AVRO AIRCRAFT

TECHNICAL REPORT

L. Thurston

ANALYZED

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

AIRCRAFT: C105

REPORT NO. 7-0564-31

FILE NO:

NO OF SHEETS:

Classification cancelled / Changed to UNCLASS
By authority of AVRS
Date 30 Sept 56
Signature
Unit / Rank / Appointment AVRS

~~CONFIDENTIAL~~

TITLE:

OUTER WING

SKIN PANELS - MAIN BOX

DETAIL STRESSING

(INCLUDING ATTACHMENT OF SKIN TO STRS)

PREPARED BY R. GAVALIS DATE May '56

CHECKED BY DATE

SUPERVISED BY DATE

APPROVED BY DATE

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

FORM 1316A

15865867

AVRO AIRCRAFT LIMITED
MALTON · ONTARIO
TECHNICAL DEPARTMENT

REPORT No. 7-0564-31
SHEET No.

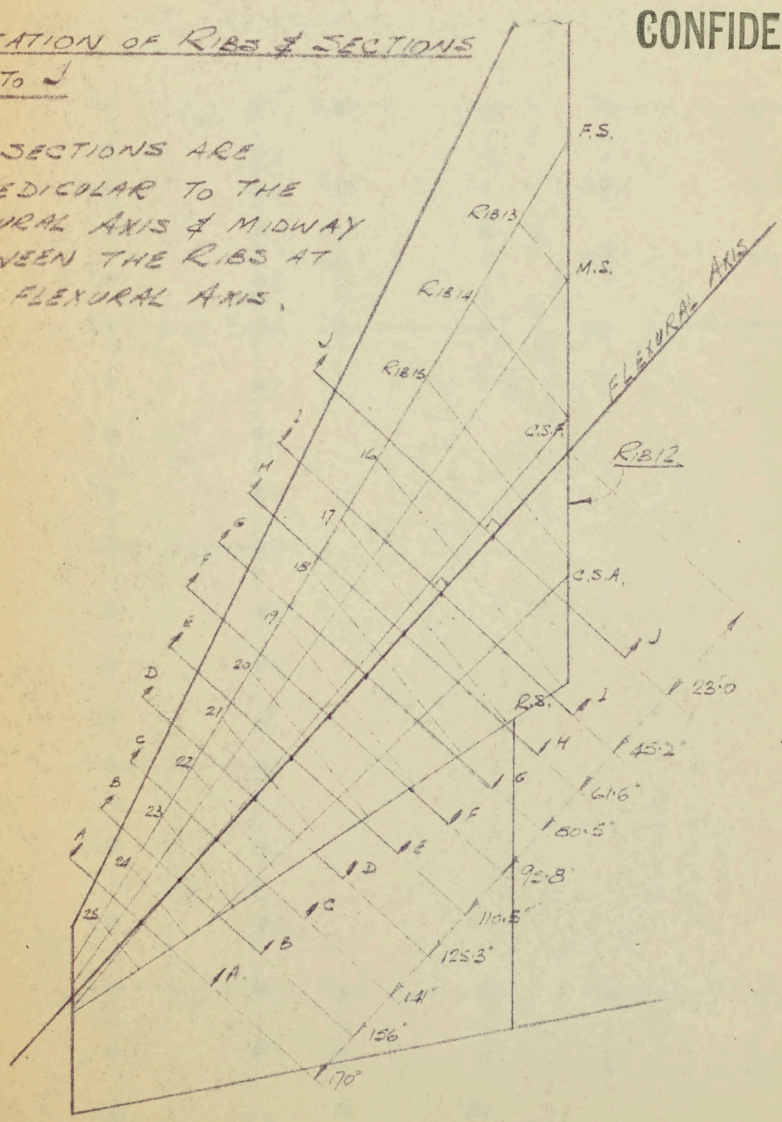
AIRCRAFT:	OUTER WING LOADS.	PREPARED BY	DATE
C105			
		CHECKED BY	DATE

SKIN & STRINGER LOADS

CONFIDENTIAL

LOCATION OF RIBS & SECTIONS A TO J

ALL SECTIONS ARE PERPEDICULAR TO THE FLEXURAL AXIS & MIDWAY BETWEEN THE RIBS AT THE FLEXURAL AXIS.



FORM 1319A

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

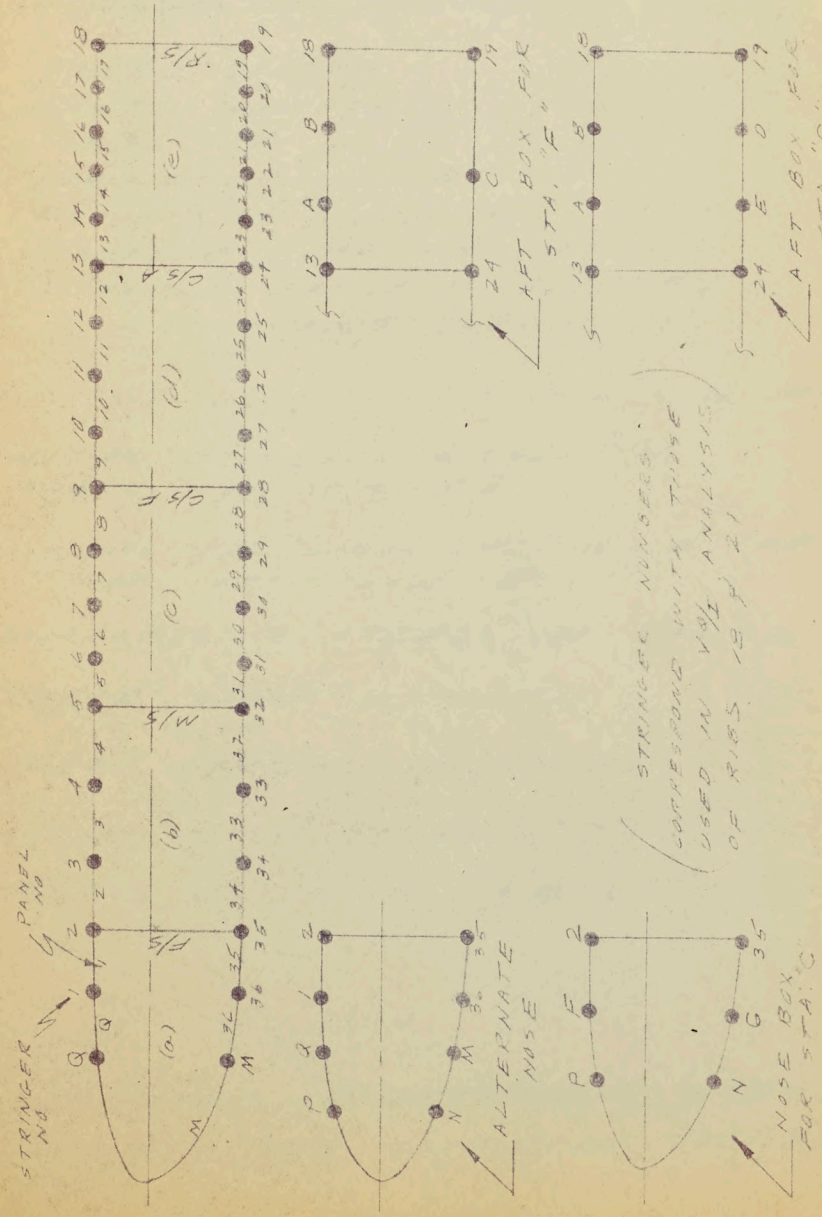
REPORT No. 7-0564-31
SHEET No.

AIRCRAFT:	
C 105	OUTER WING

PREPARED BY	DATE
R. CAVALLO	5-13-55
CHECKED BY	DATE

SKIN SHEARS

STRINGER NUMBERING SYSTEM



AVRO AIRCRAFT LIMITED
MALTON · ONTARIO
TECHNICAL DEPARTMENT

REPORT No.
SHEET No.

AIRCRAFT:		PREPARED BY	DATE
C105	OUTER WING	R. GAVALIS	
		CHECKED BY	DATE

SKIN PANELS

TABLE OF SYMBOLS

b - PANEL WIDTH
a - PANEL LENGTH
t - PANEL THICKNESS
t_u - UPRIGHT THICKNESS
t_f - FLANGE THICKNESS
d_c - DISTANCE BETWEEN UPRIGHTS
h - DISTANCE BETWEEN FLANGES
K_1, K_2, R' - RESTRAINT COEFFICIENTS

F_{cc} - INITIAL BUCKLING STRESS IN COMPRESSION

F_s - INITIAL BUCKLING STRESS IN SHEAR FOR $R' = 1.57$

F_{sc} - INITIAL BUCKLING STRESS IN SHEAR FOR PARTICULAR R'

f_c - COMPRESSIVE STRESS IN PANEL

q_s - SHEAR FLOW IN PANEL

f_s - SHEAR STRESS IN PANEL

R_c - STRESS RATIO IN COMPRESSION

R_s - STRESS RATIO IN SHEAR

SYMBOLS USED IN ULTIMATE SHOCK OF PANELS ARE GIVEN IN NACA 764

AV. 1392A

SKIN PANELS (UPPER)

BUCKLING OF PANELS

CASE 2.3

RIB BAY 18-19 (STA. "G")

TEMP. = 171°F MAT'L: 75S-T6 ALC.

PANEL / REF. →	1	2	3	4	5	6	7	8	9	10	11
	b	t_w	a	a/b	b/t_w	F_{cu}	f_c	R_c	t_f	t_f/t_w	t_{av}
				③/①	①/②	FIG. A7 TENSION FIELD THEORY	R3 K-40, COL B; R3 K-49	⑦/⑥		⑨/②	
2 F/S	3.6	.157	7/16.5	>1	19.1	51,800	4720	.091	.100	.637	.11
3	4.0				25.4	48,100	5330	.111			
4 N/S	4.9				31.2	44,600	5370	.132			
5	2.4				15.3	52,700	5530	.106			
6	3.3				21.0	51,000	6070	.119			
7	3.5				22.2	50,400	6310	.125			
8 C/S F	4.4				28.0	45,300	6260	.138			
9	3.1				19.7	51,500	6470	.126			
10	4.0				25.4	48,100	6910	.144			
11	4.2				26.8	46,600	7070	.152			
12 C/S A	4.4	.157	7/16.5	>1	28.0	45,300	6740	.149	.100	.637	.11

≠ R' CURVE HAS BEEN MODIFIED. NOW R' = .70 FOR R = .38 ↓

* $R = R_h + \frac{1}{2}\left(R_d - R_h\right)\left(\frac{d_c}{h_c}\right)^3$ (REF R3 1 OF TENSION FIELD THEORY)

K-200 FORM 1544

...LS (UPPER)

...OE PANELS

CASE 2.3a

...18-19 (STA. "G")

...1°F MAT'L: 755-T6 ALC. (ULTIMATE LOADS)

3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18
	a/b ③/①	b/t_w ①/②	F_{ca} FIG. 47 TENSION FIELD THEORY	f_c BK-40, COL B; BK-49	R_c ⑦/⑥	t_f	t_f/t_w ⑨/②	t_u	t_u/t_w ⑪/②	h_c	d_c	d_c/t_w ⑭/②	h_c/t_w ⑬/②	$\left(\frac{d}{h}\right)^3$ OR $\left(\frac{h}{d}\right)^3$ [④/⑬]^3	R_c FIG. NAC... 266
5	>1	19.1	51,800	4720	.091	.100	.637	.110	.700	16.5	3.0	19.1	105.0	.0060	.31
		25.4	48,100	5330	.111						4.0	25.4		.0142	
		31.2	48,600	5370	.132						4.9	31.2		.0261	
		15.3	52,700	5580	.106						2.4	15.3		.0031	
		21.0	51,000	6070	.119						3.3	21.0		.0077	
		22.2	50,400	6310	.125						3.5	22.2		.0095	
		28.0	45,300	6260	.138						4.4	28.0		.0137	
		19.7	51,500	6470	.126						3.1	19.7		.0066	
		25.4	48,100	6710	.144						4.0	25.4		.0142	
		26.8	46,600	7070	.152						4.2	26.5		.0164	
5	>1	28.0	45,300	6740	.149	.100	.637	.110	.700	16.5	4.4	28.0	105.0	.0187	.31

MODIFIED. NAW $R' = .70$ FOR $R = .385$

B

$\left(\frac{t_c}{t_c}\right)$ (REF. BJ 1 OF TENSION FIELD THEORY)

σ X = BUCKLING LOADS / APPLIED LOADS = 1

USING FIG. 50 AS INTE...

O.R.L.

AVRO AIRCRAFT LIMITED

MALTON, ONTARIO
ENGINEERING DIVISION

REPORT NO. J-0564-31
SHEET
DATE 10-27-55
PREPARED BY R. GAVALIS

AIRCRAFT C 105
WEIGHT
C. G. POSITION

17	18	19	20	21	22	23	24	25	26	27	28	29
$\left[\frac{d}{n}\sqrt{\frac{OR}{(h)_s}}\right]^3$	R_d	R_h	R	R'	$F_{s_{-3}} \times 10^{-3}$	F_{su}	q_s	f_s	R_s	R	N	X
(4)/(13)	FIG. 126, NACA 2661	FIG. 126, NACA 2661	*	FIG. 43 TENSION FIELD THEORY	FIG. 39	(21)×(22)	Pg K-51	(24)/(2)	(25)/(23)	SHEAR-COMPRESS. INTERACTION CURVE		$R/L - 1$
.0060	.318	.325	.395	.65	36.5	23.8	1635	10.4	.437	9.4	4.4	1.14
.6142			395		33.8	22.0	1505	9.6	.435	9.3	4.5	1.06
.6261			384		31.0	20.2	1363	8.7	.430	9.1	4.6	.98
.0031			.385		36.5	23.8	2022	12.9	.541	9.5	5.7	.67
.0077			.385		35.6	23.2	1874	12.1	.521	9.3	5.4	.72
.0095			.385		35.0	22.8	1756	11.2	.491	9.3	5.2	.79
.0137			.384		32.3	21.0	1603	10.2	.486	9.2	5.1	.80
.0066			.395		36.5	23.8	2119	13.5	.567	9.3	5.9	.58
.0142			385		33.8	22.0	1747	12.4	.564	9.3	5.7	.58
.0164			.384		33.0	21.4	1766	11.2	.523	9.2	5.6	.64
.0189	.318	.325	.384	.65	32.3	21.0	1569	10.0	.476	9.2	5.1	.80
$\frac{P_s}{P_{ss}} = 1$			INDICATES THAT PANELS ARE SAFE BELOW ULTIMATE.									
AS INTERACTION CURVE.												

O. R. L.

SKIN PANELS (UPPER)

BUCKLING OF PANELS

CASES 8.3a & 15.1a

RIB BAY 18-17 (STA. "G")

(ULTIMATE LOADS)

TEMP = 250°F MAT'L: 75S-T ALC.

A. V. ROE CA
MALTO
TECHNICAL

AIRCRAFT
WEIGHT
C. G. POSITION

PANEL ↓ REF. →	1 b/t [5] K-200	2 F_{cu} x10⁻³ FIG. 47	3 f_c ≠	4 CASE R_c ③/②	5 F_s -3 x10 FIG. 40	6 CASE 8.3a F_{scr} [21] x ⑤ K-200	7 f_s #/in² K-51	8 f_s ⑦/1.57	9 R_s ⑧/⑥	10 R INTERACTION CURVE	11 R INTERACTION CURVE	12 R *
2 F/S	19.1	42.5	23.0	.541	30.5	19.8	505	3.22	.162	9.4	5.7	.4
3	25.4	39.6	26.0	.657	28.0	19.2	243	1.55	.085	9.3	6.6	.5
4 M/S	31.2	34.8	26.2	.752	25.9	16.8	42	.27	.016	10.0	7.6	.6
5	15.3	44.0	27.2	.618	32.3	21.0	673	4.31	.205	9.4	6.6	.5
6	21.0	41.8	29.6	.716	27.7	19.3	420	2.68	.139	9.6	7.3	.5
7	22.2	41.3	30.3	.746	29.2	19.0	142	.91	.049	10.0	7.5	.6
8 C/L E	28.0	37.3	30.5	.807	27.0	17.6	157	1.00	.057	10.0	9.1	.6
9	19.7	42.4	31.5	.744	30.2	19.6	620	3.96	.202	9.5	7.8	.6
10	25.4	39.6	33.7	.852	28.0	18.2	277	1.77	.097	9.8	8.7	.7
11	26.8	38.8	34.5	.890	27.4	17.8	91	.58	.033	10.0	8.9	.7
12 C/L A	28.0	37.3	32.8	.868	27.0	17.6	488	3.11	.177	9.7	8.9	.7
④ FOR PANEL 11, FOR PANEL 12			X = +.14, X = +.07	USING		INTERACTION CURVE (TEST DATA) GIVEN ON R_s K-199a						
* $R_{c_{15.1a}} = \frac{M_{15.1a}}{M_{8.3a}}\left(R_{c_{8.3a}}\right)$				$= \frac{1.852}{2.285} \times$ ④		(REF R_s K-50 & 50a)						
≠ $f_{c_{8.3a}} = \frac{M_{8.3a}}{M_{2.3a}}\left(f_{c_{2.3a}}\right)$				$= \frac{2.285}{.470} \times$ [7] K-200		(REF R_s K-44 & 50					USING	

K-201 FORM 1543

O.R.L.

...ASES
...a & 15.1a

...LOADS)

...LC.

A. V. ROE CANADA LIMITED
MALTON, ONTARIO
TECHNICAL DEPT. (AIRFRAME)

AIRCRAFT . . C 105
WEIGHT . .
C. G. POSITION .

REPORT NO. .
SHEET . .
DATE . . 10-28-55
PREPARED BY . R. GAVALIS

7	8	9	10	11	12	13	14	15	16	17	18	19
...3a					CASE 15.1a						8.3a	15.1a
q_s #/in	f_s	R_s	R	r	R_c	q_s	R_s	R	r		X [θ]	X [θ]
K-51	⑦/.157	⑧/⑥	INTERACTION CURVE		*	K-51	⑬×⑨ / ⑦	INTERACTION CURVE			⑩/⑪ − 1	⑮/⑯ − 1
505	3.22	.162	9.4	5.7	.445	673	.216	9.2	5.0		.65	.84
243	1.55	.085	9.8	6.6	.540	873	.315	9.1	6.3		.48	.44
42	.27	.016	10.0	7.6	.618	1090	.415	9.1	7.5		.31	.21
678	4.31	.205	9.4	6.6	.503	772	.234	9.3	5.7		.42	.63
420	2.68	.139	9.6	7.3	.584	963	.320	9.2	6.7		.31	.37
142	.91	.048	10.0	7.5	.615	1130	.378	9.1	7.4		.33	.23
157	1.00	.057	10.0	9.1	.665	1407	.510	9.0	8.4		.23	.07
620	3.96	.202	9.5	7.8	.611	912	.298	9.3	6.9		.22	.35
277	1.77	.097	9.8	8.7	.700	1172	.411	9.1	8.2		.13	.11
91	.58	.033	10.0	8.9	.731	1453	.526	9.0	9.1		.12	4 −.01
88	3.11	.177	9.7	8.9	.714	1754	.636	8.9	9.7		.09	4 −.08

...TION CURVE (TEST DATA)
...1 Pg. K-199a

θ X = BUCKLING LOADS / APPLIED LOADS − 1, X < 0 INDICATES THAT PANEL BUCKLES BELOW ULTIMATE

...F. Pgs K-50 & 50a)

Pgs K-49 & 50

* USING FIG. 50 AS INTERACTION CURVE

SKIN PANELS (UPPER)

BUCKLING OF PANELS

RIB BAY 19-20 (STA. "F")

MAT'L: 75S-T6 ALC. SKIN

PANEL ↓ REF. →	1	2	3	4	5	6	7	8	9	10	11
	b	b/t ①/.150	F_{cw} FIG. 47		$(dc/hc)^3$ (①/4.75)^3	R *	R' FIG. 43	F_s $\times 10^{-3}$ FIG 39	F_{cw} ⑦×⑧	f_c COL 8 R_3 K=.25 R_3 K=.35	CASE R_c ⑩/③
2 (F/S)	2.7	18.0	52.0		.0061	.420	.70 △	37.0	25.9	3.45	.067
3	3.7	24.6	43.3		.0155	.419		34.0	23.3	3.93	.082
4 (M/S)	4.6	30.6	41.5		.0303	.419		31.8	22.2	3.94	.095
5	2.1	14.0	53.0		.0029	.420		37.9	26.4	4.09	.077
6	3.0	20.0	51.5		.0094	.420		36.2	25.4	4.46	.087
7	3.2	21.4	50.8		.0132	.420		35.5	24.8	4.57	.090
9 (C/S F)	4.0	26.6	46.9		.0199	.419		33.0	23.1	4.47	.098
7	2.6	17.3	52.3		.0055	.420		37.3	26.1	4.60	.088
10	3.7	24.6	43.9		.0163	.419		34.0	23.8	4.96	.102
11	3.8	25.4	43.0		.0171	.419		33.5	23.4	5.04	.105
12 (C/S A)	3.9	26.0	47.5		.0185	.419	.70 ▼	33.3	23.3	4.76	.100

* $R = R_h + \frac{1}{2}(R_d - R_h)\left(\frac{dc}{hc}\right)^3$ ≠ $f_c = \frac{M_{3,3a}}{M_{2,3a}}\left(f_{c_{2,3a}}\right) = \frac{1.64}{.250} \times$

△ REVISED R' CURVE (FIG 43) NOW GIVES A VALUE OF .74 中

$t_w = .150"$, $h_c = 4.75"$, $\frac{F_{su}}{F_{cw}} = \frac{.110}{.150} = .734$, $\frac{F_c}{F_{cw}} = \frac{.100}{.150} = .666$, $R_d = .345$, FIG. 13

FORM 1544

O. R. L.

PANELS (UPPER)

OF PANELS

BAY 19-20
(STA. "F")

S-TC ALC. SKIN

(ULTIMATE LOADS)

3	4	5	6	7	8	9	10	11	12	13	14	15	16	17
F_{cw} FIG. 47		$(d_c/h_c)^3$ $(①/1.035)^3$	R *	R' FIG. 43	F_s $\times 10^{-3}$ FIG 39	F_{cw} ⑦×⑧	f_c COL 8 R_3 K-25, R_3 K-35	CASE C R_c ⑩/③	g_s $g_{,K-35}$	2, 3a f_s ⑫/.150	R_s ⑬/⑨	$R_{M.S.}$ INTERACTION CURVES	$\frac{1}{n}$	F_{c-N} $\times 10^{-3}$ FIG. 47
52.0		.0061	.420	.70	37.0	25.9	3.45	.067	1672	11.2	.433	9.6	4.4	43.0
49.3		.0153	.419		34.0	23.3	3.95	.082	1658	11.1	.465	9.5	4.8	40.0
41.6		.0303	.419		31.8	22.2	3.94	.095	1475	10.0	.450	9.4	4.7	35.5
53.0		.0029	.420		37.9	26.4	4.09	.077	2152	14.4	.545	9.6	5.6	44.5
51.5		.0034	.420		36.2	25.4	4.46	.087	2034	13.9	.549	9.6	5.6	42.3
50.8		.0102	.420		35.5	24.8	4.57	.090	1962	13.1	.529	9.5	5.5	41.6
46.9		.0199	.419		33.0	23.1	4.47	.098	1832	12.2	.529	9.5	5.5	38.9
52.3		.0055	.420		37.3	26.1	4.60	.088	2231	14.9	.571	9.5	5.9	43.3
48.8		.0163	.419		34.0	23.8	4.96	.102	2084	13.9	.584	9.5	6.1	40.0
43.0		.0171	.419		33.5	23.4	5.04	.105	1930	12.9	.551	9.4	5.7	39.6
47.5		.0135	.419	.70	33.3	23.3	4.76	.100	1764	11.8	.506	9.4	5.3	37.2

$)\left(\frac{d_c}{h_c}\right)^3$ $\neq f_c = \frac{M_{3,3a}}{M_{2,3a}}\left(f_{c_{2,3a}}\right) = \frac{1.64}{.250} \times$ ⑩ (REF. R_3s K-33 & 34)

(FIG 43) NOW GIVES A VALUE OF .74 ⊕ X = 1.14 USING INTERACTION

$= \frac{F_{cu}}{F_{cw}} = \frac{.110}{.150} = .734$, $\frac{f_c}{F_{cw}} = \frac{.100}{.150} = .666$, $R_d = .345$, $R_h = .420$ ⊖ USING EQ

FIG. 126

O. R. L.

AVRO AIRCRAFT LIMITED

MALTON, ONTARIO
ENGINEERING DIVISION

AIRCRAFT - - C 105
WEIGHT - -
C. G. POSITION -

REPORT NO. -
SHEET - -
DATE - - 10-31-55
PREPARED BY - R. GAVALIS

16	17	18	19	20	21	22	23	24	25	26	27	28	29	
		CASE 8.3a						CASE 15.1a			2.3a	8.3a	15.1a	
$\frac{2}{n}$	$F_{c_{sw}} \times 10^{-3}$	f_c	R_c	F_s	F_{sw}	q_s	R_s	R_c	q_s	R_s	$\frac{\theta}{M.S.}$	$\frac{\theta}{M.S.}$	$\frac{\theta}{M.S.}$	
ION	FIG. 41	≠	(18)/(17)	FIG 40	(7) x (20)	P_g K-35	(22) / (21) x .50	ϕ	P_g K-35	(25) x (23) / (22)	$\frac{R_{sw}}{R_{max}} - 1$	$\frac{R}{n} - 1$	$\frac{R}{n} - 1$	
.4	43.0	22.5	.523	31.0	21.7	333	.102	.450	722	.222	1.18	.78	.80	2
.8	40.0	26.1	.653	28.2	19.7	301	.102	.553	746	.252	.98	.47	.51	3
.7	35.5	25.8	.728	26.2	18.3	95	.035	.616	1036	.382	1.00	.36	.24	4
.6	44.5	26.8	.602	33.0	23.1	523	.151	.510	836	.242	.71	.53	.61	5
.6	42.2	23.3	.552	30.3	21.2	350	.113	.590	957	.302	.71	.37	.37	6
.5	41.6	30.1	.724	29.6	20.8	64	.021	.613	1172	.386	.73	.37	.25	7
.5	38.8	27.4	.706	27.4	19.2	250	.087	.643	1403	.489	.73	.28	.10	8
.9	43.3	30.2	.698	31.4	22.0	556	.169	.591	852	.268	.61	.33	.43	9
.1	40.0	32.6	.815	28.2	19.7	203	.069	.690	1111	.378	.55	.21	.15	10
.7	39.6	33.0	.833	28.0	19.6	171	.058	.708	1356	.470	.65	.18	.06	11
.3	37.2	31.2	.796	27.7	19.4	570	.196	.675	1678	.576	.77	.17	-.01	12
		$\phi R_{c_{15.1a}} = \frac{M_{15.1a}}{M_{8.3a}} (R_{c_{8.3a}}) = \frac{1.37}{1.69}$						X (19)		(REF. P_gs K-34 & 34a)				
	TION	CURVE (TEST DATA) GIVEN ON P_g K-174a												
	IN - FIG. 50	AS	INTERACTION			CURVE								

O. R. L.

SKIN PANELS (UPPER)

BUCKLING OF PANELS

RIB BAY 20-21 (STA. "E")

MAT'L: 75S-T6 ALC. SKIN

PANELS	1	2	3	4	5	6	7	8	9	10	11
										CASE	2.
	b	b/t	$F_{c_{cr}}$	a/b	R	R'	$F_{s_{2,3}}$	$F_{s_{cr}}$	$f_{c_{2,3}}$	R_c	f_s
REF. →		①/.143	FIG 47	15.3/①	*	FIG 43	FIG 39	⑥ x ⑦	†	④/③	P_S K-18
2 (F/S)	5.7	39.8	25.8	2.7	.467	.74	28.7	21.2	2.3[illegible]	.089	1166
3 (M/S)	4.2	29.4	43.5	3.6		.77	32.1	24.7	2.57	.060	1855
5	4.5	31.5	39.9	3.4		.76	31.2	23.7	2.8[illegible]	.071	2164
7	2.8	19.6	51.5	5.5		.78	36.2	28.2	2.96	.058	2050
8 (C/S E)	3.2	22.4	50.2	4.8		.77	35.0	27.0	2.99	.069	1860
9	5.3	37.1	29.5	2.9		.74	29.0	21.4	3.40	.166	2111
11	3.5	24.5	48.8	4.4		.77	34.0	26.2	3.24	.067	1951
12 (C/S A)	3.4	23.8	49.3	4.5	.459	.77	34.2	26.4	3.15	.064	1734

† $f_{c_{8,3a}} = \frac{M_{8,3a}}{M_{2,3a}}\left(f_{c_{2,3a}}\right) = \frac{1.14 \times 10^6}{137,000} \times ⑨$ (REF. P_S K-17 & 17a)

* $R = R_h + \frac{1}{2}(R_d - R_h)\left(\frac{d_c}{h_c}\right)^3 = .458$ TO .466, USE .459 (AV.)

$t_w = .143"$, $t_u = .110"$, $\frac{t_u}{t_w} = \frac{.110}{.143} = .770$, $t_e = .100"$, $\frac{t_e}{t_w} = \frac{.100}{.143} = .700$

FORM 1544

K-203

N PANELS (UPPER)

…LING OF PANELS

…B BAY 20-21 (STA. "E")

: 75S-T6 ALC. SKIN

(ULTIMATE LOADS)

2	3	4	5	6	7	8	9	10	11	12	13	14	15	16
							CASE 2.3a							
b/t	F_{cw}	a/b	$\bar{R}$	R'	$F_s \times 10^{-3}$	$F_{scr} \times 10^{-3}$	$f_a \times 10^{-3}$	R_c	q_s	f_s	R_s	R_n	$M.S.$	$F_{cw} \times 10^{-3}$
①/.143	FIG. 47	15.3/①	*	FIG 43	FIG 39	⑥×⑦	PGS K-9, K-17	⑨/③	PG K-18	⑪/.143	⑫/⑧	FIG. 50		FIG 47
39.8	25.8	2.7	.459	.74	28.7	21.2	2.30	.089	1765	13.8	.650	9.78	6.59	24.2
29.4	43.5	3.6		.77	32.1	24.7	2.57	.060	1855	13.0	.526	9.76	5.32	36.8
31.5	39.9	3.4		.76	31.2	23.7	2.91	.071	2164	15.2	.642	9.72	6.51	34.5
19.6	51.5	5.5		.78	36.2	28.2	2.96	.058	2050	14.4	.511	9.71	5.18	42.4
22.4	50.2	4.8		.77	35.0	27.0	2.94	.059	1960	13.7	.503	9.80	5.14	41.2
37.1	29.5	2.9		.74	29.0	21.4	3.10	.106	2111	14.8	.691	9.75	7.02	27.3
24.5	48.8	4.4		.77	34.0	26.2	3.24	.067	1901	13.3	.510	9.79	5.12	40.0
23.8	49.3	4.5	.459	.77	34.2	26.4	3.15	.064	1794	12.5	.473	9.76	4.80	40.4

$\# \quad X = \frac{\text{BUCKLING LOADS}}{\text{APPLIED LOADS}}$

…$\left(f_{c_{2.3a}}\right) = \frac{1.14 \times 10^6}{137,000} \times ⑨$ (REF. PGS K-17 & 17a)

$\phi \quad R_{c_{15.1a}} = \frac{M_{15.1a}}{M_{2.3a}} \left(R_{c_{2.3a}}\right.$…

…$(R_d - R_h)\left(\frac{d_c}{h_c}\right)^3 = .458$ TO .466, USE .459 (AVE)

….110", $\frac{t_u}{t_w} = \frac{.110}{.143} = .770$, $t_e = .100"$, $\frac{t_e}{t_w} = \frac{.100}{.143} = .700$, $R_d = .382$, $R_h = .460$

FIG 126

O. R. L.

16	17	18	19	20	21	22	23	24	25	26	27	28	29	
	CASE 8.3a						CASE 15.1a				2.3a	8.3a	15.1a	
F_{cw} $\times 10^{-3}$	f_c	R_c	F_s	F_{sw}	q_s	R_s	R_c	q_s	R_s		X^{θ}	X^{θ}	X^{θ}	
(16)·47	F	(17)/(16)	F 6 40	(6)×(19)	Pg K-18	(21) / (20)×.143	φ	Pg K-18	(24)×(22) / (21)		FIG. 50			
24.2	19.1	.790	23.8	17.6	222	.088	.680	375	.346		.48	.22	.19	2
36.8	21.5	.585	26.5	20.9	197	.068	.503	1176	.405		.82	.66	.37	3
34.5	23.4	.679	25.8	19.6	257	.092	.584	953	.341		.49	.42	.34	5
42.4	24.6	.580	31.1	23.6	176	.052	.499	1263	.376		.87	.68	.43	7
41.2	24.4	.592	29.2	22.4	518	.162	.509	1509	.472		.90	.53	.27	8
27.3	25.8	.946	24.2	17.9	395	.154	.812	906	.314		.39	.01	.06	9
40.0	26.9	.673	28.2	21.7	403	.130	.578	1378	.444		.91	.40	.22	11
40.4	26.2	.650	25.6	22.0	347	.269	.559	1696	.386		1.04	.31	.32	12

...OADS / ...ADS − 1, X < 0 INDICATES THAT PANEL BUCKLES BELOW ULTIMATE.

... $_{8.3a}$) = $\frac{.930 \times 10^6}{1.14 \times 10^6}$ × (18) (REF. Pg K-17a & 17b)

0

O. R. L.

SKIN PANELS (UPPER)

BUCKLING OF PANELS

RIB BAY 21-22 (STA. 'D')

MAT'L: 75S-T6 ALC. SKIN

CASE 3.

PANELS ↓ / REF. →	1	2	3	4	5	6	7	8	9	10	11
	b	b/t	a/b	R	R'	F_{cw}	F_c	R_c	F_s	F_{sa}	f_s
		① / .136	15.3 / ①	*	FIG. 43	FIG. 47	COL. 1 R_s K=1.31, R_s K=1.35a	⑦ / ⑥	FIG. 37	⑤ × ⑨	R_s K=1.32
2 (R/S)	4.7	34.6	3.3	.351	.67	33.8	.500	.015	30.0	20.1	1628
4 (M/S)	4.2	30.9	3.6		.68	41.0	.594	.015	31.5	21.4	1630
6	3.6	26.5	4.3		.69	47.0	.660	.014	33.2	22.9	1730
7 (C/S-E)	6.2	45.6	2.5		.63	20.5	.722	.035	26.5	16.7	1303
9	4.2	30.9	3.6		.68	41.0	.752	.018	31.3	21.3	1552
11 (C/S-A)	6.4	47.0	2.4		.62	19.7	.809	.040	26.5	16.4	1305
13 (R/S)	5.4	39.7	2.8	.351	.66	25.9	.790	.131	29.4	18.9	1344

@ $X = \frac{\text{BUCKLING LOADS}}{\text{APPLIED LOADS}} - 1$, $X < 0$ INDICATES THAT PANEL

/ $R_{c_{15,16}} = \frac{(M/I)_{15,16}}{(M/I)_{13,14}} \left(R_{c_{13,14}}\right) = \frac{11997}{13890}$ × ⑱ (REF. R_s K=1.35a)

* $R = R_h + \frac{1}{2}\left(R_l - R_h\right)\left(\frac{d}{h}\right)^3$ = .340 .70 .352 .055 .551 (AVG) ≠

$t_w = .136''$, $t_u = .091''$, $\frac{t_u}{t_w} = \frac{.091}{.136} = .670$, $\frac{t}{t} = \frac{.100}{.136} = .735$, R_d =

FORM 1544

204

O. R. L.

IN PANELS (UPPER)

CKLING OF PANELS

RIB BAY 21-22
(STA. 'D')

L: 75S-T6 ALC. SKIN (ULTIMATE LOADS)

2	3	4	5	6	7	8	9	10	11	12	13	14	15	16
							CASE 2, 3a							
b/t	a/b	R	R'	F_{cc}	f_c	R_c	F_s	F_{sc}	γ_s	f_s	R_s	R_w	ν_w	F_{cu}
①/.136	15.3/①	*	FIG 43	FIG 47	col. 1 R_c K=1350	⑦/⑥	FIG. 39	⑤×⑨	R_s K=132	⑪/.36	⑫/⑩	FIG	50	FIG 47a
34.6	3.3	.351	.67	33.8	.500	.015	30.0	20.1	1628	12.0	.598			26.6
30.9	3.6		.68	41.0	.594	.015	31.6	21.4	1630	12.0	.561			31.0
26.6	4.3		.69	47.0	.660	.014	33.2	22.9	1730	12.7	.555			35.7
45.6	2.5		.63	20.5	.722	.035	26.5	16.7	1303	13.3	.798			17.8
30.9	3.6		.68	41.0	.752	.018	31.3	21.3	1952	13.5	.635			31.0
47.0	2.4		.62	19.7	.804	.040	26.5	16.4	1805	13.3	.812			17.2
37.7	2.8	.351	.66	25.9	.790	.131	28.4	18.9	1344	7.9	.626			21.5

ING LOADS / ED LOADS -1, $X<0$ INDICATES THAT PANEL BUCKLES BELOW U

$\frac{E)_{15.12}}{E)_{13.32}}\left(R_{c_{8.32}}\right) = \frac{11997}{13890} \times$ ⑱ (REF. R_s K=1350)

$R_d - R_h\left(\frac{d}{h}\right)^3 =$ .350 .352 .352 .351 (AVG) ≠ USE FIG 47a FOR PANE

$= .091"$, $\frac{t_w}{t_w} = \frac{.091}{.136} = .670$, $\frac{t_f}{t} = \frac{.100}{.136} = .735$, $R_d =$ .415, $R_h =$ .350,

A M.S. = $R_c +$

O. R. L.

AVRO AIRCRAFT LIMITED

MALTON, ONTARIO
ENGINEERING DIVISION

AIRCRAFT	C 105	REPORT NO.	
WEIGHT		SHEET	
C. G. POSITION		DATE	11-2-55
		PREPARED BY	R. GAVALIS

16	17	18	19	20	21	22	23	24	25	26	27	28	29	
	CASE 8.3a						CASE 15.1a				2.3a	8.3a	15.1a	
F_{cu}	f_c	R_c	F_s	F_{su}	q_s	R_s	R_c	q_s	R_s		X	X	X	PANEL ↓
FIG. 47a	Pg K-21, Pg K-135a	(17)/(16)	FIG. 40	(5)×(19)	Pg K-32	(21)/((20)×.136)	↓	Pg. K-135	(24)×(22)/(21)		FIG. 50			
26.6	17.4	.655	24.7	16.5	355	.158	.565	873	.388		.67	.42	.31	2
31.0	20.7	.668	26.0	17.7	352	.147	.576	911	.380		.78	.40	.31	4
35.7	22.8	.639	27.4	19.9	378	.147	.550	947	.368		.80	.46	.35	5
17.8	25.0	1.407	22.1	13.9	393	.208	1.213	961	.510		.25	-.30	-.29	7
31.0	26.2	.845	26.0	17.7	464	.168	.730	1049	.435		.57	.12	.06	9
17.2	28.0	1.636	22.0	13.6	401	.217	1.410	1068	.576		.23	-.40	-.38	11
21.5	27.4	1.276	24.0	15.8	297	.138	1.102	779	.362		.90	-.23	-.17	13

ULTIMATE

$R_c + \sqrt{R_c^2 + 4 R_s^2}$ ... -1

PANEL STIFFENED WITH INTERCOSTALS

O. R. L.

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

REPORT No. _____
SHEET No. _____

AIRCRAFT		PREPARED BY	DATE
C 105	OUTER WING	R CAVALIS	11-3-55
		CHECKED BY	DATE

SKIN SHEARS - RIB BAY 21-22

FAILING STRENGTH - PANEL # 7

USING TENSION FIELD THEORY,

$b = 6.2"$, $t = .136"$, $A_w = [11.0 + 12(.091)].091 = .190$

$C_f = .306 + .068 = .374"$, $C_w = .336$, $I_f = .0216\ in^4$

$$A_{we} = \frac{.190}{\left[1 + \left(\frac{.374}{.336}\right)^2\right]} = .085\ in^2$$

$\tau_w = 13,900\ psi$, $\tau = 22,500\ psi$

$$\frac{\tau}{\tau_w} = \frac{22500}{13900} = 1.62, \quad K = .1043$$

$$\frac{A_{we}}{dt} = \frac{.085}{6.2(.136)} = .1005, \quad \frac{\sigma_w}{\tau} = .18$$

$\tan\alpha = .960$, $C_1 = .001$, $C_2 = .10$

$$\tau'_{MAX} = \tau(1 + K^2C_1)(1 + KC_2) = 22500[1 + (.1043)^2(.001)][1 + .1043(.10)]$$

$\tau'_{MAX} = 22,800\ psi$

$\sigma_w = 22,500(.18) = 4050\ psi$, $\frac{d}{h} = \frac{6.2}{15.3} = .405$

$\sigma_{w_{MAX}}/\sigma_w = 1.47$, $\sigma_{w_{MAX}} = 1.47(4050) = 5950\ psi$

$R_6 = .22 t \sigma_{w_T} = .22(.136)(57,200) = 1710\ \#/in$

$R'' = \tau[1 + .414K] = \frac{22500}{.136}[1 + .1043(.414)] = 1730\ \#/in$

$P_w = A_{we}\sigma_w = .085(4050) = 344\ \#$

$\tau_{ALL} = 23,200\ psi$

$\sigma_0 = 23.4 K^{\frac{2}{3}}\left(\frac{\tau_w}{t}\right)^{\frac{1}{3}} = 23.4(.1043)^{\frac{2}{3}}\left(\frac{.091}{.136}\right)^{\frac{1}{3}}$

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FORM 3184

O. R. L.

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

REPORT No. _____
SHEET No. _____

AIRCRAFT:		PREPARED BY	DATE
C 105	OUTER WING	R. CAVALIN	11-6-55
		CHECKED BY	DATE

SKIN SHEARS

RIB BAY 21-22

FAILING STRENGTH - PANEL 7 (CONT'D.)

$\sigma_o = 4500$ psc , $\sigma_{ALL} = 4500$ psc

$\sigma_{w_{AVE}} = \frac{1150(.095)}{.190} = 1910$ psc

$\frac{\sigma_{ALL}}{\sigma_{w_{MAX}}} = \frac{4500}{5950} = .76$ ASSUMED 2 TOO HIGH

TRY $\sigma = 19,000$ psc , $\frac{\sigma}{\sigma_{cr}} = \frac{19000}{13700} = 1.37$

$K = .068$, $\sigma_w/\sigma = .12$, $\sigma_w = .12(19000) = 2280$ psc

$\sigma_{w_{MAX}}/\sigma_w = 1.43$, $\sigma_{w_{MAX}} = 1.43(2280) = 3380$ psc

$\sigma_{o_{ALL}} = 23.4(.068)^{2/3}\left(\frac{.091}{.136}\right)^{1/3} = 3400$ psc

$\therefore \sigma_{ALL\ SHEAR\ ULT.} = 19,000$ psc (FAILURE BY CRIPPLING OF STIFFENER)

ULTIMATE COMPRESSIVE STRESS ;

CRIPPLING STRESS OF INTERCOSTAL,

$\left(\frac{b}{t}\right)_{FLANGE} = \frac{1.0}{.091} = 11$, $F_{cu_{FLANGE}} = 35,000$ psc

$\left(\frac{b}{t}\right)_{WEB} = \frac{\pi}{\sqrt{21.6}}\left(\frac{3.9}{.091}\right) = 29$, $F_{cu_{WEB}} = 33,000$ psc

$F_{cu_{INTER.}} = \frac{35000(1.0)(.091) + 33000(2)(.091)\left(\frac{1}{2}\right)}{1.0(.091) + 2(.091)\left(\frac{1}{2}\right)} = 34,000$ psc

$F_{cu_{PANEL}} = 17,900$ psc (COL 16, PG. F-204) $\frac{\sigma_{cr}}{\sigma} = \frac{17.8}{34.0} = .524$

-206

FORM 1319A

D. R. L.

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

REPORT NO.
SHEET NO.

AIRCRAFT:		PREPARED BY	DATE
C 105	OUTER WING	R. GAVALIS	11-3-55
		CHECKED BY	DATE

SKIN SHEARS

RIB BAY 21-22

FAILING STRENGTH - PANEL 7 (CONT'D)

$\frac{b_e}{b} = .755$ (OUTER CURVE)

CASE 8.3a

ELE.	A_{STR}	$A_{SKIN\ BUCKLED}$	$A_{STRT+BOD}$	$A_{UNBUCKLED}$	$f_{c\ UNBUCKL.}$	$f_{c\ BUCKL.}$
7	.225	.563	.788	.893	25200	28600
9	.682	.600	1.282	1.411	24800	27200

(REF. P_{B3} K-116, 119, 135a)

$A_{SKIN\ BUCKL.\ 7} = \left(\frac{3.6+6.3}{2}(.755)\right)(.136)$, $A_{SKIN\ BUCKL.\ 9} = \left(\frac{4.2+6.2}{2}(.755)\right)(.136)$

$f_{c\ BUCKL.\ AVe} = \frac{28600+27200}{2} = 27900$ psi

FOR 8.3a,

$R_c = \frac{27900}{34000} = .821$, $R_s = \frac{393}{(.136)(17000)} = .152$

$M.S. = \frac{9.91}{8.39} - 1 = .18$

(REF. P_{B3} K-119a)

FOR CASE 15.1a,

$R_c = \frac{11997}{13890}(.821) = .710$

$R_s = \frac{961}{(.136)(17000)} = .372$

$M.S. = \frac{10.5}{8.02} - 1 = .31$

NOTE: NO ATTACHMENTS HAVE BEEN CHECKED. SEE ATTACHMENT ANALYSIS.

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FORM 1319A

O. R. L.

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

REPORT No. _____
SHEET No. _____

AIRCRAFT:		PREPARED BY	DATE
C105	OUTER WING	R. GAVALIS	11-3-55
		CHECKED BY	DATE

SKIN SHEARS

RIB BAY 21-22

FAILING STRENGTH - PANEL #11

ULTIMATE SHEAR STRENGTH;

$b = 6.4"$, $t = .136"$; $A_{st} = .190\ in^2$; $e_{st} = .374"$

$P_{st} = .336\ lb$; $A_{se} = .085\ in^2$ $\sigma_{cu} = 13,600\ psi$

$\sigma = 19,000\ psi$, $\frac{\sigma}{\sigma_{cu}} = \frac{19000}{13600} = 1.40$

$K = .0725$; $\frac{A_{se}}{dt} = \frac{.085}{6.4(.136)} = .0975$

$\frac{\sigma_{st}}{\sigma} = .125$, $\tan\alpha = .955$, $C_1 = .002$, $C_2 = .10$

$\sigma'_{MAX} = \sigma(1 + K^2C_1)(1 + KC_2) = 19000[1 + (.0725)^2(.002)][1 + .0725(.10)]$

$\sigma'_{MAX} = 19,100\ psi$

$\sigma_{st} = .125(19000) = 2380\ psi$, $\frac{d}{h} = \frac{6.4}{15.3} = .419$

$\sigma_{st\,MAX}/\sigma_{st} = 1.47$, $\sigma_{st\,MAX} = 1.47(2390) = 3500\ psi$

$R_b = .22\,t\,\sigma_{ULT} = .22(.136)(57200) = 1710\ \#/in$

$R'' = q(1 + .419K) = \frac{19000}{.136}[1 + .419(.0725)] = 1440\ \#/in$

$P_{st} = A_{se}\,\sigma_{st} = .085(2380) = 202\ \#$

$\sigma_0 = 23.4\,K^{\frac{2}{3}}\left(\frac{e_{st}}{t}\right)^{\frac{1}{3}} = 23.4(.0725)^{\frac{2}{3}}\left(\frac{.091}{.136}\right)^{\frac{1}{3}} = 3570\ psi$

$\sigma_{ALL\ WEB} = 23,600\ psi$

$\frac{\sigma_0}{\sigma_{MAX}} = \frac{3570}{3500} = 1.02$ $\therefore$ $\sigma_{ALL\ SHEAR\ ULT} = 19000\ psi$

K-208

FORM 1198A

O. R. L.

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

REPORT No.
SHEET No.

AIRCRAFT:		PREPARED BY	DATE
C105	OUTER WING	R. GAVALIS	11-8-55
		CHECKED BY	DATE

SKIN SHEARS

RIB BAY 21-22

FAILING STRENGTH - PANEL #11 (CONT'D)

ULTIMATE COMPRESSIVE STRESS;

F_{cu} INTER = 34,000 psi (REF. Pg K-206)

F_{cu} PANEL = 17,200 psi, $\frac{\sigma_{cu}}{\sigma} = \frac{17,200}{34,000} = .506$

$\frac{b_e}{b} = .746$

CASE 8.3a

ELE.	A_{STR}	$A_{SKIN\ BUCKLED}$	$A_{ISTAB\ BUCKLED}$	$A_{TOTAL\ UNBUCKLED}$	$f_{c\ UNBUCKL.}$	$F_{c\ BUCKL.}$
11	.225	.663	.283	1.061	27,600	33,000
13	.286	.650	.736	1.150	29,400	35,000

(REF. Pgs K-117, 119, 135a)

$A_{SKIN\ BUCKL.\ 11} = \left[\frac{4.6 + 6.9}{2}(.746)\right](.136)$, $A_{SKIN\ BUCKL.\ 13} = 6.9(.136)(.746)$

$f_{c\ BUCKL.\ AVE} = \frac{33000+35000}{2} = 34,000$ psi

FOR CASE 8.3a;

$R_c = \frac{34000}{34000} = 1.0$, $R_s = \frac{401}{.136(19000)} = .155$

$M.S. = \frac{9.92}{10.12} - 1 = -.02$

FOR CASE 15.1a;

$R_c = \frac{11997}{13390}(1.0) = .863$

$R_s = \frac{1068}{.136(19000)} = .412$

$M.S. = \frac{10.38}{9.59} - 1 = .08$

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FORM 1154

O. R. L.

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

REPORT NO.
SHEET NO.

AIRCRAFT:		PREPARED BY	DATE
C 105	OUTER WING	R. GAVARIS	11-8-54
		CHECKED BY	DATE

SKIN SHEARS

RIB BAY 21-22

FAILING STRENGTH - PANEL # 13

ULTIMATE SHEAR STRENGTH;

$b = 5.4"$, $t = .136"$, $A_{st} = .085$, $F_{cy} = 15,800$ psi

$F_{cy} = 21,000$ psi, $\frac{F_{cy}}{E_c} = \frac{21000}{15800} = 1.33$

$K = .0615$, $\frac{A_{st}}{bt} = \frac{.085}{5.4(.136)} = .1158$

$\frac{\sigma_w}{F_{cy}} = .10$, $\sigma_w = .10(21000) = 2100$ psi

$\frac{d}{h} = \frac{5.4}{15.3} = .352$, $\sigma_{w_{MAX}}/\sigma_w = 1.52$

$\sigma_{w_{MAX}} = 1.52(2100) = 3200$ psi

$\sigma_o = 23.4(.0615)^{\frac{1}{3}}\left(\frac{.091}{.136}\right)^{\frac{1}{3}} = 3200$ psi

$F_{s_{WEB}} = 23,800$ psi

$\frac{\sigma_o}{\sigma_{w_{MAX}}} = \frac{3200}{3200} = 1.00$; $F_{s_{FAIL\ SHEAR\ ULT.}} = 21,000$ psi

ULTIMATE COMPRESSIVE STRENGTH;

$F_{c_{INTER.}} = 34,000$ psi (REF. Pg. K-206)

$F_{c_{PANEL}} = 21,500$ psi, $\frac{\sigma_a}{\sigma} = \frac{21500}{34000} = .633$

$\frac{b_e}{b} = .820$

CASE 3.3a

ELE.	$A_{STR.}$	$A_{BUCKLED}$	$A_{UNBUCKLED}$	$A_{UNBUCKLED}$	$f_{c_{UNBUCKL.}}$	$f_{c_{BUCKL.}}$
13	.286	.650	.936	1.150	28400	35000
18	.705	.316	1.021	1.090	26500	28200

(REF. Pg K-118, 135a)

210

FORM 1319A

O. R. L.

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

REPORT No. _____
SHEET No _____

AIRCRAFT:		PREPARED BY	DATE
C 105	OUTER WING	R. GAVALIS	11-8-55
		CHECKED BY	DATE

SKIN SHEARS

RIB BAY 21-22

FAILING STRENGTH - PANEL #13 (CONT'D.)

$A_{SKIN\ BUCKL.\ 18} = .385(.820) = .316\ in^2$ (REF. P&W K-118)

$f_{c\ BUCKL.\ AVG.} = \frac{35000 + 28206}{2} = 31,600\ psi$

FOR CASE 9.3a ;

$R_c = \frac{31600}{34000} = .930$

$R_s = \frac{297}{.136(21000)} = .104$

$M.S. = \frac{9.92}{9.40} - 1 = .05$

FOR CASE 15.1a ;

$R_c = \frac{11997}{13890}(.930) = .802$

$R_s = \frac{779}{.136(21000)} = .272$

$M.S. = \frac{10.05}{9.50} - 1 = .18$

RIB BAY 21-22 : SUMMARY OF CRITICAL PANELS

PANEL ↓	X	M.S. LIMIT	M.S. ULT.
CRITERIA →	BUCKLING LOADS / APPLIED LOADS - 1	NO BUCKLING AT LIMIT	NO FAILURE AT ULTIMATE
7	-.30	-.05 †	.18
11	-.40	-.18	-.02
13	-.23	.05	.05

(ABOVE VALUES ARE FOR CASE 9.3a)
† ERROR IN PANEL SIZE, SHOULD BE 5.4" NOT 6.2
‡ PANEL IS O.K. AS IS.

FORM 1394A

O. R. L.

SKIN PANELS (UPPER)

BUCKLING OF PANELS

RIB BAY 22-23
(STA. "C")

MAT'L: 75 S-T6 ALC. SKIN

	1	2	3	4	5	6	7	8	9	10	11
								CASE 2, 3a (LO…			
PANELS ↓	b	b/t	a/b	R	R′	F_{cu}	f_c	R_c	F_s	F_{su}	
REF. →		①/.128	15.2/①	*	FIG. 43	‡ FIG. 47a	COL 1, BK-70, BK-82	⑦/⑥	FIG. 39	⑤×⑨	Pg…
2 OR 33 (F/S)	4.0	31.2	3.8	.396	.715	37.0	.86		31.1	22.2	[illegible]
4 OR 32 (M/S)	3.8	29.7	4.0	↓	.718	39.3	1.65		31.8	22.8	[illegible]
5 OR 30	3.0	23.4	5.1	↓	.728	47.7	1.23		[illegible]	25.1	[illegible]
7 (O/S F)	4.7	36.8	3.2	↓	.702	—	—	—	—	—	—
9 OR 26	3.8	29.7	4.0	↓	.718	39.3	1.36	SMALL	31.8	22.8	[illegible]
11 OR 24 (O/S A)	5.7	44.5	2.7	.396	.675	19.5	1.38		27.0	18.2	[illegible]
13 OR 19 (R/S)	PANEL	IS	A	SMALL	TRIANGULAR	ONE					
28	5.6	43.8	2.7	.396	.677	20.0	1.33	SMALL	27.8	13.8	[illegible]

$\phi\ R_{c_{15.1a}} = \frac{M_{15.1a}}{M_{8.3a}} (R_{c_{8.3a}}) = \frac{3.600}{4.380} \times ⑱$

$* \ R' = R_h + \frac{1}{2}(R_d - R_h)\left(\frac{d}{h}\right)^3 = .395$ TO .397, USE R = .396 (AVE…

‡ USE FIG 47a FOR PANEL STIFFENED WITH INTE…

$t_w = .128''$, $t_u = .091''$, $\frac{t_u}{t} = \frac{.091}{.128} = .710$, $\frac{t_f}{t} = \frac{.100}{.128} = .782$,

FORM 1544

K-212

O. R. L.

PANELS (UPPER)

ALING OF PANELS

RIB BAY 22-23 (STA. "C")

75S-T6 ALC. SKIN (ULTIMATE LOADS)

2	3	4	5	6	7	8	9	10	11	12	13	14	15	16
						CASE 2, 3a (LOWER SKIN)								
b/t ①/.128	a/b 15.2/①	R *	R' FIG 43	F_{cu} FIG 47a	f_c (OL 1, 3K-60, 7K-86)	P_c ⑦/⑥	E_s FIG. 39	E_{sc} ⑤×⑨	P_s P_s K-82	f_s ⑪/.128	R_s ⑫/⑩	R_m FIG.	m 50	F_{cu} FIG 47a
31.2	3.9	.396	.715	37.0	.86		31.1	22.2	1272	9.95	.447			30.5
27.7	4.0		.718	39.3	1.05		31.3	22.8	1494	11.7	.513			32.3
23.4	5.1		.728	47.7	1.23		32.6	25.1	1658	12.9	.514			37.0
36.8	3.2		.702	—	—	—	—	—	—	—	—	—		24.2
29.7	4.0		.718	39.3	1.36		31.3	22.8	1755	13.7	.601			32.3
44.5	2.7	.396	.675	19.5	1.38		27.0	18.2	1679	13.1	.720			18.5
HEL	IS	A	SMALL		TRIANGULAR		CASE							
43.3	2.7	.396	.677	20.0	1.33	SMALL	27.3	13.8	1734	13.5	.718			
$\frac{t_{1a}}{3a}$	$(R_{c_{8.3a}}) = \frac{3.600}{4.380} \times$ ⑱													
$(R_{s1} - R_h)\left(\frac{2}{b}\right)^3 = .395$ TO .397, USE $R = .396$ (AV.)														
7a FOR PANEL STIFFENED WITH INTERCOSTALS.														
$t_w = .091$, $\frac{t_w}{2} = \frac{.091}{.128} = .710$, $\frac{t_f}{2} = \frac{.100}{.128} = .782$, $R_s = .475$, $R_h = .395$														

ORL

...DS)

AVRO AIRCRAFT LIMITED

MALTON, ONTARIO
ENGINEERING DIVISION

AIRCRAFT . . C105
WEIGHT . .
C. G. POSITION .

REPORT NO. .
SHEET . .
DATE . . 11-9-55
PREPARED BY . R. GAVALIS

16	17	18	19	20	21	22	23	24	25	26	27	28	29	
	CASE		8.3a				CASE		15.1a		2.3a	8.3a	15.1a	
F_{cu}	f_c	R_c	F_s	F_{su}	f_s	R_s	R_c	f_s	R_s		X*	X*	X*	
# G 47a	.01 · K70 / COL.1, K 82	(17)/(16)	FIG. 40	(5) × (19)	Fig. K-82	(21) / ((20) × .128)	ϕ	Fig. K-82	((24) × (22)) / (21)		FIG. 50			
0.5	6.4	.539	26.0	18.6	610	.256	.442	817	.342		1.24	.54	.58	2
23	17.4	.540	26.3	18.9	763	.315	.444	937	.408		.95	.44	.46	4
9.0	13.4	.472	28.8	21.0	752	.280	.388	1443	.383		.95	.65	.60	5
4.2	19.4	.802	24.0	16.8	791	.363	.660	1098	.510		—	.04	.06	7
3	20.3	.630	26.3	18.9	925	.382	.518	1179	.486		.66	.22	.24	9
3.5	21.0	1.136	22.8	15.4	864	.437	.934	1118	.565		.39	-.22	-.17	11
													→	13
											.39			28

* $X = \frac{\text{BUCKLING LOADS}}{\text{APPLIED LOADS}} - 1$, $X < 0$ INDICATES THAT PANEL BUCKLES BELOW ULTIMATE

O. R. L.

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

REPORT No.
SHEET No.

AIRCRAFT:		PREPARED BY	DATE
C105	OUTER WING	R. GAVALIS	11-10-55
		CHECKED BY	DATE

SKIN SHEARS

RIB BAY 22-23

FAILING STRENGTH - PANEL # 11

ULTIMATE SHEAR STRENGTH;

$b = 5.7"$; $t = .128"$, $A_w = .1901 in^2$

$e_w = .306 + \frac{.128}{2} = .370$, $A_{we} = .085\ in^2$

$\tau_{cu} = 15,400 psi$, $\tau = 20,000 psi$ (ASSUMED)

$\frac{\tau}{\tau_{cu}} = \frac{20000}{15400} = 1.3$, $K = .0565$

$\frac{A_{we}}{dt} = \frac{.085}{5.7(.128)} = .116$, $\frac{\sigma_w}{\tau} = .10$

$\sigma_w = .10(20,000) = 2000 psi$, $d/h = \frac{5.7}{15.2} = .374$

$\sigma_{w_{MAX}}/\sigma_w = 1.51$, $\sigma_{w_{MAX}} = 1.51(2000) = 3020 psi$

$\tau_{ALL\ WEB} = 23,800 psi$

$\sigma_o = 23.4(K)^{\frac{2}{3}}\left(\frac{t}{d}\right)^{\frac{1}{3}} = 23.4(.0565)^{\frac{2}{3}}\left(\frac{.091}{.128}\right)^{\frac{1}{3}} = 3060 psi$

$\sigma_o/\sigma_{w_{MAX}} = \frac{3060}{3020} = 1.01$ $\therefore$ $\tau_{ALL\ SHEAR\ WEB} = 20,000 psi$

ULTIMATE COMPRESSIVE STRENGTH;

F_{cu} INTER. $= 34,000 psi$ (REF. B K-206)

F_{cu} PANEL $= 18,500 psi$, $\frac{\sigma_w}{F} = \frac{18500}{34000} = .545$

$\frac{b_e}{b} = .770$

FORM 1319A

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

REPORT NO.
SHEET NO.

AIRCRAFT:		PREPARED BY	DATE
C 105	OUTER WING	R. GAVALIS	11-8-55
		CHECKED BY	DATE

SKIN SHEARS

RIB BAY 22-23

FAILING STRENGTH - PANEL #11 (CONT'D).

CASE 8.3a

ELE.	A_{STR}	$A_{SKIN\ BUCKLED}$	$A_{STRGR+SKIN\ BUCKLED}$	$A_{STRGR+SKIN\ UNBUCKLED}$	$f_{c(SKIN\ BUCKL.)}$	$f_{c(PANEL)}$
11	.116	.535	.651	.7471	21,600	24,800
13	.311	.515	.826	.9100	20,500	22,600

$$A_{SKIN\ BUCKL.\ 11} = \left[\frac{3.94 + 5.81(.720)}{2}\right](.128), \quad A_{SKIN\ BUCKL.\ 13} = \left[\frac{5.81(.720) + 3.61}{2}\right](.128)$$

$$f_{c\ BUCKLED\ AVG} = \frac{24800 + 22600}{2} = 23,700\ psi$$

FOR CASE 8.3a;

$$R_c = \frac{23700}{34000} = .697, \quad R_s = \frac{367}{.128(20,000)} = .337$$

$$M.S. = \frac{.935}{.697} - 1 = .34$$

FOR CASE 15.1w;

$$R_c = \frac{3,600}{4,380}(.697) = .574$$

$$R_s = \frac{1113}{.128(20,000)} = .435$$

$$M.S. = \frac{.900}{.574} - 1 = .57$$

SUMMARY OF CRITICAL PANELS:

PANEL ↓	X	$M.S._{LIMIT}$	$M.S._{ULT.}$
CRITERIA →	BUCKLING LOADS APPLIED LOADS - 1	NO BUCKLING AT LIMIT	NO FAILURE AT ULTIMATE
11	-.22	.06	.34

(ABOVE VALUES ARE FOR CASE 8.3a)

SKIN PANELS (UPPER)

BUCKLING OF PANELS

RIB BAY 17-18 (STA. "H")

MATL: 75S-T6 ALC. SKIN

(ULTIMA

PANELS ↓ REF. →	1	2	3	4	5	6	7	8	9	10	11
	b	b/t ①/.165	t/b 16.5/①	R *	R' FIG. 43	F_{cu} FIG. 47	f_c COL. 2,3 K=65 K=66 K=177	R_c ⑦/⑥	CASE 2. 30 $F_{x10^{-3}}$ FIG. 39	F_{cu} $_{x10^{-3}}$ ⑤×⑨	f_s R_s <-17 COL 10
2 (F/S)	3.2	19.4	5.16	.342	.676	51.6	6.47	.125	36.5	25.4	1676
3	4.7	28.4	3.51		.185	44.9	7.10	.158	32.5	22.2	1551
4 (W/S)	5.6	33.3	3.00		.675	36.4	7.01	.193	30.6	20.6	1376
5	2.6	15.7	6.36		.700	52.7	7.22	.137	38.3	26.8	2131
6	3.7	22.4	4.45		.690	50.3	7.76	.154	35.1	24.2	1793
7	3.9	23.6	4.23		.690	49.5	7.43	.160	34.5	23.8	1823
8 (F/S)	3.6	21.8	4.59		.690	50.6	7.73	.152	35.4	24.4	1652
9	3.1	18.8	5.32		.695	52.0	7.86	.151	36.7	25.5	2226
10	4.4	26.6	3.75		.690	47.0	8.35	.178	33.3	23.0	2028
11	4.6	27.9	3.58		.636	45.5	8.53	.187	32.6	22.4	1918
12 (F/A)	4.7	28.5	3.51		.685	44.6	8.15	.183	32.5	22.3	1533
13	4.9	29.7	3.37		.659	43.0	8.26	.192	31.9	21.7	2142
14	4.2	25.4	3.93		.690	48.0	8.57	.185	33.8	23.3	1733
15	4.4	26.6	3.75		.690	47.0	8.40	.189	33.3	23.0	1711
16 (R/S)	5.6	34.0	2.96	.342	.676	35.0	8.48	.242	30.3	20.3	1417

± X = ±.13 USING INTERACTION CURVE (TEST DATA)

* $R = R_h + \frac{1}{2}(R_d - R_h)\left(\frac{d}{h}\right)^3 =$ .342 TO .343, USE R = .342 (+ve.)

t_w = .165", t_u = .110", $t_u/t_w = \frac{.110}{.165}$ = .667, $t_c/t_w = \frac{.100}{.165}$ = .606

K-215

FORM 1542

G.R.L.

N PANELS (UPPER)

CLING OF PANELS

RIB BAY 17-18 (STA. "A")

755-T6 ALC. SKIN (ULTIMATE LOADS)

2	3	4	5	6	7	8	9	10	11	12	13	14	15	16
						CASE 2.3a								
b/t ①/.165	a/b 16.5/①	R *	R' FIG. 43	F_{cw} FIG. 47	f_c COL. 2,3 K=.55 K=.66 K=.179	R_c ⑦/⑥	$F_{x.6-3}$ FIG. 39	F_{scw} *10-3 ⑤×⑨	f_s PG K-179 COL 10C3	f_s ⑪/.165	K_s ⑫/⑩	R_m PG K-1992	t_m	F_{cu} FIG 47
19.4	5.15	.342	.675	51.6	6.47	.125	36.5	25.4	1676	10.3	.405	.269	.125	42.5
28.4	3.51		.685	44.7	7.10	.158	32.5	22.2	1551	9.41	.424	.310	.158	37.5
33.3	3.00		.675	36.4	7.01	.193	30.6	20.6	1376	8.45	.410	.378	.193	32.4
16.7	6.36		.700	52.7	7.22	.137	38.3	26.8	2131	12.9	.481	.250	.137	43.5
22.4	4.45		.690	50.3	7.76	.154	35.1	24.2	1993	12.0	.496	.270	.154	41.2
23.6	4.23		.690	49.5	7.43	.160	34.5	23.8	1823	11.1	.466	.289	.160	40.6
21.3	4.59		.690	50.6	7.73	.152	35.4	24.4	1652	10.0	.410	.311	.152	41.5
18.8	5.32		.695	52.0	7.86	.151	36.7	25.5	2226	13.5	.530	.251	.151	42.7
26.6	3.75		.690	47.0	8.35	.178	33.3	23.0	2028	12.3	.535	.279	.178	38.8
27.9	3.58		.635	45.5	8.53	.187	32.6	22.4	1918	11.0	.491	.312	.187	38.0
29.5	3.51		.635	44.6	8.15	.183	32.5	22.3	1533	9.62	.431	.348	.183	37.5
29.7	3.37		.629	43.0	8.26	.192	31.9	21.7	2142	13.0	.600	.276	.192	36.5
25.4	3.73		.690	48.0	3.37	.185	33.8	23.3	1733	11.7	.563	.309	.185	37.6
26.6	3.75		.690	47.0	3.40	.189	33.3	23.0	1711	16.4	.452	.338	.189	38.8
34.0	2.76	.342	.676	35.0	8.48	.242	30.3	20.3	1417	8.58	.422	.435	.242	31.5

3 USING INTERACTION CURVE (TEST DATA) GIVEN ON PG K-1992

$(R_d - R_n)\left(\frac{d}{h}\right)^3 = .342$ TO .343, USE $R = .342$ (+ve.)

.110", $t_{cl}/t_{cw} = \frac{.110}{.165} = .667$, $t_c/t_{cw} = \frac{.100}{.165} = .606$; $R_n = .343$, $R_d = .233$

ORL

AVRO AIRCRAFT LIMITED

MALTON, ONTARIO
ENGINEERING DIVISION

AIRCRAFT - - C105
WEIGHT - -
C. G. POSITION -

REPORT NO. -
SHEET - -
DATE - - 11-22-55
PREPARED BY - R. GAVALIS

16	17	18	19	20	21	22	23	24	25	26	27	28	29	PANEL NO.
	C	A	S E		E. 3	a	CA	S E	15.1 a		2.3a	3.3a	15.1a	
F_{cu}	f_c	R_c	F_s	F_{su}	q_s	R_s	R_c	q_s	R_s	f_c	X^ϕ	X^ϕ	X^ϕ	
FIG 41	COL 2, K-55 COL 10 & 12, K-179	(17)/(16)	FIG 40	(5) X (19)	COLS. 7 & 9 FIG K-179	(21) / (20) X .165	(20)/(16)	COL. 13 & 15 K-179	(22) X (23) / (21)	COL. 2, K-55 COL. 14 & 16, K-179	Pg. K-179a			
42.5	26.15	.615	30.5	21.2	575	.164	.501	645	.184	21.30	1.15	.48	.75	2
37.5	29.73	.765	26.9	18.4	388	.128	.622	877	.270	23.35	.96	.24	.34	3
32.4	23.38	.875	25.4	17.2	174	.061	.710	1119	.392	23.00	.96	.12	.13	4
43.3	29.20	.667	32.0	22.4	836	.226	.541	762	.206	23.70	.83	.33	.61	5
41.2	31.40	.762	29.2	20.2	610	.183	.620	981	.294	25.55	.75	.21	.34	6
40.6	32.10	.790	28.6	19.8	361	.111	.643	1213	.372	26.10	.81	.21	.22	7
41.5	31.20	.752	29.2	20.2	167	.050	.614	1457	.435	25.45	1.04	.30	.19	8
42.7	31.76	.743	30.6	21.3	912	.260	.606	947	.242	25.90	.66	.19	.42	9
38.8	33.81	.872	27.3	18.9	573	.185	.710	1120	.362	27.50	.57	.07	.14	10
33.6	34.60	.910	24.0	16.5	206	.067	.740	1404	.459	28.10	.67	.07	.04	11
37.5	33.10	.883	26.7	18.3	400	.133	.715	1710	.565	26.80	.90	.08	-.02†	12
36.5	33.60	.920	26.4	18.0	1136	.382	.748	595	.200	27.25	.44	-.13	.23	13
37.6	36.05	.911	27.9	19.3	741	.232	.740	865	.270	27.30	.66	.01	.19	14
38.8	36.15	.931	27.3	18.8	317	.102	.758	1144	.368	27.40	.79	.04	.09	15
31.5	34.50	1.095	25.1	16.8	337	.122	.892	1517	.545	28.10	.80	-.10	-.13	16

† $X = \frac{\text{BUCKLING APPLIED}}{\text{LOADS}} - 1$, $X < 0$ INDICATES THAT PANEL WILL BUCKLE BELOW ULTIMATE

199a.

33

D. R. L.

AVRO AIRCRAFT LIMITED
TECHNICAL DEPARTMENT (Aircraft)

AIRCRAFT		REPORT No.	
C105	OUTER WING	SHEET No.	
		PREPARED BY	DATE
		R. GAVALIS	11-23-55
		CHECKED BY	DATE

SKIN PANELS

RIB BAY 17-18

FAILING STRENGTH - PANEL 13

ULTIMATE SHEAR STRENGTH ; (CASE 3.3 ~)

$b = 4.9''$, $t = .165''$, $A_u = .196 \, IN^2$, $e = .587 \, IN$

$\rho = .489 \, IN$, $A_{ue} = \dfrac{A_u}{\left[1 + \left(\frac{e}{\rho}\right)^2\right]} = \dfrac{.196}{\left[1 + \left(\frac{.587}{.489}\right)^2\right]} = .080$

$\tau_{cr} = 18,000 \, psi$ (COL. 20, PG K-215)

$\tau_{ASSUME} = 27000$, $\rho = \dfrac{\tau - \tau_{cr}}{\tau + \tau_{cr}} = \dfrac{9000}{45000} = .20$

$K = .434(\rho + \frac{1}{3}\rho^3) = .434\left[.20 + \frac{1}{3}(.20)^3\right] = .0875$

$\dfrac{A_{ue}}{bt} = \dfrac{.080}{4.9(.165)} = .0991$ $\dfrac{\sigma_u}{\tau} = .155$

$\sigma_u = .155(27000) = 4190 \, psi$, $d/h = \dfrac{4.9}{16.5} = .297$

$\sigma_{u_{MAX}}/\sigma_u = 1.54$, $\sigma_{u_{MAX}} = 1.54(4190) = 6450 \, psi$

$\sigma_0 = 23.4 \, K^{\frac{2}{3}}(t_u/t)^{\frac{1}{3}} = 23.4(.0875)^{\frac{2}{3}}\left(\frac{.110}{.165}\right)^{\frac{1}{3}} = 4040 \, psi$

TRY $\tau = 21000 \, psi$

$\rho = \dfrac{3000}{39000} = .077$, $K = .0334$, $\sigma_u/\tau = .057$

$\sigma_u = .057(21000) = 1200 \, psi$, $\sigma_{u_{MAX}}/\sigma_u = 1.57$

$\sigma_{u_{MAX}} = 1.57(1200) = 1880 \, psi$

$\sigma_0 = 23.4(.0334)^{2/3}\left(\frac{.110}{.165}\right)^{\frac{1}{3}} = 2120 \, psi$

$\dfrac{\sigma_0}{\sigma_{u_{MAX}}} = \dfrac{2120}{1880} = 1.12$ ∴ $\tau_{ULT} = 21,000 \, psi$.

K-216 $f_s = \dfrac{1136}{.165} = 6890 \, psi$, $R_s = \dfrac{6890}{21000} = .328$

AVRO AIRCRAFT LIMITED
TECHNICAL DEPARTMENT (Aircraft)

REPORT NO.
SHEET NO.

AIRCRAFT		PREPARED BY	DATE
C105	OUTER WING	R. GAVALIS	11-23-56
		CHECKED BY	DATE

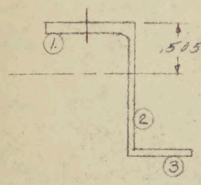
SKIN SHEARS

RIB BAY 17-18

FAILING STRENGTH - PANEL 13 (CONT'D)

ULTIMATE COMPRESSIVE STRENGTH ;

CRIPPLING STRENGTH OF Z-STIFFENER



$A = .196\ IN^2$ MAT'L: 75S-T6 EXT.

$I = .0469\ IN^4$ $T = 250°F$

$F_{cu} = \frac{9310}{.196} = 50{,}000\ psi$

ELE.	b	t	b/t	A	F_{cu}	P
1	.77	.110	7.0	.0845	46000	3890
2	1.15	.060	19.2	.0690	51000	3520
3	.47	.090	5.2	.0423	57000	2410
Σ				.1958		9810

$F_{cu_{PANEL}} = 36{,}500\ psi$ (REF. COL. 16, Rys K-214)

$\frac{F_{cu}}{E} = \frac{36500}{50000} = .730$, $\frac{b_e}{b} = .866$ (KOITER CURVE)

CASE 8.30

STRING. ELE	A_{STR}	$A_{SKIN\ BUCKLED}$	$A_{TOTAL\ BUCKL.}$	$A_{TOTAL\ UNBUCKLED}$	$f_{c_{UNBUCKL}}$	$f_{c_{BUCKLED}}$
13	.460	.711	1.171	1.216	31200	32300
14	.196	.649	.845	.889	35900	37700

(REF. Rys K-54, 55, 179)

$A_{SKIN\ BUCKL.,13} = \left[\frac{5.094 + .866(4.09)}{2}\right](.165)$, $A_{SKIN\ BUCKL.,14} = \left[\frac{4.08(.866) + 4.33}{2}\right](.165)$

$f_{c_{BUCKL\ AVE}} = \frac{32300 + 37700}{2} = 35{,}000\ psi$

FOR 8.30,

$R_c = \frac{35000}{50000} = .700$, $R_s = .328$

$M.S. = \frac{.938}{.700} - 1 = .34$

CONSERVATIVE SINCE PANEL HAS DOUBLER OVER ITS OUTBOARD HALF

FORM 1403A

O. R. L.

AVRO AIRCRAFT LIMITED
TECHNICAL DEPARTMENT (Aircraft)

REPORT No.
SHEET No.

AIRCRAFT		PREPARED BY	DATE
C105	OUTER WING	R. GAVALIS	11-23-55
		CHECKED BY	DATE

SKIN SHEARS

RIB BAY 17-18

FAILING STRENGTH – PANEL 16

ULTIMATE SHEAR STRENGTH :

$b = 5.6"$, $t = .165"$, $A_w = .196\ in^2$, $A_{w_c} = .080\ in^2$

$f_{cu} = 16,800\ psi$, $f_{c_{ASSUMED}} = 20,500\ psi$

$\rho = \frac{20500 - 16800}{20500 + 16800} = .0993$, $K = .434(.0993) = .043$

$\frac{A_{w_c}}{bt} = \frac{.080}{5.6(.165)} = .0865$, $\frac{f_{cu}}{E} = .075$

$\sigma_{cu} = .075(20500) = 1540\ psi$, $\frac{d}{h} = \frac{5.6}{16.5} = .340$

$\frac{\sigma_{u_{MAX}}}{\sigma_{cu}} = 1.53$, $\sigma_{u_{MAX}} = 1.53(1540) = 2360\ psi$

$\sigma_o = 23.7(.043)^{\frac{2}{3}}\left(\frac{.110}{.165}\right)^{\frac{1}{3}} = 2510\ psi$

$f_{c_{ALL\ WEB}} = 24100\ psi$

$\frac{\sigma_o}{\sigma_{u_{MAX}}} = \frac{2510}{2360} = 1.06$; $f_{c_{ULT\ PANEL\ ALL.}} = 20,500\ psi$

ULTIMATE COMPRESSIVE STRENGTH :

$F_{c_{PANEL}} = 31,500\ psi$, $F_{c_{ULT}} = 50,000\ psi$

$\frac{\sigma_{cu}}{\sigma} = \frac{31500}{50000} = .630$, $\frac{b_e}{b} = .819$ (KUHN'S CURVE)

CASE 3.32

RIB BAY	$A_{STR.}$	$A_{BUCKL.}$	$A_{EFFECT.}$	$A_{TOTAL\ EFFECT.}$	$f_{c_{BUCKL.}}$	$f_{c_{PANEL}}$
16	.196	.920	1.116	1.236	36200	40100
18	1.260	1.034	2.294	2.415	32800	34600

(REF Pgs. K-54, 55, 179)

1.00 – .819

$A_{SKIN\ BUCKL.,16} = \left[\frac{4.54 + 8.066(.819)}{2}\right][.165]$, $A_{SKIN\ BUCKL.,18} = 1.155 - \frac{.182(2.00)(.165)}{2}$

$f_{c_{BUCKL.\ AVG}} = \left(\frac{40100 + 34600}{2}\right) = 37400\ psi$

K-218

FORM 1139A

O. R. L.

AVRO AIRCRAFT LIMITED
TECHNICAL DEPARTMENT (Aircraft)

REPORT NO.
SHEET NO.

AIRCRAFT		PREPARED BY	DATE
C105	OUTER WING	R GAVALIS	11-24-55
		CHECKED BY	DATE

SKIN SHEARS.

RIB BAY 17-18

FAILING STRENGTH - PANEL 16 (CONT'D)

FOR CASE 8.3a,

$$R_c = \frac{37400}{50000} = .748, \quad R_s = \frac{339}{.165(20500)} = .100$$

$$M.S. = \frac{.980}{.748} - 1 = .31$$

FOR CASE 15.1a,

STR ELEMENT	$A_{BUCKL.}$	P*	f_c	
16	1.116	36327	32600	
15	2.294	64467	28100	

(REF R3 K-177 *)

$$f_{c_{BUCKL.\,AVG.}} = \frac{32600+28100}{2} = 30,400 \text{ psi}$$

$$R_c = \frac{30400}{50000} = .608, \quad R_s = \frac{1517}{.165(20500)} = .449$$

$$M.S. = \frac{.905}{.608} - 1 = .49$$

SUMMARY OF CRITICAL PANELS

PANEL ↓	X	$M.S._{LIMIT}$	$M.S._{ULT.}$
CRITERIA →	BUCKLING LOADS APPLIED (ULT) LOADS	NO BUCKLING AT LIMIT	NO FAILURE AT ULTIMATE
13	-.13	.27	.34
16	-.13 *	.17 *	.31

* CASE 15.1a, ALL OTHERS ARE CASE 8.3a

K-219

FORM 1102A

O. R. L.

SKIN PANELS (UPPER)

BUCKLING OF PANELS

RIB BAY 16-17 (STA. "I")

MAT'L: 75S-T6 ALC. SKIN

PANELS ↓ REF. →	1	2	3	4	5	6	7	8	9	10	11
	b	b/t ①/.173	a/b 16.5/①	R *	R' FIG. 43	F_{cu} FIG. 47	f_c COL. 4, K-144, K-172	R_c ⑦/⑥	CASE F_s FIG. 39	F_{su} ⑤×⑨	f_s FIG. K-
2 (F/S)	3.8	22.0	4.3	.311	.67	50.5	6970	138	35.3	23.6	2.5
3	4.9	28.4	3.4		.66	37.5	7790	.208	32.5	21.4	19.
4 (M/S)	5.9	34.1	2.8		.64	31.3	7660	.244	31.0	19.9	16
5	3.0	17.3	5.5		.67	43.3	7880	.182	37.5	25.2	26
6	4.0	23.1	4.1		.67	40.8	8520	.207	34.7	23.2	23
7	4.2	24.3	3.9		.67	40.2	8650	.216	34.1	22.8	21
8 (G/S F)	3.7	21.4	4.5		.67	41.6	8340	.200	35.5	23.5	18
9	3.3	19.1	5.0		.67	42.5	8460	.199	36.5	24.4	27
10	4.8	27.8	3.4		.66	38.0	9080	.238	32.5	21.4	23
11	5.1	29.5	3.2		.66	36.6	9325	.255	32.0	21.1	20
12 (G/S A)	5.1	29.5	3.2		.66	36.6	9000	.246	32.0	21.1	16
13	6.2	30.0	3.2		.66	36.2	9190	.254	31.8	21.0	25
14	4.6	26.6	3.6		.66	39.9	9910	.255	33.2	21.9	23
15	4.8	27.8	3.4		.66	38.0	10040	.264	32.5	21.4	19
16	5.0	28.9	3.3	↓	.66	37.2	10290	.279	32.2	21.2	16
17 (R/S)	3.0	17.3	5.5	.311	.67	43.3	9700	.224	37.5	25.2	12

$X = \frac{\text{BUCKLING LOADS}}{\text{APPLIED LOADS}} - 1$, $X < 0$ INDICATES THAT PANEL

$X = 0$ IF INTERACTION CURVE (TEST DATA) IS USED

$R = R_h + \frac{1}{2}(R_d - R_h)\left(\frac{d}{h}\right)^3 = .310$ TO .311, USE R = .311

$t_u = .110''$, $t_w = .173''$, $t_u/t_w = \frac{.110}{.173} = .635$, $t_u/t_w = \frac{.100}{.173} = .580$,

FORM 1544

K-220

O. R. L.

N PANELS (UPPER)

KLING OF PANELS

RIB BAY 16-17 (STA. "I")

(ULTIMATE LOADS)

755-T6 ALC. SKIN

2	3	4	5	6	7	8	9	10	11	12	13	14	15	16
							CASE 2.30a							
b/t ①/.173	a/b 16.5/①	R *	R' FIG. 43	F_{cw} FIG 47	f_c' col. 1, K-142 K-172	R_c ⑦/⑥	F_s FIG. 37	F_{sw} ⑤×⑨	f_s Pg K-171	⑪/.173	⑫/⑩	R_s Pg K-199a	R_w	F_{cw} FIG. 47
22.0	4.3	.311	.67	50.5	6970	.138	35.3	23.6	2.57	12.6	.530	.886		41.3
28.4	3.4		.66	37.5	7730	.208	32.5	21.4	1914	11.1	.519	.529		37.6
34.1	2.8		.64	31.3	7660	.244	31.0	19.8	1657	9.4	.435	.793		31.3
17.3	5.5		.67	43.3	7980	.184	37.5	25.2	2637	15.2	.609	.870		43.3
23.1	4.1		.67	40.8	8520	.209	34.7	23.2	2379	13.8	.595	.850		40.8
24.3	3.9		.67	40.2	8650	.216	34.1	22.8	2133	12.3	.540	.828		40.2
21.4	4.5		.67	41.6	8340	.200	35.5	23.5	1855	10.7	.450	.908		41.6
19.1	5.0		.67	42.5	8460	.179	36.5	24.4	2720	15.7	.643	.865		42.5
27.8	3.4		.66	38.0	9080	.238	32.5	21.4	2347	13.8	.645	.840		37.8
29.5	3.2		.66	36.6	9325	.255	32.0	21.1	2033	11.7	.555	.802		36.6
29.5	3.2		.66	36.6	9000	.246	32.0	21.1	1678	9.7	.460	.773		36.6
30.0	3.2		.66	36.2	9190	.254	31.8	21.0	2595	15.0	.715	.842		36.1
26.6	3.6		.66	38.9	9910	.255	33.2	21.9	2342	13.6	.621	.821		38.8
27.8	3.4		.66	38.0	10040	.264	32.5	21.4	1956	11.5	.538	.789		38.1
28.9	3.3		.66	37.2	10200	.279	32.2	21.2	1606	9.3	.439	.738		37.2
17.3	5.5	.311	.67	43.3	9700	.224	37.5	25.2	1202	7.0	.278	.677		43.3

NG LOADS -1, $X<0$ INDICATES THAT PANEL BUCKLES BELOW ULTIMATE ↑

INTERACTION CURVE (TEST DATA) IS USED (REF. Pg K-199a). ↑

$(R_1 - R_h)\left(\frac{d}{h}\right)^3 = .310$ TO .311, USE $R = .311$ ↑

$= .173''$; $t_f/t_w = \frac{.110}{.173} = .635$, $t_f/t_w = \frac{.106}{.173} = .580$, $R_h = .311$, $R_1 = .262$

AVRO AIRCRAFT LIMITED

MALTON, ONTARIO
ENGINEERING DIVISION

AIRCRAFT - - C 105
WEIGHT - -
C. G. POSITION -

REPORT NO. -
SHEET - -
DATE - - 11-26-55
PREPARED BY - R. GAVALIS

16	17	18	19	20	21	22	23	24	25	26	27	28	29
		CASE 5.3a					CASE 15.1a				2.3a	8.3a	15.1a
F_{cw}	f_c	R_c	F_s	F_{sw}	q_s	R_s	R_c	q_s	R_s	f_c	$X^{\#}$	$X^{\ddagger}$	$X^{\ddagger}$
Fig. 47	Col. 1, K-141; K-172	(17)/(16)	Fig. 40	(5)×(19)	K-171	(21)/(20)×.173	(24)/(16)	K-171	(24)×(22)/(21)	Col. 1, K-141; K-172	R_s K-171a		
41.3	26.6	.645	29.3	19.6	716	.212	.535	721	.214	22.1	.67	.38	.61
37.6	29.8	.793	26.8	17.7	615	.201	.658	910	.298	24.7	.59	.16	.28
31.3	29.2	.932	25.6	16.4	475	.167	.773	1141	.402	24.2	.61	.02	.05
43.3	30.0	.694	31.3	21.0	1010	.278	.571	873	.241	24.7	.44	.24	.49
40.8	32.5	.798	23.8	19.3	846	.254	.663	1064	.319	26.6	.43	.12	.27
40.2	33.1	.823	28.3	19.0	645	.197	.682	1269	.396	27.4	.53	.12	.16
41.6	31.8	.765	29.6	19.8	425	.124	.632	1479	.430	26.3	.79	.24	.17
42.5	32.3	.760	30.4	20.4	1120	.313	.625	987	.280	26.6	.35	.13	.36
37.8	34.3	.907	27.1	17.9	827	.268	.757	1223	.397	25.6	.30	.00	.07
36.6	35.2	.962	26.5	17.5	477	.158	.806	1483	.491	27.5	.45	-.01†	-.05†
36.6	34.3	.939	26.5	17.5	273	.010	.780	1733	.572	28.6	.65	.03	-.08‡
36.1	35.0	.970	26.2	17.3	1328	.443	.304	664	.214	29.0	.18	-.12	.14
38.8	37.8	.975	27.6	18.1	1027	.328	.807	873	.235	31.3	.32	-.07	.09
38.1	38.3	1.005	27.1	17.9	616	.199	.835	1130	.364	31.8	.47	-.03	.62
37.2	39.7	1.047	26.7	17.6	159	.052	.869	1379	.450	32.3	.68	-.05	-.07‡
43.3	37.1	.857	31.3	21.0	347	.096	.712	1637	.456	30.8	1.44	.13	.06

† X = .06 " " ALTERNATE CURVE (TEST DATA) IS USED (R_s K-171a)

‡ X = .16 " " " " " " " "

‡ X = .01 " " " " " " " "

PANEL NO ↓

O. R. L.

AVRO AIRCRAFT LIMITED
TECHNICAL DEPARTMENT (Aircraft)

REPORT NO.
SHEET NO.

AIRCRAFT		PREPARED BY	DATE
C105	OUTER WING	R. GAVALIS	11-28-56
		CHECKED BY	DATE

SKIN PANELS

RIB BAY 16-17

FAILING STRENGTH - PANEL 13

ULTIMATE SHEAR STRENGTH;

$b = 5.2"$, $t = .173"$, $A_w = .196 w^2$, $e = .591 w$.

$\rho = .489 w$, $A_{wc} = \frac{A_w}{\left[1+\left(\frac{e}{\rho}\right)^2\right]} = \frac{.196}{\left[1+\left(\frac{.591}{.489}\right)^2\right]} = .0795$

$\sigma_{cu} = 17{,}300$ psi (Vol. 20, Fig K-220)

$\sigma_{assumed} = 21{,}000$ psi, $\rho = \frac{\sigma - \sigma_{cu}}{\sigma + \sigma_{cu}} = \frac{3700}{38300} = .0967$

$K = .042$, $\frac{A_{wc}}{bt} = \frac{.0795}{5.2(.173)} = .0885$

$\frac{\sigma_u}{\sigma} = .070$, $\sigma_u = .07(21000) = 1470$ psi

$\frac{s}{h} = \frac{5.2}{16.5} = .315$, $\frac{\sigma_{w\,max}}{\sigma_u} = 1.55$

$\sigma_{w\,max} = 1.55(1470) = 2280$ psi

$\sigma_c = 23.4(K)^{\frac{2}{3}}\left(\frac{\sigma_u}{E}\right)^{\frac{1}{3}} = 23.4(.042)^{\frac{2}{3}}\left(\frac{.116}{.173}\right)^{\frac{1}{3}} = 2430$ psi

$\frac{\sigma_c}{\sigma_{w\,max}} = \frac{2430}{2280} = 1.06$, $\sigma_{ult\ web} = 24200$ psi (REF. FIG 19-2)

$\therefore \sigma_{ult\ panel} = 21{,}000$ psi

$f_s = \frac{1328}{.173} = 7670$ psi, $R_s = \frac{7670}{21000} = .365$

ULTIMATE COMPRESSIVE STRENGTH;

$F_{cx\,panel} = 36{,}100$ psi, $\frac{\sigma_w}{F} = \frac{36100}{50000} = .722$

$\frac{b_e}{b} = .861$ (KOITER CURVE)

K-221

FORM 1193A

O.R.L.

AVRO AIRCRAFT LIMITED

TECHNICAL DEPARTMENT (Aircraft)

AIRCRAFT:		REPORT No.	
C 105	OUTER WING	SHEET No.	
		PREPARED BY: R. CAVALIS	DATE: 11-29-55
		CHECKED BY:	DATE:

SKIN SHEARS

RIB BAY 16-17

FAILING STRENGTH - PANEL 13 (CONT'D.)

CASE 8.3a

ELE.	$A_{STR.}$	$A_{SKIN\ BUCKLED}$	$A_{TOTAL\ BUCKLED}$	P	f_c
13	.500	.824	1.324	44878	33800
14	.176	.680	.876	36927	42100

$A_{SKIN\ BUCKL.\ 13} = \left[\frac{4.35(.361) + 5.77}{2}\right](.173)$, $A_{SKIN\ BUCKL.\ 14} = 4.56(.361)(.173)$

(REF. Pgs K-138, 141)

$f_{c\ BUCKLED\ AVE.} = \frac{33800 + 42100}{2} = 37,950\ psi$

FOR CASE 8.3a;

$R_c = \frac{37950}{50000} = .759$, $R_s = .365$

$M.S._{ULT} = \frac{.935}{.759} - 1 = .23$

FORM 1702A

O. R. L.

AVRO AIRCRAFT LIMITED
MALTON · ONTARIO
TECHNICAL DEPARTMENT

REPORT NO.
SHEET NO.

AIRCRAFT:		PREPARED BY	DATE
C105	OUTER WING	R. GAVALIS	5-15-56
		CHECKED BY	DATE

SKIN PANELS

RIB BAY 16-17

FAILING STRENGTH - PANEL 14

ULTIMATE SHEAR STRENGTH:

$b = 4.6$; $t = .173"$, $A_u = .196 in^2$, $A_{ue} = .0795$

$\sigma_{cu} = 18,100 psi$ (Col. 20, Pg K-220)

$\sigma_{ULT\ ASSUMED} = 22,000 psi$, $k = .0425$

$\frac{A_{ue}}{bt} = \frac{.0795}{4.6(.173)} = .140$, $\sigma_u/E = .070$

$\sigma_u = .07(22000) = 1540 \#/in^2$, $d/b = \frac{4.6}{16.6} = .279$

$\sigma_{u\,MAX}/\sigma_u = 1.57$, $\sigma_{u\,MAX} = 1.57(1540) = 2420 \#/in^2$

$\sigma_0 = 3.4(.0425)^{2/3}(.635)^{1/3} = 2450 \#/in^2$

$\frac{\sigma_0}{\sigma_{u\,MAX}} = \frac{2450}{2420} = 1.01$

$\therefore \sigma_{ULT\ PANEL} = 22,000 psi$, $f_s = \frac{1029}{.173} = 5950 psi$

$k_s = \frac{5950}{22000} = .270$

ULTIMATE COMPRESSIVE STRENGTH:

$F_{cu\ PANEL} = 38,800 psi$, $\sigma_u/\sigma = \frac{38800}{50000} = .776$

$b_e/b = .890$ (KOITER EFF. WIDTH CURVE)

CASE 8.3a

ELEMENT	A_{STR}	$A_{SKIN\ BUCKLED}$	$A_{TOTAL\ BUCKLED}$	P	f_c
14	.196	.755	.951	36821	38800
15	.196	.723	.919	34019	42500
REF. →				Pg K-172	

$A_{SKIN\ BUCKL.\ 14} = \frac{(5.2+4.6)(.173)(.890)}{2} = .755 in^2$, $A_{SKIN\ BUCKL.\ 15} = \frac{(4.6+4.2)(.173)(.890)}{2} = .723$

K-223

FORM 1319A

O. R. L.

AVRO AIRCRAFT LIMITED
MALTON · ONTARIO
TECHNICAL DEPARTMENT

REPORT No.
SHEET No.

AIRCRAFT:		PREPARED BY	DATE
C106	OUTER WING	R. GAVALIS	5-15-56
		CHECKED BY	DATE

SKIN PANELS

RIB BAY 16-17

FAILING STRENGTH - PANEL 14 (CONT'D)

$f_{c_{BUCKLED\ AVG}} = \frac{38800+42500}{2} = 40,700 psi$

FOR CASE 8.3a

$R_c = \frac{40700}{50000} = .814$, $R_s = .270$

$M.S._{ULT} = \frac{.955}{.814} - 1 = .17$

FAILING STRENGTH - PANEL 15

ULTIMATE SHEAR STRENGTH:

$b = 4.8$, $t = .173"$, $A_{WC} = .0795 in^2$

$\tau_{cu} = 17,900 psi$ (col. 20, $R_c = .220$), $\tau_{ULT\ ASSUMED} = 21,500 psi$

$A_{WC}/bt = \frac{.0795}{4.8(.173)} = .0957$, $K = .0398$, $\sigma_u/\tau_{cu} = .066$

$\sigma_u = .066(21,500) = 1420 psi$, $d/h = \frac{4.8}{16.5} = .290$

$\sigma_{u_{MAX}}/\sigma_u = 1.57$, $\sigma_{u_{MAX}} = 1.57(1420) = 2230 psi$

$\sigma_b = 23.4(.0398)^{2/3}(.136)^{1/3} = 2310 psi$

$\frac{\sigma_b}{\sigma_{u_{MAX}}} = \frac{2310}{2230} = 1.03$, $\tau_{ULT\ WEB} = 24,000 psi$

$\therefore \tau_{ULT\ ALL} = 21,500 psi$, $f_s = \frac{616}{.173} = 3570 psi$

$R_s = \frac{3570}{21500} = .166$

FOR ULTIMATE COMPRESSIVE STRENGTH:

$F_{cu\ PANEL} = 38,100 psi$, $\sigma_u/b = \frac{38100}{50000} = .763$

$b_e/b = .982$ (REF. KOITER, EFF. WIDTH CURVE)

AVRO AIRCRAFT LIMITED
MALTON, ONTARIO
TECHNICAL DEPARTMENT

REPORT No.
SHEET No.

AIRCRAFT		PREPARED BY	DATE
C105	OUTER WING	R. GAVALIS	5-15-56
		CHECKED BY	DATE

SKIN PANELS

RIB BAY 16-17

FAILING STRENGTH - PANEL 15 (CONT'D)

ELEMENT	$A_{STR.}$	$A_{BUCKLED}$	$A_{BUCKLED}$	P	f_c
15	.196	.723	.919	39019	42500
16	.196	.747	.943	41869	44500
				P_3 K-172	

$$A_{SKIN\ BUCKLED\ 16} = \frac{(4.8+5.0)(.173)(.382)}{2} = .747$$

$$f_{c\ BUCKLED\ AVG} = \frac{42500+44500}{2} = 43500 psi$$

FOR CASE 3.3a,

$$R_c = \frac{43500}{50000} = .870, \quad R_s = .166$$

$$M.S. = \frac{.972}{.870} - 1 = .12$$

FAILING STRENGTH - PANEL 16

$b = 5.0$, $t = .173"$, $A_{ue} = .0795\ in^2$ $\sigma_{cy} = 17600 psi$

$\sigma_{ULT.\ ASSUMED} = 21,500 psi$, $A_{ue}/bt = \frac{.0795}{5.0(.173)} = .092$

$K = .0435$, $\sigma_u/E = .072$, $\sigma_u = .072(21,500) = 1550 psi$

$d/h = \frac{5.0}{16.5} = .303$, $\sigma_{u\,MAX}/\sigma_u = 1.56$

$\sigma_{u\,MAX} = 1.56(1550) = 2420 psi$

$\sigma_o = 23.4(.0435)^{3/4}(.635)^{1/3} = 2430 psi$

$\sigma_o/\sigma_{u\,MAX} = \frac{2430}{2420} = 1.02$ $\therefore \sigma_{ULT\ WEB} = 23,000 psi$

$\therefore \sigma_{ULT.} = 21,500 psi$, $f_s = \frac{159}{.173} = 920 psi$

$R_s = \frac{920}{21500} = .043$

K-225

AVRO AIRCRAFT LIMITED
MALTON, ONTARIO
TECHNICAL DEPARTMENT

REPORT No.
SHEET No

AIRCRAFT:		PREPARED BY	DATE
C105	OUTER WING	R. GAVALIS	5-16-56
		CHECKED BY	DATE

SKIN PANELS

RIB BAY 16-17

FAILING STRENGTH - PANEL 16 (CONT'D)

FOR ULTIMATE COMPRESSIVE STRENGTH;

$f_{c_{PANEL}} = 37,200 \text{ psi}$, $\frac{f_c}{f_{cy}} = \frac{37200}{50000} = .744$

$b_e/b = .873$ (REF. KOITER EFF. WIDTH CURVE)

CASE 8.32

ELE.	$A_{STR.}$	$A_{BUCKLED}$	$A_{EFFECTIVE}$	P	f_c
16	.196	.747	.945	41867	44500
17	.196	.637	.833	44854	53800
				Fig. K-172	

$A_{SKIN\ BUCKLED,17} = \left[\frac{3.0 + .873(5.0)}{2}\right](.173) = .833$

$f_{c_{BUCKLED\ AVE}} = \frac{44500 + 53300}{2} = 49,100 \text{ psi}$

$R_c = \frac{49110}{50000} = .983$, $R_s = .043$

$M.S._{ULT} = \frac{.992}{.983} - 1 = .01$

PANEL ↓ CRITERIA →	X BUCKLING LOADS / APPLIED LOADS − 1	M.S. LIMIT NO BUCKLING AT LIMIT	M.S. ULT NO FAILURE AT ULTIMATE
13	−.12	.18	.23
14	−.07	.25	.17
15	−.03	.27	.12
16	−.05	.28	.01

NOTE: ABOVE VALUES ARE FOR CASE 8.32

FORM 1198A

O. R. L.

SKIN PANELS (UPPER)

BUCKLING OF PANELS

RIB BAY 15-16 (STA. "J")

MAT'L: 75S-T6 ALC. SKIN

PANELS REF.	1 b	2 b/t ①/.183	3 a/b 23.6/①	4 R *	5 R' FIG. 43	6 F_{cw} x10⁻³ FIG. 47	7 f_c x10⁻³ K-184 K-175	8 R_c ⑦/⑥	9 C F_s x10⁻³ FIG. 39	10 A S F_{su} x10⁻³ ⑤x⑨	
2	4.2	23.0	5.62	.282	.640	50.0	11.97	.238	34.6	22.2	-
3	5.4	29.5	4.37		.630	43.3	12.5	.289	31.8	20.0	-
4	6.3	34.4	3.74		.600	34.2	12.7	.371	29.7	17.8	-
5	3.4	18.6	6.95		.640	52.0	13.1	.252	36.8	23.6	-
6	4.3	23.5	5.49		.640	49.5	13.6	.275	34.5	22.1	-
7	4.6	25.2	5.13		.635	48.1	13.8	.287	96.1	22.9	-
8	4.2	23.0	5.61		.640	50.0	13.3	.266	34.6	22.2	-
9	3.8	20.8	6.21		.640	51.0	14.0	.274	35.6	22.8	-
10	5.2	28.4	4.54		.635	45.0	14.3	.318	32.2	20.4	-
11	5.6	30.6	4.21		.615	41.6	14.3	.344	31.2	19.2	-
12	5.5	30.0	4.30	.282	.615	42.5	14.1	.332	31.5	19.4	-
13	5.4	29.5	3.67	.507	.805	43.3	14.1	.326	32.0	25.7	-
14	4.9	26.8	2.86	.504	.805	46.7	14.2	.304	33.6	27.0	-
15	5.1	27.8	1.98	.493	.792	45.6	14.0	.307	34.0	26.9	-
16	5.3	29.0	1.21	.436	.750	44.0	13.8	.314	35.0	26.2	-
17	2.5	13.7	1.40	.463	.790	51.7	13.6	.263	41.5	32.8	-

φ b/t = 13.7 FOR 4 SIDES φ 3.5/.183 = 19.1 FOR COMPRESSION

THESE VALUES ARE AVERAGE OF ADJACENT STRING ER STRESS

FOR PANELS 13 TO 17, t_u = .150, t_u/t_w = .820, $t_{1/2}$ = .547, R_1

* $R = R_1 + \frac{1}{2}(R_4 - R_1)\left(\frac{d}{h}\right)^3 = .282 + \frac{1}{2}(.250 - .282)\left(\frac{2}{h}\right)^3 = 292$

t_u = .110", t_w = .183", $t_u/t_w = \frac{.110}{.183} = .600$, $t_4/t_w = \frac{.100}{.183} =$

FOR PANELS 2 TO 12

K-227 FORM 1544

SKIN PANELS (UPPER)

BUCKLING OF PANELS

RIB BAY 15-16 (STA. "J")

(ULTIMATE LOADS)

MAT'L: 75S-T6 ALC. SKIN

1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
								C	A	E	Z	3		
b	b/t ①/.183	a/b 23.6/①	R *	R' FIG. 43	F_{cw} $\times 10^{-3}$ FIG. 47	f_c $\times 10^{-3}$ K-194 K-195	R_c ⑦/⑥	F_s $\times 10^{-3}$ FIG. 39	F_{sw} $\times 10^{-3}$ ⑤×⑨	f_s f_g K-195	$\frac{f_{s-3}}{\times 10^{-3}}$ ⑪/.183	R_s ⑫/⑩	R_m	
4.2	23.0	5.62	.282	.640	50.0	11.94	.238	34.6	22.2	-1707	9.31	.420	.430	
5.4	29.5	4.37		.630	43.3	12.5	.287	31.8	20.0	-1415	7.75	.387	.517	
6.3	34.4	3.74		.600	34.2	12.7	.371	29.7	17.8	-1105	6.03	.338	.648	
3.4	18.6	6.95		.640	52.0	13.1	.252	36.8	23.6	-2200	12.0	.507	.391	
4.3	23.5	5.49		.640	49.5	13.6	.275	34.5	22.1	-1725	10.5	.475	.437	
4.6	25.2	5.13		.635	48.1	13.8	.287	96.1	22.9	-1632	8.91	.389	.510	
4.2	23.0	5.61		.640	50.0	13.3	.266	34.6	22.2	-1728	7.25	.326	.547	
3.8	20.8	6.21		.640	51.0	14.0	.274	35.6	22.8	-2124	11.6	.509	.417	
5.2	28.4	4.54		.635	45.0	14.3	.318	32.2	20.4	-1783	9.75	.478	.481	
5.6	30.6	4.21		.615	41.6	14.3	.344	31.2	19.2	-1430	7.31	.406	.561	
5.5	30.0	4.30	.282	.615	42.5	14.1	.332	31.5	19.4	-1453	5.75	.296	.657	
5.4	29.5	3.67	.507	.805	43.3	14.1	.326	32.0	25.7	-2221	12.2	.475	.491	
4.9	26.8	2.86	.504	.805	46.7	14.2	.304	33.6	27.0	-1871	10.3	.382	.540	
5.1	27.8	1.98	.493	.792	45.6	14.0	.307	34.0	26.9	-1549	8.45	.314	.611	
5.3	29.0	1.21	.436	.750	44.0	13.8	.314	35.0	26.2	-1196	6.53	.249	.697	
2.5	13.7	1.40	.463	.790	51.7	13.6	.263	41.6	32.8	-774	4.22	.129	.925	

3.7 FOR SHEAR & 3.5/.183 = 19.1 FOR COMPRESSION

E VALUES ARE AVERAGE OF ADJACENT STRINGER STRESSES.

ELS 13 TO 17, t_w = .150, t_f/t_w = .820, t_f/t = .547, R_f = .510, R_d = .250, R = .5

$R_m + \frac{1}{2}(R_f - R_d)\left(\frac{d}{h}\right)^3 = .282 + \frac{1}{2}(.250 - .282)\left(\frac{d}{h}\right)^3 = .282$

0", t_w = .183", $t_f/t_w = \frac{.110}{.183}$ = .600, $t_f/t_w = \frac{.100}{.183}$ = .547, R_f = .282, R_d = .2

NELS 2 TO 12

AVRO AIRCRAFT LIMITED

MALTON, ONTARIO
ENGINEERING DIVISION

AIRCRAFT . . C105
WEIGHT . .
C. G. POSITION .

REPORT NO. .
SHEET . .
DATE . . 5-25-56
PREPARED BY . R. GAVALIS

16	17	18	19	20	21	22	23	24	25	26	27	28	29
		CASE		8.3a			CASE				2.3a	8.3a	
F_{cu} $\times 10^{-3}$ FIG. 47	f_c $\times 10^{-3}$ <-184, K-195	R_c (17)/(16)	F_s $\times 10^{-3}$ Fig 47	F_{su} $\times 10^{-3}$ (5)X(19)	g_s P_g K-195	R_s (21) (20) X.133	R_c (26)/(16)	g_s P_g K-	R_s (24)X(22) (21)	f_c	X P_g K-195a	X P_g K-195a	X PANEL NO.
40.9	27.8	.730	-9.0	18.6	-631	.135					.81	.26	2
36.6	31.2	.952	-4.3	16.6	-365	.121					.79	.12	3
31.0	31.9	1.025	29.2	14.9	-89	.033					.75	-.04	4
42.8	32.8	.768	26.2	23.6	-873	.202					.55	.19	6
40.6	33.7	.835	34.4	22.0	-624	.155					.59	.15	6
39.7	34.4	.867	33.5	21.3	-340	.092					.82	.12	7
40.9	33.2	.813	34.6	22.2	-86	.021					1.06	.22	8
42.0	35.0	.833	35.7	22.8	-759	.182					.52	.12	9
37.5	35.6	.950	32.3	20.6	-451	.120					.51	.01	10
36.6	35.8	1.010	31.5	19.4	-132	.037					.63	-.02	11
36.1	35.2	.975	31.5	11.4	207	.055					.98	.01	12
36.6	35.1	.960	32.7	25.8	-961	.204					.51	-.02	13
39.8	35.4	.912	33.7	27.1	-664	.134					.77	.05	14
38.0	34.7	.920	34.0	26.9	-355	.072					.79	.06	15
37.0	34.6	.935	32.0	26.2	-37	.011					1.22	.04	16
42.6	34.0	.800	41.3	42.6	344	.053					2.14	.22	17

$X = \frac{\text{BUCKLING LOADS}}{\text{DESIGN LOADS}} - 1$, $X < 0$ INDICATES THAT PANEL BUCKLES BELOW ULTIMATE.

$+\frac{1}{2}(.250-.010)\left(\frac{a'}{b}\right)^3$

TO

AVRO AIRCRAFT LIMITED
MALTON · ONTARIO
TECHNICAL DEPARTMENT

REPORT No. 1
SHEET No.

AIRCRAFT:		PREPARED BY	DATE
C105	OUTER WING	R. GAVALIS	5-25-56
		CHECKED BY	DATE

SKIN PANELS

RIB BAY 15-16

FAILING STRENGTH - PANEL 4 (CASE 8.30)

ULTIMATE SHEAR STRENGTH:

$b = 6.3"$; $t = .183"$, $A_u = .196 IN^2$, $e = .596"$

$\rho = .489 IN$, $A_{ue} = \frac{.196}{\left[1+\left(\frac{.596}{.489}\right)^2\right]} = .0787 IN^2$

$\tau_u = 14900 psi$ (REF. COL. 20, FIG K-227)

$\tau_{ASSUMED} = 18,800 psi$, $K = .0502$

$\frac{A_{ue}}{bt} = \frac{.0787}{6.3(.183)} = .1683$, $\sigma_u/\tau = .090$

$\sigma_u = .090(18800) = 1690 psi$, $\frac{b}{t} = \frac{6.3}{23.6} = .268$

$\sigma_{u_{MAX}}/\sigma_u = 1.58$, $\sigma_{u_{MAX}} = 1.58(1690) = 2670 psi$

$\sigma_0 = 23.4(K)^{2/3}\left(\frac{\tau_u}{t}\right)^{1/3} = 23.4(.0502)^{2/3}(1,000)^{1/3} = 2680 psi$

$\tau_{ULT_{NOB}} = 23,000 psi$

$\frac{\sigma_0}{\sigma_{u_{MAX}}} = \frac{2680}{2670} = 1.00^+$, $\therefore \tau_{ULT_{PANEL}} = 18,800 psi$

$f_s = \frac{87}{.183} = 485 psi$, $R_s = \frac{485}{18800} = .026$

ULTIMATE COMPRESSIVE STRENGTH:

$F_{cu_{PANEL}} = 31,000 psi$ (COL 16, FIG K-227), $F_{cu}/E_{tan} = \frac{21000}{33000} = .620$

$\frac{b_e}{b} = .810$ (KUHN CURVE)

(REF FIG K-183, K-185

ELE.	A_{STC}	$A_{SKIN\ BUCKLED}$	$A_{STC\ BUCKLED}$	P	F_c
4	.196	.876	1.072	37,185	34600
5	.395	.840	1.235	40,688	33000

$A_{SKIN\ BUCKL_4} = .183\left[\frac{5.25+5.35(.810)}{2}\right] = .876$, $A_{SKIN\ BUCKL_5} = .183\left[\frac{.810(5.35)+4.85}{2}\right] = .840$

K-228

2M 1308A

O.R.L.

AVRO AIRCRAFT LIMITED
MALTON - ONTARIO
TECHNICAL DEPARTMENT

REPORT No.
SHEET No.

AIRCRAFT:		PREPARED BY	DATE
C105	OUTER WING	R. GAVALIS	5-25-56
		CHECKED BY	DATE

SKIN PANELS

RIB BAY 15 & 16

FAILING STRENGTH - PANEL #4 (UNIT 10)

$f_{c_{BUCKLED\ AVG}} = \frac{34600 + 33000}{2} = 33,800$ psi

FOR CASE 8.3a;

$R_c = \frac{33800}{50000} = .676$, $R_s = .026$

$M.S._{ULT.} = \frac{.988}{.676} - 1 = .46$

PANEL ↓	X	MS_{LIMIT}	MS_{ULT}
CRITERIA →	BUCKLING LOADS / APPLIED ULT LOADS - 1	NO BUCKLING AT LIMIT	NO FAILURE AT ULTIMATE
4	-.04	.31	.46

M 1316A

O. R. L.

SKIN PANELS (UPPER)

BUCKLING OF PANELS

RIB BAY 23-24 (STA. 'B')

MAT'L: 75S-T6 ALC. SKIN

PANELS ↓ / REF. →	1	2	3	4	5	6	7	8	9	10
									CASE	
	b	b/t	a/b	R	R'	F_{cu} x10-3	f_c x10-3	R_c	F_s	F_{cu}
		①/.121	15.5/①	*	FIG. 43	FIG 47		⑦/⑥	FIG. 37	⑤x⑨
2 F/S	3.25	26.8	4.77	.351	.685	46.7	.780	.017	33.0	22.0
4 M/S	3.22	26.6	4.81	.351	.695	47.0	.960	.020	33.1	22.7
5	2.50	20.6	6.20	.350	.690	51.2	1.080	.021	35.3	24.7
7 C/S F	4.00	33.0	3.87	.351	.678	37.1	1.215	.033	30.5	20.6
9	3.30	27.2	2.58‡	.355	.688	46.3	1.295	.028	34.0	23.4
11 F/S	4.10	33.8	2.07‡	.360	.690	35.4	1.230	.036	32.0	21.8
ϕ CASE 2.3a LOADS ARE FOR LOWER SURFACE PANELS										
‡ a = 8.5" FOR THESE PANELS										
* $R = R_h + \frac{1}{2}(R_d - R_h)(\frac{d}{h})^3 = .350 + \frac{1}{2}(.522 - .350)(\frac{d}{h})^3 = .35$										
$t_u = .081$", $t_s = .121$" (AVG) $t_u/t_s = \frac{.081}{.121} = .670$, $t_s/t_u = \frac{.100}{.121}$										

K-230

FORM 1544

SKIN PANELS (UPPER)

BUCKLING OF PANELS

RIB BAY 23-24 (STA. B)

(ULTIMATE LOADS)

MAT'L: 75S-T6 ALC. SKIN

	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
S									CASE 2.3a & b						
→	b	b/t ①/.121	a/b 15.5/①	R *	R' FIG. 43	F_{cu} x10⁻³ FIG 47	f_c x10⁻³	R_c ⑦/⑥	F_s FIG. 37	F_{su} ⑤×⑨	g_s Fig. K-95	f_s ⑪/.121	R_s ⑫/⑩	R_{m_s} Fig. K-144	
F/s	3.25	26.8	4.77	.351	.685	46.7	.780	.017	33.0	22.6	-1009	8.32	.368	.980	
4/s	3.22	26.6	4.81	.351	.695	47.0	.960	.020	35.1	22.7	-1166	9.65	.425	.973	
	2.50	20.6	6.20	.350	.690	51.2	1.080	.021	36.8	24.7	-1282	10.60	.430	.973	
2F	4.00	33.0	3.87	.351	.678	37.1	1.215	.033	30.5	20.6	-1327	11.00	.534	.973	
	3.30	27.2	2.58 =	.355	.688	46.3	1.295	.028	34.0	23.4	-1294	10.70	.467	.975	
/s	4.10	33.8	2.07 =	.360	.690	35.4	1.290	.036	32.0	21.8	-1096	9.05	.415	.968	

2.3a LOADS ARE FOR LOWER SURFACE PANELS

5" FOR THESE PANELS

$R_h + \frac{1}{2}(R_d - R_h)\left(\frac{d}{h}\right)^3 = .350 + \frac{1}{2}(.522 - .350)\left(\frac{d}{h}\right)^3 = .350 + .086\left(\frac{d}{h}\right)^3$

.81", $t_u = .121$ (AVG) $t_u/t_u = \frac{.081}{.121} = .670$, $t_u/t_u = \frac{.100}{.121} = .827$, $R_h = .350$, $R_d =$

AVRO AIRCRAFT LIMITED

MALTON, ONTARIO
ENGINEERING DIVISION

AIRCRAFT	C105	REPORT NO.	
WEIGHT		SHEET	
C. G. POSITION		DATE	5-29-56
		PREPARED BY	R. GAVALIS

16	17	18	19	20	21	22	23	24	25	26	27	28	29	PANEL NO.
CASE 8.3a							CASE 15.1a				2.3a	8.3a	15.1a	
F_{cu}	f_c	R_c	F_s	F_{su}	q_s	R_s	R_c	q_s	R_s	f_c	X^*	X^*	X^*	
FIG 47		(17)/(16)	FIG 40	(5)×(19)	Pg K-98	(21)/((20)×.121)	(26)/(16)	Pg K-98	((24)×(22))/(21)		Pg K-199a			↓
38.8	10.7	.276	27.2	13.6	767	.340	.226	832	.368	8.8	1.66	.99	1.00	2
38.9	11.4	.294	27.2	13.6	937	.415	.239	987	.438	9.3	1.30	.71	.75	4
42.0	12.0	.286	27.6	20.4	952	.386	.234	1046	.425	9.8	1.27	.39	.79	5
32.7	12.7	.388	25.2	17.1	1063	.435	.318	1091	.527	10.4	.82	.40	.41	7
38.5	13.7	.356	26.1	19.3	964	.413	.291	1056	.452	11.2	1.13	.59	.61	9
31.8	14.1	.443	26.0	17.7	634	.320	.365	926	.388	11.6	1.33	.62	.63	11

$^*X = \frac{\text{BUCKLING LOADS}}{\text{APPLIED LOADS}} - 1$, $X < 0$ INDICATES THAT PANEL BUCKLES BELOW ULTIMATE.

22

SKIN PANELS (UPPER)

BUCKLING OF PANELS

RIB BAY 24-25
(STA. A)

MAT'L: 75S-T6 ALC. SKIN

PANELS / REF. →	1	2	3	4	5	6	7	8	9	
									C A	S
	b	b/t	a/b	R	R'	F_{cu}	f_c	F_c	F_s	F_{s_c}
		①/.113	15.6/①	*	FIG. 43	FIG. 47	B&K-109 & K-1140	⑦/⑥	FIG. 39	⑤ ×
2	5.3	47.0	2.94	.584	.810	19.6	1.16	.059	25.2	20
5	5.4	47.8	2.89	.584	.800	19.3	1.33	.069	24.8	19
9 ‡	3.5	31.0	4.45	.591	.870	40.9	1.53	.037	31.0	25 ϕ
ϕ 25.4 = t_{cu} MAX., SEE FIG 19 & FIG 20										
‡ ACTUAL PANEL IS TRIANGULAR										
* $R = R_h + \frac{1}{2}(R_d - R_h)(\frac{d}{h})^3$ =					.580	$+\frac{1}{2}$ (.755 - .580)$(\frac{d}{h})^3$ =				
t_w = .113" (ave), t_u = .100", t_f = .120",							$\frac{t_u}{t_w}$ = .10/.11 ^{3} =		8	85

K-231

FORM 1544

SKIN PANELS (UPPER)

BUCKLING OF PANELS

RIB BAY 24-26
(STA. A)

MAT'L: 75S-T6 ALC. SKIN (ULTIMATE LOADS)

1	2	3	4	5	6	7	8	9	10	11	12	13	14
								CASE 2.3a					
ELS b	b/t	a/b	R	R'	F_{cu}	f_c	R_c	F_s	F_{su}	f_s	f_s	R_s	$R_{m=}$
→	①/.113	15.6/①	*	Fig. 43	Fig. 47	R_{cs} K-103 & K-114a	⑦/⑥	Fig. 39	⑤ × ⑨	R_s, K-114	⑪/.113	⑫/⑩	
	5.3	47.0	2.94	.584	.810	19.6	1.16	.059	25.2	20.4	8.23	7.26	.356	.930
	5.4	47.3	2.89	.584	.800	17.3	1.33	.069	24.8	19.8	8.44	7.90	.399	.925
≠	3.5	31.0	4.45	.581	.970	40.8	1.53	.037	31.0	25.4	8.09	7.09	.262	.940

5.4 = $\frac{L}{\rho}$ MAX., SEE FIG 19 & FIG 20

TUAL PANEL IS TRIANGULAR

$= R_h + \frac{1}{2}(R_d - R_h)\left(\frac{d}{h}\right)^3 = .580 + \frac{1}{2}(.755 - .530)\left(\frac{d}{h}\right)^3 = .530 + .102\left(\frac{d}{h}\right)^3$

.113" (AVE), $t_u = .100"$, $t_f = .120$, $\frac{t_u}{t_w} = \frac{.100}{.113} = .885$, $\frac{t_f}{t_w} = \frac{.120}{.113} = 1.06$, R_c

AVRO AIRCRAFT LIMITED

MALTON, ONTARIO
ENGINEERING DIVISION

REPORT NO. ·
SHEET ·
DATE · 5-31-56
PREPARED BY · R. GAVALIS

AIRCRAFT · C105
WEIGHT ·
C. G. POSITION ·

	18	19	20	21	22	23	24	25	26	27	28	29
	C A S E		9.3a			C A S E		15.1a		2.3a	3.3a	15.1a
	R_c	F_s	F_{sa}	q_s	R_s	R_c	q_s	R_s	F_c	X^a	X^a	X^a
	(17)/(16)	Fig. 40	(5)X(19)	q_g K-114	(21)/(20 X .113)	(26)/(16)	q_g K-114	(24) X (22)/(21)	q_g E-105 q_g K-114a	q_g K-114		q_g K-114a
	.303	21.7	17.6	1045	.525	.516	797	.401	9.60	1.61	.44	.36
	.340	21.2	17.0	1150	.600	.584	876	.456	10.60	1.32	.27	.20
	.204	25.7	22.4	1076	.425	.349	870	.342	12.20	2.59	.86	.81

PANEL NO. ↓
2
5
9

a $X = \frac{\text{BUCKLING LOADS}}{\text{APPLIED LOADS}} - 1$, $X < 0$ INDICATES THAT PANEL BUCKLES BELOW ULTIMATE

$R_h = .580$

O. R. L.

AVRO AIRCRAFT LIMITED
MALTON · ONTARIO
TECHNICAL DEPARTMENT

REPORT No.
SHEET No.

AIRCRAFT:		PREPARED BY	DATE
C106	OUTER WING	R. GAVALIS	5-14-56
		CHECKED BY	DATE

STRINGER-TO-SKIN ATTACHMENTS

TENSION-FIELD EFFECTS

THE EFFECT OF TENSION FIELD IN THE SKIN PANELS WILL BE STUDIED IN RESPECT TO THE SKIN ATTACHMENTS.

RECALL THAT IN A WELL DEVELOPED TENSION FIELD, THE REQUIRED TENSILE STRENGTH OF THE WEB-TO-STIFFENER RIVETS IS:

$$f_{s_{REQ'D}} = .82\, t\, \sigma_{ULT} \ \#/IN \quad \text{(REF. NACA 2760, EQ. 42)}$$

HOWEVER, FOR A PANEL NOT WORKING TO ITS FULL CAPACITY IN SHEAR, THE REQUIRED TENSILE STRENGTH OF THE RIVETS COULD BE CONSIDERABLY LESS THAN GIVEN BY THE ABOVE FORMULA.

THE TENSION FIELD THEORIES OF NACA, OTHER AIRCRAFT COMPANIES, ETC. FAIL TO PROVIDE ANY INFORMATION IN THIS RESPECT. AN ASSUMPTION SHALL BE MADE AS TO WHAT RIVET TENSILE STRENGTH IS REQUIRED. IT IS KNOWN THAT AT FULL TENSION FIELD THE ABOVE EQUATION HOLDS. ALSO, FOR A SHEAR RESISTANT

AVRO AIRCRAFT LIMITED
MALTON · ONTARIO
TECHNICAL DEPARTMENT

REPORT No.
SHEET No.

AIRCRAFT:		PREPARED BY	DATE
C105	OUTER WING	R. GAVALIS	5-15-54
		CHECKED BY	DATE

STRINGER-TO-SKIN ATTACHMENTS

TENSION FIELD EFFECTS (CONT'D)

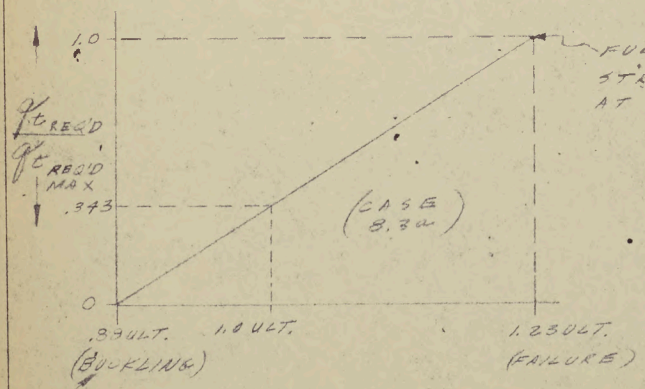
PANEL, THE REQUIRED RIVET TENSILE STRENGTH IS THEORETICALLY ZERO. IT WILL BE ASSUMED THAT THE REQUIRED TENSILE STRENGTH WILL VARY AS A STRAIGHT LINE BETWEEN THESE LIMITS.

EXAMPLE:

CONSIDER PANEL 13 OF RIB BAY 16-17 (REF. R_3 K-220) FOR CASE 8.3$\frac{1}{2}$;

M.S. = -.12 FOR BUCKLING AT ULTIMATE (REF. R_3 K-220)

M.S. = .23 FOR FAILURE AT ULTIMATE (REF. R_3 K-222)



AT BUCKLING, THE REQ'D RIVET TENSILE STRENGTH IS ZERO

NOTE THAT,

$f_{t\,REQ'D\ MAX.} = .22\ t_{ULT}$ AT

(REF. PRECEDING PAGE)

K-234

FORM 1318A

AVRO AIRCRAFT LIMITED
MALTON · ONTARIO
TECHNICAL DEPARTMENT

REPORT No.
SHEET No.

AIRCRAFT:		PREPARED BY	DATE
C105	OUTER WING	R. GAVALIS	5-15-56
		CHECKED BY	DATE

STRINGER-TO-SKIN ATTACHMENTS

TENSION-FIELD EFFECTS (CONT'D)

THEN FROM THE GRAPH,

$$\left(\frac{q_{t_{REQ'D}}}{q_{t_{REQ'D\ MAX}}}\right)_{AT\ ULT.} = \left(\frac{1.00 - .88}{1.23 - .88}\right)(1.0) = .343$$

$$\therefore\ q_{t_{REQ'D\ AT\ ULT.\ LOAD\ FOR\ CASE\ 8.3a}} = .343(.22)\,t\,\sigma_{ULT} = .0755\,t\,\sigma_{ULT}$$

STRINGER-TO-SKIN ATTACHMENTS

RIBS 16 TO 17, CASE 8.3a, T = 250 °F

MAT'L: SKIN - 75S-T6 ALC., STR. - 75S-T6 EXT.

STRINGER ↓ REF. →	1 SHEAR FLOW $q_{3\,FWD}$ Fig. K-154	2 SHEAR FLOW $q_{3\,AFT}$ Fig. K-154	3 SHEAR FLOW $q_{3\,STR.}$ (#/in) ① - ②	4 ATTACHMENTS SIZE	5 ATTACHMENTS TYPE	6 ATTACHMENTS PITCH (IN.)	7 $P_{ALL\ SHEAR}$	8 $P_{ALL\ BY\ SKIN}$	9 $P_{ALL\ BY\ STR.}$	10 $q_{ALL\ SHEAR}$ ⑦, ⑧ OR ⑨ / ⑥
3	-600	-344	256	3/16	ADC	.75	775*	> 775	> 775	1030
4	-344	-69	275	"	"	"				
6	-715	-479	236	"	"	"				
7	-479	-220	259	"	"	"				
8	-220	46	266	"	"	"				
10	-670	-372	298	"	"	"				
11	-372	-41	331	"	"	"				
12	-41	273	314	"	"	"				
14	664*	893*	229	"	"	"				
15	-538	-238	300	"	"	"				
16	-238	76	314	"	"	"				
17	76	404	328	3/16	ADC	.75	775	> 775	> 775	1030
20	220	510	290	3/16	HUCK CKL100V	.70	865*	786	> 865	1235
21	-74	220	294	"	"	"				
22	-365	-74	291	"	"	"				
23	-655	-365	290	"	"	.70				1235
25	-81	248	329	"	"	.75				1152
26	-433	-81	352	"	"	"				
27	-753	-433	320	"	"	.75				1152
29	-260	18	278	"	"	.70				1235
30	-524	-260	264	"	"	"				
31	-771	-524	247	"	"	.70				1235
33	-491	-235	256	"	"	.75				1152
34	-701	-491	210	3/16	HUCK CKL100V	.75	865	786	> 865	1152
⊟ WITH TEMP. FACTOR OF .775							✡ TWO ROWS OF RIVETS: .22 ± 0 LT (.343) = .2			
t_{SKIN} = .162 (MIN), t_{STR} = .180 (MIN)				± $P_{ALL\ SHEAR}$ = .80 (BLC)			= 775 #, ∴ $q_{ALL\ SHEAR}$ = .90 × 7			

* CASE 15.1a (FIG K-157)

FORM 1544

R-TO-SKIN ATTACHMENTS

6 TO 17 , CASE 8.3a , T = 250 °F

W-75S-T6 ALC., STR.-75S-T6 EXT.

	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17
	FLOW	ATTACHMENTS			P_{ALL} SHEAR	P_{ALL} BRG SKIN	P_{ALL} BRG STR.	q_{ALL} SHEAR ⑦, ⑧ OR ⑨ / ⑥	R_s ③ / ⑩	ΔS K-139 (NO. E)	P_{AVE}	W_{SKIN} .LLL × ⑫ × ⑬ UPR. SURFACE ONLY	P_{ALL} TENSION SKIN	P_{ALL} TENSION STR.	q_{ALL} TENS. ⑮ OR ⑯ / ⑥
T	q_{STR} (#/in) ① - ②	SIZE	TYPE	PITCH (in.)											
54															
	256	3/16	AD6	.75	775*	> 775	> 775	1030	.248	4.80	4.83	15.5	835	785	1180
9	275	"	"	"					.267	4.95	4.46	14.7			
9	236	"	"	"					.229	3.99	3.92	10.0			
0	259	"	"	"					.252	4.11	3.76	10.3			
6	266	"	"	"					.258	4.26	3.58	10.2			
2	298	"	"	"					.290	4.75	3.32	10.5			
	331	"	"	"					.322	5.30	3.25	11.5			
	314	"	"	"					.305	5.04	3.17	10.6			
*	229	"	"	"					.222	4.56	3.10	9.6			
3	300	"	"	"					.292	4.80	3.00	9.6			
6	314	"	"	"					.305	5.13	3.00	10.2			
	328	3/16	AD6	.75	775	> 775	> 775	1030	.318	5.46	3.70	10.6	835	935	1180
	290	3/16	HUCK CKL100V	.70	865*	> 865	> 865	1235	.235						
	294	"	"	"					.238						
4	291	"	"	"					.236						
	290	"	"	.70				1235	.235						
	329	"	"	.75				1152	.285						
1	352	"	"	"					.305						
3	320	"	"	.75				1152	.278						
3	278	"	"	.70				1235	.225						
	264	"	"	"					.214						
	247	"	"	.70				1235	.200						
	256	"	"	.75				1152	.222						
	210	3/16	HUCK CKL100V	.75	865	> 865	> 865	1152	.182						
R	.795				* TWO SETS OF FIGURES ARE FOR FWD & AFT PANELS. AVG										
					▲ .22 CUT (.343) = .22 (.162) (67,000) (.343) = 700 #/in										**
00 (MIN)	$\pm P_{SHR} = .90$ (BLG)				= 775 #, ϕ (P_{BRG} SKIN) = .90 × 769 = 865 #								▯ VALUES GIVEN ARE F		
T)															

AVRO AIRCRAFT LIMITED
MALTON, ONTARIO
ENGINEERING DIVISION

AIRCRAFT - - C105
WEIGHT - -
C. G. POSITION -

REPORT NO. - -
SHEET - -
DATE - - 5-16-56
PREPARED BY - R. GAVALIS

16	17	18	19	20	21	22	23	24	25	26	27	28	29	
			FOR PANEL #											
P_{ALL} TENSION STR. ⊟ 2.1462 1403	q_{ALL} TENS. (15) OR (16) / (6)	$R_{T_{AIR}}$ (14) / (17)	M.S. NO BUCKL. AT ULT Pgs K-220 TO K-222	M.S. FAIL AT ULT.	$q_{t_{REQ'D}}$ / $q_{t_{REQ'D\,MAX}}$ Pg. K-234	$q_{t_{REQ'D}}$ #/IN 22to66 × (21)	$R_{t_{TENS.\,FIELD}}$ (22) / (17)	$R_{t_{TOT}}$ (18) + (23)					M.S. $\frac{1}{(11)+(24)}-1$	No.
985	1180	.013				≈0	0	.013					2.84	3
		.013				≈0		.013					2.60	4
		.009				≈0		.009					3.21	6
		.009	PANEL DOES NOT BUCKLE AT ULTIMATE (REF. Pg K-220)			≈0		.009					2.84	7
		.009				≈0		.009					2.76	8
		.009				≈0		.009					2.36	10
		.010				≈0		.010					2.02	11
		.009				≈0	0	.009					2.20	12
		.008	-.12	.23	** .343	700#	.594	.602	ADJACENT PANELS BUCKLE BELOW ULTIMATE				.21	14
		.008	-.07	.17	⊘ .292	596	.505	.513					.24	16
		.009	-.08 / -.05	.12 / .04	.200 / .834☆	1060	.899	.908					-.18	16
985	1180	.009	-.05 / .13	.01	.834 / .000	850	.720	.729					-.04	17
													3.25	20
													3.20	21
													3.24	22
													3.25	23
													2.50	25
													2.26	26
													2.60	27
													3.44	29
													3.67	30
													4.00	31
													3.50	33
													4.50	34

...LS. AVE VALUE $= \frac{.200+.834}{2} = .517$, $q_{T_{REQ'D}} = .517(.22)(57200)(.162) = 1060$ #/IN

** SEE Pg K-235, ⊘ $\frac{1.0-.93}{1.17-.93}$

...N. ARE FOR EITHER AND OR AFT ADJACENT PANEL.

STRINGER-TO-SKIN ATTACHMENTS

RIB 17-18, CASE 8.30, T = 250°F

MAT'L: SKIN - 75ST6ALC., STR. - 75-T6 EXT.

STRINGER ↓ REF. →	1	2	3	4	5	6	7	8	9	
	ATTACHMENTS			SHEAR FLOW						
	SIZE	TYPE	PITCH (IN.)	q_{3FWD}	q_{3AFT}	q_{3STR}	$P_{ALL\ SQ}$	$P_{ALL\ SQ\ SKIN}$	$P_{ALL\ SQ\ STR}$	q_{3}
				P_3 K = 66 ℓ K = 179		④ - ⑤	Pg. K-236	Pg. K-236	Pg. K-236	⑦ ⑧ ⑤
3	3/16	AN426AD	.75	-539	-249	290	775	> 775	> 775	10
4	"	"	"	-249	54	303				
6	"	"	"	-703	-428	276				
7	"	"	"	-428	-139	289				
8	"	"	"	-139	167	306				
10	"	"	"	-680	-338	342				
11	"	"	"	-573	-205	368				
12	"	"	"	-205	207	412				
14	"	"	"	-1136	-741	395				
15	"	"	"	-741	-317	424				
16	3/16	AN426AD	.75	-317	245	562	775	> 775	> 775	10
21	3/16	CRL100V	.75	532	-110	642	845	> 845	> 845	115
22	"	"	"	-110	-518	408				
23	"	"	"	-518	-914	396				
25	"	"	"	165	-268	433				
26	"	"	"	-268	-661	393				
27	"	"	"	-768	-396	372				
29	"	"	"	-206	129	335				
30	"	"	"	-522	-206	316				
31	"	"	.75	-815	-522	293				115
33	"	"	.86	-452	-161	291				
34	3/16	CRL100V	.85	-690	-452	238	845	> 845	> 845	102

$t_{SKIN\ (INCL.\ CL)} = .152"$; $t_{STR\ (INCL.\ CL)} = .140"$; $F_{OUT} = 57,200$ psi

FORM 1544

-237

...ER-TO-SKIN ATTACHMENTS

...7-18, CASE 8.3a, T = 250°F

...N – 75S-T6 ALC., STR. – 75S-T6 EXT.

2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17
...ENTS		SHEAR FLOW													
...E	PITCH (IN.)	$q_{s\,FWD}$	$q_{s\,AFT}$	$q_{s\,STR}$	P_{ALL} SHR	P_{ALL} BY SKIN	P_{ALL} BY STR	q_{ALL} SHR	R_s	P_{ALL} TENS. SKIN	P_{ALL} TENS. STR	q_{ALL} TENS.	MS NO BUCKL AT ULT.	MS FAIL AT ULT.	f_{EXB}... / F_{ENG}...
		Pg K-66 & K-179		|(4) – (5)|	Pg. K-236	Pg. K-236	Pg. K-236	(7), (8) OR (9) / (3)	(6) / (10)	.90 × 985#	.90 × 1094#	(12) OR (13) / (3)	Pgs K-215 TO K-217		
...LAD	.75	-539	-249	290	775	>775	>775	1030	.282	885	985	1180			
	"	-249	54	303					.294						
	"	-703	-428	276					.267						
	"	-428	-139	289					.280						
	"	-139	167	306					.297						
	"	-680	-338	342					.332						
	"	-573	-205	368					.357						
	"	-205	207	412					.400						
	"	-1136	-741	395					.383				-.13	.34	.27
	"	-741	-317	424					.411				.01	—	0
...AD	.75	-317	245	562	775	>775	>775	1030	.545	885	985	1180	.04 -.10	— .31	0 .24
...OOV	.75	532	-110	642	865	>865	>865	1150	.559						
	"	-110	-518	408					.356						
	"	-518	-914	396					.344						
	"	165	-268	433					.377						
	"	-268	-661	393					.342						
	"	-768	-396	372					.324						
	"	-206	129	335					.292						
	"	-522	-206	316					.275						
	.75	-815	-522	293				1150	.255						
	.85	-452	-161	291				1020	.286						
...OOV	.85	-690	-452	238	865	>865	>865	1020	.234						

...100", $\#_{ULT}$ = 57,200 psi

AVRO AIRCRAFT LIMITED

MALTON, ONTARIO
ENGINEERING DIVISION

AIRCRAFT . . C105
WEIGHT . .
C. G. POSITION .

REPORT NO. .
SHEET . .
DATE . . 5-16-56
PREPARED BY . R. GAVALIS

16	17	18	19	20	21	22	23	24	25	26	27	28	29
M S FAIL AT ULT. 215 217	REQ'D TO MEET M.S.	REQ'D (17) x .22 x ULT	REQ'D (18) / (14)										M.S. (11)+(19) − 1
		30											2.54
													2.40
													2.74
													2.57
													2.37
													2.01
		30	6										1.80
													1.60
.34	.277	530	450										.20
		20											1.43
.31	.244	466	6										.06
													.79
													1.82
													1.90
													1.66
													1.92
													2.09
													2.42
													2.63
													2.92
													2.50
													3.27

S. T. R. NO.
3
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STRINGER-TO-SKIN ATTACHMENTS

RIBS 18 TO 19, CASE 8.3a, T= 26

MAT'L: SKIN - 75S-T6 ALC., STRINGER - 75S-T6 EXT.

STRINGER ↓ REF. →	1	2	3	4	5	6	7	8	9	
	ATTACHMENTS			SHEAR FLOW			$P_{ALL\ SHR}$	$P_{ALL\ of\ SKIN}$	$P_{ALL\ of\ STR}$	q_{fs} ⑦ ⑧
	SIZE	TYPE	PITCH	$q_{fs\ FWD}$	$q_{fs\ AFT}$	$q_{fs\ STR.}$ ④-⑤	Pg. K-236			
3	3/16	ANA2LAD	.75	-505	-243	262	775	>775	>775	1
4 H/S	"	"	"	-243	42	285				
6	"	"	"	-678	-420	258				
7	"	"	"	-420	-142	278				
8 C/SF	"	"	"	-142	157	299				
10	"	"	"	-620	-277	343				
11	"	"	"	-277	91	365				
12 C/SA	3/16	ANA2LAD	.75	91	488	397	775	>775	>775	1
25 C/6A	3/16	CKL 100V	.75	25	385	360	865	>865	>865	1
26	"	"	"	-324	25	349				
27 9/SF	"	"	"	-662	-324	338				
29	"	"	"	-125	190	315				
30	"	"	"	-427	-125	302				
31 H/S	"	"	"	-709	-427	282				
33	"	"	"	-366	-73	293				
34 F/S	3/16	CKL 100V	.75	-614	-366	248	865	>865	>865	1
σ_{ULT} = 67,200 psi										
$t_{SKIN\ (MIN.)}$ = .146", $t_{STR.\ MIN.}$ = .100"				# LOWEST VALUE OF EITHER						

FORM 1544

K-239

ER-TO-SKIN ATTACHMENTS

S 18 TO 19, CASE 8.3a, T = 250°F

SKIN – 75S-T6 ALC., STRINGER – 75S-T6 EXT.

2	3	4	5	6	7	8	9	10	11	12	13	14	15	16
MENTS		SHEAR FLOW												
TYPE	PITCH	$q_{s\,FWD}$	$q_{s\,AFT}$	$q_{s\,STR.}$	P_{ALL} SHE	P_{ALL} BY SKIN	P_{ALL} BY STR	q_{ALL} SHEAR	R_s	P_{ALL} TENS. SKIN	P_{ALL} TENS. STR	q_{ALL} TENS.	$MS_{NO\ BLKL.\ AT\ ULT.}$	$MS_{FAIL\ AT\ ULT.}$
				|(4)-(5)|	Pg. K-236			(7), (8) OR (9) / (3)	(6) / (10)	Pg. K-236	Pg. K-236	(12) OR (13) / (3)	Pgs K-200 & K-201	
426AD	.75	-505	-243	262	775	>775	>775	1030	.254	885	985	1180	.48‡	—
"	"	-243	42	285					.276				.31	—
"	"	-678	-420	258					.250				.31	—
"	"	-420	-142	278					.270				.31	—
"	"	-142	157	299					.290				.23	—
"	"	-620	-277	343					.333				.13	—
"	"	-277	91	363					.357				.12	—
426AD	.75	91	488	397	775	>775	>775	1030	.386	885	985	1180	.09	—
KL OOV	.75	25	385	360	865	>865	>865	1150	.313					
"	"	-324	25	349					.304					
"	"	-662	-324	338					.299					
"	"	-125	190	315					.274					
"	"	-427	-125	302					.263					
"	"	-709	-427	282					.246					
"	"	-366	-73	293					.255					
LL OOV	.75	-614	-366	248	865	>865	>865	1150	.216					

=.100"

‡ LOWEST VALUE OF EITHER FWD. OR AFT PANEL.

AVRO AIRCRAFT LIMITED MALTON, ONTARIO ENGINEERING DIVISION	
AIRCRAFT: C105	REPORT NO.:
WEIGHT:	SHEET:
C. G. POSITION:	DATE: 5-17-56
	PREPARED BY: R. GAVALIS

15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	STR NO
S_{NO} [illegible] ULT.	MS FAIL ULT.	$f_{t_{REQD}}$ / $f_{t_{REQD\,MAX}}$	$f_{t_{REQ'D}}$	$R_{t_{TENS\ FITD}}$										M.S.	
s K	-200		(17) x .22 x t_{ULT}	(8) / (14)											
K-	201													$\frac{1}{(11)+(19)} - 1$	↓
48#	—	—	—	0										2.94	3
31	—	—	—											2.50	4
31	—	—	—											3.00	6
31	—	—	—											2.70	7
23	—	—	—											2.45	8
3	—	—	—											2.00	10
2	—	—	—											1.80	11
09	—	—	—											1.59	12
														2.20	25
														2.29	26
														2.40	27
														2.65	29
														2.80	30
														3.06	31
														2.72	33
														3.63	34

STRINGER-TO-SKIN ATTACHMENTS

RIBS 19-20, CASE 8.30, T= 2509

MATL: SKIN — 75S-T6 ALC., STRINGER — 75S-T6 EXT.

STRINGER ↓	1	2	3	4	5	6	7	8	9
	ATTACHMENT			SHEAR FLOW			$P_{ALL\ SHR}$	$P_{ALL\ @\ SKIN}$	$P_{ALL\ @\ STR}$
	SIZE	TYPE	PITCH	q_{SKWD}	q_{AFT}	q_{STR}			
REF. →				Pg K-35		④-⑤	Pg K-236	Pg K-236	Pg K-236
3	3/16	ANA226AD	.75	-336	-301	32	775	>775	>775
4	"	"	"	-301	95	396			
6	"	"	"	-523	-358	165			
7	"	"	"	-358	-64	294			
8	"	"	.75	-64	250	314			
10	"	"	.70	-556	-203	353			
11	"	"	"	-203	171	374			
12	3/16	ANA226AD	.70	171	570	399	775	>775	>775
25	3/16	CKL 100V	.75	169	576	407	865	>865	>865
26	"	"	"	-223	169	392			
27	"	"	"	-609	-223	386			
29	"	"	"	-77	276	353			
30	"	"	"	-408	-77	331			
31	"	"	"	-595	-408	187			
33	"	"	"	-196	-41	155			
34	3/16	CKL 100V	.75	-463	-196	267	865	>865	>865

$f_{ULT} = 57,200$ psi

$t_{SKIN} = .138$ (MIN.), $t_{STR} = .100$ (MIN.) ← LOWEST VALUE

K-239

FORM 1544

INGER-TO-SKIN ATTACHMENTS

S 19-20, CASE 8.3a, T = 250°F

SKIN – 75S-T6 ALC., STRINGER – 75S-T6 EXT.

2	3	4	5	6	7	8	9	10	11	12	13	14	15	16
ATTACHMENT TYPE	PITCH	SHEAR FLOW $q_{s_{FWD}}$	SHEAR FLOW $q_{s_{AFT}}$	SHEAR FLOW $q_{s_{STR}}$	$P_{ALL\ SHR}$	$P_{ALL\ BRG\ SKIN}$	$P_{ALL\ BRG\ STR}$	$q_{ALL\ SHEAR}$ (7)(8) OR (4) / (3)	R_s (6)/(10)	$P_{ALL\ TENS.\ SKIN}$	$P_{ALL\ TENS\ STR.}$	$q_{ALL\ TENS}$ (12) OR (13) / (3)	$MS_{NO\ BOLT\ AT\ ULT}$	$M.S._{FAIL\ AT\ ULT}$
		Pg. K-35	(4)-(5)		Pg K-236	Pg K-234	Pg K-236			Pg K-236	Pg K-236		Pg K-262	
AN426AD	.75	-338	-301	32	>775	>775	>775	1030	.031	885	985	1180	.47	
"	"	-301	95	396					.384				.36	
"	"	-523	-358	165					.160				.37	
"	"	-358	-64	294					.286				.37	
"	.75	-64	250	314				1030	.305			1180	.28	
"	.70	-556	-203	353				1110	.318			1260	.21	
"	"	-203	171	374				1110	.337			1260	.18	
AN426AD	.70	171	570	399	775	>775	>775	1110	.360	885	985	1260	.17	
CKL 100V	.75	169	576	407	865	>865	>865	1150	.354					
"	"	-223	169	392					.341					
"	"	-604	-223	381					.331					
"	"	-77	276	353					.307					
"	"	-408	-77	331					.288					
"	"	-595	-408	187					.163					
"	"	-196	-41	155					.136					
CKL 100V	.75	-463	-196	267	865	>865	>865	1150	.232					

N.), t_{STR} = .100 (MIN.) * LOWEST VALUE OF EITHER FWD. OR AFT

AVRO AIRCRAFT LIMITED

MALTON, ONTARIO
ENGINEERING DIVISION

AIRCRAFT - - C105
WEIGHT - -
C. G. POSITION -

REPORT NO. -
SHEET - -
DATE - - 5-18-56
PREPARED BY - R. GAVALIS

17	18	19	20	21	22	23	24	25	26	27	28	29	STR. NO.
												M.S.	
												$\frac{1}{(11)+(19)} - 1$	
												>5.00	3
												1.60	4
												5.25	6
												2.50	7
												2.28	9
												2.14	10
												1.97	11
												1.78	12
												1.82	25
												1.94	26
												2.02	27
												2.26	29
												2.47	30
												5.15	31
												>5.00	33
												3.31	34

AVRO AIRCRAFT LIMITED
MALTON · ONTARIO
TECHNICAL DEPARTMENT

REPORT No.
SHEET No.

AIRCRAFT:		PREPARED BY	DATE
C105	OUTER WING	R. GAVALIS	5-23-56
		CHECKED BY	DATE

STRINGER-TO-SKIN ATTACHMENTS

SHEAR FLOW IN ATTACHMENTS

RIBS 21-22: (REF. Pgs 132 & 135)

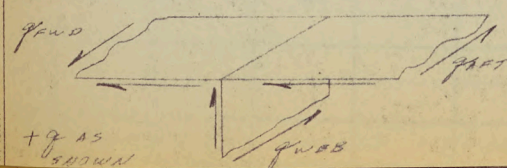
	CASE 2.3a				CASE 8.3a				CASE 15.1a			
STR.	q_{FWD}	q_{AFT}	q_{WEB}	Δq	q_{FWD}	q_{AFT}	q_{WEB}	Δq	q_{FWD}	q_{AFT}	q_{WEB}	Δq
4	-1628	-1630	-112	114	265	339	-375	300	873	911	337	-325
7	-1730	-1803	-211	284	309	287	-586	608	947	961	331	-345
11	-1832	-1805	-153	126	392	435	-687	644	1049	1068	430	-449
28	-1831	-1792	-153	108	370	435	-687	572	1036	1098	430	-493
30	-1733	-1785	-211	263	298	362	-586	522	940	1007	331	-398
33	-1650	-1568	-112	30	174	593	-376	-44	817	1067	337	-587

RIBS 22-23: (REF. Pg K-82)

	CASE 2.3a				CASE 8.3a				CASE 15.1a			
STR	q_{FWD}	q_{AFT}	q_{WEB}	Δq	q_{FWD}	q_{AFT}	q_{WEB}	Δq	q_{FWD}	q_{AFT}	q_{WEB}	Δq
4	-1562	-1432	278	-358	610	763	253	-406	817	987	53	-223
7	-1659	-1745	155	-69	752	791	445	-484	1043	1098	212	-267
11	-1748	-1679	12	-81	925	864	636	-575	1179	1118	377	-316
26	-1755	-1677	12	-88	871	866	636	-631	1149	1119	377	-347
30	-1658	-1734	155	-79	756	873	445	-562	1046	1143	212	-309
33	-1272	-1494	278	-56	542	684	253	-395	779	944	53	-218

RIBS 23-24: (REF. Pg K-98)

	CASE 2.3a				CASE 8.3a				CASE 15.1a			
STR	q_{FWD}	q_{AFT}	q_{WEB}	Δq	q_{FWD}	q_{AFT}	q_{WEB}	Δq	q_{FWD}	q_{AFT}	q_{WEB}	Δq
4	-1009	-1166	157	0	767	937	161	-331	832	927	16	-170
7	-1282	-1329	47	0	952	1003	339	-390	1045	1091	156	-201
11	-1294	-1095	-199	0	969	684	668	-388	1056	826	431	-201
26	-1294	-1095	-199	0	969	716	668	-410	1056	837	431	-212
30	-1282	-1329	47	0	954	1037	339	-422	1046	1109	156	-218
33	-1009	-1166	157	0	718	876	161	-319	806	955	15	-164



SHEAR FLOW IN ATTACHMENTS =

$\Delta q = q_{FWD} - q_{AFT} - q_{WEB}$

C-2-38 RM 1319A

STRINGER-TO-SKIN ATTACHMENTS

RIBS 20-21, CASE 8.3a, T = 250°F

& RIB 21-22, CASE 8.3a, T = 250°F

MAT'L: SKIN — 75S-T6 ALC., STRINGER — 75S-T6 EXT. FOR

STRINGER ↓ / REF. →	1	2	3	4	5	6	7	8	9	10
	ATTACHMENT			SHEAR FLOW			$P_{ALL\ SHR}$	$P_{ALL\ SKIN}$	$P_{ALL\ STR}$	$P_{ALL\ COMB}$
	SIZE	TYPE	PITCH	q_{FWD}	q_{AFT}	q_{STR}	P_{qK-236}		P_{qK-236}	⑦ ⑧ or ③
				$P_{qS\ K-18}$ & P_{qK-132}		④-⑤				
RIBS 20-21										
3	3/16	ANA2CLAD	.75	-223	197	420	775	785	> 775	10
7	"	"	"	-257	176	433				
8	"	"	"	176	518	342				
11	"	"	"	-5	403	408				
12	3/16	ANA2CLAD	.75	403	847	444	775	785	> 775	10
25	3/16	CKL 100V	.75	388	834	446	865	880	> 865	11
26	"	"	"	-39	388	427				
29	"	"	"	196	577	381				
30	"	"	"	-284	196	480				
34	3/16	CKL 100V	.75	-319	75	394	865	880	> 865	11
t_{SKIN} = .132" (MIN), t_{STR} = .100" (MIN)										
RIBS-21-22										
4	3/16	ANA2CLAD	.75			-375*	775	770	>775	10
7	"	"	"			608*	775	770	> 775	10
11	3/16	ANA2CLAD	.75	SEE P_S		644	775	770	> 775	10
26	3/16	CKL 100V	.75			572	865	865	>865	11
30	"	"	"			522	865	865	>865	11
33	3/16	CKL 100V	.75			-587*	865	865	> 865	11

* THIS SHEAR FLOW IS FOR CASE 16.1a

t_{SKIN} = .124" (MIN), t_{STR} = .091" F_{TU} = 57,200 psi

ϕ LOWEST VALUE FOR EITHER FWD. OR AFT

FORM 1544

K-241

ER-TO-SKIN ATTACHMENTS

20-21, CASE 8.3a, T= 250°F

21-22, CASE 8.32, T= 250°F

SKIN — 75S-T6 ALC., STRINGER — 75S-T6 EXT. FOR RIBS 20-21 & 75S-T6 ALC. FOR F[illegible]

2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17
HMENT		SHEAR FLOW													
YPE	PITCH	q_{FWD}	q_{AFT}	q_{STR}	P_{ALL} SHE	P_{ALL} of SKIN	P_{ALL} of STR	P_{ALL} [illegible]	R_s	P_{ALL} TENS SKIN	P_{ALL} TENS STR	q_{ALL} TENS	M.S. NO BUCKLE AT ULT.	M.S. FAIL AT ULT.	Fe[illegible]
		Pgs K-18 & K-132		|④-⑤|	Pg K-236		Pg K-236	(⑦, ⑧ or ⑨)/③	⑥/⑩			(⑫ or ⑬)/③	Pg K-20[illegible]		
A26AD	.75	-223	197	420	775	795	>775	1030	.407				.224	—	
"	"	-257	176	433	↓	↓	↓	↓	.420				.42		
"	"	176	518	342					.332				.53		
"	"	-5	403	408					.376				.01		
CLAD	.75	403	847	444	775	755	>775	1030	.430				.31		
KL / OOV	.75	383	834	446	865	880	>865	1150	.388						
"	"	-39	338	427	↓	↓	↓	↓	.371						
"	"	196	577	331					.331						
"	"	-284	196	430					.417						
KL / OOV	.75	-319	75	334	865	830	>865	1150	.342						
), t_{STR} =		.100" (AMI)													
A26AD	.75	SEE P_g		-375*	775	770	>775	1025	.366	885	985	1180	.40	—	
"	"			603	775	770	>775	1025	.573	885	955	1180	.36 / -.30	.18	
CLAD	.75			644	775	770	>775	1025	.628	885	955	1180	.12 / -.40	-.12	
KL / OOV	.75			572	865	865	>865	1150	.493						
"	"			522	865	865	>865	1150	.455						
KL / OOV	.75			-567*	865	865	>865	1156	.511						

OW IS FOR CASE 16.1a

), t_{STR} = .091" f_{ULT} = 57,200 PSI

UE FOR EITHER FWD. OR AFT PANEL. ⌶ PROBABLY UNCONSERVAT[illegible]

AVRO AIRCRAFT LIMITED

MALTON, ONTARIO
ENGINEERING DIVISION

AIRCRAFT	C105
WEIGHT	
C. G. POSITION	
REPORT NO.	
SHEET	
DATE	5-18-56
PREPARED BY	R. GAVALIS

...OR P'S 21-22

16	17	18	19	20	21	22	23	24	25	26	27	28	29	STR. NO.
...S. FAIL AT ULT.	$f_{t\,REQ'D}$ / $f_{t\,REQ'D\,MAX}$	$f_{t\,REQ'D}$ ⑰ × 22 × t_{OVER}	$R_{t\,BUS\,REQ'D}$ ⑱ / ⑭										M.S. $\frac{1}{⑪+⑲}-1$	
													1.46	3
													1.38	7
													2.01	8
													1.52	11
													1.32	12
													1.58	25
													1.70	26
													2.02	29
													1.40	30
													1.92	34
...8	.625	487	.413										1.74	4
...2	1.000	7804	.660										.06	7
													-.22	11
													1.00	26
													1.20	30
													.95	33

...ATIVE SINCE ADJACENT PANEL SHOWS NEGATIVE M.S. AT ULTIMATE

STRINGER-TO-SKIN ATTACHMENTS

RIBS 22-23, CASE 8.3a, T=250°F

& RIBS 23-24, CASE 8.3a, T=250°F

MAT'L: SKIN - 75S-T6 ALC., STRINGER - 75S-T6 A

STRINGER ↓	1 ATTACHMENTS SIZE	2 TYPE	3 PITCH	4 SHEAR FLOW q_{SKD}	5 $q_{S,AFT}$	6 q_{STR} (4)-(5)	7 $P_{ALL\ STR}$	8 $P_{ALL\ SKIN}$	9 $P_{ALL\ SEC}$	10 $q_{ALL\ SKIN}$ (7) & (8) or (3)
REF. →							P_{LK-23}			
4	3/16	ANA2CLAD	.75			-406	775	760	>775	1010
7	"	"	"			-484	775	760	>775	1010
11	3/16	ANA2CLAD	.75	SEE P_{23}		-575	775	760	>775	1010
26	3/16	CKL 100V	.75			-231	865	8[illegible]	7855	1140
30	"	"	"			-562	865	8[illegible]	>8[illegible]	1140
33	3/16	CKL 100V	.75			-395	865	859	>8[illegible]	1140
t_{SKIN} = .117" (MIN), t_{STR} = .091"										
RIBS 23-24										
4	3/16	ANA2CLAD	.75			-331	775	760	>760	1000
7	"	"	"			-396	775	760	>760	1000
11	3/16	ANA2CLAD	.75			-388	775	760	>760	1000
26	3/16	CKL 100V	.75	SEE P_{23}		-410	865	845	>845	1130
30	"	"	.75			-422	865	845	>845	1130
33	3/16	CKL 100V	.70			-319	865	845	>845	1130
t_{SKIN} = .110" (MIN), t_{STR} = .081"										
σ_{ULT} = 57,200 PSI										
ϕ LOWEST VALUE FOR EITHER FWD. OR AFT PANEL.										

FORM 1544

K-242

...TO-SKIN ATTACHMENTS

...23, CASE 8.3a, T=252°F

...3-24, CASE 8.3a, T=250°F

... - 755-T6 ALC., STRINGER - 755-T6 ALCLAD

3	4	5	6	7	8	9	10	11	12	13	14	15	16	17
...TS	SHEAR FLOW													
...ITCH	$q_{s\,FWD}$	$q_{s\,AFT}$	$q_{s\,STK}$	P_{ALL} STR	P_{ALL} OF SKIN	P_{ALL} STR	q_{ALL} SHEAR	R_s	P_{ALL} TENS SKIN	P_{ALL} TENS STR	f_{ALL} TENS	M.S. NO SIGN. @ ...T.	M.S. NO ... @ ULT.	q_{s} ...
			(4)-(5)	Pg K-23...			(7), (8) or (9) / (3)	(6)/(10)			(12) or (13) / (3)	Pg K-212, K-230	Pg K-214	
.75			-406	775	760	>775	1010	.402	885	935	1180	.441	—	—
"			-484	775	760	>775	1010	.479	885	935	1180	.64	—	—
.75	SEE Pg.		-575	775	760	>775	1010	.569	885	935	1180	.22 -.22	.34	39...
.75			-631	865	858	>858	1140	.554	—					
"			-562	865	858	>858	1140	.494	—					
.75			-395	865	859	>858	1140	.346	—					
=.091"														
.75			-331	775	750	>750	1000	.331	885	985	1180	.71		
"			-390	775	750	>750	1000	.390	885	985	1180	.39		
.75			-388	775	750	>750	1000	.333	885	985	1180	.59		
.75	SEE Pg.		-410	865	845	>845	1130	.363						
.75			-422	865	845	>845	1130	.374						
.70			-319	865	845	>845	1200	.266						
=.081"														

...R EITHER FWD. OR AFT PANEL.

AVRO AIRCRAFT LIMITED

MALTON, ONTARIO
ENGINEERING DIVISION

AIRCRAFT - - C105

WEIGHT - -

C. G. POSITION -

REPORT NO. -

SHEET - -

DATE - - 5-22-56

PREPARED BY - R. GAVALIS

17	18	19	20	21	22	23	24	25	26	27	28	29	
$f_{t\,REQ'D}$ / $f_{t\,REQ\,MAX.}$	$f_{t\,REQ}$	$K_{REQ'D}$										M.S.	STR. NO.
	(17) x .22 x t_{LOCAL}	(18)/(14)										$\frac{1}{(11)+(19)} - 1$	↓
—	—	0										1.48	4
—	—	0										1.08	7
393	580	492										-.06	11
												.80	26
												1.02	30
												1.90	33
												2.02	4
												1.56	7
												1.58	11
												1.76	26
												1.68	30
												2.76	33

STRINGER-TO-SKIN ATTACHMENTS

RIBS 15-16, CASE 8.3a, T = 250°F

MAT'L: SKIN — 75S-T6 ALC., STRINGER — 75S-T6 EX

STRINGER ↓ / REF. →	1 ATTACHMENTS SIZE	2 TYPE	3 PITCH	4 SHEAR FLOW q_{FWD}	5 q_{AFT}	6 q_{STR} ④-⑤	7 P_{ALL} SHEAR	8 P_{ALL} BY SKIN	9 P_{ALL} BY STR
3	3/16	AN426AD	.75	-631	-368	263	775	830	> 775
4	"	"	"	-268	-89	279			
6	"	"	"	-873	-624	249			
7	"	"	"	-624	-360	264			
8	"	"	"	-360	-86	274			
10	"	"	"	-759	-451	308			
11	"	"	"	-451	-132	319			
12	"	"	"	-132	201	339			
14	"	"	"	-961	-664	297*			
15	"	"	"	-664	-355	309*			
16	3/16	AN426AD	.75	-355	-37	318*	775	830	> 775
17	3/16	STEEL JO-BOLT	.80	-37	344	381*	2620	> 2620	1410
20	3/16	STEEL JO-BOLT	.65	31	425	547*	2620	> 2620	1413
21	3/16	CKL 100V	.65	-223	81	304*	870	930	> 870
22	"	"	.80	-526	-223	302*			
23	"	"	"	-822	-525	297*			
25	"	"	"	-171	188	359			
26	"	"	"	-511	-171	340			
27	"	"	"	-841	-511	330			
29	"	"	"	-403	-109	294			
30	"	"	"	-679	-403	276			
31	"	"	"	-936	-679	257			
33	"	"	"	-504	-249	255			
34	3/16	CKL 100V	.80	-713	-504	209	870	930	> 870

* SEE FIG. K- FOR SLIGHTLY HIGHER LOADS AT THESE

ϕ LOWEST VALUE FOR EITHER END, OR AFT PANEL

$\neq \sigma_{ULT} = 57,200$ PSI

$t_{SKIN} = .148$" (MIN.), $t_{STR} = .100$" (MIN.) ϕ R_o FOR

K-203

FORM 1544

IGER-TO-SKIN ATTACHMENTS

15-16, CASE 8.3a, T = 250°F

SKIN — 75S-T6 ALC., STRINGER — 75S-T6 EXT.

2	3	4	5	6	7	8	9	10	11	12	13	14	15	16
HMENTS TYPE	PITCH	SHEAR FLOW f_{FWD}	f_{AFT}	f_{STR} (4)-(5)	P_{ALL} SHEAR	P_{ALL} BT SKIN	P_{ALL} BT STR	P_{ALL} SHEAR (7)(8)OR(9) / (3)	R_S (6)/(10)	P_{ALL} TENS. SKIN	P_{ALL} TENS. STR.	P_{ALL} TENS. (12) OR (13) / (3)	M.S. NO BUCKL. ULT. P_{GK-227} / ϕ	M.S. NO FAIL. ULT. P_{GK-229}
AN426AD	.75	-631	-368	263	775	830	> 775	1030	.256	835	935	1180	.12	
"	"	-268	-89	279					.271				-.04	.46
"	"	-873	-624	249					.242				.15	
"	"	-624	-360	264					.256				.12	
"	"	-360	-86	274					.266				.12	
"	"	-759	-451	308					.299				.01	
"	"	-451	-132	319					.310				-.02	
"	"	-132	201	339					.329				-.02	
"	"	-961	-664	297*					*.400				-.02	
"	"	-664	-355	309*					*.400				.05	
AN426AD	.75	-355	-37	318*	775	830	> 775	1030	*.334	835	935	1180	.04	
STEEL JO-BOLT	.80	-37	344	381*	2620	> 2620	1410	1760	*.234				.04	
STEEL JO-BOLT CKL 100V	.65	31	423	547*	2620	> 2620	1419	2170	*.190					
CKL 100V	.65	-223	81	304*	870	930	> 870	1340	*.256					
"	.80	-626	-223	302*				1090	*.373					
"	"	-822	-525	297*					*.378					
"	"	-171	188	359					.330					
"	"	-511	-171	340					.312					
"	"	-841	-511	330					.303					
"	"	-403	-109	294					.270					
"	"	-679	-403	276					.254					
"	"	-936	-679	257					.236					
"	"	-504	-249	255					.234					
CKL 100V	.80	-713	-504	209	870	930	> 870	1090	.192					

FOR SLIGHTLY HIGHER LOADS DUE TO SHEAR LAG

DE FOR EITHER FWD. OR AFT PANEL

0075C

4.) T_{STR} = .100" (MIN.)

Ⓓ R_S FOR THESE PANELS ASSUMED EQUAL

AVRO AIRCRAFT LIMITED

MALTON, ONTARIO
ENGINEERING DIVISION

AIRCRAFT - - C105
WEIGHT - -
C. G. POSITION -

REPORT NO. -
SHEET - -
DATE - - 5-25-56
PREPARED BY - R. GAVALIS

17	18	19	20	21	22	23	24	25	26	27	28	29
												M.S.
												$\frac{1}{(11)+(19)}-1$
												2.90
.08	187	.156										1.34
												3.14
												2.90
												2.76
												2.34
												1.14
												1.06
												.80
												1.50
												1.99
												3.27
												4.26
												2.90
												1.64
												1.64
												2.03
												2.21
												2.30
												2.70
												2.94
												3.25
												3.27
												4.21
TO	RE	FOR	PANEL									

STR
NO

AVRO AIRCRAFT LIMITED
MALTON ONTARIO
TECHNICAL DEPARTMENT

REPORT No.
SHEET No.

AIRCRAFT		PREPARED BY	DATE
C105	OUTER WING	R. GAVALIS	5-28-56
		CHECKED BY	DATE

STRINGER-TO-SKIN ATTACHMENTS

RIB BAY 15-16 (CONT'D) SHEAR LAG OF STRS 14, 15, 16 & 17

STRINGERS 14, 15, 16 & 17 END AT RIB 15. THEREFORE THE SHEAR FLOW CALCULATED IN THE SECTION 'J' ANALYSIS, AND USED TO CHECK THE OTHER STRINGER ATTACHMENTS, IS ONLY PART OF THE ATTACHMENT LOADS FOR THE ABOVE MENTIONED STRINGERS. A DIFFERENTIAL LOAD DUE TO THE LAGGING OUT OF THE STRINGER AXIAL LOAD EXISTS. BELOW IS A CALCULATION OF THIS DIFFERENTIAL LOAD.

$$X' = \frac{\pi X}{2b}\sqrt{\frac{Gt}{E_x t_e}}$$ (REF. GLAUERT #1585 SHEAR LAG INFO)

WHERE,

X = LONGITUDINAL DISTANCE FROM END OF STRINGER

b = HALF WIDTH OF SKIN BETWEEN R/S 3, & R/S A

t = SKIN THICKNESS

t_e = AVERAGE CROSS SECTIONAL AREA PER INCH OF WIDTH, OF SKIN PLUS LONGITUDINAL STIFFENERS.

E_x = MODULUS OF ELASTICITY OF SKIN-STRINGER COMBINATION IN THE LONGITUDINAL DIRECTION

AVRO AIRCRAFT LIMITED
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STRINGER-TO-SKIN ATTACHMENTS

RIB BAY 15-16 (CONT'D)

G = MODULUS OF RIGIDITY OF SKIN

$b = \frac{5.4+4.7+5.1+5.3+2.5}{2} = 11.6"$, $t = .133"$

$t_c = .207"$, $E_1 = 9.7 \times 10^6$ psi, $G = 3.1 \times 10^6$ psi

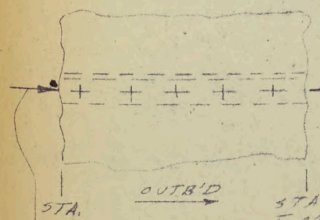
$X' = \frac{\pi X}{2(11.6)} \sqrt{\frac{.133(3.1\times10^6)}{.207(9.7\times10^6)}} = .0723 X$

$X_{IN.}$	X'_{IN}	$\Delta L_{IN.}$	σ_L/σ_S STR. 14	STR. 15	STR 16	STR 17.	$\Delta P/L$ STR. 14	STR. 15	STR. 16	STR. 17
	Y/b		.535	.112	.328	.734				
3.0	.217	2.0	.20	.16	.17	.40				
5.0	.361	2.5	.32	.27	.27	.52	#.060	.060	.050	.060
7.5	.542	2.5	.46	.34	.38	.67	.056	.028	.044	.060
10.0	.723	5.0	.56	.44	.48	.74	.040	.040	.040	.028
15.0	1.083		.70	.59	.63	.84	.028	.030	.030	.020

(REF. GLAUERT #1585, FIG. 10)

EXAMPLE: $\Delta P/L = \frac{.32(\sigma_L/\sigma_S) - .20(\sigma_L/\sigma_S)}{2.0} = .060\ \sigma_S/E$

FOR STRINGER #14 (EXAMPLE)



$\frac{\Delta P}{L} = \frac{(.32-.20)\sigma_S A_{STR}}{5.0-3.0} = \Delta\gamma_{14}$

$\Delta\gamma_{14} = \frac{(.32-.20)(35000^*)(.196^\phi)}{5.0-3.0} = 411\ \#/IN$

ALSO

$\Delta\gamma_{14} = -\Delta\gamma_{23}$

ϕ $A_{STR} = .196\ IN^2$

$^*\sigma_{S_{AVG}} = 35000$ psi (REF. PGS K-134 & K-195)

FORM 1154

AVRO AIRCRAFT LIMITED
MALTON - ONTARIO
TECHNICAL DEPARTMENT

REPORT No.
SHEET No.

AIRCRAFT:		PREPARED BY	DATE
C105	OUTER WING	R. GAVALIS	5-28-56
		CHECKED BY	DATE

STRINGER-TO-SKIN ATTACHMENTS
RIB BAY 15-16 (CONT'D)
SHEAR LAG OF STRS. 14, 15, 16 & 17

$\Delta q_{15} = .06(35000)(.196) = 411\ \#/in = -\Delta q_{22}$

$\Delta q_{16} = .05(35000)(.196) = 344\ \#/in = -\Delta q_{21}$

$\Delta q_{17} = .66(35000)(.196) = 411\ \#/in = -\Delta q_{20}$

A COMPARISON OF THE ABOVE SHEAR FLOWS WITH THOSE GIVEN IN COL. 6 OF RS K-243 SHOWS THAT THE ABOVE VALUES ARE SLIGHTLY MORE CRITICAL & SHALL BE USED FOR STRS. 14, 15, 16 & 17 ON THE UPPER SURFACE & STRS. 20, 21, 22 & 23 OF THE LOWER SURFACE.

$R_{S_{14}} = \frac{411}{1030} = .400$, $R_{S_{15}} = \frac{411}{1030} = .400$

$R_{S_{16}} = \frac{344}{1030} = .334$, $R_{S_{17}} = \frac{411}{1760} = .234$

$R_{S_{20}} = \frac{411}{2170} = .190$, $R_{S_{21}} = \frac{344}{1340} = .256$

$R_{S_{22}} = \frac{411}{1090} = .378$, $R_{S_{23}} = \frac{411}{1090} = .378$

(REF. RS K-243)

FORM 1394