY	DATE

RIB 5A

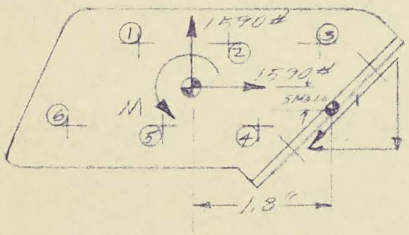
ATTACHMENT TO SPAR

(REF. $\frac{R_3}{90C}$)

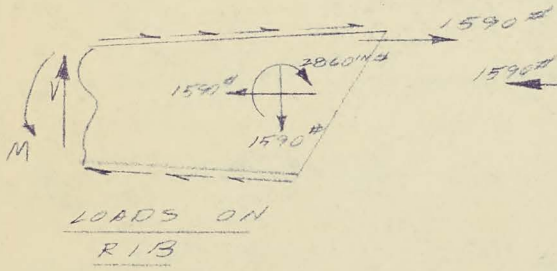
$V_{SUB} = 1167^{\#}$ (LIMIT)

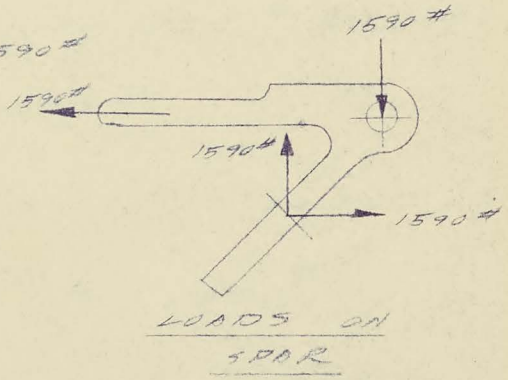
$V = 1.167(1.364) = 1590^{\#}$

$M = 1590(1.8) = 2860^{\#"}$



$\Sigma d^2 = 2[.80^2 + .38^2 + 1.29^2] = 4.90 in^2$





FOR RIVET # 3:

$P_c = \frac{M d_n}{\Sigma d^2} = \frac{2860(1.29)}{4.90} = 754^{\#}$

$P_{cV} = 754 \cos 13° = 735^{\#}$, $P_{cH} = -169^{\#}$

$P_n = P_V = \frac{1590}{6} = 265^{\#}$

$P_{V\,TOTAL} = 265 + 735 = 1000^{\#}$, $P_{H\,TOTAL} = 265 - 169 = 96^{\#}$

$P_{RSS} = 1001^{\#}$

FOR AN 470 AD 3 IN $\delta = .102$

$P_{ALL} = 1550\left(\frac{1.364}{1.50}\right) = 1410^{\#}$, $M.S. = \frac{1410}{1001} - 1 = .41$

FORM 1319A

A. V. ROE CANADA LIMITED
MALTON - ONTARIO
TECHNICAL DEPARTMENT (Aircraft)

REPORT No. 7-0574-1
SHEET No. R28

AIRCRAFT:		PREPARED BY	DATE
C105	AILERON	R. GOVALIS	
		CHECKED BY	DATE

RIB 5A

FOR 5/32" DIA. 8024T

$P_{ALL\ SHEAR} = 1438^{\#}$, $P_{b_{ALL}} = .102\left(\frac{5}{32}\right)(61000)(.064) = 1330^{\#}$

$M.S. = \frac{1330}{1001} - 1 = .33$

FOR THE CLIP - THRU MOST HVD. RIVET.

$f_s = \frac{1570}{.102(1.19)} = 13100\ psi$, $F_{su} = 37000\ psi$

$R_s = \frac{13100}{37000} = .354$, $M = 922^{\#}$, $I = .0209\ in^4$

$f_b = \frac{922(.675)}{.0209} = 29800\ psi$

$\left(\frac{e}{D}\right)_{CLIP} = \frac{.675 + .262}{.102(.95)} = 9.67$, $F_{bu} = 34,500\ psi$

$R_b = \frac{29800}{34500} = .865$, $P_c = 1590^{\#}$

$f_c = \frac{1590}{.102(1.35)} = 11540\ psi$, $R_c = \frac{11540}{34500} = .335$

$M.S. = \frac{1}{\sqrt{(.865 + .335)^2 + (1.334)^2}} - 1 = -.20$

BACK-UP RIB WITH .064" (R_3, R30), 24S-T4 CHANNEL, TIE INTO SKIN & PICK-UP 3- 5/32" HUCK (P) RIVETS IN RIB WEB AFT OF CLIP.

FORM 1319A

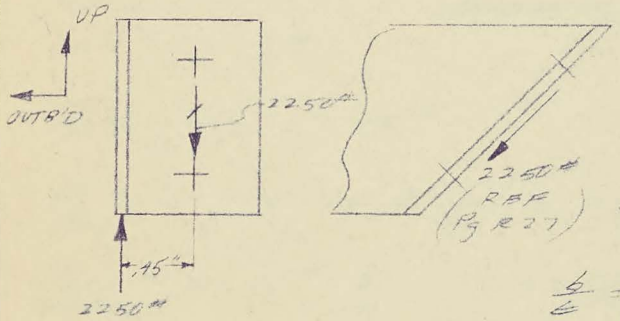
A. V. ROE CANADA LIMITED
MALTON - ONTARIO
TECHNICAL DEPARTMENT (Aircraft)

REPORT No. 7-0579-1
SHEET No. R 29

AIRCRAFT:		PREPARED BY	DATE
C105	AILERON	R. GAVALIS	
		CHECKED BY	DATE

RIB 5A

FOR THE CLIP-TO-SPAR ATTACHMENT:



$M = 2250(.45) = 1010^{IN\#}$

$I_Y = \frac{.102(1.78)^3}{12} = .0481 IN^4$

$f_b = \frac{1010(.89)}{.048} = 18720 psi$

$\frac{b}{e} = \frac{1.78}{2(.102)(.95)} = 9.2$

$F_{tu} = 36000 psi$

$R_b = \frac{18720}{36000} = .521, f_s = \frac{2250}{.102(1.40)} = 15800 psi$

$b = 1.78 - 2(\frac{3}{16})$

$R_s = \frac{15800}{37000} = .427$

$M.S. = \frac{1}{\sqrt{(.521)^2 + (.427)^2}} - 1 = .48$

IF (2) - .072" CLIPS ARE USED,

$I = .0147(\frac{.149}{.102}) = .0207 IN^4$ → L&L ATTACHED TO RIB

$f_s = 13100(\frac{.102}{.144}) = 9300 psi, R_s = \frac{9300}{37000} = .251$

$f_b = 29800(\frac{.0209}{.0207})(\frac{.600}{.1675}) = 26800 psi$

$R_b = \frac{26800}{38000} = .705, R_c = .335(\frac{.102}{.144}) = .242$

$R_t = .242 + .705 = .947$

$M.S. = \frac{10.2}{9.7} - 1 = .05$

LOCKHEED S.M. #53C
F16, 18

FORM 1319A

A. V. ROE CANADA LIMITED
MALTON - ONTARIO
TECHNICAL DEPARTMENT (Aircraft)

REPORT No. 2-0574-1
SHEET No. E 30

AIRCRAFT:		PREPARED BY	DATE
C105	AILERON	R. GAVALIS	
		CHECKED BY	DATE

RIB 5A

FOR THE CLIP-TO-SPAR BOLTS

$P_{SHEAR} = 2250^{\#}$ (REF. P_{SS} 37829)

$M = 1010$ IN#

$P_M = \frac{1010}{2(.75)} = 675^{\#}$

$P_{BOLT} = 675 + \frac{2250}{4} = 1237^{\#}$

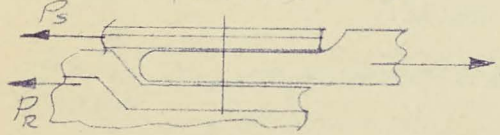
NOW USING (2) -.072" 245-T4 ALC. CLIPS.

$P_{ALL\ SHEAR} = 2070^{\#}$, $P_{ALL\ BR} = .072(\frac{3}{16})(61000)(1.364) = 1122^{\#}$

$M.S. = \frac{1122}{1237} - 1 = -.09$

TOP SKIN-TO-SPAR ATTACHMENT:

$q_{MAX\ SKIN} = 183^{\#}/IN$ (LIMIT), $q_u = 1.16(1.364)(183) = 290^{\#}/IN$



$P_S = 290(1.8) = 520^{\#}$

$P_R = 1590^{\#}$

$P = 1590 + 520 = 2110^{\#}$

NOW: 2 - 3/16" DIA. AN509 SCREWS

$t_{SPAR} = .12$ (245-T4 EXT.)

$P_{ALL\ SPAR} = .12(\frac{3}{16})(1.364)(67000) = 2060^{\#}$

$t_{RIB} = .051"$, $P_{ALL\ BR\ RIB} = .051(\frac{3}{16})(1.364)(61000) = 800^{\#}$

USE $t = .064"$ BACK-UP CHANNEL

$P_{ALL\ BY\ CHANNEL} = 800(\frac{.064}{.051}) = 1000^{\#}$

$P_{ALL} = 1000 + 800 = 1800^{\#}$

$M.S. = \frac{1800}{1590} - 1 = .13$

FORM 1319A

A. V. ROE CANADA LIMITED
MALTON - ONTARIO
TECHNICAL DEPARTMENT (Aircraft)

REPORT No. 7-0579-1
SHEET No. E 302

AIRCRAFT:		PREPARED BY	DATE
C105	AILERON	R. GAUDAIS	
		CHECKED BY	DATE

RIB 5A

BOTTOM SKIN-TO-SPAR ATTACHMENT

$q_{SKIN\ (LIMIT)}^{MAX} = 353\ ^{\#}/_{IN}$ @ RIB #7 (SUPERSONIC CASE REF. R3 S0-C)

$q_{ULT} = 491\ ^{\#}/_{IN}$, $q_{BUCKLING} = 70\ ^{\#}/_{IN}$ (9.78" PANEL) (REF. R3 4A.15)

$\frac{q_{BUCK}}{q_{ULT}} = \frac{70}{491} = .146$, $q_{A} = 1.36(491) = 635\ ^{\#}/_{IN}$ (REF. G.L.M., SDM FIG 501.09)

FOR $\frac{3}{16}$" AD'S @ 1.0" PITCH,

$t_{SKIN} = .051 + .081 = .132"$; $t_{SPAR} = .250"$

$P_{ALL} = 860^{\#}$, $q_{ALL\ T=60^{\circ}} = \frac{860}{1.0} = 860\ ^{\#}/_{IN}$

$q_{ALL\ T=250^{\circ}} = .795(860) = 685\ ^{\#}/_{IN}$

$M.S. = \frac{685}{635} - 1 = .08$

FORM 1319A

A. V. ROE CANADA LIMITED
MALTON - ONTARIO
TECHNICAL DEPARTMENT (Aircraft)

REPORT No. 7-0579-1
SHEET No. R31

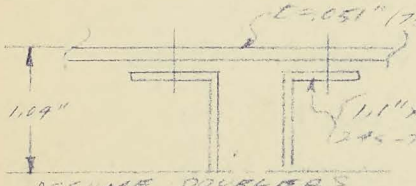
AIRCRAFT:		PREPARED BY	DATE
C 105	AILERON	R. GAVAZZI	
		CHECKED BY	DATE

RIB #5

SECTION AT 23.9" FWD. OF T.E. $\left(\frac{X}{C} = .736\right)$

$V_{SUB} = 1310^{\#}$ (LIMIT), $M_{SUB} = 19000^{IN\#}$ (LIMIT)

$V_{SUPER} = 1210^{\#}$, $M_{SUPER} = 21000^{IN\#}$ (LIMIT) (REF. Pg 90 C)



$\left(\frac{b}{t}\right)_{FLANGE} = \frac{1.1}{.064} = 17.2$

F_{cu} T=250° = 18,600 psi (REF. Pg 11.23)

$I_{RIB} = \frac{.064(1.08)^3}{12}(2) + 1.1(.064)(4)(.88)^2 = .26851^{in^4}$

$M_{RIB}^{ALL} = \frac{18600(.2685)}{.91} = 5500^{IN\#}$

$e_{RIB} = .0020^{IN/IN}$, $e_{SKIN} = .0020\left(\frac{1.015}{.88}\right) = .00231^{IN/IN}$

$F_{SKIN} = 22400$ psi, $\sigma_{cu} = 3.62(9.7)(10^4)\left(\frac{.051}{9.02}\right)^2 = 1122$ psi

$\frac{\sigma_{cu}}{F} = \frac{1122}{22400} = .0502$, $\frac{b_{av}}{b} = .331$, $b_{av} = .331(9.02) = 2.98"$

$b_{TOTAL} = 2.98 + 2.0 = 4.98"$

$M_{SKIN}^{ALL} = 4.98(1.015)(2)(22400)(1.015) = 11500^{IN\#}$

$M_{TOTAL} = 11500 + 5500 + 13600 = 30600^{IN\#}$

$M.S. = \frac{30600}{21000(1.36)} - 1 = .07$

FORM 1319A

A. V. ROE CANADA LIMITED
MALTON - ONTARIO
TECHNICAL DEPARTMENT (Aircraft)

REPORT No. 7-0574-1
SHEET No. R 32

AIRCRAFT:		PREPARED BY	DATE
C 105	AILERON	R. GAUDAIS	
		CHECKED BY	DATE

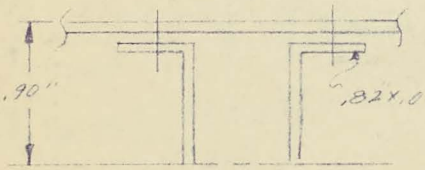
RIB #5

SECTION 21.2" FWD. OF T.E. ($\frac{x}{c}$ = .602)

V_{SUB} = 750 # (LIMIT), M_{SUB} = 10900 IN-# (LIMIT)

V_{SUPER} = 1026 # (LIMIT), M_{SUPER} = 14000 IN-# (LIMIT)

(REF. RS. 70e)



ASSUME DOUBLERS INEFFECTIVE

$\left(\frac{b}{t}\right)_{FLANGE} = \frac{.82}{.064} = 12.8$

F_{cu} T=250° = 23000 PSI (REF. RS. MZ3)

$I_{RIB} = \frac{.064(.90)^3}{12}(4) + (.736)^2(.32)(.064)(4) = .1437 \text{ IN}^4$

$M_{ALL\ RIB} = \frac{23000(.1437)}{.77} = 4290$ IN-#

$F_{SKIN} = 23000\left(\frac{.1875}{.735}\right) = 27300$ PSI, $\sigma_{cu} = 11225$ PSI (REF RS. R3)

$\frac{\sigma_{cu}}{F} = \frac{11225}{27300} = .0412$, $\frac{b_{eff}}{b} = .310$, $b_{eff} = .310(2.02) = 2.80"$

$b_{TOTAL} = 2.80 + 2.00 = 4.80"$

$M_{ALL\ SKIN} = 4.80(.061)(.1875)(27300) = 11700$ IN-#

$M_{ALL\ TOTAL} = 11700 + 4290 = 15990$ IN-#

$M.S. = \frac{15990}{14000(1.5)} - 1 = -.16$

DOUBLERS MUST BE EXTENDED AFT

WITH DOUBLERS EXTENDED M.S. = .17

FORM 1319A

A. V. ROE CANADA LIMITED
MALTON - ONTARIO
TECHNICAL DEPARTMENT (Aircraft)

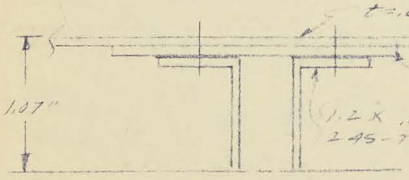
REPORT No. 7-0579-1
SHEET No. R 32a

AIRCRAFT:		PREPARED BY	DATE
C 105	AILERON	R. GAVALIS	
		CHECKED BY	DATE

RIB 5

SECTION AT $\frac{x}{c}$ = .732 (27.5" FWD OF T.E.)

$M_{SUPER} = 23700$ IN-# (LIMIT), $V_{SUPER} = 1290$ # (LIMIT)



$\frac{b}{t} = \frac{1.5}{.072} = 20.8$

$f_{cu} = 16100$ psi

$I_{RIB} = \frac{.072(1.75)^3/2}{12} + .1.5(.072)(4)(.906)^2 = .4194$ IN^4

$M_{ALL\ RIB} = \frac{16100(.4194)}{.938} = 7200$ IN-#

$f_{DOUBLER} = \frac{.930}{.906}\left(\frac{9.7}{9.2}\right)(16100) = 18300$ psi

$M_{ALL\ DOUB.} = 5.5(.064)(2)(18300)(.980) = 16000$ IN-#

$f_{SKIN} = \frac{1.045}{.936}(16100)\left(\frac{9.7}{9.2}\right) = 19600$ psi

$\sigma_{cu} = 3.62(2.24\times10^6)\left(\frac{.051}{10.6}\right)^2 = 9.15$ psi

$\frac{\sigma_{cu}}{f} = \frac{9.15}{19600} = .0466$, $\frac{b_{cr}}{b} = .322$, $b_{cr} = .322(10) = 3.22$

$b_{TOTAL} = 3.22 + 1.8 = 5.02$

$M_{ALL\ SKIN} = 5.02(.051)(2)(19600)(1.045) = 10500$ IN-#

$M_{ALL\ TOTAL} = 7200 + 16000 + 10500 = 33700$ IN-#

$M.S. = \frac{33700}{1.364(23900)} - 1 = .03$

FORM 1319A

A. V. ROE CANADA LIMITED
MALTON - ONTARIO
TECHNICAL DEPARTMENT (Aircraft)

REPORT No. 7-0574-1
SHEET No. R 33

AIRCRAFT:		PREPARED BY	DATE
C 105	AILERON	R. GAVALIS	
		CHECKED BY	DATE

RIB #5

SKIN-TO-RIB ATTACHMENT

$q_{MAX\ SUPER} = 349\ ^{\#}/_{IN}$

NOW. 5/32" HUCK CEL 100V @ 1.0" PITCH (T_{SKIN}^{TOP})

$P_{ALL\ T=250°F} = 445^{\#}$ (REF. R_3 1144)

$q_{ULT} = 1.25(349) = 435\ ^{\#}/_{IN}$ (LIMIT)

$q_{ALL} = \frac{445(2)}{1.0} = 890\ ^{\#}/_{IN}$

$M.S. = \frac{890}{435(1.364)} - 1 = .50$

5/32" DIA 56S RIVETS ARE USED OVER AFT PORTION OF RIB

$P_{ALL\ SUPER\ T=60°F} = 536^{\#}$, $P_{ALL\ SUPER\ T=250°} = .80(536) = 430^{\#}$

AT 1.0" PITCH

$q_{ALL\ T=250} = \frac{430(2)}{1.0} = 860\ ^{\#}/_{IN}$

$M.S. = \frac{860}{435(1.364)} - 1 = .45$

SECTION 4.1" FWD. OF T.E. ($\frac{x}{c} = .116$)

$V_{SUPER} = \pm 240^{\#}$ (LIMIT), $M_{SUPER} = 1500^{IN\#}$ (LIMIT) (REF. R_3 70C)



$W_{SKIN} = .55(.051)\sqrt{\frac{7.1\times10^6}{47700}} = .60"$

$W_{TOTAL} = .60(2) + 2.0 = 3.20"$

$P = \frac{500(1.364)}{.176} = 895^{\#}$ $A = 3.2(.051) + .86(.081)(2) = .302\ IN^2$

FORM 1319A

A. V. ROE CANADA LIMITED
MALTON - ONTARIO
TECHNICAL DEPARTMENT (Aircraft)

REPORT No. T-0574-1
SHEET No. R 34

AIRCRAFT:		PREPARED BY	DATE
C105	AILERON	R. GAVALIS	
		CHECKED BY	DATE

RIB #2

$f_c = \frac{878}{.302} = 2910 psi$, $R_c = \frac{2780}{49700} = .0597$

$M = \frac{VS}{4} = \frac{290(1.364)(1.65)}{4} = 64.5$ IN#

$I = .00030 + .000141 = .000445$ IN^4, $\bar{Y} = .076$ FROM O.S.L.

$f_b = \frac{64.5(.076)}{.000445} = 10700 psi$, $R_b = \frac{10900}{57200} = .191$

$f_s = \frac{290(1.364)(1.5)}{.302(2)} = 980 psi$, $R_s = \frac{780}{39200} = .029$

$M.S. = \frac{1}{.0597 + .191 + .029} - 1 = \underline{2.36}$

SKIN-TO-SPAR ATTACHMENT

$P_{SKIN\ SPAR}$ = 15986# - COMPRESSION IN SKIN (REF. 13 R3424)

ASSUME 20" OF SKIN EFFECTIVE

$f_c = \frac{15950\ 1.364\ (1.3)}{20} = 1420$ #/IN

USE (2) ROWS OF 3/16 @ 1.75" PITCH

$q_{ALL} = \frac{(2)(1442)}{1.75} = 1640$ #/IN

$M.S. = \frac{1640}{1420} - 1 = \underline{.16}$

FORM 1319A

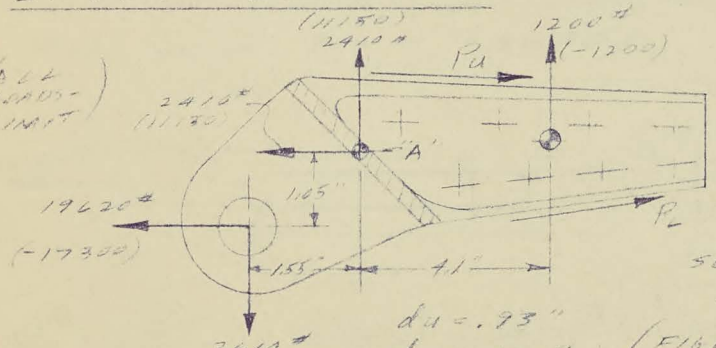
A. V. ROE CANADA LIMITED
MALTON - ONTARIO
TECHNICAL DEPARTMENT (Aircraft)

REPORT No. 7-0574-1
SHEET No. R 34a

AIRCRAFT:		PREPARED BY	DATE
C 105	AILERON	R. GAVALIS	
		CHECKED BY	DATE

RIB #6

LEVER BRACKET



(REF. P_S 07-90)

SUPERSONIC - DOWN AIL.
(FIGURES IN ( ) ARE SUPER. -UP AIL.)

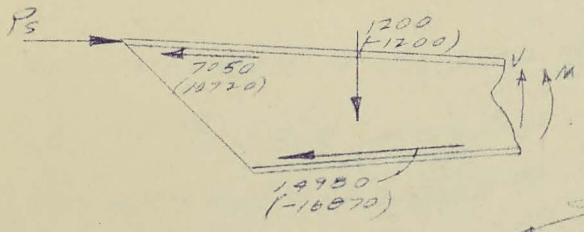
$\Sigma M_A = 19620(1.05) - 3610(1.55) - 1200(4.1) - 1.11 P_L + .93 P_U = 0$

$\Sigma F_n = P_U + P_L = 22030$

$P_U = 7050\#$, $P_L = 14980\#$ FOR DWN-SUPER

$P_U = 10720\#$, $P_L = -16870\#$ FOR UP-SUPER

FOR THE RIB,



(CHECKS WITH P_S R226)

$P_S = 14980 + 7050 = 22030\#$ FOR DWN-SUPER

$P_S = -6150\#$ FOR UP-SUPER

CRM 1194

A. V. ROE CANADA LIMITED
MALTON - ONTARIO
TECHNICAL DEPARTMENT (Aircraft)

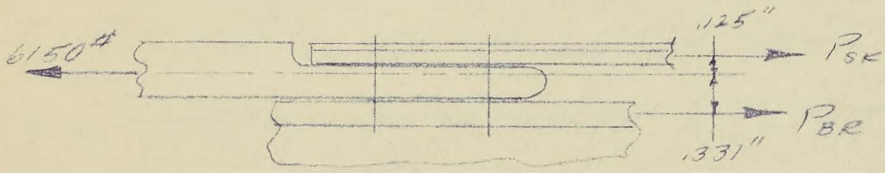
REPORT No. 7-0574-1
SHEET No. R 340-1

AIRCRAFT:		PREPARED BY	DATE
C105	AILERON	R GAVANIS	
		CHECKED BY	DATE

R13 #5

UPR. SKIN-TO-BRACKET ATTACHMENT:

FOR COND. AIL UP-SUPER:

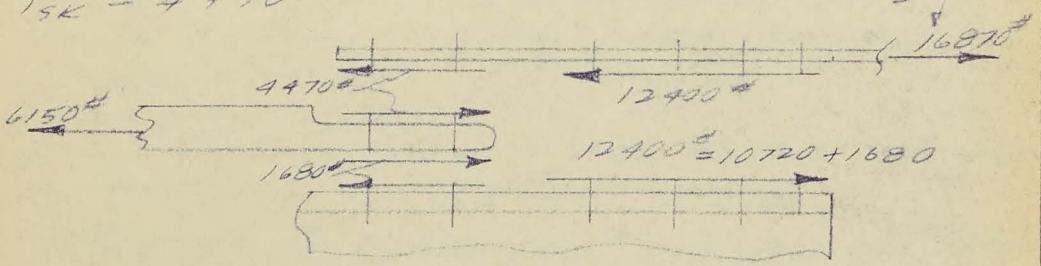


$P_{BR} = \frac{.125}{.456}(6150) = 1680\#$

$P_{SK} = 6150 - 1680$

$P_{SK} = 4470\#$

[$P_{BR} = 6050\#$
$P_{SK} = 15780\#$
FOR AIL. DWN - SUPER]



$P = 12400(1.364) = 16900\#$

NOW: (16) - $\frac{3}{16}$" DIA. HUCKS

$P_{ALL} = 16(770) = 12300\#$

USE: (22) - $\frac{3}{16}$" DIA. HUCKS

$P_{ALL} = 22(770) = 16930\#$

$M.S. = \frac{16930}{16900} - 1 = .00^{+}$

RM 1319A

A. V. ROE CANADA LIMITED
MALTON - ONTARIO
TECHNICAL DEPARTMENT (Aircraft)

REPORT No. 7-0579-1
SHEET No. R 346

AIRCRAFT:		PREPARED BY	DATE
C105	AILERON	R. GAVALIS	
		CHECKED BY	DATE

RIB #5

FOR LWR SKIN-TO-BRACKET RIVETS,

$P = 16870\#_{(LIMIT)}$, $q_{SKIN\ SHEAR} = 435\#/in_{(LIMIT)}$ (REF B3 R33)

$P_{SKIN\ SHEAR} = 435(1.364)(7.7) = 4570\#$ (ULT.)

$P_{TOTAL} = 4570 + 16870(1.364) = 27570\#$

12 - $\frac{1}{4}$" DIA. AN 509 SCREWS

$P_{ALL} = 12(2010) = 24100\#$

$M.S. = \frac{24100}{27570} - 1 = \underline{-.13}$

USE 12 - $\frac{1}{4}$" RIVETS & 4 - $\frac{3}{16}$" RIVETS

THE BRACKET WILL HAVE TO BE EXTENDED TO PICK-UP THESE ADDITIONAL RIVETS. THE SHIFT IN THE BRACKET-TO-RIB WEB RIVET PATTERN CENTROID WILL RESULT IN:

$P_A = 7480\#$, $P_L = 14550\#$ FOR AIL DWN-SUPER

$P_A = 10265\#$, $P_L = -16415\#$ FOR AIL UP-SUPER

THEN

$P_{TOTAL} = 4570 + 16415(1.364) = 26970\#$

TRY 12 - $\frac{1}{8}$" DIA & 4 - $\frac{3}{16}$" DIA.

$P_{ALL} = 12(2010) + 4(1440) = 29850\#$

$M.S. = \frac{29850}{26970} - 1 = \underline{.09}$

FOR THE BRACKET-TO-RIB WEB RIVETS:

$V = 1200\#_{(LIMIT)}$, ASSUME $I/A = .10(3871) = 3871\#/in_{(LIMIT)}$

CRM 1394

A. V. ROE CANADA LIMITED
MALTON - ONTARIO
TECHNICAL DEPARTMENT (Aircraft)

REPORT No. 7-0579-1
SHEET No. R 340

AIRCRAFT:		PREPARED BY	DATE
C105	AILERON	R. GAVALIS	
		CHECKED BY	DATE

RIB #5

$N^2 = 3.35^2 + 2.35^2 + 1.4^2 + .46^2 + 2.7^2 + 1.69^2$
$+ .72^2 + .47^2 + 1.39^2 + 2.38^2 + 3.41^2$
$+ 2.8^2 + 1.7^2 + .72^2 = 60.22 \text{ IN}^2$

$P_e = \frac{3871(1.364)(3.41)}{60.22} = 299\#$

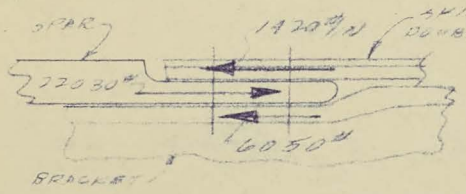
$P_{TOTAL} = \frac{1200(1.364)}{14} + 299 = 415\#$

USE 5/32" DIA HUCK (CKL) RIVETS

$P_{ALL\ PER\ RIB} = 665(.795) = 529\#$

$M.S. = \frac{529}{415} - 1 = .27$

FOR RIVETS THRU UPPER SKIN, SPAR & LOWER BRACKET,



LOADS SHOWN ARE FOR DIV. DWN.-SUPER. (REF. PS R340-1)

THE SKIN LOAD GIVES,

$q = \frac{1598.0(1.364)(1.5)}{20.04} = 1420\#/\text{IN}, \quad P_{1/2\ BOLT} = \frac{1420(1.2)}{2} = 852\#$
(REF. PS R340)

$P_{ALL\ SKIN} = 1440\#$ FOR 5/16" AN509

$M.S._{SKIN} = \frac{1440}{852} - 1 = .69$

THE BRACKET LOAD GIVES,

$P/_{SCREW} = \frac{6050(1.364)}{4} = 2060\#$

$P_{ALL\ BRACKET} = .25(.134)(1.364)(72000) = 3190\#$

$M.S._{BRACKET} = \frac{3190}{2060} - 1 = .54$

FORM 1319A

A. V. ROE CANADA LIMITED
MALTON - ONTARIO
TECHNICAL DEPARTMENT (Aircraft)

REPORT NO. 7-0579-1
SHEET NO. R 340

AIRCRAFT:		PREPARED BY	DATE
C105	AILERON	R. GAVALAS	
		CHECKED BY	DATE

RIB # 5

FOR THE SPAR LOAD

$P_{SCREW} = 352 + 2060 = 2412$ #

TRY 4 - 1/4" SCREWS, $P_{ALL\ SHEAR} = 3600$ #

$P_{ALL\ BF} = \frac{1}{4}(.24)(1.364)(63500) = 5400$ #

$M.S._{SPAR} = \frac{3600}{2412} - 1 = .26$

BRACKET-TO-SKIN RIVETS (UPPER SURFACE)

P = .80(1172) (LIMIT) (ALLOWED (REF. P3 R34)

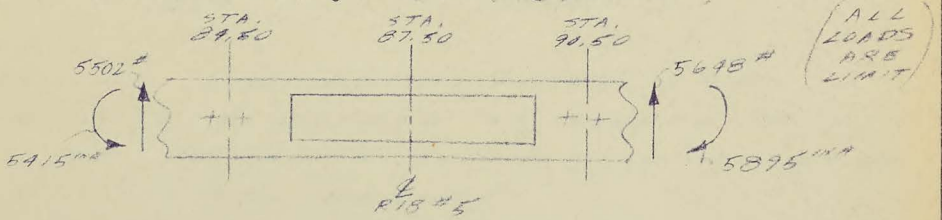
USE; 16 - 3/16" DIA. HUCK (CEL 100V) @ .75" PITCH

$P_{ALL\ SKIN} = 16(772) = 12300$ #

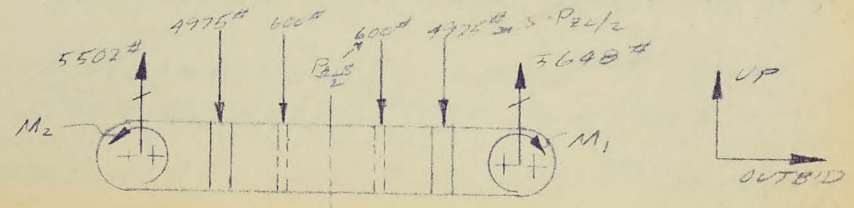
$M.S. = \frac{12300}{.80(10.13.3)(1.364)} - 1 = \cancel{.05}$

SPAR LOADING

FOR COND. AIL. UP-SUPERSONIC;



THE LEVER BRACKET LOADS ARE,



A. V. ROE CANADA LIMITED
MALTON · ONTARIO
TECHNICAL DEPARTMENT (Aircraft)

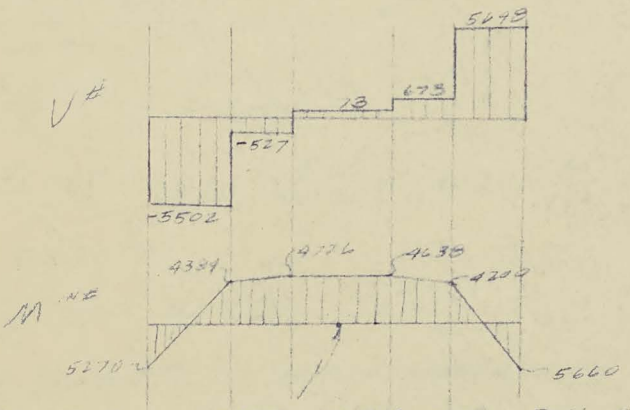
REPORT No. 7-0579-1
SHEET No. R 398

AIRCRAFT:		PREPARED BY	DATE
C 105	AILERON	R. GAVALIS	
		CHECKED BY	DATE

P.1.5 #5

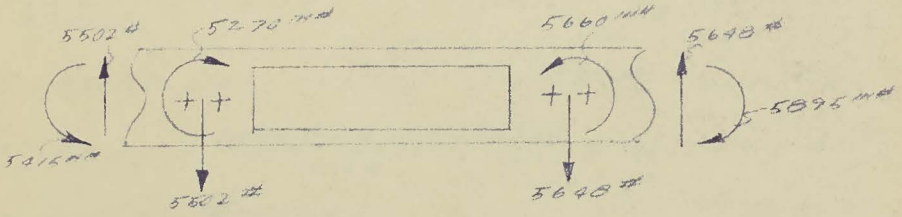
$M_1 = 5660^{IN\#}$, $M_2 = 5270^{IN\#}$ (LIMIT) FROM LEAST WORK

THE BRACKET LOADING IS AS SHOWN



MAXIMUM MOMENT HERE FOR PIN ENDS WOULD BE $10400^{IN\#}$ (LIMIT), $(V = 700^{\#}_{LIMIT})$

FOR THE SPAR:



ALL OF THE ABOVE LOADS ARE CHORDWISE & NORMAL TO CHORDWISE & WILL BE RESOLVED ALONG AXIS OF SPAR WEB & SPAR FLANGES.

FOR THE EARS OF THE BRACKET:

$M_{MAX} = 1.414(1.364)(5660) = 10900^{IN\#}$ (ULT.)
(REF. B3 R227) (REF. B3 R398)

$V = 5648(1.414)(1.364) = 10880^{\#}$ (ULT)

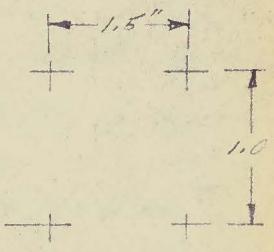
FORM 1319A

A. V. ROE CANADA LIMITED
MALTON - ONTARIO
TECHNICAL DEPARTMENT (Aircraft)

REPORT No. 7-0574-1
SHEET No. R34

AIRCRAFT:		PREPARED BY	DATE
C105	AILERON	R. GAVALIS	
		CHECKED BY	DATE

RIB #5



$N^2 = 4[.5^2 + .750^2] = 3.244$

$P_M = \frac{10900(.902)}{3.244} = 3030\#$

$P_V = \frac{10880}{4} = 2720\#$

$P_{RES} = \left\{\left[2720 + 3030\left(\frac{.5}{.902}\right)\right]^2 + \left[3030\left(\frac{.75}{.902}\right)\right]^2\right\}^{\frac{1}{2}}$

$P_{RES} = 5200\#$

NOW: $\frac{1}{4}$" DIA. BOLTS

$P_{\frac{ALL}{SHEAR}} = 3680\#$ M.S. = NEGATIVE

USE: $\frac{5}{16}$" DIA BOLT

$P_{\frac{ALL}{SHEAR}} = 5750\#$ M.S. $= \frac{5750}{5200} - 1 = .10$

FOR SECTION THRU INNER BOLTS,

$M = \left[5660 - \frac{(5660+4200)(.75)}{.625}\right](1.414)(.1364) = 414\,0^{IN\#}_{(ULT.)}$

$V = 10880\#$ (ULT)

$I = \frac{.270(2.30)^3}{12} = .240\ IN^4$

$f_b = \frac{4140(1.1)}{.240} = 19000\,PSI$, $F_{bu} = 56400\,PSI$

$f_s = \frac{10880(1.5)}{[2.20 - 7(\frac{5}{16})].270} = 38400\,PSI$, $F_{su} = 35500\,PSI$

INCREASE $t_{BRACKET}$ TO .295"

FORM 1319A

A. V. ROE CANADA LIMITED
MALTON - ONTARIO
TECHNICAL DEPARTMENT (Aircraft)

REPORT NO. 7-0579-1
SHEET NO. R349

AIRCRAFT:		PREPARED BY	DATE
C105	AILERON	R. GAVALIS	
		CHECKED BY	DATE

RIB #5

FOR THE BRACKET THRU RIB ℄:

$M_x = 10400^{\#}_{(LIMIT)}$, $V_z = 700^{\#}_{(LIMIT)}$ (REF. PS R394)

$b = 2.35"$, $t = .40"$, $I = \frac{.40(2.35)^3}{12} = .554\ IN^4$

$f_b = \frac{10400(1.364)(1.414)(1.75)}{.554} = 64500\ psi$

INCREASE t TO .50"

$f_b = \frac{.40}{.50}(64500) = 51500\ psi$

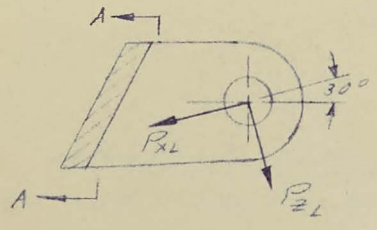
$f_s = \frac{700(1.364)(1.414)(1.5)}{(2.55-.25)(.50)} = 1760\ psi$

$R_s = \frac{1760}{35500} = .050$, $R_b = \frac{51500}{56400} = .914$

$M.S. = \frac{10.08}{9.26} - 1 = \underline{.09}$

LEVER BRACKET - LUGS

$P_{XL} = 17300^{\#}_{(LIMIT)}$, $P_{ZL} = -9950^{\#}_{(LIMIT)}$ (AIL. UP SUPER. REF. PS. 8C)



$P_a = 17300\ COS30° - 9950\ SIN30°$

$P_a = 10030^{\#}$ (LIMIT)

$P_{TR} = 17300\ SIN30° + 9950\ COS30°$

$P_{TR} = 17270^{\#}$ (LIMIT)

$b_{DVE} = \frac{6}{\frac{4}{.79} + \frac{2}{.68}} = .745\ IN$

$\frac{b_{AVE}}{b_{DV}} = \frac{.745}{.820} = .910$, $K_{RU} = .52$, $K_{RY} = .99$

FORM 1319A

A. V. ROE CANADA LIMITED
MALTON - ONTARIO
TECHNICAL DEPARTMENT (Aircraft)

REPORT No. 7-0579-1
SHEET No. R 35

AIRCRAFT:		PREPARED BY	DATE
C 105	AILERON	R. GAUDIS	
		CHECKED BY	DATE

RIB #5

$P'_{TR_4} = .52(.820)(1.780)(56400) = 13700\#$

$M.S. = \frac{13700(2)}{1.369(17270)} - 1 = .59$

FOR BENDING AT A-A

$M = 17270(1.369)(1.81) = 42600$ in-#

$I = \frac{.78(2)(2.04)^3}{12} = 1.12$ in^4

$f_{b_4} = \frac{42600(1.02)}{1.12} = 38800$ psi, $R_b = \frac{38800}{56400} = .690$

$f_c = \frac{10030(1364)}{2(2.03)(.78)} = 4290$ psi, $R_c = \frac{4290}{56400} = .076$

$f_s = \frac{17270(1.364)(1.5)}{2(2.04)(.78)} = 6710$ psi, $R_s = \frac{6710}{35500} = .189$

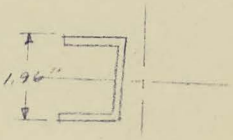
$M_2 = 10030(1.364)(1.10) = 1370$ in-# (ECCENTRICITY)

$f_{b_2} = \frac{1370(.39)}{.081} = 6600$ psi, $R_b = \frac{6600}{56400} = .117$

$R_c = .690 + .076 + .117 = .883$

$M.S. = \frac{1}{\sqrt{(.883)^2 + (.189)^2}} - 1 = .11$

FOR BENDING OF THE BRACKET JUST OFF OF THE EARS:



$b_4 = 1.50"$, $t = .280"$

$\frac{b}{t} = \frac{1.50}{.280} = 5.36$, $F_c = 47,000$ psi

A. V. ROE CANADA LIMITED
MALTON - ONTARIO
TECHNICAL DEPARTMENT (Aircraft)

REPORT No. 70579-1
SHEET No. R 35a

AIRCRAFT:		PREPARED BY	DATE
C105	AILERON	R. GAVALIS	
		CHECKED BY	DATE

RIB #5

$$I = 2\left[\frac{.25(14.6)^3}{12} + 1.50(1.28)(.755)^2(2)\right] = 1.089 \text{ IN}^4$$

$$f_b = \frac{32240(1.364)(1.98)}{1.089} = 39800 \text{ psi}$$

$$A = 2[.25(1.46) + .28(1.60)(2)] = 2.41 \text{ IN}^2$$

$$f_c = \frac{6150(1.364)}{2.41} = 3480 \text{ psi}$$

$$R_c = \frac{39800 + 3480}{47600} = .910$$

$$Q = 2\left[1.60(.28)(.755) + (1.73)^2\left(\tfrac{1}{2}\right)(.28)\right] = .80 \text{ IN}^3$$

$$f_s = \frac{1200(1.364)(.80)}{1.164(.25)(2)} = 2320 \text{ (SHEAR)}$$

$$M.S. = \frac{1}{.910} - 1 = .10$$

ORM 1319A

A. V. ROE CANADA LIMITED
MALTON - ONTARIO
TECHNICAL DEPARTMENT (Aircraft)

REPORT NO. 7057A-1
SHEET NO. R 56

AIRCRAFT:		PREPARED BY	DATE
C105	AILERON	R. GAVALIS	
		CHECKED BY	DATE

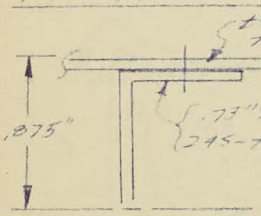
RIB #44

$V_{SUB} = \pm 460^{\#}_{(LIMIT)}$, $M_{SUB} = \pm .147(26200) = \pm 3850^{IN\#}_{(LIMIT)}$ AT $\frac{x}{c} = .68$

$V_{SUPER} = \pm 340^{\#}$, $M_{SUPER} = \pm .25(10700) = 2680^{IN\#}_{(LIMIT)}$ AT $\frac{x}{c} = .50$

(REF. RS-900, K, 5.2)

AT 19.4" F.W.D. OF T.E. ($\frac{x}{c} = .50$)



$\frac{b}{t} = \frac{.73}{.051} = 14.3$

$F_{cu} = 21500 \#/in^2$

$I_{RIB} = .73(.051)(2)(.79)^2 + \frac{.051(1.5)^3}{12}$

$I_{RIB} = .0615\ in^4$

$M_{ALL\ RIB} = \frac{21500(.0615)}{.824} = 1610\ IN\#$

$\sigma_{cu\ SKIN} = 3.62(9.7)(10^4)\left(\frac{.051}{10.44}\right)^2 = 837 \#/in^2$

$\frac{\sigma_{cu}}{f} = \frac{837}{21500} = .0389$, $\frac{b_m}{b} = .30$

$b_m = .30(10.44) = 3.13"$, $M_{ALL\ SKIN} = 3.13(.051)(2)(.850)(21500)$

$M_{ALL\ SKIN} = 5850^{IN\#}$, $M_{ALL\ TOTAL} = 1610 + 5850 = 7460^{IN\#}$

$M.S. = \frac{7460}{1.364(2680)} - 1 = \underline{1.04}$

SKIN-TO-RIB RIVETS

$q_{MAX\ SUPER} = \pm 200^{\#/in}_{(LIMIT)}$ (REF. P3. 91)

$d_{RIVET} = 10.44"$, $q_{cu} = 74^{\#/in}$

DRN 1319A

A. V ROE CANADA LIMITED
MALTON - ONTARIO
TECHNICAL DEPARTMENT (Aircraft)

REPORT No. T-0574-1
SHEET No. R 37

AIRCRAFT:		PREPARED BY	DATE
C105	AILERON	R. GAVALIS	
		CHECKED BY	DATE

RIB #A

$\frac{f_w}{f_d} = \frac{99}{300(1.364)} = .349$, $q_w = .21(300)(1.364) = 328$ #/in
EFFECT OF TENSION FIELD

NOW: 1/8" DIA HUCK CKL-604 @ 1.10" PITCH - LWR SKIN

1/8" DIA AD'S @ 1.0" PITCH - UPR SKIN

P_{ALL} for $\theta = 24.5°$ $= \frac{360(.773)}{.55} = 388$ #/in

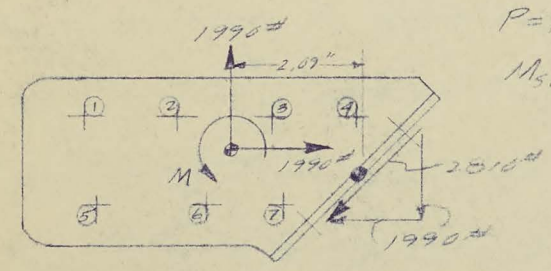
USE .55" PITCH → M.S. $= \frac{388}{328} - 1 = .18$

ATTACHMENT TO SPAR

$V_{SUB} = \pm 1458$# (LIMIT), $V_{SUPER} = \pm 1990$# (LIMIT) (REF. B. 906)

$P = 1458(1.364) = 1990$#

$M_{SUB} = 1990(2.03) = 4150$ in-#



$r_1 = 1.34$" $r_5 = 1.33$"
$r_2 = .49$" $r_6 = .60$"
$r_3 = .81$" $r_7 = .95$"
$r_4 = 1.71$"

$\Sigma r^2 = 8.64$ in.²

$P_{e_4} = \frac{M r}{r^2} = \frac{4150(1.71)}{8.64} = 821$#

$P_{e_V} = 821 \cos 14° = 795$#, $P_{e_H} = 821 \sin 14° = -199$#

$P_R = \frac{1990}{7} = 284$#, $P_{R_{TOTAL}} = 795 + 284 = 1079$#

$P_{4_{TOTAL}} = 284 - 199 = 85$#, $P_{RES} = 1080$#

FORM 1319A

A. V. ROE CANADA LIMITED
MALTON - ONTARIO
TECHNICAL DEPARTMENT (Aircraft)

REPORT No. 7-0574-1
SHEET No. R 38

AIRCRAFT:		PREPARED BY	DATE
C 105	AILERON	R. GAVALIS	
		CHECKED BY	DATE

RIB 4A

FOR A 7/32" AN BOLT,

$P_{ALL\ SHEAR} = 1435^{\#}$, $P_{ALL} = 1330^{\#}$ (REF. B R21)
OR
$t = .102$

$$M.S. = \frac{1330}{1180} - 1 = \underline{.23}$$

RIB CAN BE .051" WITH AN .051" BACK-UP CHANNEL, TIE CHANNEL INTO SKIN WITH SIMILAR RIVET PATTERN AS RIB. USE 3- 7/32" HUCK (P) RIVETS TO TIE BACK-UP CHANNEL TO RIB WEB.

FOR A SECTION THRU RIVET #7:

$M_{A-A} = 1703^{IN\#}$, $V = 910^{\#}$, $P = 1905^{\#}$

$$I = \frac{.144(1.105)^3}{12} = .054\ IN^4$$

$$f_b = \frac{1703(.825)}{.054} = 26000\ PSI$$

$$f_c = \frac{1905}{.144(1.105)} = 8000\ PSI, \quad \frac{b}{t} = \frac{.825}{.072} = 11.5$$

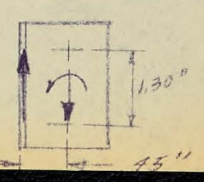
$F_{cu} = 30,000\ PSI$, $R_b = \frac{26000+8000}{30000} = 1.13$

$$M.S. = \frac{1}{1.13} - 1 = \underline{-.11}$$

(MOVE CENTROID OF PATTERN FORWARD)

FOR TIE CLIP-TO-SPAR ATTACHMENT:

$IA = 2810(.43) = 1263^{IN\#}$



A.V.ROE CANADA LIMITED
MALTON – ONTARIO

TECHNICAL DEPARTMENT (Aircraft)

REPORT NO. 7-0574-1
SHEET NO. R 39

AIRCRAFT		PREPARED BY: R GAVALIS	DATE:
C105	AILERON	CHECKED BY:	DATE:

RIB 4A

$$I_y = \frac{.125(.245)^3}{12} = .153 \text{ in}^4$$

$$f_b = \frac{1263(1.223)}{.153} = 10,100 \text{ psi}, \quad \frac{b}{t} = \frac{2.45}{2(.149)} = 8.5$$

$F_{su} = 35000 \text{ psi}$, $R_b = \frac{10100}{35000} = .290$

$$f_s = \frac{2810}{2.07(1.149)} = 9400 \text{ psi}$$

$$R_s = \frac{9400}{37000} = .254$$

$$M.S. = \frac{1}{\sqrt{(.254)^2 + (.290)^2}} - 1 = \underline{1.60}$$

FOR THE CLIP-TO-SPAR BOLTS:

$P_{SHEAR} = 2810^{\#}$

$a = .45$, $b = 1.3$, $a/b = .346$

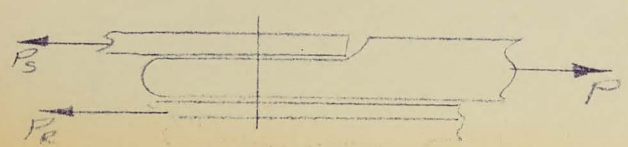
$$P_{MAX} = \frac{.61(2810)}{2} = 1716^{\#} = 3550^{\#}$$

$P_{br} = 2572^{\#}$, $P_{br} = .072\left(\frac{3}{16}\right)(1.223)(61100) = 1120^{\#}$

$$M.S. = \frac{1120}{855} - 1 = \underline{.31}$$

TOP SKIN-TO-SPAR ATTACHMENT:

$f_{max} = 198^{\#}/\text{in}$, $f_{ave} = 1.21(158)(1.369) = 524^{\#}/\text{in}$



$P_R = 1970^{\#}$

A.V. ROE CANADA LIMITED
MALTON - ONTARIO

TECHNICAL DEPARTMENT (Aircraft)

REPORT NO. 7-0574-1

SHEET NO. R 40

AIRCRAFT		PREPARED BY:	DATE:
C 105	AILERON	R. GAVALIS	
		CHECKED BY:	DATE:

RIB #4

$P_s = 324(2.0) = 648\#$

$P = 1990 + 648 = 2638\#$

NOW: (2) - $\frac{5}{16}$" DIA. AN 507 SCREWS

P_{ALL} by RIB $= 300\#$, P_{ALL} by SCREW $= 730\#$

$P_{ALL} = (300 + 730)(2) = 3060\#$

$M.S. = \frac{3060}{2638} - 1 = .16$

A.V.ROE CANADA LIMITED
MALTON – ONTARIO

TECHNICAL DEPARTMENT (Aircraft)

REPORT NO. 7-0574-1

SHEET NO. R 43
(Pgs 41 & 42 OBSOLETE)

PREPARED BY: R. GAVALIS — DATE:

CHECKED BY: — DATE:

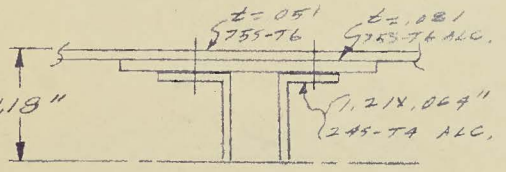
AIRCRAFT: C105

AILERON

RIB #4

SECTION AT $\frac{X}{C}$ = .674 (25.3" FWD. OF T.E.)

$M_{SUPER} = \pm 26600$ IN# (LIMIT), $V_{SUPER} = \pm 1350$ # (LIMIT) (REF Sg. 904)



$\left(\frac{b}{t}\right)_{FLANGE} = \frac{1.21}{.064} = 18.92$

$F_{cy} = 17,400$ psi

$I_{RIB} = \frac{.064(1.97)^3}{12} + 2) + 1.21(.064)(4)(1.016)^2 = .401$ IN⁴

$M_{ALL\ RIB} = \frac{17400(.401)}{1.048} = 6660$ IN#

$W_{DOUBLER} = 4.6$", $f_{DOUBLER} = \frac{1.088}{1.016}\left(\frac{9.7}{9.2}\right)(17400) = 19600$ psi

$M_{ALL\ DOUB.} = 4.6(.081)(2)(1.088)(19600) = 15900$ IN#

$f_{SKIN} = \frac{1.155}{1.016}\left(\frac{9.7}{9.2}\right)(17400) = 20800$ psi

$\frac{f_{cu}}{f} = \frac{1300}{20800} = .0625$, $\frac{b_m}{b} = .356$

$b_m = .356(8.4) = 2.98$

$b_{TOTAL} = 2.98 + 2.20 = 5.18$"

$M_{ALL\ SKIN} = 5.18(.051)(2)(20800)(1.155) = 12700$ IN#

$M_{ALL\ TOTAL} = 12700 + 15900 + 6660 = 35,260$ IN#

$M.S. = \frac{35260}{1.364(26600)} - 1 = -.03$

INCREASE WIDTH OF DOUBLER

A.V. ROE CANADA LIMITED
MALTON – ONTARIO

TECHNICAL DEPARTMENT (Aircraft)

REPORT NO. Z-0574-1
SHEET NO. R 44

AIRCRAFT		PREPARED BY:	DATE:
C105	AILERON	R. GAVALIS	
		CHECKED BY:	DATE:

RIB #4

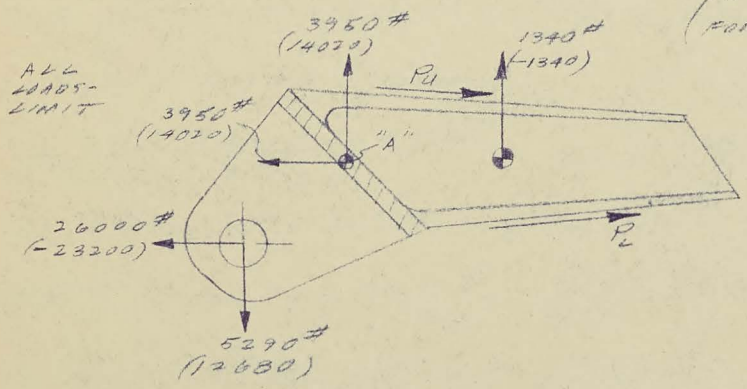
$W_{NOM} = 5.6"$, $M_{ALL\ DOUB.} = 15900\left(\frac{5.6}{4.6}\right) = 19350$ IN#

$M_{ALL\ TOTAL} = 19350 + 12700 + 8600 = 38650$ IN#

$M.S. = \frac{38650}{1.364(26600)} - 1 = .07$

LEVER BRACKET

(REF B, R 34 a FOR PROCEDURE)



AIL. DOWN-SUPERSONIC

(FIGURES IN ( ) ARE FOR AIL. UP-SUPER)

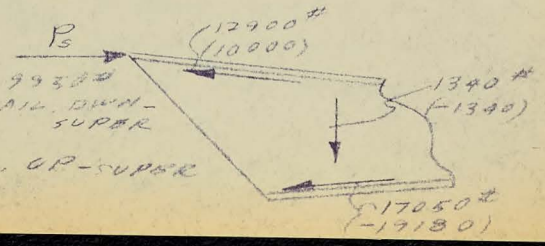
$\Sigma M_A = 26000(1.05) - 5290(1.75) - 1340(6.4) - 1.4P_L + 1.12P_U$

$\Sigma F_n = P_U + P_L - 3950 - 26000$

$P_U = 12900$#, $P_L = 17050$# FOR SUPER - DOWN

$P_U = 10000$#, $P_L = -19180$# FOR SUPER - UP

FOR THE RIB,



$P_S = 12900 + 17050 = 29950$# FOR AIL. DOWN-SUPER

$P_S = -9180$# FOR AIL. UP-SUPER

A.V. ROE CANADA LIMITED
MALTON – ONTARIO

TECHNICAL DEPARTMENT (Aircraft)

REPORT NO. 7-0579-1
SHEET NO. R 44a

AIRCRAFT		PREPARED BY: R. GAVALIS	DATE:
C105	AILERON	CHECKED BY:	DATE:

RIB 4

FOR LOWER SKIN-TO-BRACKET RIVETS:

$P = 19180(1.364) = 26200\ \#$ (ULT.)

NOW: (10) – ¼" DIA. AN 509 SCREWS PER RIB

$P_{ALL} = 20(2010) = 40100\ \#$

$M.S. = \frac{40100}{26200} - 1 = .53$

FOR SKIN-TO-SPAR ATTACHMENT:

$P_{SKIN} = 21000\ \#$ (LIMIT)

$q_c = \frac{(21000)(1.364)(1.3)}{19.0} = 1960\ \#/in$

$q_s = 952(1.204)(1.2) = 576\ \#/in$

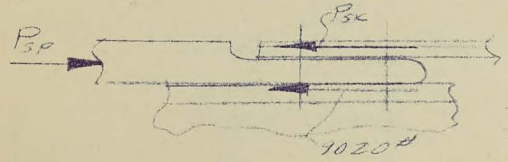
$q_d = \sqrt{(1960)^2 + (576)^2} = 2040\ \#/in$

USE TWO ROWS OF SCREWS @ 1.25"

$q_{allc} = \frac{1023(2)}{1.25} = 2310\ \#/in$

$M.S. = \frac{2310}{2040} - 1 = .13$

FOR RIVETS THRU UPPER SKIN, SPAR & LEVER BRACKET:



AIL. DWN. – SUPERSONIC

THE DISTRIBUTED LOAD IN THE SKIN IS $q_c = 1960\ \#/in$

THEN, $P_{SK} = 1960(3.2) = 6260\ \#$ (ULT.)

A.V.ROE CANADA LIMITED
MALTON – ONTARIO

TECHNICAL DEPARTMENT (Aircraft)

REPORT NO. 2-0579-1
SHEET NO. R 446

AIRCRAFT		PREPARED BY: R. GAVALIS	DATE:
C105	AILERON	CHECKED BY:	DATE:

RIB #4

$P_{S.P} = 6260 + 9020(1.364) = 18560\#$

TRY (2) – $\frac{1}{4}$" DIA. SCREWS

$P_{ALL\ SHEAR} = 3680\#$, $P_{ALL\ BRG\ OR\ SKIN} = 2010(4) = 8040\#$

$M.S. = \frac{8040}{6260} - 1 = .28$

$P_{ALL\ BRG\ SPAR} = .250(\frac{1}{4})(1.364)(63500) = 5410\#$

$P_{ALL\ SHEAR\ SPAR} = 3680(4) = 14700\#$

$P_{SHEAR} = 9020(1.364) = 12300\#$

$M.S. = \frac{14700}{12300} - 1 = .20$

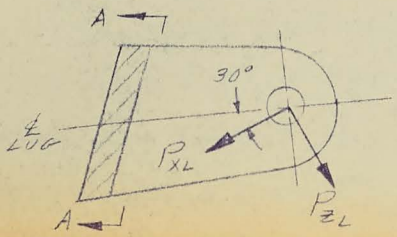
$P_{ALL\ SPAR} = 5410(4) = 21700\#$

$M.S. = \frac{21700}{18560} - 1 = .17$

PUT (2) – $\frac{3}{16}$" SCREWS IN AREA BETWEEN LEVER BRACKET FLANGES

FOR THE LUGS

$P_{TL} = 23300\#$ (LIMIT), $P_{ZL} = 12690\#$ (LIMIT) (AIL. UP – SUPERSONIC)



$P_{TR} = 13770\#$ (LIMIT)

$P_{TR} = 22600\#$ (LIMIT)

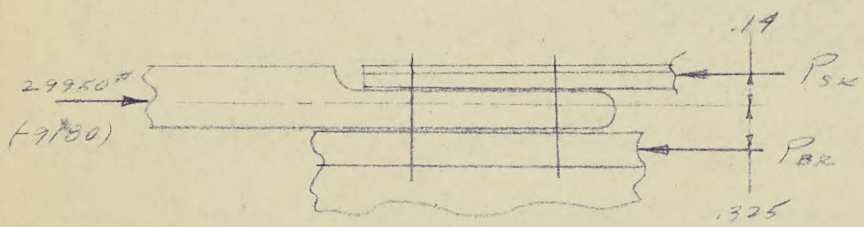
A. V. ROE CANADA LIMITED
MALTON - ONTARIO
TECHNICAL DEPARTMENT (Aircraft)

REPORT No. Z-0579-1
SHEET No. R 14-1

AIRCRAFT:		PREPARED BY	DATE
C 105	AILERON	R GAUALIS	
		CHECKED BY	DATE

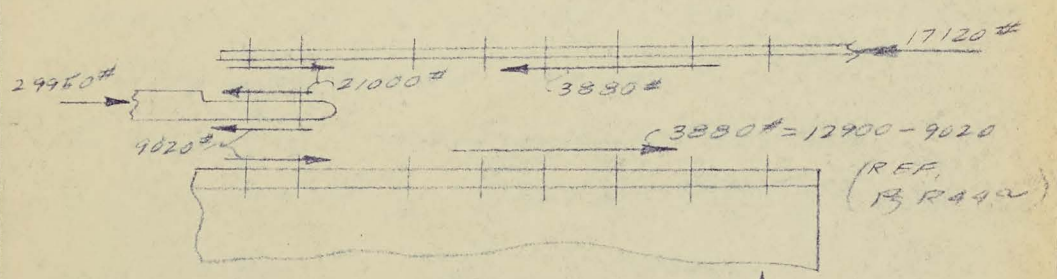
RIB #4

UPR SKIN-TO-BRACKET ATTACHMENTS:



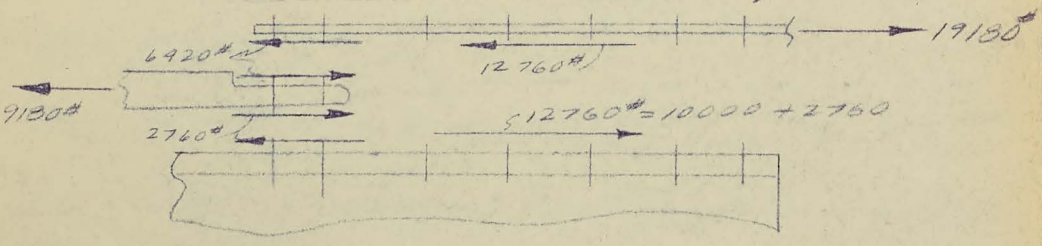
$P_{BR} = \frac{.14}{.465}(29950)(1.369) = 12300^{\#}$ $(-2760^{\#})$

$P_{SK} = 28600^{\#}$ (FIGURES IN ( ) ARE FOR AIL. UP-SUPER) $(-6420^{\#})$



FOR AIL. DOWN-SUPER

FOR AIL. UP-SUPER ?



UPR SKIN-TO-BRACKET ATTACH.:

$P = 12760(1.369) = 17400^{\#}$

$P_{B.L.} = 30(770) = 23100^{\#}$ $M.S. = \frac{23100}{17400} - 1 = .32$

FORM 1319A

A.V. ROE CANADA LIMITED
MALTON -- ONTARIO

TECHNICAL DEPARTMENT (Aircraft)

REPORT NO. Z-0579-1
SHEET NO. R 44C

AIRCRAFT		PREPARED BY: R. GAVALIS	DATE:
C105	AILERON	CHECKED BY:	DATE:

RIB #4

$$b_{AVE} = \frac{6}{\frac{1}{.80} + \frac{2}{.62}} = .73'' \quad , \frac{b_{AVE}}{b_{BT}} = \frac{.73}{.85} = .86$$

$K_{TRU} = .515$, $K_{RY} = .95$

$P'_{TRU} = .515(.95)(1.0)(56400) = 24600\ \#$

$$M.S. = \frac{24600(2)}{22600(1.364)} - 1 = .59$$

FOR BENDING AT A-A:

$M = 22600(1.364)(1.90) = 58500\ IN\#$ (ULT)

$V = 22600(1.364) = 30700\ \#$ (ULT.)

$P_R = 13770(1.364) = 18800\ \#$ (ULT.)

$$I = \frac{2(1.0)(2.7)^3}{12} = 3.28\ IN^4 \quad , f_b = \frac{58500(1.35)}{3.28} = 24,100\ PSI$$

$$R_b = \frac{24100}{56400} = .428 \quad , f_c = \frac{18800}{2.7(1.0)(2)} = 3480\ PSI$$

$$R_c = \frac{3480}{56400} = .062 \quad , f_s = \frac{30700(1.5)}{2(2.7)(1.0)} = 8600\ PSI$$

$$R_s = \frac{8600}{35500} = .242$$

← POSSIBLE ECCENTRICITY

$$M_2 = P_2\left(\frac{.063}{2.8}\right)(1.9) = 18800\left(\frac{.063}{2.8}\right)(1.9) = 805\ IN\#$$

$$I_2 = \frac{2.7(1.0)^3}{12} = .225\ IN^4 \quad , f_b = \frac{805(.5)}{.225} = 1790\ PSI$$

$$R_{b2} = \frac{1790}{56400} = .032 \quad , R_c = .428 + .062 + .032 = .522$$

$$M.S. = \frac{1}{\sqrt{(.522)^2 + (.242)^2}} - 1 = .74$$

DECREASE LUG THICKNESS IF POSSIBLE

A.V. ROE CANADA LIMITED
MALTON – ONTARIO

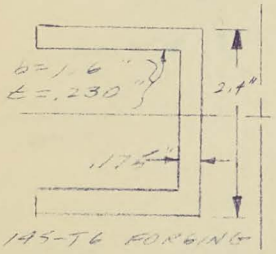
TECHNICAL DEPARTMENT (Aircraft)

REPORT NO. 7-0579-1
SHEET NO. R 440

AIRCRAFT		PREPARED BY: R. GAVALIS	DATE:
C 105	AILERON	CHECKED BY:	DATE:

RIB #4

FOR BENDING OF BRACKET JUST AFT OF EARS:



$$\left(\frac{b}{t}\right)_{FLANGE} = \frac{1.62}{.1230} = 6.6$$

$F_{cu} = 47{,}600$ psi
T=250°

$M_x = 1.05 R_L + 2.9 P_{EC} - 1.15 P_B$
VERTICAL LOAD IN RODS (REF B-3 R44a)

$M_x = 1.05(23200) + 2.9(12650) - 1.15(14000) = 45100$ in-# (LIMIT)

$V = 1390$ # (LIMIT), $P_a = 9180$ # (LIMIT) (COMP.)

$$I_x = 2\left[\frac{.175(1.94)^3}{12} + 2(1.6)(.230)(1.08)^2\right] = 1.93 \text{ in}^4$$

$$f_b = \frac{45100(1.364)(12)}{1.93} = 38300 \text{ psi}$$

$$A = 1.60(.230)(4) + 2(.175)(1.94) = 2.15 \text{ in}^2$$

$$f_c = \frac{9180(1.20)}{2.15} = 5820 \text{ psi}, \quad R_c = \frac{38300+5820}{47600} = .928$$

$$Q = 2\left[1.60(.230)(1.08) + .175(.97)^2\left(\tfrac{1}{2}\right)\right] = .961 \text{ in}^3$$

$$f_s = \frac{1340(15ca\ 1.90)}{1.93(2)(.175)} = 26600 \text{ psi}, \quad R_s = \frac{26600}{35500} = .073$$

$$M.S. = \frac{1.03}{.960} - 1 = \underline{.07}$$

($t_c = 1.6$, $t_c = .230$", $t_w = .175$")

A.V. ROE CANADA LIMITED
MALTON – ONTARIO

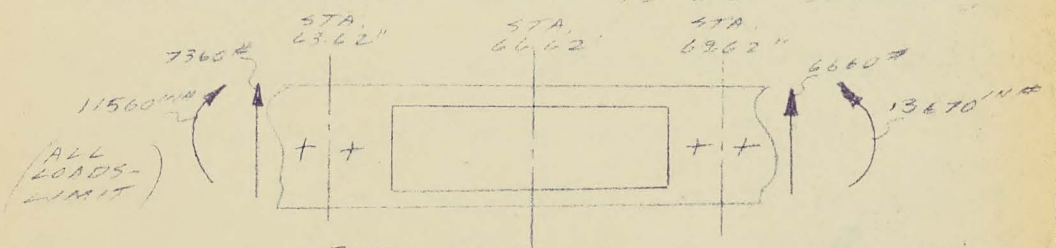
TECHNICAL DEPARTMENT (Aircraft)

REPORT NO.	Z-0574-1
SHEET NO.	R 446
PREPARED BY: R. GAUALIS	DATE:
CHECKED BY:	DATE:

AIRCRAFT	
C 105	AILERON

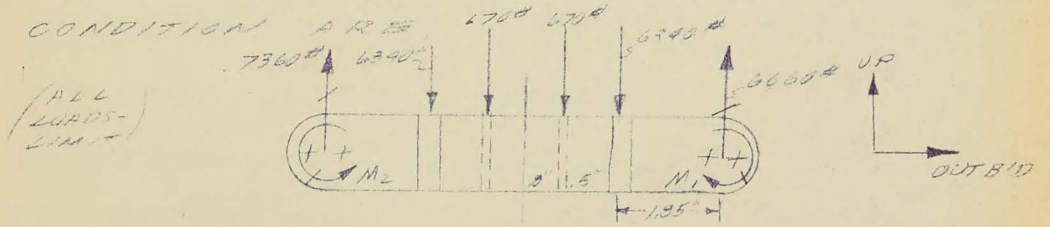
RIB #4

THE SPAR LOADING IS AS SHOWN.



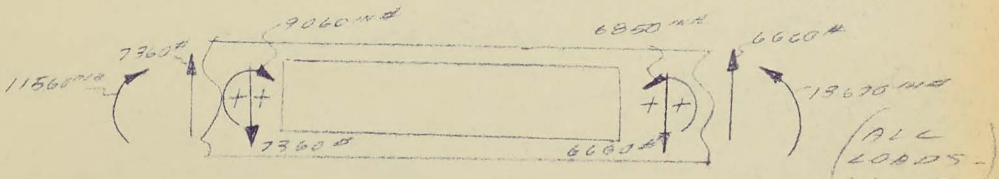
FOR COND. AIL. UP – SUPERSONIC

THE LEVER BRACKET LOADS FOR THIS CONDITION ARE



$M_1 = 6850$ IN#, $M_2 = 9060$ IN# FROM LEAST WORK THEORY

THEN THE COMPLETE SPAR LOADING IS



$V_2 = 0$ ACROSS CUT-OUT

$M_{MAX} = 20620$ IN#. ACROSS CUT-OUT

IF THE LEVER BRACKET WAS CONSIDERED PINNED, THE MAXIMUM MOMENT IN THE BRACKET AT Ø RIB WOULD BE 13300 IN# (LIMIT) & V = 6700# (LIMIT).

ABOVE LOADS ARE SUPERSONIC & VARIES TO SUBSONIC

A.V.ROE CANADA LIMITED
MALTON - ONTARIO

TECHNICAL DEPARTMENT (Aircraft)

REPORT NO. 2-0574-1
SHEET NO. R 447

AIRCRAFT		PREPARED BY:	DATE:
C105	AILERON	R. GAVALIS	
		CHECKED BY:	DATE:

RIB #4

FOR THE PARTS OF THE BRACKET,

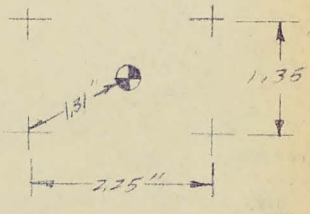
$M_{MAX} = 1.414(1.364)(9060) = 17500$ IN-# (ULT.)

$V = 7360(1.364)(1.414) = 14200$ #

$r^2 = 4(1.31)^2 = 6.86$ IN^2

$P_{TA} = \frac{17500(1.31)}{6.86} = 3340$ #

$P_{V_{SHEAR}} = \frac{14200}{4} = 3550$ #



FOR THE CRITICAL BOLT,

$P_V = 3550 + \left(\frac{1.125}{1.31}\right)(5340) = 6420$ #

$P_H = \left(\frac{1.675}{1.31}\right)(3340) = 1720$, $P_{RESULT.} = 6650$ #

$P_{BLG_{SHEAR}} = 5250$ #, $P_{BLG_{BEARING}} = .270\left(\frac{3}{8}\right)(1.364)(72000) = 9940$ #

$P_{BLG_{BEARING}} = .150(2)\left(\frac{3}{8}\right)(1.364)(63500) = 9730$ #

$M.S. = \frac{8250}{6650} - 1 = .24$

AT SECTION A-A:

$M = 4800$ IN-# (ULT.), $V = 14200$ # (ULT.)

$I = \frac{.275(3.00)^3}{12} = .620$ IN^4, $f_b = \frac{4800(1.50)}{.620} = 11600$ PSI

$f_s = \frac{14200(1.5)}{[3.00 - 2(\frac{3}{8})](.275)} = 34400$ PSI, $R_s = \frac{34400}{33500} = .971$

$R_b = \frac{11600}{56400} = .206$ $M.S. = \frac{5.10}{4.89} - 1 = .03$

A.V.ROE CANADA LIMITED
MALTON - ONTARIO

TECHNICAL DEPARTMENT (Aircraft)

REPORT NO. 2-0579-1

SHEET NO. R 449

AIRCRAFT		PREPARED BY: R. GAVALIS	DATE:
C 105	AILERON	CHECKED BY:	DATE:

RIB #4

FOR THE BRACKET THRU RIB ℄

$M = 13300 (1.364)(1.414) = 25700$ IN-# (ULT.)

$V = 670 (1.364)(1.414) = 1300$ # (ULT.)

$I = .620 \left(\frac{.500}{.276}\right) = 1.13$

$f_b = \frac{25200(1.5)}{1.13} = 34200$ #/SQ. IN.

$M.S. = \frac{56400}{34200} - 1 = .65$

DECREASE THICKNESS TO .40"

A.V.ROE CANADA LIMITED
MALTON – ONTARIO

TECHNICAL DEPARTMENT (Aircraft)

REPORT NO. 24579-1
SHEET NO. R45

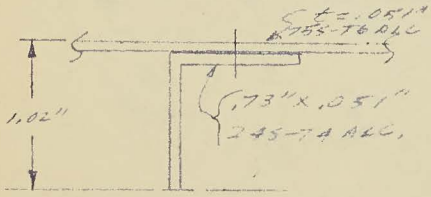
AIRCRAFT		PREPARED BY:	DATE:
C105	AILERON	R. GAVALIS	
		CHECKED BY:	DATE:

RIB 34

SECTION AT $\frac{x}{c} = .500$ (32.6" FWD. OF T.E.)

$M_{SUPER} = .25(11000) = 2750$ IN-# (LIMIT) (REF. Pg 30A)

$V_{SUPER} = 320$ # (LIMIT), $V_{MAX\ SUB} = 1400$ # (LIMIT) AT L.E.



$\frac{b}{t} = \frac{.73}{.051} = 14.3$

$F_{cc} = 21500$ PSI

$I_{RIB} = \frac{.051(1.39)^3}{12} + .73(.051)(2)(.99)^2 = .0923$ IN⁴

$M_{ALL\ RIB} = \frac{21500(.0923)}{.97} = 2040$ IN-#

$f_{SKIN} = 21500\left(\frac{9.7}{9.2}\right)\left(\frac{1.00}{.94}\right) = 24100$ PSI

$F_{cc} = 3.62(9.3)(10^3)\left(\frac{.051}{7.3}\right)^2 = 17200$ PSI

$\frac{F_{cc}}{f} = \frac{1720}{24100} = .0715$, $\frac{b_m}{b} = .372$, $b_m = .372(7.3) = 2.71$"

$M_{ALL\ SKIN} = 2.71(.051)(2)(24100)(1.00) = 6650$ IN-#

$M_{ALL\ TOT.} = 6650 + 2040 = 8690$ IN-#

$M.S. = \frac{8690}{2750(1.50)} - 1 = 1.31$

$t_{RIB} = .051$"

A.V. ROE CANADA LIMITED
MALTON – ONTARIO

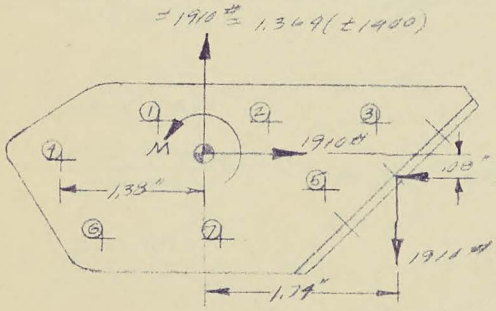
TECHNICAL DEPARTMENT (Aircraft)

REPORT NO. Z-0579-1
SHEET NO. R 45a

AIRCRAFT		PREPARED BY: R. GAVALIS	DATE:
C 105	AILERON	CHECKED BY:	DATE:

RIB # 3A

ATTACHMENT TO SPAR



$V_{SUB} = \pm 1400^{\#}$ LIMIT

$V_{SUPER} = \pm 766^{\#}$ LIMIT)
(REF. P.S. 90h)

$M = 1910(1.74) + 1910(.09)$

$M = 3470^{in\#}$ (ULT.)

$N^2 = .78^2 + .74^2 + 1.59^2 + 1.39^2 + .81^2 + 1.2^2 + .74^2$

$N^2 = 8.2\ IN^2$

FOR RIVET #3,

$P_h = P_v = \frac{1910}{7} = 273^{\#}$, $P_M = \frac{3470(1.59)}{8.2} = 674^{\#}$

$P_{M_V} = 674 \cos 22^\circ = 624^{\#}$, $P_{M_H} = 674 \sin 22^\circ = 253^{\#}$

$P_{RES.} = [(897)^2 + (20)^2]^{\frac{1}{2}} = 900^{\#}$

NOW: 5/32" DIA HOCK RIVETS, P_{ALL} SHEAR = 679# (700 LOW)

USE: 3/16" DIA HOOKS, P_{ALL} SHEAR = 967#

$M.S. = \frac{967}{900} - 1 = .07$

±2.031" ↑

FOR A SECTION THRU RIVET #5:

$M = 1065^{in\#}$, $V = 1095^{\#}$, $P = 1929^{\#}$

$I = \frac{.102(2.0)^3}{12} = .069\ IN^4$, $f_b = \frac{1065(1.0)}{.068} = 15,700\ psi$

A.V.ROE CANADA LIMITED
MALTON – ONTARIO

TECHNICAL DEPARTMENT (Aircraft)

REPORT NO. 7-0579-1
SHEET NO. R 456

AIRCRAFT		PREPARED BY: R. GAVALIS	DATE:
C 105	AILERON	CHECKED BY:	DATE:

RIB # 3A

$f_c = \frac{1924}{2.0(1.102)} = 9910 \text{ psi}$

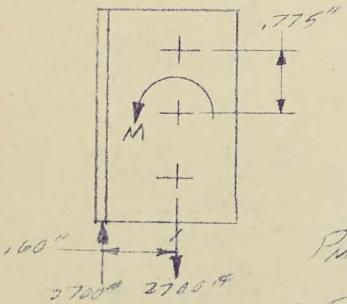
$\frac{b}{t} = \frac{1.1}{.1021.93} = 11.4, \quad F_{cc} = 30,000(.93) = 28500 \text{ psi}$

$R_b = \frac{15700+9910}{28500} = .895, \quad f_s = \frac{1095}{(2.00-\frac{.5}{16})(.107)} = 5650 \text{ psi}$

$R_s = \frac{5650}{37000} = .153$

$M.S. = \frac{1}{\sqrt{(.895)^2+(.153)^2}} - 1 = .10$

FOR THE CLIP-TO-SPAR ATTACHMENT:



$a = .60, \quad b = .775"$

$a/b = \frac{.60}{.775} = .775$

$P = 1.414(1910) = 2700 \#$

$M = 2700(.60) = 1620 \text{ IN}\#$

$P_M = \frac{1620}{1.56} = 1050 \#$

$P_V = \frac{2700}{3} = 900 \#$

$P_R = [(1050)^2 + (900)^2]^{\frac{1}{2}} = 1380 \#$

NOW: $\frac{3}{16}$ RIVETS, $P_{RIV\ SHEAR} = 2125 \#$

$P_{RIV\ BY\ CLIP} = 1910(1.369)(.610) = 1590 \#$

$M.S. = \frac{1590}{1380} - 1 = .15$

$t_{CLIP} = .102"$

A.V. ROE CANADA LIMITED
MALTON – ONTARIO

TECHNICAL DEPARTMENT (Aircraft)

REPORT NO. 7-0574-1
SHEET NO. R 45G

AIRCRAFT		PREPARED BY: R. GAVALIS	DATE:
C105	AIL FRON	CHECKED BY:	DATE:

RIB 3A

FOR A SECTION THRU THE BOLTS;

$V = 2700\#$, $M = 1620$ IN-#

$I = \frac{1.02(3.0)^3}{12} = .230$ IN^4, $f_b = \frac{1620(1.5)}{.230} = 10600$ psi

$\frac{t}{e} = \frac{3.0}{2(1.02)(.75)} = 1.96$, $F_{cu} = .92(33000) = 31000$ psi

$R_b = \frac{10600}{31000} = .436$, $f_s = \frac{2700}{[3.0 - 3(\frac{3}{8})](1.02)} = 10900$ psi

$R_s = \frac{10900}{37000} = .299$

$$M.S. = \frac{1}{\sqrt{(1.299)^2 + (.436)^2}} - 1 = .75$$

ATTACHMENT OF RIB TO UPPER FLANGE OF SPAR,

$P = 1910\#$

$P_{all} = .651(\frac{3}{16})^2(1.369)(61000) = 797\#$

$\frac{D}{t} = .021$

A.V. ROE CANADA LIMITED
MALTON – ONTARIO

TECHNICAL DEPARTMENT (Aircraft)

REPORT NO. 2-0579-1
SHEET NO. R 46

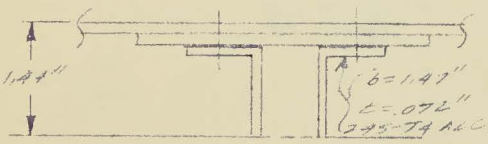
PREPARED BY: R. GAVALIS — DATE:
CHECKED BY: — DATE:

AIRCRAFT: C105 — AILERON

RIB #3

SECTION AT $\frac{X}{C}$ = .772 (37.2" FWD. OF T.E.)

$M_{SUPER} = 44500$ IN-# (6 IN. F), $V_{SUPER} = 1660$ # (REF. B_3 900)



$\frac{b}{t} = \frac{1.47}{.072} = 20.4$

$F_{cc} = 16,400$ psi (REF B_3 123)

$I_{RIB} = \frac{.072(2.88)^3}{12}(2) + 1.47(.072)(4)(1.27)^2 = .868$ IN^4

$M_{ALL\ RIB} = \frac{16000(.868)}{1.31} = 10900$ IN-#

$f_{SHOULDER} = \frac{9.7}{9.2}\left(\frac{1.35}{1.27}\right)(16400) = 18400$ psi

$W_{DOUBLER} = 7.0$", $M_{ALL\ DOUB.} = 7.0(.081)(2)(10400)(1.35) = 28200$ IN-#

$f_{SKIN} = \frac{9.7}{9.2}\left(\frac{1.41}{1.27}\right)(16400) = 17200$ psi

$F_{cc} = 17850$ psi, $\frac{\sigma_{cc}}{E} = \frac{1785}{19,200} = .093$, $\frac{b_m}{b} = .408$

$b_m = .408(7.15) = 2.92$, $b_{TOT} = 2.92 + 2.6 = 5.5$" USE 2.0" BEYOND END OF DOUBLER

$M_{ALL\ SKIN} = 7.0(.051)(2)(19200)(1.415) = 19400$ IN-#

$M_{ALL\ TOTAL} = 10900 + 28200 + 19400 = 59500$ IN-#

$M.S. = \frac{59500}{1.767(44600)} - 1 = -.03$

USE $\pm$ .03 / 11

A.V.ROE CANADA LIMTED
MALTON - ONTARIO

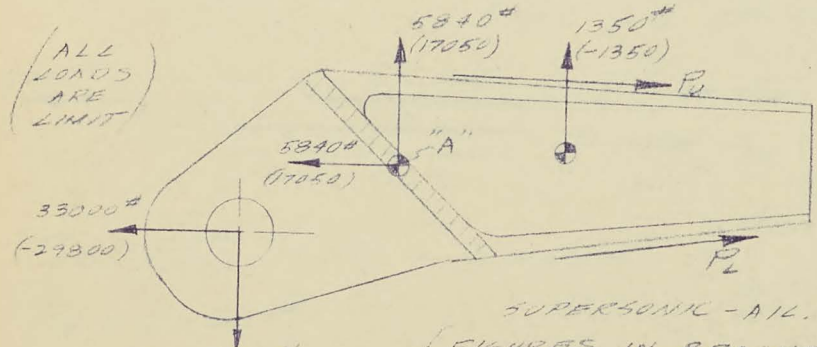
TECHNICAL DEPARTMENT (Aircraft)

REPORT NO. Z-0574-1
SHEET NO. R 47

AIRCRAFT		PREPARED BY:	DATE:
C 105	AILERON	R. GAVALIS	
		CHECKED BY:	DATE:

RIB #3

LEVER BRACKET



SUPERSONIC - AIL. DOWN
(FIGURES IN BRACKETS ARE FOR SUPER. - AIL. UP)

$\Sigma M_A = 33000(1.0) - 7190(1.9) - 1350(5.4) - 1.6P_L + 1.32P_U = 0$

$\Sigma F_n = P_U + P_L - 5840 - 33000 = 0$

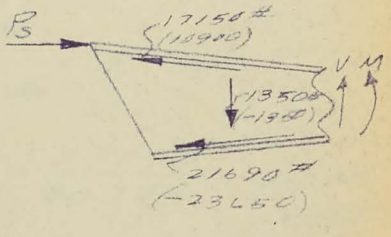
$P_U = 17150\#$, $P_L = 21690\#$ FOR AIL. DWN - SUPER.

$P_U = 10900\#$, $P_L = -23650\#$ FOR AIL. UP - SUPER.

FOR THE RIB,

$P_S = 17150 + 21690 = 38840\#$ AIL. DWN - SUPER.

$P_S = -12750\#$ FOR AIL. UP - SUPER



FOR LOWER SKW - TO - BRACKET ATTACH.:

$P = 23650(1.384) = 32400\#$ (ULT.)

NOW: (16) - 1/4" DIA. AN509 SCREWS

$P_{ALL} = 16(2020) = 32200\#$

$M.S. = \frac{32200}{32400} - 1 = -.01$

USE 18 SCREWS

A.V.ROE CANADA LIMITED
MALTON – ONTARIO

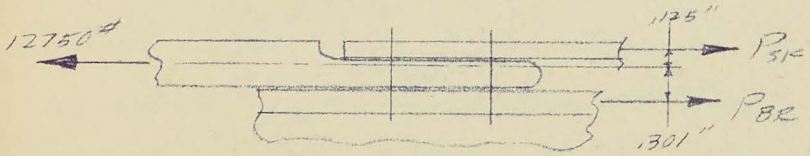
TECHNICAL DEPARTMENT (Aircraft)

REPORT NO. 2-0578-1
SHEET NO. R 47-1

AIRCRAFT		PREPARED BY:	DATE:
C105	AILERON	R. GAVALIS	
		CHECKED BY:	DATE:

RIB #3

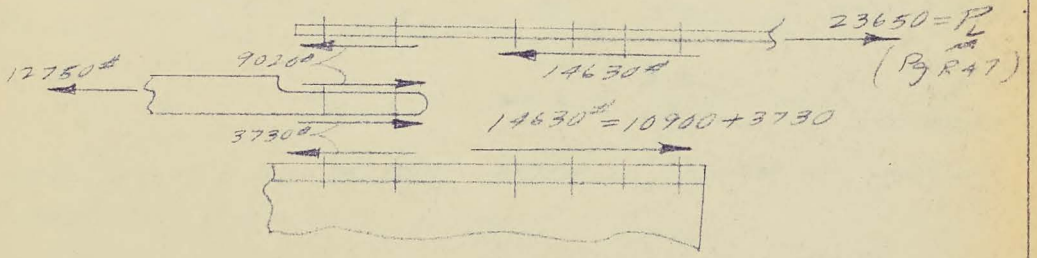
UPR. SKIN –TO– BRACKET ATTACHMENTS.
(FOR AIL. UP-SUPER)



$P_{BR} = \frac{.126}{.426}(12750) = 3730\#$

$P_{SK} = 9020\#$

$P_{BR} = 11400\#$
$P_{SK} = 27440\#$
FOR AIL. DWN-SUPER



$P = 1.364(14630) = 20,000\#$ (ULT)

NOW: (30) – 3/16" HUCKS

$P_{B.L} = 30(770) = 23100\#$

$M.S. = \frac{23100}{20000} - 1 = .15$

A.V.ROE CANADA LIMITED
MALTON - ONTARIO

TECHNICAL DEPARTMENT (Aircraft)

REPORT NO. 7-0574-1
SHEET NO. R 472

AIRCRAFT		PREPARED BY: R. GAVALIS	DATE:
C105	AILERON	CHECKED BY:	DATE:

RIB #3

FOR THE SKIN-TO-SPAR ATTACHMENT:

$P_{SKIN\ UPR.} = 27440\#$ (LIMIT)

$q_o = \frac{27440/1.364(1.3)}{18.93} = 2870\ \#/in$

$q_3 = 1.2(1.564)(211) = 395\ \#/in$

$q_d = [(2870)^2 + (395)^2]^{\frac{1}{2}} = 2890\ \#/in$

$q_{ALL} = \frac{1940(2)}{.90} = 3200\ \#/in$ FOR $\frac{3}{16}$" SCREWS

$M.S. = \frac{3200}{2890} - 1 = .11$

FOR ATTACHMENTS THRU UPPER SKIN, SPAR & LEVER BRACKET:

THE DISTRIBUTED LOAD IN THE SKIN IS $q_o = 2870\ \#/in$

THEN, $P_{SKIN} = 2870(3.8) = 10900\#$ (ULT.)

$P_{BRACKET} = 11400\#$ (LIMIT), $P_{SPAR} = 26500\#$ (ULT.)

TRY: 6 - $\frac{1}{4}$" AN BOLTS

$P_{ALL\ SHEAR} = 6(3600) = 22100\#$ $M.S. = \frac{6(2010)}{10900} - 1 = .11$ (SKIN)

$P_{ALL\ BY\ SPAR} = .25(1.25)(1.3\,C_9)(63500) = 5410\#$

$M.S. = \frac{6(5410)}{26500} - 1 = .22$

A.V. ROE CANADA LIMITED
MALTON – ONTARIO

TECHNICAL DEPARTMENT (Aircraft)

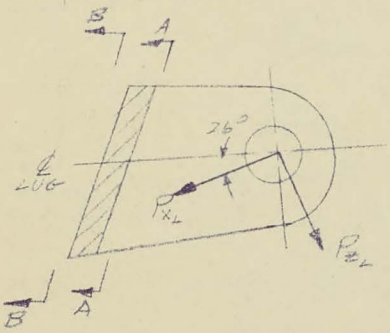
REPORT NO. 7-0579-1
SHEET NO. R 97b

AIRCRAFT		PREPARED BY: R. GAVALIS	DATE:
C105	AILERON	CHECKED BY:	DATE:

RIB #3

FOR THE LUGS:

$P_{X_L} = 29900\#$ (LIMIT), $P_{Z_L} = 15700\#$ (LIMIT) (AIL. UP – SUBSONIC)



$P_{AXIAL} = 19920\#$ (LIMIT)

$P_{TRANS.} = 27150\#$ (LIMIT)

$b_{AVE} = \dfrac{L}{\frac{4}{.95} + \frac{2}{.70}} = .85''$

$\dfrac{b_{AVE}}{b_{BR}} = \dfrac{.85}{1.00} = .85$

$K_{TRU} = .51$, $K_{TR} = .95$

$P'_{TRU} = .51(1.00)(1.1)(56400) = 31600\#$

$M.S. = \dfrac{31600(2)}{27150(1.364)} - 1 = .71$

FOR BENDING AT A–A:

$M = 27150(1.364)(2.08) = 77000$ IN-LBS (ULT)

$V = 27150(1.364) = 37000\#$ (ULT)

$P_2 = 19920(1.364) = 27200\#$ (ULT)

$I = \dfrac{2(1.1)(3.15)^3}{12} = 5.7\ IN^4$, $f_b = \dfrac{77000(1.575)}{5.7} = 21300\ psi$

$f_c = \dfrac{27200}{3.15(1.1)(2)} = 3930\ psi$, $R_c = \dfrac{21300 + 3930}{56400} = .45$

$f_s = \dfrac{37000(1.5)}{3.15(1.1)(2)} = 8000\ psi$, $R_s = \dfrac{8000}{35500} = .225$

REQUIRE THICKNESS $M.S. = \dfrac{1}{\sqrt{(.450)^2 + (.225)^2}} - 1 = .79$

TO .136" IF HEAT TREATED 3.15"

A.V.ROE CANADA LIMITED
MALTON – ONTARIO

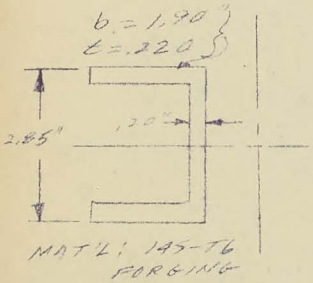
TECHNICAL DEPARTMENT (Aircraft)

REPORT NO. 7-0579-1
SHEET NO. R 47C

AIRCRAFT		PREPARED BY: R. GAVALIS	DATE:
C105	AILERON	CHECKED BY:	DATE:

RIB #3

FOR BENDING AT SECTION B-B:
(SEE SKETCH, PRECEDING PAGE)



$\left(\frac{b}{t}\right)_{FLANGE} = \frac{1.80}{.220} = 8.2$ (1.90 - .10)

F_{cy} T=250° = 41,800 psi

$M_x = 3.3(-15700) - .92(79800) + 1.4(17050) - .10(17050)$

$M_x = -57000$ in-# (LIMIT)

$P_a = 79800 - 17050 = 12750$ # (COMP), $V = 1350$ # (LIMIT)

$I_x = 2\left[\frac{.20(2.35)^3}{12} + 1.90(.220)(2)(1.3)^2\right] = 3.25$ in⁴

$f_b = \frac{57000(1.364)(1.425)}{3.25} = 34,100$ psi

$A = 2\left[.20(2.35) + .220(1.90)(2)\right] = 2.61$ in²

$f_c = \frac{12750(1.364)}{2.61} = 6670$ psi, $R_t = \frac{34100+6670}{41800} = .976$

$Q = 2\left[.20(1.175)^2\left(\frac{1}{2}\right) + .220(1.90)(1.3)\right] = 1.37$ in³

$f_s = \frac{1350(1.364)(1.37)}{3.25(.20)(2)} = 1940$ psi, $R_s = \frac{1940}{35500} = .055$

$M.S. = \frac{1}{.975} - 1 = .02$

A.V. ROE CANADA LIMITED
MALTON – ONTARIO

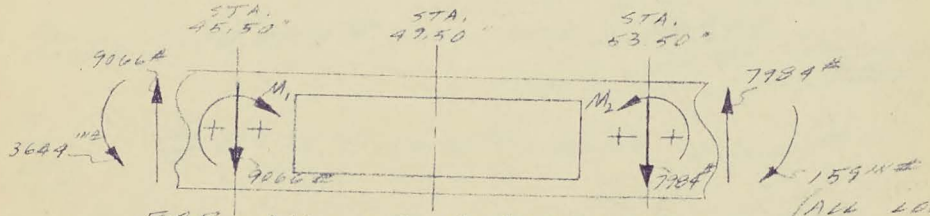
TECHNICAL DEPARTMENT (Aircraft)

REPORT NO. 2-0579-1
SHEET NO. R 470

AIRCRAFT		PREPARED BY:	DATE:
C 105	AILERON	R. GAVALIS	
		CHECKED BY:	DATE:

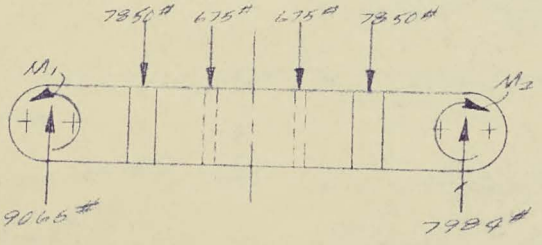
RIB # 3

THE SPAR LOADING IN THIS REGION IS



FOR AIL. UP – SUPERSONIC (ALL LOADS – LIMIT)

& THE LEVER BRACKET LOADS ARE,



$M_1 = 15,200$ IN# , $M_2 = 11,000$ IN#

FOR THE EARS OF THE BRACKET

$M_{MAX} = 1.364\,(1.414)(15200) = 29400$ IN# (ULT.)

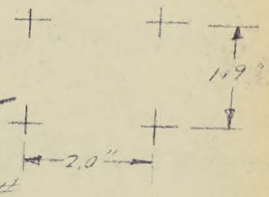
$V_{MAX} = 1.364\,(1.414)(9066) = 17500$ # (ULT.)

$r^2 = 4\,(1.38)^2 = 7.6$ IN^2

$P_M = \frac{29400\,(1.38)}{7.6} = 5350$ #

$P_V = \frac{17500}{4} = 4370$ #

BOLT PATTERN



$P_{R_{TOT}} = 4370 + \frac{1.0}{1.38}(5350) = 8230$ #

$P_{A_{TOT}} = \frac{.95}{1.38}(5350) = 3680$ #

$P_{RESULT.} = 9040$ #

A.V. ROE CANADA LIMITED
MALTON – ONTARIO

TECHNICAL DEPARTMENT (Aircraft)

REPORT NO. 7-0579-1
SHEET NO. R 47C

AIRCRAFT		PREPARED BY:	DATE:
C105	AILERON	R GAVALIS	
		CHECKED BY:	DATE:

RIB #3

USE NAS 146 BOLTS

$P_{ALL\ SHEAR} = 10500^{\#}$, $M.S. = \frac{10500}{9040} - 1 = .16$

$P_{ALL\ BY\ EAR} = \frac{3}{8}(.275)(1.364)(72000) = 10100^{\#}$

$P_{ALL\ BY\ SPAR} = \frac{3}{8}(.310)(1.364)(63500) = 10100^{\#}$

$M.S. = \frac{10100}{9040} - 1 = .12$

AT SECTION THRU INNERMOST BOLTS:

$M = 5040^{IN\#}(ULT)$, $V = 17500^{\#}(ULT)$

$I = \frac{.275(3.6)^3}{12} = 1.07\ IN^4$, $f_b = \frac{5040(1.8)}{1.07} = 8500\ PSI$

$f_s = \frac{17500(1.5)}{[3.6 - 2(\frac{3}{8})](1.275)} = 33400\ PSI$, $R_s = \frac{33400}{35500} = .943$

$M.S. = \frac{1}{.943} - 1 = .06$

FOR THE BRACKET THRU RIB ℄:

$M_{MAX} = 21690(1.364)(1.414) = 41900^{IN\#}(ULT)$

$V = 1310^{\#}(ULT)$

$I = \frac{.50(3.6)^3}{12} = 1.94\ IN^4$, $f_b = \frac{41900(1.8)}{1.94} = 38900\ PSI$

$M.S. = \frac{46800}{38800} - 1 = .20$

A.V. ROE CANADA LIMITED
MALTON – ONTARIO

TECHNICAL DEPARTMENT (Aircraft)

REPORT NO. 7-0579-1
SHEET NO. R 48

AIRCRAFT		PREPARED BY:	DATE:
C105	AILERON	R. GAVALIS	
		CHECKED BY:	DATE:

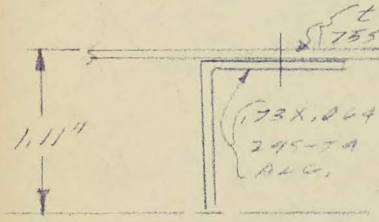
RIB #2A

SECTION AT $\frac{x}{c} = .500$ (25.5" FWD. OF T.E.)

$M_{SUBSE} = \pm 2.25(13600) = \pm 3900$ IN# (LIMIT) (REF. PGS. 90A, 90B)

$V_{SUBSE} = \pm 340$ # (LIMIT)

$V_{MAX\ SUB} = \pm 1520$ # (LIMIT) AT L.E.



$\left(\frac{b}{t}\right) = \frac{.73}{.064} = 11.4$

$F_{cu} = 25100$ psi (REF PG M23)
$F_{240°}$

$I_{RIB} = \frac{.064(2.0)^3}{12} + .73(.064)(2)(1.03)^2$

$I_{RIB} = .142$ IN⁴

$M_{RIB}^{ALC} = \frac{25100(.142)}{1.06} = 3360$ IN#

$f_{SKIN} = 25100\left(\frac{9.7}{9.2}\right)\left(\frac{1.095}{1.06}\right) = 27000$ psi

$\sigma_{cu} = 3.62(9.7)(10^6)\left(\frac{.051}{7.12}\right)^2 = 1810$ psi

$\frac{F_{cu}}{f} = \frac{1810}{25100} = .072$, $\frac{b_m}{b} = .375$, $b_m = .375(7.12) = 2.67$"

$M_{SKIN}^{ALC} = 2.67(.051)(2)(27000)(1.085) = 7990$ IN#

$M_{TOTAL}^{ALC} = 7990 + 3360 = 11340$ IN#

$M.S. = \frac{11340}{1.369(3400)} - 1 = \underline{1.44}$

USE $t_{RIB} = .051$ HERE

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MALTON – ONTARIO

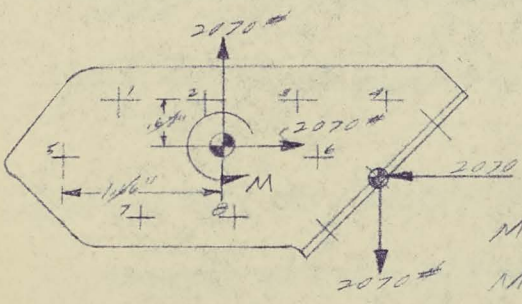
TECHNICAL DEPARTMENT (Aircraft)

REPORT NO. 7-0574-1
SHEET NO. R49

AIRCRAFT		PREPARED BY:	DATE:
C105	AILERON	R. GAVALIS	
		CHECKED BY:	DATE:

RIB 2A

ATTACHMENT TO SPAR



$V_{SUB} = \pm 1518^{\#}$ (REF. B3, 90A)

$V_{SUPER} = \pm 815^{\#}$

$V = 1.369(1518) = 2070^{\#}$ (ULT.)

$M = 2070(2.2) + 2070(.14)$

$M = 4850^{IN\#}$ (ULT)

$r^2 = 1.40^2 + .58^2 + .80^2 + 1.72^2 + .92^2 + .90^2 + .98^2 + 1.0^2 = 9.511$

FOR RIVET #4;

$P_V = \frac{2070}{8} = 259^{\#} = P_h$

$P_M = \frac{1950(1.72)}{9.511} = 877^{\#}$

$P_{RESULT.} = 1100^{\#}$ (400 HIGH) – ADD (2) RIVETS TO PATTERN

P_{ALL} for C-051 $= .051\left(\frac{2}{16}\right)(1.369)(61000) = 796^{\#}$

USE $t_{RIB} = .064"$

OR $t_{RIB} = .051"$ WITH BACK-UP CHANNEL

FOR A SECTION THRU RIVET #6;

$M = 1206^{IN\#}$, $V = 1246^{\#}$, $P_R = 2029^{\#}$

$I = \frac{.102(2.2)^3}{12} = .0905^{IN^4}$

A.V. ROE CANADA LIMITED
MALTON – ONTARIO

TECHNICAL DEPARTMENT (Aircraft)

REPORT NO. 7-0529-1
SHEET NO. R 99a

AIRCRAFT		PREPARED BY: R. GAVALIS	DATE:
C105	AILERON	CHECKED BY:	DATE:

RIB 2A

$$f_b = \frac{1205(11.1)}{.0905} = 14600 \text{ psi}$$

$$f_c = \frac{2029}{3.2(.102)} = 9050 \text{ psi}$$

$$\frac{b}{t} = \frac{1.1}{.95(.102)} = 11.9, \quad F_{cc} = 28{,}500 \text{ psi}$$

$$f_{TOTAL} = 14600 + 9050 = 23650 \text{ psi}$$

$$R_c = \frac{29650}{28500} = .831$$

$$f_s = \frac{1246}{(3.2 - \frac{3}{16})(.102)} = 6100 \text{ psi}$$

$$R_s = \frac{6100}{37000} = .165$$

$$M.S. = \frac{1}{\sqrt{(.165)^2 + (.831)^2}} - 1 = .02$$

USE $t_{SKIN} = .102"$

A.V. ROE CANADA LIMITED
MALTON – ONTARIO

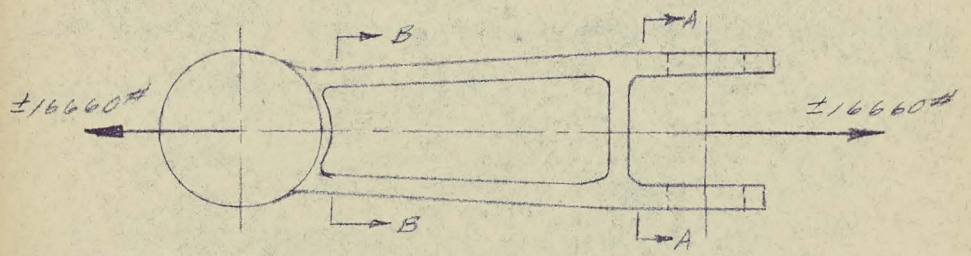
TECHNICAL DEPARTMENT (Aircraft)

REPORT NO. 7-0579-1
SHEET NO. R50

AIRCRAFT		PREPARED BY: R. GAVALIS	DATE:
C105	AILERON	CHECKED BY:	DATE:

LINKS 1, 6, & 7 (REF. DWG 7-0115-86)

$P_{LINK} = \pm 16660\#$ (LIMIT) (REF. Pg. 89)



MAT'L: STEEL AMS 6294 (4620)
HT 100,000 psi

AT B-B;

$P_{LINK} = 16660(1.369)(1.25) = 28,400\#$

$A = .88(.18)(2) + .88(.19) = .483\ in^2$

$f_c = \frac{28400}{.483} = 58,800$ psi

$M.S. = \frac{91000}{58800} - 1 = .55$ (COLUMN ALLOW.)

FOR SECTION A–A

$P_{LUG} = \frac{28400}{2} = 14200\#$

$L = 1.9"$

$\rho = .287(.18) = .052\ in$

$\frac{L}{\rho} = \frac{1.9}{.052} = 36.5$

$f_c = \frac{14200}{.18(.88)} = 89,600$ psi

A.V.ROE CANADA LIMITED
MALTON – ONTARIO

TECHNICAL DEPARTMENT (Aircraft)

REPORT NO. 2-0579-1
SHEET NO. R 51

AIRCRAFT		PREPARED BY: R. GAVALIS	DATE:
C 105	AILERON	CHECKED BY:	DATE:

LINKS 1, 6 & 7

FOR COLUMN ACTION,
(REF. JAS. – OCT. 1946 ; – NON-DIMENSIONAL BUCKLING)

$K_c = .0181$, $n = 2.5$, $F_{0.7} = 94000$ #

$B = .0181(36.3) = .46$, $\frac{F}{F_{0.7}} = .92$

$F_c = .92(94000) = 86500$ #

$$M.S. = \frac{86500}{89600} - 1 = \underline{-.04}$$

INCREASE THICKNESS

FOR THE LUG,

$t_{LUG} = .28"$, $e = .55"$, $D = .50"$

$\frac{e}{D} = \frac{.55}{.50} = 1.1$, $\frac{t}{D} = \frac{.28}{.50} = .56$

$K_{br_4} = .99$, $P'_{br_4} = .99(.28)(.50)(100,000) = 13870$ #

$\frac{W}{D} = \frac{1.1}{.50} = 2.2$, $P'_{t_4} = .96(100000)(.60)(.28) = 16100$ #

$P'_{br_4} = 1.01(.28)(.50)(75000) = 10500$ #

$$M.S. = \frac{13870}{14200} - 1 = \underline{-.03}$$

USE $t_{LUG} = .35"$, $t_{BRG} = .32"$

$P'_{br_4} = 13870\left(\frac{.32}{.28}\right) = 15810$ #

$$M.S. = \frac{15810}{14200} - 1 = \underline{.11}$$

A. V. ROE CANADA LIMITED
MALTON - ONTARIO
TECHNICAL DEPARTMENT (Aircraft)

REPORT NO. 7-0529-1
SHEET NO. R52

AIRCRAFT:		PREPARED BY	DATE
C105	AILERON	R. GAVALIS	12-8-54
		CHECKED BY	DATE

LINKS 1, C97

BOLT BENDING (BOLTS THRU CRANK)

$ARM = \frac{.135}{2} + \frac{1.125}{4} = .457"$

$M = 14200(.457) = 6500$ IN #

$d = .50"$, $D = .92$, $\frac{D}{d} = \frac{.92}{.50} = 1.84$

$Z = .25(.5)^3 = .0312$ (REF. BENDING ON BOLTS WITH COLLARS, REP. NO. ESN/TD/22 SEPT. 24, 1948)

$f_t = \frac{6500}{.0312} = 208{,}000$ PSI

$R_t = \frac{208000}{160000} = 1.30$

$P_{\text{ALL SHEAR}} = 37300$ # (DOUBLE SHEAR)

$R_s = \frac{14200(2)}{37300} = .760$

$M.S. = \frac{1}{(.760)^2 + (1.30)^2} - 1 = -.53$

TRY $\frac{9}{16}"$ DIA BOLT (HT = 160-180,000);

$d = .5626"$, $D = 1.1"$, $\frac{D}{d} = \frac{1.1"}{.5625} = 1.96$

$Z = .277(.5626)^3 = .0492$

$f_t = \frac{6500}{.0492} = 132{,}000$ PSI

$R_t = \frac{132{,}000}{160{,}000} = .825$, $R_s = \frac{14200(2)}{47200} = .602$

$M.S. = \frac{1}{(.825)^2 + (.602)^2} - 1 = .11$

A. V. ROE CANADA LIMITED
MALTON - ONTARIO
TECHNICAL DEPARTMENT (Aircraft)

REPORT NO. T-0579-1
SHEET NO. R520

AIRCRAFT:		PREPARED BY	DATE
C105	AILERON	R. GAVALIS	12-8-54
		CHECKED BY	DATE

LINKS 1, 6, & 7

FOR A 5/8" BOLT,

$d = .625"$, $D = 1.0"$, $D/d = 1.60$

$Z = .200(.625)^3 = .0489$

$f_t = \frac{6500}{.0489} = 133{,}000$ psi

$R_t = \frac{133000}{160000} = .831$, $R_s = \frac{14200(2)}{58300} = .487$

$$M.S. = \frac{1}{.831^2 + .487^3} - 1 = .24$$

FOR THE 3/16" BOLT, THE LOG IS,

$e = .575"$, $D = .3625"$, $t = .35"$

$K_{br4} = .87$, $P'_{br4} = 15650\#$, M.S. = .10

FOR THE 5/8" BOLT, THE LOG IS;

$e = .575"$, $D = .475"$, $t = .35"$

$K_{br4} = .73$, $P'_{br4} = 15920\#$, M.S. = .12

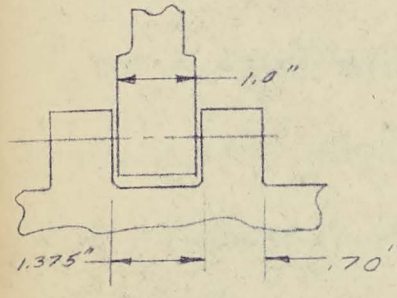
A. V. ROE CANADA LIMITED
MALTON - ONTARIO
TECHNICAL DEPARTMENT (Aircraft)

REPORT No. 7-0574-1
SHEET No. 526

AIRCRAFT:		PREPARED BY	DATE
C105	AILERON	R. GAVALIS	12-9-54
		CHECKED BY	DATE

LINKS 1, C & 7

BOLT BENDING (BOLTS THRU AILERON BRACKET)



LUG THICKNESS IS NOW .70" FOR A M.S. = .10, LUG THICKNESS REQUIRED IS .475"

LEVER #1

$$\text{ARM (ASSUMED)} = \frac{.475}{2} + \frac{1.375}{4}$$

$$\text{ARM} = .582$$

$P = 14200(.582) = 8300$ IN #

TRY: $d = .5625"$, $D = 1.27"$, $D/d = 2.26$

$Z = .350(.5625)^3 = .0623$ IN^3

$f_t = \frac{8300}{.0623} = 133{,}000$ psi, $R_t = \frac{133{,}000}{160{,}000} = .834$

$R_s = \frac{2(14200)}{47200} = .602$

$$M.S. = \frac{1}{(.602)^2 + (.834)^2} - 1 = .10$$

USE $D = 1.27"$ (9/16" BOLT)

FOR A 5/8" BOLT:

$d = .625"$, $D = 1.125"$, $D/d = 1.8$ (LUG IS OK AS IS)

$Z = .241(.625)^3 = .0587$ IN^3

$f_t = \frac{8300}{.0587} = 141{,}000$ psi, $R_t = \frac{141000}{160000} = .882$

$R_s = \frac{2(14200)}{58300} = .488$, $M.S. = \frac{1}{(.488)^2 + (.882)^2} - 1 = .12$

A. V. ROE CANADA LIMITED
MALTON - ONTARIO
TECHNICAL DEPARTMENT (Aircraft)

REPORT No. 7-0574-1
SHEET No. R 53

AIRCRAFT:		PREPARED BY	DATE
C105	AILERON	R GAVALIS	
		CHECKED BY	DATE

LINKS 2 & 3 (REF DWG. 7-0115-87)

$P_{LINK} = \pm 33760\#$ (LIMIT) (REF PS 546 OF AILERON LEVER LOADS)

$P_{LINK_{ULT}} = 1.25(1.364)(33760) = 57500\#$

MINIMUM AREA THRU I SECTION:

$A = 1.25(.25)(2) + .19(1.9) = .891\ IN^2$

$f_c = \frac{57500}{.891} = 64500 psi$

$M.S. = \frac{75000}{64500} - 1 = .16$

FOR SECTION THRU TANGS:

$L = 2.75"$, $P = .289(.25) = .0722\ IN$



$P = \frac{57500}{2} = 28800\#$

$I = \frac{1.25(.25)^3}{12} = .00163\ IN^4$

$\frac{L}{\rho} = \frac{2.75}{.0722} = 38.1$, $B = .0191(38.1) = .691$

$F/F_{0.7} = .90$, $F_c = .90(94000) = 84500 psi$

$f_c = \frac{28800}{1.25(.25)} = 92400 psi$

$M_1 = .17P = .17(28800) = 4900\ IN\#$

ECCENTRICITY MUST BE ELIMINATED

FORM 1319A

A. V. ROE CANADA LIMITED
MALTON - ONTARIO
TECHNICAL DEPARTMENT (Aircraft)

REPORT No. 70579-1
SHEET No. R 54

AIRCRAFT:		PREPARED BY	DATE
C 105	AILERON	R. GAVAZIS	
		CHECKED BY	DATE

LINKS 2 & 3

FOR THE LUGS,

$P_a = 28,800\#$

$e = .80"$, $D = .75$, $W = 1.60 - .20 = 1.40"$

$t = .39"$, $\frac{e}{D} = \frac{.80}{.75} = 1.068$, $\frac{W}{D} = \frac{1.40}{.75} = 1.87$

$P'_{a_{tu}} = .98(.65)(.39)(100,000) = 21600\#$

$P'_{a_{bru}} = .93(.39)(.75)(100,000) = 28600\#$

$M.S. = \frac{21600}{28800} - 1 = \underline{-.25}$

USE $t_{lug} = .500"$

$P'_{a_{tu}} = .98(.65)(.80)(100,000) = 31800\#$

$P'_{a_{bru}} = .93(.80)(.75)(100,000) = 39800\#$

$M.S. = \frac{31800}{28800} - 1 = \underline{.10}$

MINIMUM DEPTH THRU LUG $= .40"$

$P = .289(.40) = .115$, $\frac{L}{D} = \frac{2.75}{.115} = 24$

$B = .0181(24) = .434$, $\frac{F}{F_{cy}} = .98$

$F_c = .98(94000) = 92100$ psi

$f_c = \frac{28800}{1.25(.40)} = 57500$ psi

$M.S. = \frac{92100}{57500} - 1 = \underline{.60}$

A. V ROE CANADA LIMITED
MALTON - ONTARIO
TECHNICAL DEPARTMENT (Aircraft)

REPORT No. 7-0574-1
SHEET No. R540

AIRCRAFT:		PREPARED BY	DATE
C105	AILERON	R. GAVALIS	12-8-54
		CHECKED BY	DATE

LINKS 2 & 3

BOLT BENDING (BOLTS THRU CRANK)

$ARM = \frac{.50}{2} + \frac{1.50}{4} = .625"$

$M = 28800(.625) = 18000$ IN#

$d = .75"$, $D = 1.23"$, $D/d = 1.64$

$Z = .206(.75)^3 = .0866$ IN^3

$f_b = \frac{18000}{.0866} = 208{,}000$ PSI

$R_b = \frac{208000}{160000} = 1.30$, $R_s = \frac{28800(2)}{83900} = .687$

$M.S. = \frac{1}{(1.30)^2 + (1.687)^3} - 1 = \underline{.50}$

FOR A $\frac{7}{8}$" DIA BOLT

$d = .875"$, $D = 1.355"$, $D/d = 1.55$

$Z = .1(.875)^3 = .1272$ IN^3

$f_b = \frac{18000}{.1272} = 141{,}000$ PSI, $R_b = \frac{141000}{160000} = .884$

$R_s = \frac{28800(2)}{114200} = .504$

$M.S. = \frac{1}{(.504)^2 + (.884)^2} - 1 = \underline{.10}$

FOR THE LUG:

$e = .825"$; $D = .875"$, $t = .50"$, $K_{brg} = .755$

$P'_{brg} = 33000$#

$M.S. = \underline{.15}$

FORM 1319A

A. V. ROE CANADA LIMITED
MALTON - ONTARIO
TECHNICAL DEPARTMENT (Aircraft)

REPORT No. T-0579-1
SHEET No. R546

AIRCRAFT:		PREPARED BY	DATE
C105	AILERON	R. GAVALIS	12-9-54
		CHECKED BY	DATE

LINKS 2 & 3

BOLT BENDING (BOLT THRU. AILERON BRACKET)

CONSIDERING PEAKING, LEVER BRACKET LUG THICKNESS CAN BE TAKEN AS .75".

$$ARM_{(ASSUMED)} = \frac{.75}{2} + \frac{1.87}{4} = .842"$$

$P = 28,800^{\#}$, $M = .842(28800) = 24200^{IN\#}$

FOR $d = .8125"$ & $D = 1.73"$

$D/d = 2.13$, $Z = .318(.8125)^3 = .170 IN^3$

$f_t = \frac{24200}{.170} = 142,200 PSI$, $R_t = \frac{142000}{160000} = .890$

$A = \frac{\pi(.8125)^2}{4} = .520 IN^2$, $F_{SU} = 95000 PSI$

$P_{ULL\ SHEAR} = .520(95000) = 49,350^{\#}$

$R_S = \frac{28800}{49350} = .585$

$$M.S. = \frac{1}{(.585)^2 + (.890)^2} - 1 = .01$$

USE $d = .8125"$, $D = 1.80"$

FOR A $\frac{7}{8}"$ DIA. BOLT:

$d = .875"$, $D = 1.65"$, $D/d = 1.65$

$Z = .260(.875)^3 = .174 IN^3$, $f_t = \frac{24200}{.174} = 139000 PSI$

$R_t = \frac{139000}{160000} = .870$, $R_S = \frac{2(28800)}{114200} = .504$

(LUG IS OK)

$$M.S. = \frac{1}{(.870)^2 + (.504)^2} - 1 = .12$$

A. V. ROE CANADA LIMITED
MALTON - ONTARIO
TECHNICAL DEPARTMENT (Aircraft)

REPORT No. 7-0579-1
SHEET No. R 55

AIRCRAFT:		PREPARED BY	DATE
C105	AILERON	R GAVALIS	
		CHECKED BY	DATE

LINKS 4 & 5 (REF. DWG. 7-0116-88)

$P_{LINK} = \pm 26590\#$ (LIMIT) (REF AIL. LEVER LOADS P5 596)
(LEVER #4)

FOR THE MINIMUM SECTION THRU I:

$A = 1.12(.20)(2) + .19(1.25) = .686\ IN^2$

$P_{LINK\ ULT} = 1.25(1.364)(26590) = 45500\#$

$f_c = \frac{45500}{.686} = 66300 psi$

$M.S. = \frac{.92(100000)}{66300} - 1 = .39$

$P_{WEB} = \frac{.19(1.25)}{.686}(45500) = 15700\#$

$f_{s_{WEB}} = \frac{15700}{2(.19)(1.5)} = 31900 psi$, $F_{s_u} = 65,000 psi$

FOR THE LUGS,

$P_a = \frac{45500}{2} = 22,750\#$

$t = .30$, $D = .750"$, $W_e = 1.30"$ $e_e = .70"$

$e/D = \frac{.70}{.750} = .935$, $K_{br_u} = .74$, $K_{br_y} = .73$

$P'_{br_u} = .74(.30)(.750)(100,000) = 16600\#$

$P'_{br_y} = .73(.30)(.750)(75000) = 13160\#$

$W/D = \frac{1.30}{.750} = 1.73$, $K_{tu} = .98$, $A_t = (1.30 - .75)(.30) = .165$

$P'_{t_u} = .98(.165)(100,000) = 16200\#$

$M.S. = \frac{16200}{22750} - 1 = -.29$

A. V. ROE CANADA LIMITED
MALTON - ONTARIO
TECHNICAL DEPARTMENT (Aircraft)

REPORT No. 7-0574-1
SHEET No. R 56

AIRCRAFT:		PREPARED BY	DATE
C 105	AILERON	R. GAVOLIS	
		CHECKED BY	DATE

LINKS 4 & 5

USE $t_{LUG} = .400$ INCREASE WIDTH OF STRAPS AS SHOWN

$P'_{brU} = .84(.75)(.40)(100{,}000) = 25200\#$

$M.S. = \frac{25200}{22750} - 1 = .11$

FOR A SECTION THRU THE LANGS:

$L = 2.52"$, $C = .289(.30) = .0867"$

$\frac{L}{D} = \frac{2.52}{.0867} = 29$, $B = .0181(29) = .526$

$F/F_{0.7} = .96$, $F_c = .96(94000) = 90{,}200$ psi

$f_{c\,max} = \frac{22750}{1.12(.30)} = 67700$ psi

$M.S. = \frac{90200}{67700} - 1 = .33$

$M.S. = \frac{75000(.96)}{67700} - 1 = .06$

BASED ON F_c ($\phi = 0$) $= F_{cy}$

FOR LINK #5 AT THE LUG,

$t = .40"$, $e = .70"$, $D = .625"$

$e/D = \frac{.70}{.625} = 1.12$, $K_{brU} = 1.0$

$P'_{brU} = 1.0(.625)(.40)(100{,}000) = 25{,}000\#$

$P = 19960(1.25)(1.364) = 34000\#$

$M.S. = \frac{25000(2)}{34000} - 1 = .47$

RM 1319A

A. V. ROE CANADA LIMITED
MALTON - ONTARIO
TECHNICAL DEPARTMENT (Aircraft)

REPORT No. T-0574-1
SHEET No. R56a

AIRCRAFT:		PREPARED BY	DATE
C105	AILERON	R. GAVALIS	12-9-54
		CHECKED BY	DATE

LINKS 4 & 5

BOLT BENDING (BOLTS THRU CRANK)

CONSIDER LINK #4:

$ARM = \frac{.40}{2} + \frac{1.38}{4} = .545"$

$P = 22{,}750\#$, $M = 22750(.545) = 12{,}400$ IN#

$d = .750"$, $D = 1.23"$, $D/d = \frac{1.23}{.750} = 1.64$

$Z = .206(.75)^3 = .0866 IN^3$

$f_t = \frac{12400}{.0866} = 143{,}000$ psi, $R_t = \frac{143000}{160000} = .895$

$R_s = \frac{2(22750)}{83900} = .542$

$M.S. = \frac{1}{(.542)^3 + (.895)^2} - 1 = .04$

USE $D = 1.25"$ (M.S. = .10)

CONSIDER LINK #5:

$ARM = .545"$, $P = 17000\#$

$M = .545(17000) = 9260$ IN#

$d = .625"$, $D = 1.00"$, $D/d = \frac{1.0}{.625} = 1.6$

$Z = .2(.625)^3 = .0488 IN^3$

$f_t = \frac{9260}{.0488} = 190{,}000$ psi, $R_t = \frac{190000}{160000} = 1.19$

$R_s = \frac{2(17000)}{58300} = .584$

$M.S. = \frac{1}{(.584)^3 + (1.19)^2} - 1 = -.38$

A. V. ROE CANADA LIMITED
MALTON - ONTARIO
TECHNICAL DEPARTMENT (Aircraft)

REPORT No. T-0579-1
SHEET No. R566

AIRCRAFT:		PREPARED BY	DATE
C105	AILERON	R. GAVALIS	12-9-54
		CHECKED BY	DATE

LINKS 4 & 5

TRY: $d = .625"$, $D = 1.25"$, $D/d = 2.00$

$Z = .285(.625)^3 = .0695 IN^3$

$f_t = \frac{9260}{.0695} = 133000 psi$, $R_t = \frac{133000}{160000} = .832$

$R_s = .584$

$M.S. = \frac{1}{(.832)^2 + (.584)^3} - 1 = .11$

TRY: $d = .750"$, $D = 1.1"$, $D/d = 1.47$

$Z = .173(.75)^3 = .073$, $f_t = \frac{9260}{.073} = 127,000 psi$

$R_t = \frac{127000}{160000} = .795$, $R_s = \frac{2(17000)}{83900} = .406$

$M.S. = \frac{1}{(.406)^3 + (1.795)^2} - 1 = .43$

THE LUG SIZE FOR A 3/4" BOLT IS.

$C = .750"$, $d = .750"$, $e/d = 1.0$

$K_{brU} = .83$, $P'_{brU} = 24850\#$, $M.S. = .46$

A. V. ROE CANADA LIMITED
MALTON - ONTARIO
TECHNICAL DEPARTMENT (Aircraft)

REPORT No. 7-0574-1
SHEET No. R56C

AIRCRAFT:		PREPARED BY	DATE
C105	AILERON	R. GAVALIS	12-9-54
		CHECKED BY	DATE

LINKS 4 & 5

BOLT BENDING (BOLT THRU AILERON BRACKET)

FOR LINK # 4:

CONSIDERING PEAKING IN THE LEVER BRACKET LUGS, THEIR THICKNESS CAN BE TAKEN AS .725".

$$\text{ARM (ASSUMED)} = \frac{.725}{2} + \frac{1.56}{4} = .753"$$

$P = 22{,}750^{\#}$, $M = 22750(.753) = 17{,}100^{IN\#}$

FOR A 11/16" BOLT,

$d = .688"$, $D = 1.72"$, $D/d = 2.50$

$Z = .413(.688)^3 = .1342\ IN^3$

$f_t = \frac{17100}{.1342} = 127{,}400\ psi$, $R_t = \frac{127400}{160000} = .796$

$A = \frac{\pi(.688)^2}{4} = .372\ IN^2$, $P_{ALL\ SHEAR} = 95000(.372) = 35{,}300^{\#}$

$R_s = \frac{22750}{35300} = .645$

$$M.S. = \frac{1}{(.796)^2 + (.645)^2}^{-1} = .11$$

FOR A 3/4" DIA. BOLT,

$d = .75"$, $D = 1.525"$, $D/d = 2.04$

$Z = .296(.75)^3 = .1245\ IN^3$

$f_t = \frac{17100}{.1245} = 137{,}300\ psi$

$R_t = \frac{137300}{160{,}000} = .860$, $R_s = \frac{22750(2)}{83900} = .541$

$$M.S. = \frac{1}{(.860)^2 + (.541)^2}^{-1} = .11$$

A. V. ROE CANADA LIMITED
MALTON - ONTARIO
TECHNICAL DEPARTMENT (Aircraft)

REPORT No. Z-0574-1
SHEET No. R 560

AIRCRAFT		PREPARED BY	DATE
C105	AILERON	R. GAVALIS	12-9-54
		CHECKED BY	DATE

LINKS 4 & 5

FOR LINK #5:

CONSIDERING PEAKING, THE LEVER BRACKET LUG THICKNESS CAN BE TAKEN AS .570".

$A_{REA} = \frac{.570}{2} + \frac{1.69}{4} = .707''$ (ASSUMED)

$P = 17000\#$, $M = 17000(.707) = 12,010$ IN#

FOR A 11/16" DIA BOLT:

$d = .688$, $D = 1.3$, $D/d = 1.89$

$Z = .260(.688)^3 = .0845$ IN^3

$f_t = \frac{12010}{.0845} = 142000$ psi, $R_t = \frac{142000}{160000} = .890$

$R_s = \frac{17000}{35300} = .482$ $\quad M.S. = \frac{1}{(.890)^2 + (.482)^3} - 1 = .11$

FOR A 3/4" BOLT:

$d = .75$, $D = 1.2$"; $D/d = 1.60$, $Z = .084$ IN^3

$f_t = \frac{12010}{.084} = 143000$, $R_t = \frac{143,000}{160,000} = .895$

$R_s = \frac{17000}{41950} = .406$, $M.S. = \frac{1}{(.406)^2 + (.895)^2} - 1 = .15$

FOR A 5/8" BOLT: $d = .625$, $D = 1.475$"

$D/d = 2.36$, $Z = .375(.623)^2 = .0915$

$f_t = 132,000$ psi, $R_t = .824$

$R_s = \frac{17000}{29160} = .585$, $M.S. = .14$

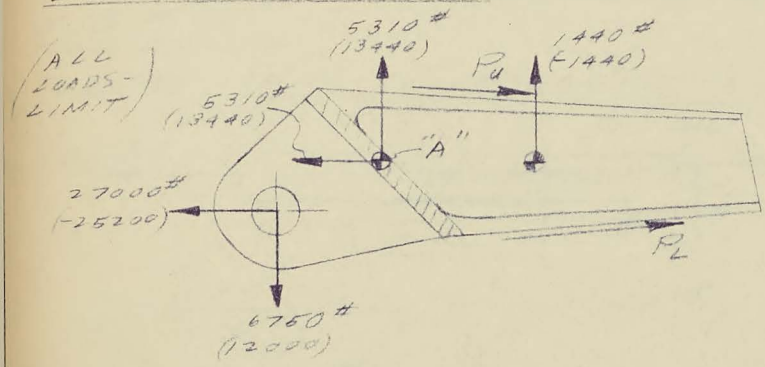
A. V. ROE CANADA LIMITED
MALTON - ONTARIO
TECHNICAL DEPARTMENT (Aircraft)

REPORT No. Z-0579-1
SHEET No. R 57

AIRCRAFT:		PREPARED BY	DATE
C105	AILERON	R. GAVALIS	
		CHECKED BY	DATE

RIB #2

LEVER BRACKET



SUPERSONIC - AIL. DWN
(FIGURES IN ( ) ARE FOR SUPER - AIL. UP
(REF. Pg. 40)

$\Sigma M_A = 27000(1.85) - 6750(1.72) - 1440(4.88) + 1.5P_U - 1.85P_L$

$\Sigma F_n = P_U + P_L - 27000 - 5310 = 0$

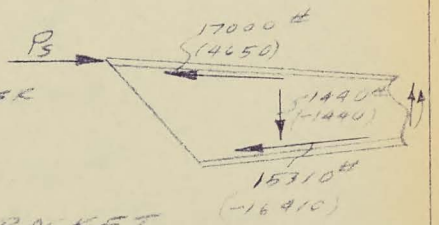
$P_U = 17000\#$, $P_L = 15310\#$ FOR DWN-SUPER

$P_U = 4650\#$, $P_L = -16410\#$ FOR UP-SUPER

FOR THE RIB,

$P_S = 17000 + 15310 = 32310\#$ FOR DWN.-SUPER

$P_S = -11760\#$ FOR UP-SUPER



FOR LOWER SKIN-TO-BRACKET ATTACHMENTS:

$P = 16410(1.369) = 22400\#$ (OUT.)

NOW: (12) - 1/4" DIA. AN 509 SCREWS

$P_{ALL} = 12(2010) = 24100\#$

$M.S. = \frac{24100}{22400} - 1 = .08$

A.V. ROE CANADA LIMITED
MALTON – ONTARIO

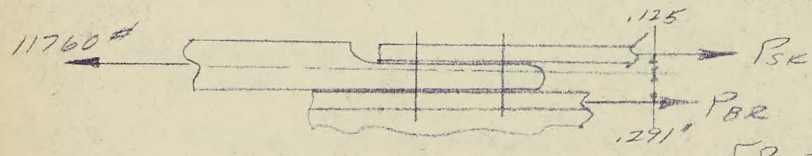
TECHNICAL DEPARTMENT (Aircraft)

REPORT NO. Z-0579-1
SHEET NO. R 572

AIRCRAFT		PREPARED BY: R. GAVALIS	DATE:
C105	AILERON	CHECKED BY:	DATE:

RIB #2

UPPER SKIN-TO-BRACKET ATTACH.

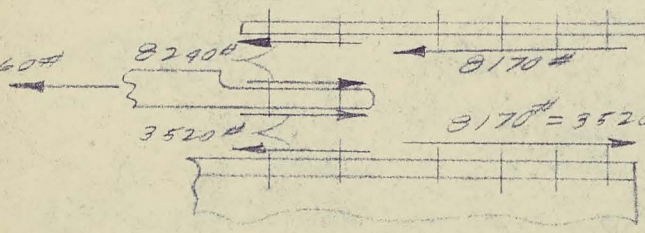


$P_{BR} = \frac{.125}{.416}(11760) = 3520\#$

$P_{SK} = 8240\#$

$P_{BR} = 9710\#$
$P_{SK} = 22600\#$
FOR AIL. DWN-SUPER

8170+8240=16410# = P_L



$P = 8170(1.364) = 11160\#$

NOW: (26) – 3/16" DIA. HOOKS

$P_{ALL} = 26(770) = 20,000\#$

$M.S. = \frac{20000}{11160} - 1 = .80$

A. V. ROE CANADA LIMITED
MALTON - ONTARIO
TECHNICAL DEPARTMENT (Aircraft)

REPORT No. 20579-1
SHEET No. R 58

AIRCRAFT:		PREPARED BY	DATE
C105	AILERON	R. GAVALIS	
		CHECKED BY	DATE

RIB #2

LEVER BRACKET

FOR THE SKIN-TO-SPAR ATTACHMENTS:

$P_{SKIN} = 22600\#$ (LIMIT)

$q_o = \frac{22600(1.364)(1.3)}{16.75} = 2390\ \#/in$

$q_s = 1.364(1.2)(.246) = 403\ \#/in$

$q_d = [(2390)^2 + (403)^2]^{\frac{1}{2}} = 2420\ \#/in$

USE: (2) ROWS OF $\frac{3}{16}$" DIA. SCREWS @ 1.1"

$q_{all} = \frac{1440(2)}{1.1} = 2620\ \#/in$

$M.S. = \frac{2620}{2420} - 1 = .08$

FOR ATTACHMENTS THRU UPPER SKIN, SPAR & LEVER BRACKET:

THE LOAD IN THE SKIN IN THIS REGION IS,

$P_{SKIN} = 2420(3.0) = 7260\#$

& $P_{BRACKET} = 1.364(9710) = 13220\#$ (ULT)

$\therefore P_{SPAR} = 7260 + 13220 = 20480\#$ (ULT)

USE: (4) - $\frac{1}{4}$" SCREWS AN [illegible] AT

$P_{ALL\ SHEAR} = 4(3680) = 14700\#$

$M.S. = \frac{14700}{13220} - 1 = .11$

$P_{ALL\ by\ SKIN} = 4(2010) = 8040\#$

$M.S. = \frac{8040}{7260} - 1 = .10$

A. V. ROE CANADA LIMITED
MALTON - ONTARIO
TECHNICAL DEPARTMENT (Aircraft)

REPORT No. 7-0579-1
SHEET No. R 59

AIRCRAFT:		PREPARED BY	DATE
C105	AILERON	R. GAVALIS	
		CHECKED BY	DATE

RIB #2

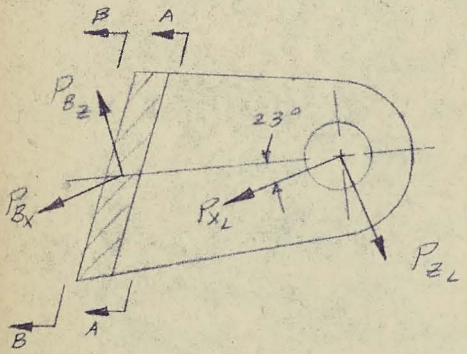
$P_{ALL\ BY\ BRACKET} = .20(\frac{1}{4})(1.364)(72000)(9) = 19600\#$ (U.C.)

$P_{ALL\ BY\ SPAR} = .25(\frac{1}{4})(1.364)(4)(63500) = 21700\#$

$P_{ALL\ BY\ SPAR\ (ANG-5)} = .420(1.364)(63500) = 22200$ (A)

$M.S. = \frac{22200}{20480} - 1 = .08$

FOR THE LUGS:



$P_{X_L} = 25200\#$ (LIMIT), $P_{Z_L} = 12000\#$ (LIMIT)

$P_{AXIAL} = 18520\#$ (LIMIT)

$P_{TRANS.} = 20830\#$ (LIMIT)
AIL. UP - SUPERSONIC

$b_{AVE} = \frac{6}{\frac{3}{.85} + \frac{1}{1.0} + \frac{2}{.62}} = .773"$

$\frac{b_{AVE}}{b_{BY}} = \frac{.773}{1.00} = .773$, $K_{TRU} = .505$, $K_{TRY} = .88$

$P'_{TRU} = .505(1.00)(1.1)(56900) = 31200\#$

$M.S. = \frac{31200(2)}{1.364(20830)} - 1 = 1.20$

DECREASE LUG SIZE

FOR BENDING AT A-A:

$M = 20830(2.0)(1.364) = 57000$ in-lbs (ULT.)

$I = \frac{2(1.1)(3.25)^3}{12} = 6.30$ in^4, $f_b = \frac{57000(1.625)}{6.30} = 14700$ psi

A. V. ROE CANADA LIMITED
MALTON - ONTARIO
TECHNICAL DEPARTMENT (Aircraft)

REPORT NO. 7-0577-1
SHEET NO. R60

AIRCRAFT:		PREPARED BY	DATE
C105	AILERON	R. GAVALIS	
		CHECKED BY	DATE

RIB #2

$f_c = \frac{3520(.1364)}{2(1.1)(3.25)} = 3540 \text{ psi}, R_L = \frac{(1900+3540)}{56400} = .324$

$f_s = \frac{2083(1.369)(11.5)}{2(1.1)(3.25)} = 5960 \text{ psi}, R_S = \frac{5960}{35500} = .168$

$M.S. = \frac{1}{\sqrt{(.324)^2+(.168)^2}} - 1 = \underline{1.74}$

DECREASE LUG THICKNESS TO .70"

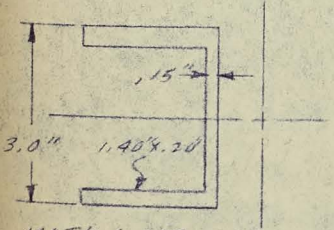
$M.S._{LUG} = \frac{.70}{1.1}(2.20) - 1 = \underline{.40}$

$M.S._{SECT. A-A} = \frac{.70}{1.1}(2.74) - 1 = \underline{.74}$

x_L = ECCENTRICITY OF LOAD NEGLECTED

LUG THICKNESS MAY BE REDUCED FURTHER IF HEIGHT (3.25") DOES NOT DECREASE.

FOR BENDING AT SECTION B-B:



MAT'L: 145-T6 FORGING

$\left(\frac{e}{t}\right)_{FLANGE} = \frac{1.40}{.20} = 7.0$

F_{cu} T=260° = 46,000 psi

$M_x = 3.2 P_{ZL} - .70 P_{XL} + 1.2 P_{BZ} + .14 P_{BX}$

$M_x = 3.2(-12000) - .70(25200) + 1.2(13440) + .14(-13440)$

$M_x = 1.364(41800) = 57000 \text{ in\#(ULT.)}$

$V = 1.364(1440) = 1965 \text{ \#(ULT.)}$

A. V. ROE CANADA LIMITED
MALTON - ONTARIO
TECHNICAL DEPARTMENT (Aircraft)

REPORT No. 7-0579-1
SHEET No. R 61

AIRCRAFT:	
C 105	AILERON

PREPARED BY	DATE
R. GAVALIS	
CHECKED BY	DATE

RIB #2

$P_o = 1.364(11760) = 16030\#$ (ULT) (AIL.-UP SUPER.)

$I_x = 2\left[\frac{.15(2.60)^3}{12} + 1.40(1.20)(2)(1.40)^2\right] = 2.69\ in^4$

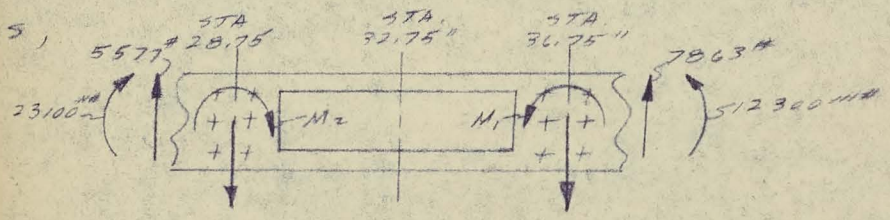
$f_b = \frac{57000(1.50)}{2.69} = 32400\ psi$, $A = 1.90\ in^2$

$f_c = \frac{16030}{1.90} = 8450\ psi$, $R_c = \frac{32400+8950}{46000} = .887$

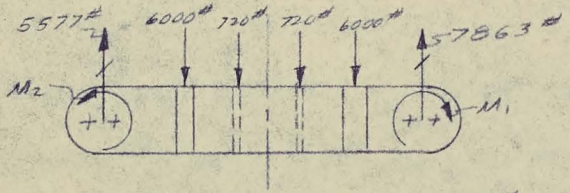
$f_s = \frac{1965(1.5)}{1.90} = 1550\ psi$, $R_s = \frac{1550}{35500} = .044$

$$M.S. = \frac{1}{\sqrt{(.887)^2+(.044)^2}} - 1 = .12$$

THE SPAR LOADING IN THIS REGION IS,



& THE LEVER BRACKET LOADS ARE,



(ALL LOADS-LIMIT)

$M_1 = 15300$ in# (LIMIT), $M_2 = 6200$ in# (LIMIT)

FOR THE EARS OF THE BRACKET:

$M_{MAX} = 15300/(1.364)(1.414) = 29500$ in# (ULT)

$V_{MAX} = 7863/(1.364)(1.414) = 15200\#$ (ULT)

$P_{V_{MAX}} = \frac{15200}{4} = 3800\#$

A. V ROE CANADA LIMITED
MALTON - ONTARIO
TECHNICAL DEPARTMENT (Aircraft)

REPORT NO. 7-0579-1
SHEET NO. R 62

AIRCRAFT:		PREPARED BY	DATE
C105	AILERON	R. GAUALIS	
		CHECKED BY	DATE

RIB #2

$r^2 = 4(1.41)^2 = 8.02\ in^2$

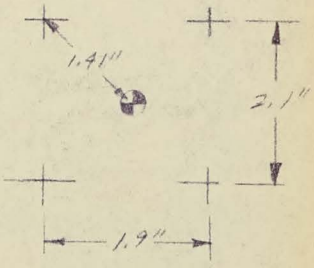
$P_M = \frac{29500(1.41)}{8.02} = 5200\#$

$P_{M_V} = \frac{.95}{1.41}(5200) = 3500\#$

$P_{M_H} = \frac{1.05}{1.41}(5200) = 3860\#$

$P_{V_{TOTAL}} = 3500 + 3800 = 7300\#$

$P_{H_{TOTAL}} = 3860\#$, $P_{RESULT.} = 8260\#$



USE NAS 146 BOLTS,

$P_{ALL\ SHEAR} = 10500\#$ $\quad M.S. = \frac{10500}{8260} - 1 = .27$

$P_{ALL\ IN\ EAR} = \frac{3}{8}(.260)(1.364)(72000) = 9580\#$

$M.S. = \frac{9580}{8260} - 1 = .16$

$P_{ALL\ PER\ LUG} = .310(\frac{3}{8})(1.364)(63500) = 10,000\#$ (O.K.)

AT SECTION THRU INNERMOST BOLTS (OR EAR)

$M = 6760\ in\#$ (ULT.) , $V = 15200\#$ (ULT.)

$I = \frac{.260(3.6)^3}{12} = 1.01\ in^4$, $f_b = \frac{6760(1.8)}{1.01} = 12400\ psi$

$R_b = \frac{12400}{46800} = .264$

$f_s = \frac{15200(1.5)}{[3.6 - 2(\frac{3}{8})](1.260)} = 3090\ psi$

A. V. ROE CANADA LIMITED
MALTON - ONTARIO
TECHNICAL DEPARTMENT (Aircraft)

REPORT No. 7-0579-1
SHEET No. R 63a

AIRCRAFT: C105	AILERON	PREPARED BY: R GAVALIS	DATE:
		CHECKED BY:	DATE:

RIB #2

$M_{ALL\ SKIN} = 5.1(.051)(2)(29800)(1.32) = 20400$ IN-#

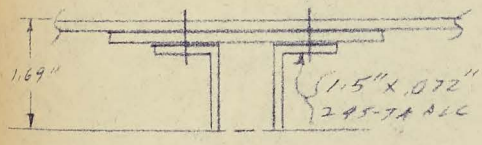
$M_{ALL\ TOTAL} = 9860 + 20400 = 30260$ IN-#

$M.S. = \frac{30260}{1.369(22800)} - 1 = \underline{-.03}$

INCREASE FLANGE TO .90" & EXTEND DOUBLER AFT

SECTION AT $\frac{x}{c} = .825$ (9.5" AFT OF L.E.)

$M_{SUBR} = 42300$ IN-# (LIMIT), $V_{SUBR} = 1500$ # (LIMIT) (REF RS 906)



$\frac{b}{t} = \frac{1.50}{.072} = 20.8$

$F_a = 16200$ psi

$I_{RIB} = \frac{2(.072)(2.98)^3}{12} + 4(.072)(1.50)(1.52)^2 = 1.32$ IN⁴

$M_{ALL\ RIB} = \frac{16200(1.32)}{1.56} = 13700$ IN-#

$f_{DOUBLER} = \frac{1.60}{1.52}\left(\frac{9.7}{9.2}\right)(16200) = 18000$ psi

$W_{DOUBLER} = 5.55$", $M_{ALL\ DOUBL.} = 2(.081)(5.55)(1.66)(18000) = 26000$ IN-#

$f_{SKIN} = \frac{1.66}{1.52}\left(\frac{9.7}{9.2}\right)(16200) = 18700$ psi

$\frac{\sigma_u}{f} = \frac{1830}{18700} = .098$, $\frac{b_m}{b} = .418$, $b_m = .418(7.07) = 2.95$"

$b_{TOTAL} = 2.95 + 2.6 = 5.55$"

$M_{ALL\ SKIN} = 2(5.55)(1.051)(18700)(1.66) = 17600$ IN-#

A. V. ROE CANADA LIMITED
MALTON - ONTARIO
TECHNICAL DEPARTMENT (Aircraft)

REPORT No. Z-0579-1
SHEET No. R 63b

AIRCRAFT:		PREPARED BY	DATE
C105	AILERON	R. GAVALIS	
		CHECKED BY	DATE

RIB #2

$M_{ALL\ TOTAL} = 13700 + 26000 + 17600 = 57300^{LBS}$

$M.S. = \frac{57300}{1369(42300)} - 1 = +.01$

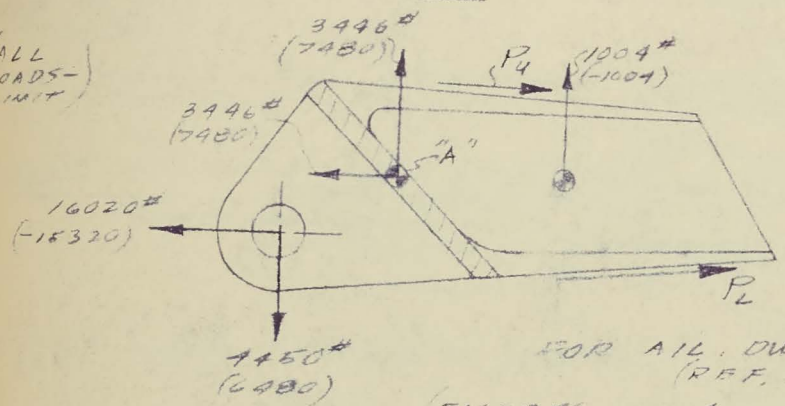
A. V. ROE CANADA LIMITED
MALTON - ONTARIO
TECHNICAL DEPARTMENT (Aircraft)

REPORT NO. 7-0579-1
SHEET NO. R64

AIRCRAFT:		PREPARED BY	DATE
C105	AILERON	R. GAVALIS	
		CHECKED BY	DATE

RIB #1

LEVER BRACKET



FOR AIL. DWN. - SUPER (REF. PG. 90)
(FIGURES IN ( ) ARE FOR AIL. UP - SUPER)

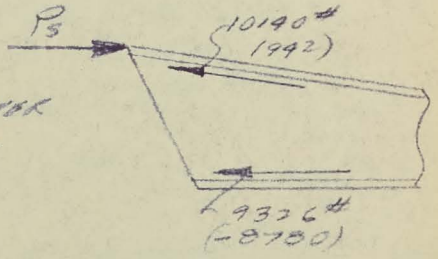
$\Sigma M_A = 16020(.62) - 9450(2.1) - 1004(9.1) - 2.1 P_L + 1.68 P_U = 0$

$\Sigma F_n = P_U + P_L - 16020 - 3446 = 0$

$P_U = 10140\#$, $P_L = 9326\#$ FOR DWN. - SUPER.

$P_U = 942\#$, $P_L = -8730\#$ FOR UP - SUPER.

FOR THE RIB,



$P_S = 10140 + 9326 = 19470\#$ FOR DWN. - SUPER

$P_S = -7540\#$ FOR UP - SUPER

FOR LWR. SKIN - TO - BRACKET ATTACH.:

$P = 9326(1.364) = 12710\#$ (ULT.)

NOW: (6) - $\frac{1}{4}$" BOLTS & (2) - $\frac{3}{16}$" SCREWS

$P_{ULL\ BOLTS} = 6(2010) = 12070\#$

$P_{ULL\ SCREWS} = .40(1440)(2) = 1150\#$, $P_{ULL} = 13220\#$

M FACTOR FOR SHANKING OF SCREWS (CONSERVATIVE)

$M.S. = \frac{13220}{12710} - 1 = .04$

A.V. ROE CANADA LIMITED
MALTON – ONTARIO

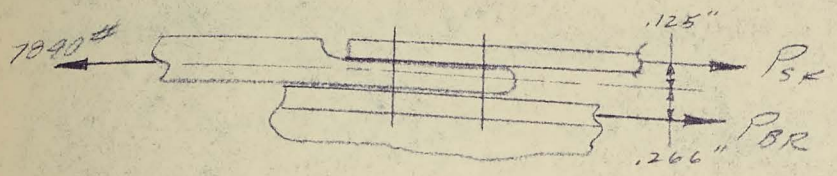
TECHNICAL DEPARTMENT (Aircraft)

REPORT NO. Z-0574-1
SHEET NO. R 64 a

AIRCRAFT		PREPARED BY:	DATE:
C105	AILERON	R. GAVALIS	
		CHECKED BY:	DATE:

RIB #1

UPR. SKIN-TO-BRACKET ATTACH.



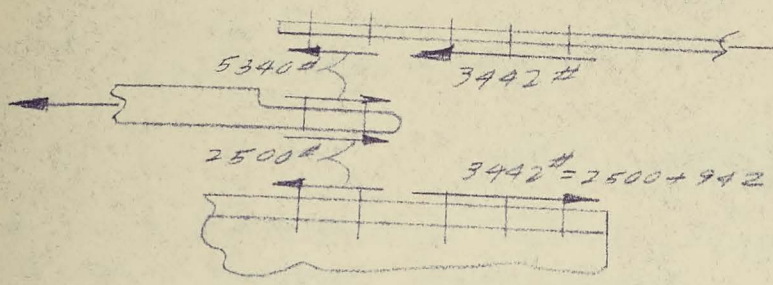
(COND, AIL, UP – SUPER)

$P_{BR} = \frac{.125}{.391}(7840) = 2500\#$

$P_{SK} = 5340\#$

[P_{BR} = 6220# D/L DWN SUPR.
P_{SK} = 13260# SUPR.]

3442 + 5340 = 8780 = P_L



$P = 3442(1.364) = 4700\#$ (ULT)

NOW: (8) – 3/16" DIA. HUCKS

$P_{ALL} = 8(770) = 6150\#$

$M.S. = \frac{6150}{4700} - 1 = .31$

A. V. ROE CANADA LIMITED
MALTON - ONTARIO
TECHNICAL DEPARTMENT (Aircraft)

REPORT No. Z-0579-1
SHEET No. R 65

AIRCRAFT:		PREPARED BY	DATE
C105	AILERON	R. GAVALIS	
		CHECKED BY	DATE

RIB #1

FOR THE UPPER SKIN-TO-SPAR ATTACHMENT:

$P_{SKIN} = 13250\#$ (ULT.)

$q_c = \frac{13250(1.364)(.15)}{16.40} = 1430\ \#/in$

$q_s = 1.364(1.2)(202) = 330\ \#/in$

$q_{rl} = [(1430)^2 + (330)^2]^{\frac{1}{2}} = 1470\ \#/in$ (ULT.)

USE: 1 ROW OF $\frac{3}{16}$" DIA. AN509 @ .90"

$q_{ALL} = \frac{1440}{.90} = 1600\ \#/in$

$M.S. = \frac{1600}{1470} - 1 = .09$

FOR ATTACHMENTS THRU UPPER SKIN, SPAR & LEVER BRACKET:

THE LOAD IN THE SKIN IN THIS REGION IS,

$P_{SKIN} = 1470(2.5) = 3680\#$ (ULT.)

& $P_{BRACKET} = 6240(1.364) = 8510\#$ (ULT.)

$\therefore P_{SPAR} = 3680 - 8510 = 12190\#$ (ULT.)

TRY: (4) - $\frac{1}{2}$" BOLTS

$P_{ALL\ SHEAR} = 4(3680) = 14700\#$

$P_{ALL\ BY\ BRACKET} = \frac{1}{4}(.15)(1.364)(72000)(4) = 14700\#$

$M.S. = \frac{14700}{8510} - 1 = .73$

$P_{ALL\ BY\ SPAR} = \frac{1}{4}(.340)(1.364)(63600)(4) = 21640\#$ $M.S. = \frac{21640}{12190} - 1 = .78$

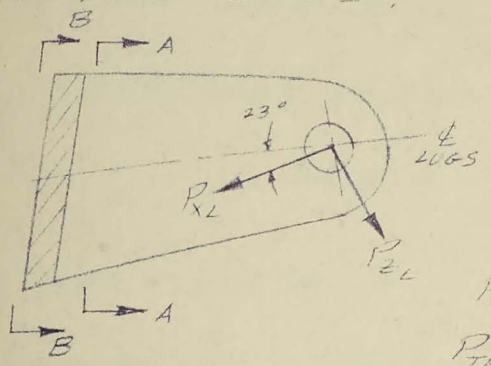
A. V. ROE CANADA LIMITED
MALTON - ONTARIO
TECHNICAL DEPARTMENT (Aircraft)

REPORT No. 2-0579-1
SHEET No. R67 (No. R66)

AIRCRAFT: C105	AILERON	PREPARED BY R. GAVALIS	DATE
		CHECKED BY	DATE

RIB #1

FOR THE LUGS:



$R_{XL} = 15320^{\#}$ (LIMIT)

$R_{ZL} = 6980^{\#}$ (LIMIT)
(FOR AIL. UP-SUPER)

$P_{AXIAL} = 11580^{\#}$ (LIMIT)

$P_{TRANS.} = 11930^{\#}$ (LIMIT)

$$b_{AVE} = \frac{6}{\frac{4}{.80} + \frac{2}{.50}} = .666"$$

$$\frac{b_{AVE}}{b_{BR}} = \frac{.666}{.666} = 1.0, \quad K_{TRU} = .525$$

$$P'_{TRU} = .525(.666)(.85)(56400) = 16720^{\#}$$

$$M.S. = \frac{16720(2)}{1.369(11930)} - 1 = \underline{1.06}$$

FOR SECTION A-A:

$M = 11930(1.364)(1.3) = 21200^{IN\#}$ (ULT.)

$V = 11930(1.364) = 16300^{\#}$ (ULT.)

$P_a = 15800^{\#}$ (ULT.)

$$I = \frac{2(.85)(3.3)^3}{12} = 5.1010^{-9}, \quad f_b = \frac{21200(1.65)}{5.10} = 6850 \text{ PSI}$$

$$f_c = \frac{15800}{2(.84)(3.3)} = 2820 \text{ PSI}, \quad R_c = \frac{2820 + 6850}{56400} = .172$$

$$f_s = \frac{16300(1.5)}{.85(3.3)(2)} = 4350 \text{ PSI}, \quad R_s = \frac{4350}{35400} = .123$$

$$M.S. = \frac{1}{\sqrt{(.172)^2 + (.123)^2}} - 1 = \underline{3.7}$$

DRM 1318A

A. V. ROE CANADA LIMITED
MALTON - ONTARIO
TECHNICAL DEPARTMENT (Aircraft)

REPORT No. Z-0574-1
SHEET No. R 68

AIRCRAFT:		PREPARED BY	DATE
C 105	AILERON	R. GAVALIS	
		CHECKED BY	DATE

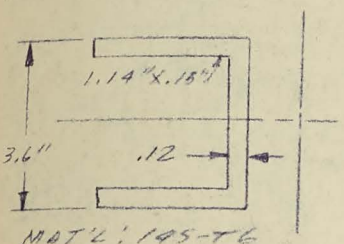
RIB #1

DECREASE LUG THICKNESS TO .60"

$P'_{TR_U} = 1.525(1.666)(.60)(56400) = 11800\#$

$$M.S. = \frac{11800(2)}{1.364(11930)} - 1 = .45$$

FOR SECTION B-B;



MAT'L: 14S-T6 FORGING

$\left(\frac{D}{t}\right)_{LUGS} = \frac{1.14}{.15} = 7.6$

F_{cu} $_{T=250°}$ $= 49{,}000$ psi

$M_y = 3.56 P_{ZL} - .96 P_{XL} + .16 P_{Bx} + 1.47 P_{Bz} = 0$

$M_y = 3.56(-6480) - .96(15320) + .16(-7480) + 1.47(7480) = 0$

$M_y = -20250\#$ (LIMIT), $V_z = 1009\#$ (LIMIT)

$P_a = 7840\#$ (LIMIT) REF P 3.64 (AIL. DP SUPERSONIC)

$I_y = 2\left[\frac{.12(3.3)^3}{12} + 1.14(.15)(2)(1.73)^2\right] = 2.76$ IN^4

$f_b = \frac{20250(1.364)(.8)}{2.76} = 18{,}050$ psi

$A = 2[3.3(.12) + 1.14(.15)(2)] = 1.48$ IN^2

$f_c = \frac{7840(1.364)}{1.48} = 7220$ psi; $R_L = \frac{18050+7220}{49000} = .575$

$f_s = \frac{1004(1.364)(.06)}{1.48} = 139$ psi, $R_S = \frac{1390}{35500} = .039$

FORM 1319A

A. V. ROE CANADA LIMITED
MALTON · ONTARIO
TECHNICAL DEPARTMENT (Aircraft)

REPORT No. 2-0574-1
SHEET No. R 69

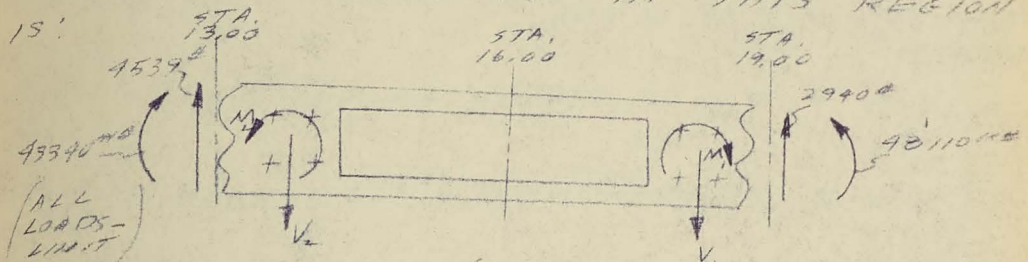
AIRCRAFT: C105	AILERON	PREPARED BY: R. GAVALIS	DATE:
		CHECKED BY:	DATE:

R18 #1

$$M.S. = \frac{1}{\sqrt{(1.575)^2 + (1.037)^2}} - 1 = .73$$

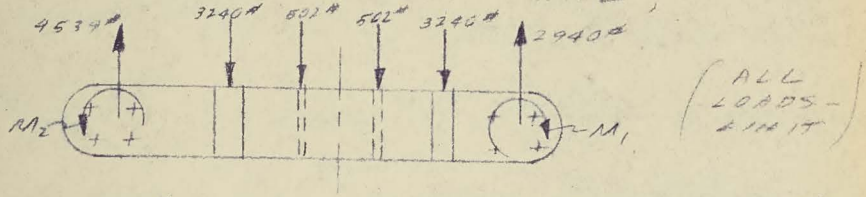
THICKNESS OF FLANGE NEEDED FOR BEARING OF SCREWS. DECREASE FLANGE WIDTH IF POSSIBLE.

THE SPAR LOADING IN THIS REGION IS:



(AIL. UP - SUPERSONIC)

& THE BRACKET LOADS ARE;



$M_1 = 2000$ IN#, $M_2 = 6790$ IN# FROM LEAST WORK THEORY

FOR THE EARS OF THE BRACKET:

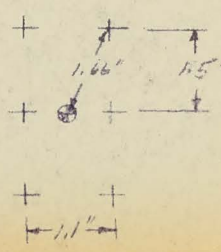
$$M_{MAX} = 1.364(1.414)(6790) = 13100\#$$

$$V_{MAX} = 1.364(1.414)(4539) = 8740\#$$

$$P_{V_{MAX}} = \frac{8740}{6} = 1454\#$$

$$L^2 = 4(1.66)^2 + 2(.55)^2 = 11.65$$

$$P_M = \frac{13100(1.66)}{11.65} = 1865\#$$



CRM 1312A

A. V. ROE CANADA LIMITED
MALTON - ONTARIO
TECHNICAL DEPARTMENT (Aircraft)

REPORT No. Z-0579-1
SHEET No. R 70

AIRCRAFT:		PREPARED BY	DATE
C105	AILERON	R. GAVALIS	
		CHECKED BY	DATE

RIB #1

$P_{MU} = 1865\left(\frac{.55}{1.66}\right) = 618^{\#}$

$P_{MA} = 1865\left(\frac{1.50}{1.66}\right) = 1762^{\#}$

$P_{V_{TOT.}} = 2072^{\#}$, $P_{H_{TOT}} = 1762^{\#}$

$P_{RESULT.} = 2720^{\#}$

$$M.S. = \frac{3680}{2720} - 1 = .35$$

$P_{ALL\ BY\ BAR} = .20\left(\frac{1}{4}\right)(1.364)(72000) = 4900^{\#}$

$P_{ALL\ BY\ SPAR} = .20\left(\frac{1}{4}\right)(1.364)(63500) = 4340^{\#}$ (O.K.)

AT SECTION THRU INNERMOST BOLTS.

$M = 2925^{\#-"}$ (ULT.), $V = 8740^{\#}$ (ULT.)

$I = \frac{.20(4.2)^3}{12} = 1.23 IN^4$, $f_b = \frac{2925(2.1)}{1.23} = 5000 psi$

$\frac{h}{t} = \frac{4.2}{2(.20)} = 10.5$, $F_{ca} = 35000 psi$, $R_t = \frac{5000}{35000} = .143$

$f_s = \frac{8740(1.5)}{(4.2 - \frac{1}{4}(4))(1.20)} = 20500 psi$, $R_s = \frac{20500}{35500} = .577$

$$M.S. = \frac{1}{\sqrt{(.577)^2 + (.143)^2}} - 1 = .68$$

FOR THE SPAR,

$M_{MAX} = 50130^{IN\#}$ (ULT.)

$P_{CAP} = \frac{50130(1.364)}{3.8} = 18000^{\#}$

A. V. ROE CANADA LIMITED
MALTON - ONTARIO
TECHNICAL DEPARTMENT (Aircraft)

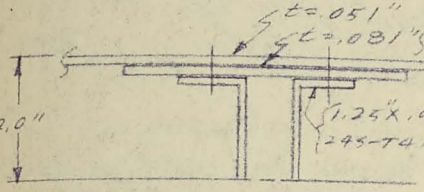
REPORT No. 2-0579-1
SHEET No. R 70a

AIRCRAFT:		PREPARED BY	DATE
C 105	AILERON	R. GRUALIS	
		CHECKED BY	DATE

RIB #1

SECTION AT $\frac{X}{C} = .780$ (16" AFT OF HL)

$M_{SUPER} = 22,200$ IN-# (LIMIT), $V_{SUPER} = 1390$ # (LIMIT)



$\left(\frac{b}{t}\right) = \frac{1.25}{.069} = 19.5$

$F_{cu} = 17,000$ psi

$I_{RIB} = \frac{2(.069)(3.6)^3}{12} + 4(1.25)(.069)(1.84)^2 = 1.58$ IN⁴

$M_{ALL\ RIB} = \frac{17000(1.58)}{1.87} = 14320$ IN-#

$f_{DOUB.} = \frac{1.91}{1.84}\left(\frac{9.7}{9.2}\right)(17000) = 18600$ psi

$W_{DOUBLER} = 5.10"$, $M_{ALL\ DOUBLER} = 21.051)(5.10)(18600)(1.91)$
$= 29300$ IN-#

$f_{SKIN} = \frac{1.97}{1.84}\left(\frac{9.7}{9.2}\right)(17000) = 19200$ psi

$\sigma_{cu_{0-1}} = 913$ psi, $b_{EFF} = 16"$ FOR PANEL BETWEEN ROOT & RIB #1

$\frac{\sigma_{cu}}{f} = \frac{913}{19200} = .0475$, $\frac{b_m}{b} = .322$, $b_{EFF_{0-1}} = \frac{.322(10)}{2} = 1.61"$

$\sigma_{cu_{1-1A}} = 3.62(9.7)(10^6)\left(\frac{.051}{7.5}\right)^2 = 1622$ psi

$\frac{\sigma_{cu}}{f} = \frac{1622}{19200} = .0845$, $\frac{b_m}{b} = .395$, $b_{EFF} = \frac{.395(7.5)}{2} = 1.48"$

$b_{TOTAL} = 1.61 + 1.48 + 2.0 = 5.09"$

$M_{ALL\ SKIN} = 21.051)(5.10)(19200)(1.97) = 19700$ IN-#

$M_{ALL\ TOTAL} = 14320 + 29300 + 19700 = 63320$ IN-#

$M.S. = \frac{63320}{1.364(22200)} - 1 = 1.08$

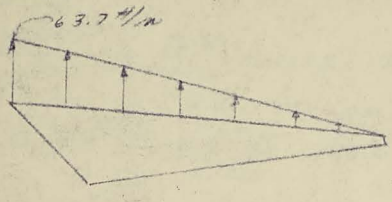
ORM 1319A

A. V. ROE CANADA LIMITED
MALTON - ONTARIO
TECHNICAL DEPARTMENT (Aircraft)

REPORT NO. Z-0579-1
SHEET NO. R 71

AIRCRAFT:		PREPARED BY	DATE
C105	AILERON	R. GAVALIS	
		CHECKED BY	DATE

ROOT RIB



$P_{AIR} = \pm 2000^{\#}$

$M_{\frac{LE}{AIR}} = \frac{2000(62.8)}{3} = \pm 41900^{in\#}$

TRIANGULAR DISTRIBUTION WAS USED SINCE ROOT RIB PROVIDES A PATH THAT IS MUCH LESS STIFF THAN RIBS 1A & 2 NEAR THE TRAILING EDGE. THEN,

$$M_x = M_{\frac{LE}{AIR}}\left[\left(\frac{x}{c}\right)^3 - \left(\frac{x}{c}\right)^2\right] \qquad (\text{REF. P3.78})$$

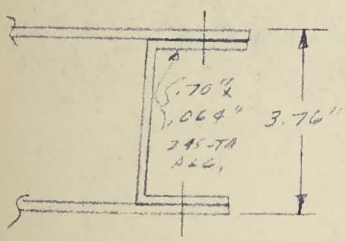
$$V_x = P_{AIR}\left[\left(\frac{x}{c}\right)^2 - \frac{1}{3(b+d)}\left\{b - (b-d)\left(\frac{x}{c}\right)\right\}\right]$$

AT $\frac{x}{c} = .670$

$M_x = \pm 41900\left[(.67)^3 - (.67)^2\right] = 6240^{in\#}$ (LIMIT)

$V_x = 2000\left[(.67)^2 - \frac{1}{3(4.80+2.76)}\left\{2.76 - (2.76-4.80)(.67)\right\}\right]$

$V_x = 540^{\#}$ (LIMIT)



$\frac{b}{t} = \frac{.70}{.064} = 11$

$F_{cu} = 25{,}600^{\#}/sq$

$I_{RIB} = .70(.064)(1.80)^2/2) + \frac{.064(3.52)^3}{12}$

$I_{RIB} = .523\ in^4$

$M_{\frac{ALL}{RIB}} = \frac{25600(.523)}{1.88} = 7110^{in\#}$

FORM 13-9A

A. V. ROE CANADA LIMITED
MALTON - ONTARIO
TECHNICAL DEPARTMENT (Aircraft)

REPORT No. 7-0579-1
SHEET No. R 72

AIRCRAFT:		PREPARED BY	DATE
C105	AILERON	R. GAVALIS	
		CHECKED BY	DATE

ROOT RIB

$$F_{SKIN} = \frac{185}{1.80}\left(\frac{9.7}{9.2}\right)(25600) = 27800 \text{ psi}$$

$$M_{OLC_{SKIN}} = 2(15)(.051)^2(27800)/1.85) = 4010 \text{ IN\#}$$ (15" of SKIN USED)

$$M_{OLC_{TOTAL}} = 7110 + 4010 = 11120 \text{ IN\#}$$

$$R_b = \frac{6240(1.369)}{11120} = .765$$

$$f_s = \frac{540(1.364)(1.5)}{.069(3.52)} = 4900 \text{ psi}, R_s = \frac{4900}{30400} = .162.$$

$$M.S. = \frac{1}{\sqrt{(.162)^2 + (.765)^2}} - 1 = .28$$

LEADING EDGE ATTACHMENT:

$$V = 2000(1.364)(1.419) = 3850 \text{\#}$$

NOW: (4) $\frac{5}{16}$" DIA. RIVETS

$$P_{ALL} = 4(685) = 2740 \text{\#}$$

USE:
(4) $\frac{1}{4}$" DIA. RIVETS

$$P_{ALL} = 4(1960 \times .795) = 4650 \text{\#}$$

$$M.S. = \frac{4650}{3850} - 1 = .21$$

CRM 1319A

A. V. ROE CANADA LIMITED
MALTON - ONTARIO
TECHNICAL DEPARTMENT (Aircraft)

REPORT NO. ZD579-1
SHEET NO. R 73

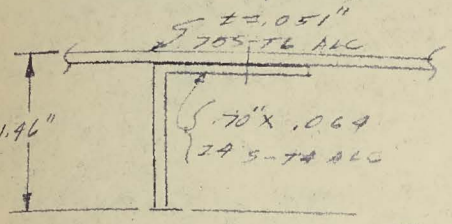
AIRCRAFT:		PREPARED BY	DATE
C 105	AILERON	R. GAVALIS	
		CHECKED BY	DATE

RIB #1A

SECTION AT $\frac{x}{c} = .500$ (20.8" FWD. OF T.E.)

$M_{SUPER} = \pm .25(14600) = 3650$ IN-# (LIMIT)

$V_{SUPER} = \pm 1800$ # (LIMIT) (REF. PG. 40b & 2)



$\frac{b}{t} = \frac{.70}{.064} = 10.9$

$F_{cu} = 26000$ psi

$I_{RIB} = \frac{.064(2.68)^3}{12} + .70(.064)(2)(1.38)^2$

$I_{RIB} = .274$ IN^4

$M_{ALL\ RIB} = \frac{26000(.274)}{1.41} = 5050$ IN-#

$f_{SKIN} = \frac{1.43}{1.38}\left(\frac{9.7}{9.2}\right)(26000) = 28,400$ psi

$\sigma_{cu} = 3.62(9.7)(10^6)\left(\frac{.051}{7.27}\right)^2 = 1730$ psi

$\frac{\sigma_{cu}}{f} = \frac{1730}{28400} = .061$, $\frac{b_m}{b} = .355$, $b_m = .355(7.27) = 2.58$"

$M_{ALL\ SKIN} = 2.58(.051)(2)(28400)(1.43) = 10700$ IN-#

$M_{ALL\ TOTAL} = 5050 + 10700 = 15750$ IN-#

$f_s = \pm 32000$ psi

$M.S. = \frac{15750}{1.364(3650)} - 1 = \underline{2.16}$

$t_{RIB} = .064$"

IF $t_{RIB} = .051$",

$\frac{b}{t} = 13.7$, $F_{cu} = 22000$ psi, $M_{ALL\ RIB} = 5400$ IN-#

$\sigma_{REF} = 2.72$, $M_{ALL\ SKIN} = 9550$ IN-#, $M_{ALL\ TOT} = 14950$ IN-#

$t_{RIB} = .051$" $\rightarrow$ $M.S. = \frac{14950}{1.364(3650)} - 1 = \underline{1.6}$

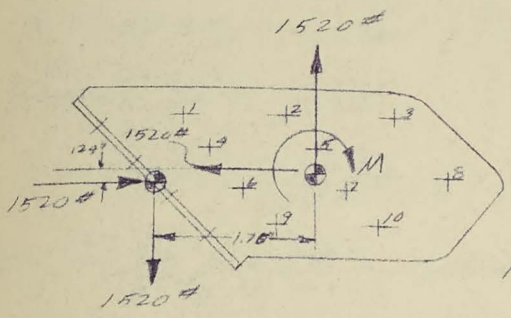
FORM 1194

A. V. ROE CANADA LIMITED
MALTON - ONTARIO
TECHNICAL DEPARTMENT (Aircraft)

REPORT No. Z-0579-1
SHEET No. R 74

AIRCRAFT:		PREPARED BY	DATE
C 105	AILERON	R. ENNALLS	
		CHECKED BY	DATE

RIB # 1A



$V_{SUB} = 1115^{\#}$ (LIMIT)

$V_{SUPER} = 740^{\#}$ (LIMIT)

$V = 1.369(1115) = 1520^{\#}$ (ULT)

$M = 1520(1.7) + 1520(.24)$

$M = 2945$ IN#

$N^2 = 1.78^2 + .80^2 + 1.30^2 + 1.10^2 + .28^2 + .60^2 + .80^2 + 1.85^2 + .90^2 + 1.52^2 = 14.31 IN^2$

$P_{V_V} = \frac{1520}{10} = 152^{\#} = P_{H_H}$

FOR RIVET # 9:

$P_N = \frac{3100(1.10)}{14.3} = 238^{\#}$, $P_{N_V} = 234$, $P_{N_H} = 60^{\#}$

$P_{TOT.} = 152 + 234 = 386^{\#}$, $P_{TOT} = 152 - 60 = 102^{\#}$

$P_{RESULT.} = 399^{\#}$

NOW: 5/32" DIA. RIVETS

$P_{ULT} = 590^{\#}$ (REF. C.L.M.)

$M.S. = \frac{590}{399} - 1 = .48$

FOR A SECTION THRU RIVET # 6:

$M = \underset{(ULT)}{1380}$ IN#, $P_{AXIAL} = \underset{(COMP)}{1440}^{\#}$, $V = 704^{\#}$

$I = \frac{.091(2.45)^3}{12} = .116$ IN^4, $f_b = \frac{1380(1.23)}{.116} = 14630$ psi

$f_a = \frac{1440}{2.45(.091)} = 6470$ psi, $\frac{b}{t} = \frac{1.5}{1.095(.091)} = 17.4$

FORM 1319A

A. V. ROE CANADA LIMITED
MALTON - ONTARIO
TECHNICAL DEPARTMENT (Aircraft)

REPORT No. 2-0579-1
SHEET No. R 75

AIRCRAFT: C105	AILERON	PREPARED BY: R. GAVALIS	DATE:
		CHECKED BY:	DATE:

RIB #14

$F_{cu} = 20000$ psi, $R_c = \frac{14670+6470}{20,000} = 1.05$

USE $t_{clip} = .102$

$f_b = 14670\left(\frac{.091}{.102}\right) = 13100$ psi

$f_c = 6470\left(\frac{.091}{.102}\right) = 5770$ psi.

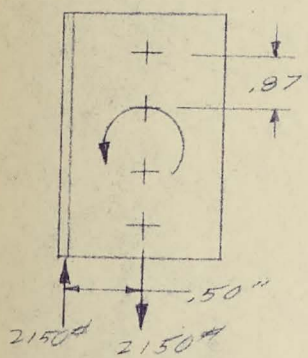
$\frac{b}{t} = \frac{1.5}{.95(.102)} = 15.5$, $F_{cu} = .95(23000) = 21800$ psi

$R_c = \frac{13100+5770}{21800} = .865$

$f_s = \frac{704}{(2.95-\frac{3}{16})(.102)} = 3060$ psi

$M.S. = \frac{1}{.865} - 1 = .15$

FOR THE CLIP-TO-SPAR ATTACHMENT;



USE: (4) - AN 3 BOLTS

A. V. ROE CANADA LIMITED
MALTON · ONTARIO
TECHNICAL DEPARTMENT (Aircraft)

REPORT No. 7-0579-1
SHEET No R77 (No Rg R26)

AIRCRAFT:		PREPARED BY	DATE
C105	AILERON	R. GAVALIS	12-21-54
		CHECKED BY	DATE

FRONT SPAR @ 19.00"

THE DEFLECTION LOADS WERE CALCULATED BASED ON AN ASSUMED MOMENT OF INERTIA OF THE SPAR. THE ACTUAL MOMENT OF INERTIA IS CONSIDERABLY GREATER THAN ASSUMED. A RECALCULATION OF THE DEFLECTION LOADS (Rg 129) INDICATES THAT THE STIFFNESS OF THE SPAR IS SUCH THAT THE ACTUAL DEFLECTION OF THE AILERON HINGE LINE WILL NOT BE NEARLY AS GREAT AS CALCULATED ON Rg 24 & USED ON Rg 966(etc). FOR THE PRESENT IT WILL BE ASSUMED THAT THE SPAR FLANGES ARE WORKING TO A STRESS OF 22,000 psi (LIMIT) DUE TO WING DEFLECTION.

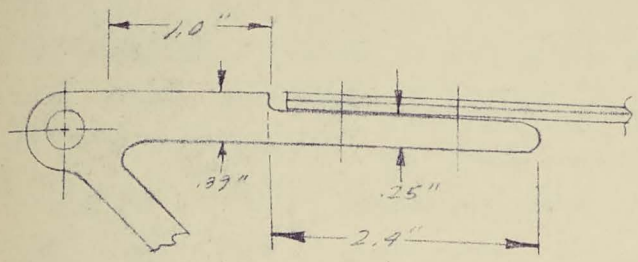
A. V. ROE CANADA LIMITED
MALTON · ONTARIO
TECHNICAL DEPARTMENT (Aircraft)

REPORT No. 7-0579-1
SHEET No. R 78

AIRCRAFT:		PREPARED BY	DATE
C105	AILERON	R GAVALIS	
		CHECKED BY	DATE

FRONT SPAR

UPPER FLANGE



$A = 1.0(.39) + 2.4(.25) = .990\ IN^2$

$t_{EFF} = \frac{.990}{3.4} = .291"$

$\left(\frac{b}{t}\right)_{EFF.} = \frac{3.4}{.291} = 11.7$

$F_{cy} = 30,000 psi$
$T = 60°$

FORM 1318A

A. V. ROE CANADA LIMITED
MALTON - ONTARIO
TECHNICAL DEPARTMENT (Aircraft)

REPORT No. 7-0579-1
SHEET No R 79

AIRCRAFT:		PREPARED BY	DATE
C105	AILERON	R. GAVALIS	
		CHECKED BY	DATE

FRONT SPAR

SPAR WEB ATTACHMENTS

DOUBLE ROW OF ATTACHMENTS WILL BE USED FROM ROOT TO RIB #5A. FROM THERE OUTBOARD, A SINGLE ROW WILL BE USED.
USE $\frac{3}{16}$" DIA. AN 507 SCREWS @ 1.50"

FORM 1394

A. V. ROE CANADA LIMITED
MALTON · ONTARIO
TECHNICAL DEPARTMENT (Aircraft)

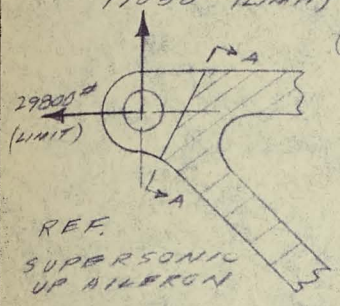
REPORT No. 7-0514-1
SHEET No. R80

AIRCRAFT:		PREPARED BY	DATE
C 105	AILERON	R. GAVALIS	12-8-54
		CHECKED BY	DATE

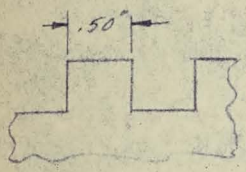
HINGE

CRITICAL SECTION OF HINGE IS AT RIB #3.

17050# (LIMIT) + 2429# (LIMIT)
(WING DEFLECTION LOAD PG. 106)



REF. SUPERSONIC UP AILERON



ASSUME THAT LOADS ARE DISTRIBUTED OVER 10.5" (REF PG. R476):

$$q_z = \frac{19479(1.364)}{10.5} = 2530\ \#/in$$

$$q_x = \frac{29800(1.364)}{10.5} = 3870\ \#/in$$

FOR A TANG WIDTH OF .5",

$$P_{z/TANG} = 1.0(2530) = 2530\#$$

$$P_{x/TANG} = 1.0(3870) = 3870\#$$

$$P_{RESULTANT} = [(3870)^2 + (2530)^2]^{\frac{1}{2}} = 4630\#$$

NOW: $e = .25$, $D = .25$, $W = .50$ (TANG WIDTH)

$$\frac{W}{D} = \frac{.50}{.25} = 2.0, \quad \frac{e}{D} = 1.0$$

$P/D^2 = 62500$ (REF. GLENN L. MARTIN, PIANO HINGE ANALYSIS)

$P_{ALL.} = 62500(.25)^2 = 3910\#$ FOR $T = 60°F$

$P_{ALL} = .92(3910) = 3600\#$ FOR $T = 250°F$

$$M.S. = \frac{3600}{4630} - 1 = -.22$$

TRY: $e = .33"$, $D = .25$, $W = .50$

$\frac{W}{D} = 2.0$, $\frac{e}{D} = \frac{.33}{.25} = 1.32$, $P/D^2 = 85000$

A. V ROE CANADA LIMITED
MALTON - ONTARIO
TECHNICAL DEPARTMENT (Aircraft)

REPORT No. 20574-1
SHEET No. R81

AIRCRAFT:		PREPARED BY	DATE
C105	AILERON	R. GAVALIS	12-8-54
		CHECKED BY	DATE

HINGE

$P_{ALL} = 85000(.25)^2 = 5300\#$ FOR $T = 60°F$

$P_{ALL} = 5300(.92) = 4870\#$

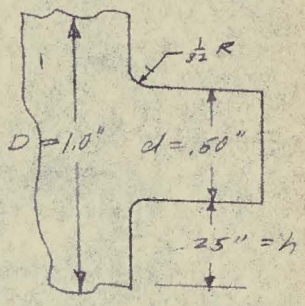
$$M.S. = \frac{4870}{4630} - 1 = .05$$

FOR SECTION A-A :

$$P_{LIMIT} = \frac{4630}{1.364} = 3400\#$$

CYCLE LIFE = 4000

$$f_t = \frac{3400}{(.66)(.50)} = 10310 \text{ psi}$$



FOR NOTCH EFFECT,

$$\frac{h}{d} = \frac{.25}{.50} = .50, \quad \frac{r}{d} = \frac{1/32}{.50} = .0625$$

USE $K = 1.70$ (REF. ROARK)

$f_t = 1.70(10310) = 17500 \text{ psi}$

NEGLECTING FATIGUE

$$M.S. = \frac{46900}{17500} - 1 = 1.68$$

CONSIDERING FATIGUE,

$$F_t = \frac{46900}{57000}(33000) = 27200 \text{ psi}$$

(REF ANC-5, NOTCH EFFECT IN 245-T, 10,000 CYCLES, MODIFIED FOR TEMPERATURE)

$$M.S. = \frac{27200}{17500} - 1 = .56$$

FORM 1318A

A. V. ROE CANADA LIMITED
MALTON - ONTARIO
TECHNICAL DEPARTMENT (Aircraft)

REPORT No. 7-0574-1
SHEET No. R82

AIRCRAFT:		PREPARED BY	DATE
C105	AILERON	R. GAVALIS	12-11-59
		CHECKED BY	DATE

HINGE USING MORE LIBERAL EFFECTIVE SKIN WIDTHS (REF B. VALE)

$b_{3A-3} = 6.42"$

$\sigma_u = 3.62(9.7)(10^6)\left(\frac{.132}{6.42}\right)^2 = 14,900$ psi

$f_c = \frac{21690(1.364)}{16.93(.132)} = 13300$ psi

$\frac{\sigma_u}{f_c} = \frac{14900}{13300} = 1.12$

$b_{3-3A} = 6.61"$

$\sigma_u = 3.62(9.7)(10^6)\left(\frac{.132}{6.61}\right)^2 = 14000$ psi

$\frac{\sigma_u}{f} = \frac{14000}{13300} = 1.05$ ∴ SKIN IS TOTALLY EFFECTIVE.

$b_{TOTAL} = 6.42 + 6.61 + 3.90 = 16.93"$

$q_x = \frac{29800(1.364)}{16.93} = 2400$ #/in

$q_z = \frac{19474(1.364)}{16.93} = 1570$ #/in

$q_{RESULTANT} = [(2400)^2 + (1570)^2]^{\frac{1}{2}} = 2870$ #/in

$P_{ULL} = 3600$ # (REF. P3. R80

$P = 2870(1.0) = 2870$ #

USING A PEAKING FACTOR OF 1.25

$P = 1.30(2870) = 3590$

$M.S. = \frac{3600}{3590} - 1 = .00$

FORM 1198A

A. V. ROE CANADA LIMITED
MALTON - ONTARIO
TECHNICAL DEPARTMENT (Aircraft)

REPORT NO. 7-0574-1
SHEET NO. R 83

AIRCRAFT:		PREPARED BY	DATE
C105	AILERON	R. GAVALIS	12-10-54
		CHECKED BY	DATE

HINGE

FOR THE SKIN-TO-SPAR ATTACHMENTS:

$P_{XH} = 33000\#$ (LIMIT) FOR AIL. DOWN SUPERSONIC

$q_x = \frac{33000(1.364)}{16.73} = 2660\ \#/IN$

$q_{SHEAR} = 370(1.364) = 506\ \#/IN$

$q_{RESULTANT} = [(2660)^2 + (503)^2]^{\frac{1}{2}} = 2719\ \#/IN$ (ULT.) OBS

FOR ALL RIBS:

RIB	P_{XH} # (LIMIT)	RIB IN SPACING	q_x #/IN (ULT.)	q_{TORQUE} #/IN	$q_{RESULT.}$ #/IN
1	16020	16.40	1332	208	1350
2	27000	16.75	2200	322	2220
3	33000	16.93	2660	388	2680
4	26000	19.00	1870	238	1890
5	19620	20.04	1338	273	1370
6	11780	18.50	870	246	905
7	12320	18.90	890	341	951
REF →	P. 90				

OBS

USING 5/16" AN 509 SCREWS FOR SKIN-TO-SPAR ATTACHMENTS, THE REQUIRED SPACING IS
(SEE ANALYSIS FOR EACH RIB)

CELL	SPACING	CELL	SPACING
ROOT - 1	.90	4 - 5	.625
1 - 2	.55	5 - 6	.975
2 - 3	.45	6 - 7	1.10
3 - 4	.45	7 - TIP	1.10

A. V. ROE CANADA LIMITED
MALTON - ONTARIO
TECHNICAL DEPARTMENT (Aircraft)

REPORT NO. 7-0579-1
SHEET NO. 5-0

AIRCRAFT:		PREPARED BY	DATE
C105	AILERON	R. GAVALIS	
		CHECKED BY	DATE

MAIN RIBS

RIB CAP LOADS AT FRONT SPAR

RIB	$\pm M_y$ IN# VLT.	ESTIMATED CENTROID HEIGHT (IN)	P #
REFERENCE →	1.364 X		
1	50,000	4.37	±12500
2	83,700	3.60	±23200
3	101,400	3.20	±31700
4	75,300	2.80	±26900
5	53,900	2.35	±22700
6	30,400	1.85	±16200
7	29,300	1.54	±19000

MAXIMUM STRINGER SPACING

RIB	q	RIB SPACING MAX.	d_w ±	
REFERENCE →	P_3		.051	.064
1	153	8.37	7.1	10.0
1A	154	8.37	8.7	12.4
2	90	8.37	9.5	13.4
2A	163	8.37	7.0	9.9
3	211	8.56	6.1	8.7
3A	167	8.56	7.1	10.0
4	179	10.44	6.8	9.5
4A	206	10.44	6.3	8.9
5	157	10.44	7.1	10.0
5A	180	9.60	6.7	9.4
6	125	9.60	8.7	12.4
6A	163	8.40	7.0	9.9
7	252	9.78	5.6	7.9
7A	421	9.78	4.0	5.7

± .051 & .064" d_w FOR SHEAR ONLY

A. V ROE CANADA LIMITED
MALTON - ONTARIO
TECHNICAL DEPARTMENT (Aircraft)

REPORT NO. 7-0574-1
SHEET NO. 5-0a

AIRCRAFT:		PREPARED BY	DATE
C105	AILERON	R. GAVALIS	
		CHECKED BY	DATE

STRINGER SPACING

AN ESTIMATE OF THE MAXIMUM SKIN PANEL SIZE IS GIVEN ON THE FOLLOWING PAGE. A SAMPLE CALCULATION OF d_{cr} VIBRATION IS GIVEN:

RIB SPACING = 7.37"

$f_{\infty} = 1750$ cps $\quad t_{SKIN} = .051"$ *

$F_{\infty} = 1750(.051) = 89.0$ cps

$\frac{f}{F_{\infty}} = \frac{60}{89.0} = .675$ ASSUMING 100 cps IS MINIMUM PANEL FREQUENCY.

$\frac{\text{PANEL LENGTH}}{\text{PANEL WIDTH}} = \infty$ (SHT. NO. 4)

$\text{PANE LENGTH}_{MAXIMUM} = \infty$

FOR $d_{CRITICAL\ SHEAR}$:

ENTER BUCKLING CURVE ON P_3 A' WITH $\frac{}{}_{MAX}$, OBTAIN d_{cr}.

* SHT. 3A OF INTER-DEPT. MEMO 2400/08/EEN-5/13/54

A. V. ROE CANADA LIMITED
MALTON - ONTARIO
TECHNICAL DEPARTMENT (Aircraft)

REPORT NO. T-0574-1
SHEET NO. 30b

AIRCRAFT:		PREPARED BY	DATE
C105	AILERON	R. GAVALIS	
		CHECKED BY	DATE

STRINGER SPACING

(RIB SPACING MUST BE 9.9" OR LESS FOR VIBRATION NOT TO BE CRITICAL)

RIB	RIB SPACING	$q_{MAX.}$	$I_{CRITICAL\ SHEAR}$	$d_{CRITICAL\ VIBRATION}$	$d_{MAX.}$
ROOT		q_3 T.E.			
	16.00	39	12.8	10.75	7.7
1					
	8.37	164	6.5	∞	6.5
1A					
	8.37	81	3.7	∞	8.9
2					
	8.37	139	6.0	∞	6.0
2A					
	8.37	151	6.7	∞	6.7
3					
	8.56	242	5.3	∞	5.3
3A					
	8.56	96	3.2	∞	8.2
4					
	10.44	252	4.9	28.0	4.9
4A					
	10.44	116	7.6	28.0	7.6
5					
	9.60	269	5.1	∞	5.1
5A					
	9.60	103	8.0	∞	8.6
6					
	8.90	228	5.5	∞	5.5
6A					
	8.90	141	6.9	∞	6.9
7					
	9.80	353	4.3	∞	4.3
7A					
	≈ 8	204	5.8	∞	5.8
TIP		*	$d_{cr} = 10.75"$ FOR 16" PANEL LENGTH		

A. V. ROE CANADA LIMITED
MALTON · ONTARIO
TECHNICAL DEPARTMENT (Aircraft)

REPORT NO. Z-0579-1
SHEET NO 50-C

AIRCRAFT:		PREPARED BY	DATE
C 105	AILERON	R. SAVALIS	
		CHECKED BY	DATE

SKIN SHEAR FLOW (LIMIT)

RIB REFERENCE	$\pm T_{OUTB'D}$ Pgs [illegible]	$\pm T_{INB'D}$ [illegible]	2A Pg [illegible]	$q_{OUTB'D}$ #/IN	$q_{INB'D}$ #/IN.
1	29660	7000	161.3	164	39
1A					
2	46970	20140	248.6	187	81
2A					
3	48500	30290	220.1	242	151
3A					
4	44140	15050	167.0	282	96
4A					
5	29960	12940	111.4	269	116
5A					
6	17310	7830	76.2	228	103
6A					
7	17400	6980	49.4	353	141
7A	8000		39.0	204	

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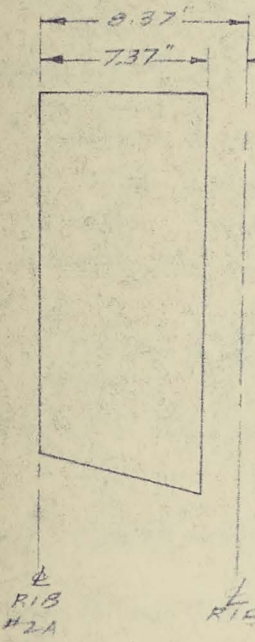
REPORT No. Z-0579-1
SHEET No. S-09

AIRCRAFT:		PREPARED BY	DATE
C105	AILERON	R GAVALIS	
		CHECKED BY	DATE

INVESTIGATION OF PANEL SIZE

INVESTIGATE THE POSSIBILITY OF USING FULL CHORD PANEL LENGTH WITH RIB SPACING AS WIDTH.

CONSIDER PANEL BETWEEN RIB #2 & #2A:



$W = 7.37"$

$f_\infty = 1750$ psi

$F_\infty = (1.051)(1750) = 891$ psi

$\frac{F}{F_\infty} = \frac{60}{99.1} = .675$

$\frac{\text{PANEL LENGTH}}{\text{PANEL WIDTH}} = \infty$

PANEL WOULD BE O.K.

FOR PANEL BETWEEN RIB # & 4A:

$W = \frac{20.88}{2} - 1 = 9.44$

$f_\infty = 1060$ psi

$F_\infty = 1060(.051) = 54.0$ psi

$\frac{F}{F_\infty} = \frac{60}{54.0} = 1.11$

PANEL LENGTH (MAXIMUM) $= 3(9.44) = 28.4$

$\frac{\text{PANEL LENGTH}}{\text{PANEL WIDTH}} = 3.0$, FULL-CHORD PANEL WOULD NOT BE O.K.

A. V. ROE CANADA LIMITED
MALTON - ONTARIO
TECHNICAL DEPARTMENT (Aircraft)

REPORT No. 7-0574-1
SHEET No. 5-1

AIRCRAFT:		PREPARED BY	DATE
C105	AILERON	R. GAVALIS	
		CHECKED BY	DATE

MAIN RIBS

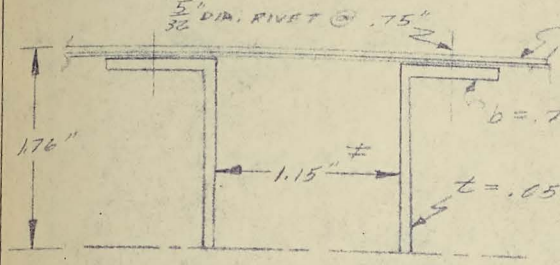
(ON THE FOLLOWING PAGES ARE STRENGTH CHECKS OF THE MAIN RIBS FROM $\eta = 0$ TO $\eta = \frac{2}{3}c$, η IS MEASURED FROM TRAILING EDGE.)

RIB #1 (TWIN RIBS)

CHORD 27.3", $d = 4.30$", $b = 2.76$"

SECTION AT $\eta = \frac{c}{2} = \frac{27.3}{2} = 13.65$"

$M_{SUPER\ LIMIT} = \pm 9100$ IN#, $V_{SUPER\ LIMIT} = \pm 1040$# (REF B.)



MAT'L: 75S-T6 ALCLAD

(REF. GLENN L. MARTIN (GLM) SDM FIGS 403.10-.17 & Pgs 4.51 4.52 FOR CRIPPLING ALLOWABLES)

$\frac{b}{t} = \frac{.75}{.051} = 14.7$

$F_{c\ T=250°} = 27100$ psi

$I = 4\left[30(.051)(.051)(1.73)^2 + .75(.051)(1.68)^2 + \frac{.051(1.66)^3}{3}\right]$

$I = 1.68$ IN^4

$f_b = \frac{M \cdot c}{I} = \frac{9100(1.364)(1.76)}{1.68} = 13000$ psi

$R_b = \frac{13000}{27100} = .480$

$A = 4\left[30(.051)(.051) + (.75 + 1.66)(.051)\right] = .802$ IN^2

$f_{s\ AVG.} = \frac{1040(1.364)}{.802} = 1770$ psi, $F_s = .795(43000) = 34200$ psi

$R_s = \frac{1770}{34200} = .052$, $M.S. = \frac{1}{\sqrt{(1.48)^2 + (.052)^2}} - 1 = \underline{1.07}$

* MAXIMUM DISTANCE FOR SKIN TO BE FULLY EFFECTIVE

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TECHNICAL DEPARTMENT (Aircraft)

REPORT No. T-0574-1
SHEET No. 5-2

AIRCRAFT:		PREPARED BY	DATE
C105	AILERON	R. GAVALIS	
		CHECKED BY	DATE

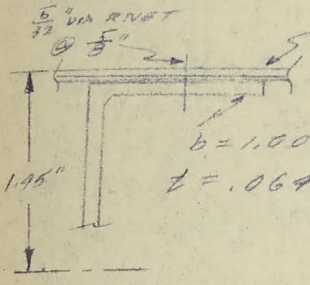
MAIN RIBS

RIB #2 (TWIN RIBS)

SECTION AT $\eta = \frac{2}{3}C = \frac{2(54)}{3} = 36"$

CHORD = 54", $d = 3.90"$, $b = .90"$

$M_{LIMIT} = 26900$ IN #, $V_{LIMIT} = 1210$ # (REF. σ_g 30 b)



MAT'L: 75S-T6 ALCLAD

$\frac{b}{t} = \frac{1.00}{.064} = 15.6$

F_{cr} T=60° = 28000 psi

F_c T=260° = 26000 psi

$A = 4[1.81(.123) + 1.00(.064) + 1.31(.069)] = 1.48$ IN²

$I = 4\left[\frac{.069(1.26)^3}{3} + .222(1.39)^2 + 1.0(.064)(1.29)^2\right] = 2.31$ IN⁴

$f_b = \frac{MC}{I} = \frac{26900(1.364)(1.45)}{2.31} = 23000$ psi

M.S. $= \frac{26000}{23000} - 1 = \underline{+.13}$

TRY 1" x .072" :

$\frac{b}{t} = \frac{1.0}{.072} = 13.9$, $F_{cr} = 28200$ psi

$I = 2.39$ IN⁴

$f_b = \frac{26900(1.364)(1.45)}{2.39} = 22200$ psi, M.S. $= \underline{+.27}$

FORM 1219A

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MALTON - ONTARIO
TECHNICAL DEPARTMENT (Aircraft)

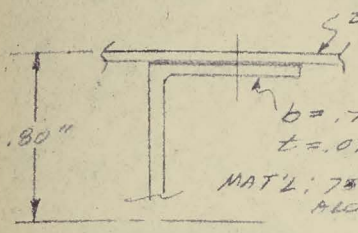
REPORT No. 7-0574-1
SHEET No S-3

AIRCRAFT:		PREPARED BY	DATE
C105	AILERON	R. GAVALIS	
		CHECKED BY	DATE

MAIN RIBS

RIB #2 (CONT'D)

SECTION AT $y = \frac{c}{3} = \frac{54}{3} = 18"$



$M_{LIMIT} = 6600$ IN# (REF P.S 465)
$V_{LIMIT} = 660$#

$\frac{b}{t} = \frac{.75}{.072} = 10.4$

F_{cy} T=60° $= 39,600$ psc

F_c T=360° $= 34,300$ psc

$A = 4\left[.30(.051)^2 + .75(.072) + .68(.072)\right] = .725\ IN^2$

$I = 4\left[\frac{.072(.68)^3}{3} + .078(.775)^2 + .75(.072)(.713)^2\right] = .327\ IN^4$

$f_b = \frac{MC}{I} = \frac{6600(1.364)(.80)}{.327} = 22100$ psc

$f_{s\ AVG.} = \frac{660(1.364)}{.725} = 1240$ psc, $R_s = \frac{1240}{34200} = .036$

$R_c = \frac{22100}{34300} = .645$ $\quad M.S. = \frac{1}{\sqrt{(.645)^2 + (.036)^2}} - 1 = \underline{+.55}$

TRY .75" X .064":

$\frac{b}{t} = \frac{.75}{.064} = 11.7$, $F_{cy} = 31700$ psc

$I = .3115\ IN^4$, $f_b = 23200$ psc

$M.S. = \frac{31700}{23200} - 1 = \underline{+.37}$

FORM 1319A

A. V. ROE CANADA LIMITED
MALTON - ONTARIO
TECHNICAL DEPARTMENT (Aircraft)

REPORT NO. Z-0574-1
SHEET NO. S-4

AIRCRAFT: C 105	AILERON

PREPARED BY	DATE
R. GAVALIS	
CHECKED BY	DATE

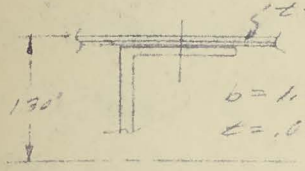
MAIN RIBS

RIB # 3 (TWIN RIBS)

CHORD 40.2", $d = 3.50$", $b = .83$"

SECTION AT $y = \frac{2}{3}c = \frac{2(48.2)}{3} = 32.2$"

$M_{LIMIT} = 32900$ IN#, $V_{LIMIT} = 1460$# (REF R_B 21-



MAT'L: 75S-T6 ALCLAD

$\frac{b}{t} = \frac{1.0}{.072} = 13.9$

F_{cr} $T=60°$ $= 30800$ psi

F_c $T=240°$ $= 28200$ psi $(30(\frac{.051+.072}{2}))$

FOR $b = .80$, $t = .072$"
$\frac{b}{t} = 11.1$, $F_c = 32800$ psi
$f_b = 30200$ psi
M.S. = + .09

$A = 4[180(.123) + 1.0(.072) + 1.0(.072)] = 1.510$ IN²

$I = 4[.221(1.374)^2 + 1.0(.072)(1.17)^2 + \frac{.072(4.02)^3}{3}] = 1.95$ IN⁴

$f_b = \frac{32900(1464)(130)}{1.95} = 29900$ psi, $R_A = 1.06$

$f_{s\ AVG.} = \frac{1460(1.364)}{1.615} = 1233$ psi

M.S. $= \frac{28200}{29900} - 1 = -.06$

SECTION AT $y = \frac{1}{3}c = 16.1$"

$M_{LIMIT} = 8250$ IN#, $V_{LIMIT} =$ (REF GLM, 30M FIG AC3.15 R_B 1.14)

$C = .2c$, $b = 1.0$, $t = .051$, $F_c = 30600$ psi R_B 1.14

$I = .450$ IN², $f_b = \frac{8250(1.364)(1.02)}{.450} = 21500$ psi

FOR $b = 1.0$", $t = .072$"
$F_c = 28200$ psi
$f_b = 22800$ psi M.S. = +.24

M.S. $= \frac{30600}{21500} - 1 = .42$

A V ROE CANADA LIMITED
MALTON - ONTARIO
TECHNICAL DEPARTMENT (Aircraft)

REPORT No. 7-0574-1
SHEET No. 5-5

AIRCRAFT:		PREPARED BY	DATE
C105	AILERON	R. CAVALIS	
		CHECKED BY	DATE

MAIN RIBS

RIB #4 (TWIN RIBS) $t_{SKIN} = .051"$ $t_{DOUBLER} = .072"$

$C = 42.3"$, $d = 3.10"$, $b = .77"$ 75S-T6 ALCLAD

SECTION AT $A = \frac{1}{3}C = 28.2"$ FWD OF T.E.

$M_{LIMIT} = 24600$ IN#, $V_{LIMIT} =$ (REF β_3)

$C = 1.16$, $b = 1.0"$, $t = .072$, $\frac{b}{t} = \frac{1.0}{.072} = 13.9$

F_c 28,200 PSI (1 REF. C.L.N. SDM. 510403.15 # β_3. 2.2)

$A = 4[1.8(.123) + 1.0(.072) - (1.0 - .123 - .072)(.072)] = 1.456 IN^2$

$I = 4[.221(1.135)^2 + 1.0(.072)(1.03)^2 + \frac{.072(.75)^3}{3}] = 1.52 IN^4$

$f_b = \frac{24600(43.2)(1.16)}{1.52} = 25604$ PSI

FOR $b = .35$, $t = .072"$ M.S. $= .18$

M.S. $= \frac{28200}{25600} - 1 = .10$

SECTION AT $A = \frac{1}{3}C = 14.1"$

$M_{LIMIT} = 6150$ IN#, $V_{LIMIT} =$

$C = .78"$, $b = .75$, $t = .072"$, $\frac{b}{t} = \frac{.75}{.072} = 10.4$

$F_c = 34800$ PSI

$A = 4[.30(.051)^2 + .75(.072) + (.78 - .051 - .072)(.051)] = .718 IN^2$

$I = 4[.078(.753)^2 + .75(.072)(.693)^2 + \frac{.072(.663)^3}{3}] = .3082 IN^4$

$f_b = \frac{6150(1.34)(.78)}{.3082} = 21200$ PSI

M.S. $= \frac{34200}{21200} - 1 = .61$

A. V ROE CANADA LIMITED
MALTON - ONTARIO
TECHNICAL DEPARTMENT (Aircraft)

REPORT NO. 7-0579-1
SHEET NO. S-6

AIRCRAFT:		PREPARED BY	DATE
C105	AILERON	R. CAVALIS	
		CHECKED BY	DATE

MAIN RIBS

RIB #5 (TWIN RIBS)

$t_{SKIN} = .051"$
$t_{SPINNER} = .032"$

$C = 35.2"$, $d = 2.61$, $b = .69"$ (REF B_3)

SECTION AT $x = \frac{2}{3}C = 23.4"$

$M_{LIMIT} = 17200$ IN#, $V_{LIMIT} =$ (B_3 REF)

$\bar{c} = .98"$, $b = .85"$, $t = .064"$, $\frac{b}{t} = \frac{.85}{.064} = 13.3$

$F_c = 29000$ psi — 75S-T6 ALCLAD

$A = 4[1.8(.123) + .85(.064) + .064(.98 - .123 - .064)] = 1.31$ in²

$I = 4\left[.123(.955)^2 + .85(.064)(.800)^2 + \frac{.064(.8)^3}{3}\right] = 1.02$ in⁴

$f_b = \frac{17200(1.364)(.98)}{1.02} = 22600$ psi

$M.S. = \frac{29000}{22600} - 1 = .28$

FOR $b = .85$, $t = .051"$, $F_c = 25000$ psi

$I = .979$, $f_b = 23400$ psi, $M.S. = .07$

SECTION AT $x = \frac{1}{3}C = 11.7"$

$M_{LIMIT} = 4310$ IN#, $V_{LIMIT} =$

$\bar{c} = .66"$, $b = .75"$, $t = .064"$, $\frac{b}{t} = \frac{.75}{.064} = 11.7$

$F_c = 31700$ psi

$I = 4\left[.30(.051)^2(.634)^2 + .75(.064)(.577)^2 + \frac{.064(.593)^3}{3}\right] = .203$ in⁴

$f_b = \frac{4310(1.364)(.66)}{.203} = 19120$ psi

$M.S. = \frac{23000}{19120} - 1 = .65$

A. V. ROE CANADA LIMITED
HALTON · ONTARIO
TECHNICAL DEPARTMENT (Aircraft)

REPORT NO. 7-0574-1
SHEET NO. 5-7

AIRCRAFT:		PREPARED BY	DATE
C105	AILERON	R. GAVALIS	
		CHECKED BY	DATE

MAIN RIBS

RIB #6 (TWIN RIBS)

$c = 28.6"$; $d = 2.16"$; $b = .62"$ .072 DOUBLER

SECTION AT $\eta = .80c = 22.8"$

$M_{LIMIT} = 13720$ IN#, $V_{LIMIT} =$ (REF. B)

$\bar{c} = .92"$, $b = .85$ 75S-T6 SHEAR, $t = .051"$, $\frac{b}{t} = \frac{.85}{.051} = 16.6$

$F_c = 25000$ psc

$I = 4\left[1.81(.123)(.895)^2 + .85(.051)(.816)^2 + \frac{.051(.749)^3}{3}\right] = .851$ in^4

$f_b = \frac{Mc}{I} = \frac{13720(1.36)(.92)}{.851} = 20200$ psc

$M.S. = \frac{25000}{20200} - 1 = .24$

FOR $b = .80$, $t = .040$, $F_c = 21900$ psc

$I = .820$ in^4, $f_b = 19500$ psc, $M.S. = .12$

SECTION AT $\eta = .40c = 11.6"$

$M_{LIMIT} = 3440$ in#, $V_{LIMIT} =$

$\bar{c} = .62"$, $b = .75"$, $t = .051"$, $\frac{b}{t} = \frac{.75}{.051} = 14.7$

$F_c = 27,100$ psc

$I = 4\left[.30(.051)^2(.595)^2 + .75(.051)(.595)^2 + \frac{.051(.52)^3}{3}\right] = .1651$ in^4

$f_b = \frac{3440(1.364)(.62)}{.165} = 17600$ psc

$M.S. = \frac{27100}{17600} - 1 = .54$

A. V ROE CANADA LIMITED
MALTON · ONTARIO
TECHNICAL DEPARTMENT (Aircraft)

REPORT NO. S-0574-1
SHEET NO. S-8

AIRCRAFT:		PREPARED BY	DATE
C105	AILERON	R. GAVALIS	
		CHECKED BY	DATE

MAIN RIBS

RIB #7 (TWIN RIBS)

$t_{SKIN} = .051"$

$t_{DOUBLER} = .072"$

$C = 22.5"$, $d = 1.74"$, $b = .55"$ (REF. Fig. 4)

SECTION AT $y = .80C = 18.0"$

$M_{LIMIT} = 13020$ IN#, $V_{LIMIT} =$ (Fig REF)

$\bar{C} = .75"$, $b = .85"$, $t = .051"$, $\frac{b}{t} = \frac{.85}{.051} = 16.7$ 75S-TL ALCLAD

$F_c = 25{,}000$ PSI *

$I = 4\left[(1.81)(.123)(.436)^2 + .85(.051)(.436)^2 + \frac{.051(.574)^3}{3}\right] = .546$ IN^4

$f_b = \frac{13020(1.364)(.75)}{.546} = 24{,}400$ PSI

$M.S. = \frac{25000}{24400} - 1 = .02$

FOR $b = .85$, $t = .064"$, $\frac{b}{t} = 13.3$

$F_c = 29{,}000$ PSI, $I = .566$ IN^4, $f_b = 23600$ PSI

$M.S. = .23$

SECTION AT $y = .40C = 9"$

$M_{LIMIT} = 3200$ IN#, $V_{LIMIT} =$

$\bar{C} = .512"$, $b = .700"$, $t = .051$, $\frac{b}{t} = \frac{.700}{.051} = 13.71$

$F_c = 27{,}100$ PSI

$I = 4\left[.30(.051)(.487)^2 + .70(.051)(.436)^2 + \frac{.051(.41)^3}{3}\right] = .106$ IN^4

$f_b = \frac{3200(1.364)(.512)}{.106} = 21{,}500$ PSI

$M.S. = \frac{27100}{21500} - 1 = .26$

FOR $b = .700$ $t = .064"$, $\frac{b}{t} = 10.9$

$F_c = 34600$ PSI, $I = .113$ IN^4, $f_b = 20400$ PSI

$M.S. = \frac{34600}{20400} - 1 = .69$

*REF Fig 4.5

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MALTON - ONTARIO
TECHNICAL DEPARTMENT (Aircraft)

REPORT NO 7-0574-1
SHEET NO 5-9

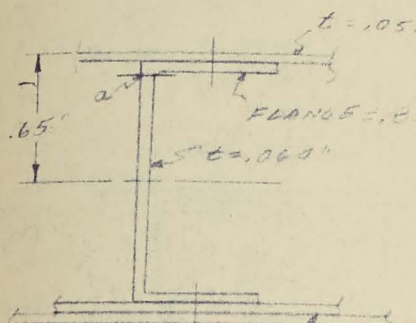
AIRCRAFT:		PREPARED BY	DATE
C105	AILERON	R. GAVALIS	
		CHECKED BY	DATE

MAIN RIBS

RIB #7 (REF. DWG. 7-0174-0010)

SECTION 8" AFT OF HINGE LINE

$M_{LIMIT} = 8470$ IN#, $V_{LIMIT} = 730$# (REF. RP 3.09)



MAT'L: 75S-T6 ALCLAD

$\frac{b}{t} = \frac{.85}{.064} = 13.3$

$F_c = 29200$ psi

$E = 9.7 \times 10^6$ psi (REF. REP 7/0200/2 P3.11)

$W_{SKIN} = .85t\sqrt{\frac{E}{F_c}} = .85(.051)\sqrt{\frac{9.7\times10^6}{25000}} = .855"$

$A = 4\left[.855(.051) + .85(.064) + .535(.064)\right] = .709\ IN^2$

$I = 4\left[.0872(.625)^2 + .0595(.567)^2 + \frac{.0342(.535)^2}{3}\right] = .219\ IN^4$

$f_b = \frac{8470(.364)(.65)}{.219} = 34200$ psi

$M.S. = \frac{29200}{34200} - 1 = \underline{-.15}$

AT "a":

$f_s = \frac{VQ}{It} = \frac{730(1.364)(.1700)}{.219(.064)} = 12950$ psi

$F_s = .795(43000) = 34105$ psi, $R_s = .378$

$f_b = \frac{.535}{.650}(34200) = 28220$ psi, $R_b = .946$

$M.S. = \frac{1}{\sqrt{(.946)^2 + (.378)^2}} - 1 = \underline{-.04}$

A. V ROE CANADA LIMITED
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REPORT NO. Z-0574-1
SHEET NO. S-10

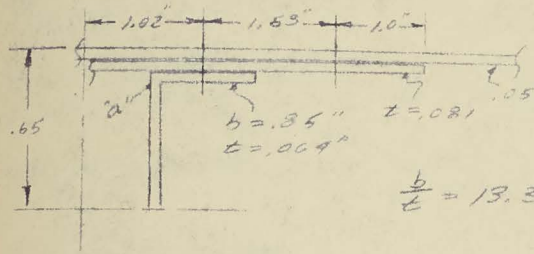
AIRCRAFT:		PREPARED BY	DATE
C105	AILERON	R. GAVALIS	
		CHECKED BY	DATE

MAIN RIBS

RIB #7 (CONT.) SECTION 3" AFT OF H.

TRI EXTENDING UPPER DOUBLER BACK TO THE SAME POINT AS THE LOWER DOUBLER. RIVET DOUBLER TO SKIN.

$$W_{\substack{\text{SKIN \&}\\ \text{DOUBLER}}} = .85(.051+.081)\sqrt{\frac{9.7\times10^6}{45000}} = 2.21"$$



$M_{LIMIT} = 8470$ IN#

$V_{LIMIT} = 780$ #

$\frac{b}{t} = 13.3$, $F_c = 29000$ psi

FOR SKIN & DOUBLER WORKING TOGETHER,

$$W = .85(.051+.081)\sqrt{\frac{9.7\times10^6}{45000}} = 2.21"$$

$A_{\substack{\text{SKIN}\\ \&\\ \text{DOUB.}}} = (2.21+1.02)(.051+.081) = .426\ IN^2$

$A_{FLG} = .85(.064) = .0543\ IN^2$; $A_{WEB} = .454(.064) = .029\ IN^2$

$$I = 4\left[.426(.580)^2 + .0543(.486)^2 + \frac{.029(.454)^2}{3}\right] = .640\ IN^4$$

$$f_b = \frac{8470(1.364)(.65)}{.640} = 11710\ psi$$

$$M.S. = \frac{29000}{11710} - 1 = \underline{1.48}$$

AT "a":

$$f_s = \frac{780(0.364)[.426(.580)+.0543(.486)]}{.640(.064)} = 7150\ psi$$

$$f_b = \frac{.454}{.650}(11710\ psi) = 8190\ psi$$

$R_s = .209$, $R_b = .282$ $\quad M.S. = \frac{1}{\sqrt{(.209)^2+(.282)^2}} - 1 = \underline{1.85}$

A. V ROE CANADA LIMITED
MALTON · ONTARIO
TECHNICAL DEPARTMENT (Aircraft)

REPORT NO. Z-0579-1
SHEET NO. S-11

AIRCRAFT:		PREPARED BY	DATE
C105	AILERON	R. GAVALIS	
		CHECKED BY	DATE

MAIN RIBS

RIB #7 (CONT.)

AT LIMIT LOAD, ADDITIONAL EFFECTIVE SKIN IS,

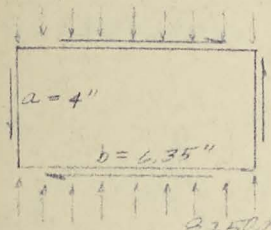
$\Delta A_{SKIN} = 4(3.17)(.051) = .647\ IN^2$

$\Delta I = .647(.625)^2 = .252\ IN^4$

$I_{LIMIT} = .640 + .252 = .892\ IN^4$

$f_{b_{LIM}} = \frac{8470(.65)}{.892} = 6160\ psi$

$q = 250\ \#/IN$, $f_{s_{LIM}} = \frac{250}{.051} = 4900\ psi$



$\frac{a}{b} = \frac{4.0}{6.35} = .63$

$K = 5.0$ (PERRY R_3 372)

$\frac{\pi}{\sqrt{5.0}}\left(\frac{6.35}{.051}\right) = 175$ a IS TOO LARGE

$\frac{a}{b} = \frac{3}{6.35} = .473$, $\frac{\pi}{\sqrt{7.0}}\left(\frac{6.35}{.051}\right) = 148$ a IS STILL TOO LARGE

FOR $a = 3.0$ & $t = .064$, $C = 118$

IF STIFFENER SPACING IS 5" & $t = .051$"

$q_{BUCK.} = .795(395) = 314\ \#/IN$, $R_s = \frac{250}{314} = .796$

$F_{c_{REQ'D}}$ $T = 250°$ $= 16{,}700\ psi$, $F_c = 7000\ psi$ TOO LOW

$d_w = 6.3$" (FIG 5010 2 FOR $t = .051$")

$d_w = 8.7$" FOR $t = .064$"

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MALTON · ONTARIO
TECHNICAL DEPARTMENT (Aircraft)

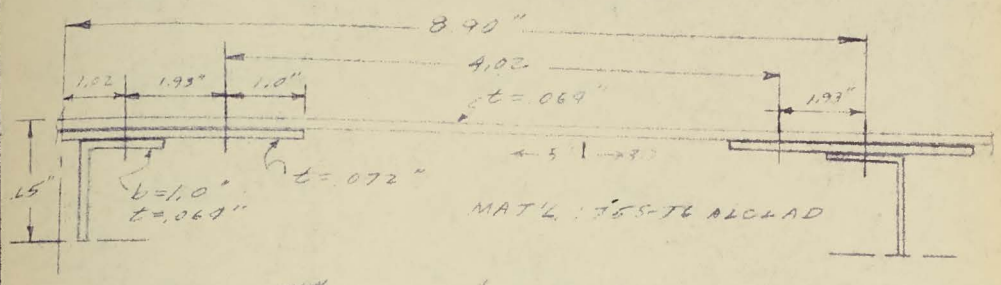
REPORT NO. 7-0579-1
SHEET NO. 5-12

AIRCRAFT:		PREPARED BY	DATE
C105	AILERON	R. GAVALIS	
		CHECKED BY	DATE

MAIN RIBS

RIB #7 (CONT.)

TRY SECTION AS SHOWN



$M = 8470^{IN\#}$ (LIMIT), $V = 780^{\#}$ (LIMIT)

ULTIMATE:

$$W = .85(.072+.064)\sqrt{\frac{9.7\times10^6}{15000}} = 2.93 \text{ FOR SKIN \& DOUBLER}$$

$$\left(\frac{b}{t}\right)_{FLANGE} = \frac{1.0}{.064} = 15.7,\ F_c = 26000 \text{ psi}$$

$$A_{SKIN\ \&\ DOUBLER} = (1.02+2.93)(.064+.072) = .5371\ IN^2$$

$$A_{FLANGE} = 1.0(.064) = .064\ IN^2,\ A_{L\&C} = .45(.064) = .0288\ IN^2$$

$$I = 4\left[.637(.582)^2 + .064(.482)^2 + \frac{.0288(.45)^2}{3}\right] = .795\ IN^4$$

$$f_{b_u} = \frac{8470(1.364)(1.55)}{.795} = 9460 \text{ psi}$$

$$M.S. = \frac{26000}{9460} - 1 = \underline{1.74}$$

LIMIT:

ADDITIONAL EFFECTIVE SKIN IS,

$$\Delta A_{SKIN} = 4(.064)\left(\frac{4.02}{2}\right) = .515\ IN^2$$

$$\Delta I = .515(.618)^2 = .197\ IN^4$$

A. V. ROE CANADA LIMITED
MALTON · ONTARIO
TECHNICAL DEPARTMENT (Aircraft)

REPORT NO. 7-0579-1
SHEET NO. S-13

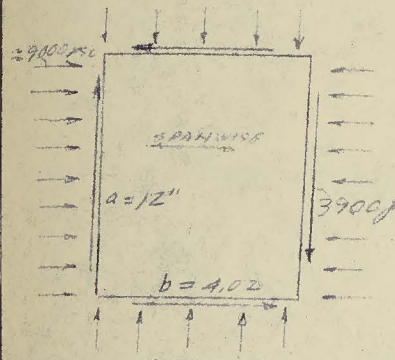
AIRCRAFT:		PREPARED BY	DATE
C105	AILERON	R SAVALIS	
		CHECKED BY	DATE

MAIN RIBS

RIB #7 (CONT.)

$I_{TOTAL} = .197 + .795 = .992 \text{ IN}^4$

$f_{b_y} = \frac{8470(.65)}{.992} = 5550 \text{ psi}$



$q = 250 \#/\text{in}$

$f_{s_y} = \frac{250}{.064} = 3700 \text{ psi}$

$q_{BUCKL.} = 1060 \#/\text{in}$ (REF FIG 501.C2 CAM-SOM) UNCORRECTED FOR TEMPERATURE

$F_{s_y} = \frac{1060}{.064} = 16600 \text{ psi}$

$R_s = \frac{3900}{16600} = .236$

$\left(\frac{L}{\rho}\right)_{EQUIV.} = \frac{\pi}{\sqrt{K}} \frac{b}{t} = \frac{\pi(4.02)}{\sqrt{3.62}(.064)} = 104$

$F_c = 8700 \text{ psi}$

NOTE: INTERACTION BETWEEN AXES NOT CONSIDERED.

$R_{c_x} = \frac{5550}{8700} = .639$

$M.S._x = \frac{1}{R_s^2 + R_c} - 1 = \frac{1}{(.236)^2 + .639} - 1 = +.44$

$\frac{b}{a} = \frac{4.02}{10.00} = .402, \quad K = 7.75$ (REF REPORT R9, 372)

$\left(\frac{L}{\rho}\right)_{EQUIV} = \frac{\pi(10.00)}{\sqrt{7.75}(.064)} = 177, \quad F_c = 5000 \text{ psi}$

$R_{c_y} = \frac{9000}{5000} = 1.8 \qquad M.S._y = \frac{1}{1.8 + (.236)^2} - 1 = -.46$

IT HAS BEEN DECIDED THAT SKIN BUCKLING AT LIMIT LOAD WILL NOT BE A CRITERION (SEE FOR RULE) (8-27-54)

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MALTON · ONTARIO
TECHNICAL DEPARTMENT (Aircraft)

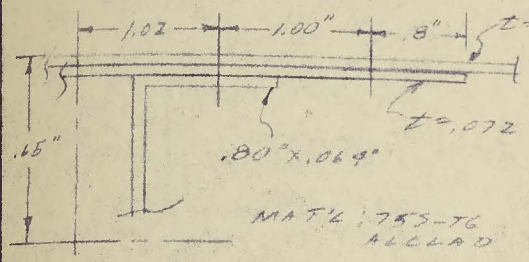
REPORT NO Z-0574-1
SHEET NO 5-14

AIRCRAFT: 0105	AILERON	PREPARED BY: R GAVALIS	DATE:
		CHECKED BY:	DATE:

MAIN RIBS

RIB #7 (CONT'D)

FOR SECTION AS SHOWN



$M = 8470$ "#" (LIMIT)

$V = 780$ # (LIMIT)

$W = .85(.051+.072)\sqrt{\frac{9.7\times10^6}{20000}} = 2.3$" FOR SKIN & DOUBLER

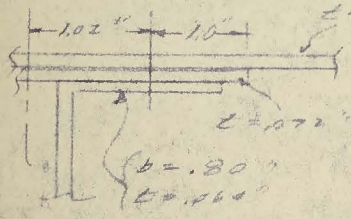
$\frac{b}{t} = \frac{.80}{.064} = 12.5$, $F_c = 30300$ psc

$A_{SKIN\ \&\ DOUBLER} = (1.02+1.8)(.051+.072) = .346\ IN^2$

$A_{FLANGE} = .80(.064) = .0512$, $A_{LEG} = .46(.064) = .0294\ IN^2$

$I = 4\left[.346(.589)^2 + .0512(.495)^2 + \frac{.0294(.46)^2}{3}\right] = .539\ IN^4$

$f_{bu} = \frac{8470(1.364)(.65)}{.539} = 14000$ psc



$M.S. = \frac{30300}{14000} - 1 = \underline{1.16}$

$W_{SKIN} = .955$"

$W_{DOUBLER} = .955$"

$I = 4\left[1.975(.123)(.589)^2 + .0512(.495)^2 + \frac{.0294(.46)^2}{3}\right] = .396$

$f_b = \frac{8470(1.364)(.65)}{.396} = 19000$ psc

$M.S. = \frac{30300}{19000} - 1 = \underline{.59}$

A. V ROE CANADA LIMITED
MALTON - ONTARIO
TECHNICAL DEPARTMENT (Aircraft)

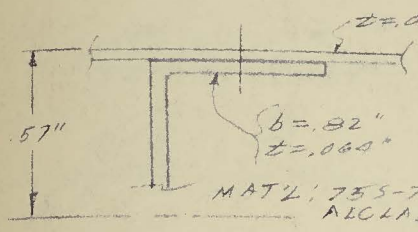
REPORT NO. Z-0574-1
SHEET NO. S-15

AIRCRAFT:		PREPARED BY	DATE
C105	AILERON	R. EAVALIS	
		CHECKED BY	DATE

INTERMEDIATE RIBS

RIB 7A

SECTION AT $y = .666C = 12.8"$ (MAXIMUM MOMENT HOLE)



$M = \pm 11200(.147) = \pm 1650$ IN# (LIMIT)

$V = \pm 330^{\#}$ (LIMIT)

(REF. θ_{33} 10th & 8th FS U/S AILERON – SUB SONIC CASE)

$$W_{SKIN} = .85(.051)\sqrt{\frac{9.7\times10^6}{30000}} = .778"$$

$$A_{SKIN} = .778(2)(.051) = .0794 IN^2$$

$A_{CHANNEL} = .82(.064) = .0525 IN^2$; $A_{FLG} = .455(.064) = .029 IN^2$

$$I = 2\left[.0794(.545)^2 + .0525(.437)^2 + \frac{.029(.451)^2}{3}\right] = .0762 IN^4$$

$$f_b = \frac{1650(1.364)(.57)}{.0762} = 16,850 \text{ PSI}$$

$$\frac{b}{t} = \frac{.82}{.064} = 12.8, \quad F_c = 29,800 \text{ PSI}$$

$$f_s = \frac{330(1.364)\left[.0794(.545) + .0525(.437) + \frac{.029(.451)}{2}\right]}{.0762(.064)} = 6750 \text{ PSI}$$

$R_b = .565$, $R_s = .204$

$$M.S. = \frac{1}{\sqrt{(.565)^2 + (.204)^2}} - 1 = .66$$

∴ SECTION O.K. AS IS.

A. V. ROE CANADA LIMITED
MALTON - ONTARIO
TECHNICAL DEPARTMENT (Aircraft)

REPORT No. 7-0579-1
SHEET No. 5-16

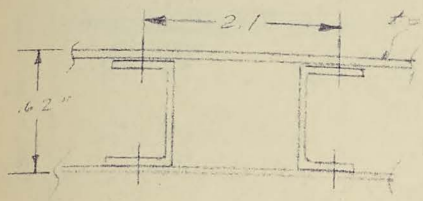
AIRCRAFT:		PREPARED BY	DATE
C105	AILERON	R GAUDAIS	
		CHECKED BY	DATE

MAIN RIBS

RIB #7 - 2.7" FWD. OF TRAILING EDGE

$M = 20300\left(\frac{L}{C}\right)^2 = 20300(.1)^2 = 292$ IN# (LIMIT)

$V = 260$ # (LIMIT)

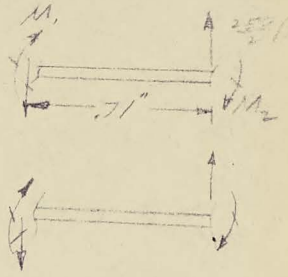


$\frac{S}{t} = \frac{.71}{.051} = 13.9$

$\left(\frac{L}{\rho}\right)_c = 1.65(13.9) = 23$

$F_c = 48000$ PSI (REF. R_3 AS)

$A = 2.96(.051) = .126$ IN^2



$P_c = \frac{M}{h} = \frac{292(1.364)}{.569} = 700$ #

$P_{ALL} = .126(48000) = 6040$ #

LET $M_1 = M_2$

$M_1 = \frac{250}{2}(1.364)(.71)\left(\frac{1}{2}\right) = 60.5$ IN#

$f_b = \frac{MC}{I} = \frac{60.5(.025)}{.0000231} = 65000$ PSI

$F_b = .795(115{,}000) = 91500$ PSI

$R_b = \frac{65000}{91500} = .713$, $R_c = \frac{700}{6040} = .116$

$M.S. = \frac{1}{.713 + .116} - 1 = .19$

CRM 1194

A. V. ROE CANADA LIMITED
MALTON - ONTARIO
TECHNICAL DEPARTMENT (Aircraft)

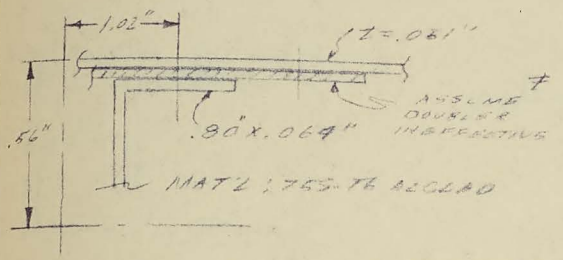
REPORT No. T-6579-1
SHEET No. S-17

AIRCRAFT:		PREPARED BY	DATE
C105	AILERON	R. GAVALIS	
		CHECKED BY	DATE

MAIN RIBS

RIB #7 - SECTION 11.7" FWD. OF T. EDGE

M = 5500 IN# (LIMIT) (REF. [illegible])
V = 650 # (LIMIT)



$\frac{b}{t} = \frac{.80}{.064} = 12.5$

MAT'L: 75S-T6 ALCLAD $F_{CR} = 30300$ PSI

$W_{SKIN} = .85(.051)\sqrt{\frac{11000}{30300}} = .775$

$A_{SKIN} = .775(2)(.051) = .079\ IN^2$

$A_{CLANGE} = .80 \times .064 = .0511\ IN^2$

$A_{LEG} = .373(.064) = .0238\ IN^2$

$I = 4\left[.079(.535)^2 + .0511(.406)^2 + \frac{.0238(.373)^2}{3}\right] = .1282$

$f_{b4} = \frac{5500(1.364)(.56)}{.1282} = 32700$ PSI

$M.S. = \frac{30300}{32700} - 1 = \underline{-.07}$

LESS CONSERVATIVELY, THE DOUBLER CAN BE CARRYING ABOUT 6(250) OR 1500 #. THE MOMENT CARRIED BY THE DOUBLER WOULD BE,

$M = 1500^{\#}(.56 - .087)(2) = 1420$ IN#. THEN,

$f_b = \frac{(5500 - 1420)(1.364)(.56)}{.1282} = 24300$ PSI

$M.S. = \frac{30300}{24300} - 1 = .24$

* DOUBLER ENDS THREE RIVETS AFT OF [illegible]

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MALTON - ONTARIO
TECHNICAL DEPARTMENT (Aircraft)

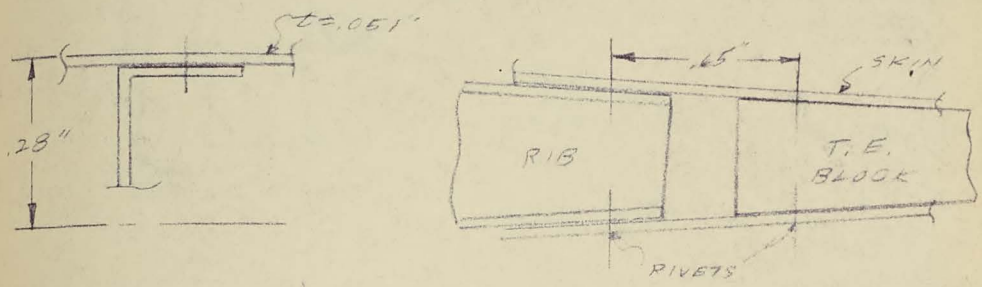
REPORT No. 7-0574-1
SHEET No. S-18

AIRCRAFT:		PREPARED BY	DATE
C105	AILERON	R. GAVALIS	
		CHECKED BY	DATE

INTERMEDIATE RIBS

RIBS 7A - 3" FWD OF TRAILING EDGE

M = 224 IN# (LIMIT), V = 218# (LIMIT) ← SUBSONIC CASE
(REF. P95 [illegible])



$$R_c = \frac{224(1.364)}{2(.255)} = 600\#$$

$$V_{VDR} = \frac{218(1.364)}{2} = 149\#$$

$$M = \frac{218(.60)(1.364)}{(2)(12)} = 44.6 \text{ IN\#}$$

$$1.65\frac{S}{d} = 1.65\left(\frac{.65}{.051}\right) = 21$$

$F_c = 49000$ psc, $W_c = .85(.051)\sqrt{\frac{27\times10^6}{49000}} = .6"$

$P_{cu} = 49000(.6)(.051)(2) = 3000\#$

$I = .0000132 \text{ IN}^4$

$$f_b = \frac{44.6(.025)}{.0000132} = 84600 \text{ psc}$$

$F_b = 91500$ psc $\quad R_b = \frac{84600}{91500} = .925$

$$R_c = \frac{600}{3000} = .20$$

$$M.S. = \frac{1}{.925+.20} - 1 = \underline{-.11}$$

FOR SUPERSONIC CASE M.S. = +.05

ORM 1319A

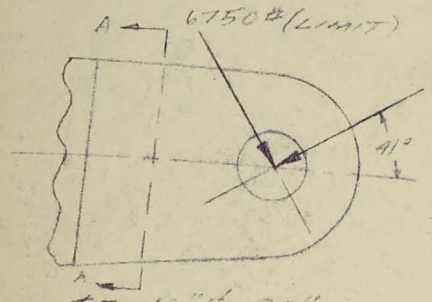
A. V. ROE CANADA LIMITED
MALTON · ONTARIO
TECHNICAL DEPARTMENT (Aircraft)

REPORT No. 7-0574-1
SHEET No. 5-19

AIRCRAFT:		PREPARED BY	DATE
C105	AILERON	R. GAVALIS	
		CHECKED BY	DATE

LEVER BRACKET - LUGS - RIB 7

SUBSONIC CASE - UP AILERON



(SIDE COMPONENT OF LINK LOAD HAS BEEN NEGLECTED SEE P3 5-21A)

MATL: 245-T4 EXT.

$t = .40" \& 80"$

AT A-A

$$I = \frac{(.401+.401+.80)(1.27)^3}{12} = .273 \text{ IN}^4$$

$$A = 1.6(1.27) = 2.03 \text{ IN}^2$$

$$M = 11300(.484) + 6750(.158) = 9450 \text{ IN-\#} \text{ (LIMIT)}$$

$$P_c = 4120\# \text{ (COMP.)}, \quad V = 12510\# \text{ - LIMIT}$$

$$f_{b_u} = \frac{9450(1.364)(.635)}{.273} = 30{,}000 \text{ psi}$$

$$f_{c_u} = \frac{4120(1.364)}{2.03} = 2770 \text{ psi}$$

$$f_{s_u} = \frac{12510(1.364)[(.635)^2(1.6)(\frac{1}{2})]}{.273(1.6)} = 12600 \text{ psi}$$

$F_{b_u} = 81000$ psi, $F_c = 57000$ psi, $F_{s_u} = 30{,}000$ psi

$F_{b_y} = 40000$ psi, $F_{c_y} = 39000$ psi, $F_{s_y} = 23{,}000$ psi

$R_{b_u} = .371$, $R_{c_u} = .049$, $R_{s_u} = .420$

$R_{b_y} = .473$, $R_{c_y} = .054$, $R_{s_y} = .461$

$$M.S._u = \frac{1}{\sqrt{(.371+.049)^2+(.420)^2}} - 1 = .68$$

$$M.S._y = \frac{1}{\sqrt{(.473+.054)^2+(.461)^2}} - 1 = .42$$

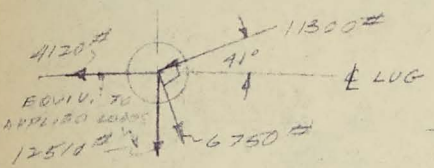
FORM 1319A

A. V. ROE CANADA LIMITED
MALTON - ONTARIO
TECHNICAL DEPARTMENT (Aircraft)

REPORT No. 7-0570-1
SHEET No. S-20

AIRCRAFT:		PREPARED BY	DATE
C105	AILERON	R. GAVALIS	
		CHECKED BY	DATE

LEVER BRACKET - LUGS - RIB #7 (CONT'D.)



FOR TRAIL EDGE (E=.40),

$$\frac{A_{AV.}}{A_{BY}} = \frac{6}{\left(\frac{3}{.44}+\frac{1}{.36}+\frac{1}{.35}+\frac{1}{.41}\right)(1.425)}$$

$$\frac{A_{AV}}{A_{BY}} = .95 \qquad P_{ALL_x} = 108000(.4)(.425) = 18300\#$$

$$K_{TR_x} = .48 \;,\; K_{TR_y} = 1.025 \qquad R_x = \frac{4120(1.364)}{4(18300)} = .077$$

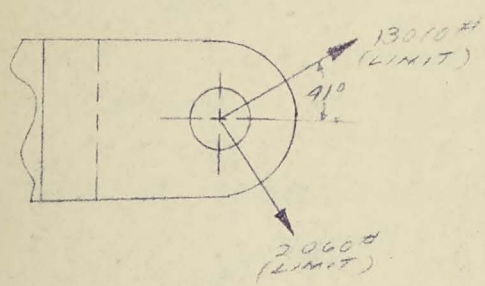
$$P_{ALL\ TR.\ U.} = .48(.40)(.425)(51000) = 4150\#$$

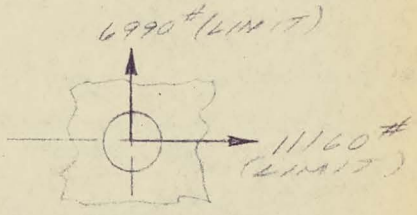
$$P_{ALL\ TR.\ Y} = 1.025(.40)(.425)(36000) = 6260\#$$

ALLOWABLE: 41820 POUNDS
TRAIL EDGE ULTIMATE DUE TO NELCON'S LUG ANALYSIS EQUALS OUT TO PIN CLEVIS

$$P_{LUG} = \frac{12510}{4} = 3130\#\ (\text{LIMIT}) \qquad M.S. = \frac{4150}{3130(1.364)} - 1 = \underline{-.03}$$

SUBSONIC CASE - DOWN AILERON





$$P'_{ALL\ TR.\ U} = 4150\#$$

$$\frac{e}{D} = \frac{.56}{.425} = 1.32 \;,\; P_{ALL\ ULT.\ TENSION} = 1.03(.425)(.4)(51000) = 8920\#$$

$$R_a = \frac{11160(1.364)}{4(8920)} = .427 \;,\; R_b = \frac{6990(1.364)}{4(4150)} = .574$$

$$M.S. = \frac{1}{\left[(1.427)^{1.6}+(1.574)^{1.6}\right]^{.625}} - 1 = \underline{.29}$$

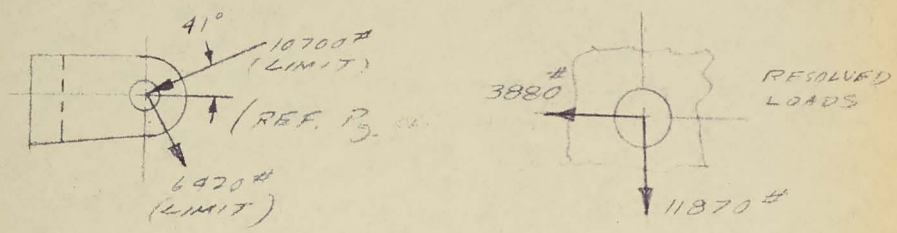
A. V. ROE CANADA LIMITED
MALTON · ONTARIO
TECHNICAL DEPARTMENT (Aircraft)

REPORT No. 7-0574-1
SHEET No. S-21

AIRCRAFT:		PREPARED BY	DATE
C105	AILERON	R. GAVALIS	
		CHECKED BY	DATE

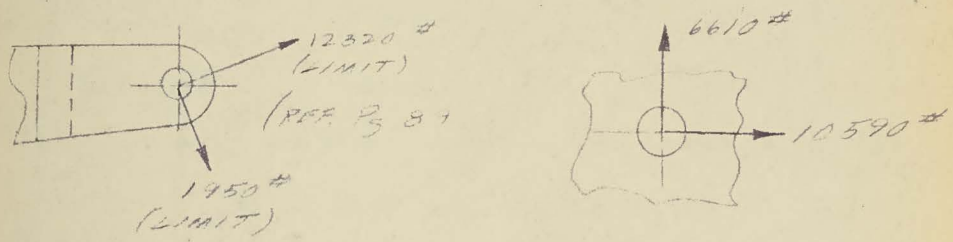
LEVER BRACKET - LUGS - RIB #7 (CONT'D.)

SUPERSONIC CASE - UP AILERON



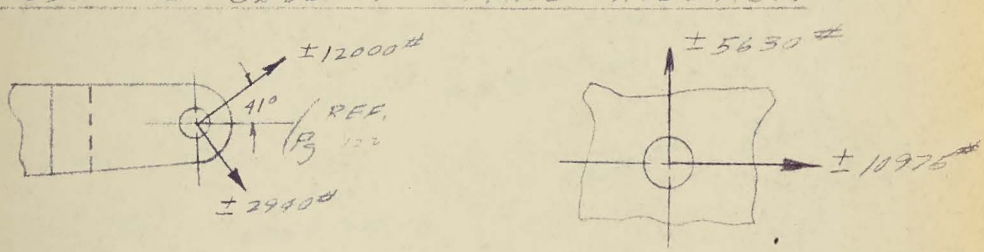
CONDITION IS CRITICAL BY COMPARISON WITH SUBSONIC CASE - UP AILERON, M.S. = -.05 (REF. P3 S-21)

SUPERSONIC CASE - DOWN AILERON



CONDITION NOT CRITICAL BY COMPARISON WITH SUBSONIC CASE - DOWN AILERON, (REF. P3 S-20)

SUBSONIC CASE - NEUTRAL AILERON



CONDITION IS NOT CRITICAL BY INSPECTION

∴ ONLY SUBSONIC CASE - UP & DOWN AILERON PROVIDES DESIGN LOADS FOR LUGS. (PROGRAMMED ONLY UP AILERON)

A. V. ROE CANADA LIMITED
MALTON · ONTARIO
TECHNICAL DEPARTMENT (Aircraft)

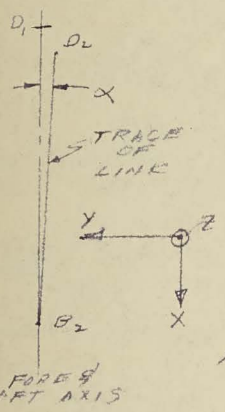
REPORT NO. 7-0574-1
SHEET NO. 5-21a

AIRCRAFT:		PREPARED BY	DATE
C105	AILERON	R. GAVALIS	9-22-54
		CHECKED BY	DATE

LEVER BRACKET - LUGS - RIB #7

SUBSONIC CASE - UP AILERON

DUE TO ECCENTRICITY IN LINK GEOMETRY, THE LINK LOAD HAS A COMPONENT IN THE SPANWISE DIRECTION AT THE LUGS. THIS COMPONENT PRODUCES BENDING IN THE LUGS ABOUT A VERTICAL AXIS & WILL BE TAKEN INTO ACCOUNT AT THIS POINT. FROM THE AILERON GEOMETRY DRAWING, IT WAS FOUND THAT,



	LASTEST FIGURES (11-16-54)
$\alpha_{UP} = 1^\circ$	1.5°
$\alpha_{NEUT} = 0^\circ$	1.5°
$\alpha_{DWN} = 0.5^\circ$	1.5°

THEN THE OUTWARD FORCE FOR UP AILERON IS,

$$P_y = D_0 \sin 1^\circ = .01744\, D_0$$

$$P_{y_{SUB.}} = .01744\left(\frac{22100}{1.25}\right) = 308^{\#}\ (ULT.)$$

(REF. P_y 7 LEVER LOADS RPT.

THEN M_z AT SECTION A-A IS:

$$M_{z_A} = 308^{\#}(.74) = 228^{IN\#}$$

ASSUME THIN LUG HAS $M_{z_{ULT.}} = \frac{228}{4} = 57^{IN\#}$

$$I = \frac{1.27(.40)^3}{12} = .00675\ IN^4$$

$$f_b = \frac{57(.2)}{.00675} = 1690\ PSI, \quad F_b = .92(86600) = 79500\ PSI$$

$$R_b = \frac{1690}{86600} = .0195, \quad f_s = \frac{308(1.5)}{41.4(1.27)} = 22.7\ PSI$$

∴ EFFECT OF SIDE COMPONENT OF LINK LOAD AT RIB 7 CAN BE NEGLECTED.

FORM 1319A

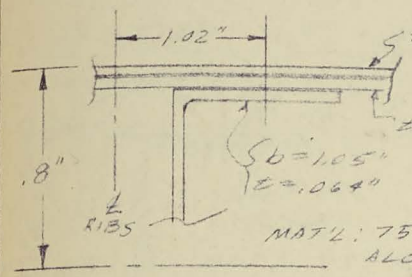
A. V ROE CANADA LIMITED
MALTON · ONTARIO
TECHNICAL DEPARTMENT (Aircraft)

REPORT No. I-0579-1
SHEET No. 5-22

AIRCRAFT: C105	AILERON	PREPARED BY R. GAVALIS	DATE
		CHECKED BY	DATE

MAIN RIBS

RIB #7 AT FRONT SPAR



$M = \pm 21500$ IN# (LIMIT)

$V = \pm 1640$ # (LIMIT)

(REF R.S. [illegible])

$\frac{b}{t} = \frac{1.05}{.064} = 16.4$, $F_c = 25100$ PSI (REF. MIL-HDBK-5 16)

$W_{SKIN} = .85(.051)\sqrt{\frac{9.7\times10^6}{25100}} = .851$, $W_{DOUBLER} = 1.2$

$A_{SKIN\ \&\ DOUBLER} = (.851)(.072)(1.02) + .851(.051) + 1.2(.072) = .255\ IN^2$

$A_{FLANGE} = 1.05(.064) = .0671\ IN^2$; $A_{LEG} = .064(.613) = .0392\ IN^2$

$I = 4\left[.255(.739)^2 + .0671(.145)^2 + \frac{.0392(.613)^2}{3}\right] = .686\ IN^4$

$f_{bu} = \frac{21500(1.364)(.80)}{.686} = 34200$ PSI

NEGLECTING COMPATING EFFECT OF CORNERS.

TAKING THIS INTO ACCOUNT GIVES:

$A_{SKIN\ \&\ DOUBLER} = (1.02+2.7^{\dagger})(.051+.072) = .457\ IN^2$.

$I = 1.126\ IN^4$, $f_b = \frac{.686(34200)}{1.126} = 20900$ PSI

$M.S. = \frac{25100}{20900} - 1 = .20$

† ESTIMATED EFFECTIVE WIDTH

A. V. ROE CANADA LIMITED
MALTON · ONTARIO
TECHNICAL DEPARTMENT (Aircraft)

REPORT No. 7-0574-1
SHEET No. 5-23

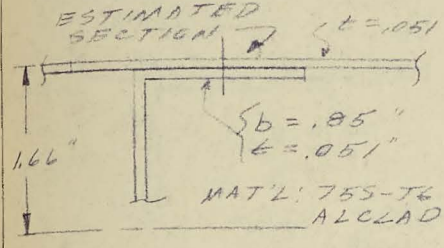
AIRCRAFT:		PREPARED BY	DATE
C105	AILERON	R. GAVALIS	
		CHECKED BY	DATE

INTERMEDIATE RIBS

RIB # 1A

(ESTIMATE OF RIB SIZE)

SECTION AT $\eta = .666c = 27.8"$



$M = \pm 20700(.147) = 3040$ IN# (LIMIT)

$V = \pm 260$# (LIMIT)

REF. Pgs. 104 & 90A

$\frac{b}{t} = \frac{.85}{.051} = 16.7$, $F_{cr} = 24{,}900$ psc

$W_{SKIN} = .85(.051)\sqrt{\frac{9.7 \times 10^6}{24900}} = .855$

$I = 2\left[(21.86)(.051)(1.635)^2 + .85(.051)(1.573)^2 + \frac{.051(1.537)^3}{3}\right] = .806$ IN^4

$f_b = \frac{3040(1.364)(1.66)}{.806} = 8550$ psc

$M.S. = \frac{24900}{8550} - 1 = \underline{1.91}$

TRY .85" x .040":

$\frac{b}{t} = \frac{.85}{.040} = 21.2$, $F_{cr} = 20900$ psc

$W_{SKIN} = .932"$

$I = 2\left[(21.932)(.051)(1.635)^2 + .85(.040)(1.59)^2 + \frac{.040(1.57)^3}{3}\right] = .781$ IN^4

$f_b = \frac{3040(1.364)(1.66)}{.781} = 8800$ psc

$M.S. = \frac{20900}{8800} - 1 = \underline{1.37}$

FORM 1191A

A. V. ROE CANADA LIMITED
MALTON · ONTARIO
TECHNICAL DEPARTMENT (Aircraft)

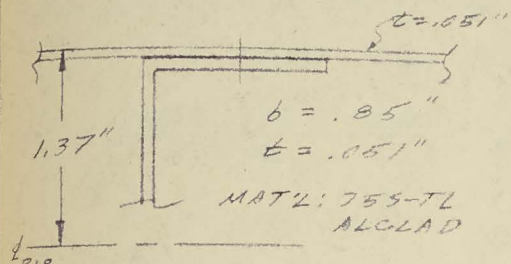
REPORT No. Z-0574-1
SHEET No. S-24

AIRCRAFT:		PREPARED BY	DATE
C 105	AILERON	R. GAVALIS	
		CHECKED BY	DATE

INTERMEDIATE RIBS (ESTIMATE OF RIB SIZE)

RIB # 2A

SECTION AT $\eta = .666C = 34.6"$



$M = \pm 35820(.147) = \pm 5260$ IN# (LIMIT)

$V = \pm 410$ # (LIMIT)

(REF P_{93} [illegible])

$\frac{b}{t} = \frac{.85}{.051} = 16.7$, $F_{cr} = 24900$ PSI

$W_{SKIN} = .85(.051)\sqrt{\frac{3.77\times10^7}{24900}} = .855"$

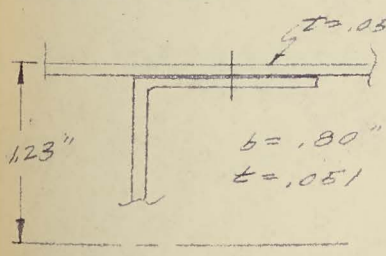
$I = 2\left[2(.855)(.051)(1.345)^2 + .85(.051)(1.29)^2 + \frac{.051(1.27)^3}{3}\right] = .630$ IN^4

$f_b = \frac{5260(1.369)(1.37)}{.630} = 18600$ PSI

$M.S. = \frac{24900}{18600} - 1 = .34$

RIB # 3A

SECTION AT $\eta = .666C = 30.1"$



$M = \pm 27300(.147) = \pm 4310$ IN# (LIMIT)

$V = \pm 380$ # (LIMIT)

(REF P_{93} [illegible])

$\frac{b}{t} = \frac{.80}{.051} = 15.7$ $F_{cr} = 26000$ PSI

FORM 1319A

INTERMEDIATE RIBS

RIB #3A (CONT'D.) (ESTIMATE OF RIB SIZE)

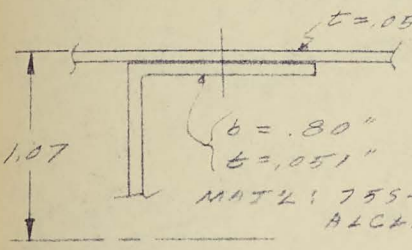
$$W_{SKIN} = .85(.051)\sqrt{\frac{9.7\times10^6}{26000}} = .835"$$

$$I = 2\left[.835(2)(.051)(1.20)^2 + .80(.051)(1.154)^2 + \frac{.051(1.13)^3}{3}\right] = .396\ IN^4$$

$$f_b = \frac{4310(1.364)(1.23)}{.396} = 18300\ psi$$

$$M.S. = \frac{26000}{18300} - 1 = .42$$

RIB #4A



$M = \pm 26200(.147) = \pm 3860^{IN\#}$ (LIMIT)

$V = \pm 370^{\#}$ (LIMIT)

$$\frac{b}{t} = \frac{.80}{.051} = 15.7, \quad E_s = 26000\ psi$$

$$I = 2\left[.835(2)(.051)(1.04)^2 + .80(.051)(.994)^2 + \frac{.051(.97)^3}{3}\right] = .296\ IN^4$$

$W_{SKIN} = .835"$

$$f_b = \frac{3860(1.364)(1.07)}{.296} = 19100\ psi$$

$$M.S. = \frac{26000}{19100} - 1 = .36$$

A. V. ROE CANADA LIMITED
MALTON - ONTARIO
TECHNICAL DEPARTMENT (Aircraft)

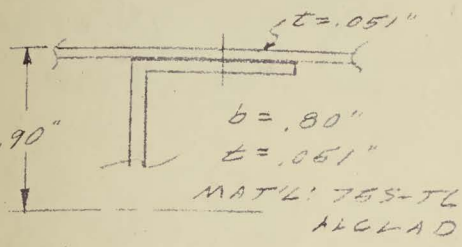
REPORT No. 7-0574-1
SHEET No. 5-26

AIRCRAFT:		PREPARED BY	DATE
C105	AILERON	R. GAVALIS	
		CHECKED BY	DATE

INTERMEDIATE RIBS

(ESTIMATE OF RIB SIZE)

RIB # 5A



$M = \pm 16980(.147) = \pm 2500$ IN# (LIMIT)

$V = \pm 320$ # (LIMIT)

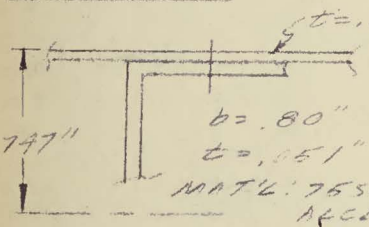
$\frac{b}{t} = \frac{.80}{.051} = 15.7$, $F_{cy} = 26000$ psi

$I = 2\left[.9=5(2)(.051)(.875)^2 + .80(.051)(.824)^2 + \frac{.051(.80)^3}{3}\right] = .203$ IN^4

$f_b = \frac{2500(1.364)(.90)}{.203} = 15100$ psi

$M.S. = \frac{26000}{15100} - 1 = .72$

RIB # 6A



$M = \pm 16520(.147) = \pm 1550$ IN# (LIMIT)

$V = \pm 240$ # (LIMIT)

REF [illegible]

$\frac{b}{t} = \frac{.80}{.051} = 15.7$, $F_{cy} = 26000$ psi

$I = 2\left[.835(2)(.051)(.722)^2 + .80(.051)(.671)^2 + \frac{.051(.647)^3}{3}\right] = .135$ IN^4

$f_b = \frac{1550(1.364)(.747)}{.135} = 11700$ psi

$M.S. = \frac{26000}{11700} - 1 = 1.22$

FORM 1319A

A. V. ROE CANADA LIMITED
MALTON ONTARIO
TECHNICAL DEPARTMENT (Aircraft)

REPORT NO. Z-0579-1
SHEET NO. 5-27

AIRCRAFT:		PREPARED BY	DATE
C105	AILERON	R. CAVALIS	
		CHECKED BY	DATE

ESTIMATE OF RIB SIZE

RIB ↓ LOCATION →	RIB GAGE						FLANGE SIZE					
	L.E	.80C	.666C	.50C	.40C	.333C	L.E	.80C	.666C	.50C	.40C	.333C
1				.051						.75		
2			.072			ϕ .072			1.00			ϕ .75
3			.081			≠ .081			.85			≠ .85
4			.072			.072			.85			.75
5			.064			.064			.86			.75
6		.051			.051			.85			.75	
7	ϕ .064	.064			* .064		1.05	.85			* .70	
1A			.051						.85			
2A			.051						.85			
3A			.051						.80			
4A			.051						.80			
5A			.051						.80			
6A			.051						.80			
7A			.064						.82			

(REF. Pgs 5-51 TO 53 F

ϕ OR .064" X .75" ⊖ REF Pg. 5-12

≠ OR .072" X .85"

* OR .051 X .70"

FORM 1518A

A. V. ROE CANADA LIMITED
MALTON · ONTARIO
TECHNICAL DEPARTMENT (Aircraft)

REPORT No. 7-0579-1
SHEET No 5-28

AIRCRAFT:		PREPARED BY	DATE
C105	AILERON	R. GAVALIS	
		CHECKED BY	DATE

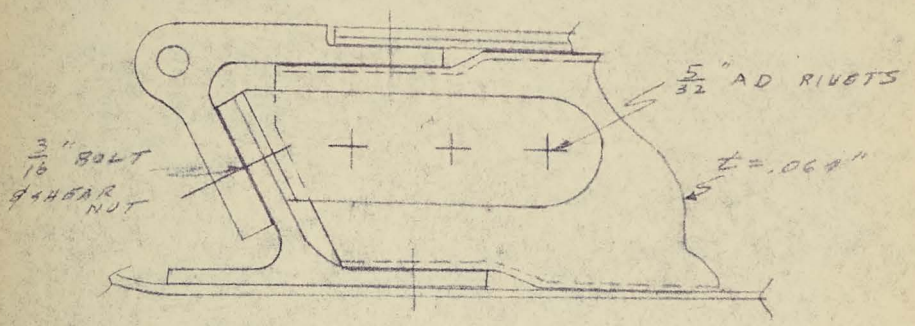
5-28

INTERMEDIATE RIBS

RIB #7A

ATTACHMENT TO FRONT SPAR

(REF. DWG. 7-0174-0010)



$V_{SUB.} = 1300^{\#}$ (LIMIT) (REF. Pg 10 L

TRANSFER OF SHEAR FROM WEB TO FITTING:

$V_{ALL.\ ULT.\ BY.} = 3(1020)(1.37)(.795) = 3330^{\#}$

$V_{ALL\ YIELD\ BY.} = 3(1020)(1.01)(.78) = 2420^{\#}$

$V_{ALL\ ULT.\ SHEAR} = 3(596) = 1790^{\#}$ (CRITICAL)

$M.S. = \frac{1790}{1300(1.364)} - 1 = .01$

MOMENT IN RIVET PATTERN NEGLECTED

RIVETS MUST BE STRENGTHENED IF DD'S CAN BE USED.

$V_{ALL\ ULT.\ SHEAR} = 3(815) = 2440^{\#}$

$M.S. = \frac{2440}{1300(1.364)} - 1 = .37$ FOR DD RIVETS

FORM 1318A

A. V. ROE CANADA LIMITED
MALTON - ONTARIO
TECHNICAL DEPARTMENT (Aircraft)

REPORT No. 7-0574-1
SHEET No 5-29

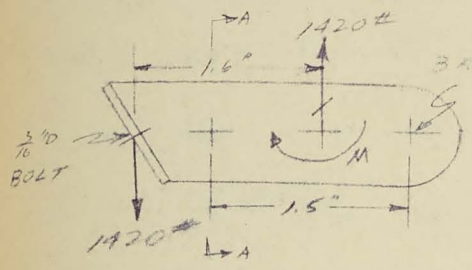
AIRCRAFT:		PREPARED BY	DATE
C 105	AILERON	R GAVALIS	
		CHECKED BY	DATE

INTERMEDIATE RIBS

R'16 74

ATTACHMENT TO FRONT SPAR (CONT'D.)

CONSIDER THE CLIP



BRIVETS SHEAR AT FRONT SPAR IS 1300 #/LIN.IN.

$V_{ULT} = 1300(1.364) = 1770$ #

ASSUME CLIP CARRYS 80% OF V.

$V_{CLIP} = .80(1770) = 1420$ #

$M = 1.6(1420) = 2270$ IN#

$P_{RIVET} = \frac{1420}{3} + \frac{2270}{1.5} = 1983$ #

$P_{ALL\ RIVET\ SHEAR} = 2120\#(.688) = 1460$ #
DOUBLE N.A. SHEAR CORRECTION FACTOR

$P_{ALL\ RIVET\ BY} = 1640(1.37) = 2240$ #

} 1/4" DD RIVETS

$P_{ALL\ RIVET\ SHEAR} = 3360(.688) = 2310$ #

$P_{ALL\ RIVET\ BY} = 2070(1.37) = 2840$ #

} 5/16" DD RIVETS

$M.S. = \frac{2310}{1983} - 1 = .16$

FOR THE BOLT

$P_{SHEAR} = 1420 \sin 45^\circ = 1000$ #

$P_{TENSION} = 1420 \cos 45^\circ = 1000$ #

$P_{ALL\ SH} = 2070$ #, $P_{ALL\ TENSION} = 2000$ #

BOLT O.K., USE TENSION NUT

FORM 1319A

A. V ROE CANADA LIMITED
MALTON - ONTARIO
TECHNICAL DEPARTMENT (Aircraft)

REPORT No. Z-0579-1
SHEET No. 5-30

AIRCRAFT: C105	AILERON	PREPARED BY R. GAUDETS	DATE
		CHECKED BY	DATE

INTERMEDIATE RIBS

RIB 7A

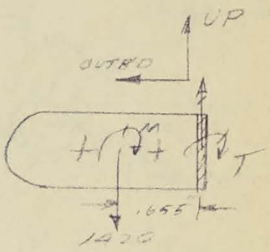
FRONT SPAR ATTACHMENT

FOR SECTION A-A

$M_b = 1420(.9) = 1280$ IN#

USE TWO EXTRUDED CLIPS .80" X .125

$I = \frac{.125(.80)^3}{12}(2) = .0107$ IN⁴



$f_b = \frac{1280(.40)}{.0107} = 47900$ #/SQ

$f_s = \frac{1420}{(.498)(.125)(2)} = 11,600$ #/SQ

ASSUME,

$T = 1420(.655)(.25) = 232$ IN#

$f_{sT} = \frac{232}{.333(.80)(.125)^2(2)} = 27800$ #/SQ

$R_b = \frac{47900}{104000} = .46$

$R_s = \frac{11600 + 27800}{43000} = .916$ $\quad M.S. = \frac{1}{.916} - 1 = .09$

A. V ROE CANADA LIMITED
MALTON - ONTARIO
TECHNICAL DEPARTMENT (Aircraft)

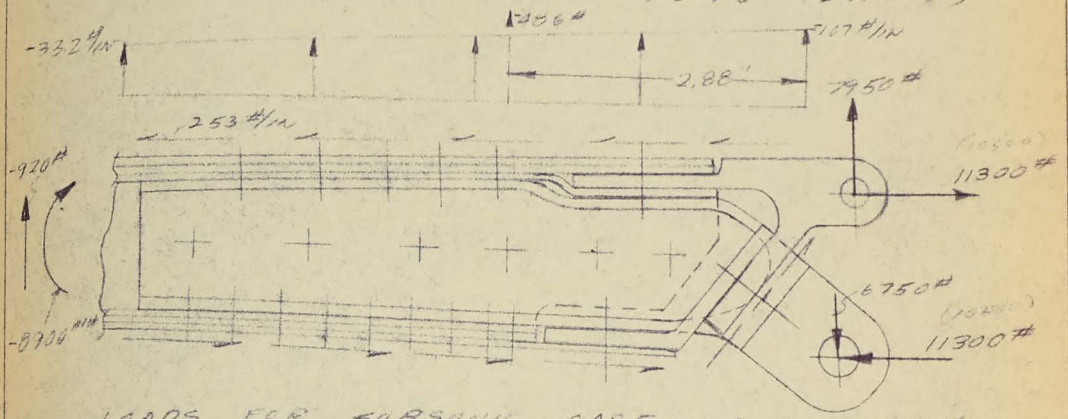
REPORT No. 7-0579-1
SHEET No. 5-31

AIRCRAFT:		PREPARED BY	DATE
C105	AILERON	R. GAVALIS	
		CHECKED BY	DATE

RIB #7 ATTACHMENT TO FRONT SPAR

$M = 20300$ IN# (LIMIT), $V = 1120$ # (LIMIT) (SUPERSONIC, SUBSONIC) (REF. P_3)

$M = 21500$ IN# (LIMIT) $V = 1600$ # (LIMIT)



LOADS FOR SUBSONIC CASE - UP AILERON

(REF. P_{3S})

CENTROIDAL HEIGHT AT FRONT SPAR = .70"

P = CAP LOAD $= \frac{21500}{2(.70)} = 15350$ # (LIMIT)

ATTACHMENT TO SPAR:

11 3/16" SCREWS, $P_{ALL} = 11(.92)(1.18)(1710) = 22800$ #

$M.S. = \frac{22800}{15350(1.364)} - .09$

BRACKET - TO - RIB FLANGE RIVETS - UPPER

$P = 15350$ # (LIMIT)

10 AN509 3/16" DIA SCREWS

$P_{ALL\ BRACKET} = 10(.92)(1.18)(1910) = 20700$ #

$P_{ALL\ SKIN} = 10(.795)(1.37)(2390) = 26000$ #

$M.S. = \frac{20700}{1.364(15350)} - 1 = -.01$

SOME LOAD WILL BE ON SKIN-TO-SPAR

* REF

A. V. ROE CANADA LIMITED
MALTON · ONTARIO
TECHNICAL DEPARTMENT (Aircraft)

REPORT NO. 7-0574-1
SHEET NO 5-32

AIRCRAFT: C105	AILERON	PREPARED BY R. GAVALIS	DATE
		CHECKED BY	DATE

RIB # 7

ATTACHMENT TO FRONT SPAR

BRACKET - TO - RIB FLANGE RIVETS, LOWER

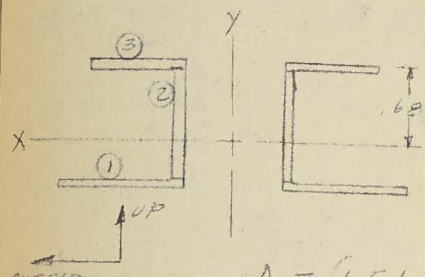
P = 15350# (LIMIT)

18 AN 509 3/16" SCREWS

$P_{ALL} = 18(1.92)(1.15)(1910) = 37,300$ #

$M.S. = \frac{37300}{1.369(15350)} - 1 = .78$

SECTION THRU BRACKET



$A = (1.5+1.0+1.0)(.10)(2) = .70$ IN²

$\bar{y} = \frac{.5(.10)(2)(.65)}{.70} = .077$" (BELOW CENTER)

$I_x = 2\left[(1.10)(.63)^2 + (1.2)(.10)(.47)^2 + \frac{.10(1.0)^3}{12}\right] = .162$ IN⁴

$\frac{b}{t} = \frac{1.5}{.10} = 15$, $F_{bc} = .85(24000) = 22800$ psi

$x = \frac{2\left[(1.0)(.10)(.63) + (1.5)(.10)(.05)\right](2)}{.162/.68} = 1.34$

$F_b = 23000$ psi

$M_{ALL} = \frac{23000(.162)}{.60} = 6200$ IN-#

INCREASE t_{WEB} TO .15"

$I_x = .162\left(\frac{.15}{.10}\right) = .243$

A. V. ROE CANADA LIMITED
MALTON - ONTARIO
TECHNICAL DEPARTMENT (Aircraft)

REPORT NO. 7-0579-1
SHEET NO. 5-33

AIRCRAFT:		PREPARED BY	DATE
C105	AILERON	R. GALLIS	
		CHECKED BY	DATE

RIB #7

ATTACHMENT TO FRONT SPAR

$\frac{b}{2} = \frac{1.5}{.15} = 10$, $F_c = .96(39000) = 37600$ psi

$F_b = 33000$ psi

$M_{ALL} = \frac{33000(.243)}{.60} = 13350$ in#

19100# LOADS USED
$M = 16000$ in#(LIMIT), $M_{ULT} = 22200$ in# (20160)

INCREASE LEGS TO .1875"

$\frac{b}{2} = \frac{1.5}{.1875} = 8$, $F_{bc} = .94(41200) = 38600$ psi

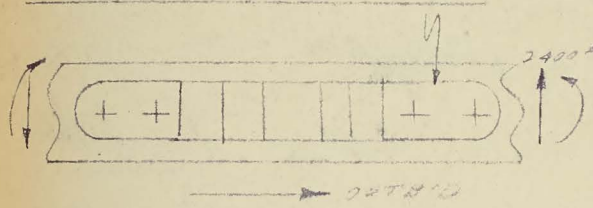
$I = \left(\frac{.1875}{.70}\right)(.102) = .0274$ in^4

$M_{ALL} = \frac{38600(.0274)}{.60} = 1760$ in#

MS = (M.S. + 1) = 1.25 (20160 in# INCREASED BY 25%)

USE t = 18.75" USE t = .2175"
Bush = 2.25"

EARS OF BRACKET



TRY CARRYING ENTIRE SPAR LOADS THRU BRACKET

$P_{BOLTS} = \frac{M}{.30} = \frac{4600}{.80} = 5750$ #/BOLT ↑↓

$P_{BOLTS\ SHEAR} = \frac{2400}{4} = 1200$ #/BOLT ↑↑

$P_{BOLTS\ LEVER\ SHEAR} = \frac{10650}{4} = 2660$ #/BOLT ↑

$P_{BOLTS\ LEVER\ TENSION} = \frac{3000}{4} = 750$ #/BOLT

FORM 1510A

A. V. ROE CANADA LIMITED
MALTON · ONTARIO
TECHNICAL DEPARTMENT (Aircraft)

REPORT No. Z-0574-1
SHEET No. S-34

AIRCRAFT: C105	AILERON	PREPARED BY: R GAYANIS	DATE:
		CHECKED BY	DATE

RIB # 7

ATTACHMENT TO FRONT SPAR

$P_{SHEAR\ TOTAL} = 5750 + 1200 + 2650 = 9600\#$

$P_{TENSION} = 750\#$

$P_{ALL\ SHEAR} = 5750\#$, $P_{ALL\ TENSION} = 6500\#$ (WITH TENSION NUT)

3/16" DIA BOLT

USE NAS 145 BOLTS

$P_{ALL\ SHEAR} = 7300\#$, $P_{ALL\ BV} = \frac{5}{16}(1.20)(108000) = 6750\#$

ASSUME BOLTS CARRY V_{SPAR}, $V_{LOWER\ CAP}$ & A PERCENTAGE OF M.

$P_M = 6750 - 1200 - 2650 = 2900\#$

THEN % M SHARED BY BOLTS IS

$\%\ M_{BOLTS} = \frac{2900(1.80)}{4600} = 50\%$

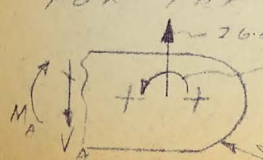
$M_{SPAR\ CAPS} = .50(4600) = 2300$ IN#

$P_{ODD} = \frac{2300}{1.4} = 1650\#$

$f_c = \frac{1650}{.11(1.0)} = 16500$ psi LOWER CAP

$\frac{b}{t} = \frac{1.0}{.11} = 10$, $F_{cc} = .92(33000) = 30500$ psi O.K.!

FOR THE FAIL



$V_A = 3950\#$

$M_A = 6150$ IN#

USE .30" x 1.2"

A. V ROE CANADA LIMITED
MALTON · ONTARIO
TECHNICAL DEPARTMENT (Aircraft)

REPORT NO 7-0574-1
SHEET NO 5-35

AIRCRAFT:		PREPARED BY	DATE
C105	AILERON	R. GAVALIS	7-24-54
		CHECKED BY	DATE

RIB #6 (REF. DWG. 7-0174-11)

RIB WEB FLANGES & O.K. BY COMPARISON WITH ASSUMED SECTION SHOWN ON P.S. 57.

SECTION 2.5" FWD. OF TRAILING EDGE

$M = 170^{IN\#}$ (LIMIT), $V = 160^{\#}$ (LIMIT) (REF. P.S. 57)

$P_c = \frac{M}{h} = \frac{170(1.364)}{.55} = 422^{\#}$, $\frac{s}{t} = \frac{1.0}{.051} = 19.6$

$F_{CR} = 42500\ psi$, $P_{ALL} = \frac{1.60}{2.0}(.051)(42500) = 3300^{\#}$

$M = \frac{VS}{4} = \frac{160(1.364)(1.0)}{4} = 54.5^{IN\#}$

$f_b = \frac{54.5(.025)}{.000017} = 80{,}000\ psi$

$F_b = .795(115{,}000) = 91500\ psi$

$R_b = \frac{80000}{91500} = .878$, $R_c = \frac{422}{3300} = .128$

$f_s = \frac{160(1.364)(.5)}{2.0(.051)} = 1070\ psi$, $R_s = \frac{1070}{.795(42000)} = .031$

$M.S. = \frac{1}{.878 + .128^2 + .031} - 1 = -.03$ STRENGTH LESS THAN REQUIRED

SKIN-TO RIB ATTACHMENT

$q = 288\ \#/in$ (LIMIT)

$p = 1.0"$, $\frac{5}{32}$ AD RIVETS

$q_{ALL\ YIELD} = \frac{P_{ALL}}{1.0} = \frac{.790(321)}{1.0} = 250\ \#/in$ (2 ROWS)

$M.S. = \frac{250(2)}{288} - 1 = .74$

A. V. ROE CANADA LIMITED
MALTON - ONTARIO
TECHNICAL DEPARTMENT (Aircraft)

REPORT NO. 7-0574-1
SHEET NO. 5-36

AIRCRAFT:		PREPARED BY	DATE
C105	AILERON	R. GAVALIS	9-24-54
		CHECKED BY	DATE

RIB 6A. (REF. DWG. 7-0174-11)

RIB WEB & FLANGES O.K. BY COMPARISON WITH P_3. 5-26

SKIN-TO-RIB ATTACHMENT

$q_{LIMIT} = 163$ #/in (REF P_3 5-1)

$p = 1.0"$, $q_{ALL\ YIELD} = \frac{.780(32.1)}{1.0} = 250$ #/in

$M.S. = \frac{250}{163} - 1 = .53$

SECTION 2.5" FWD OF TRAILING EDGE

$V_{SUB} = 120$ # (LIMIT), $M_{SUB} = 63.1$ in# (LIMIT)

$V_{SUPER} = 35$ #/LIMIT, $M_{SUPER} = 414$ in#(LIMIT)

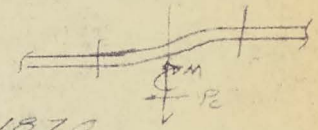
REF. P_3 5-26, 10-6, 7-2

RIVETS @ 1" PITCH $1.65\frac{S}{t} = 1.65\left(\frac{1.0}{.051}\right) = 32.4$

$F_c = 42400$ psi FOR SUPERSONIC CASE

$P_c = \frac{M}{h} = \frac{63.1(1.364)}{.73} = 118$ #

$W_e = .85(.051)\sqrt{\frac{10.5 \times 10^6}{51,500}} = .620$



$f_c = \frac{118}{.051(2)(.620)} = 1870$ psi, $R_c = \frac{1870}{51500} = .0362$

$M = \frac{VP}{4} = \frac{120(1.364)(1.0)}{4} = 40.9$ in#

$f_b = \frac{40.9(.025)}{.0000136} = 75100$ psi, $F_b = 100,000$ psi

$R_b = \frac{75100}{100000} = .751$, $f_s = \frac{120(1.364)}{2(.051)(2)(1.62)} = 1290$ psi

$R_s = \frac{1290}{43000} = .03$

$M.S. = \frac{1}{\sqrt{(1.03)(.751)^2 + (.03)^2}} - 1 = .27$

A. V ROE CANADA LIMITED
MALTON - ONTARIO
TECHNICAL DEPARTMENT (Aircraft)

REPORT NO. 2-0574-1
SHEET NO 5-37

AIRCRAFT:		PREPARED BY	DATE
C105	AILERON	R. GAVALIS	9-27-54
		CHECKED BY	DATE

RIB 5A (REF. DWG. 7-0174-11)

RIB WEB & FLANGES SUFFICIENT BY COMPARISON WITH R_3 5-26

SKIN-TO-RIB ATTACHMENT:

$q = 180\ ^{\#}/_{IN}$ (LIMIT), $q_{ULT} = 246\ ^{\#}/_{IN}$ / R_3 REF.

$p = 1.0"$, $^{5}/_{32}"$ DIA AD RIVETS

$f_{all\ yield} = \frac{.700(321)}{1.0} = 250\ ^{\#}/_{IN}$

$M.S. = \frac{250}{180} - 1 = \underline{.39}$

SECTION 2.75" FWD. OF TRAILING EDGE

$V_{SUB} = 134^{\#}$ (LIMIT), $M_{SUB} = 119\ ^{IN\#}$ (LIMIT) R_{3S} REF

$V_{ULT} = 183^{\#}$, $M_{ULT} = 162\ ^{IN\#}$

RIVET @ 1" PITCH, $1.65\ \frac{5}{2} = 32.9$, $F_c = 51500$ PSI

$W_2 = .620$ (REF. PRECEDING PAGE), $h = .75"$

$P_c = \frac{M}{h} = \frac{162}{.75} = 216^{\#}$, $f_c = \frac{216}{.62(2)(.051)} = 3430$ PSI

$R_c = \frac{3430}{51500} = .0666$, $M = \frac{V_{ULT}}{q} = \frac{183(1.0)}{4} = 45.8\ ^{IN\#}$

$f_b = \frac{45.8(.025)}{.0000136} = 84,100$, $F_b = 100,000$ PSI

$R_b = \frac{84100}{100,000} = .841$, $f_s = \frac{183}{(2)(1.051)(2)(.67)} = 1440$ PSI

$R_s = \frac{1440}{43000} = .034$

$M.S. = \frac{1}{\sqrt{(.841 + .0666)^2 + .034^2}} - 1 = \underline{.10}$

FORM 1319A

A. V. ROE CANADA LIMITED
MALTON - ONTARIO
TECHNICAL DEPARTMENT (Aircraft)

REPORT NO. 7-0579-1
SHEET NO 5-38

AIRCRAFT:		PREPARED BY	DATE
C105	AILERON	R. GAVALIS	9-27-54
		CHECKED BY	DATE

RIB #5 (REF DWG. 7-0174-11)

RIB WEB & FLANGES SUFFICIENT BY COMPARISON WITH ASSUMED SECTION ON P_5 +4

RIB-TO-SKIN ATTACHMENTS

$q = \underset{(LIMIT)}{348}$ #/IN, P = 1.0", 5/32" DIA. AD RIVETS

$q_{ALL} = \frac{780(321)}{1.0} = 250$ #/IN FOR (1) ROW

$M.S. = \frac{250(2)}{348} - 1 = .43$

L.E. & T.E. SECTIONS MUST BE CHECKED

RIB #4A (REF DWG 7-0174-11)

RIB WEB & FLANGES ARE SUFFICIENT BY COMPARISON WITH P_5 5-25

RIB-TO-SKIN ATTACHMENTS

$q = 200$ #/IN (LIMIT)

5/32" DIA RIVETS @ 1.0", $q_{ALL} = 250$ #/IN

$M.S. = \frac{280}{200} - 1 = .25$

L.E. & T.E. SECTIONS MUST BE CHECKED.

RIB #4 (REF. DWG. 7-0174-12)

RIB FLANGES ARE SUFFICIENT BY COMPARISON WITH P_5 5-3, INCREASE WEB GAUGE TO $t = .072$"

RIB-TO-SKIN ATTACHMENT

$q = 352$ #/IN

FORM 1319A

A. V. ROE CANADA LIMITED
MALTON · ONTARIO
TECHNICAL DEPARTMENT (Aircraft)

REPORT NO. Z-0579-1
SHEET NO. 5-39

AIRCRAFT: C105	AILERON	PREPARED BY: R. GAVALIS	DATE: 9-27-59
		CHECKED BY:	DATE:

RIB #4 (CONT'D.)

FOR THE 5/32" DIA AD RIVETS @ 1.0" PITCH.

q_{ALL} = 250 #/IN FOR (1) ROW

$$M.S. = \frac{250(2)}{352} - 1 = .42$$

FOR THE HUCK BLIND RIVETS @ 1.0"

$$q_{ALL} = \frac{.780(22)}{1.0}\left(\frac{1.37}{1.14}\right) = 206\ \#/IN$$

$$M.S. = \frac{206(2)}{252} - 1 = .17$$

RIB #3A (REF DWG. 7-0174-12)

RIB WEB & FLANGES SUFFICIENT BY COMPARISON WITH R.S. #14.

RIB-TO-SKIN ATTACHMENT

q_{SUPER} = 159 #/IN (LIMIT)

q_{ALL} = 250 #/IN FOR AD'S

q_{ALL} = 206 #/IN FOR HUCKS

$$M.S. = \frac{206}{159} - 1 = .30$$

RIB #3 (REF DWG 7-0174-12)

RIB. FLANGES ARE SUFFICIENT BY COMPARISON WITH R.S. #4. INCREASE WEB GAUGE TO t = .072".

SKIN-TO-RIB ATTACHMENT

q_{SUPER} = 370 #/IN (LIMIT), q_{ALL} = 250 #/IN FOR AD'S

q_{ALL} = 206 #/IN FOR HUCKS $\quad M.S. = \frac{206(2)}{370} - 1 = .11$

AVRO 1394A

A. V. ROE CANADA LIMITED
MALTON · ONTARIO
TECHNICAL DEPARTMENT (Aircraft)

REPORT No. 7-0579-1
SHEET No. S-40

AIRCRAFT:		PREPARED BY	DATE
C105	AILERON	R. GAVALIS	9-27-54
		CHECKED BY	DATE

RIB 2A (REF. DWG. 7-0174-12)

RIB WEB & FLANGES ARE SUFFICIENT BY COMPARISON WITH P.9 S-29.

RIB-TO-SKIN ATTACHMENTS:

$q_{SUPER} = 163^{\#}/IN$ (ULT)

$q_{ALL} = 250^{\#}/IN$ FOR AD'S, $q_{ALL} = 206^{\#}/IN$ FOR HUCKS

$$M.S. = \frac{206}{163} - 1 = .26$$

RIB 6A - L.E. ATTACHMENT

A. V. ROE CANADA LIMITED
MALTON - ONTARIO
TECHNICAL DEPARTMENT (Aircraft)

REPORT No. 7-1579-1
SHEET No. 5-41

AIRCRAFT:		PREPARED BY	DATE
C105	AILERON	R. GAVALIS	9-28-54
		CHECKED BY	DATE

RIB 3

LEVER BRACKET - LUGS

FOR COND. SUPERSONIC CASE - UP AILERON

$P_{2L} = -15700\#$, $P_{XL} = 29800\#$ (REF. PG. 56

$P_{TR} = -P_{2L}\cos 24^\circ + P_{XL}\sin 24^\circ$

$P_{TR} = 26430\#$ (LIMIT)

FOR THIN LUGS

$b_2 = .75"$, $b_3 = .70"$; $b_1 = b_4 = .91"$

$$b_{AVE} = \frac{6}{\frac{4}{.91} + \frac{1}{.75} + \frac{1}{.70}} = .838, \quad A_{AVE} = .838(.168) = .545 \text{ IN}^2$$

$A_{BR} = .75(.66) = .487 \text{ IN}^2$ $\quad \frac{A_{AVE}}{A_{BR}} = \frac{.545}{.487} = 1.12$

$K_{TRU} = .49$, $P'_{TRU} = .49(.487)(46900) = 11200\#$

FOR 24S-T4 EXT.:

$T = 60^\circ F$, $F_{bux} = 51000$ psi, $F_{by_x} = 36000$ psi

$T = 250^\circ F$, $F_{bux} = 46900$ psi, $F_{by_x} = 34200$ psi

$K_{TR_y} = 1.13$, $P'_{TR_y} = 1.13(.487)(34200) = 18800\#$

FOR THE THICK LUG:

$A_{BR} = 1.3(.75) = .975$

$K_{TRU} = .49$, $P'_{TRu} = .49(.975)(46900) = 22400\#$

$P_{LL_{TOTAL}} = 2(11200) + 22400 = 44800\#$

$M.S. = \frac{44800}{26430(1.3)(1.5)} - 1 = .29$

EFFECT OF P_2 HAS BEEN NEGLECTED ∴ M.S. IS SLIGHTLY UNCONSERVATIVE

BENDING AT BASE OF LUG SHOULD BE CHECKED

FORM 1319A

A. V ROE CANADA LIMITED
MALTON · ONTARIO
TECHNICAL DEPARTMENT (Aircraft)

REPORT No. T-0579-1
SHEET No. 5-92

AIRCRAFT:		PREPARED BY	DATE
C.105	AILERON	R. GAVALIS	1-28-59
		CHECKED BY	DATE

RIB #4

LEVER BRACKET - LUGS

FOR COND OF AILERON - SUPERSONIC:

$P_{zL} = -12680\#$ (LIMIT), $P_{xL} = 23200\#$ (REF. P_3 BC

$P_{TR} = -P_{zL}\cos 27° + P_{xL}\sin 27°$

$P_{TR} = 21790\#$ (LIMIT)

FOR THE THIN LUGS:

$b_1 = .80" = b_4$, $b_2 = .65"$, $b_3 = .60"$

$$b_{ave} = \frac{c}{\frac{1}{.80} + \frac{1}{.65} + \frac{1}{.60}} = .73", \quad b_{bt} = .69"$$

$$\frac{b_{AVE}}{b_{bt}} = \frac{.73}{.69} = 1.059, \quad K_{TRU} = .485$$

$P'_{TRU} = .485(.69)(.60)(46900) = 9400\#$

FOR THE THICK LUG, $T_{WC} = 1.2"$

THEN

$P_{\substack{LUG \\ TOTAL}} = 4(9400) = 37600\#$

$M.S. = \frac{37600}{1.364(21790)} - 1 = .27$

BENDING AT BASE OF LUG SHOULD BE CHECKED

FORM 1394A

