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You searched: in

Name Cooke, A.
Title **Rear fuselage skinning (stn. 742.5-803) : C 105 / prepared by A. Cooke, L.K. Jarman.**
Publisher Malton, Ont. : A.V. Roe Canada Limited, Technical Dept. (Aircraft), 1956.
Edition Issue 3, Aug. 1956.

LOCATION	CALL #	STATUS
<u>Rare Books</u>	<u>TL685.3 R425 no. 7-0559-7 Iss-3</u>	BY APP. ONLY

Call # TL685.3 R425 no. 7-0559-7 Iss-3
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Subject Avro Arrow (Turbojet fighter plane) -- Design and construction
Alt author Jarman, L. K.
A.V. Roe Canada. Aircraft Division. Technical Dept.
A.V. Roe Canada. Technical Dept. (Aircraft)

100 page

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CISTI and partners / ICIST et partenaires



A. V. ROE CANADA LIMITED
MALTO - ONTARIO

TECHNICAL DEPARTMENT (Aircraft)

J. Shurston
TL 123-56/08

ANALYZED

AIRCRAFT: C.105.

REPORT No. 7-0559-7.

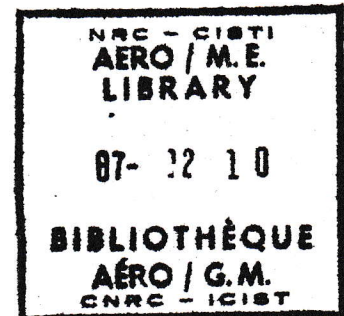
FILE No.

NO OF SHEETS: 104.

TITLE: REAR FUSELAGE SKINNING. (STN. 742.5-803)

CONFIDENTIAL

Classification cancelled / Changed to UNCLASS
By authority of AVRS
Date 30 Sept 66
Signature [Signature]
Unit / Rank / Appointment AVRS



PREPARED BY A. COOKE
L.K. JARMAN. DATE JAN. '56.
AUG '56.
CHECKED BY DATE
SUPERVISED BY DATE
APPROVED BY DATE

ISSUE NO.	REVISION NO.	REVISED BY	APPROVED BY	DATE	REMARKS
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2		ROBERTS	[Signature]	5 JULY 1955	TO COMPLETE AND BRING UP TO DATE.
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AVRO AIRCRAFT LIMITED
MALTON - ONTARIO

TECHNICAL DEPARTMENT

REPORT NO.

7-0559-7

SHEET NO.

AIRCRAFT:

C. 105

REAR FUSELAGE

SKINNING (STNS 742-5-803)

INDEX

PREPARED BY

JARMAN

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DATE

AUG '56

DATE

PRODUCTION DRG. NOS. 7-1059-15 - TOP SKIN
7-1059-17 - SIDE AND
BOTTOM SKINS

CONFIDENTIAL

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REAR FUSELAGE

SKINNING (STN 742-5 TO 803)

INDEX (CONT'D)

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SHEET NO.

AIRCRAFT:

C. 105

REAR FUSELAGE.

SKINS.

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LIST OF DRAWINGS

(TO BE INCLUDED LATER.)

REFERENCE REPORTS:-

NO. 7-0559-4 — REAR FUSELAGE GEOMETRY SECTIONS, AND
SKIN SHEAR FLOWS.

NO. 7-0559-25 — CENTRE BEAM (SN 7425 TO SN 7521)

NO. 7-0559-1 ISSUE 6. — REAR FUSELAGE CRITICAL LOADING.

A.E.M. → AIRCRAFT ENGINEERING MANUAL (STRESS SECTION)
AVRO.

A.N.C.E.

NACA. 2661. TN. — A SUMMARY OF DIAGONAL TENSION.



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7-0559-7

SHEET NO.

AIRCRAFT:

C 105

REAR FUSELAGE

STRESSING NOTE

PREPARED BY

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STRESSING NOTE

IN STRESSING THE REAR FUSELAGE SKINS, IT HAS BEEN POSSIBLE TO SELECT THE MOST CRITICALLY LOADED SHEAR PANELS, BY SIMPLY COMPARING PANEL SIZES AND THE APPLIED LOADS. WHERE THERE WAS ANY DOUBT AS TO WHICH OF TWO PANELS WAS CRITICAL, BOTH HAVE BEEN STRESSED. ALL OTHER PANELS HAVE BEEN COVERED FOR STRENGTH BY COMPARISON WITH THESE CRITICAL CASES, BUT HAVE NOT BEEN STRESSED INDIVIDUALLY.



AVRO AIRCRAFT LIMITED
MALTON ONTARIO

TECHNICAL DEPARTMENT

AIRCRAFT C 105

REAR FUSELAGE
LOADS

REPORT NO.

7-0559-7

SHEET NO.

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DATE

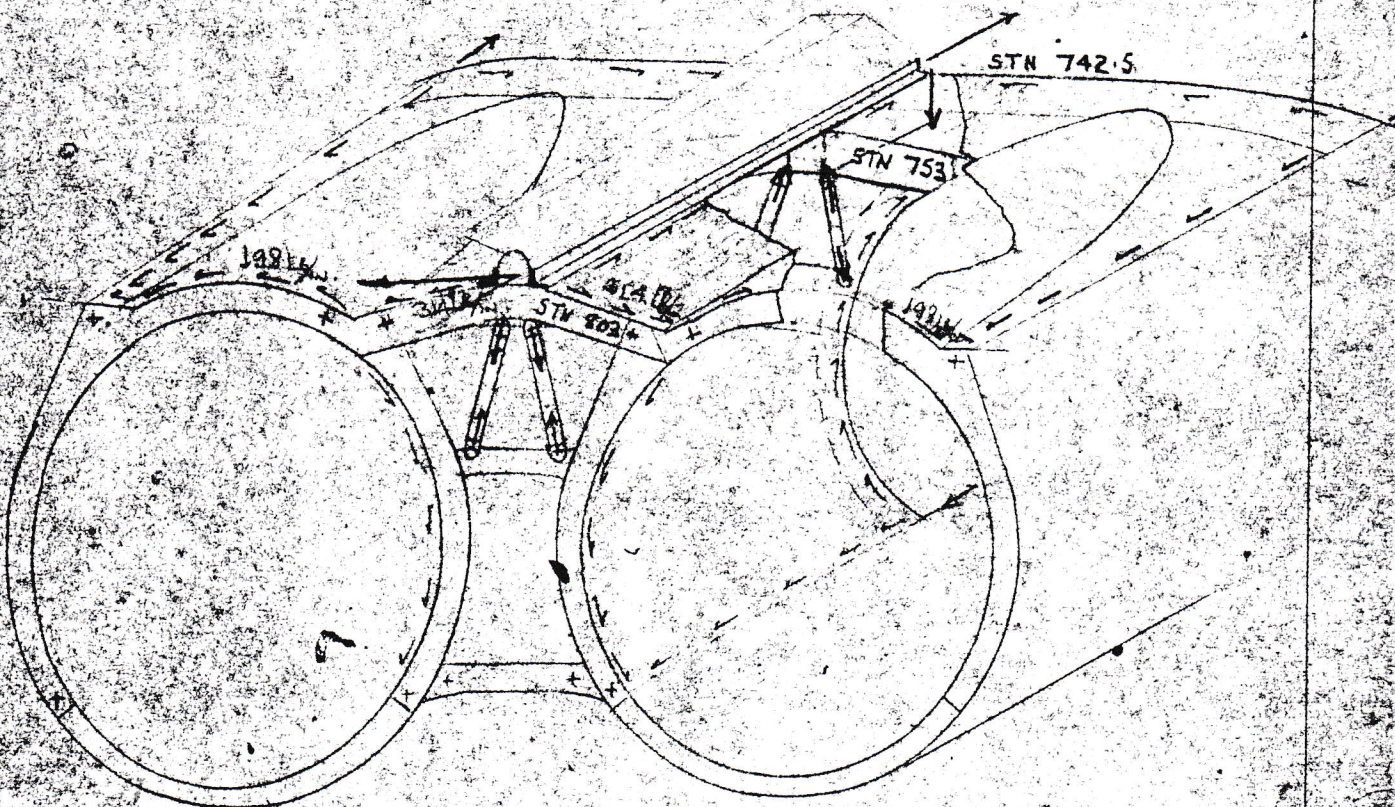
Cook

MAR 12/5

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1. PARACHUTE 'UP' LOAD.





AVRO AIRCRAFT LIMITED
MALTON, ONTARIO

TECHNICAL DEPARTMENT

REPORT NO. 7-0559-7

SHEET NO. 2

AIRCRAFT C105

REAR FUSELAGE

LOADS

PREPARED BY

DATE

Cooke

MAR 12/51

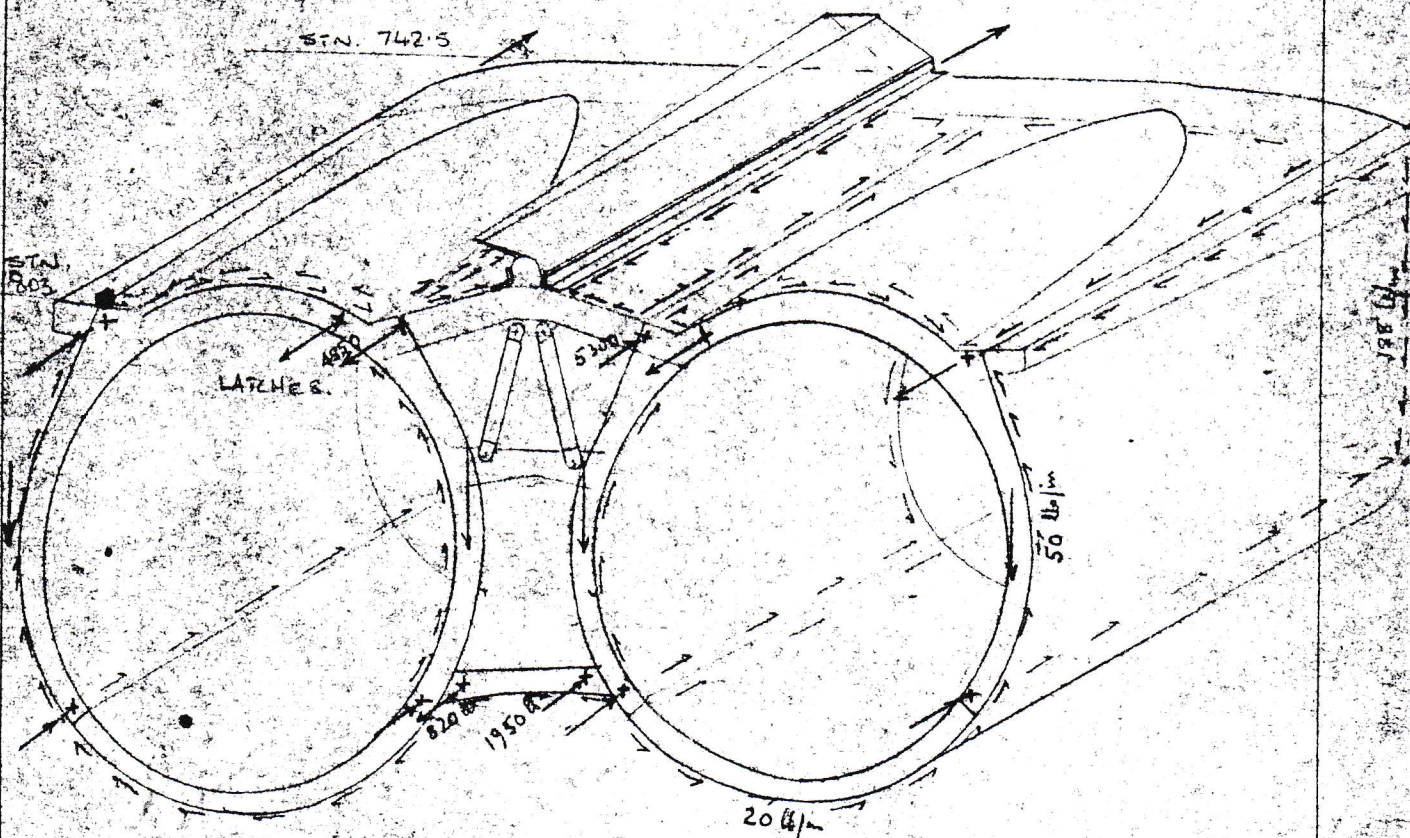
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2. MAX DOWN AIRLOAD CASE 7.3.c.

- M-2, 18000 lb 1 ENGINE CASE

NOTE: THE ABOVE CASES WILL NOT OCCUR SIMULTANEOUSLY.



TECHNICAL DEPARTMENT (Aircraft)

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7-0559-7

SHEET NO.

3

AIRCRAFT:

C 105

REAR FUSELAGE

TOP SKIN

PREPARED BY

JARMAN

DATE

APR. '56

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DATE

LOADS FROM PARABRAKE DRAG -

FROM 7-0559-4, SHEET 1-31, IN THE PARACHUTE RELEASE CASE
THE LOAD SHEARED ACROSS TOP SKIN (BETWEEN STN^S 803 AND 7425)

$$\text{TOP OUTBD LONG^S} = \frac{64,000 - 48,500}{64,000} \times 100\% = \frac{15,500}{64,000} \times 100\%$$

$$= 24.2\%$$

$$= 12.1\% \text{ TO EACH TOP-OUTBD LONG^N .}$$

THE VERY HIGH SHEAR FLOWS ($q = 432 \text{ LB/IN}$) AT STN 803, (SEE REAR 7-0559-4 SHEET 1-61)
WERE CONSIDERED UNREALISTIC IN VIEW OF THE FLEXIBILITY
OF FORMER STN 803. . . . (H. SHOJI.)

IT WAS DECIDED TO APPLY THE ABOVE 12.1% OF PARABRAKE
DRAG LOAD, AS A CONSTANT SHEAR FLOW ACROSS THE TOP
SKIN.

$$\text{PARABRAKE DRAG LOAD} = 53,660 \text{ LB.}$$

$$12.1\% \times 53,660 = 6,500 \text{ LB.}$$

$$q = \frac{6,500}{60} = 108.3 \text{ LB/IN.}$$

IN PARACHUTE UP CASE, DRAG LOAD = 51,440 LB.

$$q = 108 \times \frac{51,440}{53,660} = 103.5 \text{ LB/IN.}$$

IN MAX LATERAL LOAD CASE, DRAG LOAD = 52,440 LB.

$$q = \frac{108 \times 52,440}{53,660} = 106.1 \text{ LB/IN.}$$

REPORT NO.

13 SHEET

DATE _____

PREPARED BY:

L. K. JACKMAN.

A. V. ROE CANADA LIMITED

MALTON, ONTARIO

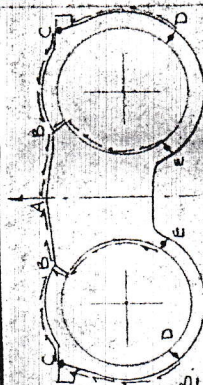
TECHNICAL DEPT. (AIRFRAME)

AIRCRAFT

WEIGHT

C. G. POSITION

C. 105.



PARACHUTE CASES

SKIN SHEARS

ULTIMATE PARACHUTE LOAD = 53660 Lb.

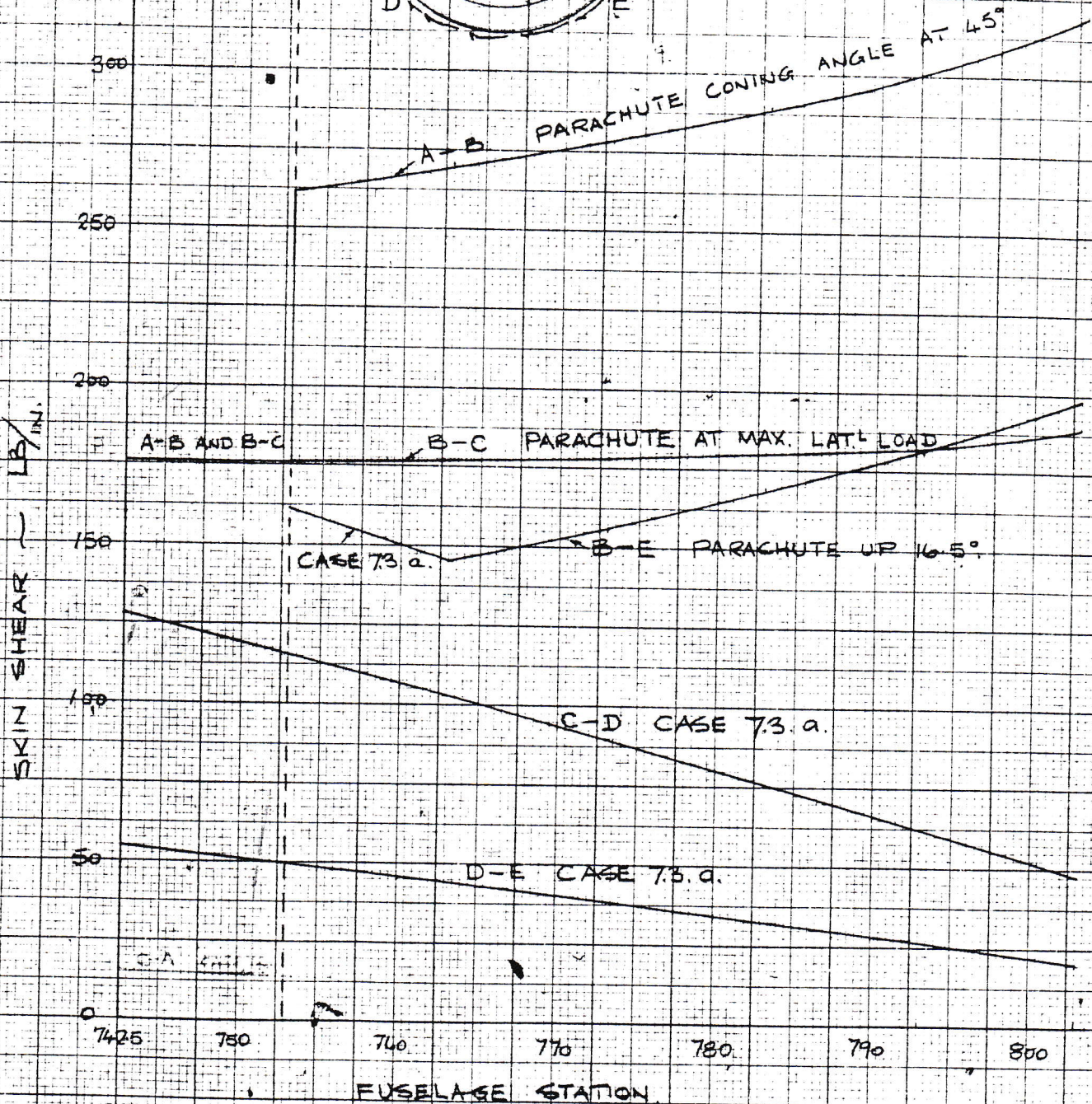
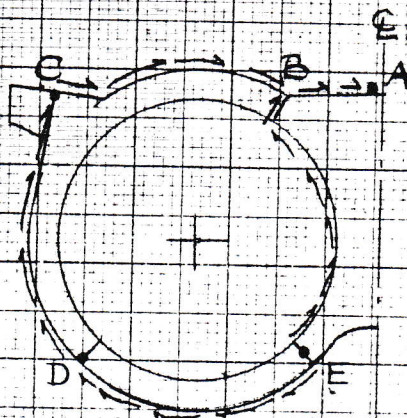
1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19
P_B - PARACHUTE UP	51440 LB AIR LOAD AND INERTIA	$P_V = 15230$ LB CASE		$P_R = 0$														
q_{BC}	q_{BC}	q_{BC}	q_{AB}	q_{BC}	q_{BC}	q_{BC}	q_{A-B}			q_{BC}	q_{BC}	q_{BC}	q_{BC}	q_{A-B}		q_{BC}	q_{A-B}	q_{BC}
742.5	.8	103.5	9.6	0	0	104	114			106	106	69.5	176	176		105	48.5	154 154
753	.8	103.5	9.2	8.3	136	104	249			106	60.2	70.5	177	237		105 108	49.2	154 266
763	.8	103.5	8.7	7.9	146	104	259			106	64.6	70.9	177	242		105 116	49.5	155 271
773	.7	103.5	8.1	7.4	156	104	268			106	68.6	71.7	178	247		105 123	50.0	155 278
783	.6	103.5	7.4	6.8	169	104	280			106	73.9	73.5	180	254		105 135	51.3	156 289
793	.5	103.5	6.7	6.3	181	104	292			106	79.7	76.3	182	262		105 145	53.5	158 30
803	.4	103.5	6.0	5.7	198	104	308			106	87	82.7	189	276		105 156	57.7	163 31

Diagram showing a parachute pack with three force vectors: P_1 (upward), P_2 (downward), and P_3 (downward). The pack is labeled with '57.1' and '742.5'.

7-0559-71

SKIN SHEAR FLOW ENVELOPE FIXED REAR FUSELAGE

JARMAN. APR. '56





AVRO AIRCRAFT LIMITED
MALTON, ONTARIO

TECHNICAL DEPARTMENT

REPORT NO.

7-0559-7

SHEET NO.

6

AIRCRAFT:

C. 105.

REAR FUSELAGE.

DEFLECTION REQUIREMENTS.

PREPARED BY

DATE

JARMAN

AUG. '54

CHECKED BY

DATE

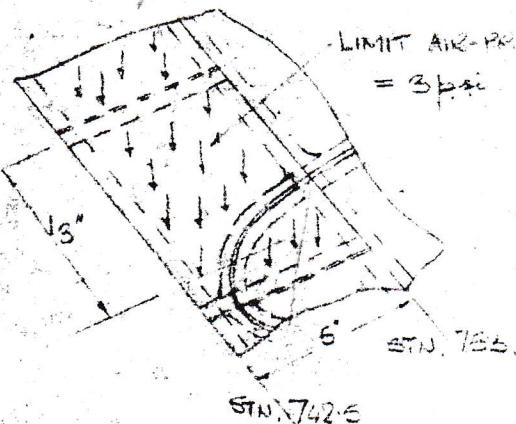
DEFLECTION REQUIREMENTS.

REF: - BASIC DATA FOR STRESSING REPORT 7-0500-1. SHEET 81.50.11
(BOOK 3.)
OR, AERODYNAMICS DEPT MEMO. NO. 9448/20/J. FEB 10TH '54

THE DEFLECTIONS OF THE FUSELAGE SKIN PANELS DUE TO AIRLOADS AND MANUFACTURING TOLERANCES, SHOULD NOT EXCEED 2% OF THE PANEL CHORD, AND THERE SHOULD BE NO THEORETICAL TENSION FIELD BUCKLING BELOW 2g. FOR THE REAR FUSELAGE SKIN PANELS THE REQUIREMENT HAS BEEN MODIFIED TO, 'NO BUCKLING BELOW (2g + LIMIT AIR LOADS)'

CHECK FOR DEFLECTION DUE TO AIR LOADS:-

SINCE THE TOP SKIN PANELS BETWEEN STNS 742.5 AND 75'S ARE THE LARGEST, AND ARE SUBJECTED TO THE GREATEST NORMAL AIR LOAD OF ANY PANEL IN THE REAR FUSELAGE, IT WILL BE SUFFICIENT TO CHECK THEM FOR DEFLECTION.



PANEL 10.5" x 13" x .04" Mg.

$$a/L = \frac{13}{10.5} = 1.237$$

$$\frac{p}{E} \left(\frac{b}{t} \right)^4 = \frac{3}{6.5 \times 10^8} \times \left(\frac{10.5}{.04} \right)^4 = 2.2 \times 10^{-3}$$

FROM K A. S. D. S. 02. 09.

$$\frac{\delta}{t} = 4.05$$

$$\delta = 4.05 \times .04 = .162$$

PERCENTAGE CORDWISE DEFLECTION. $\left(\frac{\delta}{b} \right) \times 100 = \frac{.162}{10.5} \times 100 = 1.54\%$

MAX. ALLOWABLE DEFLECTION = 2%.

THE REAR FUSELAGE SKIN PANELS MEET THE DEFLECTION REQUIREMENTS.



REPORT NO.

7-0559-7

SHEET NO

PREPARED BY

DATE _____

JARMAN

AUG '56.

CHECKED BY

DATE _____

AIRCRAFT:

C. 105

REAR FUSELAGE

"LIMIT AIR LOAD + 2g."
BUCKLING CRITERIA

IN ALL CASES APPLIED LOADS ARE 'LIMIT AIR-LOAD + 2g INERTIA LOAD.'

TOP SKIN: -

(a). PANELS BETWEEN STN^s 742.5 AND 753 — $(10.5' \times 15' \times .04" Mg)$
ULT. APPLIED SHEAR FLOW, $q = 15 \text{ lbs/in}$. $\therefore$ SHEAR STRESS $\tau = \frac{15}{.04} = 375 \text{ psi}$
PANELS WILL NOT BUCKLE.

(b) PANELS BETWEEN STNS 753 AND 758. $\div (70" \times 5" \times .04" \text{ Mg})$
FROM SHT. SHEAR BUCKLING STRESS $C_{cr} = 2770 \text{ psi}$.

TO FIND: LIMIT AIR-LOAD +2g INERTIA LOADS AT S.N. 7555:-
AT S.N. 7555

GIVES SHEAR = $\frac{23560}{1364} + \frac{5692 \times 2}{10} = 18388$ LB.

AND CORRESPONDING SHEAR FORCE AT SJN 758 = $\frac{21830}{1364} + \frac{5434 \times 2}{10} = 17057$ LB.

(FROM RPT 7-0559-1, ISS 6 SAT 3-7.)

SHEAR AT STN. 7553 = 17,723 LB.

USING UNIT CASES OF RPT 7-0559-4 SHG. 1-17.

APPLIED SHEAR FLOW AT 755°C = 112 LB/IN.

APPLIED STRESS $\sigma = 2800 \text{ psi}$

1. PANEL ONLY JUST BUCKLES.

IF SHEAR RELIEF DUE TO LONGERON SLOPE WAS INCLUDED, THE PANEL WOULD NOT BUCKLE.

③. PANELS BETWEEN 758 AND 763:- (9"x5"x.04" Mg).

$$\text{SHEAR FORCE AT STN. 763 (FROM LIMIT AIR-LOAD + 2g)} = \frac{20800}{1364} + \frac{5179}{5}$$

$$= 1568 \text{ LB}$$

FROM RPT 7-0559-4 DTD 1-17, SHEAR FLOW AT E-JT 763 = 107 LB/IN.

755 = 112 LB/100

760.5 = 109 LB/100

APPLIED SHEAR STRESS AT $S_{11} 760.4 = 2725 \text{ PSI}$

SHEAR BUCKLING STRESS $\tau_{CR} = K_S \left(\frac{t}{L} \right)^2 \frac{G}{C} = \frac{9}{6} = 1.8$ $K_S = 6$



AVRO AIRCRAFT LIMITED
MALTON - ONTARIO

TECHNICAL DEPARTMENT

REPORT NO.

7-0559-7

SHEET NO.

8

AIRCRAFT:

C. 105

REAR FUSELAGE

BUCKLING CRITERIA (CONTD)

PREPARED BY

JARMAN

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DATE

AUG '56

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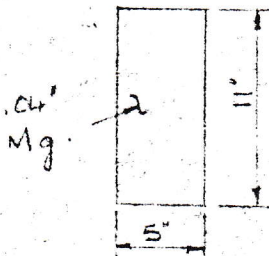
LIMIT AIR-LOAD + 2g INERTIA LOAD, BUCKLING CRITERIA (CONTD):-

SINCE THE PANEL BETWEEN 758 AND 763 BUCKLES, IT WAS AGREED WITH THE AERODYNAMICS DEPT. (J HODGE) THAT IF THE BUCKLES WERE NO GREATER THAN 1%, THE PANEL WOULD STILL BE ACCEPTABLE.

DEPTH OF BUCKLES WILL BE ESTIMATED BY COMPARISON WITH TEST PANEL RESULTS, AS FOLLOWS:-

FROM AVRO, ADVANCE TEST RESULTS (19TH APRIL '55)

"RT No 08-243 ADD. 1, 3, 4 AND 5 ATR. No 2402
PANEL M₃, SHEET MATH .04" QQ-NI-54 COND. A.
DIMENSIONS 11" X 5" X .04" Mg."



$$\frac{\tau}{\tau_c} = \frac{3780}{2520} = 1.54$$

INITIAL BUCKLING LOAD = 6000 LB.

BUCKLING SHEAR STRESS $\tau_c = 2520 \text{ psi}$

AT 9000 LB (3780 psi), DEPTH OF PANEL BUCKLES = .02" TO .06"

i.e. BUCKLES ALONG 11" SIDE OF .18% TO .55%
AND " " 5" " .14% TO .12%

BY COMPARISON, THE PANEL BETWEEN STN 758 AND 763, HAS THE SAME SHEAR BUCKLING STRESS (2500 psi) AND A LOWER APPLIED SHEAR STRESS (2725 psi, COMPARED WITH 3780 psi), SO THAT THE BUCKLES ARE WELL BELOW 1%.

(d) PANELS BETWEEN STN. 763 AND 803:-

APPLIED SHEAR FLOW DECREASES ALMOST LINEARLY FROM STN 742 TO STN. 803, THEREFORE ALL PANELS AFT OF STN. 763 ARE SATISFACTORY.



AVRO AIRCRAFT LIMITED
MALTON - ONTARIO

TECHNICAL DEPARTMENT

REPORT NO.

7-0559-7

SHEET NO.

9

AIRCRAFT:

C. 105.

REAR FUSELAGE

BUCKLING CRITERIA.

PREPARED BY

JARMAN.

CHECKED BY

DATE

AUG. 56

DATE

"LIMIT AIR-LOAD + 2g INERTIA LOAD" BUCKLING CRITERIA (CONT'D).

SIDE SKINS:-

LOADING:- "LIMIT AIR-LOAD + 2g INERTIA LOAD"

A ROUGH ESTIMATE OF THIS WILL BE OBTAINED BY FACTORING THE VALUES OBTAINED FOR THE TOP SKIN PANELS.

② PANELS BETWEEN STN 742.5 AND 753:- (10.5" x 16" x .04" Mg).

SHEAR BUCKLING STRESS, $\tau_{cr} = 1750 \text{ psi}$ (FROM SHT. ...)

APPLIED SHEAR FLOW, $q = \frac{18388 \times 42.2}{10,000}$ (RPT 7-0559-4 SHT 1-17)
 $= 77.8 \text{ lb/in.}$

APPLIED SHEAR STRESS $\tau = 1945 \text{ psi}$

$\frac{\tau}{\tau_{cr}} = \frac{1945}{1750} = 1.11$ COMPARED WITH 1.54 OF THE TEST PANEL.

ABOVE PANEL BUCKLED BUT IS STILL ACCEPTABLE (BUCKLES BEING $< 1\%$.)

⑥ PANELS BETWEEN STN 753 AND 803.

APPLIED SHEAR FLOW DECREASES ALMOST LINEARLY FROM STN. 753 TO STN. 803.

APPLIED SHEAR STRESS AT STN. 753, $\tau = 1945 \text{ psi}$.

FROM SHT. SHEAR BUCKLING STRESS $\tau_{cr} > 2040 \text{ psi}$.

PANELS BETWEEN 753 AND 803 WILL NOT BUCKLE (UNDER LIMIT AIR-LOAD + 2g).

THE TOP AND SIDE SKINS MEET THE REQUIREMENT FOR NO BUCKLES GREATER THAN 1% WHEN SUBJECTED TO LIMIT AIR-LOAD + 2g INERTIA LOAD.



AVRO AIRCRAFT LIMITED
MALTON - ONTARIO

TECHNICAL DEPARTMENT

REPORT NO.

7-0559-7

SHEET NO

10

AIRCRAFT:

C. 105.

REAR FUSELAGE

PANEL FLUTTER

PREPARED BY

JARMAN.

DATE

DEC. '55.

CHECKED BY

DATE

REF. - AVRO J. MCKILLOP 3.13.54 2400/08/GEN.

TOP SKIN PANELS ARE THE LARGEST AND WILL BE THE MOST CRITICAL.

29" x 5" x .04" Mg. PANEL.

$$\frac{a}{b} = \frac{29}{5} = 5.8.$$

FROM SHEET 3A. OF ABOVE REF.

FOR 5" PANEL WIDTH $f_{\infty} = 3600$ C.P.S.

$$\text{TRUE } f_{\infty} = 3600 \times .040 = 144 \text{ C.P.S.}$$

FROM SHT. 4. $\frac{f}{f_{\infty}} \approx 1.05.$

NATURAL FREQUENCY OF PANEL, $f = 144 \times 1.05 = 151 \text{ C.P.S.}$

NATURAL FREQUENCY OF AIRCRAFT $\approx 30 \text{ C.P.S.}$

ABOVE PANELS ARE SATISFACTORY.

PANELS BETWEEN ST. 742.5 AND 753. -

LARGEST PANEL IS 10.5" x 13" x .04" Mg

FROM SHEET 3A. $f_{\infty} = 860$ C.P.S.

$$\text{TRUE } f_{\infty} = 860 \times .04 = 34.4 \text{ C.P.S.}$$

$$\frac{a}{b} = \frac{13}{10.5} = 1.238.$$

FROM SHT 4. $\frac{f}{f_{\infty}} = 1.662.$

NATURAL FREQUENCY = $1.662 \times 34.4 = 57.2 \text{ C.P.S.}$

NATURAL FREQUENCY OF AIRCRAFT = 30 C.P.S., AND ALL

PANELS VIBRATING AT ABOUT 60 C.P.S. OR GREATER ARE CONSIDERED SAFE

ABOVE PANEL IS SATISFACTORY.

NOTE:-

USE OF AL INSTEAD OF Mg DOES NOT AFFECT THE FREQUENCY.

BECAUSE:-

$$\frac{E_{AL}}{E_{Mg}} \times \frac{\rho_{AL}}{\rho_{Mg}} = \frac{10.5}{10.5} = 1.$$



AVRO AIRCRAFT LIMITED
MALTON - ONTARIO

TECHNICAL DEPARTMENT

REPORT NO.

7-0559-7

SHEET NO.

11

PREPARED BY

DATE

JARMAN.

JULY '56.

CHECKED BY

DATE

AIRCRAFT:

C. 105

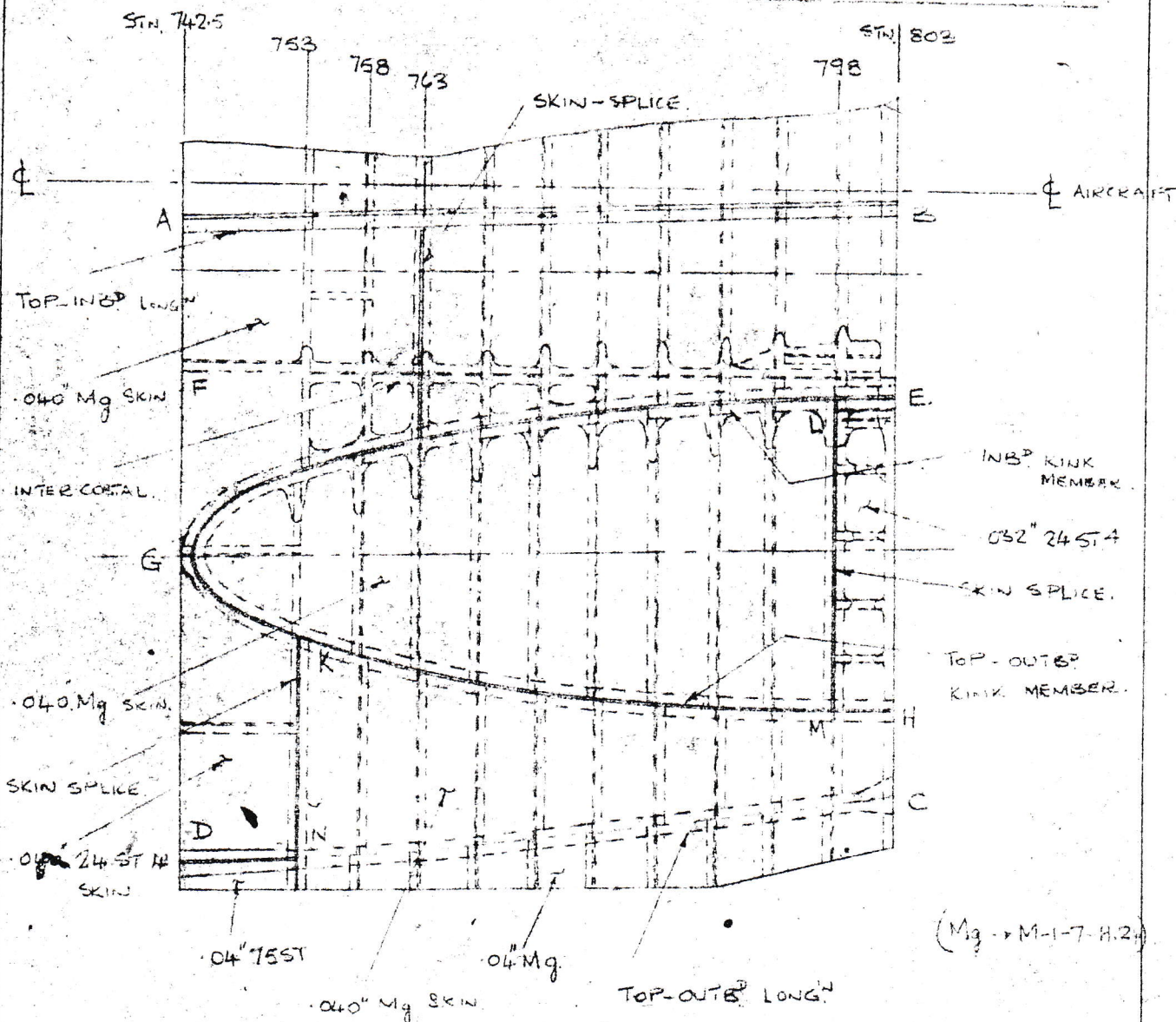
REAR FUSELAGE.

TOP SKINS

TOP SKINS.

SCHEME DRG No. 7-0159-86.

PRODUCTION DRG No. 7-1059-15



THE TOP SKIN CONSISTS OF MAGNESIUM ALLOY SHEETS, "ABEG", "LGM", AND "KHCH", AND 24ST4 AL-ALLOY SHEETS "EHML" AND "GKND".

FE IS THE INTERCOSTAL CONNECTING THE DUCT SKINS TO TOP SKIN. EG AND HG ARE THE INBD AND OUTBD KINK MEMBERS RESPECTIVELY, AND CONNECT THE FLAT SHEETS "ABEG" AND "HGDC", TO THE CURVED SHEET "EGH".

DC IS THE TOP-OUTBD LONGERON AND AB THE TOP-INBD LONGON OR DRAG ANGLE. BOTH ARE CONNECTED TO STRUCTURE FWD. OF STN 742.5.

(Mg - M-1-7-H.2)



AVRO AIRCRAFT LIMITED
MALTON ONTARIO

TECHNICAL DEPARTMENT

AIRCRAFT:

C. 105

REAR FUSELAGE

TOP SKIN

REPORT NO. 7-0559-7

SHEET NO. 12

PREPARED BY

DATE

VARMAN.

APR. '56

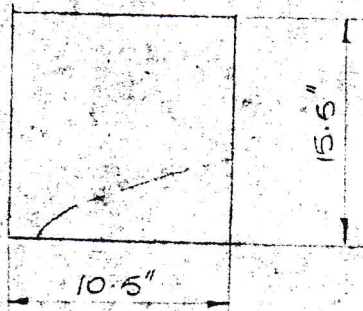
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PANELS BETWEEN STN. 742.5 AND 753 :-

SCHEM. DRG. NO. 7-0159-86

MODIFICATION. 7-10-4-15



MAX. PANEL DIMENSIONS ARE:-

15.5" x 10.5" x .04" Mg.

(i) MAX. APPLIED SHEAR FLOW, IN CASE 7.3a.

$q = 15 \text{ LB/IN.}$ (FROM 7-0559-4a
SHEET No. 20.a.)

ALSO, MAX. ULT AIRLOAD ON TOP

SKIN = $3 \times 1.364 = 4.09 \text{ p.s.i.}$

(ii)

IN PARACHUTE DRAG CASE WITH MAX LATERAL LOAD, (SHEET
SHEAR FLOW IN TOP SKIN (B-C) IS A MAX. $q = 176 \text{ LB/IN.}$

(i) CONSIDERING FIRST THE LOADS IN CASE 7.3a. -

FROM SECHLER AND DUNN, FOR FLAT PLATE UNDER NORMAL

AIR LOAD, DEFLECTION, $w = \eta_1 a \left(\frac{p_m a}{Et} \right)^{\frac{2}{3}}$
(IN TERMS OF MEMBRANE PRESSURE) $p_m = \frac{w^3 Et}{\eta_1^3 a^4}$

p_m = PRESSURE

a = LENGTH OF SIDE

η_1 = SIDE FACTOR

t = THICKNESS

FROM TIMOSHENKO (PLATES AND SHELLS), p. 206.

DEFLECTION, $w_{MAX} = \alpha \frac{p_b b^4}{Et^3}$
(IN TERMS OF BENDING PRESSURE)

$$p_b = \frac{w Et^3}{\alpha b^4}$$

APPLIED PRESSURE $p = p_m + p_b$ (ie. $p_{MEMBRANE}$ AND $p_{BENDING}$)

$$\frac{w^3 Et}{\eta_1^3 a^4} + \frac{w Et^3}{\alpha b^4} - p = 0.$$

$$ie. \quad w^3 + w t^2 \frac{\eta_1^3}{\alpha} \left(\frac{a}{b} \right)^4 - \frac{p \eta_1^3 a^4}{Et} = 0.$$

FROM SECHLER AND DUNN, FOR $\frac{a}{b} = \frac{15.5}{10.5} = 1.475$, $\eta_1 = .232$

FROM TIMOSHENKO (TWO SIDES FIXED) $\alpha = .027$



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REPORT NO. 7-0559-7

SHEET NO. 13

AIRCRAFT:

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REAR FUSELAGE.

TOP SKIN.

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PANELS BETWEEN 742.5 AND 753 (CONT'D): -

$$w^3 + w \times .04^2 \times \frac{232^3}{.027} \times 1.475^4 - \frac{4.09 \times 232^3 \times 15.5^4}{6.5 \times 10^6 \times .04} = 0$$

$$i.e. w^3 + .00392 w - .01133 = 0$$

$$w = .220 \text{ IN.}$$

CHECK: -

$$p_m + p_b = p = 4.09 \text{ lb/in}^2$$

$$i.e. \frac{220^3 \times 6.5 \times 10^6 \times .04}{232^3 \times 15.5^4} + \frac{220 \times 6.5 \times 10^6 \times .04^3}{.027 \times 10.5^4} = 4.09$$

$$220^3 = .01063; 232^3 = .01248; 10.5^4 = 1.215 \times 10^4; 15.5^4 = 5.77 \times 10^4$$

$$3.83 + .273 = 4.09$$

$$4.103 = 4.09$$

STRESS FROM MEMBRANE TENSION: -

(REF. SECHLER AND DUNN. PG. 290.)

$$(STRESS AT MIDDLE OF LONG SIDE) \sigma_{MAX} = n_b \left\{ E \left(\frac{p_m a}{t} \right)^2 \right\}^{\frac{1}{3}}$$

$$\text{FOR } \frac{a}{b} = 1.475, n_b = .365 \therefore \sigma = .365 \left\{ 6.5 \times 10^6 \left(\frac{3.83 \times 15.5}{.04} \right)^2 \right\}^{\frac{1}{3}}$$

$$= .365 \times 24,300$$

$$= 8870 \text{ PSI.}$$

$$\text{LOAD/IN. (ACTING AXIALLY)} q_m = 8870 \times .04$$

$$= 355 \text{ LB/IN (ALONG FORMERS)}$$

STRESS FROM BENDING: -

REF TIMOSHENKO, "PLATES AND SHELLS" PG. 228

$$\text{B.M. AT MIDDLE OF LONG SIDE } M_x = \beta p_b b^2 \text{ LB.IN/IN.}$$

$$\text{FOR } \frac{a}{b} = \frac{15.5}{10.5} = 1.475, \beta = .075 \therefore M_x = .075 \times .273 \times 10.5^2$$

$$= .226 \text{ LB.IN/IN.}$$

$$\text{BENDING STRESS } \sigma_b = \frac{6M}{t^2} \text{ PSI/IN.} = \frac{6 \times .226}{.04^2} = 8470 \text{ PSI.}$$



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7-0559-7

SHEET NO.

14

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AIRCRAFT:

C. 105

REAR FUSELAGE

TOP SKIN.

PANELS BETWEEN 742.5 AND 753 (CONTD) -

STRESS FROM SHEAR FLOW:-

FROM 7-0559-4 SHEET 11-19, APPLIED SHEAR FLOW IN CASE 730.

$$\text{APPLIED SHEAR STRESS, } f_s = \frac{9.83}{.04} = 246 \text{ PSI} = 9.83 \text{ LB./IN.}$$

COMBINING MEMBRANE TENSION, BENDING AND SHEAR AT MIDDLE OF LONG SIDE.

(FROM ROARK pg. 91.) $\text{PRINCIPAL STRESS} = \frac{1}{2}(S_1 + S_2) + \sqrt{\frac{(S_1 - S_2)^2}{2} + S_s^2}$

S_1 = BENDING + MEMBRANE STRESSES

$$= (8470 + 8870)$$

$$= 17340 \text{ PSI}$$

$$S_2 = K_1 \left(E \left[\frac{p a}{t} \right]^2 \right)^{\frac{1}{2}} = .11 \times 24,300$$

$$= 2670 \text{ PSI}$$

$$S_s = 246 \text{ PSI}$$

$$\begin{aligned} \therefore \text{PRINCIPAL STRESS (AT MIDDLE OF LONG SIDE)} &= \frac{1}{2}(17340 + 2670) + \sqrt{\frac{(17340 - 2670)^2}{2} + 246^2} \\ &= 10,005 + \sqrt{7,335^2 + 246^2} \\ &= 17,345 \text{ LB./IN.}^2 \end{aligned}$$

$$F_{TU} (.04 \text{ Mg SKIN}) \text{ AFTER HEATING TO } 279^\circ \text{F.} = 40,000 \text{ PSI}$$

M.S.

>1.



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TECHNICAL DEPARTMENT

REPORT NO.

7-0559-7

SHEET NO.

15

AIRCRAFT:

C.105.

REAR FUSELAGE.

TOP SKIN.

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PANELS BETWEEN 742.5 AND 753. (CONT'D.) -

RIVETING ALONG SKIN SPLICES:

APPLIED LOADS ARE FROM (1) MEMBRANE TENSION
(2) APPLIED SHEAR.

APPLIED LOAD/IN (FROM MEMBRANE TENSION) = 355 LB/IN.

" SHEAR FLOW (CASE 73a) = 9.83 LB/IN.

∴ TOTAL APPLIED LOAD/IN. = $\sqrt{(355)^2 + 9.83^2}$
= 355 LB/IN.

BEARING STRENGTH OF $\frac{1}{8}$ " DIA CSK BLIND RIVETS IN .040 Mg. AFTER
EXPOSURE TO 261°F = $200 \times .85 \times .985$
= 168 LB.

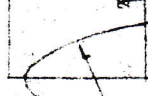
RIVET PITCH = .5 IN. ∴ APPLIED LOAD/RIVET = 5×355
= 178 LB.

M.S. -06

IT WAS FELT THAT THE STIFFENING EFFECT OF THE KINK MEMBERS
WOULD REDUCE THE NOMINAL LENGTH OF THE PANEL, THEREBY
REDUCING THE MEMBRANE TENSION AND THE LOAD/RIVET, SO THAT
THE ABOVE NEGATIVE MARGIN IS ACCEPTABLE.

STN. 742.5 753

PANEL



KINK MEMBER

(D. SPROSON.)

M.S. 0.



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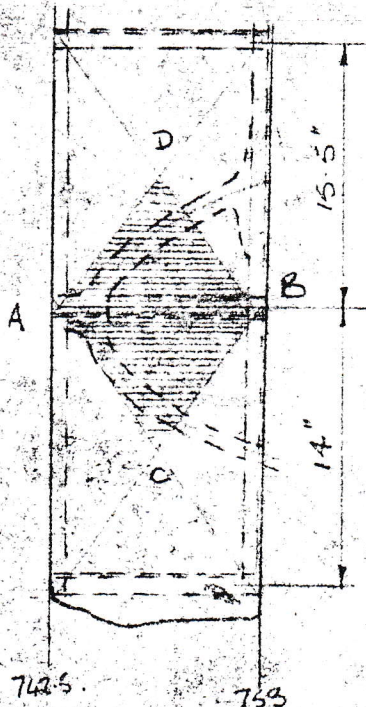
AIRCRAFT:

G. 105.

REAR FUSELAGE.

TOP SKIN.

STIFFENERS IN PANELS BETWEEN 742.5 AND 753:-



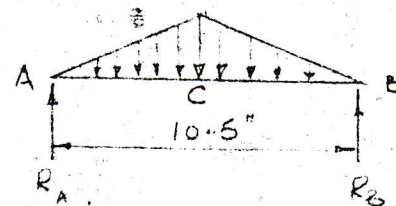
FROM CASE 7.3.2.

LIMIT NORMAL PRESSURE = 3.0 P.S.I.

MULT " " = 3.0 x 1.364 P.S.I.

= 4.09 P.S.I.

ASSUME THAT STIFFENER AB CARRIES THE PRESSURE ON THE SHADED AREA. LOAD DISTRIBUTION IS SHOWN BELOW.

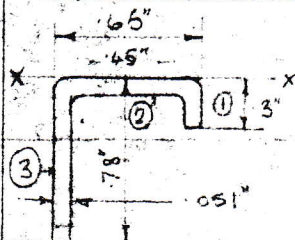


LOAD AT CENTRE C:-

$$\text{TOTAL LOAD ON SHADED AREA } ABCD = 4.09 \times \frac{10.5}{2} \left(\frac{15.5}{2} + \frac{14}{2} \right) = 317.0 \text{ LB.}$$

$$\begin{aligned} \text{BM AT C. } M_C &= R_B \times \frac{10.5}{2} - \frac{317}{2} \times \left(\frac{10.5}{2} \right) \frac{1}{2} \\ R_B &= \frac{317}{2} = 158.5 \text{ LB.} \\ M_C &= \frac{317}{2} \times \frac{10.5}{2} \left(1 - \frac{1}{3} \right) = 555 \text{ LB. IN.} \end{aligned}$$

TO FIND I OF ANGLE AB:-



ITEM	AREA (IN ²)	$\bar{y}_x$	$A\bar{y}_x$	$A\bar{y}_x^2$	I_{NA}
1	$.051 \times 3 = .01530$	.15	.002295	.000344	.000115
2	$.051 \times 4.5 = .02295$	.0255	.000585	.000015	.000005
3	$.051 \times 7.8 = .03980$	.39	.015520	.006050	.002020
TOTAL	.07775		.01840	.006409	.002140

$$\bar{y} = \frac{.0184}{.07775} = .2365 \quad I_{AG} = .00436 \quad I = A\bar{y}^2 + I_{NA} - A\bar{y}^2 = .008549 - .00436$$

TECHNICAL DEPARTMENT (Aircraft)

REPORT NO.

7-0559-7

SHEET NO.

17

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AIRCRAFT:

C. 105

REAR FUSELAGE

TOP SKIN.

BENDING STRESS,

$$\text{TENSION, } f_t = \frac{My_t}{I} = \frac{555 \times (78 - 2365)}{004189} = 72,000 \text{ PSI.}$$

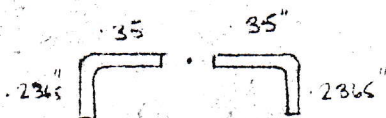
$$F_{TU} \text{ (AFTER HEATING TO } 260^\circ\text{F)} = .96 \times 72,000 = 69,100 \text{ PSI.}$$

$$\text{COMPRESSION, } f_c = \frac{My_c}{I} = \frac{422 \times (.2365)}{004189} = 23,850 \text{ PSI.}$$

M.S.

(SEE BELOW)

LOCAL INSTABILITY STRESS:-



(NEEDHAM'S METHOD).

$$\frac{a+b}{2t} = \frac{35 + 2365}{2 \times .051} = \frac{.5865}{.102} = 5.75.$$

$$\text{FROM GRAPH, } F_{cc} = F_{cy} = 64,000 \text{ PSI.}$$

$$\text{AND } F_{cy} \text{ (AFTER HEATING TO } 260^\circ\text{F)} = .94 \times 64,000 \text{ PSI.} = 60,100 \text{ PSI.}$$

NO SKIN HAS BEEN INCLUDED IN THE BENDING SECTION, SO IT WILL BE INCLUDED BELOW.

$$\text{TAKE BOT SKIN (Mg). } A_s' = 30t^2 = 30 \times .04^2 = .048 \text{ Mg} \equiv .048 \times \frac{6.5}{10.3} = .0303 \text{ IN}^2$$

$$A_{sy} = .0303 \times .02 = .0006 \quad A_y^2 = .000012 \text{ IN}^4$$

$$I_{NA} = .000001 \text{ IN}^4$$

$$\therefore \text{NEW } I = .002409 + .000012 + .002141 = .004562 \text{ IN}^4$$

$$\bar{y} = .1758 \text{ IN.}$$

$$\text{AND } f_t = \frac{555(78 - .1758)}{.004562} = 1,112,000 \text{ PSI.}$$

$$M.S. = \frac{60100}{23800} - 1 > 1.$$



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TECHNICAL DEPARTMENT

REPORT NO. **7-0559-7**

SHEET NO. **18**

AIRCRAFT:

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REAR FUSELAGE.

**CLIPS FOR STIFFENERS
IN TOP SKIN.**

PREPARED BY

JARMAN.

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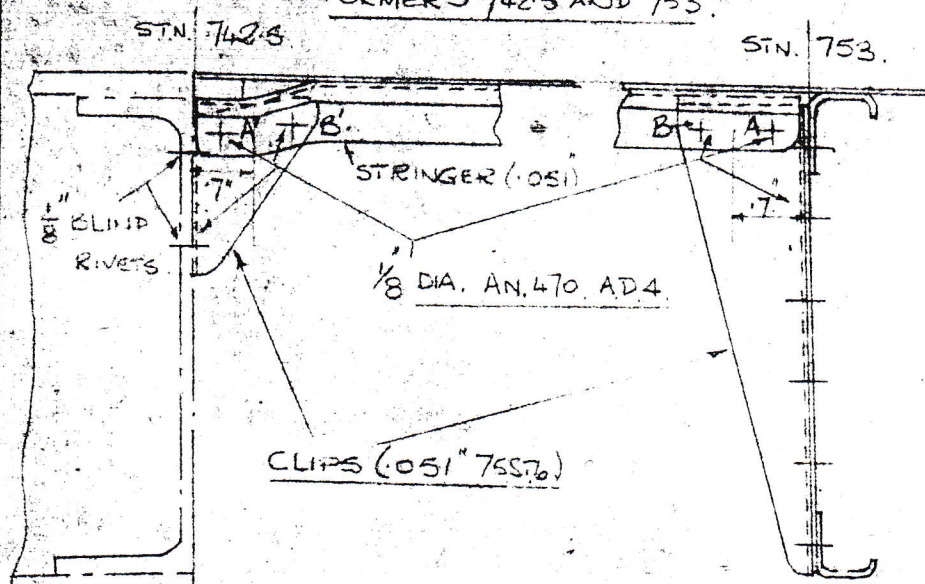
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**ATTACHMENT OF STIFFENERS (IN TOP SKIN) TO
FORMERS 742.5 AND 753.**

**DRG. NO 7-1059 - 5053
5054.**



AT STN. 753, (REF SH.)

FROM NORMAL AIRLOAD ON TOP SKIN (CASE 7.3.9), APPLIED LOAD AT
CLIP = 159 LB. THIS IS REACTED BY THE FORMER WEB THROUGH
6, 1/8" DIA RIVETS. LOAD / RIVET = 27 LB. M.S. > 1.

RIVETS A AND B CARRY 159 LB. TOGETHER WITH A MOMT (159 x .7)

$$\text{APPLIED LOAD ON RIVET A} = \frac{159}{2} + \frac{111}{.75} = (79 + 148) = 227 \text{ LB.}$$

$$\text{SHEAR STRENGTH OF } \frac{1}{8} \text{ DIA RIVET IN .051 .75 ST. 6 AFTER EXPOSURE TO } 279^{\circ}\text{F.} \\ = 388 \times .88 = 342 \text{ LB.}$$

$$\text{APPLIED LOAD ON RIVET B} = 79 - 148 = 69 \text{ LB.}$$

$$\text{M.S.} = \frac{342}{227} - 1 = .51$$

AT STN. 742.5

$$\text{APPLIED LOAD ON RIVET A'} = \frac{159}{2} + \frac{159 \times .7}{.75} = 227 \text{ LB.}$$

$$\text{SHEAR STRENGTH, } \frac{1}{8} \text{ DIA RIVET} = 342 \text{ LB.}$$

$$\text{M.S.} = .51$$



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SHEET NO. 19

AIRCRAFT:

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PARACHUTE BOX

TOP SKIN

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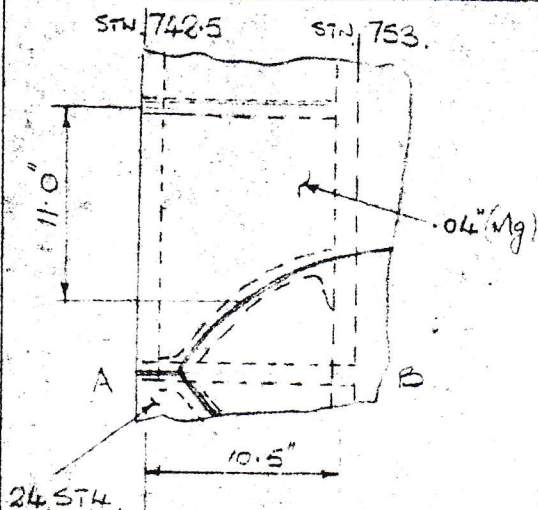
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PANELS BETWEEN 742.5 AND 753 UNDER MAX. SHEAR LOADS:-



AIR LOADS IN THE PARACHUTE CASES ARE SMALL, AND WILL BE NEGLECTED.

MAX. APPLIED SHEAR FLOW, OCCURS IN THE PARACHUTE CASE WITH MAX. LATERAL LOAD,
 $q = 176 \text{ LB/IN.}$ (SHEET NO. 5)

$$\tau = \frac{176}{.04} = 4400 \text{ p.s.i.}$$

ASSUME PANEL IS 11" x 10.5" x .04 (Mg)

SHEAR BUCKLING STRESS, $\tau_{cr} = K_s E \left(\frac{t}{b} \right)^2$

$$a/b = \frac{11}{10.5} = 1.048$$

FROM BRUHN, FIG. B. 2-5, $K_s = 7.9$

$$\tau_{cr} = 7.9 \times 6.5 \times 10^6 \times \left(\frac{.04}{10.5} \right)^2 = 744.0 \text{ p.s.i.}$$

$$\frac{\tau}{\tau_{cr}} = \frac{4400}{744} = 5.92$$

FROM A.E.M. SECT. V, FIG. 224-2, $K = .366$

RIVETING ALONG SKIN EDGE AND SPLICE:-

$$q_r = q (1 + .414 K) = 176 (1 + .414 \times .366) = 202.5 \text{ LB/IN.}$$

RIVET PITCH = 5 IN. APPLIED LOAD / RIVET = 101. LB.

BEARING STRENGTH OF 1/8" DIA. BLIND RIVET IN .040" Mg. SKIN AFTER EXPOSURE TO 270°F
 $= 200 \times .85 \times .944 \text{ (TEMP.)}$
 $= 160 \text{ LB.}$

$$\therefore M.S. = \frac{160}{101} - 1 = .58$$

(NOTE:- LOADS FROM MEMBRANE TENSION ARE MORE SEVERE.)



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REPORT NO. **7-0559-7**

SHEET NO. **20**

AIRCRAFT:

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REAR FUSELAGE:

TOP SKIN.

PREPARED BY

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PANELS BETWEEN 742.5 AND 753. UNDER SHEAR (CONT'D.)

TO DETERMINE STRESS IN UPRIGHT AB

FROM NACA. TN. 2661, PG. 41.

$$A_{ue} = \frac{A_u}{1 + \left(\frac{e}{\rho}\right)^2}$$

$$A_u = 0.7775 \text{ in}^2 \text{ (NO SKIN INCLUDED)}$$

$$t = .051 \text{ in}$$

DISTANCE TO WEB MEDIAN FROM SECTION CENTROID, $e = .2365 \text{ in}$.

$$\text{RAD. OF GYRATION ABOUT CENTROID, } \rho = \sqrt{\frac{I}{A}} = \sqrt{\frac{.004189}{.07775}} = .232 \text{ in}$$

$$A_{ue} = \frac{.07775}{1 + \left(\frac{.2365}{.232}\right)^2} = .0381 \text{ in}^2$$

$$\frac{A_{ue}}{dt} = \frac{.0381}{11 \times .051} = .068$$

$$K = .366$$

NACA. TN. 2661, FIG. 14, GIVES.

$$\frac{\sigma_u}{\tau} = .80$$

$$\text{BUT } \tau = 4400 \text{ psi}$$

$$\sigma_u = 3520 \text{ psi}$$

FROM FIG. 15, FOR $K = .366$ AND $\frac{h_u}{d} = .955$.

$$\frac{\sigma_{u \text{ MAX}}}{\sigma_u} = 1.11$$

$$\sigma_{u \text{ MAX}} = 1.11 \times 3520 = 3910 \text{ psi}$$

CHECK UPRIGHT FOR COLUMN, AND CRIPPLING FAILURE :-

$$\text{AVERAGE APPLIED STRESS, } \sigma_u = 1475 \text{ psi}$$

$$L = 11 \text{ in. } \rho = .232$$

$$\frac{L}{\rho} = \frac{11}{.232} = 47.4 \therefore f_c (\text{COLUMN}) = 42500 \text{ psi}$$

$$\frac{t_u}{t} = \frac{.051}{.04 \times \frac{10.3}{10.3}} = 2.02$$

FROM NOMOGRAM FIG. 20. b (75516) ALLOWABLE UPRIGHT STRESS,
(FORCED CRIPPLING) = 21,200 psi

M.S.

>1



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REPORT NO. 7-0559-7

SHEET NO. 21

AIRCRAFT:

C. 105

REAR FUSELAGE.

TOP SKIN.

PREPARED BY

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STRENGTH OF WEB WHEN SUBJECTED TO SHEAR:-

PANELS BETWEEN 753 AND 742.5 (CONT'D):-

FROM BRUHN C.77,

SHEAR LOAD CARRIED BY WEB AFTER BUCKLING,

$$V_{tu} = \left(F_{tu} - \frac{\tau_{cr}}{k_t} \right) k_t R h t \sin \alpha \cos \alpha. \quad (\text{STRESSING TO ULTIMATE})$$

WHERE $h = 10.5 \text{ in.}$ $\alpha = ?$ $k_t = ?$

$t = .04 \text{ in. Mg}$ $R = ?$ $\tau_{cr} = 744 \text{ psi}$

FOR .04" Mg (M-1-7-H24) $F_{tu} = 40,590 \text{ psi}$

TO FIND k_t :-

$$k_t = \frac{\text{RIVET SPACING} - \text{RIVET DIA}}{\text{RIVET SPACING}} = \frac{5 - 1.25}{5} = .75$$

TO FIND THE ANGLE OF DIAGONAL TENSION α :-

FROM BRUHN C.74. EQN. 13.

$$\sin^2 \alpha = \sqrt{(a^2 + a)} - a$$

$$\text{WHERE } a = \frac{1 + \frac{ht}{A_u + A_L}}{\frac{ht}{A_s} - \frac{ht}{A_u + A_L}}$$

$$= \frac{1 + \frac{10.5 \times .04}{.0727 + .1625}}{\frac{15.5 \times .04}{.0775} - \frac{10.5 \times .04}{.0727 + .1625}}$$

$$= \frac{2.786}{7.97 - 1.786}$$

$$= \frac{2.786}{6.184}$$

$$= .45$$

$$\sin^2 \alpha = \sqrt{.45^2 + .45} - .45$$

$$= .3575$$

$$\sin \alpha = .5975$$

$$\alpha = 36^\circ 46'$$

A_u = AREA OF UPPER 753

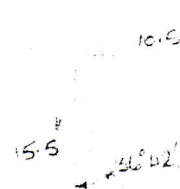
A_L = " " " " 742.5

A_s = AREA OF STIFFENER

$$A_u = .051 (24.8 + 54.8 + .028) = .0727 \text{ in}^2$$

$$A_L = .02 (1.07 + .16) = .1625 \text{ in}^2$$

$$A_s \text{ (FROM SHEET 16)} = .0775 \text{ in}^2$$





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REPORT NO. **7-0559-7**

SHEET NO. **2/2**

AIRCRAFT:

C. 105

REAR FUSELAGE

STRENGTH OF SHEAR WEB
PANEL STD 7475 TO 755 (CONT'D)

PREPARED BY

JARMAN

DATE

SEPT '54

CHECKED BY

DATE

TO FIND THE STRESS CONCENTRATION FACTOR FOR THE WEB DUE TO FLANGE DEFLECTION **R**

FROM BROWN C74, EQN. 14,

$$\begin{aligned} Wd &= 1.25d \sin \alpha \left(4 \sqrt{\frac{t}{I_u + I_L}} h \right) \\ &= 1.25 \times 11.0 \times 5975 \times \left(4 \sqrt{\frac{.04}{(1.00289 + .00105) 10.5}} \right) \\ &= 822 \times .639 \\ &= 4775 \end{aligned}$$

FROM 70501 - 20, SHEET 105,

$$I_u = .00289 \text{ in}^4$$

$$I_L = .00105 \text{ in}^4$$

FROM BROWN FIG. C.7-12, **R = .42**

SHEAR LOAD CARRIED BY WEB AFTER BUCKLING

$$\begin{aligned} V_{TU} &= (F_{TU} - \frac{C_u}{K_4}) K_4 R L \text{ (SEE FIG. C.7-12)} \\ &= \left(40000 - \frac{744}{75} \right) 75 \times .42 \times 10.5 \times .04 \times 5975 \times .8019 \\ &= 39008 \times .0634 \\ &= 2472 \text{ LB} \end{aligned}$$

$$K_4 = 5975$$

$$C_u = 744$$

$$\begin{aligned} \text{TOTAL ULTIMATE SHEAR RESISTANCE OF WEB} &= 2472 \text{ LBS (744 X .00105)} \\ &= 2784 \text{ LBS OR (6630 PSI)} \end{aligned}$$

APPLIED SHEAR STRESS **S** = $\frac{176}{104}$

$$= 44.00 \text{ PSI}$$

$$N.F. = \frac{2784}{4400} - 1 = .51$$



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REPORT NO.

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SHEET NO.

23

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JULY '56

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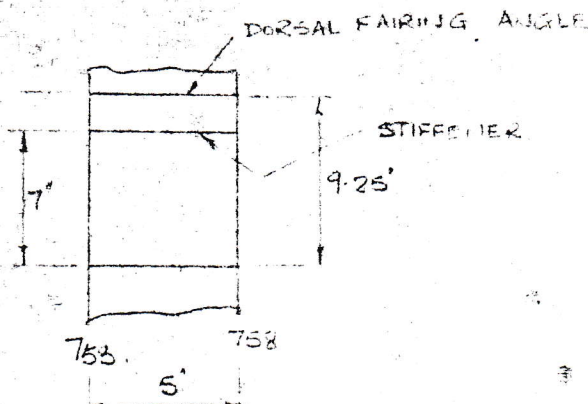
AIRCRAFT:

C. 105

REAR FUSELAGE

TOP SKIN

TOP-CENTRE PANEL STNG 758 TO 758:-



PANEL 7.0 X 5' X .005" Mg. SKIN

$$\frac{a}{b} = \frac{7.0}{5} = 1.40$$

SHEAR BUCKLING STRESS

$$\tau_{cr} = K_s E \left(\frac{t}{L} \right)^2$$

FROM BRUHNS FIG B.2-5

$$K_s = 6.67$$

$$\tau_{cr} = 6.67 \times 6.5 \times 10^4 \times \left(\frac{.04}{5} \right)^2$$

$$= 2770 \text{ p.s.i.}$$

APPLIED SHEAR FLOW, $q = 264 \text{ LB/L}$ (FROM SHEETING)
PARACHUTE STREAMING CASE WITH MAX. LATE LOAD

$$\text{APPLIED SHEAR STRESS } \tau = \frac{264}{.04} = 6600 \text{ p.s.i.}$$

$$\frac{\tau}{\tau_{cr}} = \frac{6600}{2770} = 2.385$$

FROM AEM. FIG. 2.24-2 DIAGONAL TENSION FACTOR, $K = 1.85$

STRESS IN UPRIGHT:-

FROM AEM. SECT. V. 2.22.3

$$\text{EFFECTIVE UPRIGHT AREA, } A_{ue} = \frac{A_u}{1 + (e/p)^2}$$

WHERE $A_u \equiv$ UPRIGHT AREA, (NO WEBS INCLUDED)

$e \equiv$ DISTANCE OF UPRIGHT CENTROID TO WEBS

$p \equiv$ RAD. OF GYR. OF UPRIGHT II TO WEBS (NO WEBS INCLUDED)



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AIRCRAFT:

C 105.

REAR FUSELAGE

TOP SKIN.

TOP-CENTRE (753-758)

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JARMAN.

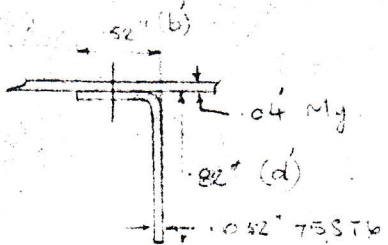
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STRESS IN UPRIGHT (CONT'D) :-



$$A_u = .032 (.50 + .80) \\ = .0416 \text{ in}^2$$

FROM AEM. FIG. 4.16-2, WITH $\frac{d'}{b'} = \frac{.82}{.52}$

$$\frac{d'}{b'} = \frac{.82}{.52} = 1.577$$

$$\text{THEN } K_2 = .3252$$

$$\text{AND } \rho = .3252 \times .82 \\ = .2665 \text{ in.}$$

FROM AEM. FIG. 4.16-1, $K_1 = .321$

$$c = .321 \times .82 \\ = .263 \text{ in.}$$

$$A_{ue} = \frac{.0416}{1 + \left(\frac{.263}{.2665}\right)^2} = .0211$$

$$\frac{A_{ue}}{dt} = \frac{.0211}{7 \times .032} = .09425$$

$$K = .175$$

FROM AEM. FIG. 2.22-5, $\frac{\sigma_u}{\bar{\sigma}} = .34$

$$\bar{\sigma} = 6600 \text{ psi} \quad \therefore \text{AVERAGE COMPRESSION STRESS } \sigma_u = .34 \times 6600 \\ = 2245 \text{ psi}$$

AND FROM AEM. FIG. 2.22-5, FOR $\frac{d'}{h} = 1.4$ OR $\frac{h}{d} = .715$

$$\frac{\sigma_u}{\sigma_u} = 1.265 \quad \therefore \sigma_{u \text{ MAX}} = 1.265 \times 2245 = 2840 \text{ psi}$$

ALLOWABLE CRIPPLING STRESS, F_c :-

$$\frac{t_u}{t} = \frac{.032 \cdot 75376}{.04 \times \frac{6.5}{10.3}} = 1.27$$

(F_c = CRIPPLING BETWEEN TENSION-BELL BUCKLES)

FROM AEM. FIG. 2.22-10, $F_c = 9,200 \text{ psi}$

M.S.

RIVETING: PITCH = .54" APPLIED LOAD/RIVER = $2665 \times .54 = 137 \text{ LB}$

BRACING: STRENGTH $\frac{1}{8}$ " DIA RIVET CSK (852-125) AFTER EXPOSURE TO 279°F = $2000 \times .54 = 1080 \text{ LB}$



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AIRCRAFT:

C. 105.

REAR FUSELAGE

TOP SKIN.

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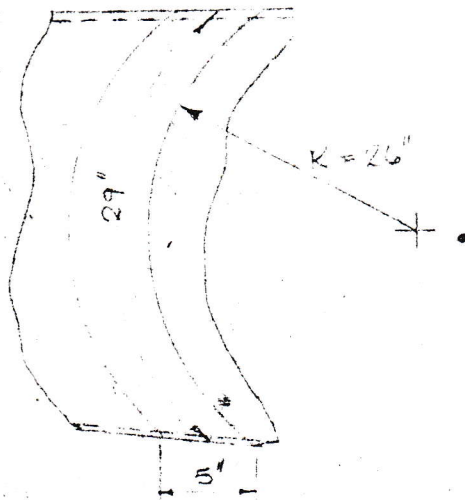
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TOP SKIN - LONG CURVED PANELS.

CRITICAL PANEL FOR LENGTH AND APPLIED LOAD IS THAT BETWEEN STNS 793 TO 798.

STN. 793 798.



$$h = 29", d = 5" t = .04 \text{ in. Mg.}$$

$$R = 26' E = 6.5 \times 10^6$$

FROM AEM. 224-2.

$$K = .954 \frac{d^2}{Rt} = .954 \frac{5^2}{26 \times .04} = 23.$$

$$\frac{h}{d} = \frac{29}{5} = 5.8$$

FROM FIG. 224-1b.

$$K_s = 9.8.$$

$$\frac{\tau}{\tau_{cr}} = K_s E \left(\frac{t}{b} \right)^2$$

$$\tau = 9.8 \times 6.5 \times 10^6 \times \left(\frac{.04}{5} \right)^2$$

$$= 4075 \text{ psi.}$$

MAX. APPLIED SHEAR FLOW

$$q = 183 \text{ lb./in. (SHEET 5)}$$

STRESS

$$\tau = 4560 \text{ psi.}$$

IN THIS STRESS LEVEL $\tau = 1.1 \tau_{cr} = 4075 \text{ psi.}$

i.e. PANEL BUCKLES.

$$\frac{\tau}{\tau_{cr}} = \frac{4560}{4075} = 1.118$$

$$\frac{300th}{Rd} = \frac{300 \times .04}{26} \times 2 = 9.23$$

FROM AEM. FIG. 224-2, DIAGONAL TENSION FACTOR, $K = 10.$

TO FIND STRENGTH OF WEB IN SHEAR -

TO FIND σ_{EDT}

PARAMETERS GIVEN IN FIG. 224-4(b).

$$R_R = \frac{dt}{A_{RG}}, R_E = \frac{ht}{A_{ST}}$$

$$R_R = \frac{5 \times .04}{.03607}, R_E = \frac{29 \times .04}{.1552}$$

$$= 57$$

$$= 7.48$$

$$A_{RG} = \text{AREA OF ANGLE OF MEMBER 798} = .03607 \text{ in}^2$$

$$A_{ST} = \text{AREA OF KIRK MEMBER}$$

$$= .1552 \text{ in}^2$$



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AIRCRAFT:

C. 105

REAR FUSELAGE

TOP SKIN

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LONG CURVED PANELS (SER. 793 TO 798) CONT'D :-

$$\frac{1 + R_s}{1 + R_r} = \frac{1 + 7.48}{1 + 5.7} = 1.265$$

$$\text{AND, } \frac{\frac{d}{R} \sqrt{\frac{E}{\tau}}}{\sqrt{1 + R_r}} = \frac{\frac{5}{26} \sqrt{\frac{6.5 \times 10^6}{4560}}}{\sqrt{1 + 5.7}} = \frac{1.925 \times 37.8}{2.59} = 28.1$$

FROM AEM. FIG. 224-4 (b)

$$\alpha_{PDT} = 42^\circ$$

FROM AEM. FIG. 224-5, $\frac{\alpha}{\alpha_{PDT}} = .55$

α_{PDT}

$$\therefore \alpha = .55 \times 42 = 23.1^\circ$$

FROM AEM. 224-5

ULT. STRENGTH OF WEB, $\tau_{ALL} = \tau_{ALL}^* (.65 + \Delta)$

FROM FIG. 224-6, FOR 24ST, $\tau_{ALL}^* = 25,000 \text{ psi}$

FOR Mg

$$\tau_{ALL}^* = 25,000 \times \frac{46,000 + (\text{Fro Mg})}{56,000 + (\text{Fro 24ST4})} = 20,800 \text{ psi}$$

TO FIND Δ -

$$\frac{A_{ST}}{ht} = \frac{1}{7.48} = .134$$

$$\frac{A_{MG}}{dt} = \frac{1}{5.7} = .1755$$

FROM AEM. FIG. 224-8, $\Delta = .062$

$$\tau_{ALL} = 20,800 (.65 + .062) = 14,800 \text{ psi}$$

$$\text{APPLIED } \tau = 4560 \text{ psi}$$

M.S.

>1



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AIRCRAFT:

C. 105.

REAR FUSELAGE

TOP SKIN.

LONG CURVED PANELS. (CONT'D) -

RIVETING ALONG SKIN SPLICE AT KINK MEMBERS:-

FORCE/IN ALONG RIVET LINE, $q_v = q_v(1 + 4.4K)$

APPLIED SHEAR FLOW = 183 LB/IN. $K = .10$

$$\therefore q_v = 183(1 + 4.4 \times .1)$$

$$= 191.16 \text{ LB/IN.}$$

MAX RIVET PITCH = .54 IN.

MAX APPLIED LOAD/RIVET = $191 \times .54 = 103.14 \text{ LB.}$

(SEE 1025)

BEARING STRENGTH OF $\frac{1}{8}$ " DIA CSK RIVET IN .04" Mg. SKIN

AFTER EXPOSURE TO 270°F = $200 \times .75 \times .94 \times \text{TEMP.}$

$$= 160 \text{ LB.}$$

M.F. =

55



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AIRCRAFT:

C. 105

REAR FUSELAGE.

TOP SKIN.

REPORT NO.

77-0559-7

SHEET NO.

28

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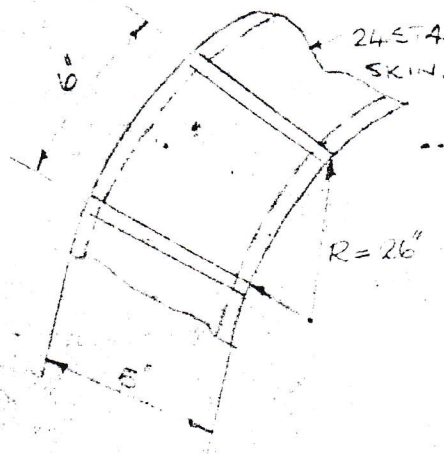
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TOP SKIN CURVED PANELS (798-803)



$$d = 5, \quad R = 26, \quad t = .032$$

$$h = 6, \quad 24ST4.$$

FROM A.E.M. 224-2,

$$Z = \frac{.954 d^2}{R t} = \frac{.954 \times 5^2}{26 \times .032} = 28.7$$

$$\frac{h}{d} = \frac{6}{5} = 1.2$$

FROM FIG. 224-1b.

$$K_s = 14.5, \quad E = 10.3 \times 10^6 \text{ psi}$$

$$\therefore \frac{\tau_{cr}}{\eta} = 14.5 \times 10.3 \times 10^6 \times \left(\frac{.032}{5} \right)^2$$

$$= 6120 \text{ psi}$$

MAX APPLIED SHEAR FLOW, q ,
PARACHUTE UP 16.5° CASE.

$$= 194 \text{ lb/in. (AVERAGE ACROSS PANEL SIN 798-803.) (SHEET NO 3)}$$

$$\therefore \text{MAX. APPLIED SHEAR STRESS } \tau = \frac{194}{.032} = 6070 \text{ psi}$$

IN THIS STRESS LEVEL, THE GRAPH A.E.M. FIG. 224-11 FOR 24ST3 SHOWS $\tau_{cr}(\text{ELASTIC}) = \tau_{cr}$. $\therefore \eta = 1$.

AND CRITICAL BUCKLING STRESS, $\tau_{cr} = 6120 \text{ psi}$.

PANELS ARE SHEAR RESISTANT

RIVETING:- RIVETS ALONG SIN 798 IN Dimple CSK SKIN TO CSR 125.34
5 IN. PITCH. $\therefore \text{LOAD/RIVET} = 194 \times 5 = 97 \text{ LB}$.

STRENGTH OF $\frac{1}{8}$ " DIA. RIVET IN .032" DIMPLED 24ST4 SHEET = 413 LB
BUT SHEAR STRENGTH = $.553 \times 964 = 374 \text{ LB}$



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AIRCRAFT:

C. 105.

REAR FUSELAGE.

TOP SKINS.

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SHEET NO. 29.

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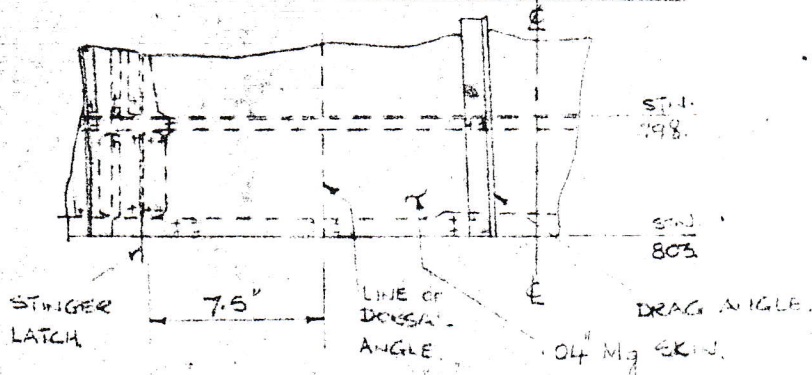
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INBOARD PANELS. STN. 798 - STN. 803:-



THIS PANEL IS SUBJECTED
TO MAX. APPLIED SHEAR
FLOW (PARACHUTE STREAMING
CASE.)

PANEL 7.5" x 5" x .04" Mg.

$$a = 7.5 \quad b = 5 \quad \frac{a}{b} = \frac{7.5}{5} = 1.5$$

FROM BRUHN. FIG. B. 2-5 $K_s = 6.47$

$$\begin{aligned} \text{SHEAR BUCKLING STRESS, } \tau_{cr} &= K_s E \left(\frac{t}{b} \right)^2 \\ &= 6.47 \times 6.5 \times 10^6 \times \left(\frac{.04}{5} \right)^2 \\ &= 2690 \text{ p.s.i.} \end{aligned}$$

FROM SHEET. NO. 5, APPLIED SHEAR FLOW, $q_i = 314 \text{ lb/in.}$ IN THE
PARACHUTE RELEASE CASE WITH PARACHUTE CONING ANGLE AT 45° .

$$\text{APPLIED SHEAR STRESS, } \tau = \frac{314}{.04} = 7850 \text{ p.s.i.}$$

i.e. PANEL BUCKLES.

$$\frac{\tau}{\tau_{cr}} = \frac{7850}{2690} = 2.92$$

FROM AEM. SECTION V. FIG. 2.2.14-2. $K = 22$.

RIVETING ALONG STN. 803:-

$$\begin{aligned} q_t &= q(1 + 4.14K) \\ &= 314(1 + 4.14 \times 22) = 342.5 \text{ lb/in.} \\ &\quad (\text{CSK 125 BA}) \end{aligned}$$

BEARING STRENGTH OF $\frac{1}{8}$ " DIA CSK RIVET IN .04" Mg. SHEET AFTER
EXPOSURE TO $280^\circ\text{F} = 200 \times .75 \times .86 = 146 \text{ LB}$



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SHEET NO.

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AIRCRAFT:

C. 105

REAR FUSELAGE

TOP SKINS

INBOARD PANELS, STNS 798 TO 803. (CONTD) :-

ALLOWABLE STRENGTH OF WEB IN SHEAR :-

FROM BRUHN, C.7.7,

SHEAR LOAD CARRIED BY WEB AFTER BUCKLING

$$V_{tu} = \left(F_{tu} - \frac{\tau_{cr}}{K_t} \right) K_t K h t \sin \alpha \cos \alpha \quad (\text{STRESSING TO ULTIMATE})$$

WHERE, $h = 5 \text{ in.}$ $\alpha = ?$ AND $K_t = ?$

$t = .04 \text{ in.}$

$K = ?$

$$\tau_{cr} = 2,690 \text{ psi}$$

$$(\text{FOR } .04 \text{ Mg}) F_{tu} = 40,000 \text{ psi}$$

TO FIND K_t :-

$$K_t = \frac{\text{RIVET SPACING} - \text{RIVET DIA.}}{\text{RIVET SPACING}} = \frac{.5 - .125}{.5} = .75$$

TO FIND THE ANGLE OF DIAGONAL TENSION α :-

FROM BRUHN, C.7.4, EQN. 15,

$$\sin^2 \alpha = \sqrt{a^2 + a} - a$$

$$\text{WHERE } a = \frac{1 + \frac{ht}{A_u + A_L}}{\frac{dt}{A_s} - \frac{ht}{A_u + A_L}}$$

$$= \frac{1 + \frac{7.5 \times .04}{.321 + .0351}}{\frac{5 \times .04}{.04} - \frac{.3}{.3501}}$$

$$= \frac{1.842}{4.158} = 4.425$$

$$\sin^2 \alpha = \sqrt{(4.425^2 + 4.425)} - 4.425$$

$$= .475$$

$$\sin \alpha = .6885$$

$$\alpha = 43^\circ 30'$$

A_u = AREA OF UPPER FLANGE (STN 803)

A_L = " LOWER " (STN 798)



$$A_u = 1.25 \times .18 + 1.2 \times .08 = .225 + .096 = .321 \text{ in}^2$$

$$A_L = .03507 \text{ in}^2 \text{ (FROM LIT.)}$$

$$A_s = .036 \times (.75 + .5) = .04 \text{ in}^2$$

$$I_u = .0492 \text{ in}^4$$

TO FIND R , (THE STRESS CONCENTRATION FACTOR FOR THE WEB DUE TO

$$Wd = 1.25 d \sin \alpha \sqrt{\frac{t}{I_u + I_L h}} \quad \text{FROM BRUHN, C.7.4, EQN. 14.} \quad \left[\text{FLANGE DEFLECTION} \right]$$

$$= 1.25 \times 5 \times .6885 \times \sqrt{\frac{.04}{(.0492 + .011) \times 75}}$$



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REPORT NO. **7-0559-7**

SHEET NO. **31**

AIRCRAFT:

C. 105

REAR FUSELAGE

TOP SKINS.

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PANELS STNS 798 TO 803 (CONT'D):

SHEAR LOAD CARRIED BY WEB AFTER BUCKLING,

$$\begin{aligned}
 V_{TU} &= \left(F_{TU} - \frac{\tau_{CR}}{K_1} \right) K_1 R h t \sin \alpha \cos \alpha \\
 &= \left(40900 - \frac{2690}{.75} \right) .75 \times .67 \times 5 \times .04 \times .6884 \times .7254 \\
 &= (40900 - 3590) \times .0506 \\
 &= 1830 \text{ LB.}
 \end{aligned}$$

SHEAR LOAD CARRIED BY WEB AT BUCKLING,

$$\begin{aligned}
 V_{CR} &= 2690 \times 5 \times .04 \\
 &= 538 \text{ LB.}
 \end{aligned}$$

$$\begin{aligned}
 \text{TOTAL ULTIMATE SHEAR RESISTANCE OF WEB} &= 1830 + 538 \\
 &= 2368 \text{ LB. OR } (11840 \text{ LBS.})
 \end{aligned}$$

APPLIED SHEAR STRESS, $\tau = 7850 \text{ PSI.}$

$$\text{M.S.} = \frac{11840}{7850} - 1 = .5$$

STRESSING TO YIELD

SHEAR LOAD CARRIED BY WEB AFTER BUCKLING,

$$\begin{aligned}
 V_{TY} &= \left(F_{TY} - \frac{\tau_{CR}}{K_1} \right) K_1 R h t \sin \alpha \cos \alpha \\
 &= (30000 - 3590) \times .0503 \\
 &= 1330 \text{ LB.}
 \end{aligned}$$

$$V_{CR} = 538 \text{ LB.}$$

$$\begin{aligned}
 \text{TOTAL YIELD SHEAR RESISTANCE OF WEB} &= (1330 + 538) \\
 &= 1868 \text{ LB. } (9340 \text{ LBS.})
 \end{aligned}$$

$$\text{LIMIT SHEAR STRESS, } \tau_L = \frac{7850}{1.364} = 5750 \text{ PSI.}$$

$$\text{M.S.} = \frac{9340}{5750} - 1 = 0.62$$



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REPORT NO. 7-0559-7

SHEET NO. 44

AIRCRAFT:

C.105

REAR FUSELAGE
FORMER, 753.

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DUCT SKINS AT STN. 753. (CONT'D): -

ULT. SHEAR STRESS OF WEB,

$$\tau_{ALL} = \tau_{ALL}^* (.65 + \Delta)$$

FROM AEM, FIG. 224-8,

$$\text{FOR, } \frac{A_{RG}}{dt} = \frac{.0727}{5 \times .02} = .727, \text{ AND } \frac{A_{ST}}{ht} = \frac{.025}{8.25 \times .02} = .1516.$$

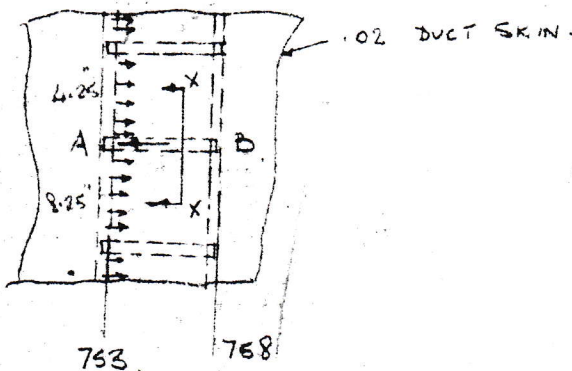
$$\Delta = .2.$$

$$\therefore \tau_{ALL} = 23400 (.65 + .2) \\ = 18720 \text{ psi.}$$

$$(\text{APPLIED}) \tau = 7565 \text{ psi.}$$

$$M.S. = \frac{18720}{7565} = 2.47$$

INTER COSTAL DIAPHRAGMS: - LOAD ON STIFFENERS.



REF. AEM 224L

APPLIED SHEAR FLOW = 151.3 Lb/in AT 753.

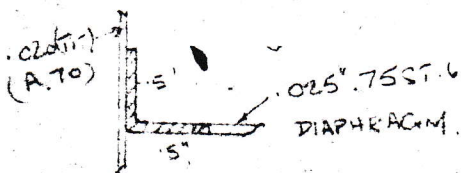
$$\sigma_{ST} = \frac{K \tau \cot \alpha}{\frac{A_{ST}}{ht} + 0.5(1-K)}$$

FROM FIG. 224-5, $\frac{\alpha}{\sqrt{P.R.}} = .682$

BUT $\alpha_{PDT} = 40^\circ$

$$\therefore \alpha = 27^\circ 15'$$

$$(\text{AV.}) \sigma_{ST} = \frac{.23 \times 7565 \times \cot 27^\circ 15'}{.1516 + .5 \times .77} \\ = 6310 \text{ psi.}$$



SECTION XX

$$\sigma_{ST(MAX)} = \sigma_{ST} \times \left(\frac{\sigma_{ST(MAX)}}{\sigma_{ST}} \right) = 6310 \times 1.3 = 8200 \text{ psi.}$$

(FIG. 224-9)



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SHEET NO. 32

AIRCRAFT:

C-105

REAR FUSELAGE

SIDE SKINS

PREPARED BY

JARNIAN

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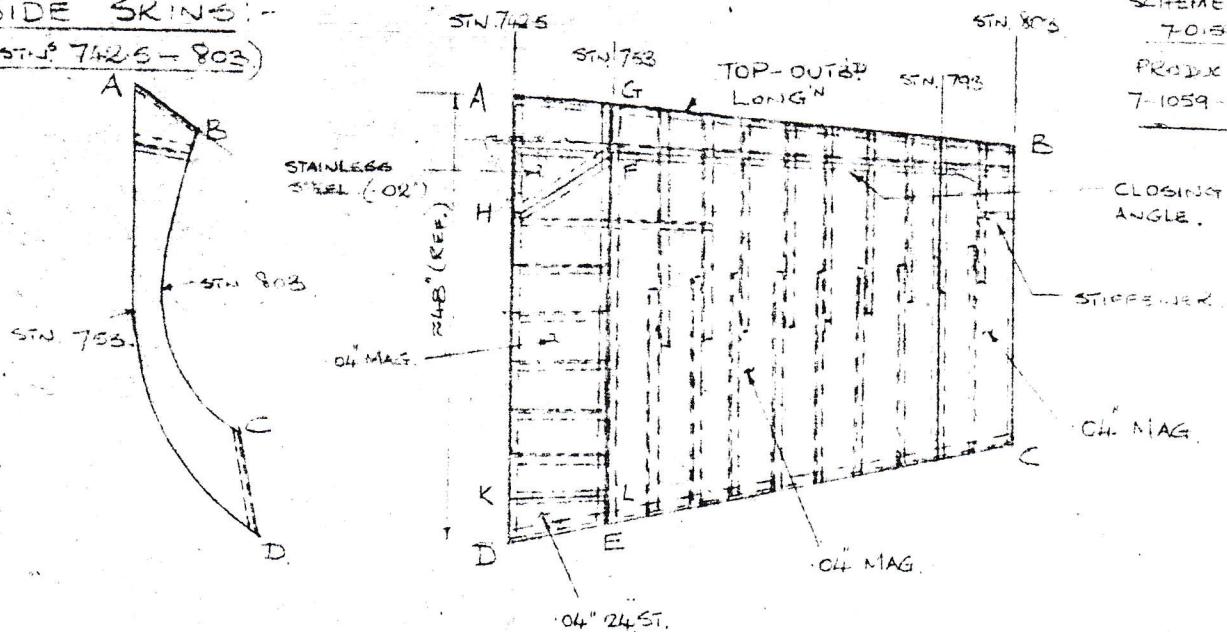
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SIDE SKINS:-

(STN 742.5 - 803)



SCHEME DRG. NO.

7-0559-10

PRODUCTION DRG.

7-1059-17 SHIP 1

DESCRIPTION:-

THE SIDE SKINS CONSIST MAINLY OF '04" MAG' SHEET COVERING AN AREA OF APPROXIMATELY 60"X50", AND HAVING BUTT JOINTS RUNNING ALONG FORMERS '753' AND '798'. THE SKINS ARE BOUNDED BY FORMERS '742.5' AND '803', AND BY THE TOP-OUTER AND LOWER-OUTER LONGERONS. THE PORTION 'GECB' IS STABILISED BY FORMERS AT 5" PITCH, AND 'HFED' HAS HORIZONTAL STIFFENERS AT ABOUT 6" PITCH. PORTION 'KLED' IS MADE OF '04" 24 ST SHEET TO FACILITATE DIMPLING OF THE SKIN INTO THE CSK. LONGON. PORTION 'AGFH' IS STAINLESS STEEL SHEET, LOCATED JUST AFT OF THE HINGE AT 'A' FROM WHICH THE REAR FUSELAGE IS SUSPENDED. THE SHEET IS EXPECTED TO FLEX WITH THE RELATIVE MOVEMENT OF THE WING TO THE REAR FUSELAGE.

LOADING:- CRITICAL LOADS OCCUR IN CASE 7.3a.

MAY NORMAL PRESSURE = ± 5 psi.

(FROM SHEET 5)

SHEAR FLOW INCREASES FROM 47.5 LB/IN AT STN 803, TO 128 LB/IN AT 742.5.



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AIRCRAFT:

C. 105.

REAR FUSELAGE.

SIDE SKINS.

PREPARED BY

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JARMAN

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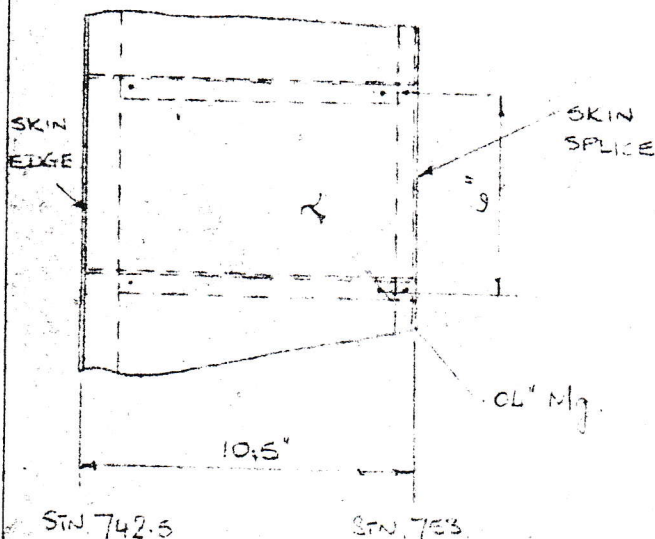
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SIDE SKINS (CONTD): -

PORTION "AGED" (BETWEEN STNS 742.5 AND 753) -

THE STAINLESS STEEL PART, (AGFH) HAS BEEN CHECKED ON SHEET NO. 15 OF THE LONGERON REPORT 7-0559-6. MAG SKIN PANELS WILL BE CHECKED BELOW.

THE LARGEST PANEL IS 6" x 10.5" x .04" Mg.



SHEAR BUCKLING STRESS,

$$\tau_{cr} = K_s \left(\frac{t}{b} \right)^2$$

$$\frac{a}{b} = \frac{10.5}{6} = 1.75$$

FROM BRUHN FIG. B.2-5,

$$K_s = 6.07$$

$$\tau_{cr} = 6.07 \times 6.5 \times 10^6 \times \left(\frac{.04}{6} \right)^2 = 1750 \text{ p.s.i.}$$

FROM SHEET 5: APPLIED SHEAR FLOW (AVERAGE ACROSS PANEL),

$$q = 122 \text{ LB/IN.}$$

$$\text{APPLIED SHEAR STRESS, } \tau = \frac{122}{.04} = 3050 \text{ p.s.i.}$$

$$\therefore \frac{\tau}{\tau_{cr}} = \frac{3050}{1750} = 1.745$$

FROM A.E.M. SECT. V. FIG. 224-2,

DIAGONAL TENSION FACTOR, $K = 12$.

RIVETING ALONG SPLICE: -

$$\begin{aligned} \text{FORCE/IN. ALONG RIVET LINE, } q_r &= q (1 + .414 K) \\ &= 122 (1 + .414 \times 12) \\ &= 128 \text{ LB/IN.} \\ &= 64 \text{ LB.} \end{aligned}$$

RIVET PITCH = .5" .
LOAD/RIVET

BEARING STRENGTH OF $\frac{1}{8}$ " DIA CSK. IN .04" Mg SKIN AFTER EXPOSURE TO 279°F



AVRO AIRCRAFT LIMITED
MALTON, ONTARIO

TECHNICAL DEPARTMENT

REPORT NO. 7-0559-7

SHEET NO. 34

AIRCRAFT:

C. 105

REAR FUSELAGE

SIDE SKINS

PREPARED BY

JARMAN

CHECKED BY

DATE

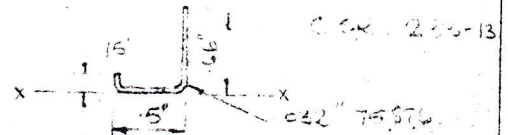
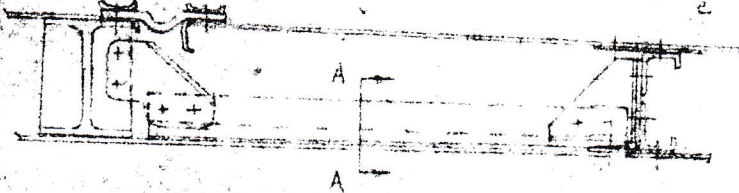
JULY '36

DATE

STIFFENERS BETWEEN STNS 7425 AND 7531 -

FROM AEM. SECT V. 2223

$$\text{EFFECTIVE UPRIGHT AREA } A_u = \frac{A_u}{1 + \frac{e^2}{\rho^2}}$$



$$\begin{aligned} \text{AREA OF UPRIGHT} &= (.66 + .15 + .5 - .5) \times .032 \\ &= .0368 \text{ IN}^2 \end{aligned}$$

CG. UPRIGHT?

$$\begin{aligned} y_{xx} &= \frac{.66 \times .032 \times .53 + .15 \times .032 \times .075 + .34 \times .032 \times .016}{.0368} \\ &= \frac{.00697 + .00036 + .000174}{.0368} = \frac{.007504}{.0368} \\ &= .204 \text{ IN} \end{aligned}$$

$$\begin{aligned} \text{TO FIND } \rho: \quad I &= \left(\frac{.032 \times .66^3}{12} + .0211 \times .12^2 + \frac{.34 \times .032^3}{12} + .0087 \times .12^2 + \frac{.032 \times .15^3}{12} + .0044 \times .024^2 \right) \\ &= .000767 + .000335 + .000000726 + .000534 + .00009 + .000014 \\ &= .00151 \text{ IN}^4 \\ \rho &= \sqrt{\frac{I}{A}} = \sqrt{\frac{.00151}{.0368}} = \sqrt{.0411} = .2026 \text{ IN} \end{aligned}$$

$$\begin{aligned} \text{EFFECTIVE AREA, } A_u &= \frac{.0368}{1 + \left(\frac{.204}{.2026} \right)^2} = .0185 \text{ IN}^2 \end{aligned}$$

$$\frac{A_u}{A} = \frac{.0185}{.0368} = .5036 \quad \text{FROM SHEET 33, } K = .12$$

$$\text{FROM AEM FIG 222-5. } \frac{\sigma_u}{\tau} = .22$$

$$\text{SINCE } \tau = 3052 \text{ PSI, THE AV COMP STRESS } \sigma_u = .22 \times 3050 = 671 \text{ PSI}$$

$$\begin{aligned} \text{AND FROM AEM FIG 222-5, FOR } \frac{d}{h} &= \frac{10.5}{11} = .954 \\ \frac{\sigma_{u \text{ MAX}}}{\sigma_u} &= 1.14 \quad \therefore \sigma_{u \text{ (MAX)}} = 1.14 \times 671 = 765 \text{ PSI} \end{aligned}$$

ALLOWABLE CRIPPLING STRESS, F_c -

$$\frac{t_u}{t} = \frac{.032}{.04 \times \frac{4.5}{10.5}} = 1.27 \quad (F_c = \text{CRIPPLING BETWEEN TENSION FIELD RIBBONS})$$

$$\text{FROM AEM FIG 222-10. } F_c = 6930 \text{ PSI}$$



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TECHNICAL DEPARTMENT

REPORT NO. 7-0559-7

SHEET NO. 35

AIRCRAFT:

C. 105.

REAR FUSELAGE.

SIDE SKINS.

PREPARED BY

JARMAN.

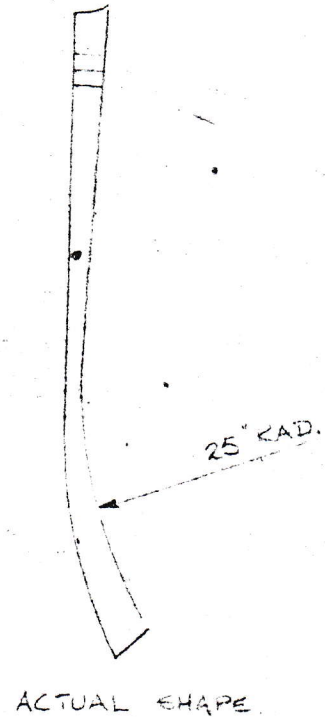
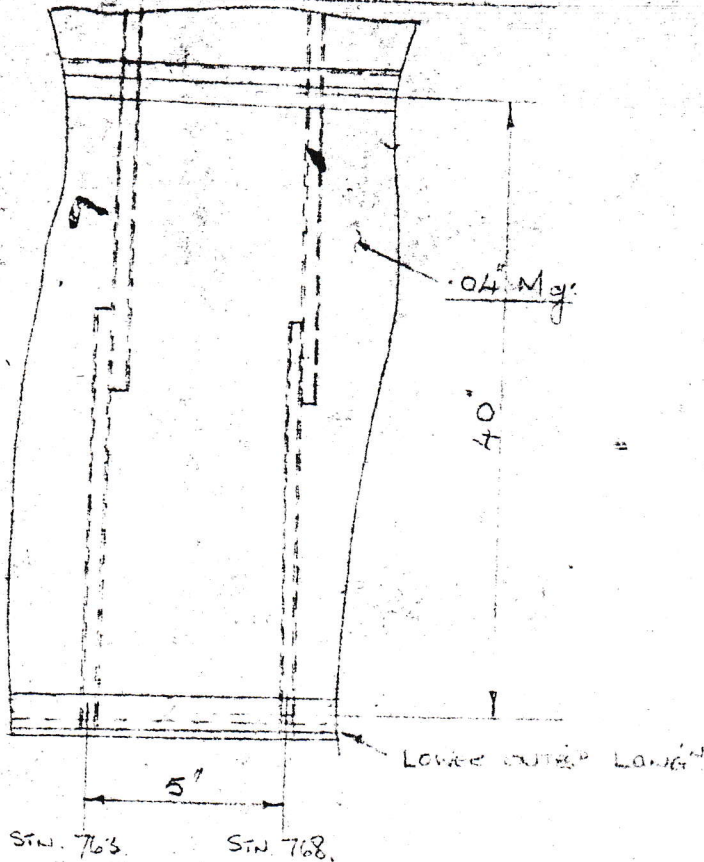
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LONG UNSTIFFENED PANELS.



THE PANEL BETWEEN STN. 763 AND 768 IS THE LONGEST.

APPLIED SHEAR FLOW, $q = 100 \text{ LB/IN.}$ (FROM SHEET 5)

APPLIED SHEAR STRESS, $\tau = \frac{100}{0.4} = 2500 \text{ PSI}$

ACTUAL SHAPE OF THE PANEL IS AS SHOWN ABOVE. FOR STRESSING A FLAT PANEL WILL BE ASSUMED (CONSERVATIVE)

PANEL, $5" \times 40" \times 0.04" \text{ Mg}$

SHEAR BUCKLING STRESS, $\tau_{cr} = K_s E \left(\frac{t}{b}\right)^2$

$$\frac{a}{b} = \frac{40}{5} = 8$$

FROM BRUHN, FIG. B.2-C, $K_s = 4.9$

$$\tau_{cr} = 4.9 \times 6.5 \times 10^4 \times \left(\frac{0.04}{5}\right)^2$$

$$= 2040 \text{ PSI}$$

$$\frac{\tau}{\tau_{cr}} = \frac{2500}{2040} = 1.225$$

FROM AEM, FIG. 2.4.12

$$K = 0.04$$

RIVETING:- $q_r = q(1 + 4.14K) = 100(1 + 4.14 \times 0.04) = 102 \text{ LB/IN.}$

RIVET PITCH = $5"$ APPLIED LOAD/PITCH = 51 LB.

M.S. >1



AVRO AIRCRAFT LIMITED
MALTON - ONTARIO

TECHNICAL DEPARTMENT

REPORT NO. **7-0559-7**

SHEET NO. **36**

AIRCRAFT:

C. 105.

REAR FUSELAGE.

BOTTOM SKIN

PREPARED BY

JARMAN

DATE

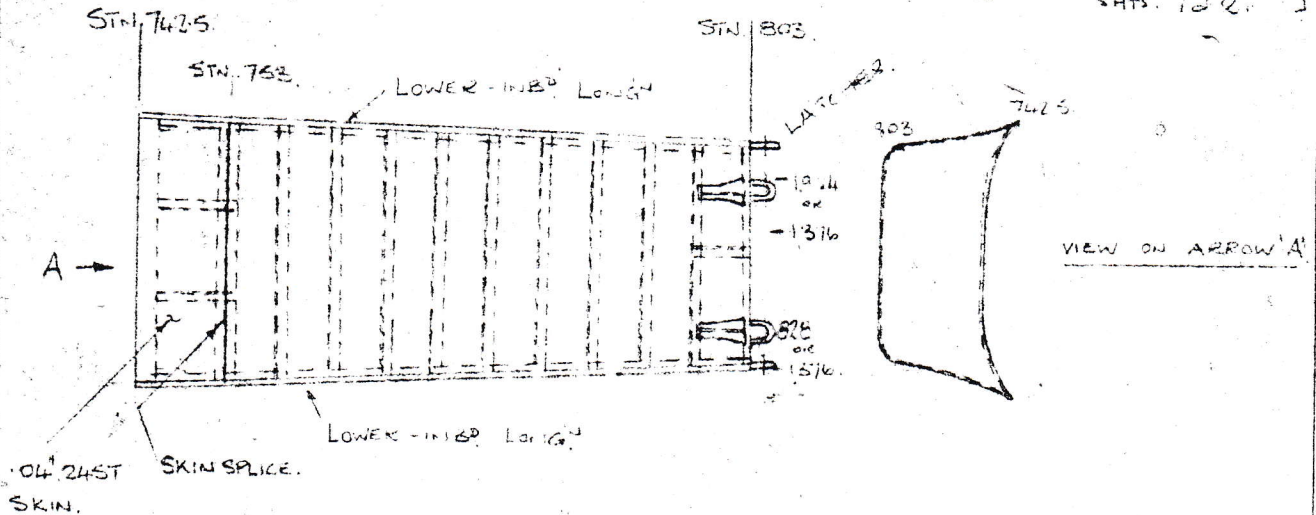
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BOTTOM SKIN. (SKIN BETWEEN DOORS)

SCHEME - 7-0159-26.
PRODUCTION - 7-1059-17.
SHTS. 1 & 2.



THE BOTTOM SKIN CONSISTS OF ONE PIECE OF 24ST SHEET (48" x 24") BETWEEN STNS 753 AND 803, AND A STRIP OF 24ST SHEET BETWEEN STN 742.5 AND 753 (TO FACILITATE DIMPLING THE SKIN INTO THE CUT CSK. LONGERON)

LOADING - MAX. APPLIED NORMAL PRESSURE IN CASE 739 = ± 1 ps. (LIMIT).
= 1.364 ps. (ULT)

ASYMMETRIC ENGINE THRUST CASE (400 ps.f.) COMBINED WITH INTERNAL PRESSURE (-300 ps.f.) EXERTS THE FOLLOWING LOADS AT STN. 803.

-1924 LB ON ONE LATCH, +828 LB ON THE OTHER,

OR, IN THE CASE WHERE ONLY THE ASSYMMETRIC LOAD IS APPLIED,

-1376 LB ON ONE LATCH, +1376 LB ON THE OTHER.

CASE 739 :- SINCE THESE SKINS REACT NORMAL AIR PRESSURES OF ONLY 1.364 ps. (ULT) WHEREAS THE TOP SKINS REACT NORMAL AIR PRESSURES OF 4.09 ps. (ULT), THE STRESS ANALYSIS OF THE LATTER SKINS WILL COVER THAT FOR THE FORMER.

ASYMMETRIC ENGINE THRUST CASE

THE NACELLE LATCH AT STN. 803 HAS BEEN CHECKED IN REPT. NO. 7-0559-9 SHEETS (35-41)

LOADS FROM THE STINGER LATCH AT STN. 803, WILL BE CHECKED.



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TECHNICAL DEPARTMENT

REPORT NO. 7-0559-7

SHEET NO. 37

AIRCRAFT:

C. 105

REAR FUSELAGE

BOTTOM-CENTRE SKINS

PREPARED BY

JARMAN

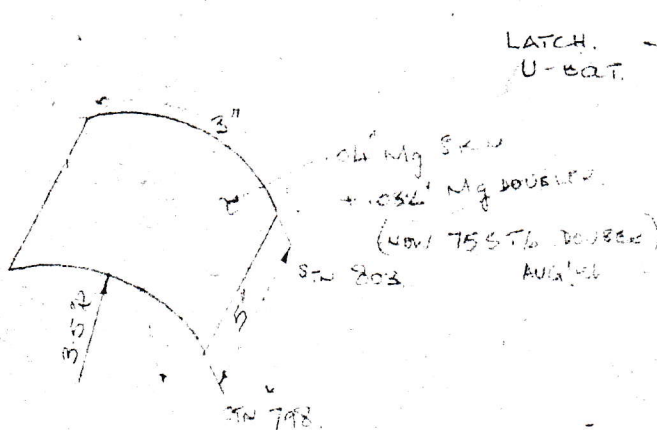
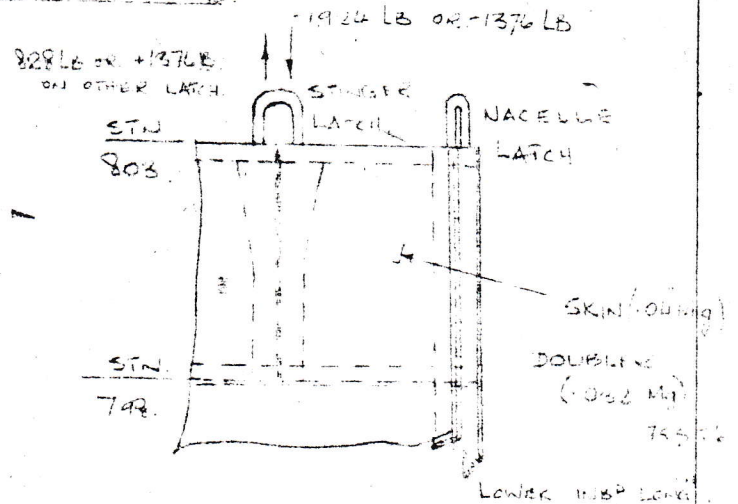
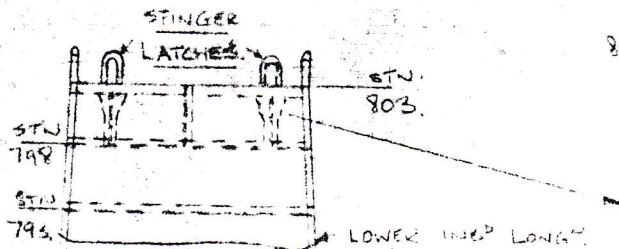
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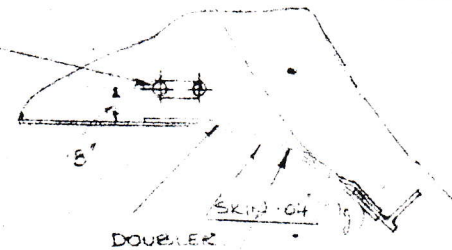
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SKIN BETWEEN DOORS AT STNS 798 TO 803



LATCH
U-BOLT



MAX. APPLIED LOAD = 1924 LB ON ONE LATCH AND 828 LB ON THE OTHER.

THIS LOAD WILL BE SHEARED ACROSS THE BOTTOM SKIN TO BOTH LONGERONS IN PROPORTION TO THEIR DISTANCES FROM THE LATCH. ASSUME (CONSERVATIVELY) THAT ALL THE LOAD IS SHEARED TO THE LONGERON NEAREST THE LATCH ONLY. THE PANEL CARRYING THIS SHEAR IS SHOWN ABOVE AND IS BUILT UP OF .04" SKIN + .032" DOUBLER.

CURVED PANEL: 3" x 5" x .072" Mg, $R = 3.5"$ (TO BE REVISED)

SHEAR BUCKLING STRESS, $\tau_{cr} = K_s E \left(\frac{t}{b} \right)^2$

TO FIND K_s : - FROM A.E.M. FIG 224-1(a)

$$Z = .954 \frac{h^2}{K_s t} = .954 \times \frac{3^2}{5 \times .072}$$

$$= 34.1$$

$$h = 3 \text{ in.}$$

$$d = 5 \text{ in.}$$

$$t = .072 \text{ in.}$$



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MALTON - ONTARIO

TECHNICAL DEPARTMENT

REPORT NO.

7-0559-7

SHEET NO.

38

AIRCRAFT:

C. 105

REAR FUSELAGE

BOTTOM - CENTRE SKINS

PREPARED BY

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JARMAN

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STU 798 to 803 (CONT'D):-

$$\frac{d}{h} = \frac{5}{3} = 1.67$$

FROM AEM FIG 224-1(a) $K_c = 12.5$

$$\text{SHEAR BUCKLING STRESS } \tau_{cr} = 12.5 \times 6.5 \times 10^6 \times \left(\frac{0.72}{3}\right)^2$$

$$= 46,200 \text{ psi}$$

$$\text{APPLIED SHEAR FLOW, } q = \frac{1924}{5} = 385 \text{ LB/IN.}$$

$$\text{APPLIED SHEAR STRESS, } \tau = \frac{385}{0.72} = 5350 \text{ psi}$$

PANEL IS SHEAR RESISTANT

RIVETING ALONG SKIN EDGES AND LONG.

RIVET PITCH = .55"

$$\text{APPLIED LOAD/RIVET} = 385 \times .55 = 212 \text{ LB.}$$

$$\text{BEARING STRENGTH OF } \frac{1}{8}" \text{ DIA (BLIND) CSK RIVET IN } \frac{0.72}{16} \text{ Mg SKIN}$$

$$\text{AT } 270^\circ \text{F} = (340 \times .85) \times .70$$

$$= 202 \text{ LB}$$

$$M.S. = \frac{202}{212} - 1 = -.05$$

WITH A MORE RIGOROUS ANALYSIS,

APPLIED SHEAR LOAD ON ABOVE SKIN WILL BE REDUCED BY THE LOAD SHEARED ACROSS TO THE OTHER LONG.

$$\text{L.O BY } \frac{1924 \times 3 \text{ IN}}{18.8 \text{ IN}} = 307 \text{ LB.}$$

$$\text{ACTUAL APPLIED SHEAR FLOW } q = \frac{1924 - 307}{5} = \frac{1617}{5} = 323 \text{ LB/IN.}$$

$$\text{AND APPLIED LOAD/RIVET} = 323 \times .55 = 178 \text{ LB.}$$

[NOTE:- NOW THAT THE DOUBLER IS .032" THICK, 75%6, INSTEAD OF .032" Mg ALLOY, THE M.S. WILL BE INCREASED.]

$$M.S. = \frac{204}{178} - 1 = .13$$

A. V. ROE CANADA LIMITED
MALTON - ONTARIO

TECHNICAL DEPARTMENT (Aircraft)

REPORT NO. **7-0559-7**

SHEET NO. **39**

AIRCRAFT: **C. 105.**

REAR FUSELAGE.

TUNNEL SKIN.

PREPARED BY

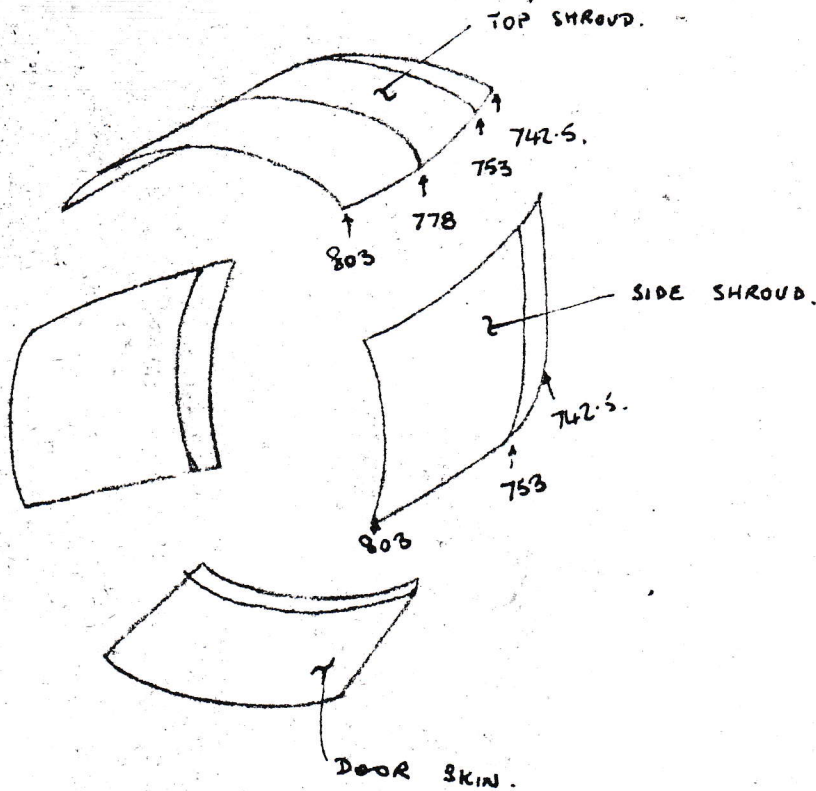
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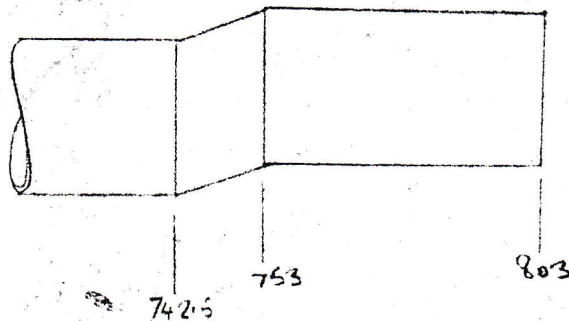
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TITANIUM (A.T.O.)





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TECHNICAL DEPARTMENT

REPORT NO. 7-0559-7

SHEET NO. 40

AIRCRAFT:

C. 105.

REAR FUSELAGE.

DUCT SKINS.

PREPARED BY

JARMAN.

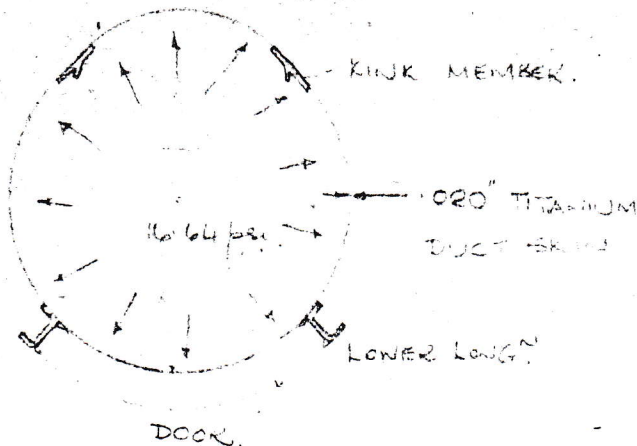
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HOOP TENSION LOADS ON THE DUCT SKINS.



MAX. PRESSURE IN THE
DUCT OCCURS IN THE
FOLLOWING CASES:-
9.1.6, 3.2.6, AND THE
MIL CASE AT 30000 FT.

$$\text{MAX. PRESSURE} = (12.2 \times 1.364) \text{ psi} \\ = 16.64 \text{ psi}$$

HOOP TENSION IN DUCT SKINS = $p \cdot R$.

ASSUME AN AVERAGE R OF 25.25 IN. --- (SEE 7.3.9)

$$\text{THEN HOOP TENSION} = 16.64 \times 25.25 \\ = 420.6 \text{ LB/IN.}$$

THE INBOARD SIDE DUCT SKIN WILL ALSO BE SUBJECTED TO SHEAR
FROM APPLIED AIRLOAD, THE MOST SEVERE CASE BEING 9.1.6.

$$\begin{aligned} \text{(AT 8 IN. 1753, IN CASE 7.3.9, DUCT SHEAR} &= 151.5 \text{ LB/IN. (REF 7-0559-21)} \\ \text{IN CASE 9.1.6.} &= 151.5 \times \left(\frac{179}{396}\right) \text{ RATIO OF } \left(\frac{9.1.6}{7.3.9}\right) \\ &= 70.25 \text{ LB/IN.} \end{aligned}$$

$$\begin{aligned} \therefore \text{LOAD/IN ON RIVETS AT SKIN SPLICES} &= \sqrt{420.6^2 + 70.25^2} \\ &= 426 \text{ LB/IN.} \end{aligned}$$

RIVETS AT 5" PITCH.

$$\therefore \text{LOAD/RIVET} = 426 \times 5 = 213.5 \text{ LB.}$$

SKIN IS (A.70) TITANIUM (MIL-T-7993) $F_{820} = 120900 \text{ PSI AT 820°F}$

$$\therefore F_{820} \text{ AT } 329^\circ\text{F} = 120900 \times .66 = 79100 \text{ PSI}$$

$$\begin{aligned} \therefore \text{BEARING STRENGTH OF } \frac{1}{8} \text{\" DIA AN L35 MODEL RIVETS IN } 1.020 \text{\" TI.} \\ \text{SKINS AT } 329^\circ\text{F} &= 79100 \times \frac{1}{8} \times .92 = 198 \text{ LB/RIVET.} \end{aligned}$$



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MALTON - ONTARIO

TECHNICAL DEPARTMENT

REPORT NO. 7-0559-7

SHEET NO. 41

AIRCRAFT:

C. 105.

REAR FUSELAGE

DUCT SKINS

PREPARED BY

JARMAN

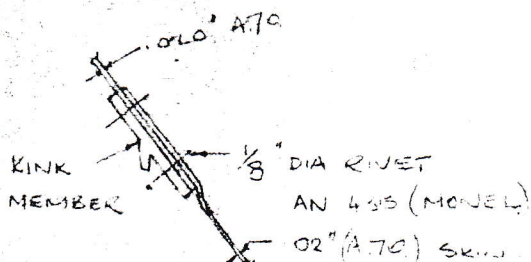
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HOOP TENSION LOADS ON DUCT SKINS. (CONT'D) -



THE NEGATIVE MARGIN (-07), WAS RECTIFIED BY HAVING A DOUBLE ROW OF RIVETS AT THE LOWER LONGERON SKIN SPLICES, AND BY LAPPING THE SKINS AT THE KINK MEMBER SPLICES. (AS IN THE SKETCH).

APPLIED LOAD / RIVET BECOMES $\frac{213.5}{2} = 107. \text{ LB.}$

$$\text{AND M.S.} = \frac{118}{107} - 1 = .85$$

HOOP TENSION ONLY: - TENSILE STRESS IN SKIN -

APPLIED LOAD / IN (FROM HOOP TENSION LOADS ONLY) = 420.6 LB.

WITH .5" RIVET PITCH,

$$\begin{aligned} \text{TENSILE AREA / IN.} &= \left(1 - \frac{1}{.5} \times .125\right) \times .02 \\ &= .015 \text{ IN.}^2 \end{aligned}$$

$$\text{APPLIED HOOP STRESS, } \frac{f}{j_t} = \frac{420.6}{.015} = 28,000 \text{ PSI}$$

$$\begin{aligned} F_{TU} \text{ FOR A70 TITANIUM AT } 329^\circ\text{F} &= 80,000 \times .68 \\ &= 54,400 \text{ PSI} \end{aligned}$$

$$\text{M.S.} = \frac{54,400}{28,000} - 1 = .94$$



AVRO AIRCRAFT LIMITED
MANTON - ONTARIO

TECHNICAL DEPARTMENT

AIRCRAFT:

C 105

REAR FUSELAGE

DUCT SKINS AT STN. 753

REPORT NO.

7-0559-71

SHEET NO.

42

PREPARED BY

JARMAN.

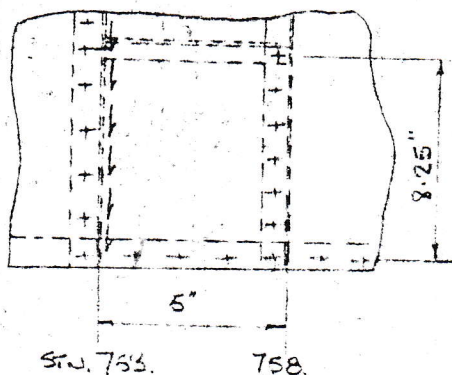
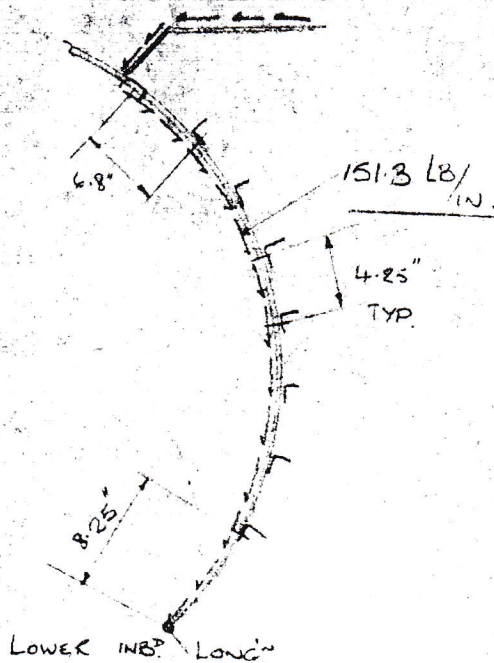
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DUCT SKINS AT STN. 753:-



FROM 7-0559-25, SHT 8.

MAX. SHEAR FLOW IN DUCT AT
STN. 753 IS FROM CASE 7.3a.

$$q = \frac{15450}{2 \times 51.05} = 151.3 \text{ LB/IN.}$$

LARGEST PANEL IS NEXT TO THE
LOWER INB LONG.

PANEL IS CURVED $R = 25 \text{ IN.}$

REF 'AVRO STRESS MANUAL' 2.2.4-2,
CRITICAL BUCKLING STRESS OF WEB,

$$\frac{\tau_{cr}}{\eta} = K_s E \left(\frac{t}{d} \right)^2 \dots h > d$$

CURVED PANEL:-

$$h = 8.25 \text{ IN. } d = 5 \text{ IN. } t = .02 \text{ IN. (A70)}$$

$$Z = .954 \frac{d^2}{Kt} = .954 \frac{5^2}{25 \times .02} = 47.7$$

$$\frac{h}{d} = \frac{8.25}{5} = 1.65$$

FROM FIG 2.2.4-1b,

$$K_s = 17.2 \quad E = 15 \times 10^6 \text{ (A70)}$$

$$\frac{\tau_{cr}}{\eta} = 17.2 \times 15 \times 10^6 \times \left(\frac{.02}{5} \right)^2$$

$$= 4125 \text{ psi}$$

$$\tau (\text{APPLIED}) = \frac{151.3}{.02} = 7565 \text{ psi}$$

FOR THIS STRESS LEVEL, THE GRAPH IN A.E.M. FIG. 2.2.4-11 FOR
24ST.B. AND 75.SF6, SHOWS $\tau_{cr}(\text{ELASTIC}) = \tau_{cr}$, AND IT IS
ASSUMED THAT THIS WILL ALSO APPLY TO TITANIUM (A.70) SKINS

$\eta = 1$. AND CRITICAL BUCKLING STRESS $\tau_{cr} = 4125 \text{ psi}$



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MALTON - ONTARIO

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REPORT NO. 7-0559-7

SHEET NO. 43

AIRCRAFT:

C. 105

REAR FUSELAGE
FORMER 753.

DUCT SKINS AT STN. 753

PREPARED BY

JARMAN

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DUCT SKINS AT STN. 753 (CONT'D): -

TO FIND THE DIAGONAL TENSION FACTOR, K : -

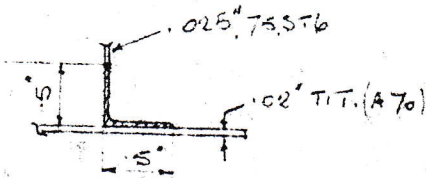
REF AEM. FIG. 224-2.

$$\frac{300 \frac{t_h}{R_t}}{R_t} = \frac{300 \times .02 \times 8.25}{25 \times 5} = .396$$

$$\frac{\tau}{\tau_{cr}} = \frac{7565}{4125} = 1.835$$

$$\therefore K = .23$$

TO FIND ULTIMATE SHEAR STRESS IN WEB: -



AREA OF STRINGER, $A_{ST} = .025 \times 1 = .025 \text{ in}^2$

" FORMER 753, $A_{RG} = .051 (248 + 548 + 628) = .0727 \text{ in}^2$

$$K_s = \frac{R_t}{A_{ST}} = \frac{8.25 \times .02}{.025} = 6.6$$

$$K_r = \frac{d_t}{A_{RG}} = \frac{5 \times .02}{.0727} = 1.376$$

REF. AEM. FIG. 224-4.b.

$$\frac{\frac{d}{R} \sqrt{\frac{E}{\tau}}}{\sqrt{1 + K_r}} = \frac{\frac{5}{25} \sqrt{\frac{15 \times 10^6}{7565}}}{\sqrt{1 + 1.376}} = \frac{8.91}{1.542} = 5.78$$

AND $\frac{1 + K_s}{1 + K_r} = \frac{1 + 6.6}{1 + 1.376} = 3.2$

FROM AEM. FIG. 224-4.b, $\alpha_{PDT} = 40^\circ$

THE ALLOWABLE SHEAR STRESS, FOR TITANIUM (A70.) AT ROOM TEMP. = 42000 PSI.

TEMP BETWEEN 753 AND 758 = $\frac{188 + 195}{2} = 192^\circ \text{F}$. REF 8097/09/J.

$\therefore F_{SU} \text{ AT } 192^\circ \text{F} = .92 \times 42000 = 38600 \text{ PSI.}$

AEM. FIG. 224-6, GIVES τ_{ALL}^* FOR 24ST. ($F_{SU} = 37000 \text{ RT.}$)

USING THE SAME CURVE FOR TIT. (A70) $\tau_{ALL}^* = 23400 \text{ PSI.}$



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REPORT NO.

7-0559-7

SHEET NO.

45

AIRCRAFT:

C. 105

REAR FUSELAGE

FORMER. 753

PREPARED BY

JARMAN.

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DATE

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INTERCOSTAL DIAPHRAGMS ON DUCT SKINS: -

(CONT'D)

ALLOWABLE CRIPPLING STRESS FOR STIFFENERS (NEEDHAM) -

$$\frac{a+b}{2t} = \frac{.5 + .5}{2 \times .025} = 20. \quad (75 \text{ STG})$$

$$\frac{F_{cc}}{F_{cy} E} = .0335$$

$$\sqrt{F_{cy} E} \text{ AT } 192^{\circ} \text{F} = 814,000 \times .92$$

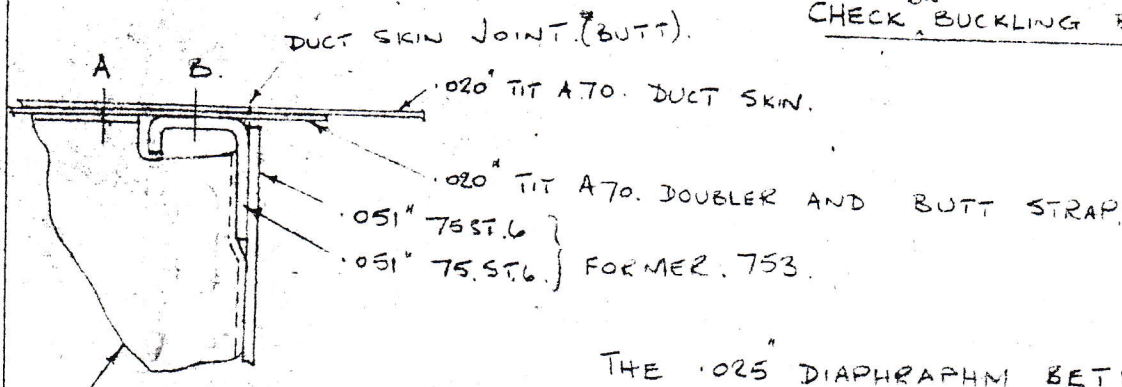
$$F_{cc} = 814,000 \times .92 \times .0335$$

$$= 25,100 \text{ psi}$$

$$M.S. = \frac{25,100}{8,200} - 1 = > 1$$

CONNECTION BETWEEN INTERCOSTAL AND FORMER: -

CHECK ^{ON} BUCKLING BETWEEN 'A' AND 'B'



THE .025" DIAPHRAGM BETWEEN STNS 753 AND 758 HAS AN AVERAGE APPLIED STRESS OF 6,310 psi

ASSUMING THAT THE TITANIUM SKIN CARRIES AN APPLIED STRESS OF $\frac{15 \times 10^6}{10 \times 3 \times 10^6} \times 6,310 = 9,180 \text{ psi}$

END LOAD IN (.020 DUCT SKIN + .020 DOUBLER) = $A \times f_c$

$$P = 6,310 \times .025 + 9,180 \times (.30 \times .02^2)$$

$$= 158 + 110$$

$$= 268 \text{ LB.}$$

COMPRESSIVE STRESS IN SKIN AND DOUBLER = $\frac{268}{30 \times .04^2} = 5,580 \text{ psi}$

FROM G. L. MARTIN, HANDBOOK PG. 404, 131e

$$\sigma_{cr} = 5,580 \quad S = T \times .04 \times 10 \quad \frac{15}{3} = 2.71$$

$$\sigma_{cr} = \frac{\pi^2 E}{3 \left(\frac{S}{t} \right)^2} = \frac{\pi^2 \times 15 \times 10^6}{3 \times \left(\frac{15}{.04} \right)^2}$$



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MALTON, ONTARIO

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REPORT NO. 7-0559-7

SHEET NO. 16

AIRCRAFT:

C-105

FORMER @ 803
TIE AIR FUSELAGE

PREPARED BY

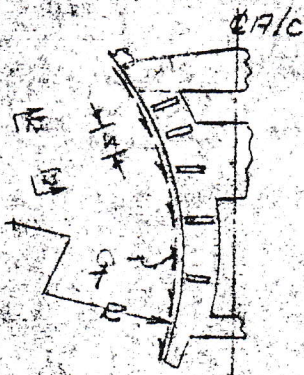
W. Nutley

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INNER SKIN PANELS BETWEEN STA 803 & STA 793



max shear flow $q = 216 \text{ lb/in}$
Ref T3

Panel length (h) = 5"

E (for titanium @ 240°F) 14.9×10^6

Radius of curvature (R) = 24.70"

Titanium skin thickness = .020"

Dist between formers (d)

= 303 - 298 = 5"

Actual shear stress = $216 / .020 = 10800 \text{ psi}$

CRITICAL BUCKLING STRESS

Ref Analysis, AVRO Stress Manual Sect 2.2.4-1

$$\frac{\tau_{cr}}{n_s} = K_s E \left(\frac{t}{d} \right)^2$$

$$z = 954 \left(\frac{h^2}{R E} \right) = 954 \left(\frac{5^2}{24.7 \times 10^6} \right) = 48.2$$

$$h/d = 5/5 = 1$$

From Fig 2.2.4-1 $K_s = 20$

$$\tau_{cr} = 20 \cdot 14.9 \times 10^6 \left(\frac{.020}{5.0} \right)^2 = 4760 \text{ psi}$$

Since the graph of τ_{cr} elastic (τ_{cr}/n_s) vs τ_{cr} shows a slope of approx 45° for both 255TL & 245T3 up to 20000 psi (See Fig 2.2.4-1), n_s will be assumed equal to 1.0 for Titanium.

Crit Buckling Stress (τ_{cr})
= 4760 psi



AVRO AIRCRAFT LIMITED
MALTON - ONTARIO

TECHNICAL DEPARTMENT

AIRCRAFT:

C-105

FORMER @ 803
REAR FUSELAGE

REPORT No. 7-0559-7

SHEET No. 47

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INNER SKIN PANELS BETWEEN STA 803 & STA 798

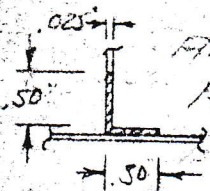
ALLOWABLE ULTIMATE SHEAR STRESS

$$\tau_{ALL} = \tau_{ALL}^* (.65 + \Delta)$$

$$\frac{360 \text{ ksi}}{R_h} = \frac{300 \times .020 \times 5}{24.7 \times 5} = .243$$

$$\tau / \tau_{cr} = 10800 / 4760 = 2.27$$

$$\text{From Fig 2.24-2} \quad R_h = .25$$



Area of Ring (A_{RG}) = 1.5377 in² Ref pg

Area of Stringer (A_{ST}) = 2.5 × .025 = .025 in²

$$R_R = \frac{dt}{A_{RG}} = \frac{5 \times .020}{.5597} = .179$$

$$R_S = \frac{dt}{A_{ST}} = \frac{5 \times .020}{.025} = 4.0$$

$$\frac{(h/t)(\sqrt{E/\tau})}{\sqrt{1 + R_R}} = \frac{(5/24.7)\sqrt{14.9 \times 10^6 / 10910}}{\sqrt{1 + .179}} = 5.60$$

$$\frac{1 + R_S}{1 + R_R} = \frac{1 + 4.0}{1 + .179} = \frac{5.0}{1.179} = 4.25$$

$$\text{From 2.24-4} \quad \alpha = 44^\circ$$

Cont'd on next page



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REPORT NO.

7-0559-7

SHEET NO.

48

AIRCRAFT:

C-105

FORMER @ 803
REAR FUSELAGE

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INNER SKIN PANELS BETWEEN STA 803 & STA 793

ALLOWABLE ULTIMATE SHEAR STRESS

The allowable shear stress of Titanium
@ 240°F is $.87 \times 42000 = 36500$ psi (Ref pg)
Since this is approx equal to the allowable
shear stress of 240T at room temperature,
Fig 2.2.4-6 will be used

$$\tau_{ALL}^* = 22200 \text{ psi}$$

$$\frac{F_{EG}}{dt} = \frac{.5591}{5 \times .020} = 5.6$$

$$\frac{F_{ST}}{dt} = \frac{.025}{5 \times .02} = .250$$

From Fig 2.2.4-8 $\Delta = .325$

$$\begin{aligned} \text{Ult. shear strength of web} &= \tau_{ALL}^* (0.65 + \Delta) \\ &= 22200 (0.65 + .325) \\ &= 21600 \text{ psi} \end{aligned}$$

$$MS = \frac{21600}{10800} - 1 = .99$$



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TECHNICAL DEPARTMENT

AIRCRAFT:

C-105

FORMER @ 803

BEAR FUEL TANK

REPORT NO. 7-0559-7

SHEET NO. 1A

PREPARED BY

W. Nutley

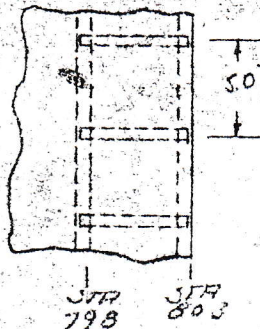
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INNER SKIN PANELS BETWEEN STA 803 & STA 798

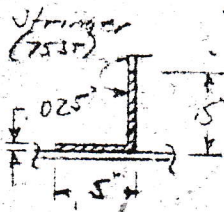
SECTION R-X



The side bending stresses in the flange of the former @ 803 caused by the tension field have been checked. The interselds themselves will be checked here. Ref AVRO's Stress Manual Sect 22.44

$$\frac{300 \text{ lbf}}{K h} = \frac{300 \times .02 \times 5}{247 \times 5} = .243$$

$$\frac{T}{T_{\text{ave}}} = \frac{10800}{4760} = 2.27$$



From Fig 2-2.4-2 $K = .26$

$$\text{Area of stringer} = .025(.50 + .48) = .0245 \text{ in}^2$$

$$\begin{aligned} \text{Average stress in the stringer } (\sigma_{\text{ST}}) &= \frac{K \sigma_{\text{ct}} a}{\frac{A_{\text{ST}}}{h t} + 0.5 (1-K)} = \frac{.26 \times 10800 \times 1.0355}{\frac{.0245}{5 \times .02} + 0.5 (1-.26)} \\ &= 4730 \text{ psi} \end{aligned}$$

When $h/d = 5/5 = 1$

From Fig 2-2.4-9 $\sigma_{\text{ST max}} / \sigma_{\text{ST}} = 1.13$

$$\begin{aligned} \text{max stress in stringer} &= 1.13 \times 4730 \\ &= 5340 \text{ psi} \end{aligned}$$

$$\text{@ } 240^\circ \text{ Fcc} = \frac{342 \sqrt{49000 \times 94 \times 10^4}}{(.49 / .025)^{.75}} = 25000 \text{ psi}$$

ms = High

TECHNICAL DEPARTMENT (Aircraft)

REPORT NO. 7-0559-117

SHEET NO. 50

AIRCRAFT: C105

REAR FUSELAGE ENGINE

DOCT LOADS 742.5 - 803

PREPARED BY

DATE

A. Cooke

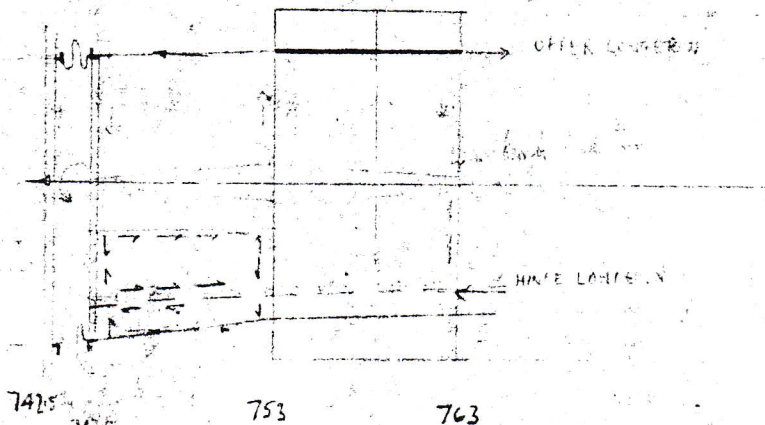
OCT 28/55

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INTRODUCTION

742.5 - 753 - 763



DOCT HAS A FLEXIBLE JOINT AT 742.5 AND THE TRANSITION SECTION OF DOCT IS CONSIDERED AS A CANTILEVER SUPPORTED AT 753 & 763. FORE & AFT LOADS INDUCED IN THE DOCT DUE TO INTERNAL PRESSURE ACTING ON CHANGES IN AREA ARE TAKEN BY SHEAR IN SKIN OF DOCT AND ^{PRODUCE} END LOADS IN LONGERONS & INTERCOSTAL MEMBERS

AS DOCT IS NOT SUPPORTED BY FORMER AT 742.5 AN EDGE MEMBER IS REQ^D ON THE DOCT AFT OF THE FLEXIBLE JOINT TO REDISTRIBUTE THE END LOADS & MOMENTS DUE TO SHEAR FLOWS.

THE END LOAD TAKEN BY THE UPPER OUTBD LONGERON IS COLLECTED BY THE KINK MEMBER ON THE DOCT & TRANSFERRED THROUGH AN INTERCOSTAL BETWEEN 753 - 758 TO THE OUTER SKIN & HENCE TO LONGERON. THE SHEAR FLOWS IN THE INTERCOSTAL INDUCE IN & OUT LOADS ON FORMERS 753 & 763

TECHNICAL DEPARTMENT (Aircraft)

REPORT NO.

SHEET NO.

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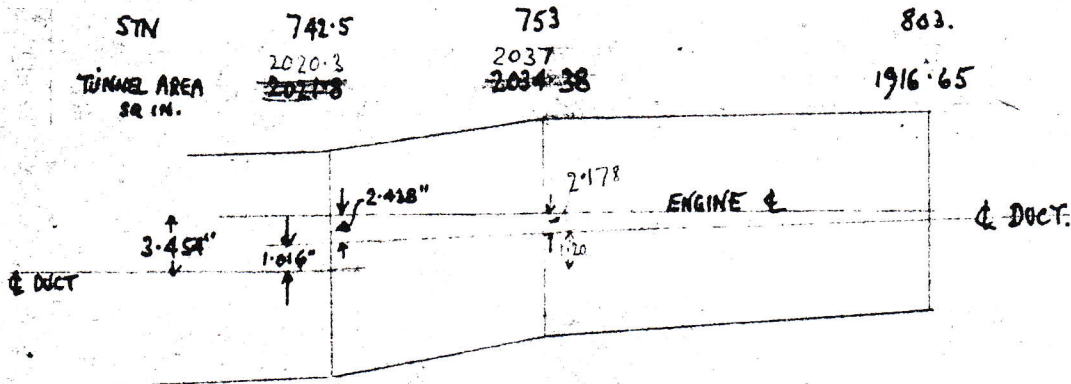
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AIRCRAFT: C105

REAR FUS. LOADS DUE
TO TUNNEL TAPER
STN 742.5 - 753



FROM GEOMETRY TABLE (SLOAN JUN 14/51) ϵ DUCT AT STN 753 IS 2.178" BELOW ϵ ENGINE
ASSUMING ϵ DUCT IS STRAIGHT LINE FROM 803 $\rightarrow$ 753 & PROJECTING THIS
LINE FWD TO 742.5 IT WILL BE 2.178" + .26" = 2.438" BELOW ϵ ENGINE
DIFFERENCE .26"

FROM GEOMETRY CALC. (COOKE OCT 13) ϵ DUCT AT STN 742.5 IS 3.454" BELOW ϵ ENGINE
 $\therefore$ DEVIATION OF DUCT ϵ FROM 753 TO 742.5 IS 3.454 - 2.438
OFFSET IN DUCT ϵ = 1.016"

2. ASSUMING ϵ DUCT IS STRAIGHT LINE FROM 727.4 AFT TO 742.5 ϵ
PROJECTING THIS LINE AFT TO 753 IT WILL BE $(3.454) - (11 \times \frac{10.5}{15.1}) = 3.378"$
DEVIATION OF DUCT = 3.378 - 2.178 = 1.20" DIFFERENCE .076

$$\text{MEAN DEVIATION} = \frac{1.20 + 1.016}{2} = 1.108"$$

$$\text{MOMENT DUE TO DEVIATION} = 16.64 \times 2021.8 \times 1.108 = 37.00 \text{ lb-in}$$

PARTLY (25100 lb) TAKEN BY END LOAD IN LONG.

" (5200) " " VERT LOAD ON FORMERS 753-763

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TECHNICAL DEPARTMENT (Aircraft)

AIRCRAFT: C105

REAR FJS LOAD DUE TO
DUCT TAPER 742.5 - 753

REPORT NO.

7-0559-7
7-0559-12

SHEET NO.

52

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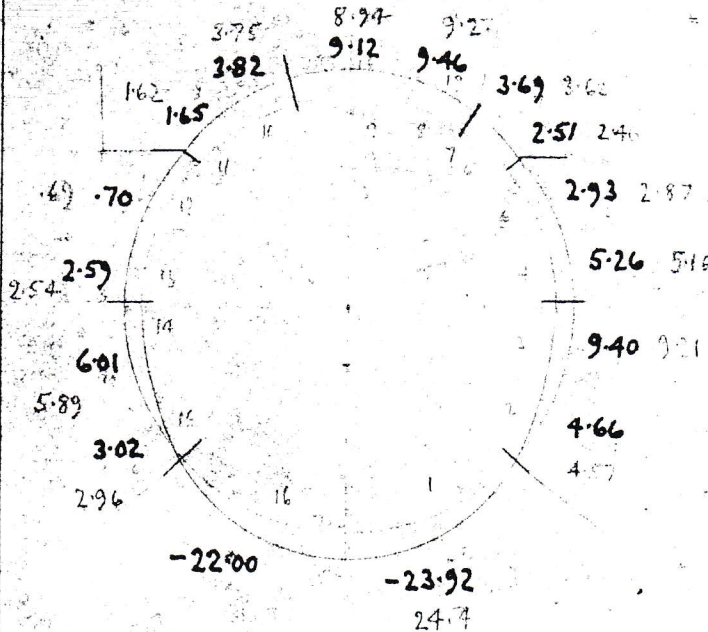
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AREA CHANGE .17" BETWEEN ENGINE QS AT 742.5 & 753



$$+ 64.82$$

$$- 45.92$$

$$18.90$$

$$2037 \quad 753$$

$$2020.1 \quad 742.5$$

$$16.7$$

TO BALANCE AREAS

$$18.90 + 64.82 \times \frac{63.5}{64.7} = .98 \text{ corr. factor}$$

$$18.90 - 45.92 \times \frac{45.92}{45.7} = -1.02 \text{ corr. factor}$$

for 2 engine offset etc.

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

7-0559-7
7-0559-127
REPORT NO.
SHEET NO. 53

AIRCRAFT: C105

REAR FUS.
AREA OF DOCT AT STN 753

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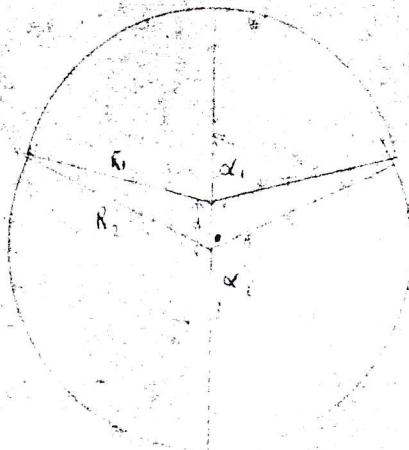
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To find total area of duct at 753.

from R_1, R_2, d .

$$R_1 = 23.750 \quad R_2 = 25.258 \quad d = 2.586$$

$$c^2 = a^2 + b^2 - 2ab \cos C$$

$$a^2 + b^2 - c^2 = 2ab \cos C$$

$$80.59146$$

$$130.6244$$

$$.616924 = \cos C$$

$$C = 51.54^\circ$$

$$51.54^\circ$$

$$\sin C = .78762$$

$$\sin A = \frac{a}{c} \sin C$$

$$\sin A = \frac{.78762}{1.03653}$$

$$= 1.03653$$

$$\sin A = .83699$$

$$= 180 - 56^\circ 49.04' = 123^\circ 11.96'$$

$$123^\circ 11.96'$$

$$66.7135$$

$$\alpha_1 = 180 - A = 56^\circ 49.04' = 56.817 \times .017453 = .991627$$

$$\alpha_2 = 180 - C = 128.5^\circ = 128.091 \times .017453 = 2.23557$$

$$A_1 = R_1^2 \left(\frac{2\alpha_1}{2} - \sin 2\alpha_1 \right)$$

$$A_2 = R_2^2 \left(\frac{2\alpha_2}{2} - \sin 2\alpha_2 \right)$$

$$282031 (1.983254 - .91600)$$

$$10672$$

$$A_1 = 300.983$$

$$318983 (4.47114 + .9710)$$

$$5.44214$$

$$A_2 = 1735.337$$

1425-753

TECHNICAL DEPT. (AIRFRAMED)

54

A. Cooke

C. G. POSITION

[illegible]

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TECHNICAL DEPARTMENT (Aircraft)

REPORT NO.

SHEET NO.

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NOV 3 / 55

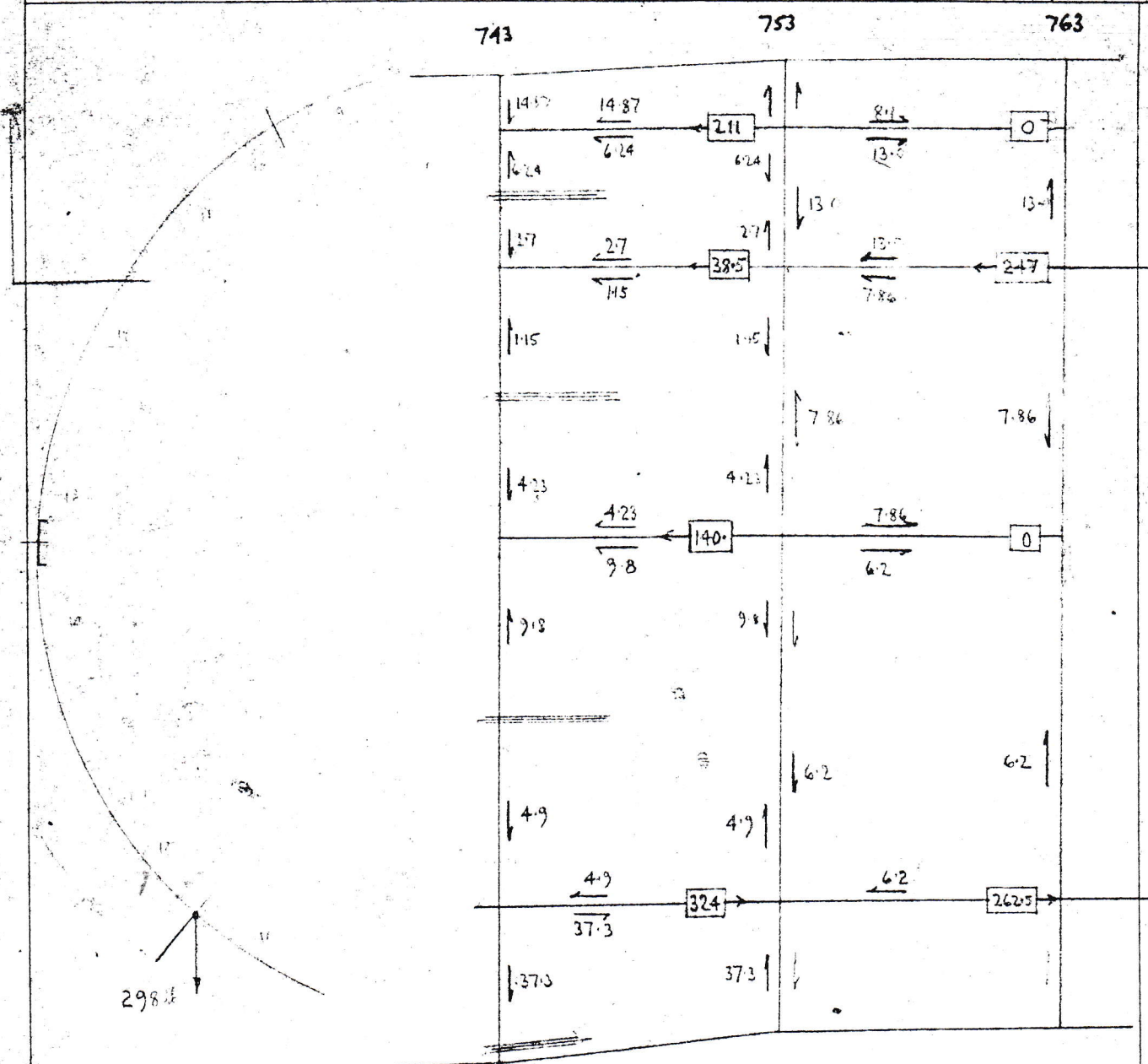
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AIRCRAFT: C 105

REAR FUS.

SHEAR FLOWS DUE TO
DUCT TAPER (OUTER SKIN)



TECHNICAL DEPARTMENT (Aircraft)

REPORT NO.

SHEET NO.

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AIRCRAFT: C105

REAR FOS.
SHEAR FLOWS DUE TO
DOCT TAPER

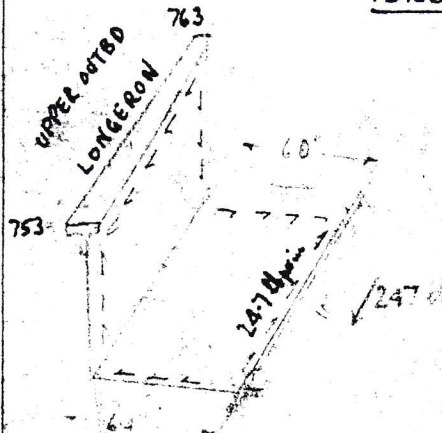
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NOV 3/58

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SHEAR IN UPPER INTERCOSTAL MEMBERS &
FORCES INDUCED ON FORMERS.



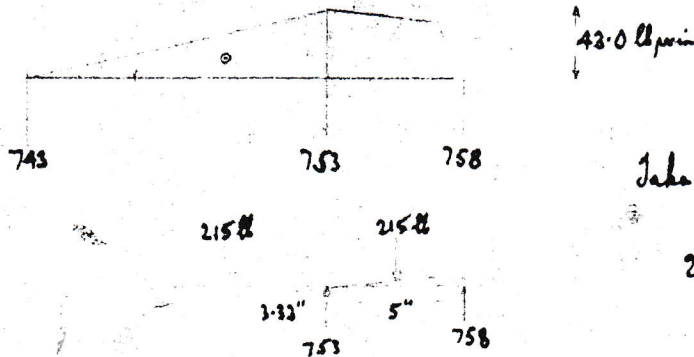
$$\text{Shear flow} = 24.7 \text{ lb/in}$$

$$\text{Outward force on 753} = 6.4 \times 24.7 = 158 \text{ lb}$$

$$\text{Inward force on 763} = 6.4 \times 24.7 = 148 \text{ lb}$$

This adds to 'kink' load on former 753
subtracts on 758

KINK LOAD ON 753 DUE TO CANTILEVERED PORTION OF DOCT.



Take moments about 758.

$$215 \times 8.33 + 215 \times 2.5 = T \times 5$$

$$T = \frac{215 \times 10.83}{5}$$

$$T = 466 \text{ lb}$$

$$\text{TOTAL LOAD AT KINK} = 466 + 158 = 624 \text{ lb} \quad (\text{at } 16.64 \text{ psi in doct})$$

$$\text{Case 7a} \quad \frac{18}{122} \times 624 = 92 \text{ lb.}$$

$$\text{Case 91b.} \quad 624 \text{ lb T} \quad p_2 = \frac{179}{386} \times$$



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AIRCRAFT: C. 105.

REAR FUSELAGE.

OUTB^d SIDE INTERCOSTAL.

REPORT NO. 7-0559-7

SHEET NO. 58

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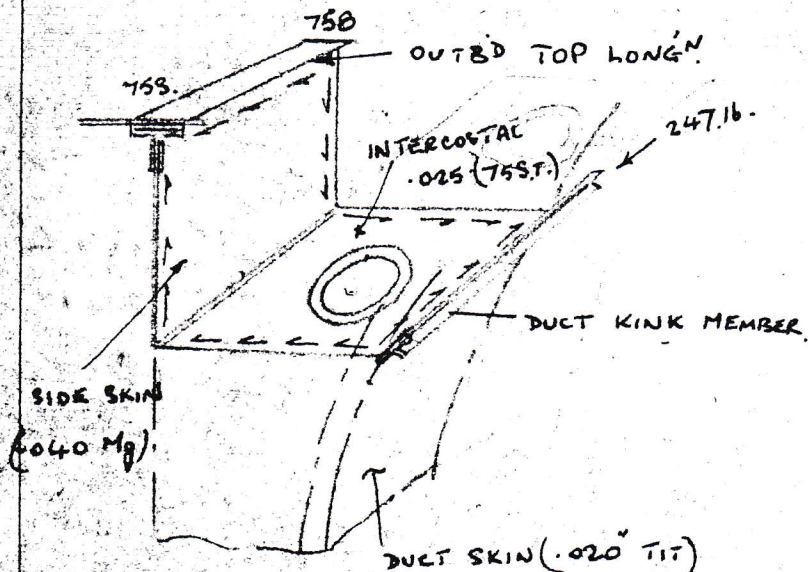
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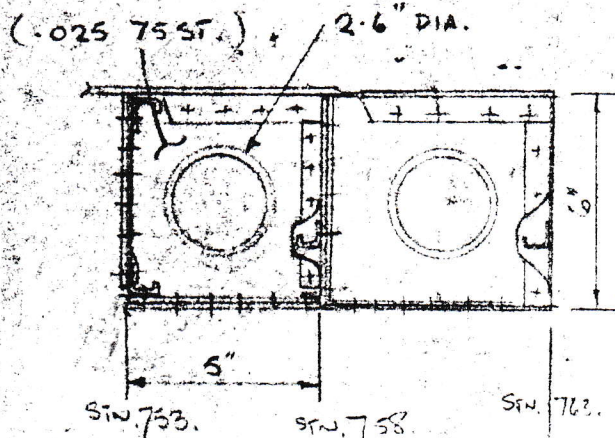


THIS INTERCOSTAL TRANSFERS
AN END LOAD OF 247 LB.,
(ARISING FROM CHANGE IN
DUCT AREA)

FROM THE DUCT KINK
MEMBER TO THE SIDE
SKINS, WHICH IN TURN
CARRY THE LOAD TO THE
OUTB^d TOP LONGⁿ

[TWO PANELS USED NOW]

PANEL. 5" x 6" x .025" 75ST.



$$\frac{a}{b} = \frac{6}{5} = 1.2$$

FROM BRAHN. FIG B. 25.

$$K_s = 7.15.$$

BUCKLING SHEAR STRESS $\tau_{cr} = K_s E \left(\frac{t}{b}\right)^2$

$$\tau_{cr} = 7.15 \times 10.3 \times 10^6 \left(\frac{.025}{5}\right)^2$$

$$= 1840 \text{ psi.}$$

$$\frac{D}{R} = \frac{3}{6} = \frac{1}{2}$$

FROM. A.E.M. SECT. V. FIG. 223-2, $C_s = 1.4$.

$$\tau_{cr} = \frac{1840}{1.4} = 1313 \text{ psi.}$$

$$\text{APPLIED SHEAR STRESS } \tau = \frac{247}{5 \times .025} = 1978 \text{ psi.}$$

$$\frac{\tau}{\tau_{cr}} = \frac{1978}{1313} = 1.505, \text{ FROM A.E.M. FIG. 224-2, } K = .085.$$

USING TWO PANELS (753-758) AND (758-762) TO PREVENT BUCKLING,

$$\text{APPLIED SHEAR STRESS } \tau = 1978/2 = 989 \text{ psi.} \leftarrow \text{THIS IS CORRECT TO PRODUCTION Dwg.}$$

$$\text{BUCKLING SHEAR STRESS } \tau_{cr} = 1313 \text{ psi.}$$



AVRO AIRCRAFT LIMITED
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TECHNICAL DEPARTMENT

AIRCRAFT: C105

REAR FUSELAGE

DUCT LOADS

STN 742.5 TO STN 753

REPORT NO.

7-0559-7

SHEET NO.

59 73

PREPARED BY

A Cooke

DATE

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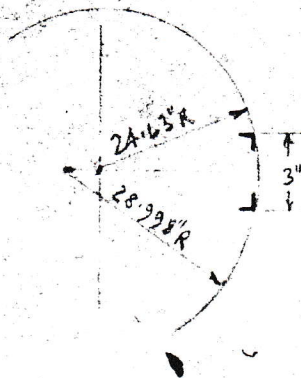
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ANGLES AT CENTRE ON INSIDE OF DUCT SKIN

REF SHEET 73.

MATL ALTERED TO .025 S.S.

(FROM 24.5)



DIFFERENCE IN HOOP TENSIONS = $p(R_1 - R_2)$

$$= 16.64 (28.998 - 24.63)$$

$$= 72.68 \text{ LB/IN.}$$

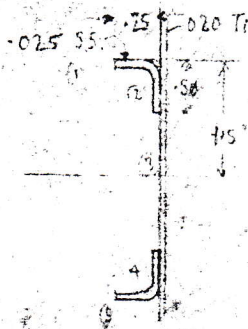
AT 753, THIS IS ZERO.

REACTING LOAD AT 763 AND 753 (AS IN DIAGRAM)

$$\text{MOMT AT 753} = \left(72.68 \times \frac{10.5}{2} \right) \times \frac{1}{3} \times 10.5$$

$$= 2,674 \text{ LB. IN.}$$

$$M \text{ AT STA 753} = 2,674 \text{ LB. IN.}$$



K	b x t	A	y	Ay ²	I _{xx}
1	.23 x .025	.00575	1.49	.0128	
2	.47 x .025	.0117	1.24	.0181	
3	.02 x 3.0	.0600	0		.045
4	.47 x .025	.0117		.0181	
5	.23 x .025	.00575	1.49	.0128	
				.0618	.0450

$$\text{Total } I = .1068 \text{ in}^4$$

$$\sigma_m = \frac{M y}{I} = \frac{2,674 \times 1.5}{.1068} = 37,600 \text{ psi}$$

$$\frac{b'}{t} = \frac{.23 + .47}{2 \times .025} = 14.$$

$$\frac{F_{cc}}{\sqrt{F_{cc} E}} = .046$$

$$\sqrt{F_{cc} E} = \sqrt{110,000 \times 30 \times 10^6} = \sqrt{10^{10} \times 3300} = 181,000$$

$$F_{cc} = 83,500 \text{ psi}$$

SS. MH-1-1117 18-8 11-11-11

MS > 1.0

SHEET 3 OF 4



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REPORT NO.

7-0559-7

SHEET NO.

60.

AIRCRAFT:

C. 105

REAR FUSELAGE

SKINS

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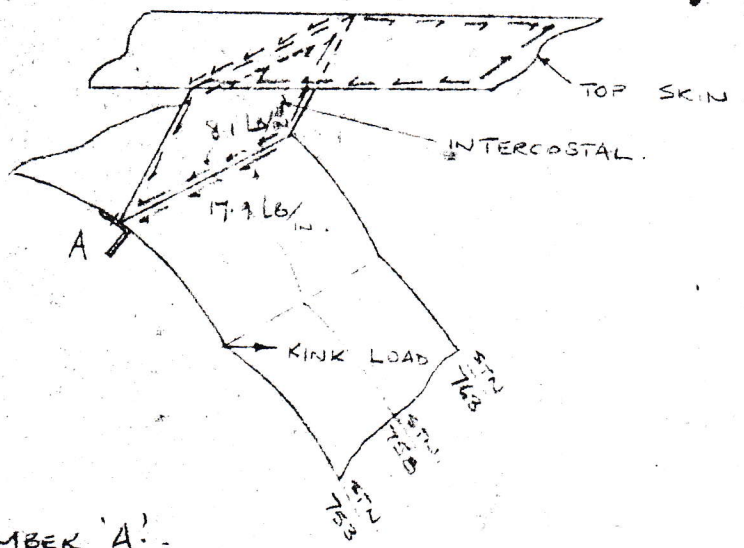
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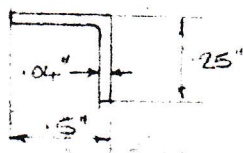
INTERCOSTAL WEB CONNECTING DUCT SKINS TO TOP SKIN:-



MEMBER 'A':-

SHEAR FLOWS FROM CHANGE IN DUCT AREA:-

MAX END LOAD IN MEMBER AT A' = (470.4 - 214) LB TENSION
(FROM MAX DUCT PRESSURE CASE 16.64 PSI.)



AREA OF ANGLE

= 256.4 LB TENSION.

= $0.4(2.5 + 0.5) \times 0.030 \text{ IN}^2$

APPLIED TENSILE STRESS $f_t = \frac{256.4}{0.030}$

= 8540 PSI. M.S. > 1.

INTERCOSTAL DIAPHRAGM:-

THIS TRANSFERS SHEAR LOADS FROM THE DUCT SKINS TO THE TOP SKIN IN THE REGION BETWEEN STN'S 753 AND 803. IT WILL BE SUFFICIENT TO CHECK THE DIAPHRAGMS LYING BETWEEN STN'S 753 AND 758 AND BETWEEN STN'S 798 TO 803.

INTERCOSTAL DIAPHRAGM BETWEEN STN'S 753 AND 758. (REF DRG.

IN CASE 739 FROM SHEET NO. 5. OR, REPORT 7-0559-L, 7-0559-106. SECTION A

MAX SHEAR FLOW, $q = 157 \text{ LB/IN}$ (AVERAGE ACROSS PANEL)

THERE WILL BE ADDITIONAL SHEAR FLOW FROM THE CHANGE IN (LIMIT)



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TECHNICAL DEPARTMENT

REPORT NO.

7-0559-7

SHEET NO.

61

AIRCRAFT:

C. 105.

REAR FUSELAGE
SKINS (DUCT)

PREPARED BY

JARMAN

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DATE

JAN. 56

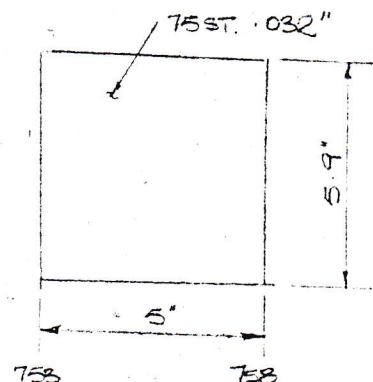
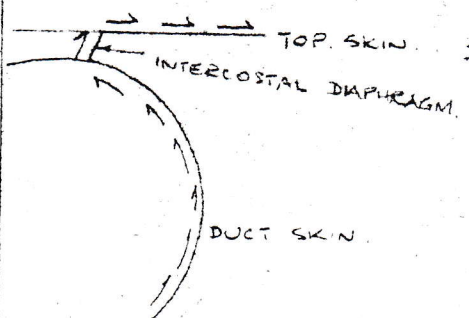
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INTERCOSTAL DIAPHRAGM. STN 753 TO 758 (CONT'D.) -

BUT MAX DUCT PRESSURE IN CASE 9.1b = 12.2 psi LIMIT.
THIS GIVES RISE TO A SHEAR FLOW OF $\frac{470.4}{10} = 47.04 \text{ LB/IN.}$

APPROPRIATE SHEAR FLOW FOR CASE 7.3a = $\frac{1.8}{12.2} \times 47 = 6.93 \text{ LB/IN.}$

TOTAL SHEAR FLOW IN DIAPHRAGM, $q_t = 157 + 7 = 164 \text{ LB/IN.}$
AND APPLIED SHEAR STRESS, $\tau = \frac{164}{.032} = 5125 \text{ psi.}$



$$\frac{a}{b} = \frac{5.9}{5} = 1.18$$

$$t = .032'' \text{ 75 ST.}$$

SHEAR BUCKLING STRESS $\tau_{cr} = K_s E \left(\frac{t}{b} \right)^2$

FROM BEUTH FIG B.2-5, $K_s = 7.22$, $E = 10.3 \times 10^6 \text{ psi.}$

$$\tau_{cr} = 7.22 \times 10.3 \times \left(\frac{.032}{5} \right)^2 = 3040 \text{ psi.}$$

$$\frac{\tau}{\tau_{cr}} = \frac{5125}{3040} = 1.687$$

FROM AEM, SECT. V, FIG 22.4-2, $K = .11$.

RIVETS ALONG WEB TO FLANGE -

APPLIED FORCE / IN. OF RIVET LINE, $q_t = q_v (1 + .411 K)$
 $= 164 (1 + .411 \times .11)$
 $= 170.5 \text{ LB/IN.}$

RIVET PITCH AT 75' MAX. LOAD / RIVET = $170.5 \times .75 = 128 \text{ LB.}$

BEARING STRENGTH OF $\frac{1}{8}$ " DIA RIVET IN .032" 75 ST. 6. AFTER EXPOSURE TO 279°F = $411 \times 1.33 \times 87 = 473 \text{ LB}$

SHEAR STRENGTH = $388 \times .964 \times 87 = 326 \text{ LB.}$ M.S.

WEB SHEAR STRENGTH IS SATISFACTORY



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MALTON, ONTARIO

TECHNICAL DEPARTMENT

REPORT NO.

7-0559-7

SHEET NO.

42

AIRCRAFT:

C.105.

REAR FUSELAGE.

INTERCOSTAL AT (798-803)

PREPARED BY

JARMAN

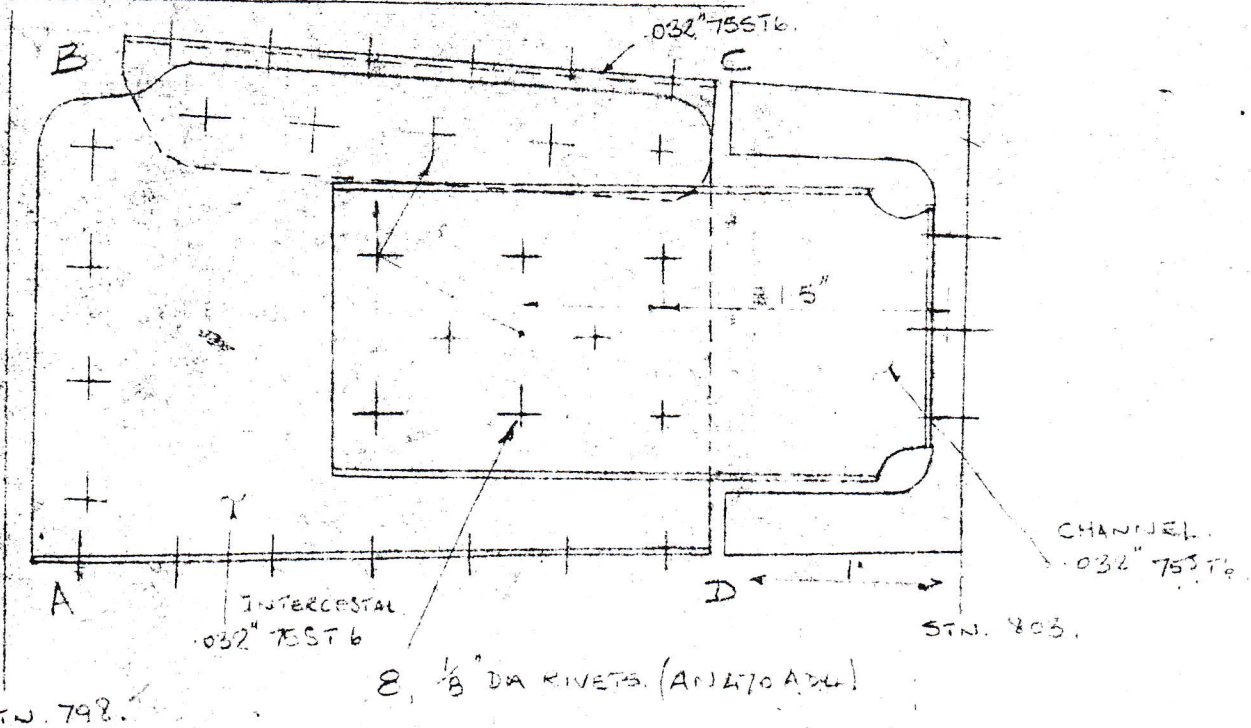
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DATE

JUNE '56

DATE

INTERCOSTAL BETWEEN STN^S 798 AND 803.

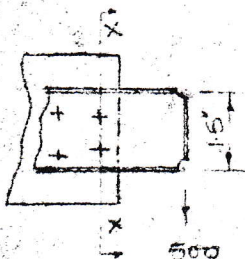


APPLIED SHEAR FLOW = 194 LB/IN. (FROM PARACHUTE UP 16.5°
CASE REF 7-0559-4.)

ADDITIONAL SHEAR FROM NEGATIVE DUCT PRESSURE OF 1.5 P.S.I. (LINE)
(SEE RPT 7-0559-7 SHT. 80.) = 5.73 LB/IN.

TOTAL SHEAR FLOW IN DUCT SKINS = 194 + 6 = 200 LB/IN.

SECTION XX IN BENDING.



SHEAR REACTED AT STN. 803 = 2.5 x 200 = 500 LB.

BM. AT SECTION XX = 500 x 1.5 = 750 LB.IN.

$$I = \frac{15^3 \cdot 0.032}{12} + (0.032 \cdot (\frac{15}{2})^2 \cdot 1.5) 2$$

$$= 0.009 + 0.0108$$

$$= 0.0198 \text{ in}^4$$

$$f_c - f_t = \frac{My}{I} = \frac{750 \times 0.75}{0.0198}$$

$$= 28400 \text{ P.S.I.}$$



AVRO AIRCRAFT LIMITED
MALTON - ONTARIO

TECHNICAL DEPARTMENT

REPORT NO. 7-0559-7

SHEET NO. 63

AIRCRAFT:

C. 125.

REAR FUSELAGE

INTERCOSTAL AT (7-R TO 803)

PREPARED BY

JARMAN

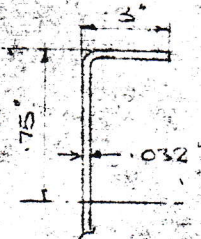
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CRIPPLING STRESS FOR CHANNEL:-



$$\frac{a+b}{2t} = \frac{3+75}{2 \times .032} = 16.4$$

FROM GRAPH, $\frac{F_{cc}}{\sqrt{E_0 E}} = .0415$

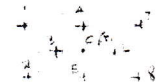
AT ROOM TEMP. $\sqrt{E_0 E} = 814,000$

AFTER EXPOSURE TO 270°F, $\sqrt{E_0 E} = 814,000 \times \sqrt{.94 \times .95}$
 $= 814,000 \times .945$
 $= 770,000$
 $F_{cc} = 770,000 \times .0415$
 $= 31,900 \text{ PSI}$

(CONSERVATIVE) $\frac{31,900}{28,400} = 1.12$

RIVETS CONNECTING CHANNEL TO INTERCOSTAL:-

THERE ARE 8, $\frac{1}{8}$ " DIA RIVETS.



THESE MUST REACT A SHEAR OF 500 LB., TOGETHER WITH A MOMT OF $(500 \times 2.15) = 1075 \text{ LB. IN}$

DIRECT SHEAR/RIVET = $\frac{500}{8} = 62.5 \text{ LB.}$

LOAD FROM MOMT = $\frac{M}{\sum r^2} = \frac{1075 \times .85}{4 \times .95^2 + 2 \times .41^2 + 2 \times .375^2} = \frac{914}{3.513} = 260 \text{ LB.}$

MAX. SHEAR/RIVET = $62.5 + 260 = 317 \text{ LB.}$

SHEAR STRENGTH OF $\frac{1}{8}$ " DIA RIVET IN .032" 7557 SHEET AFTER EXPOSURE TO 270°
 $= 388 \times .964 \times .94$
 $= 352 \text{ LB.}$

M.S. = 1.1

BEARING STRENGTH OF $\frac{1}{8}$ " DIA RIVET IN .032" 7557 SHEET AFTER EXPOSURE TO 270°
 $= 411 \times 1.35 \times .94 = 514 \text{ LB.}$

M.S. = 1.49



AVRO AIRCRAFT LIMITED
MALTON - ONTARIO

TECHNICAL DEPARTMENT

REPORT NO.

7-0559-7

SHEET NO.

64

PREPARED BY

DATE

JARMAN

SEPT. '56

CHECKED BY

DATE

AIRCRAFT:

C. 105

REAR FUSELAGE

INTERCOSTAL (798 TO 803)

INTERCOSTAL CONNECTING DUCT TO TOP SKIN AT STNS 798 TO 803:-

JOINT ~ DUCT SKIN TO INTERCOSTAL ALONG AD:-

THERE ARE 7 RIVETS $\frac{1}{8}$ " DIA (AN. 435 M.) AT .51" PITCH.

$$\text{APPLIED LOAD/RIVET} = 200 \times .51 = 102 \text{ LB.}$$

$$\text{BEARING STRENGTH OF } \frac{1}{8} \text{ DIA (AN. 435 M.) IN .020" (A70 TIT) SKINS AT } 329^{\circ}\text{F} = \frac{1}{8} \times .02 \times 120000 \times .66 = 198 \text{ LB.}$$

$$MS = \frac{198}{102} - 1 = .94$$

JOINT ~ INTERCOSTAL TO TOP SKIN ANGLE (B TO C):-

THERE ARE 6 RIVETS $\frac{1}{8}$ " DIA (AN. 470 AD) AT .62" MAX PITCH.

$$\text{APPLIED LOAD/RIVET} = 200 \times .62 = 124 \text{ LB.}$$

$$\text{BEARING STRENGTH OF } \frac{1}{8} \text{ DIA (AN. 470 AD) RIVET IN .032" 75576 (CLAD) SHEET AFTER EXPOSURE TO } 270^{\circ}\text{F} = 411 \times .964 \times .95 = 519 \text{ LB.}$$

$$\text{SHEAR STRENGTH} = 388 \times .964 \times .95 = 355 \text{ LB.}$$

$$MS = \frac{355}{124} - 1 = .71$$

JOINT ~ CHANNEL TO FORMER 803 (FITTING):-

3 RIVETS $\frac{1}{8}$ " DIA AN. 416 CSK. 100°

$$\text{APPLIED LOAD/RIVET} = \frac{500}{3} = 167 \text{ LB.}$$

$$\text{SHEAR STRENGTH IN .032 75576 CLAD AFTER EXPOSURE TO } 270^{\circ}\text{F} = 388 \times .964 \times .95 = 355 \text{ LB.}$$

$$MS = \frac{355}{167} - 1 = .71$$



AVRO AIRCRAFT LIMITED
MALTON - ONTARIO

TECHNICAL DEPARTMENT

AIRCRAFT: C105

REAR FOS. SLOT AT HINGE
STN 743.

REPORT NO.

7-0559-7

SHEET NO.

65

PREPARED BY

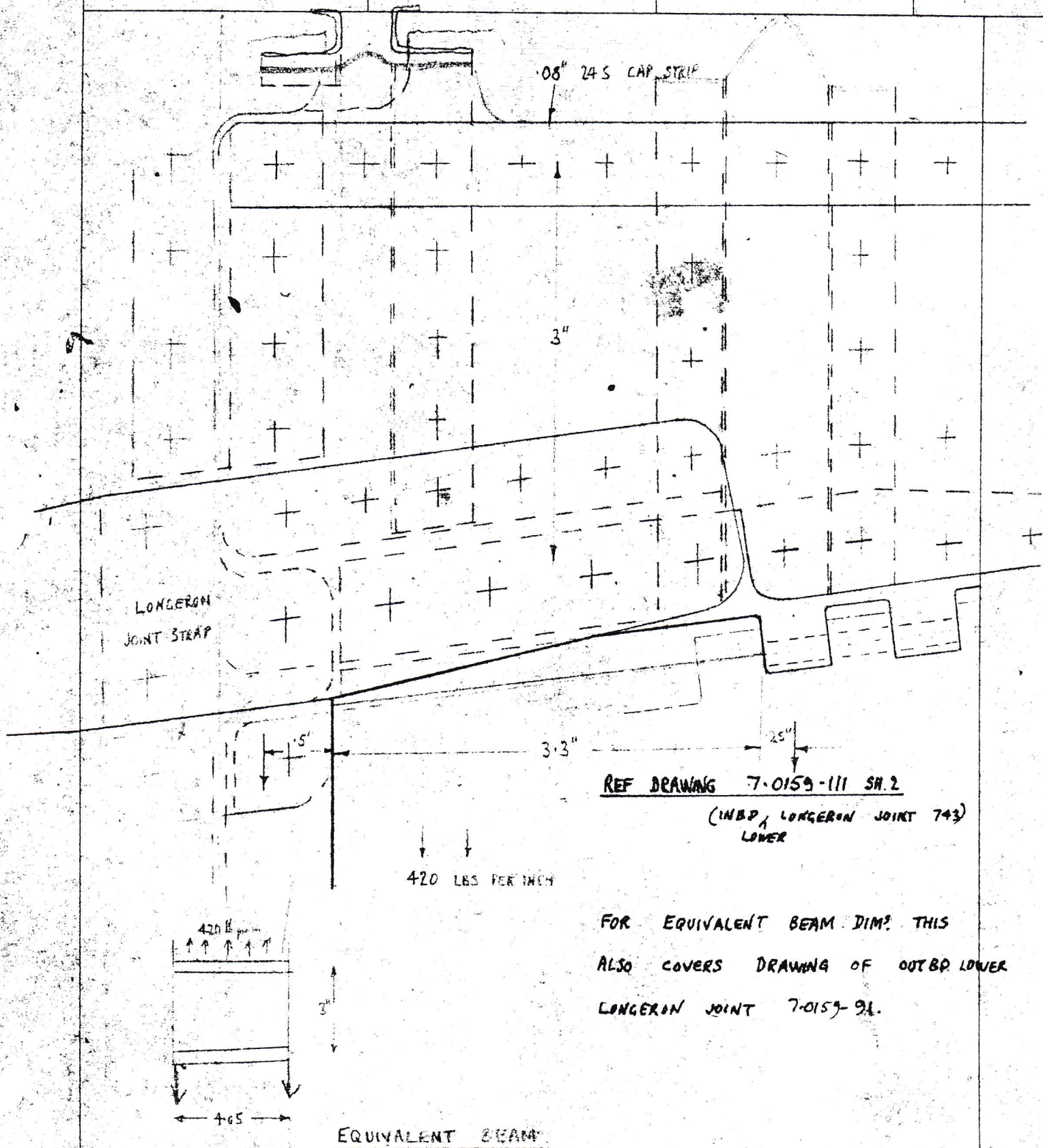
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EQUIVALENT BEAM



AVRO AIRCRAFT LIMITED
MALTON - ONTARIO

TECHNICAL DEPARTMENT

AIRCRAFT: C105

REAR FUS DOOR HINGE

CUT OUT AT 743

REPORT NO.

7-0559-7
7-0559-27

SHEET NO.

66

PREPARED BY

A Cooke

DATE

JAN 18/56

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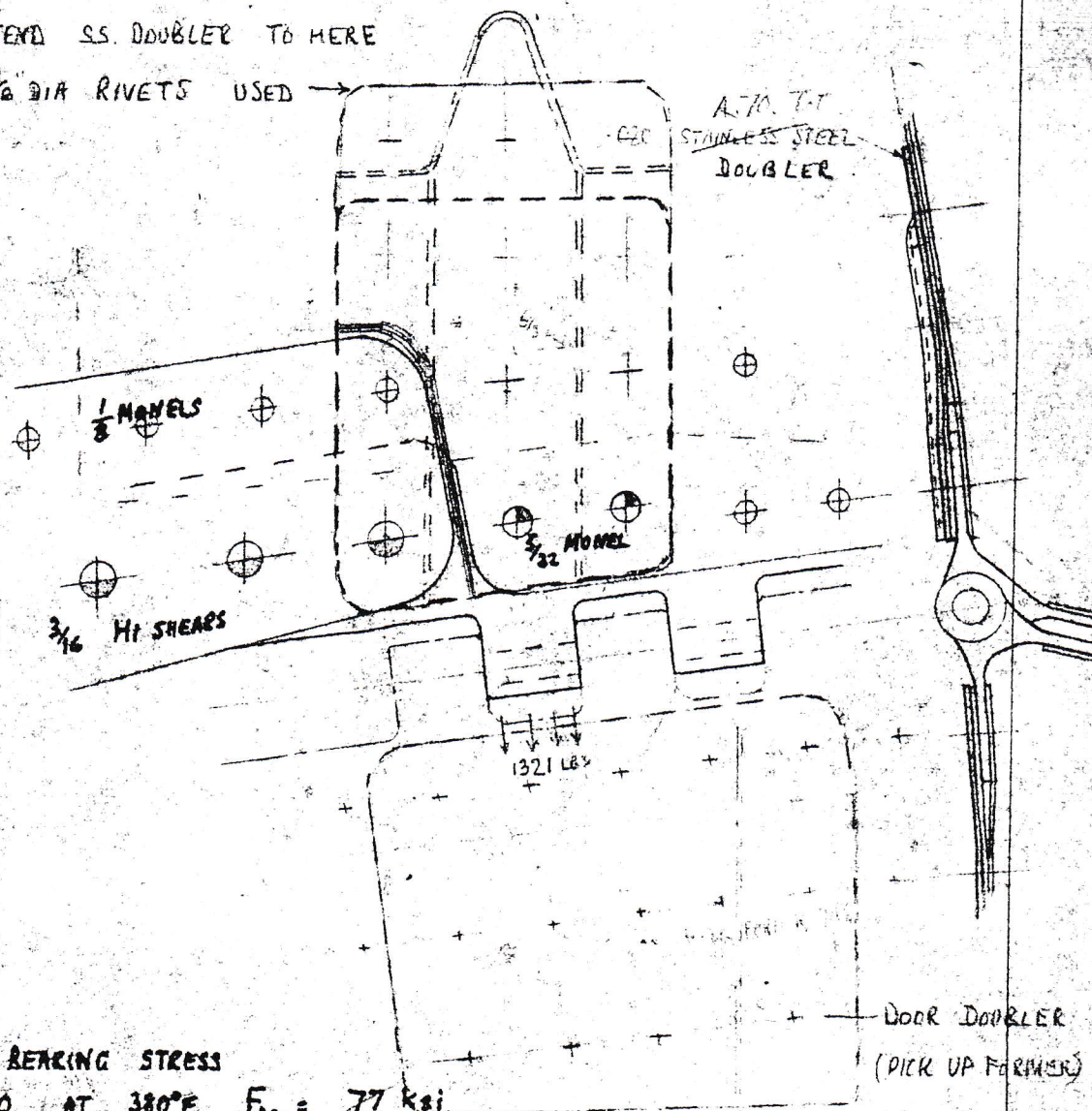
DATE

STABILISING STRINGERS & DIAPHRAGMS — DRG 7-0159-111 - SH 2

JOINT AT 742 — 7-0159-92

EXTEND SS DOUBLER TO HERE

IF 1/2" DIA RIVETS USED



ALLOWABLE ULT BEARING STRESS

IN TITANIUM A70 AT 380°F $F_{B01} = 77 \text{ ksi}$

BEARING AREA $S_{32} \times .020 = .00312 \text{ sq in}$

BEARING ALLOWABLE PER S_{32} RIVET IN .020" A70 AT 380°F = $.00312 \times 77 \text{ ksi} = 240 \text{ LBS}$

ALLOWABLE ULT LOAD FOR 2. S_{32} RIVET BEARING IN $3 \times .020 \text{ Ti} = 6 \times 240 = 1440 \text{ LBS}$

APPLIED LOAD 1321 LBS

BEARING IN 245 AT 300°F ALLOWABLE 77.5 ksi STRESS

AREA = $.07 \times S_{32} = .01095$

ALLOWABLE ULT LOAD PER S_{32} RIVET IN 070 245 AT 300°F = $.01095 \times 77.5 = 848 \text{ LB}$

FOR 2 RIVETS = 1696 LBS

REVISD IN LONG REPORT

MS-09



AVRO AIRCRAFT LIMITED
MALTON, ONTARIO

TECHNICAL DEPARTMENT

AIRCRAFT: C105

REAR FUS. SLOT AT HINGE

STN 743.

REPORT NO.

7-0559-7

SHEET NO.

47

PREPARED BY

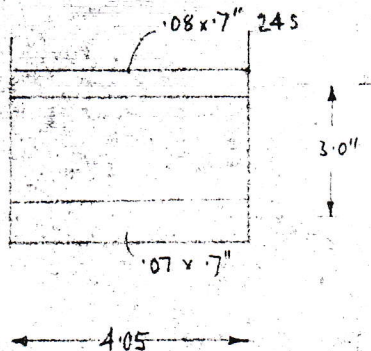
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EQUIVALENT BUILT IN BEAM

$$\text{ASSUME FLANGE IS } 7 \times .07 \text{ L.A.} + .7 \times .02 \text{ T.I.}$$

$$= .049 \text{ sq in L.A.} + .014 \text{ sq in T.I.}$$

$$\text{EQUIVALENT AREA} = .049 + .014 \times 1.5$$

$$\text{IN L.A.} = .07 \text{ sq in}$$

$$I = 2Ay^2$$

$$= 2 \cdot .07 \cdot 1.5^2$$

$$I = .315 \text{ in}^4$$

$$M = \frac{wl^2}{12} \text{ at ends}$$

$$= \frac{420 \cdot 4.05^2}{12}$$

$$M = 575 \text{ lb in}$$

$$\sigma = \frac{Mc}{I} = \frac{575 \cdot 1.5}{.315}$$

$$\sigma = 2740 \text{ psi}$$

MS > 1



AVRO AIRCRAFT LIMITED
MALTON - ONTARIO

TECHNICAL DEPARTMENT

AIRCRAFT:

C105

REAR FUS. SLOT AT
HINGE STN 743.

REPORT NO.

7-055277

SHEET NO.

68

PREPARED BY

A. Cooke

DATE

JAN 16/56

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DATE

BENDING SHEAR IN RIVETS (WEB TO BOOM) ON EQUIVALENT BEAM

$$\text{SHEAR AT ENDS OF BEAM} = \frac{wl}{2} = \frac{420 \times 3.3}{2}$$

$$\text{SHEAR} = 693 \text{ lb}$$

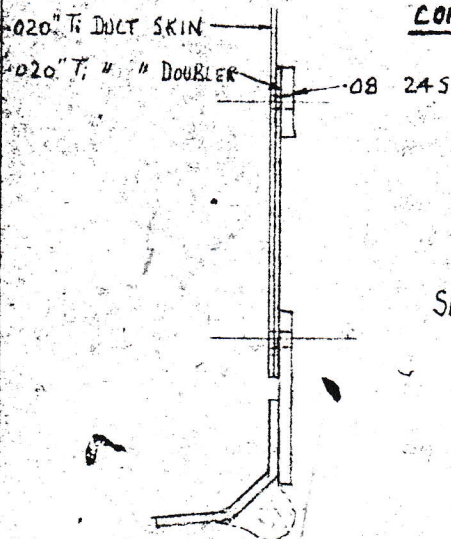
$$\text{SHEAR FLOW} = \frac{\text{SHEAR FORCE}}{\text{DEPTH}} = \frac{693}{3} = 231 \text{ lb per inch}$$

THIS MUST BE TAKEN BY BOOM TO WEB RIVETS

RIVET PITCH .65"

$$\text{LOAD PER RIVET} = .65 \times 231 = 150 \text{ lb}$$

(A70 allowable = 192 lb)



COMBINED SHEAR

THIS WILL COMBINE WITH

Hoop TENSION LOADS ON RIVET

AT JOINT BETWEEN TWO .020 SHEETS

WHICH TRANSFERS 1/2 LOAD FROM SKIN TO DOUBLER.

$$\text{SHEAR} = \frac{\text{DIRECT LOAD}}{2} + \frac{\text{HOK. SHEAR LOAD}}{2}$$

$$= \sqrt{\frac{273^2}{2} + \frac{150^2}{2}}$$

$$= \sqrt{137^2 + 75^2}$$

$$= \sqrt{183^2 + 56^2}$$

$$\text{COMBINED BENDING \& DIRECT SHEAR} = 156 \text{ lb}$$

A70 allowable 192 lb

TECHNICAL DEPARTMENT (Aircraft)

REPORT NO.

7-0359-7

SHEET NO.

69.

PREPARED BY

A. Cooke

DATE

JAN 6/56

CHECKED BY

DATE

AIRCRAFT:

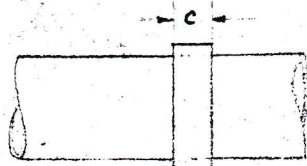
C105

REAR FUS. DUCT JOINT

AT 743.

ROARK P. 271.

(9) UNIFORM INTERNAL PRESSURE p LB/SQIN

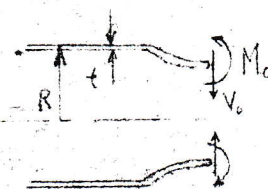


CROSS SECTIONAL AREA OF RING A SQ. IN.

RADIUS THIN SHELL R IN.

THICKNESS OF SHELL t IN.

WIDTH OF RING c IN.

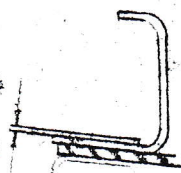


$$M_o = .304 p R t (K_1)$$

$$V_o = .78 p \sqrt{Rt} (K_1)$$

$$K_1 = \left(\frac{A - ct}{A + 1.56t \sqrt{Rt}} \right)$$

EQUIVALENT
STIFFNESS $T = .03M$



.032 .63 .75 .25 RADIUS

$$A = .032 \times .63 = .02016$$

$$A = .0448$$

$$c = .6$$

$$ct = .6 \times .03 = .018$$

$$A - ct = .0448 - .018$$

$$= .0268$$

$$1.56t \sqrt{Rt} = 1.56 \times .03 \sqrt{25.03}$$

$$= .0405$$

$$A + 1.56t \sqrt{Rt} = .0405 + .0448$$

$$= .0853$$

$$k_1 = \frac{A - ct}{A + 1.56t \sqrt{Rt}} = \frac{.0268}{.0853}$$

$$k_1 = .314 \quad (k = 1.0 \text{ for rigid ring})$$

TECHNICAL DEPARTMENT (Aircraft)

AIRCRAFT:

C105

REAR FUS DUCT JOINT

AT 743

REPORT NO.

7-0559-7

SHEET NO.

70

PREPARED BY

A. Cooke

DATE

JAN 6/56

CHECKED BY

DATE

$$M_o = .304 p R t K_1$$

$$p = 12.2 \times 1.364 = 16.64$$

$$= .304 \cdot 16.64 \cdot 25 \cdot .03 K_1$$

$$= 38 K_1 \quad (K_1 = .314)$$

$$M_o = 1.2 \text{ lb-in}$$

$$V_o = .78 p \sqrt{R t} K_1$$

$$= .78 \cdot 16.64 \cdot \sqrt{25 \cdot .03} K_1$$

$$= 11.3 K_1 \quad (K_1 = .314)$$

$$V_o = 3.54 \text{ lb}$$

$$\text{MAX. LONG. BENDING STRESS} = \frac{-6 M_o}{t^2} \quad \text{AT EDGE OF RING.}$$

$$= \frac{-6 \cdot 1.2}{.02^2} \quad (T_i \text{ SKIN})$$

$$\text{BENDING STRESS} = 18,000 \text{ psi}$$

$$\text{HOOP TENSION IN RING} = V_o R$$

$$= 3.54 \cdot 25$$

$$\text{LOAD} = 88.5 \text{ lb}$$

$$\text{TENSION STRESS} = \frac{V_o R}{A} = \frac{88.5}{.0449}$$

$$\text{TENSION STRESS} = 1980 \text{ psi}$$

TECHNICAL DEPARTMENT (Aircraft)

AIRCRAFT: C105

REAR FUS. TUNNEL

SHROUD 742 - 803

REPORT NO.

7-0559-7

SHEET NO.

71

PREPARED BY

A. Cooke

DATE

NOV 23/55

CHECKED BY

DATE

RINGS REQ^d TO PREVENT COLLAPSE 743-753
UNDER SUCTION CASE

$$P_{cr} = \frac{3EI}{R^3}$$

$$I = I \text{ of ring } \cancel{\text{ring spacing}}$$

$$= \frac{.011 \text{ in}^4}{3.5 \text{ in}}$$

$$I = .00314$$

$$P_{cr} = \frac{3 \times 15.5 \times 10^6 \times .00314}{27^3}$$

$$P_{cr} = 7.41 \quad \text{no allowance for out of round nose at 743.}$$

$P < P_{cr} \therefore$ CHECK BENDING DUE TO OUT OF ROUND

$$M = \frac{pR \delta_0}{1 - \frac{p}{P_{cr}}}$$

$$\frac{2.44 \times 27 \times 2}{1 - \frac{2.44}{7.41}}$$

$$\delta_0 = \frac{1}{4}(D_{max} - D_{min})$$

$$= \frac{1}{4}(29 - 25)$$

$$= 2$$

$$M = 197$$

$$f_b = \frac{M c}{I} = \frac{197 \times 6}{.00314} = 37,600 \text{ psi.}$$

$$f_c = \frac{PR}{A} = \frac{2.44 \times 29}{.03} = 24,200 \text{ psi. (area of } \Delta \text{ not included)}$$

$$\text{include strip } \times \frac{.01}{.032} \therefore f_c = 15,000 \text{ psi.}$$

$$15,000 \times \frac{2.44}{1000} = 27,000 \text{ for comparison}$$

$$f_b + f_c = 52,600 \text{ psi.}$$

Allowable crippling or yield stress of ring

F_{ty} after 300 at 526 in. diameter

$$f_c = 39,500 \text{ psi.}$$

$$F_y = 49.5 \text{ at } 300$$



AVRO AIRCRAFT LIMITED
MALTON - ONTARIO

TECHNICAL DEPARTMENT

AIRCRAFT C105

REAR FUS. LATCH
LOAD AT STN 803

REPORT NO.

7-0559-7
1-0559-7

SHEET NO.

72

PREPARED BY

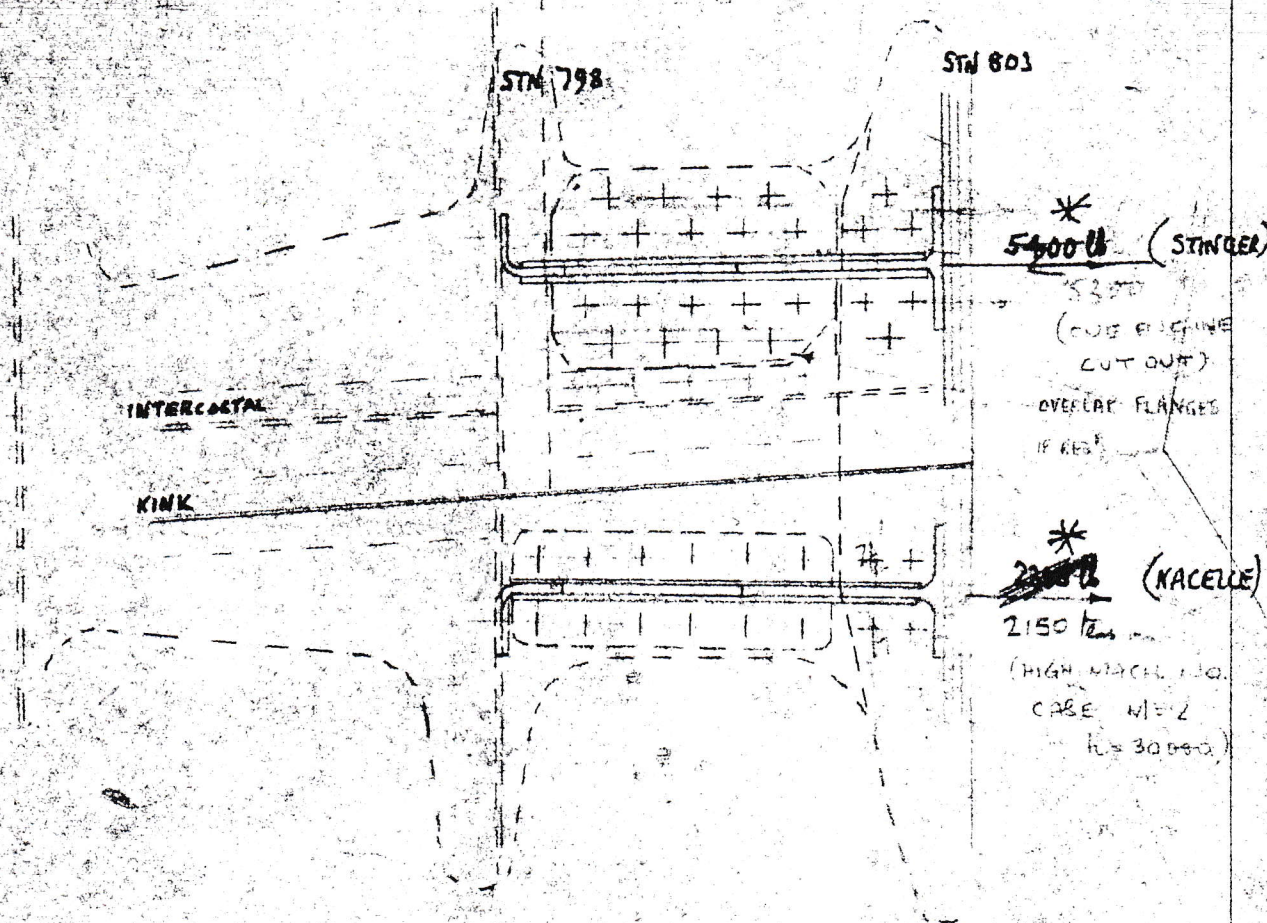
A. Cooke

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REVISED LOADS ISSUED JAN 5TH 1956 *

NOW AS BELOW

REF. REPORT 7-0559-4 SH. 2. 1.

4850
TENSION

5300
COMPRESSION



FOR DIFFUSION OF LATCH LOADS

TO LONGERONS SEE 7-0559-4 SH. 1. 28

TECHNICAL DEPARTMENT

REPORT NO.

7-0559-7

SHEET NO.

73

AIRCRAFT:

C. 105

REAR FUSELAGE.

NACELLE LATCH AT SN 803

PREPARED BY

DATE _____

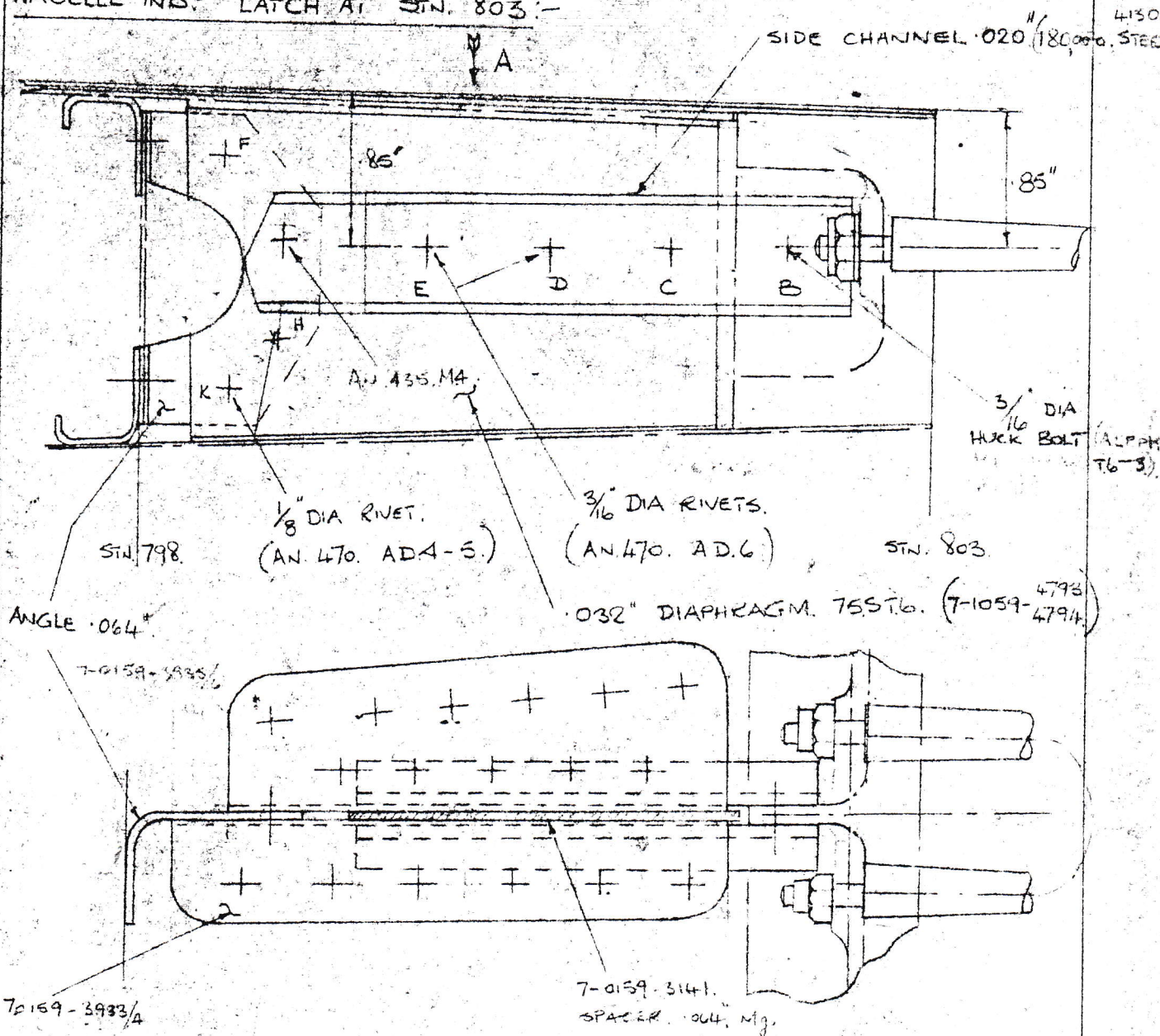
JARMAN.

JUNE '56

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DATE _____

NACELLE INBD LATCH AT STN. 803:-



LOADING -

MAX. LOAD IS APPLIED IN THE $M=2$. CASE AT 30000 FT.

FROM RPT 7-0559-4 SHEET 3-40.

$$P_{\text{max}} = 2150 \text{ Lb AT SIN. } 803.$$

(TENSION).



AVRO AIRCRAFT LIMITED
MALTON - ONTARIO

TECHNICAL DEPARTMENT

AIRCRAFT:

C. 105

REAR FUSELAGE

INBD NACELLE LATCH (STN. 803)

REPORT NO.

7-0559-7

SHEET NO.

74

PREPARED BY

JARMAN.

DATE

JUNE '56

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INBD NACELLE LATCH AT STN. 803 (CONT'D.): -

TENSION LOAD OF 2150 LB, APPLIED AT THE LATCH, IS SHEARED TO (.072") SIDE CHANNELS BY 1. $\frac{3}{16}$ " DIA HI-SHEAR RIVET. LOAD IS TRANSFERRED FROM CHANNELS TO (.032") DIAPHRAGMS BY 3, $\frac{3}{16}$ " DIA RIVETS, AND FINALLY, FROM DIAPHRAGMS TO TOP SKIN AND DOUBLER BY 16, $\frac{1}{8}$ " DIA BLIND RIVETS.

APPLIED LOAD IS OFFSET FROM SKIN LINE BY .85 IN. MOMT IS REACTED AT FORMERS 798 AND 803.

RIVET AT 'B'. ($\frac{3}{16}$ " DIA HI-SHEAR): -

APPLIED TENSION LOAD = 2150 LB.

APPLIED MOMT = $2150 \times .85 = 1827 \text{ LB. IN.}$ $\therefore \text{LOAD AT FORMERS} = \frac{1827}{4.1} \text{ LB.} = 446 \text{ LB.}$

LOAD ON RIVET 'B' = $\sqrt{2150^2 + 446^2} = 2185 \text{ LB.}$

DOUBLE SHEAR STRENGTH OF $\frac{3}{16}$ " DIA HI-SHEAR RIVET = $(2 \times 2070) = 4140 \text{ LB.}$ MS = 9

BEARING STRENGTH $\frac{3}{16}$ " HI-SHEAR IN $2 \times .020$ " (149,000 PSI) STEEL CHANNELS, WITH EXPOSURE TO 270°F = $(2 \times .020 \times \frac{3}{16}) \times 21600 \times 1.0 + \text{TEMP.}$

= 2450 LB.

BEARING IN FORMER 803 = $.14 \times \frac{3}{16} \times 146,000 \times 1.07 = 2570 \text{ LB.}$ MS = $\frac{2450}{2185} - 1 = .12$

RIVETS 'E, D, C': - (NOW EXTENDED TO INCLUDE ONE FURTHER RIVET) (JULY '56)

APPLIED LOAD = 2150 LB, APPLIED MOMT = $446 \times BD = 668 \text{ LB. IN.}$

$\therefore \text{APPLIED LOAD ON 'E AND C'} = \frac{2150}{3} + \frac{668.0}{EC} = 717 + 434 = 837 \text{ LB.}$

DOUBLE SHEAR STRENGTH OF $\frac{3}{16}$ " DIA A.D. RIVET AT 270°F = $(792 \times .80 \times .862) \times 2 = 1092 \text{ LB.}$.30

BEARING STRENGTH OF $\frac{3}{16}$ " DIA RIVET IN $2 \times .032$ " DIAPHRAGMS AT 270°F = $(\frac{3}{16} \times .032) \times 2 \times 1.37 \times .81$



AVRO AIRCRAFT LIMITED
MALTON, ONTARIO

TECHNICAL DEPARTMENT

REPORT NO.

SHEET NO.

75

AIRCRAFT:

C 105

REAR FUSELAGE.

INBD NACELLE LATCH (STN 803)

PREPARED BY

JARMAN

CHECKED BY

DATE

JUNE '56

DATE

INBD NACELLE LATCH (STN 803.) CONT'D :-

RIVETS CONNECTING DIAPHRAGM TO DOUBLER AND TOP SKIN.

11 RIVETS, $\frac{1}{8}$ " DIA. BLIND CSK (CSR 125-B-4)

5 " " " " (CSR 125 AD 4)

BEARING STRENGTH OF $\frac{1}{8}$ " DIA RIVET IN (.032" 75ST6) DIAPHRAGM
AT 270°F = $277 \times .81 = 224.5 \text{ LB.}$

ASSUME THAT ONLY 6 RIVETS ON EACH SIDE OF THE LATCH &
ARE EFFECTIVE. ALLOWABLE LOAD = $224.5 \times 12 = 2694 \text{ LB.}$
(CONSERVATIVE) APPLIED " = 2150 LB.

M.S. =

25.

RIVETS CONNECTING DIAPHRAGM TO .064" ANGLE AT STN 798 :-

4, (AN 470 AD 4) RIVETS, F, G, H, K.

FROM MOMT (DUE TO OFFSET OF LATCH LOAD FROM SKIN-LINE), LOAD
AT FORMER 798 = 446 LB.

CENTROID OF RIVETS IS .75" FROM FORMER

$$\begin{aligned} \therefore \text{MAX. LOAD / RIVET} &= \frac{446}{4} + \frac{M F_{\text{max}}}{\sum t^2} = 111.5 + \frac{(446 \times .75) \times .75}{2(.75^2 + .25^2)} \\ &= 111.5 + 201 \\ &= 230 \text{ LB.} \end{aligned}$$

SHEAR STRENGTH OF $\frac{1}{8}$ " RIVET IN .032" AT 270°F = $388 \times .964 \times .792$
= 296 LB. M.S. 29

BEARING STRENGTH OF $\frac{1}{8}$ " RIVET IN .032" 75ST6 AT 270°F = $411 \times 1.33 \times .81$
= 442 LB. M.S. 93



AVRO AIRCRAFT LIMITED
MALTON - ONTARIO

TECHNICAL DEPARTMENT

REPORT NO.

7-0559-7

SHEET NO.

76

PREPARED BY

JARMAN

DATE

JUNE 36

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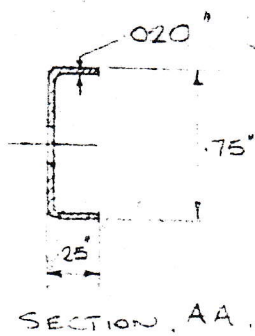
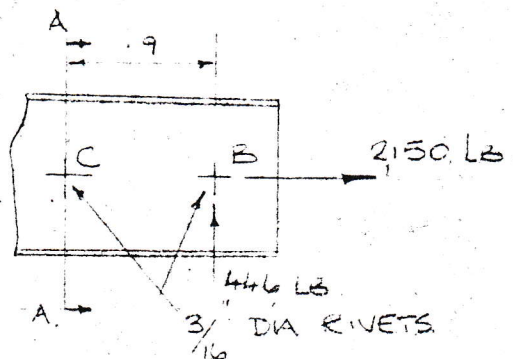
AIRCRAFT:

C. 105

REAR FUSELAGE

NACELLE LATCH AT STN. 803

CHANNEL (.0219" 4130 STEEL, HEAT TREATED TO 180,000 PSI)
T.S.



$$\text{APPLIED STRESS AT SECTION AA} = \left(\frac{P}{A} + \frac{M y}{I} \right)$$

$$A = (.71 + 2 \times .2) \times .020 - \frac{3}{16} \times .020 = .0222 - .00375 = .01845 \text{ IN}^2$$

$$I = \frac{.75^3 \times .020}{12} + (.2 \times .020) \times .364^2 \times 2$$

$$= .000703 + .00106$$

$$= .001763 \text{ IN}^4$$

THERE ARE TWO ANGLES

$$\text{MAX. STRESS } f_t = \frac{2150}{2 \times .01845} + \frac{(446 \times .9) \times .375}{.001763 \times 2 \times 1.5}$$

$$= 58,300 + 28,300$$

$$= 86,600 \text{ PSI}$$

$$F_{TU} = 180,000 \text{ PSI}$$

M.S.

>1



AVRO AIRCRAFT LIMITED
MALTON, ONTARIO

TECHNICAL DEPARTMENT

REPORT NO.

7-0559-7

SHEET NO.

77

PREPARED BY

DATE

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DATE

AIRCRAFT:

C-105

FORMER @ 803
BEAR FUELLAGE

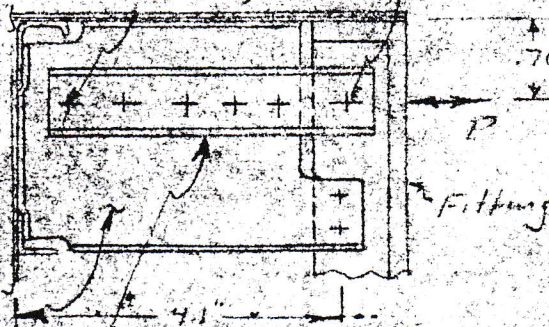
LONGERONS CONNECTING TO TOP CENTER BEAM

INTERCOSTALS IMMEDIATELY FWD OF 803

STINGER LATCHES AT STN 803. —

STINGER LONGERON INTERCOSTAL - SECTION C-C (Pg 12A)

5/32" to 1/2" (75ST) 1/4" Huck (steel)



Max comp load = 5611

tensile = 5384

Modulus = 300° F

Note: Temp reduction
will be used on alum
but not on steel

Z-.0375" 4130 Channels (4130-INTERCOSTAL)
Z-.040" 75ST Diaphragms

Connection of Fitting to Channel

1/4" Steel Huckbolt Used

Allow double shear load: $2 \times 4650 = 9300$

Allow brg load (Z-.0375" 4130 Pls - $F_{cu} = 100 \text{ ksi}$)
 $= Z \times .0375 \times .25 \times 326000 = 6100$

Allow brg (.25" thick top of fitting)
 $= .25 \times .25 \times 146000 \times .65 = 5930$

$\therefore \text{Min MS} = .05$

Connection of Channel to Diaphragm

5/32" Alum ~~to 5/16"~~ Huckbolts Used

@ 300° F Allow shear (double) = $\frac{(5/32) \times 11200}{(7/16)} \times 1330 \times 2 \times .5 \times .62 = 5200$

@ 300° F Allow brg (Z-.040" 75ST Pls)

$2 \times 636 \times 1.77 \times .5 \times .65 = 5250$

$\therefore \text{Min MS (Brg)} = .01$

* The value of F_{cu} for 4130 steel quoted in
AVRO's design manual is incorrect (Ref Smalley's Test)
Note a on pg 41 of 17065 states that the
design mechanical properties listed there
correspond closely with 4130 steel

$F_{cu} = 326000 \text{ psi}$



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REPORT No. **7-0559-7**

SHEET No. **78**

AIRCRAFT:

C-105

FORMER @ 803
BEAR FUSELAGE

PREPARED BY

W. Nottley

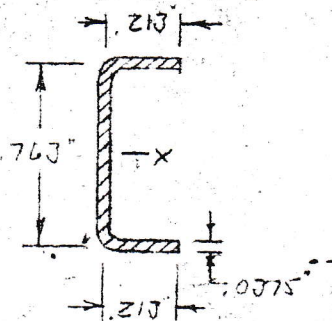
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LONGERONS CONNECTING TO TOP CENTER BEAM
INTERCOSTALS IMMEDIATELY AWD OF 803

STINGER LONGERON INTERCOSTAL - Contd
Steel Channel Connecting Fitting to Intercostal



Mtl Steel (4130)
 $F_{tu} = 180 \text{ ksi}$

$$\text{Max comp load} = 5611/2 = 2805$$

$$\text{Area} = 0.0375 (.213 + 7.63 + .213) \\ = .0445 \text{ in}^2$$

$$\text{Actual comp stress} \\ = 2805 / .0445 \\ = 63000 \text{ psi}$$

Needhams method will be used in checking the allowable crippling stress. Since the channel is symmetrical about the xx axis only one side will be checked

$$b' = \frac{.213 + .301}{2} = .257 \text{ in}$$

$$F_{cg} = 179000 \text{ psi} *$$

$$F_{cc} = \frac{.342 \sqrt{179000 \times 29 \times 10^6}}{(.257 / .0375)^{.75}} = 161000 \text{ psi}$$

$$M.S. = \frac{161000}{63000} - 1 =$$

Ample

* Since the value for the allowable bearing stress has been taken from ANC-5 (See note on previous page), the value for F_{cg} will be taken from the same source of information



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SHEET NO.

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AIRCRAFT:

C-105

FORMER @ 803
REPAIR FUSELAGE

PREPARED BY

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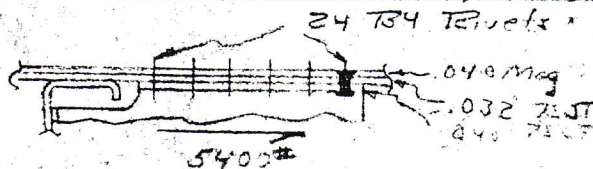
W. NUTLEY

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LONGERONS CONNECTING TO TOP CENTER BEAM
STINGER LONGERON INTERCOSTAL

Connection of Diaphragm to Skin-Doubler Combination



$$\text{Load/rivet} = 5411 / 23 = 244 \text{ }^{\circ}$$

24-B4 Rivets Used

Assuming the percentage reduction due to temperature is the same as that for A12 rivets

$$\text{Allow shear load @ } 300^{\circ}\text{F} = 361 \times .72 = 260^{\circ} \text{ /rivet}$$

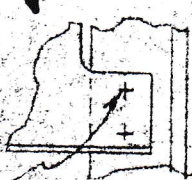
$$\text{Allow brg load (0.40" 75ST sheet)} = 514 \times 1.37 \times .65 = 458^{\circ} \text{ /rivet}$$

$$\text{Min MS (Shr)} = \frac{260}{244} = .66$$

.66

This margin of safety is conservative as there are 5 more rivets immediately aft of the ones shown (connecting fitting to skin doubler) which can pick up the load.

Connection of Diaphragm to Fitting



Shear Load on Rivets

$$= 5400 \times .76 / 4.1 \text{ R.f pg 12r} = 1000^{\circ}$$

23E-108-5-8

Rivets Used

402" Dia Blind Cherry *

Rivet M11 A12T

Stem M11 10ST

Allow (double) shear load @ 300°F

$$= 2 \times 2 \times .72 \times 490 = 1410^{\circ}$$

Allow brg load (2-0.40" 75ST Pls)

$$= 2 \times 2 \times 636 \times 1.37 \times .65 = 2270^{\circ}$$

* From old RNC-5

$$\text{Min MS (Shr)} = .71$$



AVRO AIRCRAFT LIMITED
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TECHNICAL DEPARTMENT

AIRCRAFT:

C. 105

REAR FUSELAGE

STN. 803. STINGER LATCH

REPORT NO.

8-0559-7

SHEET NO.

80

PREPARED BY

JARMAN.

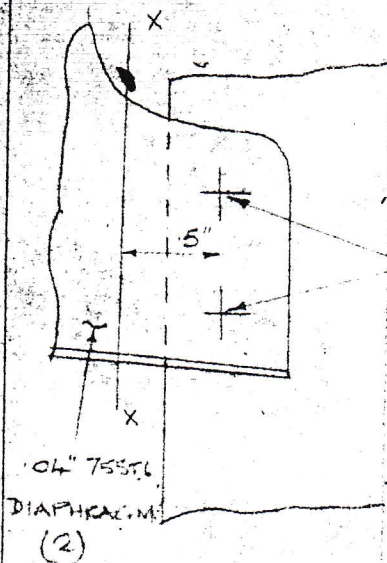
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JULY '56

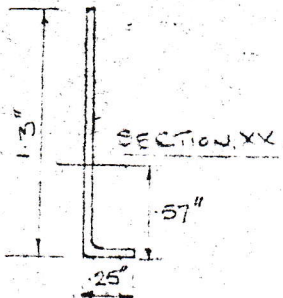
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BENDING OF INTERCOSTAL



16" DIA
AD. 5 RIVETS

STN. 803.



APPLIED LOAD AT RIVETS,

$$= \frac{5490 \times 76}{4.1} = 1000 \text{ LB.}$$

AT SECTION XX,

$$\text{MOMT/DIAPHRAGM.} = 500 \times 1.5 = 250 \text{ LB. IN.}$$

$$\text{AREA OF SECTION} = (0.4 \times 1.5) = 0.6 \text{ IN.}^2$$

$$\bar{y} = \frac{(1.3 \times 0.4 \times 0.65) + (2.5 \times 0.4 \times 0.2)}{0.6} = \frac{0.338 + 0.2}{0.6} = 0.93 \text{ IN.}$$

$$I = \frac{0.4 \times 1.3^3}{12} + 1.3 \times 0.4 \times 0.8^2 + \frac{0.4^3 \times 2.5}{12} + 0.4 \times 2.5 \times 0.55^2 = 0.00732 + 0.003325 + 0.000013 + 0.003025 = 0.013673$$

$$f_c = \frac{My_c}{I} = \frac{250 \times 0.73}{0.013673} = 17,050 \text{ psi}$$

30250
00013
03346
73200
0.0106738

ALLOWABLE CRIPPLING STRESS:-

$$\frac{b}{t} = \frac{1.73}{0.04} = 18.25$$

FROM CURVES (REPUBLIC MEMO 1423 AUG '46)

$$F_{cr} = 22600 \text{ psi}$$

M.S.

$$= \frac{22600}{17050} = 1.32$$



AVRO AIRCRAFT LIMITED
MALTON, ONTARIO

TECHNICAL DEPARTMENT

REPORT NO.

8-0559-7

SHEET NO.

81

AIRCRAFT:

C-105

FORMER @ 803

REAR FUSELAGE

PREPARED BY

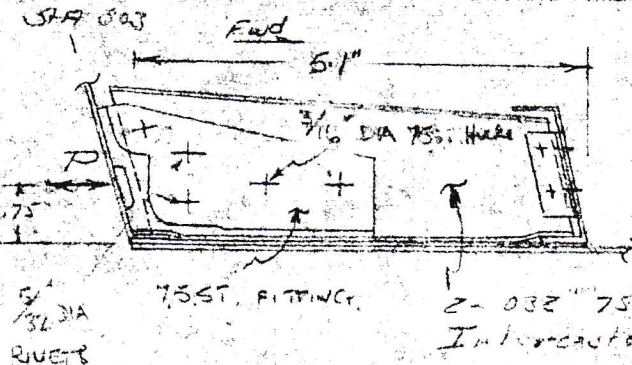
W. Nutley

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INNER SECTION OF FORMER CONNECTION TO LOWER STRINGER LONGERON



Max Loading (P)
= 1900⁺ Comp
AND 1376 lb Tension
(Mach 2 Case - 270°F)

STEEL FITTING

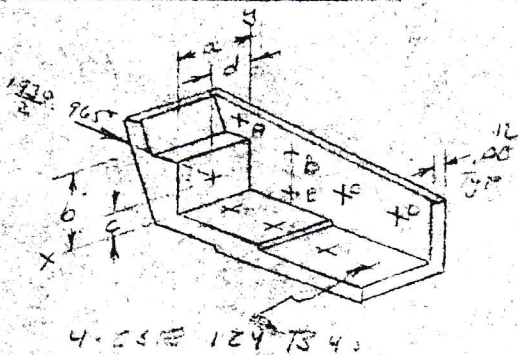
Ref Analysis - Lockheed's Stress Manual

a = .73

b = 1.76

d = .35

c = .57



$$M_x = \left(\frac{965}{.73 + 1.76} \right) .73 \times .57 = 161.2 \text{ Lb. in.}$$

$$M_y = \left(\frac{965}{.73 + 1.76} \right) 1.76 \times .35 = 239.2 \text{ Lb. in.}$$

Max bending stress abt x-x axis

$$= \frac{6 \times 161.2}{.73 \times (.14)^2} = 67600 \text{ psi}$$

Max bending stress abt y-y axis

$$= \frac{6 \times 239.2}{1.76 \times (.12)^2} = 56750 \text{ psi}$$

$$\text{Allow bending stress} = 1.5 \times 77000 \times .60 = 69250 \text{ psi} + .025$$

Min MS (x-x axis) = +.025 (Conservative
as this is actually a compressive
load)



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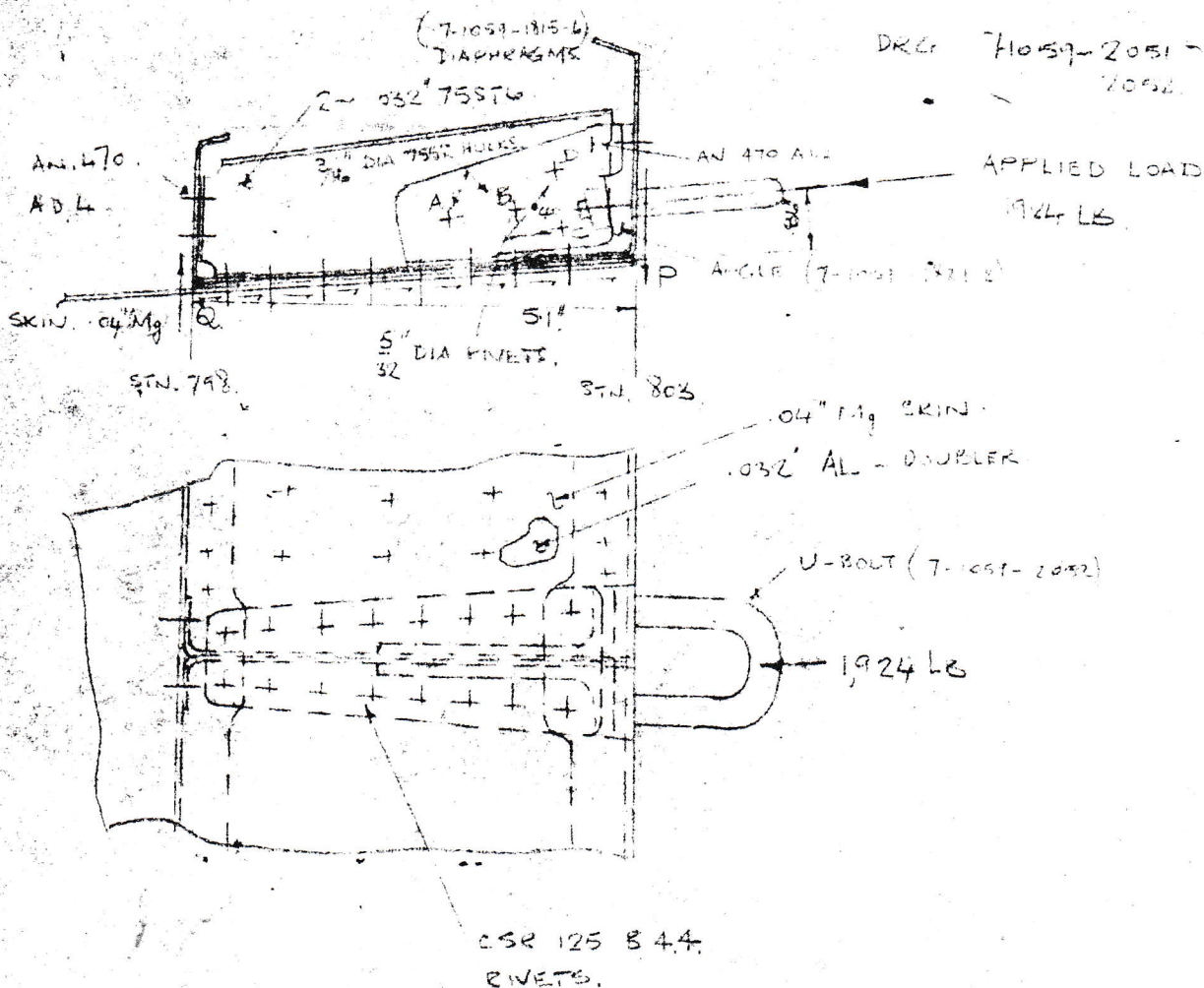
AIRCRAFT:

C. 105

REAR FUSELAGE

STINGER LATCH AT STN 803

RIVETING OF INTERCOSTAL TO 'BOTTOM-CENTRE' SKIN:-



16 RIVETS TRANSFER THE LOAD (OF 1924 LB) FROM THE DIAPHRAGM TO THE SKIN.

$$\text{APPLIED SHEAR / RIVET} = \frac{1924}{16} = 120 \text{ LB}$$

SHEAR STRENGTH OF CSR 125 B 4.4 RIVET IN [032'75STG] DIAPHRAGM

$$\begin{aligned} \text{AT } 270^{\circ} \text{ F} &= 388 \times .914 \times .794 \\ &= 297 \text{ LB/RIVET} \end{aligned}$$

BALANCE OF DIAPHRAGM:-

$$\text{M.S.} = \frac{297}{120} = 2.475$$

$$\text{APPLIED MOMENT} = 1924 \times .86 = 1655 \text{ LB IN.}$$

THIS IS REACTED AT THE FORMERS (STN) 798 AND 803

$$\text{NO LOAD AT P AND Q} = \frac{1655}{51} = 325 \text{ LB}$$

$$\text{ASSUMING A CONSTANT SHEAR FLOW ALONG Q-Q} = \frac{1924}{51} = 377 \text{ LB IN.}$$



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REPORT NO. **7-0559-7**

SHEET NO. **8.3**

AIRCRAFT:

C. 105

REAR FUSELAGE

LOWER-INBOARD LATCH AT STN 82

PREPARED BY

DATE

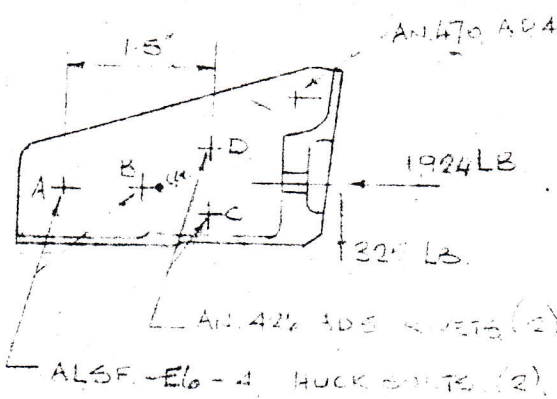
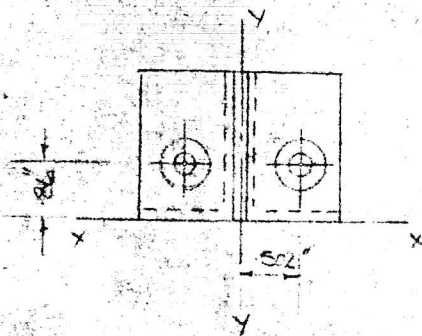
JARMAN

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RIVETING OF LATCH FITTING TO DIAPHRAGM - 154"



MAX. APPLIED LOADS ARE: 1924 LB (COMPRESSION) PER LATCH
(ASYMMETRIC ENGINE THRUST AT M=2 CASE.) AND 1376 (TENSION) PER LATCH (PG 58)

TO FIND CENTROID OF BOLT GROUP TAKE MOMENTS OF BOLT AREAS ABOUT DC. THEN
$$\bar{y} = \frac{2 \times \left(\frac{\pi}{16}\right)^2 \times 1.125}{2 \left[\left(\frac{3}{16}\right)^2 + \left(\frac{5}{32}\right)^2 \right]} = \frac{.0791}{.1192} = .664 \text{ IN. FROM DC.}$$

APPLIED LOAD ON BOLT GROUP = 1924 LB + MOMENT (270° ASH)

$$\begin{aligned} \text{LOAD ON BOLT A} &= \frac{1924 \times \frac{5}{32}}{2 \left[\left(\frac{3}{16}\right)^2 + \left(\frac{5}{32}\right)^2 \right]} + \frac{M.K.A.}{2(AK^4)} \quad (= 5 \text{ TO BOLT}) \\ &= \frac{1924 \times .03515}{2 \times .0596} + \frac{500 \times .836 \times .03515}{.03515(836^2 + .086^2) + .02445 \times 2 \times .75^2} \\ &= 568 + 280 \\ &= 633 \text{ LB.} \end{aligned}$$

SINGLE SHEAR STRENGTH OF HUCK BOLT $\frac{3}{16}$ " DIA IN 2-.032" 70576(141) SHEET
AT 270° = 1330 LB. $\therefore$ DOUBLE SHEAR STRENGTH = 2660 LB.

BEARING STRENGTH = 1220 x 1.33 x .78 = 1265 LB. M.S. 11.04

$$\begin{aligned} \text{APPLIED LOAD ON RIVETS C+D} &= \frac{1924 \times .02445}{2 \times .0596} + \frac{325 \times .75 \times .02445}{.05236} \\ &= 395 + 175 = 505 \text{ LB.} \end{aligned}$$

DOUBLE SHEAR STRENGTH OF $\frac{5}{16}$ " DIA RIVETS IN 2-.032" 70576(141) SHEET AT 270° = 2 x 575 = 1150 LB.



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TECHNICAL DEPARTMENT

REPORT NO.

7-0559-7

SHEET NO.

34

AIRCRAFT:

C. 105

REAR FUSELAGE.

LOWER-7 INCH LATCH AT STATION 803

PREPARED BY

JARMAN

DATE

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RIVETING OF LATCH-FITTING TO DIAPHRAGM (CONT'D) :-

THE MARGINS (+140% + 7%) ARE CONSERVATIVE BECAUSE THE APPLIED LOAD IS COMPRESSIVE AND WILL BE TRANSMITTED BY BEARING ON ALL SURFACES AROUND THE LATCH AND NOT AT ONE POINT ONLY. (AS WAS ASSUMED FOR THE PRECEEDING WORK.) FURTHERMORE, ALL THE LOAD WAS ASSUMED TO BE TRANSFERRED AS A CONSTANT SHEAR FLOW FROM THE DIAPHRAGM TO THE SKIN, WHEREAS SOME WOULD INEVITABLY BE TRANSFERRED DIRECTLY FROM THE FITTINGS TO THE SKIN, THEREBY RELIEVING THE APPLIED MOMENT. THE ABOVE MARGINS ARE AMPLIFIED. A CHECK WILL BE MADE FOR THE TENSION CASE.

$$\begin{aligned} \text{APPLIED LOAD ON BOLT GROUP ABC} &= 1376 \text{ LB (TENSION)} + \frac{1376 \times 86 \times 1.54}{51} \\ \text{LOAD ON BOLT A} &= 1376 \times \frac{.02515}{.05962} + \frac{357 \times 9.76 \times .02515}{.05236} \\ &= 406 \text{ LB} + 200 \text{ LB} \\ &= 606 \text{ LB} \end{aligned}$$

$$\begin{aligned} \text{BEARING STRENGTH OF } \frac{3}{16} \text{ STEEL HUCK BOLT IN 2-} .032 \text{ " 70576 CLAD} \\ \text{SHEETS AT } 270^{\circ}\text{F} &= 1220 \times 1.33 \times .78 \\ &= 1265 \text{ LB} \end{aligned}$$

$$MS = > 1$$

$$\begin{aligned} \text{APPLIED LOAD ON RIVETS 'C' AND 'D'} &= \frac{1376 \times .02445}{.05916} + \frac{357 \times 7.5 \times .02445}{.05236} \\ &= 283 + 125 \\ &= 408 \text{ LB} \end{aligned}$$

$$\begin{aligned} \text{BEARING STRENGTH OF } \frac{5}{16} \text{ DIA AN 426 RIVET IN 2-} .032 \text{ " 70576} \\ \text{(CLAD) SHEETS AT } 270^{\circ}\text{F} &= 875 \times 2 \times .78 = 897 \text{ LB} \end{aligned}$$

$$MS = > 1$$

MOMENT ABOUT VERTICAL AXIS YY:-

$$M_y = \frac{1924}{2} \times 1502 = 432 \text{ LB IN.}$$

ASSUME THIS IS REACTED BY COMPRESSION BETWEEN THE LATCH FITTINGS IN THE REGION OF BOLT A AND BY TENSION IN BOLTS 'D' AND 'C'. TENSION IN EACH OF BOLTS 'D' AND 'C' = $\frac{1}{2} (484) = 101 \text{ LB}$. MS = > 1

IN THE TENSION CASE, $M_y = 1376 \times 502 = 345 \text{ LB IN}$. ASSUME THIS IS REACTED BY TENSION IN BOLT A AND BY COMPRESSION IN THE LATCH FITTINGS AT STN 803.



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TECHNICAL DEPARTMENT

REPORT NO.

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AIRCRAFT:

C-105

FORMER @ 803
REAR FUSELAGE

PREPARED BY

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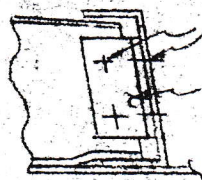
W. Nutley

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INNER SECTION OF FORMER CONNECTION TO LOWER STRINGER LONGERON

RIVETING - INTERCOSTAL TO CLIP



AD 4 Rivets

.032" 75ST
Clips

Shear load at clip

$$= \frac{1924 \times 86}{51} = 325 \text{ Lb.}$$

Ref pg

$$\text{Load / rivet } 325 / 2 = 163$$

AD 4 Rivets Used

Allow shear load: $.61 \times 308 = 237 \text{ * / rivet}$

Allow brg load (.032" 75ST sheet)

$$= 1.33 \times 411 \times .42 = 229 \text{ * / rivet}$$

Min WTS. (TBrq) = Ample



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TECHNICAL DEPARTMENT

REPORT NO.

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SHEET NO.

86

AIRCRAFT:

C105

Former 803

Rear Fuselage

PREPARED BY

W. P. BLACK

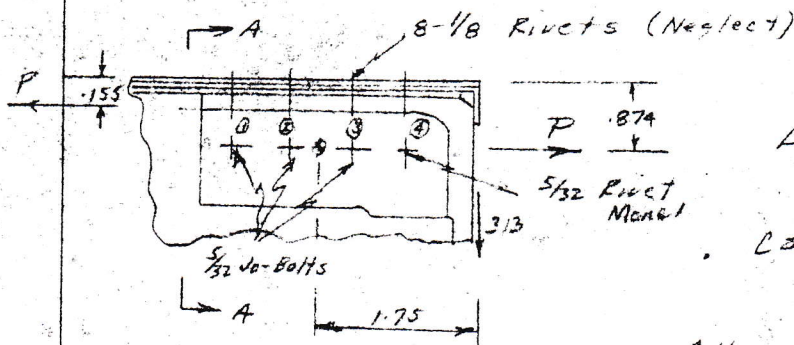
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Outer Portion of Former
Section at Cutbd. Upper Langeron
Connection of Nacelle Latch to Langeron



Load $P = 2175$ lb. Tens.

or 630 lb. Comp.

Case Natch 2 - Temp = $347^{\circ}F$

Ref. P. Frost.

Attach.

Brq. Allow. $5/32$ Monel CSA in .080 = 7940 lb.

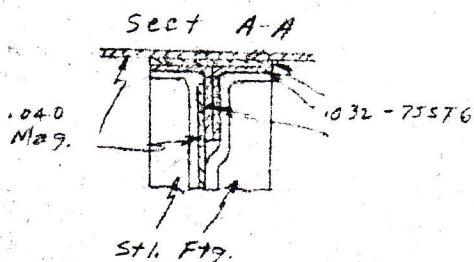
Shear Allow. Jo-Bolt = $2 \times 1800 = 3600$ lb.

Shear Allow. $5/32$ Monel = $2 \times 798 = 1596$ lb.

Brq. Allow. in $2 \times .032 - 755 + 1 \times .040$ Mag.

= $2 \times .032 \times 156 \times 133,000 \times .43 + .040 \times 156 \times 68,000 \times .35$

= 804 lb.



Langeron Centroid

Area (1) = $1.4 \times .040 \times .619 = .03466$

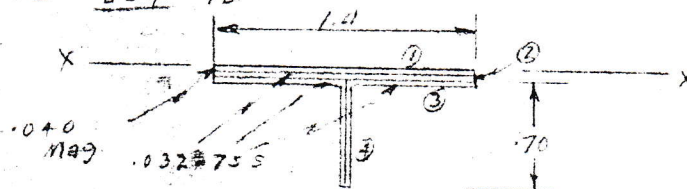
(2) = $1.4 \times .032 = .04480$

(3) = $1.4 \times .032 = .04480$

(4) = $.668 \times .064 = .04275$

.16701

$\bar{Y} = \frac{.03466 \times .020 + .0448 \times .056 + .0448 \times .088 + .04275 \times .438}{.16701} = .155$



$M = (.874 - .155) 2175 = 1564$ in.-lb.

This moment is balanced by vertical loads at Former's

Reactions = $1564 = 313$ lb.

803 + 798

Moment on Bolt Group = $313 \times 1.75 = 548$ in.-lb.

$\sum R^2 = (.35)^2 \times 2 + (.105)^2 \times 2 = 2.450$

Reactions at Bolts ① & ④ Due to $M = \frac{548 \times 1.4}{2.45} = 235$ lb.

Direct Shear Reaction on bolts = $\frac{2175}{4} = 544$ lb.

Result. Bolt Load = $\sqrt{544^2 + 235^2} = 593$ lb.

M.S. = 804 - 1 (Brq.)



AVRO AIRCRAFT LIMITED
MALTON, ONTARIO

TECHNICAL DEPARTMENT

AIRCRAFT:

C105

Former 803

Rear Fuselage

REPORT No.

7-0559-7

SHEET No.

87

PREPARED BY

W. F. Black

DATE

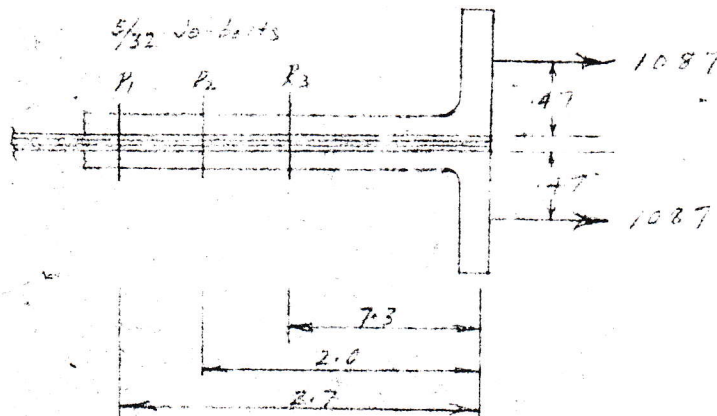
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Outer Portion of Former
Section at Cutted Upper Longeron
Connection of Noelle Latch to Longeron (cont'd.)

Reaction & Moment Due to a Test of U-bolt
Load from Longeron Section.



$$\text{Moment} = 1087 \times 4.7 = 511 \text{ in-lb.}$$

Assume bearing on .10 inch of ftg. for a length of 1 inch.
Erg. Area = $.10 \times 1.0 = .10 \text{ in}^2$

Comp. Load at U-bolt End of Ftg. and Resultant Tension
at Bolt ② = $\frac{511}{2.0} = 256 \text{ lb.}$

$$fbr = \frac{256}{.10} = 2560 \text{ psi.}$$

$$\text{Tension Load Bolt ②} = 256/2 = 128 \text{ lb.}$$

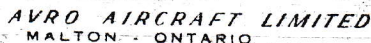
$$\text{" " " ③} = 256 \times \frac{1.3}{2.0} = 35 \text{ lb.}$$

$$\text{" " " ①} = 256 \times \frac{2.7}{2.0} = 115 \text{ lb.}$$

Hence Max. Load on a Jo-bolt = $593 \text{ lb. shear} + 115 \text{ lb. Tens.}$

This is obviously satisfactory.

M. S. = 2-10



TECHNICAL DEPARTMENT

REPORT NO.

7-0559-7

SHEET NO.

84

AIRCRAFT:

2105

Form 2-3

Agar-Agar

PREPARED BY

DATE _____

W. F. Lock

Aug 21/56

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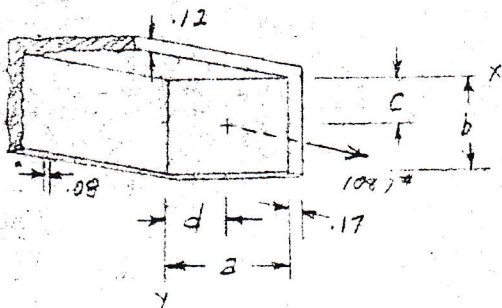
DATE _____

Outer Portion of Former

Section at Cut 4, Upper Longmire

Steel Fitting

Ref. Lock head Stress Monitor



$$a = 172$$

$\Delta = 1.00$

$C = .55$

$d = 135$

$$M_x = \left(\frac{1087}{.72 + 1.00} \right) \cdot .72 \times .58 = 284 \text{ lb-ft}$$

$$M_T = \left(\frac{1087}{.72 + 100} \right) 1.00 \times 35 = 221 \text{ lb} \cdot \text{ft}$$

$$F_x = \frac{.72 \times .12^2}{.6} = .001728$$

$$Z_4 = \frac{1.028 \cdot 0.9^2}{6} = .001267$$

About XX $f_b = \frac{26.4}{.001728} = 152,780 \text{ psi.}$

About 44 $fb = \frac{221}{.001057} = 207,120 \text{ psi}$

Assume Form Factor = 1.5

$$FB = 150,000 \times 1.5 = 225,000 \text{ p.e.}$$

M.S. = 225,000 - 1 = 207,120

Attach. To Form at Sts. 803

4- $\frac{1}{8}$ " csk rivets in .051 sheet (Monel Rivets)

For A175T Rivets $val_{oc} = 4 \times 260 = 1040 \text{ lb}$

Since plots are made/ assume Temp. reduction

for sheet Allow = $10948.43 = 447 \text{ kg}$

Lead = 313.16.

$$M.E. \geq \frac{449}{573}$$

80.

2.4.4



AVRO AIRCRAFT LIMITED
MALTON, ONTARIO

TECHNICAL DEPARTMENT

REPORT NO.

7-0559-7

SHEET NO.

89

PREPARED BY

DATE

JARMAN.

MAY. '56.

CHECKED BY

DATE

AIRCRAFT:

C. 105.

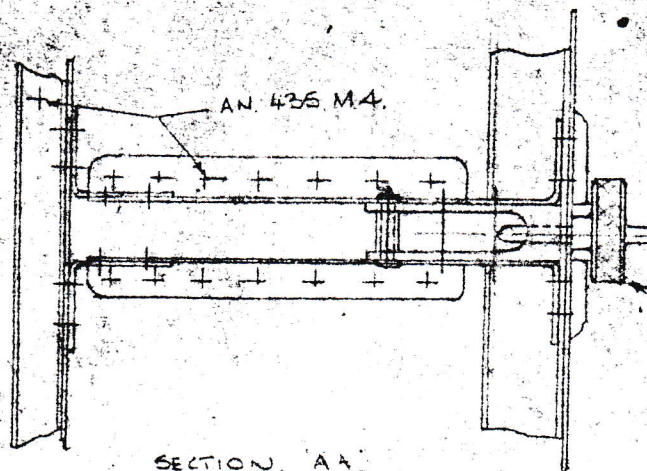
REAR FUSELAGE.

STOP FOR ENGINE

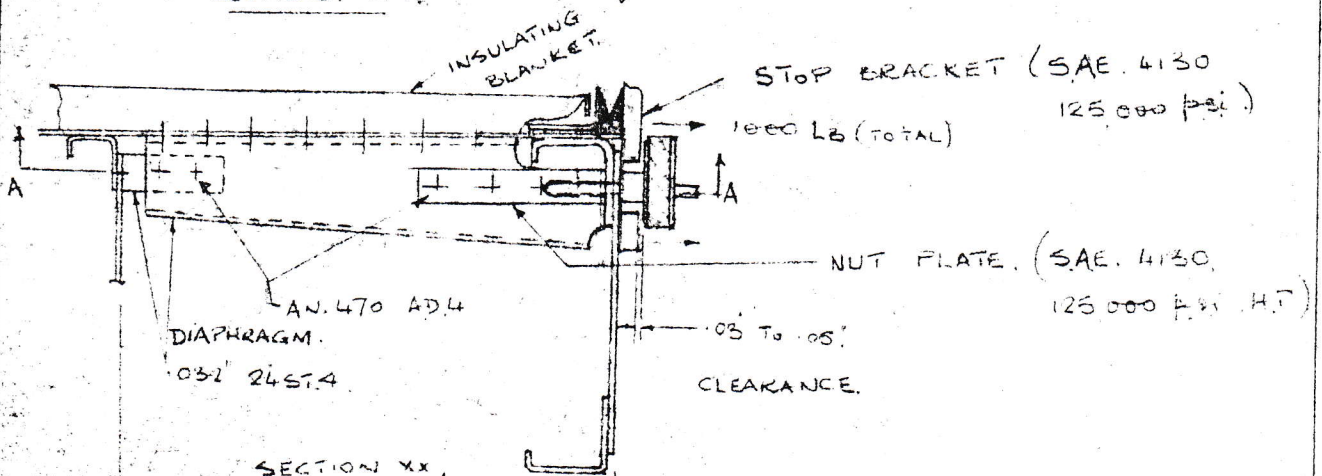
REMOVAL RAIL. STN. 803.

STOP ~ ENGINE REMOVAL RAIL (INBD SIDE)

DRG. NO. 7-0159-163.



SECTION AA.



STN. 798

803. STN.

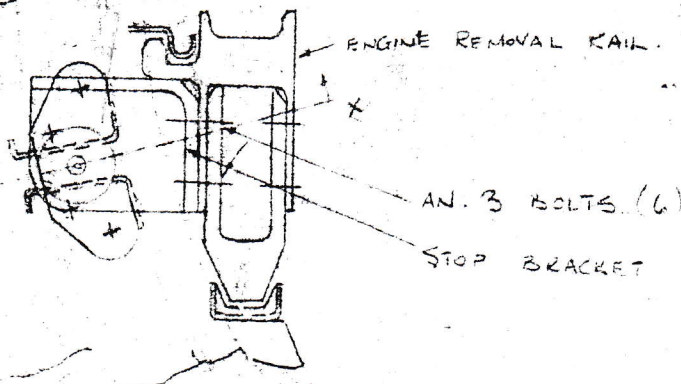


FIG. 1.

THE ENGINE REMOVAL RAIL IS SUBJECTED TO AXIAL LOAD OF 1000 LB., AND IS PREVENTED FROM MOVING (AXIALLY) BY THE STOP. — THE STOP BRACKET HITS AGAINST THE THUMB SCREW WHICH IS CONNECTED THROUGH A NUT PLATE AND TWO DIAPHRAGMS, TO THE DUCT SKIN.



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REAR FUSELAGE

STOP ~ ENGINE REMOVAL

RAIL AT STN. 803. (W.B.D.)

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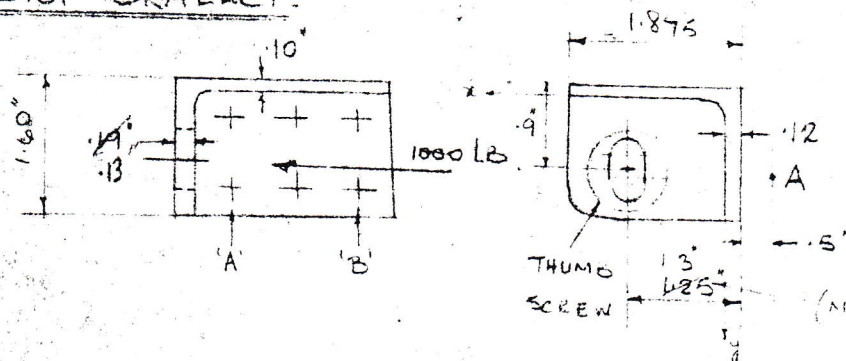
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DATE

DESIGN LOAD

APPLIED LOAD = ± 1000 LB. (AT CENTROID OF RAIL) --- D. SPROSON

STOP BRACKET: -



MAT. SAE A130.

(125,000 PSI)

(MOD. MAY '56)

LATERAL OFFSET. = $1.25 + .5 = 1.75$ IN.

MOM. = 1750 LB. IN.

REF: LOCKHEED STRESS MEMO No. 88 JULY 15 '47.

$$M_x = \frac{P}{a+b} \cdot a \cdot c = \frac{1000}{(1.5 + 1.75)} \times 1.5 \times 8 = 368.5 \text{ LB. IN.}$$

$$M_y = \frac{P}{a+b} \cdot b \cdot d = \frac{1000}{(1.5 + 1.75)} \times 1.75 \times 1.13 = 610 \text{ LB. IN.}$$

$$I_{xx} = \frac{1.75 \times 1^3}{12} = .0001462 \text{ IN}^4$$

$$I_{yy} = \frac{1.60 \times 12^3}{12} = .000216 \text{ IN}^4$$

FORM FACTOR 1.5

$$f_y = \frac{M_y}{I_y} = \frac{610 \times .06}{1.5 \times .000216} = 173,000 \text{ PSI.}$$

$$f_x = \frac{M_x}{I_x} = \frac{368.5 \times .05}{1.5 \times .0001462} = 84,000 \text{ PSI.}$$

F_{TU} (SAE A130) = 125,000 PSI.

$$M.S. = \frac{125,000}{115,000} = 1.1$$

JOINT ~ STOP BRACKET TO RAIL: -

THE STOP BRACKET IS SECURED TO THE ENGINE REMOVAL RAIL BY 6 AN.3. BOLTS. THESE MUST CARRY A SHEAR FORCE OF 1000 LB



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AIRCRAFT:

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REAR FUSELAGE

STOP ~ ENGINE REMOVAL
RAIL AT STN. 803. (INBP)

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JOINT ~ STOP BRACKET TO RAIL. (CONT'D.) :-

$$\text{APPLIED SHEAR/BOLT} = \frac{1000}{6} = 167 \text{ LB.}$$

N/S

>1.

MOM. T (1750 LB. IN) IS REACTED BY TENSION IN BOLTS 'A' AND COMPRESSION ON THE SURFACE OF THE BRACKET AT 'B'.

$$\text{TENSION IN EACH BOLT 'A' (FROM MOM. T)} = \frac{1750}{1.64 \times 2} = 534 \text{ LB.}$$

$$\text{ALLOWABLE TENSION IN THREAD OF AN. 3 BOLT} = 2210 \text{ LB.} \quad \text{MS.} \quad >1.$$



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AIRCRAFT:

C.105.

REAR FUSELAGE

STOP - ENGINE REMOVAL
RAIL. (INB?)

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MAY '56

DATE

JOINT ~ THUMB SCREW TO NUT PLATE: -

(FIG. I.)

THESE ARE SECURED BY A 10-32 NF 3A THREAD, .26" (LENGTH).
AN ORDINARY NUT FOR AN. 3. BOLT IS $(\frac{15}{64} = .2345)$ " IN WIDTH AND
IS CAPABLE OF CARRYING 2,200 LB IN TENSION. (125,000 PSI)

APPLIED LOAD = 1000 LB.

$$\therefore M.S. = \frac{1770}{1000} - 1 = .77$$

FOR 100,000 PSI STEEL

ALL. LOAD = 1770 *

JOINT. ~ NUT PLATE TO .032" DIAPHRAGMS.

(FIG. I. SECTION AA)

THE NUT PLATE IS SECURED TO TWO DIAPHRAGMS (.032" 24 STL) BY 3 RIVETS (AN 470 AD 4).

THERE ARE 6 SHEAR SURFACES, $\therefore \text{LOAD/SURFACE} = \frac{1000}{6} = 167 \text{ LB.}$

BEARING STRENGTH OF $\frac{1}{8}$ " DIA RIVET IN .032" 24 STL = $411 \times 1.1 = 452 \text{ LB.}$

SHEAR " = $.964 \times 388 = 374 \text{ LB.}$

M.S. > 1.

JOINT. ~ .032" DIAPHRAGMS TO .02" (TIT) DUCT SKINS.

(SEE FIG. I. SECTION XX.)

THE TWO .032" DIAPHRAGMS ARE SECURED TO THE DUCT SKIN BY 14 (AN 435 M 4) RIVETS AND TO THE FORMERS AT STN. 803 AND 798 BY AN 470 AD 4 RIVETS.

APPLIED LOAD = 1000 LB OFFSET BY .5" FROM THE SKIN LINE.

$\therefore \text{MOMT} = 500 \text{ LB. IN.}$

ASSUME THE LOAD IS REACTED BY THE RIVETS ALONG THE DUCT SKIN LINE AND THE MOMT BY RIVETS AT THE FORMERS 803, 798.

LOAD/RIVET ALONG SKIN LINE = $\frac{1000}{14} = 71.5 \text{ LB.}$

BEARING STRENGTH OF $\frac{1}{8}$ " RIVET IN .02" TIT SHEET = $1.2 \times 250 = 300 \text{ LB.}$

APPLIED LOAD AT FORMERS (STN) 803 & 798 (FROM MOMT) = $\frac{500}{5} = 100 \text{ LB.}$

1/8" DIA RIVETS REACT THIS

M.S.

> 1



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AIRCRAFT:

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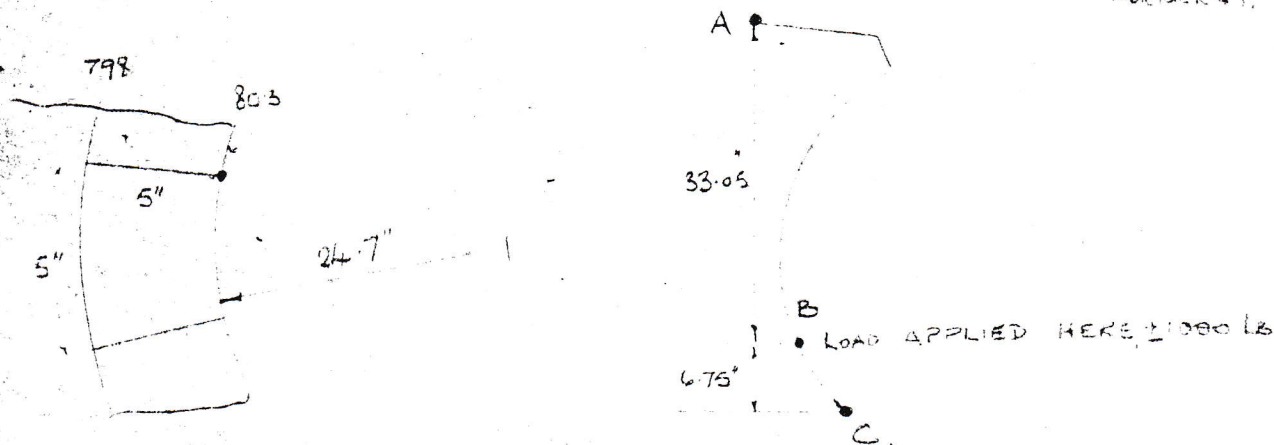
REAR FUSELAGE.

STOP FOR ENGINE REMOVAL

RAIL STN 803 (INBD.)

DUCT SKIN UNDER SHEAR: -

SINCE THE STOP IS LOCATED EIGHT INCHES FROM THE LOWER INBD LONG^N, THE ± 1000 LB AXIAL LOAD WILL SHEAR ACROSS THE DUCT SKIN TO THE LONG^N IN 5" (DISTANCE BETWEEN FORMERS).



$$P_A = 1000 \times \frac{6.75}{(33.05 + 6.75)} = 170 \text{ LB}, \quad P_C = 1000 - 170 = 830 \text{ LB}$$

APPLIED SHEAR FLOW (B TO A) $q_{B-A} = \frac{170}{5} = 34 \text{ LB/IN.}$

" " (B TO C) $q_{B-C} = \frac{830}{5} = 166 \text{ LB/IN.}$

CHECK ON CURVED PANEL BETWEEN BC:

PANEL 5" x 5" x .020 TIT. SKIN. (A.70)

i.e. $a = 5$; $b = 5$ $R = 24.7 \text{ IN.}$ $E = 15.5 \times 10^6 \text{ LB/IN.}^2$

$\therefore \frac{a}{b} = 1.$

USING AEM. SECT. V. 22.4,

SHEAR BUCKLING STRESS $\frac{\tau_{cr}}{\tau_s} = K_s E \left(\frac{t}{h} \right)^2$

$Z = .954 \frac{R^2}{Rt} = \frac{.954 \times 3^2}{24.7 \times .02} = 48.25.$

FROM AEM. SECT. V. FIG. 224-1, $K_s = 20.$

$\therefore \frac{\tau_{cr}}{\tau_s} = 20 \times 15.5 \times 10^6 \times \left(\frac{.02}{5} \right)^2 = 4960.$

4960 PSI.



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REAR FUSELAGE

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DATE

DUCT SKIN BETWEEN BC - (CONTD)

$$\tau (\text{APPLIED}) = \frac{166}{.02} = 8300 \text{ psi}$$

$$\frac{\tau}{\tau_{cr}} = \frac{8300}{4960} = 1.675$$

FROM AEM. SECT. V. FIG. 224-2, WHEN $\frac{300td}{RR} = \frac{300 \times 0.2 \times 5}{25 \times 5} = .24$,
 $K = .16$

FROM AEM. SECT. V. 224.5, ULT. STRENGTH OF WEB

$$\tau_{ALL} = \tau_{ALL}^* (0.65 + \Delta)$$

FROM FIG. 224-5, $\frac{\alpha}{\alpha_{PDT}} = .62$

IF $\alpha_{PDT} = 45^\circ$ THEN $\alpha = .62 \times \frac{\pi}{4} = .487 = 27.9^\circ$

FROM FIG. 224-6 $\tau_{ALL}^* = 24500$ FOR 24 ST.

FOR TITANIUM (A70) $\tau_{ALL}^* = 24500 \times \frac{42000}{36000} = 28600 \text{ psi}$

TO FIND Δ

$$A_{ST} = .032 (.65 + .40) = .0336$$

$$\frac{A_{ST}}{ht} = \frac{.0336}{5 \times .02} = .336$$

$$A_{RG} = .051 (.70 + .60) = .0662$$

$$\frac{A_{RG}}{dt} = .662$$

FROM AEM. FIG. 224-8,

$$\Delta = .2025$$

$$\tau_{ALL} = 28600 (.65 + .2025) = 24400 \text{ psi}$$

$$(\text{APPLIED}) \tau = 8300 \text{ psi}$$

M.S.

21



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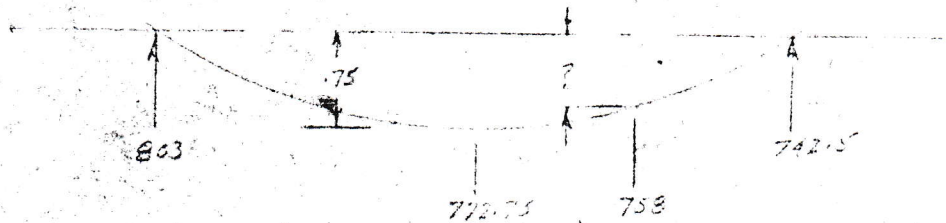
AUG. 29/51

DATE

Engine Rail Deflection Fwd End.

Assume Rail Pinned at Stns. 803 & 842.5

Assume Vertical Defl. at Centre = 0.75 in.



Req'd. Defl. at 758

Ref. Basic Structures - Stanley - Page 378 Table 3.5

$$X = \frac{(758 - 842.5)}{(803 - 842.5)} = \frac{15.5}{40.5} = .256$$

From Curve

$$\text{at } X = .5$$

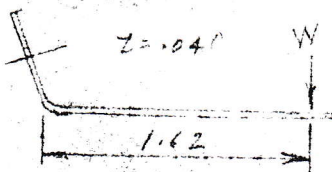
$$y_0 = .0209$$

$$X = .256$$

$$y_0 = .0145$$

$$y_{758} = .750 \times \frac{.0145}{.0209} = .5203 \text{ in.}$$

Consider a 1" wide strip of Rail Girth



$$I = \frac{1.62}{12} \times .040^3 = .000005333 \text{ in}^4$$

$$E = 4.62 \times 10^6 \text{ psi} = .300267 \text{ in}^2$$

$$\delta = .5203 - .040 (\text{clearance}) = .4803 \text{ in.}$$

$$W = \frac{3 \delta E I}{L^3} = \frac{3 \times .4803 \times 1.62 \times 10^6 \times .000005333}{1.62^3} = 50.608 \text{ lb.}$$

$$M = 50.608 \times 1.62 = 81.985$$

$$f_b = \frac{81.985}{.300267} = 307,000 \text{ psi.}$$

$$F_{ty} = 100,000 \text{ psi.}$$

N.G.



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AIRCRAFT:

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PREPARED BY

W. P. Black

DATE

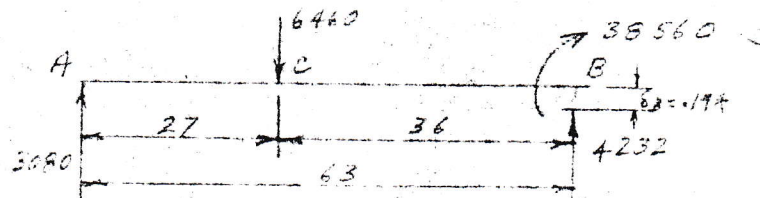
Aug 29, 1945

CHECKED BY

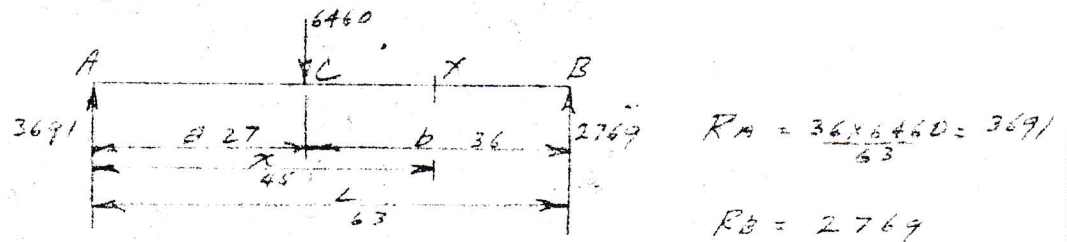
DATE

Engine Rail Deflection - Fwd. End.

Ref. Engine Rail Report - by M. Sevik



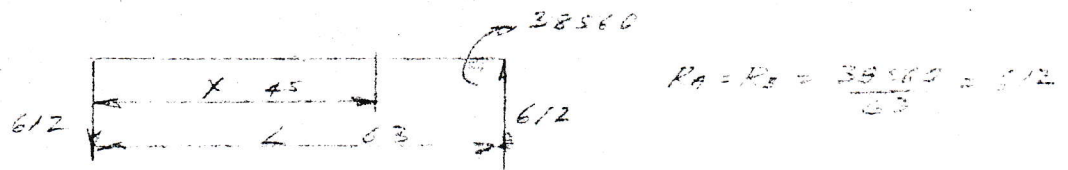
(1) Assume Simple Beam - Intermediate Load



$$\gamma x = \frac{-Wb(L-x)}{6EI} [b(L+a) - (L-x)^2]$$

$$= \frac{-6460 \times 27(19)}{6 \times 28 \times 10^6 \times 1541 \times 63} [36(90) - (63)^2] = -0.561313 \text{ in.}$$

(2) Assume Simple Beam - End Moment



$$\gamma x = -\frac{1}{6} \frac{M_0}{EI} (3x^2 - \frac{x^3}{L} - 2Lx) = -\frac{1}{6} \times \frac{38560}{28 \times 10^6 \times 1541} (3 \times 45^2 - \frac{45^3}{63} - 2 \times 63 \times 45)$$

$$= 0.155052$$

$$\delta x = -0.561313 + 0.155052 = -0.4062 \text{ in.}$$



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REPORT NO. **7-0559-7**

SHEET NO. **97**

AIRCRAFT:

C 105

PREPARED BY

W. P. Block

DATE

Sept. 6/50

CHECKED BY

DATE

Engine Rail Deflection - Fwd. End

7-1059-2795/6

To Find Min. Allow. Gap for .025 sheet with $F_y = 150,000$
(Mil-S-25043 cond. 7H2)

$$I = \frac{L \times .025^3}{12} = .000001301 \text{ in}^4$$

$$Z = \frac{F_y \times .025^2}{6} = .000104167 \text{ in}^3$$

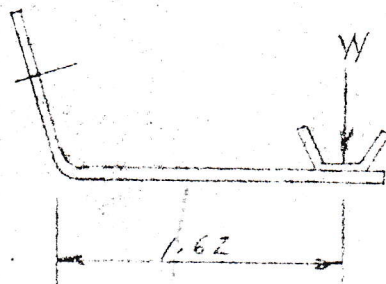
$$M = F_y Z = 150,000 \times .000104167 = 15.625050 \text{ in-lb.}$$

$$W = \frac{M}{1.62} = 9.645093 \text{ lb.}$$

$$\delta = \frac{WL^3}{3EI} = \frac{9.645093 \times 1.62^3}{3 \times 28 \times 10^6 \times .000001301} = .375228 \text{ in.}$$

$$\text{Min. Req'd. Clearance} = .4062 - .3752 = .0310 \text{ in.}$$

$$\text{Capacity} = 9.645 \text{ lb./in.}$$





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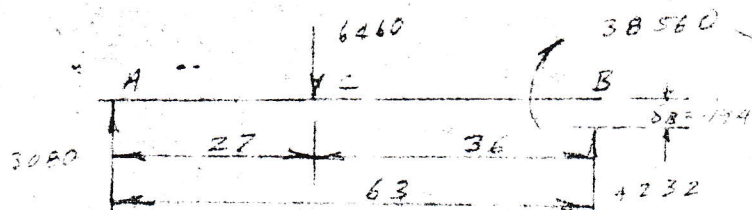
DATE

Aug. 30/

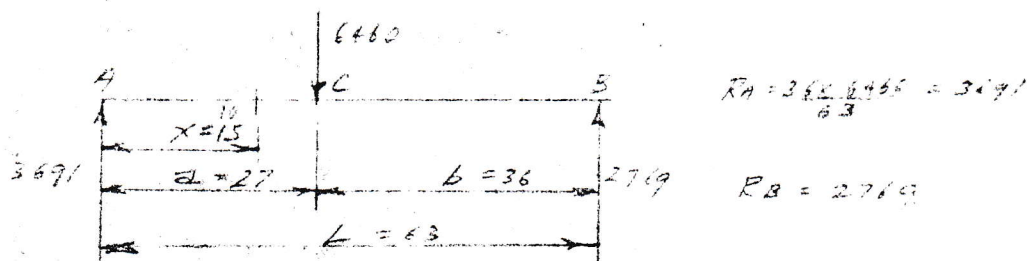
DATE

Engine Rail Deflection - Aft. End.

Ref. Engine Rail Report - by M. Souk



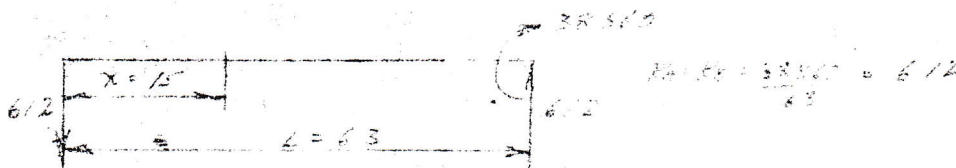
(1) Assume Simple Beam - Intermediate Load



$$\gamma_x = -\frac{Wbx}{6EIL} [a(L+b) - x^2] = -\frac{6460 \times 36 \times 15}{6 \times 28 \times 10^6 \times 1.41 \times 63} [27(99) - 15^2]$$

$$= -0.5236 \text{ in.}$$

(2) Assume Simple Beam - End Moment



$$\gamma_x = -\frac{M_0}{6EI} (3x^2 - \frac{x^3}{L} - 2Lx) = -\frac{1}{6} \times \frac{38560}{28 \times 10^6 \times 1.41} (\frac{15^3}{63} - \frac{15^3}{27} - 2 \times 63 \times 15)$$

$$= 0.1889 \text{ in.}$$

$$\delta_x = -0.5236 + 0.1889 = -0.3347 \text{ in.}$$

P. 1 - Aug 30 aft end of rail


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W. P. Black

Sept 6/56

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DATE

AIRCRAFT:

C 105

Engine Rail Deflection - Aft. End

7-1059-2865/6

 To Find Min. Allow Gap for .0219 sheet with $E_{ty} = 150,000$
(Mil-S-25043 cond T4D)

$$I = \frac{1.00 \times .0219^3}{12} = .000000875 \text{ in}^4$$

$$Z = \frac{1.00 \times .0219^2}{6} = .000079935 \text{ in}^3$$

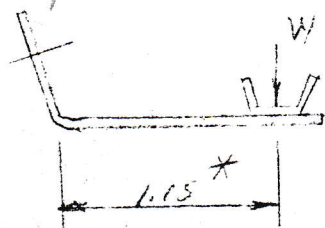
$$M = f_b Z = 150,000 \times .000079935 = 11.990250 \text{ in-lb.}$$

$$W = \frac{M}{1.15} = 10.426304 \text{ lb.}$$

$$\delta = \frac{WL^3}{3EI} = \frac{10.426304 \times 1.15^3}{3 \times 28 \times 10^6 \times .000000875} = .215743 \text{ in.}$$

$$\text{Min. Req'd Clearance} = .3347 - .2157 = 0.1190 \text{ in.}$$

$$\text{Capacity} = 10.426 \text{ lb./in.}$$



* This dim. altered on production drawing to read
D. O. Error

This will obviously increase the stresses considerably