

QCX
Avro
CF105
R-7-0564-31
ANALYSIS



TECHNICAL REPORT



A. V. ROE CANADA LIMITED
MALTON - ONTARIO

TECHNICAL DEPARTMENT (Aircraft)

J. Shriverton

ANALYZED

AIRCRAFT: *C105*

REPORT NO. *7-0564-31*

FILE NO.

~~CONFIDENTIAL~~

TITLE:

OUTER WING

NO. OF SHEETS

Classification cancelled / Changed to *UNCLASS*

By authority of *AVRS*

Date *30 Sept 96*

Signature *DD Selly*

Unit / Rank / Appointment *AVRS*

SKIN PANELS - MAIN BOX

DETAIL STRESSING

(INCLUDING ATTACHMENT OF SKIN TO STRES)

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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

15865867



AVRO AIRCRAFT LIMITED
MALTON - ONTARIO

TECHNICAL DEPARTMENT

REPORT NO. _____

SHEET NO. _____

PREPARED BY

DATE

R. CAVALIS

CHECKED BY

DATE

AIRCRAFT:

C105

OUTER WING

SKIN PANELS

TABLE OF SYMBOLS

- b - PANEL WIDTH
 a - PANEL LENGTH
 t - PANEL THICKNESS
 t_u - UPRIGHT THICKNESS
 t_f - FLANGE THICKNESS
 d_u - DISTANCE BETWEEN UPRIGHTS
 d_f - DISTANCE BETWEEN FLANGES
 R_1, R_2, R' - RESTRAINT COEFFICIENTS
 F_{bu} - INITIAL BUCKLING STRESS IN COMPRESSION
 F_s - INITIAL BUCKLING STRESS IN
SHEAR FOR $R' = 1.57$
 F_{bu} - INITIAL BUCKLING STRESS IN SHEAR
FOR PARTICULAR R'
 f_c - COMPRESSIVE STRESS IN PANEL
 f_s - SHEAR FLOW IN PANEL
 S_s - SHEAR STRESS IN PANEL
 R_c - STRESS RATIO IN COMPRESSION
 R_s - STRESS RATIO IN SHEAR

SYMBOLS USED IN ULTIMATE CHECK
OF PANELS ARE GIVEN IN NACA 2661

SKIN PANELS (UPPER)

BUCKLING OF PANELS

CASE 2.30

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

TEMP = 171°F MAT'L: 755-TL ALZ.

	1	2	3	4	5	6	7	8	9	10	11
PANEL ↓	b	t _w	a	a/b	0/t _w	F _{cu}	F _c	R _c	t _f	t _f /t _w	t _f
REF. →				③/①	①/②	FIG. 47 TENSION FIELD THEORY B K-40 OFL B; B K-49		⑦/⑥		⑨/②	
2 H/S	3.0	.157	16.5	71	19.1	51,800	4720	.091	.100	.637	.11
3	4.0				25.4	48,100	5330	.111			
4 W/S	4.9				31.2	46,600	5370	.132			
5	2.4				15.3	55,700	5580	.106			
6	3.3				21.0	51,100	6070	.119			
7	3.5				22.2	50,400	6310	.125			
8 9/5 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	6710	.144			
11	4.2				26.8	46,600	7070	.152			
12 9/5 A	4.9	.157	16.5	71	28.0	45,300	6740	.147	.100	.637	.11
* R' CURVE HAS BEEN MODIFIED. NOW R' = .70 FOR R = .385											
* $R = R_h + \frac{1}{2} (R_d - R_h) \left(\frac{d_c}{h_c} \right)$ (REF B 1 OF TENSION FIELD THEORY)											

FORM 1544

K-200

PAVANE

18-19 (STA. "G")

71°F MAT'L: 755-T6 ALZ.

(ULTIMATE LOADS)

	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18
	a/b	$0/t_w$	F_{cr}	f_c	R_c	t_f	t_f/t_w	t_{fl}	t_{fl}/t_w	h_c	J_c	d_o/t_w	h_o/t_w	$(\frac{d}{a})^2$ OR $(\frac{h}{a})^2$	R
	(3)/(1)	(1)/(2)	FIG. 47 TENSION FIELD THEORY	FIG. 48 DCL B, FIG. 49 B K-49	(7)/(6)		(9)/(2)		(11)/(2)			(14)/(2)	(13)/(2)	(4)/(3)	FIG. NAF 200
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	46,600	5370	.132						4.9	31.2		.0261	
		15.3	52,700	5530	.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	
		26.3	46,600	7070	.152						4.2	26.3		.0164	
5	>1	28.0	45,300	6740	.147	.100	.637	.110	.700	16.5	4.4	28.0	105.0	.0187	.31
MODIFIED. NOW $R' = .70$ FOR $R = .385$ 3 (REF B, 1 OF TENSION FIELD THEORY) X = $\frac{\text{BUCKLING LOADS}}{\text{REF. BD. LOADS}}$ — / USING FIG. 50 AS INT.															

MALTON, ONTARIO
ENGINEERING DIVISION

REPORT NO.

SHEET

DATE _____

PREPARED BY

AIRCRAFT

WEIGHT

C. G. POSITION

O. R. L.

SKIN PANELS (UPPER)

BUCKLING OF PANELS

CASES

9.3a & 15.1a

RIB BAY 18-19

(STA. "G")

(ULTIMATE LOADS)

TEMP. = 250°F

MAT'L: 755-T ALCL.

A. V. ROE CA
MALTO
TECHNICAL

AIRCRAFT

WEIGHT

C. G. POSITION

	1	2	3	4	5	6	7	8	9	10	11	12
PANEL	b/E	F_{CCW}	F_C	R_C	F_S	F_{SCW}	F_S	R_S	R	n		
REF. →	5	K-200	FIG. 47	#	3/2	FIG. 40	21 x 5	K-51	7/157	3/6	INTERACTION CURVE	*
2	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	13.2	243	1.55	.085	9.8	6.6	.5
4	31.2	34.8	26.2	.752	25.9	16.3	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	41.3	29.6	.710	21.7	17.3	420	2.68	.139	1.6	7.3	.5
7	22.2	41.3	30.3	.746	29.2	19.0	142	.91	.049	10.0	7.5	.6
8	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	28.0	37.3	32.8	.863	27.0	17.6	488	3.11	.177	9.7	8.9	.7
Δ FOR PANEL 11, X = +.14 } USING INTERACTION CURVE (TEST DATA)												
FOR PANEL 12 X = +.07 } GIVEN ON P ₃ K-199a												
* $R_C = \frac{M_{15.1a}}{M_{9.3a}} (R_{C_{9.3a}}) = \frac{1.580}{2.235} \times \textcircled{4}$ (REF. P ₃ K-50 & 50a)												
# $F_C = \frac{M_{9.3a}}{M_{15.1a}} (F_{C_{15.1a}}) = \frac{2.235}{.470} \times \textcircled{7}$ K-200 (REF. P ₃ K-48 & 50) USING												

TECHNICAL DEPT. (AIRFRAME)

SHEET - -

DATE . . . 10-23-55

PREPARED BY - R. GAVALIS

AIRCRAFT . . . C 705

WEIGHT _____

C. G. POSITION _____

7	8	9	10	11	12	13	14	15	16	17	18	19
CASE 15.1a											9.3a	15.1a
f_s	f_s	R_s	R	R	R_c	f_s	R_s	R	R			
K-51	7/1.57	8/8	INTERACTION CURVE			*	K-51	13x9/7	INTERACTION CURVE		10/11-1	15/12-1
505	3.22	.162	9.4	5.7	.445	673	.216	9.2	5.0		.66	.84
43	1.55	.085	9.8	6.6	.540	873	.315	9.1	6.3		.48	.44
42	.127	.016	10.0	7.6	.618	1090	.415	9.1	7.5		.31	.21
673	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	.049	10.0	7.5	.615	1130	.370	9.1	7.4		.33	.23
57	1.00	.057	10.0	8.1	.665	1407	.510	9.0	8.4		.23	.07
20	3.96	.202	9.5	7.8	.611	912	.298	9.3	6.7		.22	.35
77	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	.01
88	3.11	.177	9.7	8.9	.714	1754	.636	8.9	9.7		.09	.08
THIN CURVE (TEST DATA) θ $X = \frac{\text{BUCKLING LOADS}}{\text{APPLIED LOADS}}$ -1, $X < 0$ INDICATES THAT PANEL BUCKLES BELOW ULTIMATE USING FIG. 50 AS INTERACTION CURVE												

PANELS (UPPER)

OF PANELS

AY 19-20
(STA. "F")

3-TL ALC. SKIN

(ULTIMATE LOADS)

3	4	5	6	7	8	9	10	11	12	13	14	15	16	17
F_{cu}		$(d_c/h_c)^3$	R	R	F_s x10 ⁻³	F_{cu}	f_c	R_c	ρ_s	f_s	R_s	$R_{n.s.}$	ρ_n	F_{cu} x10 ⁻³
FIG. 47		$(\frac{1}{14.75})^3$	*	FIG. 43	FIG. 39	7 x ⑧	COL. 8 R _s = 26 R _k = 35	⑩/③	P _g K-35	⑫/⑬	⑬/⑭	INTERACTION CURVES		FIG. 41
52.0		.0061	.420	.70	37.0	25.9	3.45	.067	1672	11.2	.433	9.6	9.4	43.0
49.3		.0158	.419		34.0	23.3	3.75	.082	1658	11.1	.465	9.5	9.3	40.0
41.6		.0303	.419		31.8	22.2	3.94	.095	1495	10.0	.450	9.4	9.7	35.5
53.0		.0029	.420		37.3	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	42.2
50.8		.0102	.420		35.5	24.8	4.59	.090	1962	13.1	.529	9.5	5.5	41.6
46.9		.0179	.419		33.0	23.1	4.47	.098	1832	12.2	.523	9.5	5.5	39.8
52.3		.0055	.420		37.3	26.1	4.60	.088	2231	14.9	.571	9.5	5.9	43.3
49.8		.0153	.419		34.0	23.3	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
$\left(\frac{d_c}{h_c}\right)^3 \neq f_c = \frac{M_{+32}}{M_{+32}} \left(\frac{f}{C_{+32}}\right) = \frac{1.64}{.250} \times ⑩ \text{ (REF. } P_s \text{ K-33 \& 34)}$														
(FIG. 43) NOW GIVES A VALUE OF .74 Φ $X = +14$ USING INTERACTION														
$\frac{F_{cu}}{F_{cu}} = \frac{.110}{.150} = .734, \frac{F_s}{F_s} = \frac{.190}{.150} = .466, R_s = .345, R_n = .420$														
Φ USING FIG. 126														

AVRO AIRCRAFT LIMITED

MALTON, ONTARIO
ENGINEERING DIVISION

REPORT NO. _____

SHEET _____

DATE 10-31-55

AIRCRAFT C 105

WEIGHT _____

C. G. POSITION _____

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_{LW} $\times 10^{-3}$	f_c	R_c	F_3	F_{SW}	q_s	R_s	R_c	q_s	R_s	$M.S.$	$M.S.$	$M.S.$
	FIG. 41	#	$\frac{R}{L}$	FIG. 40	$\frac{R}{L}$	$\frac{R}{L}$	$\frac{R}{L}$	$\frac{R}{L}$	$\frac{R}{L}$	$\frac{R}{L}$	$\frac{R}{L}$	$\frac{R}{L}$	$\frac{R}{L}$
4	43.0	22.3	.537	31.0	21.7	333	.102	.450	722	.222	1.18	.78	.80
3	40.0	26.1	.583	28.2	19.7	301	.102	.553	746	.252	.98	.47	.51
7	35.5	25.8	.628	26.2	18.3	275	.035	.616	1036	.382	1.00	.36	.24
6	44.5	26.8	.602	33.0	23.1	523	.151	.510	836	.242	.71	.53	.61
6	43.2	27.3	.606	30.3	21.2	350	.113	.590	957	.302	.71	.37	.37
5	41.6	30.1	.729	29.6	20.8	64	.021	.613	1172	.386	.73	.37	.25
5	38.8	29.4	.581	27.7	19.2	250	.087	.643	1403	.489	.73	.28	.10
9	43.3	30.2	.678	31.4	22.0	556	.169	.591	852	.258	.61	.33	.43
1	40.0	32.6	.911	28.2	19.7	203	.069	.690	1111	.378	.55	.21	.15
7	39.6	43.0	.335	28.0	19.6	171	.058	.708	1386	.470	.65	.18	.06
3	37.2	31.2	.796	27.7	19.4	570	.196	.675	1678	.576	.77	.17	.01
$PR = \frac{M_{15.1a}}{M_{8.3a}} (R_{c,3a}) = \frac{1.39}{1.69} \times (9) \quad (\text{REF. } P_{35} \text{ K-34 \& 34a})$													
THE CURVE (TEST DATA) GIVEN ON P. K-1792													
AND FIG. 50 AS INTERACTION CURVE													

SKIN PANELS (UPPER)

BUCKLING OF PANELS

RIB BAY 20-21
(STA. E')

MAT'L: 755-T6 ALCL. SKIN

	1	2	3	4	5	6	7	8	9	10	11
PANELS ↓	0	b/t	F_{cu}	a/b	$\bar{r}$	R'	$F_{b,3}$	$F_{b,2}$	$F_{b,1}$	R_c	P_s
REF. →		①/143	FIG. 47	14.3 ①	*	FIG. 43	FIG. 37	⑥X⑦	②X③	④X⑤	FIG. 18
2 (W/L)	5.7	39.8	25.8	2.7	.461	.74	28.7	21.2	13.1	.057	1164
3 (W/L)	4.2	29.4	43.5	3.6		.77	32.1	24.1	15.9	.060	1855
5	4.5	31.5	39.9	3.4		.76	31.2	23.7	13.1	.071	2164
7	2.8	19.6	51.5	5.5		.78	36.2	24.2	24.6	.053	2050
8 (CASE)	3.2	22.4	50.2	4.8		.77	35.0	27.0	24.9	.054	1700
9	5.3	37.1	29.5	2.9		.74	29.0	21.4	13.0	.066	3111
11	3.5	24.5	48.8	4.4		.77	34.0	26.2	22.4	.067	1921
12 (CASE)	3.4	23.8	49.3	4.5	.459	.77	34.2	26.4	3.15	.069	1734
$\neq f_{b,2a} = \frac{M_{2,2a}}{M_{2,2a}} (f_{b,2a}) = \frac{1.14 \times 10^6}{137,000} \times ⑨ = (\text{REF. } P_{5K-17 \times 172})$											
$* R = R_h + \frac{1}{2} (R_l - R_h) \left(\frac{b}{h} \right)^3 = .458 \text{ TO } .466 \text{ USE } .459 (\text{AVE})$											
$t_w = .143", t_{2a} = .110", \frac{t_{2a}}{t_w} = \frac{.110}{.143} = .770, t_{2b} = .100", \frac{t_{2b}}{t_w} = \frac{.100}{.143} = .70$											

$$X = \frac{\text{ROLLING LOADS}}{\text{RAILED LOADS}}$$

MALTON, ONTARIO
ENGINEERING DIVISION

SHEET . . .

DATE . . . 11-2-55

PREPARED BY . R. GAVAZIS

AIRCRAFT - - C-105

WEIGHT

C. G. POSITION

O. R. L.

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

753-76 ALC. SKIN

ULTIMATE LOADS)

2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	
CASE 3.3a															
b/c	a/b	R	R'	F _{cr}	F _c	R _c	F _s	F _{sa}	γ _s	F _s	R _s	R _n	N _n	F _{cr}	
①/136	15.3/①	*	FIG. 43	FIG. 47	COL. 1, 2, 3, 4, 5, 6, 7, 8, 9, 10, 11, 12, 13, 14, 15, 16, 17, 18, 19, 20, 21, 22, 23, 24, 25, 26, 27, 28, 29, 30, 31, 32, 33, 34, 35, 36, 37, 38, 39, 40, 41, 42, 43, 44, 45, 46, 47, 48, 49, 50, 51, 52, 53, 54, 55, 56, 57, 58, 59, 60, 61, 62, 63, 64, 65, 66, 67, 68, 69, 70, 71, 72, 73, 74, 75, 76, 77, 78, 79, 80, 81, 82, 83, 84, 85, 86, 87, 88, 89, 90, 91, 92, 93, 94, 95, 96, 97, 98, 99, 100, 101, 102, 103, 104, 105, 106, 107, 108, 109, 110, 111, 112, 113, 114, 115, 116, 117, 118, 119, 120, 121, 122, 123, 124, 125, 126, 127, 128, 129, 130, 131, 132, 133, 134, 135, 136, 137, 138, 139, 140, 141, 142, 143, 144, 145, 146, 147, 148, 149, 150, 151, 152, 153, 154, 155, 156, 157, 158, 159, 160, 161, 162, 163, 164, 165, 166, 167, 168, 169, 170, 171, 172, 173, 174, 175, 176, 177, 178, 179, 180, 181, 182, 183, 184, 185, 186, 187, 188, 189, 190, 191, 192, 193, 194, 195, 196, 197, 198, 199, 200, 201, 202, 203, 204, 205, 206, 207, 208, 209, 210, 211, 212, 213, 214, 215, 216, 217, 218, 219, 220, 221, 222, 223, 224, 225, 226, 227, 228, 229, 230, 231, 232, 233, 234, 235, 236, 237, 238, 239, 240, 241, 242, 243, 244, 245, 246, 247, 248, 249, 250, 251, 252, 253, 254, 255, 256, 257, 258, 259, 260, 261, 262, 263, 264, 265, 266, 267, 268, 269, 270, 271, 272, 273, 274, 275, 276, 277, 278, 279, 280, 281, 282, 283, 284, 285, 286, 287, 288, 289, 290, 291, 292, 293, 294, 295, 296, 297, 298, 299, 300, 301, 302, 303, 304, 305, 306, 307, 308, 309, 310, 311, 312, 313, 314, 315, 316, 317, 318, 319, 320, 321, 322, 323, 324, 325, 326, 327, 328, 329, 330, 331, 332, 333, 334, 335, 336, 337, 338, 339, 340, 341, 342, 343, 344, 345, 346, 347, 348, 349, 350, 351, 352, 353, 354, 355, 356, 357, 358, 359, 360, 361, 362, 363, 364, 365, 366, 367, 368, 369, 370, 371, 372, 373, 374, 375, 376, 377, 378, 379, 380, 381, 382, 383, 384, 385, 386, 387, 388, 389, 390, 391, 392, 393, 394, 395, 396, 397, 398, 399, 400, 401, 402, 403, 404, 405, 406, 407, 408, 409, 410, 411, 412, 413, 414, 415, 416, 417, 418, 419, 420, 421, 422, 423, 424, 425, 426, 427, 428, 429, 430, 431, 432, 433, 434, 435, 436, 437, 438, 439, 440, 441, 442, 443, 444, 445, 446, 447, 448, 449, 450, 451, 452, 453, 454, 455, 456, 457, 458, 459, 460, 461, 462, 463, 464, 465, 466, 467, 468, 469, 470, 471, 472, 473, 474, 475, 476, 477, 478, 479, 480, 481, 482, 483, 484, 485, 486, 487, 488, 489, 490, 491, 492, 493, 494, 495, 496, 497, 498, 499, 500, 501, 502, 503, 504, 505, 506, 507, 508, 509, 510, 511, 512, 513, 514, 515, 516, 517, 518, 519, 520, 521, 522, 523, 524, 525, 526, 527, 528, 529, 530, 531, 532, 533, 534, 535, 536, 537, 538, 539, 540, 541, 542, 543, 544, 545, 546, 547, 548, 549, 550, 551, 552, 553, 554, 555, 556, 557, 558, 559, 560, 561, 562, 563, 564, 565, 566, 567, 568, 569, 570, 571, 572, 573, 574, 575, 576, 577, 578, 579, 580, 581, 582, 583, 584, 585, 586, 587, 588, 589, 590, 591, 592, 593, 594, 595, 596, 597, 598, 599, 600, 601, 602, 603, 604, 605, 606, 607, 608, 609, 610, 611, 612, 613, 614, 615, 616, 617, 618, 619, 620, 621, 622, 623, 624, 625, 626, 627, 628, 629, 630, 631, 632, 633, 634, 635, 636, 637, 638, 639, 640, 641, 642, 643, 644, 645, 646, 647, 648, 649, 650, 651, 652, 653, 654, 655, 656, 657, 658, 659, 660, 661, 662, 663, 664, 665, 666, 667, 668, 669, 670, 671, 672, 673, 674, 675, 676, 677, 678, 679, 680, 681, 682, 683, 684, 685, 686, 687, 688, 689, 690, 691, 692, 693, 694, 695, 696, 697, 698, 699, 700, 701, 702, 703, 704, 705, 706, 707, 708, 709, 710, 711, 712, 713, 714, 715, 716, 717, 718, 719, 720, 721, 722, 723, 724, 725, 726, 727, 728, 729, 730, 731, 732, 733, 734, 735, 736, 737, 738, 739, 740, 741, 742, 743, 744, 745, 746, 747, 748, 749, 750, 751, 752, 753, 754, 755, 756, 757, 758, 759, 760, 761, 762, 763, 764, 765, 766, 767, 768, 769, 770, 771, 772, 773, 774, 775, 776, 777, 778, 779, 780, 781, 782, 783, 784, 785, 786, 787, 788, 789, 790, 791, 792, 793, 794, 795, 796, 797, 798, 799, 800, 801, 802, 803, 804, 805, 806, 807, 808, 809, 810, 811, 812, 813, 814, 815, 816, 817, 818, 819, 820, 821, 822, 823, 824, 825, 826, 827, 828, 829, 830, 831, 832, 833, 834, 835, 836, 837, 838, 839, 840, 841, 842, 843, 844, 845, 846, 847, 848, 849, 850, 851, 852, 853, 854, 855, 856, 857, 858, 859, 860, 861, 862, 863, 864, 865, 866, 867, 868, 869, 870, 871, 872, 873, 874, 875, 876, 877, 878, 879, 880, 881, 882, 883, 884, 885, 886, 887, 888, 889, 890, 891, 892, 893, 894, 895, 896, 897, 898, 899, 900, 901, 902, 903, 904, 905, 906, 907, 908, 909, 910, 911, 912, 913, 914, 915, 916, 917, 918, 919, 920, 921, 922, 923, 924, 925, 926, 927, 928, 929, 930, 931, 932, 933, 934, 935, 936, 937, 938, 939, 940, 941, 942, 943, 944, 945, 946, 947, 948, 949, 950, 951, 952, 953, 954, 955, 956, 957, 958, 959, 960, 961, 962, 963, 964, 965, 966, 967, 968, 969, 970, 971, 972, 973, 974, 975, 976, 977, 978, 979, 980, 981, 982, 983, 984, 985, 986, 987, 988, 989, 990, 991, 992, 993, 994, 995, 996, 997, 998, 999, 1000	FIG. 47a									
34.6	3.3	.351	.67	33.8	.500	.015	30.0	20.1	1628	12.0	.598			26.0	
30.9	3.6		.68	41.0	.594	.015	31.5	21.4	1630	12.0	.561	INTERACTION SURVEY		31.0	
26.6	4.3		.69	47.0	.660	.014	33.2	22.9	1730	12.7	.555			35.7	
16.6	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	1552	13.5	.635			31.0	
47.0	2.4		.62	19.7	.804	.045	26.5	16.4	1805	13.3	.812		N	R _c	17.2
37.7	2.8	.351	.66	25.9	.790	.131	28.4	18.8	1344	7.9	.626			21.5	

MALTON, ONTARIO
ENGINEERING DIVISION

SHEET . . .

DATE . . . 11-2-55

PREPARED BY . R. GAVALIS

AIRCRAFT . . . C 165

WEIGHT _____

C. G. POSITION : _____

PANEL 4 ↓ 2

A. V. ROE CANADA LIMITED
MALTON - ONTARIO

TECHNICAL DEPARTMENT (Aircraft)

AIRCRAFT:

C 105

OUTER
WING

REPORT No.

SHEET No.

PREPARED BY

DATE

R. CAVALIS

11-3-55

CHECKED BY

DATE

SKIN SHEARS - RIB BAY 21-32

FAILING STRENGTH - PANEL # 7

USING TENSION FIELD THEORY,

$$b = 6.2", t = .136", A_u = [1.0 + 12(1.091)] \cdot .091 = .190$$

$$C_u = .3064, .068 = .374", I_u = .336, I_{u'} = .0216 \text{ in}^4$$

$$A_{ue} = \frac{.190}{\sqrt{1 + \left(\frac{.374}{.336}\right)^2}} = .085 \text{ in}^2$$

$$E_u = 13,900 \text{ psi}, E = 22,500 \text{ psi}$$

$$\frac{E}{E_u} = \frac{22500}{13900} = 1.62, K = .1043$$

$$\frac{A_{ue}}{dt} = \frac{.085}{6.2(.136)} = .1000, \frac{\sigma_{tu}}{E} = .18$$

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

$$E'_{MAX} = E(1 + K^2 C_1)(1 + K C_2) = 22500 \left[\frac{1 + (.1043)^2 (.001)}{1 + .1043(.10)} \right]$$

$$E'_{MAX} = 22,300 \text{ psi}$$

$$\sigma_{tu} = 22,500(.18) = 4050 \text{ psi}, \frac{d}{h} = \frac{6.2}{15.5} = .405$$

$$\sigma_{tu \max} / \sigma_{tu} = 1.47, \sigma_{tu \max} = 1.47(4050) = 5950 \text{ psi}$$

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

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

$$P_u = A_{ue} \sigma_{tu} = .085(4050) = 344 \text{ #}$$

$$E_{ALL} = 23,200 \text{ psi}$$

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

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

REPORT NO. _____

SHEET NO. _____

AIRCRAFT:

C 105

OUTER
WING

PREPARED BY

DATE

R. GAVAZIS

11-8-55

CHECKED BY

DATE

SKIN SHEARS

RIB BAY 21-22

FAILING STRENGTH - PANEL # 13

ULTIMATE SHEAR STRENGTH:

$$b = 5.4", t = .136", A_{wc} = .085, E_u = 15,800 \text{ psc}$$

$$E = 21,000 \text{ psc}, \frac{E}{E_u} = \frac{21000}{15800} = 1.33$$

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

$$\frac{\sigma_u}{E} = .10, \sigma_u = .10(21000) = 2100 \text{ psc}$$

$$\frac{d}{h} = \frac{5.4}{15.3} = .352, \frac{\sigma_{u \max}}{\sigma_u} = 1.52$$

$$\sigma_{u \max} = 1.52(2100) = 3200 \text{ psc}$$

$$\sigma_o = 23.4(.0615) \left(\frac{.091}{.136} \right)^{\frac{1}{2}} = 3200 \text{ psc}$$

$$\frac{\sigma_o}{\sigma_{u \max}} = 23,800 \text{ psc}$$

$$\frac{\sigma_o}{\sigma_{u \max}} = \frac{3200}{3200} = 1.00, \frac{\sigma_{u \max}}{\sigma_o} = 21,000 \text{ psc}$$

ULTIMATE COMPRESSIVE STRENGTH:

$$F_{u \text{ INTER.}} = 34,000 \text{ psc (REF. B. K-206)}$$

$$F_{u \text{ PANEL}} = 21,500 \text{ psc}, \frac{\sigma_u}{\sigma} = \frac{21500}{34000} = .633$$

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

CASE 9.3a

ELE.	A.T.R.	A _{STICK}	A _{STRUT}	A _{STRUT}	F _C (NOMINAL)	F _C (SUCKER)
13	.286	.650	.936	1.150	28400	35000
18	.705	.316	1.021	1.090	26500	28200

(REF. B. K-118, 135a)

PANELS (UPPER)

LINE OF PAIR'S

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

75 5-76 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	a/b	R	R'	F_{cu}	f_c	R_c	F_s	F_{su}	F_u	f_s	R_s	R_m	A_m	F_{cu}	
①/128	15.2/①	*	FIG. 43	FIG. 47	34.5	⑦/⑥	FIG. 39	⑤x⑨	Pg. K-32	⑪/128	⑫/⑩	FIG. 50	50	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		31.8	22.8	1494	11.7	.513			32.3	
23.4	5.1		.728	47.7	1.23		32.5	25.1	1658	12.9	.514			39.0	
36.3	3.2		.702	—	—		—	—	—	—	—			29.2	
29.7	4.0		.718	39.3	1.36		31.8	22.8	1755	13.7	.401			32.3	
44.5	2.7	.396	.675	19.5	1.38		27.0	18.2	1679	13.1	.720			13.5	
PANEL IS A SMALL TRIANGULAR ONE															
43.8	2.7	.396	.677	20.0	1.33	small	27.8	18.8	1734	13.5	.718				

A. V. ROE CANADA LIMITED
MALTON, ONTARIO

TECHNICAL DEPARTMENT (Aircraft)

REPORT No. _____

SHEET No. _____

AIRCRAFT:

C 105

OUTER
WING

PREPARED BY

DATE

R. GAVALIS

11-10-55

CHECKED BY

DATE

SKIN SHEETS

RIB BAY 22-23

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

CASE B.3a						
ELE.	A _{STR}	A _{SKIN}	A _{TOTAL}	A _{TOTAL}	P _{CRITICAL}	P _{CRITICAL}
11	.116	.535	.651	.7471	24,000	29,000
13	.311	.515	.826	.9100	20,500	22,600

$$A_{SKIN} = \left[\frac{3.7 + 5.5(1.715)}{2} \right] (.128) \quad A_{SKIN} = \left[\frac{5.3(1.715) + 3.01}{2} \right] (.128)$$

$$f_c = \frac{24000 + 22600}{2} = 23,700 \text{ psi}$$

FOR CASE B.3a ;

$$R_c = \frac{23700}{34000} = .697 \quad R_s = \frac{.935}{.128(20,500)} = .337$$

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

FOR CASE 15.1W ;

$$R_c = \frac{3.600}{4.380} (.697) = .574$$

$$R_s = \frac{1.113}{.128(20,500)} = .435$$

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

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 B.3a)

PANELS (UPPER)

LINE OF PANELS

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

75S-T6 ALG. SKIN

(ULTIMATE LOADS)

2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	
CASE 2.32															
b/t	a/b	R	R'	F_{cu}	f_c	R_c	F_{cu} x 10 ⁻³	F_{cu} x 10 ⁻³	f_s	f_s	R_s	R_m	R_m	F_{cu}	
① / .165	16.5 / ①	*	FIG. 43	FIG. 47	COL. 2.5 L-55 K-66, 117	⑦ / ⑥	FIG. 37	⑤ x ⑨	B-179 COL. 1023	⑪ / .166	⑫ / ⑩	B-1992	FIG. 47	⑬ / ⑭	
19.4	5.16	.342	.675	51.6	6.47	.125	36.5	26.4	1676	10.3	.405	.269	.125	42.5	
28.4	3.51		.185	44.9	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	
45.7	6.36		.700	52.7	7.22	.137	34.3	26.8	2131	12.7	.451	.250	.137	43.5	
22.4	4.45		.690	50.3	7.76	.154	35.1	24.2	1533	12.0	.445	.270	.154	41.2	
23.6	4.23		.690	49.5	7.93	.160	34.5	23.8	1823	11.1	.466	.289	.160	40.6	
21.3	4.57		.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	2022	12.3	.535	.279	.178	38.8	
27.9	3.58		.635	45.5	8.53	.187	32.6	22.4	1518	11.0	.491	.312	.187	35.0	
28.5	3.51		.635	44.6	8.15	.183	32.5	22.3	1538	9.62	.431	.348	.183	37.5	
29.7	3.31		.680	43.0	8.26	.192	31.9	21.7	2142	13.0	.600	.276	.192	36.5	
25.4	3.73		.690	48.0	8.57	.185	33.5	23.3	1933	11.7	.503	.309	.185	37.6	
26.6	3.75		.690	47.0	8.40	.187	33.3	23.0	1711	10.4	.452	.338	.187	38.8	
34.0	2.75	.342	.670	35.0	8.43	.242	30.3	20.3	1417	8.58	.422	.435	.242	31.5	

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

$$1 - R_n \left(\frac{d}{h} \right)^3 = .342 \text{ TO } .343, \text{ USE } R = .342 (\text{AVE.})$$

$$.110", \frac{E_u}{t_w} = \frac{.110}{.165} = .667, \frac{f_c}{t_w} = \frac{.100}{.165} = .606, R_n = .343, R_d = .283$$

MALTON, ONTARIO
ENGINEERING DIVISION

SHEET

DATE _____

AIRCRAFT

WEIGHT

C. G. POSITION

PREPARED BY - R. GAVALIS

P
A
N
E
L
N
O.

$$X = \frac{\text{RUCKLING 20003} - 1}{\text{APPL ED 20003}} - 1, X \leq 0 \text{ INDICATES}$$

THAT PANEL WILL BUCKLE BELOW ULTIMATE



AVRO AIRCRAFT LIMITED

TECHNICAL DEPARTMENT (Aircraft)

REPORT NO.

SHEET NO.

AIRCRAFT

C105

OUTER
WING

PREPARED BY

R. SAVAKIS

DATE

11-23-55

CHECKED BY

DATE

SKIN PANELSRIB BAY 17-18FAILING STRENGTH - PANEL 13

ULTIMATE SHEAR STRENGTH; (CASE 3.5-2)

$$b = 4.9", t = .165", A_u = .196 \text{ in}^2, E = .597 \text{ in}$$

$$P = .189 \text{ in}, A_{ue} = \frac{A_u}{\left[1 + \left(\frac{E}{P}\right)^2\right]} = \frac{.196}{\left[1 + \left(\frac{.597}{.189}\right)^2\right]} = .080$$

$$E_{cu} = 18,000 \text{ psi (COL. 20, BK-215)}$$

$$E_{\text{ASSUME}} = 27000, P = \frac{E - E_{cu}}{E + E_{cu}} = \frac{9000}{45000} = .20$$

$$K = .434 \left(P + \frac{1}{3} P^2 \right) = .434 \left[.20 + \frac{1}{3} (.20)^2 \right] = .0875$$

$$\frac{A_{ue}}{t} = \frac{.080}{4.9(.165)} = .0971, \frac{\sigma_u}{E} = .155$$

$$\sigma_u = .155(27000) = 4190 \text{ psi}, \frac{f_u}{h} = \frac{4.9}{16.5} = .297$$

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

$$\sigma_o = 23.4 K^{\frac{2}{3}} \left(\frac{t_u}{t} \right)^{\frac{1}{3}} = 23.4 (.0875)^{\frac{2}{3}} \left(\frac{.110}{.165} \right)^{\frac{1}{3}} = 4290 \text{ psi}$$

$$\text{TRY } E = 21000 \text{ psi}$$

$$P = \frac{3000}{39000} = .077, K = .0334, \sigma_u / E = .057$$

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

$$\sigma_{u_{max}} = 1.57(1200) = 1880 \text{ psi}$$

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

$$\frac{\sigma_o}{\sigma_{u_{max}}} = \frac{2120}{1880} = 1.12, \therefore E_{ult} = 21,000 \text{ psi}$$

$$f_s = \frac{1136}{.165} = 6890 \text{ psi}, R_s = \frac{6890}{21000} = .328$$

K-216

FORM 1734

D. R. L.



AVRO AIRCRAFT LIMITED

TECHNICAL DEPARTMENT (Aircraft)

REPORT NO. 1

SHEET NO.

AIRCRAFT

C105

OUTER
WING

PREPARED BY

R. GAVALLIS

DATE

11-23-55

CHECKED BY

DATE

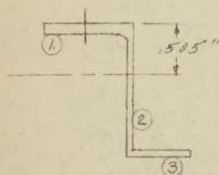
SKIN SHEARS

RIB BAY 17-18

FAILING STRENGTH - PANEL 13 (CONT'D)

ULTIMATE COMPRESSIVE STRENGTH ;

CRIPPLING STRENGTH OF Z-STIFFENER



$$A = .196 \text{ IN}^2$$

MATERIAL: 755-TL EXT.

$$I = .0469 \text{ IN}^4$$

$$T = 250^\circ\text{F}$$

$$F_u = \frac{9810}{.196} = 50,000 \text{ psi}$$

ELE.	b	t	o/l	A	F_u	P
1	.77	.116	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

$$F_{u \text{ PANEL}} = 36,500 \text{ psi (REF. COL. 16, P. K-215)}$$

$$\frac{t_w}{b} = \frac{36500}{50000} = .730, \quad \frac{b_e}{b} = .866 \quad (\text{KOITER CURVE})$$

CASE 8.3a

STRIN- GLE	A_{STR}	A_{SKIN} BUCKLED	A_{TOTAL} BUCKLED	A_{TOTAL} UNBUCKLED	$f_{c \text{ UNBUCKLED}}$	$f_{c \text{ BUCKLED}}$
13	.400	.711	1.171	1.216	31200	32300
14	.196	.649	.845	.889	35900	37700

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

$$A_{SKIN \text{ BUCKL. 13}} = \left[\frac{5.09 + .866(4.09)}{2} \right] (.165), \quad A_{SKIN \text{ BUCKL. 14}} = \left[\frac{4.08 + .866(4.33)}{2} \right] (.165)$$

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

FOR 8.3a,

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

$$M.S. = \frac{.738}{.700} - 1 = .34$$

CONSERVATIVE SINCE PANEL HAS A
DOUBLER OVER ITS OUTBOARD HALF



AVRO AIRCRAFT LIMITED

TECHNICAL DEPARTMENT (Aircraft)

REPORT NO.

SHEET NO.

AIRCRAFT

C105

OUTER
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PREPARED BY

R. GAVALIS

DATE

11-23-55

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SKIN SHEARSRIB BAY 17-18FAILING STRENGTH - PANEL 16

ULTIMATE SHEAR STRENGTH:

$$b = 5.6", t = .165", A_u = .196 \text{ in}^2, A_{uc} = .080 \text{ in}^2$$

$$F_u = 16,800 \text{ psi}, F_{u \text{ ASSUMED}} = 20,500 \text{ psi}$$

$$P = \frac{20500 - 16800}{20500 + 16800} = .0973, K = 434(.0973) = .043$$

$$A_{uc}/b t = \frac{.080}{5.6(.165)} = .075, F_u/b t = .075$$

$$\sigma_u = .075(20500) = 1540 \text{ psi}, d/b = \frac{5.6}{16.5} = .340$$

$$\sigma_{u \text{ MAX}}/b t = 1.53, \sigma_{u \text{ MAX}} = 1.53(1540) = 2360 \text{ psi}$$

$$\sigma_o = 23.4(.043)^{2/3} \left(\frac{.118}{.165} \right)^{1/3} = 2510 \text{ psi}$$

$$\sigma_{u \text{ ALL}} = 24100 \text{ psi}$$

$$\frac{\sigma_o}{\sigma_{u \text{ MAX}}} = \frac{2510}{2360} = 1.06, F_{u \text{ ALL}} = 20,500 \text{ psi}$$

ULT
PANEL
ALL.

ULTIMATE COMPRESSIVE STRENGTH:

$$F_{u \text{ PANEL}} = 31,500 \text{ psi}, F_{u \text{ ALL}} = 50,000 \text{ psi}$$

$$\sigma_u/\sigma_o = \frac{31500}{50000} = .630, b_o/b = .813 \text{ (KAITHE CURVE)}$$

CASE 5.32

STRE.	A _{SKIN}	A _{BUCKL.}	A _{TOTAL}	A _{TOTAL}	F _{u \text{ PANEL}}}	F _{u \text{ ALL}}}
16	.196	.930	1.116	1.236	36200	43100
18	1.260	1.034	2.294	2.415	32800	39600

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

1.00 - .813

$$A_{SKIN} = \left[\frac{3.54 + 0.04(8.5)}{2} \right] (.165), A_{u \text{ ALL}} = 1.155 - \frac{.162(2.0)(.165)}{2}$$

$$F_{u \text{ BUCKL. AVE}} = \left(\frac{40100 + 39600}{2} \right) = 39850 \text{ psi}$$

K-218

D.R.L.

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

[illegible]
$$t_u = .110", t_w = .173", \frac{t_u}{t_w} = \frac{.110}{.173} = .635, \frac{t_p}{t_w} = \frac{.108}{.173} = .580,$$

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AIRCRAFT

C105

OUTER
WINGSKIN PANELSRIB BAY 16-17FAILING STRENGTH - PANEL 13

ULTIMATE SHEAR STRENGTH;

$$b = 5.2", t = .173", A_u = .196 in^2, e = .591 in.$$

$$p = .489 in, A_{ue} = \frac{A_u}{\left[1 + \left(\frac{e}{p}\right)^2\right]} = \frac{.196}{\left[1 + \left(\frac{.591}{.489}\right)^2\right]} = .0795$$

$$Z_u = 17,300 psi (Vol. 20, BK-220)$$

$$Z_{ASSUMED} = 21,000 psi, p = \frac{Z - Z_u}{Z + Z_u} = \frac{3700}{38300} = .0967$$

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

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

$$\lambda/b = \frac{5.2}{16.5} = .315, \sigma_{u_{max}}/b = 1.55$$

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

$$\sigma_0 = 23.4(K)^{\frac{2}{3}} / \left(\frac{t}{b}\right)^{\frac{1}{3}} = 23.4(.042)^{\frac{2}{3}} / \left(\frac{.173}{5.2}\right)^{\frac{1}{3}} = 2430 psi$$

$$\frac{\sigma_0}{\sigma_{u_{max}}} = \frac{2430}{2280} = 1.06, Z_{ULT} = 24200 psi (REF. FIG 19.1)$$

$$\therefore Z_{ULT} = 21,000 psi$$

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

ULTIMATE COMPRESSIVE STRENGTH;

$$F_{COMPANEL} = 36,100 psi, \sigma_{u/t} = \frac{36100}{50000} = .722$$

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

K-221

FORM 1570A

D. R. L.



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SKIN SHEARSRIB BAY 16-17FAILING STRENGTH - PANEL 13 (WIND)

CASE 8.30

ELE.	ASTR.	A _{SKIN}	A _{TOTAL}	P	F ₂
13	.500	.829	1.324	44878	33000
14	.176	.680	.876	36927	42100

$$A_{SKIN} = \frac{4.35(.361) + 5.77}{2} (.173), A_{SKIN} = 4.56(.361)(.173)$$

BUCKL. 13 (REF. Pgs K-138, 141) BUCKL. 14

$$F_{BUCKLED AVE.} = \frac{33000 + 42100}{2} = 37,950 \text{ psi}$$

FOR CASE 8.30;

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

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

ULT

K-222

FORM 119A

O. R. L.



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SKIN PANELS

RIB BAY 16-17

FAILING STRENGTH - PANEL 14

ULTIMATE SHEAR STRENGTH:

$$b = 4.6; \bar{c} = .173; A_u = .196 \text{ in}^2; A_{u2} = .0795$$

$$\bar{c}_{u2} = 18,100 \text{ psi (100,200, } P_3 \text{ K-220)}$$

$$\bar{c}_{u2} = 22,000 \text{ psi, } K = .0425$$

$$\frac{A_{u2}}{A_u} = \frac{.0795}{4.6(.173)} = .120, \sigma_u/\bar{c} = .070$$

$$\sigma_u = .07(22,000) = 1540 \text{ psi, } d/b = \frac{4.6}{16.6} = .279$$

$$\sigma_{u_{max}}/\sigma_u = 1.57, \sigma_{u_{max}} = 1.57(1540) = 2420 \text{ psi}$$

$$\bar{c}_0 = 23.4(.0425)^{2/3}(.635)^{1/3} = 2450 \text{ psi}$$

$$\sigma_0/\sigma_{u_{max}} = \frac{2450}{2420} = 1.01$$

$$\therefore \bar{c}_{u2} = 22,000 \text{ psi, } f_3 = \frac{1029}{.173} = 5950 \text{ psi}$$

$$f_3 = \frac{5950}{22000} = .270$$

ULTIMATE COMPRESSIVE STRENGTH:

$$F_{c_{panel}} = 38,300 \text{ psi, } \sigma_u/\bar{c} = \frac{38300}{50000} = .776$$

$$b/\bar{c}_0 = .890 \text{ (K01EL CURVE)}$$

CASE 8.3a

ELEMENT	A _{STR}	A _{SKIN}	A _{TOTAL}	P	f _c
14	.196	.755	.951	36927	38300
16	.196	.723	.919	37019	42500
REF.				P ₃ K-172	

$$A_{u_{panel}} = \frac{(5.2+4.6)(.173)(820)}{2} = .755 \text{ in}^2, A_{u_{skin}} = \frac{(4.6+4.6)(.173)(820)}{2} = .723 \text{ in}^2$$



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SKIN PANELS

RIB BAY 16-17

FAILING STRENGTH - PANEL 14 (CONT'D)

$$f_c = \frac{38800 + 42500}{2} = 40700 \text{ psi}$$

BUCKLED
AVE

FOR CASE 8.3a

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

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

FAILING STRENGTH - PANEL 15

ULTIMATE SHEAR STRENGTH:

$$b = 4.8, t = .173, A_w = .0795 \text{ in}^2$$

$$Z_{uw} = 17,900 \text{ psi} (100,200 \text{ psi} - 220), f_{uw} = 21,500 \text{ psi}$$

$$A_w/t = \frac{.0795}{4.8(.173)} = .0957, K = .0398, \sigma_u/2 = .066$$

$$\sigma_u = .066(21500) = 1420 \text{ psi}, d/b = \frac{4.8}{16.5} = .290$$

$$\sigma_{u\max}/\sigma_u = 1.57, \sigma_{u\max} = 1.57(1420) = 2230 \text{ psi}$$

$$\sigma_o = 23.4(.0398)^{1/3}(.435)^{1/3} = 2310 \text{ psi}$$

$$\sigma_o/\sigma_{u\max} = \frac{2310}{2230} = 1.03, f_{uw} = 24000 \text{ psi}$$

$$f_s = \frac{616}{.173} = 3570 \text{ psi}$$

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

FOR ULTIMATE COMPRESSIVE STRENGTH

$$F_{c\text{panel}} = 33,100 \text{ psi}, \sigma_u/2 = \frac{33100}{50000} = .763$$

$$b_o/b = .982 \quad \left(\begin{array}{l} \text{REF.} \\ \text{KORTER} \\ \text{REF. WIDTH} \\ \text{CURVE} \end{array} \right)$$



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4KIN PANELS

RIB BAY 16-17

FAILING STRENGTH - PANEL 15 (CONT'D)

ELEMENT	A _{ST}	A _{BUCKLED}	A _{BUCKLED}	P	f _c
15	.196	.723	.719	39017	42500
16	.196	.747	.743	41869	44500
				PK-172	

$$A_{SKIN} = \frac{(4.9 + 5.0)(.173)(.382)}{2} = .747$$

$$f_{c_{BUCKLED AVE}} = \frac{42500 + 44500}{2} = 43500 \text{ psi}$$

FOR CASE 9.32,

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

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

FAILING STRENGTH - PANEL 16

$$b = 5.0, t = .173, A_{UC} = .0795 \text{ in}^2, E_{UC} = 17600 \text{ psi}$$

$$E_{ULT. ASSUMED} = 21500 \text{ psi}, A_{UC}/b = \frac{.0795}{5.0(.173)} = .092$$

$$K = .0435, \sigma_u/\sigma = .072, \sigma_u = .072(21510) = 1550 \text{ psi}$$

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

$$\sigma_{u_{max}} = 1.56(1550) = 2420 \text{ psi}$$

$$\sigma_u = 23.4(.0435)^{2/3}(.635)^{1/3} = 2430 \text{ psi}$$

$$\sigma_u/\sigma_{u_{max}} = \frac{2430}{2420} = 1.02, E_{UC} = 23,000 \text{ psi}$$

$$\therefore E_{ULT. ASSUMED} = 21500 \text{ psi}, f_s = \frac{159}{.173} = 920 \text{ psi}$$

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

K-225

MAT'L: 755-T6 ALG. SKIN

[illegible]

K-22.7

FORM 1544

SKIN PANELS (UPPER)

BULKING OF PANELS

RIB BAY 15-16
(STA. 5")

MATL: 755-TL ALG. SKIN

(ULTIMATE LOADS)

1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
b	b/t	a/b	R	R'	F _{cu} x10 ⁻³	f _c x10 ⁻³	R _c	F _s x10 ⁻³	F _{cu} x10 ⁻³	F _s	f _s x10 ⁻³	R _s	R _m	
	①/183	23.6/①	*	FIG. 13	FIG. 47	K-184 K-175	⑦/⑥	FIG. 39	⑤x⑨	P _g K-195	⑪/183	⑫/⑩		
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	24.7	17.8	-1105	6.03	.338	.648	
3.4	19.6	6.95		.640	52.0	13.1	.262	36.8	23.6	-2200	12.0	.507	.371	
4.3	23.5	5.47		.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	.281	36.1	22.9	-1632	8.91	.339	.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	.313	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	7.81	.406	.561	
5.5	30.0	4.30	.282	.615	42.5	14.1	.332	31.6	19.4	-1453	6.75	.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	-1547	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	.677	
2.5	13.7	1.40	.463	.790	51.7	13.6	.263	41.5	32.8	-774	4.22	.129	.925	

FOR 4" RIB $\frac{3.5}{183} = 19.1$ FOR COMPRESSION

VALUES ARE AVERAGE OF ADJACENT STRINGS STRESSES.

PLS 13 TO 17, $t_u = .150$, $t_u/t_w = .820$, $t_u/t_w = .547$, $R_h = .510$, $R_l = .250$, $R = .5$

$$R_h + \frac{1}{2}(R_l - R_h)\left(\frac{t_u}{t_w}\right)^3 = .282 + \frac{1}{2}(.250 - .282)\left(\frac{.150}{.183}\right)^3 = .282$$

$$t_u/t_w = .183 \quad t_u/t_w = \frac{.110}{.183} = .600, \quad t_u/t_w = \frac{.100}{.183} = .547, \quad R_h = .282, \quad R_l = .2$$

PANELS 2 TO 12

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SKIN PANELS

RIB BAY 15-16

FAILING STRENGTH - PANEL 4 (CASE 8,30)

ULTIMATE SHEAR STRENGTH:

$$b = 6.3", t = .183", A_u = .196 \text{ IN}^2, e = .596"$$

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

$$F_u = 14900 \text{ psi (REF. COL. 20, P. K-227)}$$

$$F_{u, \text{ASSUMED}} = 18,800 \text{ psi}, K = .0502$$

$$\frac{A_{ue}}{A_u} = \frac{.0787}{.196} = .401, \sigma_u/\sigma = .090$$

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

$$F_{u, \text{max}}/\sigma_u = 1.58, F_{u, \text{max}} = 1.58(1690) = 2670 \text{ psi}$$

$$\sigma_s = 23.4(K)^{1/3} (\sigma_u/\sigma)^{1/3} = 23.4(.0502)^{1/3} (.600)^{1/3} = 2680 \text{ psi}$$

$$F_{u, \text{ULT}} \approx 23,000 \text{ psi}$$

$$\frac{\sigma_s}{F_{u, \text{max}}} = \frac{2680}{2670} = 1.00, \therefore F_{u, \text{ULT}} = 18,800 \text{ psi}$$

PANEL

$$f_s = \frac{87}{.183} = 475 \text{ psi}, R_s = \frac{435}{18800} = .026$$

ULTIMATE COMPRESSIVE STRENGTH:

$$F_{u, \text{PANEL}} = 31,000 \text{ psi}, F_u/F_{u, \text{max}} = \frac{21000}{30000} = .70$$

$$\frac{b_e}{d} = .810 \text{ (KRIEGER CURVE)}$$

(REF. Pgs K-103, K-195)

ELE.	A _{STC}	A _{SKIN}	A _{STC, \text{CORR}}	P	F _c
4	.196	.876	1.072	37,185	34,600
5	.395	.840	1.235	40,688	33,000

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

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AIRCRAFT . . . C105

WEIGHT

C. G. POSITION - _____

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WEIGHT

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PANEL NO. 1

NE
↓

2

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9

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

$$2.5 = .580$$



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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:

$$q_{\text{REQD}} = .33 \pm \text{CULT} \frac{F_u}{IN} \left(\text{REF. NACA 44601, PG. 42} \right)$$

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

K-233

HOLDS ALSO, FOR A SHEAR RESISTANT



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STRINGER-TO-SKIN ATTACHMENTS

TENSION FIELD EFFECTS (CONT'D)

PANEL, THE REQUIRED RIVET TENSILE STRENGTH IS THEORETICALLY ZERO.

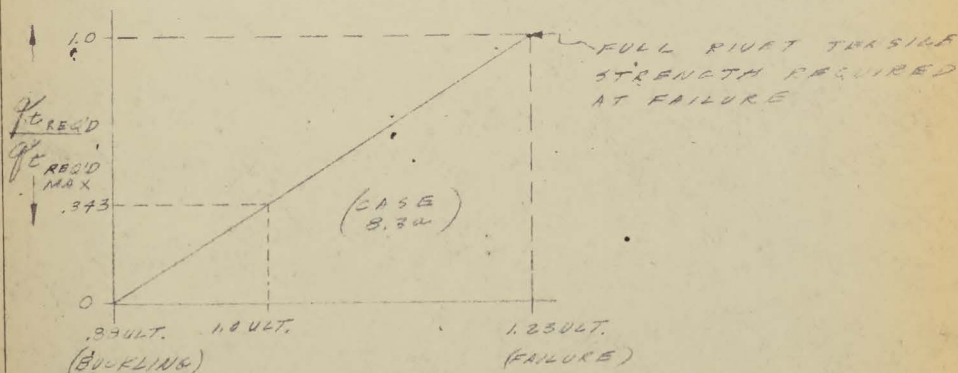
IT WILL BE ASSUMED THAT THE REQUIRED TENSILE STRENGTH WILL VARY AS A STRAIGHT LINE BETWEEN THESE LIMITS.

EXAMPLE:

CONSIDER PANEL 13 OF RIB BAY 16-17
(P₃ K-220) FOR CASE 8.30,

M.S. = -.12 FOR BUCKLING AT ULTIMATE
(REF. P₃ K-220)

M.S. = .23 FOR FAILURE AT ULTIMATE
(REF. P₃ K-222)



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

NOTE THAT,

$F_{REQ'D MAX} = .22 \pm \text{ULT}$

(REF. PRECEDING
PAGE)

K-214

FORM 118A

STRINGER-TO-SKIN ATTACHMENTS

RIBS 16 TO 17, CASE 8.3a, T = 250 °

MAT'L: SKIN-755-TEALC., STR.-755-TEEXT.

	1	2	3	4	5	6	7	8	9	10
STRINGER ↓	SHEAR FLOW			ATTACHMENTS			P _{ALL} SHEAR	P _{ALL} BY SKIN	P _{ALL} BY STR.	P _{ALL} SHEAR
	P _{END}	P _{INT}	P _{STR.} (MIN)	SIZE	TYPE	PITCH (IN.)				
REF. →	P _{K-157}	P _{K-157}	①-②							⑦, ⑧ OR ⑨ ⑥
3	-600	-344	256	3/16	ADG	.75	775 [†]	777 [†]	775 [†]	1030
4	-344	-69	275	"	"	"				
6	-715	-479	236	"	"	"				
7	-479	-220	257	"	"	"				
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	ADG	.75	775	777 [†]	775 [†]	1030
20	220	510	290	3/16	HUCK CKL100V	.70	865 [†]	786 [†]	782 [†]	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 [†]	782 [†]	1152
☐ WITH TEMP. FACTOR OF .775							* TWO 3573 OR 4100A Δ .2250 IN. (.343) =			
T _{MIN} = .162 (MIN), T _{MAX} = .100 (MIN)							± P _{ALL} = .90 (862) = 775 [†] , P _{SHEAR} = .90 X 775			
* CASE 15.1a (P _{K-157})										

FORM 1524

TO-SKIN ATTACHMENTS

6 TO 17 CASE 8.32, T = 250 °F

N-755-T6ALC., STR.-755-T6EXT.

	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17
LOW	ATTACHMENTS				PALL SHEAR	PALL BY SKIN	PALL BY STR.	PALL SHEAR	R _S	SS	Pave	W #/IN	PALL TENSION SKIN	PALL TENSION STR.	PALL TENS.
T	953 STR. (21/10)	SIZE	TYPE	PITCH (IN.)											
4	①-②							⑦, ⑧ OR ⑨ ⑥	③/⑩	K-135 (N.C.) E.		ULLX ⑫ X ⑬ UPE. SECTY. 702, 1000 D. 702, 1000	ULLX SECTY. 702, 1000 D. 702, 1000	⑬ OR ⑭ ⑥	⑬ OR ⑭ ⑥
	256	3/16	ADG	.75	775	7775	7775	1030	.248	4.80	4.83	15.5	835	985	1180
	275	"	"	"					.247	4.95	4.46	14.7			
	236	"	"	"					.229	3.94	3.92	10.0			
	259	"	"	"					.252	4.11	3.16	10.3			
	266	"	"	"					.258	4.26	3.58	10.2			
	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	9.5			
	300	"	"	"					.292	4.80	3.00	9.6			
	314	"	"	"					.305	5.13	3.00	10.2			
	928	3/16	ADG	.75	775	7775	7775	1030	.318	5.46	2.78	10.6	835	935	1180
	290	3/16	HUCK CNL100V	.70	865	7865	7865	1235	.235						
	294	"	"	"					.238						
	291	"	"	"					.236						
	290	"	"	.70				1235	.235						
	329	"	"	.75				1152	.285						
	352	"	"	"					.305						
	320	"	"	.75				1152	.273						
	278	"	"	.70				1235	.225						
	264	"	"	"					.214						
	247	"	"	.70				1235	.200						
	256	"	"	.75				1152	.222						
	210	3/16	HUCK CNL100V	.75	865	7865	7865	1152	.182						

R OF .795

* TWO SETS OF FIGURES ARE FOR END & AFT PANELS. AVE

.22 to 0.17 (.343) = .22 (.162) (57000) (.343) = 700 #/IN **

100 (MIN) ± P_{ALL} = .90 (862) = 775 #, P_{ALL} = .90 X 769 = 865 # □ VALUES GIVEN ARE F

AVRO AIRCRAFT LIMITED

MALTON, ONTARIO
ENGINEERING DIVISION

REPORT NO. _____

SHEET _____

DATE _____

PREPARED BY R. GAVALIS

AIRCRAFT C105

WEIGHT _____

C. G. POSITION _____

16	17	18	19	20	21	22	23	24	25	26	27	28	29
			PER PANEL										
ALL TRANSITION STR.	FALL TENS.	R _T AIR	M.S. BUREAU AT VLT	M.S. BUREAU AT VLT	VERBOD	VERBOD H/V	R _T TENS. BUREAU	R _T TENS.					M.S.
2.1007 403	(13 OR 16) (6)	(14) (17)	PAS K-220 79 C-220	PAS K-220 79 C-220	VERBOD H/V	22000 X (21)	(22) (17)	(18+23)					1 (11+14)
785	1180	.013				20	0	.013					2.84
		.013				20		.013					2.60
		.009				20		.009					3.21
		.009	PANEL DENS			20		.009					2.89
		.009	NOT BUCKLE AT ULTIMATE			20		.009					2.76
		.009	(REF. BK-220)			20		.009					2.36
		.010				20	!	.010					2.82
		.009				20	0	.009					2.20
		.003	.12	.23	** 243	7004	.574	.603					.21
		.008	.07	.17	292	576	.505	.513					.24
		.009	.05	.12	200	1060	.899	.908					.18
935	1180	.009	.05	.04	234	1850	.720	.729					.04
		.13	.01	.02	834 .000								3.25
													3.20
													3.24
													3.25
													2.50
													2.28
													2.60
													3.44
													3.67
													4.00
													3.50
													4.50

25. AVE VALUE = $\frac{2.00 + .834}{2} = .517$, $\frac{2}{2} \text{ TRESSD} = .517(22)(57200)(.162) = 1060 \text{ H/V}$
 ** SEE BK 225, $\frac{1.0 - .93}{1.17 - .93}$

1. ARE FOR EITHER AWD. OR ART ADJACENT PANEL.

STRINGER-TO-SKIN ATTACHMENTS

RIB 17-18, CASE 8.3a, $T = \underline{250^\circ F}$

MAT'L: SKIN - 755-T6 ALCL. STR. - 755-T6 EXT.

	1	2	3	4	5	6	7	8	9	
STRINGER ↓ REF. →	ATTACHMENTS			SHEAR FLOW			P _{A1A} ALL BY STE	P _{A2A} ALL BY STE	P _{A3A} ALL BY STE	9
	SIZE	TYPE	PITCH (IN.)	F _{BWD}	F _{FT}	F _{STR}				
				P.K-66	F _{FT}	F _{STR}	Pg.K-230	Pg.K-230	Pg.K-230	9
				K-177		(4)-(5)				9
3	3/16	ANALCAD	.75	-539	-247	290	775	775	775	10
4	"	"	"	-247	54	303				
6	"	"	"	-703	-428	276				
7	"	"	"	-428	-139	209				
8	"	"	"	-139	167	306				
10	"	"	"	-680	-350	342				
11	"	"	"	-573	-205	368				
12	"	"	"	-205	207	412				
14	"	"	"	-1136	-741	375				
15	"	"	"	-241	-317	427				
16	3/16	ANALCAD	.75	-317	245	562	775	775	775	10
21	3/16	CKL100V	.75	532	-110	642	865	7865	7865	115
22	"	"	"	-110	-518	408				
23	"	"	"	-518	-914	396				
25	"	"	"	165	-268	433				
26	"	"	"	-268	-661	393				
27	"	"	"	-768	-390	372				
29	"	"	"	-206	129	335				
30	"	"	"	-522	-206	316				
31	"	"	.75	-815	-522	293				115
33	"	"	.85	-452	-161	291				10
34	3/16	CKL100V	.85	-690	-452	238	865	7865	7865	10
T _{MIN} = .152", t _{MIN} = .100", F _{OUT} = 57,200/50										

RE-TO-SKIN ATTACHMENTS

7-18 CASE 8.3a , $T = \underline{250^\circ F}$

N - 755TG ALL. STR. - 755-TL EXT.

TEST LOG - STR. - 7-12 EX-11																
	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	
ENTS	SHEAR FLOW				P _{ALL} SOIL	P _{ALL} BY SHEAR	P _{ALL} BY STR	P _{ALL} V _{SHR}	R _s	P _{ALL} TENS. STR	P _{ALL} TENS. STR	P _{ALL} TENS.	MS _{NO} SHAKE AT ALT.	MS _{NO} SHAKE AT ALT.	P _{ALL} BY SHEAR	
E PITCH (IN)	P _{AND}	P _{AND}	P _{AND}	P _{AND}	P _{AND}	P _{AND}	P _{AND}	P _{AND}	P _{AND}	P _{AND}	P _{AND}	P _{AND}	P _{AND}	P _{AND}	P _{AND}	
	P _{K-66}	P _{K-179}	P _{K-179}	P _{K-179}	P _{K-179}	P _{K-179}	P _{K-179}	P _{K-179}	P _{K-179}	P _{K-179}	P _{K-179}	P _{K-179}	P _{K-179}	P _{K-179}	P _{K-179}	
	P _{K-66}	P _{K-179}	P _{K-179}	P _{K-179}	P _{K-179}	P _{K-179}	P _{K-179}	P _{K-179}	P _{K-179}	P _{K-179}	P _{K-179}	P _{K-179}	P _{K-179}	P _{K-179}	P _{K-179}	
LAD .75	-539	-249	290	775	775	775	1030	.282	885	985	1180					
"	-249	54	303					.274								
"	-703	-428	276					.267								
"	-428	-139	289					.280								
"	-139	167	306					.297								
"	-680	-350	342					.332								
"	-573	-285	368					.357								
"	-205	207	413					.400								
"	-1136	-741	375					.383								
"	-741	-317	424					.411								
AD .75	-317	245	562	775	775	775	1030	.545	885	985	1180					
00V .75	532	-110	642	845	7865	7865	1150	.559								
"	-110	-518	408					.355								
"	-518	-914	376					.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								
0V .85	-690	-452	238	845	7865	7865	1020	.234								
100"	F _{OUT} = 57,200/50															

AVRO AIRCRAFT LIMITED

MALTON, ONTARIO
ENGINEERING DIVISION

AIRCRAFT

WEIGHT

C. G. POSITION

REPORT NO.

SHEET

DATE _____

PREPARED BY,

[illegible]

S.
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STRINGER-TO-SKIAL ATTACHMENTS

RIBS 18 TO 19, CASE 8.3a T = 26

MAT'L: BRIN - 755-T6 ALG., STRINGER - 755-T6 EXT.

	1	2	3	4	5	6	7	8	9	10
STRINGER	ATTACHMENTS			SHEAR FLOW			PALL 342	PALL 24 SKIN	PALL 24 STR	9 15
REF. →	SIZE	TYPE	PITCH	P ₃ FWD	P ₃ AFT	P ₃ STR.	(4-5) P. K-236			(7)
3	3/16	ANALCAD	.75	-505	-243	262	776	7775	7775	10
4 MIS	"	"	"	-243	42	285				
6	"	"	"	-678	-420	258				
7	"	"	"	-420	-142	278				
8 C/SR	"	"	"	-142	157	299				
10	"	"	"	-620	-277	343				
11	"	"	"	-277	91	363				
12 C/SR	3/16	ANALCAD	.75	91	438	397	775	7775	7775	10
25 C/SR	3/16	CKL 100V	.75	25	385	360	865	7865	7865	11
26	"	"	"	-324	25	349				
27 3/45	"	"	"	-662	-324	338				
29	"	"	"	-125	190	315				
30	"	"	"	-427	-125	302				
31 MIS	"	"	"	-709	-427	282				
33	"	"	"	-366	-73	293				
34 F/S	3/16	CKL 100V	.75	-614	-366	248	865	7865	7865	11

VOLT = 67,200 VOLT
 L_{SKIN} = .146" L_{STR.} = .100"
 (MIN.) (MIN.)
 ≠ LOWEST VALUE OF EITHER

HEEL-TO-SKIN ATTACHMENTS

18 TO 19, CASE 8.3a, $T = 250^\circ\text{F}$

GRIN - 755-T6 ALC. } STRINGER - 755-T6 EXT.

2	3	4	5	6	7	8	9	10	11	12	13	14	15	16
MENTS		SHEAR FLOW			P _{ALL} SHE	P _{ALL} BY SKIN	P _{ALL} BY STR	P _{ALL} SHEAR	R _s	P _{ALL} TENS. SKIN	P _{ALL} TENS. STR	P _{ALL} TENS.	MS _{NO.} 3000. AT 200°	MS _{ALL} CLT.
TYPE	PITCH	P ₃ FWD	P ₃ AFT	P ₃ STR.										
				(4-5)	P ₃ K-236			(7) (8) (9)	(6) / (10)	P ₃ K-236	P ₃ K-236	(12) (13) (14)	P ₃ K-200	P ₃ K-201
ARLAD	.75	-505	-243	262	775	7775	7775	1030	.254	885	985	1180	.467	
"	"	-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	
ARLAD	.75	91	488	397	775	7775	7775	1030	.386	885	985	1180	.09	
RL DOV	.75	25	385	360	865	7865	7865	1150	.313					
"	"	-324	25	349					.304					
"	"	-662	-324	338					.294					
"	"	-125	190	315					.274					
"	"	-427	-125	303					.263					
"	"	-709	-427	282					.246					
"	"	-366	-73	293					.255					
RL DOV	.75	-614	-366	248	865	7865	7865	1150	.216					

AVRO AIRCRAFT LIMITED

MALTON, ONTARIO
ENGINEERING DIVISION

REPORT NO. - _____

SHEET . . .

DATE . . . 5-17-36

AIRCRAFT . . . 6705

WEIGHT - - - - -

C. G. POSITION

PREPARED BY . R. GAVALIS

[illegible]

RIBS 19-20, CASE 8.30, T = 250°

MAT 2: SKIN - 755-T6 ALCL, STRINGER - 755-T6 EXT.

[illegible]

FINGER-TO-SKIN ATTACHMENTS

S 19-20, CASE 8.3a, $T = 250^\circ\text{F}$

SKIN - 755-T6 ALU., STRINGER - 755-T6 EXT.

2	3	4	5	6	7	8	9	10	11	12	13	14	15	16
ATTACHMENT		SHEAR FLOW			P_{ALL} SHE	P_{ALL} OF SKIN	P_{ALL} OF STR	P_{ALL} SAFE R	R_s	P_{ALL} TENS. SKIN	P_{ALL} TENS. STR.	P_{ALL} TENS.	MS. NO. BOULDER AT OUT.	MS. FAIL. AT OUT.
TYPE	PITCH	P_{END}	P_{AFT}	P_{STR}										
		P_g K-35	(4)-(5)	P_g K-236	P_g K-236	P_g K-236	(7)(8)(9) (3)	(6)(10)	P_g K-236	P_g K-236	(12)(13) (3)	P_g K-202		
ANAZGAD	.75	-358	-301	32	775	7775	7775	1030	.031	885	985	1130	.47	
"	"	-301	95	376					.384				.36	
"	"	-523	-353	165					.160				.37	
"	"	-358	-64	294					.286				.37	
"	.75	-64	250	314				1030	.305			1130	.28	
"	.70	-556	-203	353				1110	.313			1260	.21	
"	"	-203	171	374				1110	.337			1260	.18	
ANAZGAD	.70	171	570	399	775	7775	7775	1110	.360	885	985	1260	.17	
OKL 100V	.75	169	576	407	365	7865	7865	1150	.354					
"	"	-223	169	372					.341					
"	"	-604	-223	381					.331					
"	"	-77	276	353					.307					
"	"	-403	-77	331					.288					
"	"	-595	-403	187					.163					
"	"	-196	-41	155					.136					
OKL 100V	.75	-463	-196	267	365	7865	7865	1150	.232					

STRINGER-TO-SKIN ATTACHMENTS

RIBS 20-21, CASE 8.30, $T = 250^{\circ}F$

RIB 21-22, CASE 8.32, $T = 250^{\circ}F$

MAT'L: SKIN - 755-TL ALL., STRINGER - 755-TL EXT. FOR

STRINGER ↓ REF →	1	2	3	4	5	6	7	8	9	10
	ATTACHMENT			SHEAR FLOW			P _{ALL} SHE	P _{ALL} SKIN	P _{ALL} STR	P _{ALL} VIB
	SIZE	TYPE	PITCH	P _{END}	P _{ANT}	P _{STR}				
				P _g K-18		(4)-(5)	P _g K-236		P _g K-236	(7)(8)
				9 K-132						(3)
RIBS 20-21	3	3/16	AN426AD	.75	-223	197	420	175	785	> 775 100
	7	"	"	"	-257	176	433			
	8	"	"	"	176	518	342			
	11	"	"	"	-5	403	408			
	12	3/16	AN426AD	.75	403	847	444	775	755	> 775 100
	25	3/16	CKL 100V	.75	380	834	446	865	880	> 865 115
	26	"	"	"	-39	338	427			
	29	"	"	"	196	577	331			
	30	"	"	"	-284	196	430			
	34	3/16	CKL 100V	.75	-319	75	394	865	830	> 865 115
$t_{SKIN} = .132" (MIN), t_{STR} = .100" (MIN)$										
RIBS-21-22										
RIBS 21-22	4	3/16	AN426AD	.75			-375*	775	770	> 775 100
	7	"	"	"			603*	775	770	> 775 100
	11	3/16	AN426AD	.75	SHEAR		644	775	780	> 775 100
	26	3/16	CKL 100V	.75			572	865	865	> 865 115
	30	"	"	"			522	865	865	> 865 115
	33	3/16	CKL 100V	.75			-50*	865	865	> 865 115
* THIS SHEAR FLOW IS FOR CASE 10.1a										
$t_{SKIN} = .124" (MIN), t_{STR} = .091" \quad \text{ULT} = 57,200 \text{ PSI}$										
LOWEST VALUE FOR EITHER END. OR AFT										

FORM 1544

K-241

ER-TO-SKIN ATTACHMENTS

20-21, CASE 8.30, $T = 240^{\circ}\text{F}$

21-22, CASE 9.32, $T = 250^\circ\text{F}$

SKIN - 753-T6 ALL, STRINGER - 753-T6 EXT. FOR RIBS 20-21 & 753-T6 ALL, COP P

2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	
HMENT		SHEAR FLOW			P _{ALL} SHE	P _{ALL} SHE	P _{ALL} SHE	P _{ALL} SHE	R _s	P _{ALL} TENS	P _{ALL} TENS	P _{ALL} TENS	M.S. 40 BOLTS AT JLT	M.S. 40 BOLTS AT JLT	P _{ALL} TENS	
TYPE	PITCH	P _{END}	P _{ANT}	P _{STR}												
		P ₃₅ K-13		(4-5)	P ₃₅ K-13			P ₃₅ K-13	(7-8) (9)	(6)		(12 OR 13)				
		9 K-132							(3)			(3)				
26	75	-223	197	420	175	795	> 775	1030	.407				.224			
"	"	-257	176	433					.420				.42			
"	"	176	518	342					.332				.53			
"	"	-5	403	408					.376				.01			
26	75	403	847	444	775	795	> 775	1030	.430				.31			
26	75	333	834	446	865	880	> 865	1150	.428							
"	"	-39	388	427					.371							
"	"	196	577	331					.331							
"	"	-284	196	430					.417							
26	75	-319	75	394	865	880	> 865	1150	.342							
T _{STR} =		.108 (S.N.)														
26	75			-375	775	795	> 775	1025	.362	885	905	1180	.40			
"	"			603	775	795	> 775	1025	.593	885	905	1180	.30	.18		
26	75			644	775	795	> 775	1025	.428	885	905	1180	.40	.42		
26	75			572	865	880	> 865	1150	.493							
"	"			522	865	880	> 865	1150	.455							
26	75			-507	865	880	> 865	1150	.511							
HOW IS FOR CASE 16.10																
T _{STR} =		.091"			T _{STR} = 57,200 PSI											
OR FOR EITHER END. OR AFT PANEL. □ PROBABLY UNCONSERVATIVE																

AVRO AIRCRAFT LIMITED

MALTON, ONTARIO
ENGINEERING DIVISION

REPORT NO.

SHEET

DATE 5-18-56

AIRCRAFT C105

WEIGHT

C. G. POSITION

PREPARED BY R. GAVALIS

6	17	18	19	20	21	22	23	24	25	26	27	28	29
	Handwritten notes	Handwritten notes	Handwritten notes										M.S.
		17 x 22	18										1
		xt 5000	14										11 + 19
													1.96
													1.38
													2.01
													1.52
													1.32
													1.58
													1.70
													2.02
													1.40
													1.92
													1.74
													1.00
													1.22
													1.00
													1.20
													1.95

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

8 RIBS 23-24, CASE B.32, $T = 250^{\circ}F$

MATL: SKIN - 755-T6 ALG. STRINGER - 755-T6 A

	1	2	3	4	5	6	7	8	9	10
STRINGER	ATTACHMENTS SHEAR FLOW					P_{ALL}	P_{ALL}	P_{ALL}	P_{ALL}	
1	SIZE	TYPE	PITCH	P_{FWD}	P_{AFT}	P_{STR}	P_{ALL}	P_{ALL}	P_{ALL}	P_{ALL}
REF.						(4-5)	P_K-23			(7-8) (9-10)
RIBS 22-23	4	3/16	ANALAD	.75		-406	775	760	775	1010
	7	"	"	"		-484	775	760	775	1010
	11	3/16	ANALAD	.75	SEE P_K	-575	775	760	775	1010
	26	3/16	CKL 100V	.75		-331	845	845	845	1140
	30	"	"	"		-562	845	845	845	1140
	33	3/16	CKL 100V	.75		-395	845	845	845	1140
$t_{SKIN} = .117(\text{MIN})$, $t_{STR} = .091"$										
RIBS 23-24										
RIBS 23-24	4	3/16	ANALAD	.75		-331	775	760	775	1010
	7	"	"	"		-390	775	760	775	1010
	11	3/16	ANALAD	.75	SEE P_K	-388	775	760	775	1010
	26	3/16	CKL 100V	.75		-410	845	845	845	1140
	30	"	"	.75		-422	845	845	845	1140
	33	3/16	CKL 100V	.70		-319	845	845	845	1140
$t_{SKIN} = .110(\text{MIN})$, $t_{STR} = .081"$										
$OUT = 57,200 \times 54$										
LOWEST VALUE FOR EITHER FWD. OR AFT PANEL.										

K-242

TO-SKIN ATTACHMENTS

23, CASE 8.3a $T = 257^{\circ}\text{F}$

23-24, CASE 8.30, $T = 250^{\circ}\text{F}$

- 755-T6 ALC, STR NEAR - 755-T6 ALC AD

[illegible]

STRINGER-TO-SKIN ATTACHMENTS

RIBS 15-16, CASE B.3a, $T = 250^{\circ}F$

MAT'L: SKIN - 755-T6 ALCL., STRINGER - 755-T6 EX

	1	2	3	4	5	6	7	8	9
STRINGER ↓	ATTACHMENTS			SHEAR FLOW			PALL SHEAR	PALL BY SKIN	PALL BY STR
	SIZE	TYPE	PITCH	FWND	FSPT	FSTR			
REF →						(4)-(5)			
3	3/16	AN426AD	.75	-631	-368	263	775	830	> 775
4	"	"	"	-268	-89	279			
6	"	"	"	-873	-624	299			
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	313*	775	830	> 775
17	3/16	STEEL JO-BOLT	.80	-37	344	381*	2620	> 2620	1410
20	3/16	STEEL UN-BOLT	.65	31	428	547*	2620	> 2620	1410
21	3/16	SKL 100V	.65	-223	31	304*	870	930	> 870
22	"	"	.80	-525	-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	SKL 100V	.80	-713	-504	289	870	930	> 870
* SEE P. K- FOR SLIGHTLY HIGHER LOADS DUE TO LOWEST VALUE FOR EITHER FWD. OR AFT PANEL # FULT = 57,200 PSI $t_{SKIN} = .148" (MIN.)$, $t_{STR} = .100" (MIN.)$ # R ₀ FOR									

AVRO AIRCRAFT LIMITED

MALTON, ONTARIO
ENGINEERING DIVISION

AIRCRAFT . . . C105

WEIGHT _____

C. G. POSITION _____

REPORT NO. - _____

SHEET _____

DATE . . . 5-25-56

PREPARED BY - R. GAVALIS

[illegible]



AVRO AIRCRAFT LIMITED
MALTON, ONTARIO

TECHNICAL DEPARTMENT

REPORT No. _____

SHEET No. _____

AIRCRAFT:

C105

OUTER
WING

PREPARED BY

R. CAVALIS

DATE

5-28-56

CHECKED BY

DATE

STRINGER-TO-SKIN ATTACHMENTS

RIB BAY 15-16 (UNITED) 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.

$$X' = \frac{\pi X}{2b} \sqrt{\frac{Gt}{E_x t_c}} \quad \left(\text{REF. GLM ER \#1585} \right)$$

SHEAR LAG INFO

WHERE,

X = LONGITUDINAL DISTANCE FROM END
OF STRINGER

b = HALF WIDTH OF SKIN BETWEEN
R/S & C/S

t = SKIN THICKNESS

t_c = 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

