

 <b>MAJOR REPAIR AND ALTERATION</b> <b>(Airframe, Powerplant, Propeller, or Appliance)</b>					Form Approved OMB No. 2120-0020 228/2011	Electronic Tracking Number  For FAA Use Only
<b>INSTRUCTIONS:</b> Print or type all entries. See Title 14 CFR §43.9, Part 43 Appendix B, and AC 43.9-1 (or subsequent revision thereof) for instructions and disposition of this form. This report is required by law (49 U.S.C. §44701). Failure to report can result in a civil penalty for each such violation. (49 U.S.C. §46301(a))						
<b>1. Aircraft</b>	Nationality and Registration Mark <b>USA N8129G</b>			Serial No. <b>21059429</b>		
	Make <b>Cessna</b>			Model <b>T210</b>		Series <b>K</b>
	Name (As shown on registration certificate) <b>JOHNSON RICHARD A TRUSTEE</b>			Address (As shown on registration certificate) Address <b>4923 S Meadows PL</b> City <b>Chandler</b> State <b>AZ</b> Zip <b>85248</b> Country <b>US</b>		
<b>3. For FAA Use Only</b>						
<b>4. Type</b>		<b>5. Unit Identification</b>				
<input checked="" type="checkbox"/> Repair	<input type="checkbox"/> Alteration	Unit	Make	Model		Serial No.
<input checked="" type="checkbox"/>	<input type="checkbox"/>	<b>AIRFRAME</b>	<b>_____</b>	<i>(As described in Item 1 above)</i>		<b>_____</b>
<input type="checkbox"/>	<input type="checkbox"/>	<b>POWERPLANT</b>	<b>_____</b>			
<input type="checkbox"/>	<input type="checkbox"/>	<b>PROPELLER</b>	<b>_____</b>			
<input type="checkbox"/>	<input type="checkbox"/>	<b>APPLIANCE</b>	Type <b>_____</b>			
		Manufacturer <b>_____</b>				
<b>6. Conformity Statement</b>						
<b>A. Agency's Name and Address</b>			<b>B. Kind of Agency</b>			
Name <b>Richard A. Johnson</b> Address <b>4923 S Meadows PL</b> City <b>Chandler</b> State <b>AZ</b> Zip <b>85248</b> Country <b>US</b>			<input checked="" type="checkbox"/> U. S. Certified Mechanic			
			<input type="checkbox"/> Foreign Certified Mechanic			
			<input type="checkbox"/> Certified Repair Station			
			<input type="checkbox"/> Certified Maintenance Organization			
<b>C. Certificate No.</b> <b>3402889 A&amp;P</b>						
<b>D. I certify that the repair and/or alteration made to the unit(s) identified in Item 5 above and described on the reverse or attachments hereto have been made in accordance with the requirements of Part 43 of the U.S. Federal Aviation Regulations and that the information furnished herein is true and correct to the best of my knowledge.</b>						
Extended range fuel per 14 CFR Part 43: App. B: <input type="checkbox"/>		Signature/Date of Authorized Individual <b>Richard Johnson</b> <b>27 January, 2020</b>				
<b>7. Approval for Return to Service</b>						
Pursuant to the authority given persons specified below, the unit identified in Item 5 was inspected in the manner prescribed by the Administrator of the Federal Aviation Administration and is: <input checked="" type="checkbox"/> Approved <input type="checkbox"/> Rejected						
<b>BY</b>	<b>FAA Fit Standards Inspector</b>	<b>Manufacturer</b>	<b>Maintenance Organization</b>		<b>Persons Approved by Canadian Department of Transport</b>	
	<b>FAA Designee</b>	<b>Repair Station</b>	<input checked="" type="checkbox"/>	<b>Inspection Authorization</b>	<b>Other (Specify)</b>	
<b>Certificate or Designation No.</b> <b>A&amp;P 2448625 IA</b>		Signature/Date of Authorized Individual <b>P. D. Johnson</b> <b>2020</b>				

## NOTICE

*Weight and balance or operating limitation changes shall be entered in the appropriate aircraft record. An alteration must be compatible with all previous alterations to assure continued conformity with the applicable airworthiness requirements.*

## 8. Description of Work Accomplished

*(If more space is required, attach additional sheets. Identify with aircraft nationality and registration mark and date work completed.)*

USA N8129G

01/27/2020

Nationality and Registration Mark

Date

Description of Major Repair: Compliance with TEXTRON SEL-57-06 WINGS - MODEL 210 CARRY-THRU SPAR ONE-TIME EDDY CURRENT INSPECTION. Work performed by Roark Summerford (A&P 3631954) and Richard Johnson (A&P 3402889) in accordance with SEL-57-06.

## Description of work:

SEL-57-06 was complied with IAW the ACCOMPLISHMENT INSTRUCTIONS. Steps 9 and 10 of SEL-57-06 were further complied with IAW Revision 1 November 19, 2019 as outlined in paragraph 1 of the revision block on page 2 "Airplanes which have complied with SEL-57-06 but yet with this service letter do not need to the inspection outlined in this service letter, however, these airplanes need to complete Steps 9 and 10 of this service letter within 200 flight hours or at the next annual inspection, whichever occurs first."

Removal of the foam from bottom of the carry-thru spar was accomplished with a plastic scraper and remaining adhesive was removed with acetone. Visual inspection was carried out as detailed in the service letter. The surface appeared to be "water stained", there was surface corrosion, and some deeper pitting corrosion present. There were also surface scratches roughly longitudinal in direction in relation to the aircraft penetrating through the chromate conversion coating.

Most of the surface scratches and chromate conversion coating were removed with Aluminum oxide 240 grit sandpaper, followed by 400 grit on a 6" DA sander from the entire lower surface of the carry through spar to help facilitate visual inspection as directed in the consumable material table on page 3.

Areas of remaining corrosion pitting, and 3 scratches were removed using a combination of 180, 240, and 400 grit Aluminum oxide 02" sanding discs on a right-angle hand sander. The deepest pits were found to be appx .022" in depth after 20:1 blending was accomplished. Particular attention was given to the lower surface edge radius to minimize any stress risers. After blending, the entire lower surface was prepped with aluminum oxide 240 and 400 grit 06" DA sander and cleaned with alcohol in preparation for Eddy current inspection.

Canyon State Inspection performed Eddy Current inspection on 07/18/2019 in accordance with SEL-57-06. No defects were found. (See Attached)

Measurements were taken of all areas where material was removed with a depth gage. A grid pattern establishing buttline from aircraft centerline was drawn in 1-inch increments. Right of centerline to Right 1 inch is in zone R0, and so on out to R20 and the same convention is used for the Left buttline zones. There were 55 blended areas. See Attached.

On August 15, 2019 Brandon Judson, representing Textron Aviation, upon learning the aircraft was classified in the Severe Usage category indicated that Textron Aviation would not support the aircraft with the following statement in email, "The STCs installed on this aircraft have an impact on the aircraft loading, stress levels, and operational envelope that we were not involved in developing, have no certification data for, as well as no evaluation of the potential impact and are outside of the 210 TCDS as certified by Cessna/Textron Aviation and therefore we cannot provide support to this aircraft."

Additional Sheets Are Attached

## NOTICE

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## 8. Description of Work Accomplished

(If more space is required, attach additional sheets. Identify with aircraft nationality and registration mark and date work completed.)

USA N8129G

01/27/2020

Nationality and Registration Mark

Date

The DER services of Richard A. Coveno, P.E. DERT-810015-NE were engaged to provide Structural Substantiation of the spar repair as performed and provide the 8110-3 Statement of Compliance with Airworthiness Standards. On October 28, 2019 Mr. Coveno provided form 8110-3 Statement of Compliance with Airworthiness Standards (See Attached), along with supporting document 19022 Structural Substantiation of Spar Repair on Cessna 210M Aircraft, 19022 Rev B including this aircraft N8129G S/N 21059429. (See Attached)

Protective coatings applied to the carry-thru spar per SEL-57-08 Steps (9)(C)(1-4) and (10)(A-G),

BONDERITE C-IC 33 AERO

BONDERITE M-CR 1201 AERO

AkzoNobel 10P8-11 EPOXY PRIMER (Base) & AkzoNobel EPOXY PRIMER EC-286 (Curing Solution)

Cor-Ban 23

No changes to weight and balance were made by this repair.

## Instructions for Continued Airworthiness

1. Introduction: See above (Form 337 section 8).
2. Description: See above (Form 337 section 8).
3. Control: Not Applicable.
4. Servicing Information: Not Applicable.
5. Maintenance Instructions: Not Applicable.
6. Trouble Shooting Information: Not Applicable.
7. Removal and Replacement Information: Not Applicable.
8. Diagrams: Not Applicable.
9. Special Inspection Requirements: Not Applicable.
10. Application of Special Treatment: Not Applicable.
11. Data: Not Applicable.
12. List of Special Tools: Not Applicable.
13. For Commuter Category Aircraft: Not Applicable.
14. Recommended Overhaul Periods: Not Applicable.
15. Airworthiness Limitation Section: There are no airworthiness limitations as a result of this repair.
16. Revision: A letter will be submitted to the local FSDO with a copy of the revised FAA Form 337 and a revised ICA. The FAA inspector accepts the change by signing Block 3 of the 337.

Additional Sheets Are Attached

**Paperwork Reduction Act Statement:** The reason for collecting this information is to track major maintenance performed on aircraft. The collected information is used as part of the aircraft's historical file. The public reporting burden for this collection of information is estimated to average 30 minutes per response. Responses are mandated by 14 CFR Part 43. Collected information becomes part of the public record and no confidentiality is required. An agency may not conduct or sponsor, and a person is not required to respond to a collection of information unless it displays a currently valid OMB control number. The OMB control number associated with this collection is 2120-0020. Comments concerning the accuracy of this burden and suggestions for reducing the burden should be directed to the FAA at 800 Independence Ave. SW Washington, DC 20591, Attn: Information Collection Clearance Officer, AES-200.



## FIELD INSPECTION REPORT

CLIENT: Richard Johnson

AIRCRAFT TAIL #: N8129G

PURCHASE ORDER#: Verbal - Richard Johnson

AIRCRAFT SERIAL #: 21059429

CSI JOB #: AC19-867

ACCEPT	REJECT	REPAIRMAN	PRELIMINARY INSPECTION		REMARKS
✓		C. Hoffmann			

Date completed: 7/18/19

DESCRIPTION	NON-DESTRUCTIVE TEST		QUANTITY	ACCEPT	REJECT
	P/N	S/N			
Eddy current inspection of the carry thru spar.	N/A	N/A	100%	100%	

REMARKS: No indications noted.

A/CT.T. : ~~TBD~~-4306.1

Nortec 600 SN: 160012140023 cal due: 1/24/20

A/C cycles: N/A

Date completed: 7/18/19

REFERENCE	TECHNICAL DATA	VERIFICATION
Serviceletter SEL-57-06 Cessna Aircraft company Model 210 series (1977+1981) servicemanual	June 24 <sup>th</sup> 2019 D2057-3-13 Temporary Rev. 10 Aug. 1 <sup>st</sup> 2011	Customer supplied

CANYON STATE INSPECTION CERTIFIES THAT THE WORK SPECIFIED, EXCEPT AS OTHERWISE SPECIFIED, WAS CARRIED OUT IN ACCORDANCE WITH FAA AIRWORTHINESS REGULATIONS, 14 CFR PART 43 AND 145 AND IN RESPECT TO THAT WORK PERFORMED IS APPROVED FOR RETURN TO SERVICE UNDER FAA REPAIR STATION:

FAA HI3R554L  FAA HI3D554L

CANYON STATE INSPECTION CERTIFIES THAT THE WORK SPECIFIED, EXCEPT AS OTHERWISE SPECIFIED, WAS CARRIED OUT IN ACCORDANCE WITH EASA PART-145 AND IN RESPECT TO THAT WORK THE AIRCRAFT IS CONSIDERED READY FOR RELEASE TO SERVICE UNDER EASA REPAIR STATION:

EASA 145.6501  EASA 145.6523

PERTINENT DETAILS OF THE MAINTENANCE PERFORMED ARE ON FILE AT THE ABOVE MARKED REPAIR STATION  
UNDER WORK ORDER: AC19-867

NAME: Carly Hoffmann

SIGNATURE: Carly Hoffmann

Date Completed: 7/18/19

103 South Southgate • Chandler, Arizona 85226-3222 (480) 783-7100  
3625 East Ajo Way • Tucson, Arizona 85713 (520) 745-3672 Fax (520) 745-8608

U.S. DEPARTMENT OF TRANSPORTATION FEDERAL AVIGATION ADMINISTRATION STATEMENT OF COMPLIANCE WITH AIRWORTHINESS STANDARDS				1. DATE 28 Oct 2019
AIRCRAFT OR AIRCRAFT COMPONENT IDENTIFICATION				
2. MAKE Textron	3. MODEL NO. Cessna 210M	4. TYPE (Airplane, Radio, Helicopter, etc.) Aircraft	5. NAME OF APPLICANT Richard Johnson	
LIST OF DATA				
6. IDENTIFICATION 19022, Rev B 28 Oct 2019	7. TITLE Structural Substantiation of Spar Repair on Cessna 210M Aircraft			
SEL-57-06 for T210K SN 21059429 N8129G	SEL-57-06 for T210K SN 21059429 N8129G			
***END***	**END DATA**			
<p><b>Note<sup>1</sup>:</b> This approval is for engineering design data only. It indicates the data listed above demonstrates compliance only with the regulations specified by paragraph and subparagraph listed below as "Applicable Requirements." This form does not constitute FAA approval of all the engineering data necessary for substantiation of compliance to necessary requirement for the entire alteration.</p> <p><b>Note<sup>2</sup>:</b> Only the structural aspects of the above listed data are approved herein.</p> <p><b>Note<sup>3</sup>:</b> Installation only applies to N8129G, SN 21059429 and is not transferable to any other aircraft.</p> <p><b>Note<sup>4</sup>:</b> Compliance certification may also be required for other areas.</p> <p>*** END ***</p>				
8. PURPOSE OF DATA In support of major repair.				
9. APPLICABLE REQUIREMENTS (List specific sections) CAR 3, effective May 15, 1956, through Amendments 3-8 Paragraphs: 3.171(a)(b), 3.172, 3.173, 3.174, 3.186(a)(b), 3.187(a)(b), 3.188, 3.291, 3.301				
10. CERTIFICATION - Under authority vested by direction of the Administrator and in accordance with conditions and limitations of appointment under Part 183 of the Federal Aviation Regulations, data listed above and on attached sheets numbered <u>0</u> has been examined in accordance with established procedures and found to comply with applicable requirements of the Federal Aviation Regulations.				
<input type="checkbox"/> Recommend approval of these data <input checked="" type="checkbox"/> Approve these data				
11. SIGNATURE (S) OF DESIGNATED ENGINEERING REPRESENTATIVE (S) Richard A. Covino <i>[Signature]</i>		12. DESIGNATION NUMBERS (S) DERT 810015-NE	13. CLASSIFICATION (S) STRUCTURES	

# Aviation Engineering Services LLC

73 Pleasant Street, Groton MA 01450

(937) 478-4959

[rick.coveno@verizon.net](mailto:rick.coveno@verizon.net)

28 Oct 2019

## AES INVOICE STATEMENT

1928

The amount of \$800.00 USD is to be paid by:

Roark Summerford or Richard Johnson

For the following services:

Engineering Consulting Services in Oct 2019 for

1. Review of N8129G Spar repair inspection report
2. Revision of AES Report 19022 to Rev B to include N8129G
3. 8110-3 Compliance finding on repair inspection results and analysis.

Make Check payable to:

**Richard A. Coveno**  
025-56-0228

Please Mail the Check to:

Richard A. Coveno, P.E.  
Aviation Engineering Services, LCC  
73 Pleasant Street  
Groton MA 01450

Sincerely,

*Richard A Coveno*

Richard A. Coveno, P.E.  
DERT 810015-NE

# Aviation Engineering Services LLC

73 Pleasant Street, Groton MA 01450  
(937) 478-4959  
[rick.coven@verizon.net](mailto:rick.coven@verizon.net)

19022

## Structural Substantiation of Spar Repair on Cessna 210M Aircraft

Richard Coven, PE  
DER 810015-NE  
Chief Engineer  
Aviation Engineering Services LLC

### LOG OF REVISIONS

REVISION	DATE	DESCRIPTION	PAGES AFFECTED
IR	11 Sep 2019	Original for N32PW	12/12
A	22 Sep 2019	Revised for N994RA	10-13
B	28 Oct 2019	Revised for N8129G	13-14

## Table of Contents

1. Purpose
2. Documents
3. Situation for Analysis
4. Analysis
5. Conclusions

## APPENDIX

**1. PURPOSE:** The purpose of this report is to show that the spar repair on Cessna 210 aircraft maintains the structural compliance of the aircraft.

### 2. DOCUMENTS

19-06-24	Textron Mandatory Service Letter
19-06-27	FAA Airworthiness Concern Sheet, Wichita ACO Branch
19-07-19	Power Aviation Inc 723PW Eddy Current Report
19-07-23	Citation Service Center 732PW initial carry thru Spar inspection report
19-07-23	Textron Structural Damage Report and Service Request- 723PW carry thru spar
19-08-06	GV Air, N732PW TTAF 14489.32 Cessna Service Letter SEL-57-06 Wing Model 210 Carry Thru Spar One time Eddy Current Inspection Report #2

**18-23. WING SPAR.**

**18-24. NEGLIGIBLE DAMAGE.** Due to the stresses which the wing spar encounters, very little damage can be considered negligible. Smooth dents, light

scratches and abrasions may be considered negligible.

**18-25. REPAIRABLE DAMAGE.** All cracks, stress wrinkles, deep scratches and sharp dents must be repaired. However, repairs must not be made to the main wing spar inboard of wing station 155.00 without factory approval. Refer to Section 1 for wing station locations. Figure 18-7 outlines a typical main wing spar repair.

**18-26. DAMAGE NECESSITATING REPLACEMENT OF PARTS.** An entire wing spar may be replaced without factory approval.

Single  
Engine

**SERVICE LETTER**

 DacraCraft

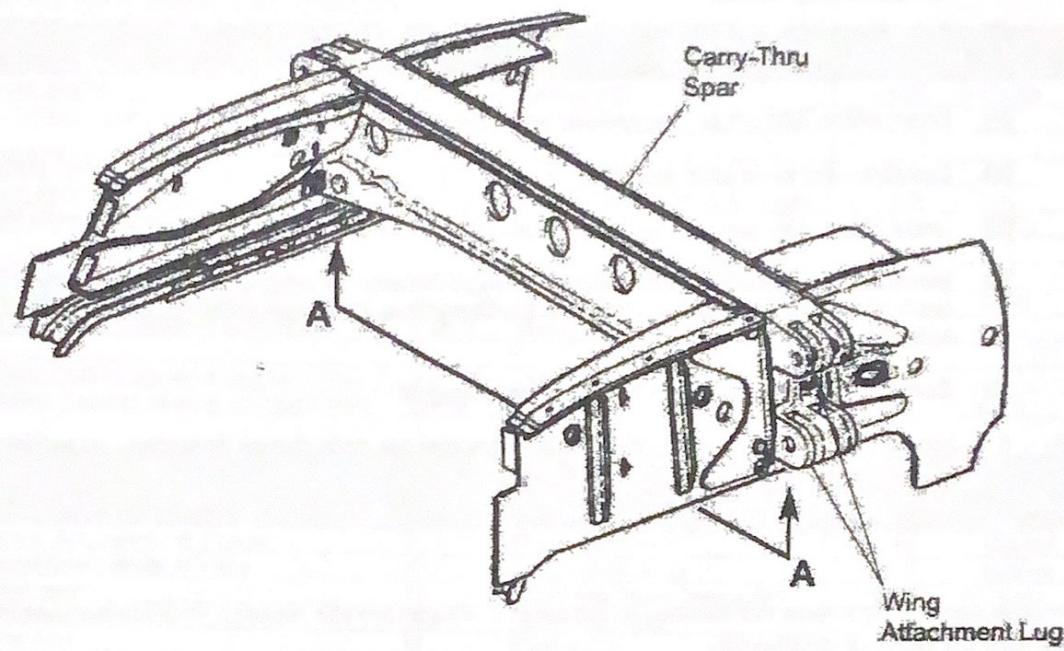
**MANDATORY**

**SEL-57-06**

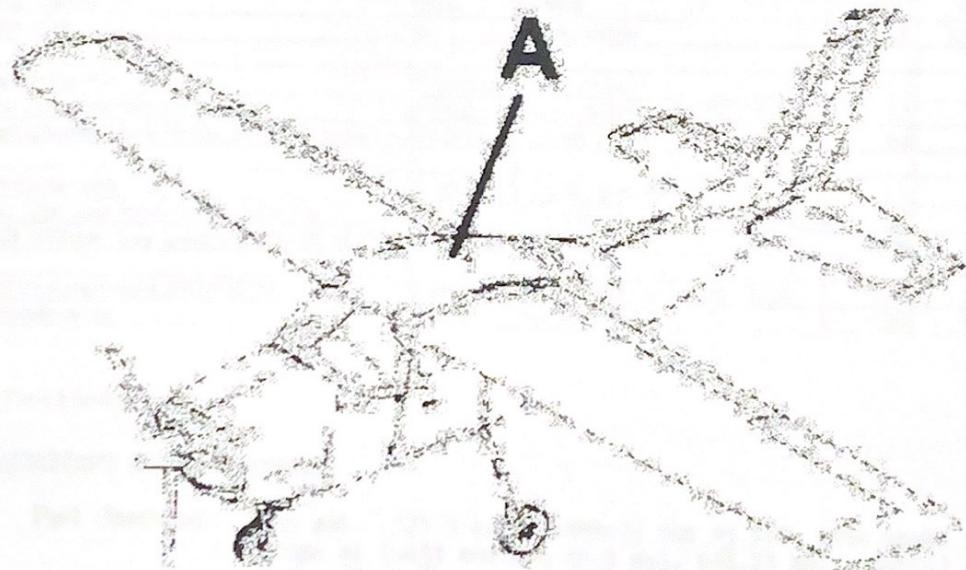
- (5) Finish with a 220 grit or finer grained aluminum oxide sandpaper.
- (6) Use clean dry air to blow off dust.
- (7) Use a clean cloth wet with isopropyl alcohol to clean the surface.
- (8) Measure the blended area and contact Textron Aviation Structures with the dimension of blended area for evaluation. (Refer to the Carry-Thru Spar Inspection Report for contact information.)
- (9) Complete the eddy current inspection, go to Step 7.

B. If no corrosion is found on the carry-thru spar, complete the eddy current inspection, go to Step 7.

3. Situation for Analysis:  
Cessna 210 Spar inspection repair.



3.1 Installation Location



- A. If corrosion is found on the carry-thru spar, the area can be reworked as follows:
  - (1) Use 180 grit or finer aluminum oxide abrasive paper, cloth or pads to carefully remove corrosion and blend that area locally around the affected region.
  - (2) Make sure to only remove the minimum material necessary to blend the corroded surface with the surrounding surface.
  - (3) Maintain a minimum of 20:1 blend to depth ratio.
  - (4) Leave no sharp edges after blending.
  - (5) Finish with a 220 grit or finer grained aluminum oxide sandpaper.
  - (6) Use clean dry air to blow off dust.
  - (7) Use a clean cloth wet with isopropyl alcohol to clean the surface.
  - (8) Measure the blended area and contact Textron Aviation Structures with the dimension of blended area for evaluation. (Refer to the Carry-Thru Spar Inspection Report for contact information.)
  - (9) Complete the eddy current inspection, go to Step 7.
- B. If no corrosion is found on the carry-thru spar, complete the eddy current inspection, go to Step 7.

Textron Aviation Structures has declined to approved or disapprove this repaired situation because of the wing tip fuel tank modification.

### 3.2 Loading:

#### 3.2.1 Gust and Inertial Load Factors:

CAR 3 Gust and Inertial Load Factors are:

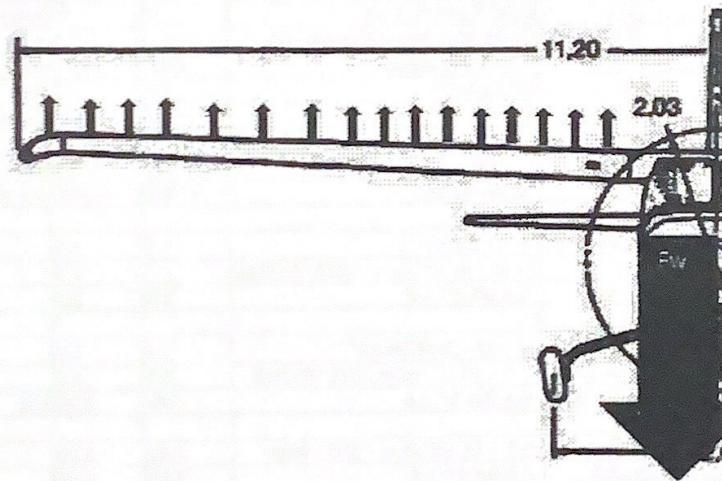
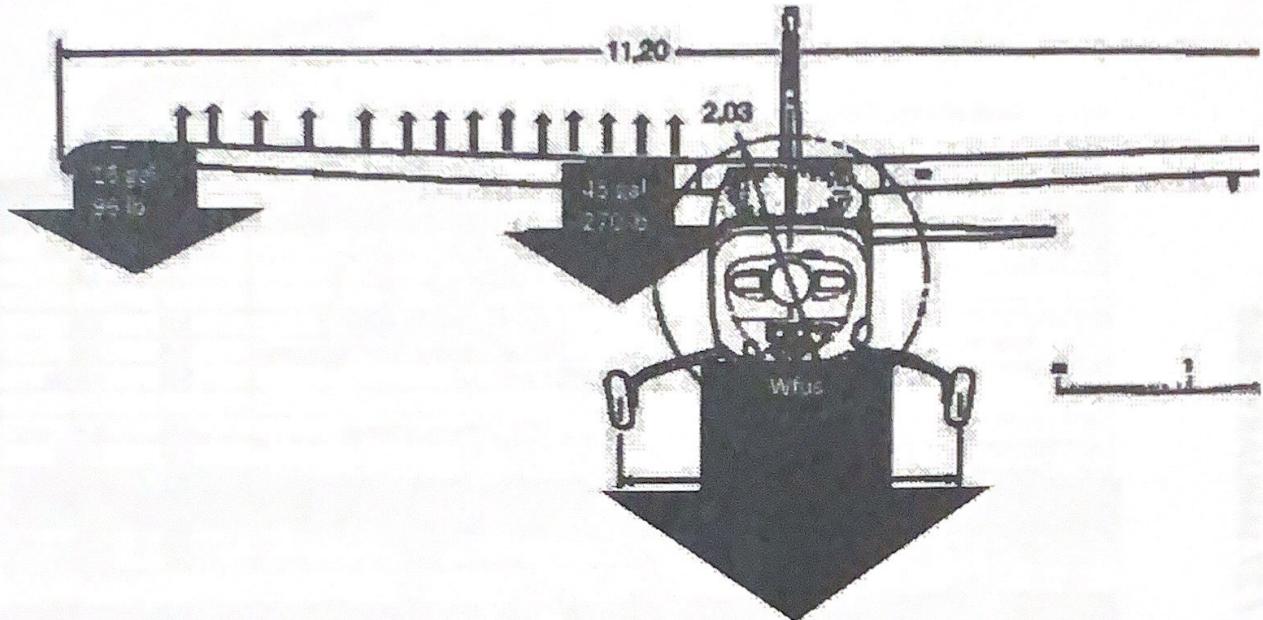
Aircraft Weight	W	Cessna 210	3,800	2,438	lbs
3.172 Factor of safety	FS		1.5	1.5	
3.186(a) Positive limit maneuver load factor N	$n+z$	$= 2.1 + 24000/(W + 10000)$	3.8	4.0	
Limit Maneuver Load Factor	$n N$	Normal Category Need not exceed	3.5	3.5	
3.186 Ultimate Maneuver LF Normal cat	$n+z$ ult	$= n+z * 1.5$	5.8	6.0	Gz
Limit Maneuver Category U (Utility)	$n$ lim U	Utility Category Maneuver	4.4	4.4	
Ultimate Maneuver Category U (Utility)	$n+z$ ult U	$= n U * 1.5$	6.6	6.6	G
Limit Maneuver Category A (Acrobatic)	$n$ lim A	Acrobatic Category Maneuver	6.0	6.0	
3.186(b) Neg limit maneuver load factor N&U	$n-z$	$= -.4 * n + z$	-1.5	-1.6	
Ultimate negative maneuver load factor N&U	$n-z$ ult	$= n-z * 1.5$	-2.3	-2.4	G

CAR 3.188 Gust Load Factor	Symbol	Equation/Source	Max Weight Value	Min Weight Value	Units
Nominal Gust Velocity at $V_{cruise}$	$U_1$	Gust Velocity at $V_c$	30	30	ft/sec
Nominal Gust Velocity at $V_{dive}$	$U_2$	Gust Velocity at $V_d$	15	15	ft/sec
Aircraft speed	$V_c$	TCDS Max Speed Cessna 201	197.9	197.9	m/hr
Aircraft Dive Speed	$V_d$	TCDS $V_{ne}$ speed	229.0	229.0	m/hr
Wing Area	$S$	Cessna 210	175	175	ft <sup>2</sup>
Design Weight	$W$		3,800	2,438	lbs/ft <sup>2</sup>
Wing Loading	$W/S$	$= W/S$	21.71	13.93	lbs/ft <sup>2</sup>
Slope of lift curve	$m$	CL per radian	5.3400	5.3400	per rad
K factor For $W/S < 16$	$K_{W/S<16}$	$= 1/2 (W/S)^{1/4}$	1.1	1.0	
Gust Limit Load factor ( $W/S < 16$ )	$n$ limit1	$= 1 + [K_{U1} V_c m / [575 * (W/S)]]$	3.7	4.8	
Gust Ultimate Load Factor ( $W/S < 16$ ) at $V_c$	$n$ ult 1	$= n$ ult 1 * 1.5	5.6	7.2	
K factor for $W/S > 16$	$K_{W/S>16}$	$= 1.33 - [2.67/(W/S)]^{3/4}$	1.1	1.0	
Gust Limit Load factor ( $W/S > 16$ ) at $V_c$	$n$ lim 2	$= 1 + [K_{U1} V_c m / 575 * (W/S)]$	3.7	4.8	
3.188 Ultimate Gust Load LF( $W/S > 16$ ) at $V_c$	$n+z$ ult 2	$= n$ lim 1 * 1.5	5.56	7.20	G-z
Gust Limit load factor ( $W/S > 16$ ) $V_d$	$n$ lim 3	$= 1 + [K_{U2} V_d m / 575 * W/S]$	2.56	3.20	
$n$ Ultimate at $V_d$	$n$ ult 3	$= n$ lim 3 * 1.5	3.85	4.80	

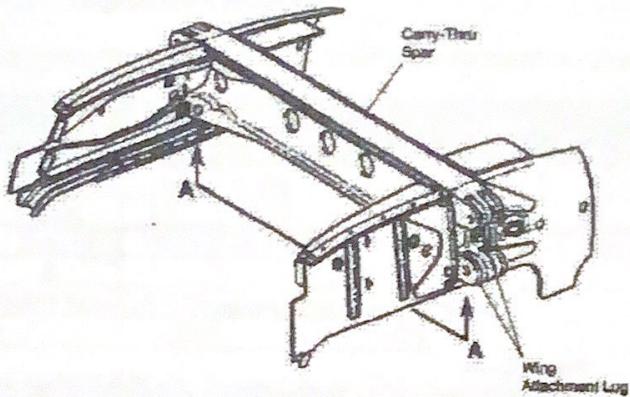
Tip Tank Loading:

#### LIMITATIONS AND CONDITIONS:

Fuel Capacity 123 gal. (121.5 gal. usable); two 45 gal. main tanks in wings at (+43) and two 16.5 gal. (16.25 gal. usable) aux. tanks in wings at (+49.5).



Location/Value	Equation				
Acceleration	G	CAR3.188 Gust Load Factor	5.56	7.20	G
Downward Force on wings	$F_{\text{down}} = W_{\text{fus}} * G$		13841	8131	lbs
Max single wing load	$F_{\text{wing}} = (W_{\text{f}}/2) * G$		6920.7	4065.5	lbs
Distributed Load on single wing	$w = P_{\text{wing}} / L_{\text{wing}}$		35.310	20.742	lbs/in
Max single wing moment on Spar	$M_{\text{wing}} = w * L^2 / 2$		678,231	398,417	in lbs

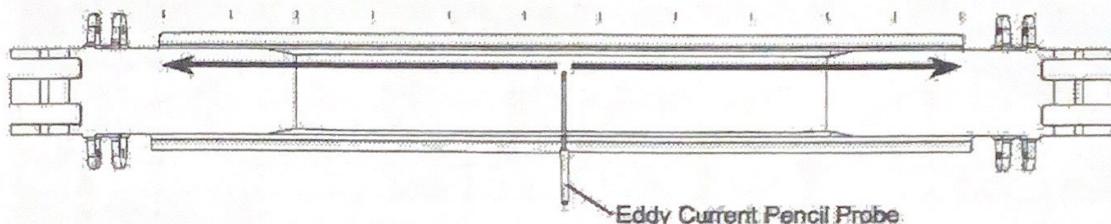


Spar Lugs translate wing bending into tensile load on the spar flange

Spar Clevis Bolt Arm	Base		6	6	in
Pitch Moment	PM	RC = PM / Base	678,231	398,417	in-lbs
Reaction tensile force on Spar Flange	RF	= PM / Base	113,038	66,403	lbs

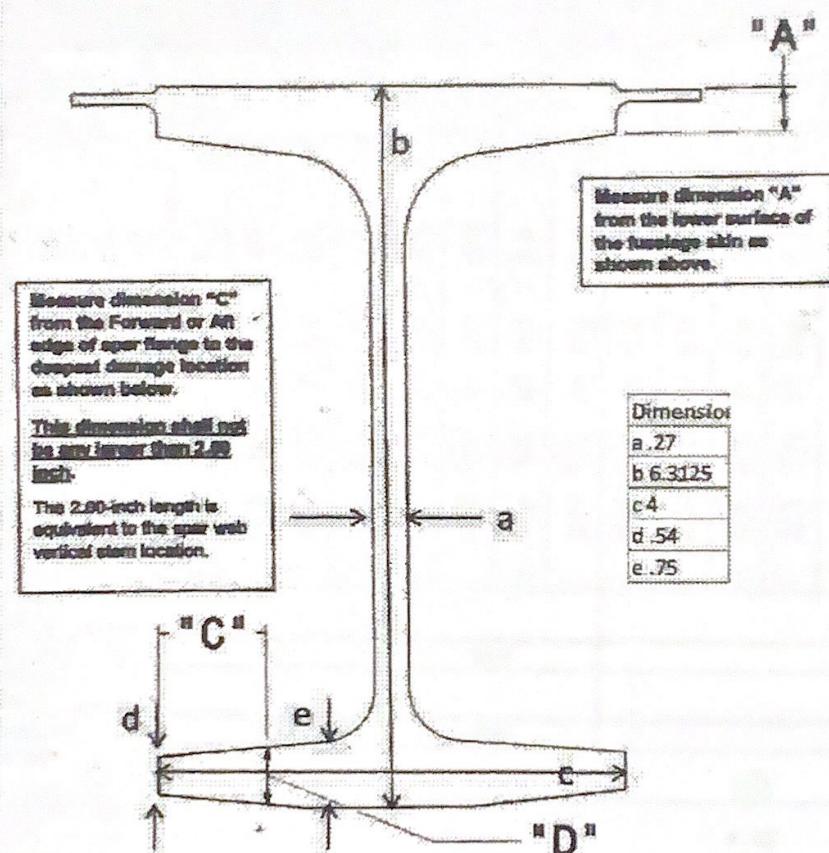
4.0 ANALYSIS:

4.1 Item: Spar Body



VIEW A-A

View Looking Up at Lower Surface of the Carry-Thru



"A" - Vertical thickness of end of upper spar flange.

Measure dimension "A" from the lower surface of the skin as shown above.

"C" - Horizontal distance from end of spar flange to deepest spot of corroded area being evaluated.

"D" - Vertical thickness of spar flange at deepest spot of corrosion.

#### 4.1.1 Original SPAR Properties

The spar properties can be conservatively calculated as follows using the minimum flange thickness.

SPAR Section	Flange	4.0	0.5400	0.0525	2.1600	3.15625	6.8175	3.16	21.517734	21.5702
Web	0.27	6.3125	5.6596	1.7044	0	0	0.00	0	0	5.6596
Flange	4.0	0.5400	0.0525	2.1600	-3.15625	-6.818	-3.156	21.517734	21.5702	
$\Sigma$			5.7646	6.0244		0.000		43.0355	48.8001	
Neutral Axis	$\Sigma A_r / \Sigma A$									
Y	4.236	$V_y$	11.51964							

**Table 3.2.3.0(e). Design Mechanical and Physical Properties of Cold 2024 Aluminum Alloy**

Specification	Form	Temper	AMS-QQ-A-250/3												
			Flat sheet and plate												
Thickness, in.	T3				T351				T351						
	0.008- 0.039	0.010- 0.062	0.063- 0.128	0.139- 0.249	0.250- 0.499	0.500- 1.000 <sup>a</sup>	1.001- 1.500 <sup>b</sup>	1.501- 2.000 <sup>c</sup>	A	B	A	B	A	B	A
<b>Mechanical Properties</b>															
$F_u$ , ksi															
L	59	60	60	61	62	63	63	64	62	64	61	63	60	62	60
LT	59	59	59	60	61	62	62	63	62	64	61	63	60	62	60
ST	**	**	**	**	**	**	**	**	**	**	**	**	**	**	**
$F_u$ , ksi															
L	44	45	44	43	43	47	45	47	46	48	45	48	45	48	45
LT	39	40	39	40	42	40	42	42	40	42	40	42	42	42	40
ST	**	**	**	**	**	**	**	**	**	**	**	**	**	**	**
$F_u$ , ksi															
L	36	37	36	37	37	39	37	39	37	39	37	39	37	39	36
LT	42	43	42	43	43	45	43	45	43	45	42	45	42	44	42
ST	**	**	**	**	**	**	**	**	**	**	**	**	**	**	**
$F_u$ , ksi															
$F_u$ , ksi															
(c/D = 1.5)	37	37	37	38	38	39	39	40	37	38	36	37	35	37	35
(c/D = 2.0)	96	97	97	99	101	102	102	104	94	97	92	95	91	94	91
$F_u$ , ksi															
(c/D = 1.5)	119	121	121	123	125	127	127	129	115	119	117	117	111	115	111
(c/D = 2.0)	68	70	68	70	70	73	70	72	69	72	69	72	69	72	69
$\sigma_{p0.01}$ (S-tensile)															
L	82	84	82	84	84	85	84	85	82	85	82	85	82	86	82
LT	10	11	4	11	15	12	15	12	12	12	8	12	7	12	6
$E$ , $10^6$ ksi															
Primary															
Secondary															
9.5	10.5													10.7	
10.0															10.2
$E$ , $10^6$ ksi															
Primary															
Secondary															
10.7															10.9
9.7	10.2														10.4
$G$ , $10^6$ ksi															
															0.33
$\mu$															
Physical Properties															
$\alpha_3$ , $10^6$ in/in															0.100
C, K, and $\alpha$															

a. These values, except in the ST direction, have been adjusted to represent the average properties across the whole section, including the 2%.

b. Caution: This specific alloy, temper, and product form exhibit poor circumferential cracking resistance in this grain direction. It is exempt as indicated in Table 3.1.2.3.1(a).

c. Bearing values are "dry pin" values per Section 1.4.7.1. See Table 3.1.2.1.1.

d. See Table 3.2.3.0(f).

#### 4.1.2 Applied Loading

Structural Calculations					
Max TO Weight	W total	given	3800	2,438	lbs
Empty Weight of Structure	W empty	given	2238	2238	
Wing Tip Fuel Weight	W/wt	given 16 Gal max	96.16	96.16	lb
Main tank weight	W main	given 45 Gal each wing	540.9	540.9	
Weight of Wing	W wing	= W empty * .3	671.4	671.4	
Wing and Fuel	W w&f	= Wwt+Wmain+ Wwing	1308.46	1308.46	lbs
Fuselage Payload Weight	Wfus	= Wtotal - W w&f	2491.54	1,130	lbs
Max Payload with Max Fuel	W payload	given	1473	1473	lbs
Total Aircraft Weight Check	Wt		3800	2438	lbs
Cantilevered wing Length	L wing	one wing no spar	196	196	in
Environmental					
Acceleration	G	CAR3.188 Gust Load Factor	5.56	7.20	G
Downward Force on wings	F down	= Wfus * G	13841	8131	lbs
Max single wing load	F wing	= (W/2) * G	6920.7	4065.5	lbs
Distributed Load on single wing	w	= P wing / L wing	35.310	20.742	lbs/in
Max single wing moment on Spar	M wing	= w * L <sup>2</sup> / 2	678,231	398,417	in lbs

The clevis attachment translates the bending moment into tensile and compression loading in the spar:

Spar Clevis Bolt Arm					
Spar Clevis Bolt Arm	Base		6	6	in
Pitch Moment	PM	RC = PM / Base	678,231	398,417	in-lbs
Reaction tensile force on Spar Flange	RF	= PM / Base	113,038	66,403	lbs

#### 4.1.3 Original Geometry Analysis

Original Geometry Analysis					
Spar Ultimate Tensile Strength	Ftu	2024-T3 MMPDS	59,000	59,000	lbs/in <sup>2</sup>
Flange thickness / height	h		0.540	0.540	in
Flange base width	b		4.0	4.0	in
Unrepaired Flange Area	A f	= B * h	2,1600	2,1600	in <sup>2</sup>
Reaction tensile force on Spar Flange	RF	= PM / Base	113,038	66,403	lbs
Unrepaired Tensile Stress	$\sigma$ ten	= F / Af	52,333	30,742	lbs/in <sup>2</sup>
Original Tensile Load Margin of Safety	MS Ten	= Ftu / $\sigma$ ten			

## 4.1.4. A Repaired area removed N6643N

N6643N					
Damage Locating/ Locating Mark (Inches)	"A" (Inches)	"C" (Inches)	"D" (Inches)	Material Removed at Blended Region (Inches)	Blended Region Size - Length and Width or Diameter (Inches)
12.5		.5576	.577	.007	.53.5
14.5		.5576	1.143	.014	.753.5
18			4.040	.012	135.81
<i>BFT Face</i>					
17.5			.340	.016	.50
<i>BFT Web</i>					
16.75			.373	.007	.253.5
17.75			.3725	.014	.52.35
19			.362	.006	.52.35
<i>Ring + base</i>					
18.6					

## 4.1.4. B Repaired area removed N994RA

Damage Locating/ Locating Mark (Inches)	"A" (Inches)	"C" (Inches)	"D" (Inches)	Material Removed at Blended Region (Inches)	Blended Region Size - Length and Width or Diameter (Inches)
.25		.25	.5915	.008	
.75			.590	.011	
1.25			.595	.0095	
1.75			.595	.0075	
2.25			.593	.006	
2.75			.590	.005	
3.25			.5915	.006	
3.75			.5915	.0065	
4.25			.5825	.0055	
4.75			.580	.004	
5.25			.5865	.0055	
5.75			.5845	.0075	
6.25			.585	.007	
6.75			.588	.0065	
7.25			.591	.006	
7.75			.596	.0065	
8.25			.5925	.011	
8.75			.605	.0085	
9.25			.6012	.0065	
10.25			.592	.013	
10.75			.598	.013	
11.25			.617	.007	
11.75			.672	.013	
12.25			.769	.016	
12.75			.7635	.016	
13.25			.764	.004	

## 4.1.4.C Repair area removed N8129G

CORROSION REMOVAL BLEND DEPTHS

1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	31	32	33	34	35	36	37	38	39	40	41	42	43	44	45	46	47	48	49	50	51	52	53	54	55	56	57	58	59	60	61	62	63	64	65	66	67	68	69	70	71	72	73	74	75	76	77	78	79	80	81	82	83	84	85	86	87	88	89	90	91	92	93	94	95	96	97	98	99	100	101	102	103	104	105	106	107	108	109	110	111	112	113	114	115	116	117	118	119	120	121	122	123	124	125	126	127	128	129	130	131	132	133	134	135	136	137	138	139	140	141	142	143	144	145	146	147	148	149	150	151	152	153	154	155	156	157	158	159	160	161	162	163	164	165	166	167	168	169	170	171	172	173	174	175	176	177	178	179	180	181	182	183	184	185	186	187	188	189	190	191	192	193	194	195	196	197	198	199	200	201	202	203	204	205	206	207	208	209	210	211	212	213	214	215	216	217	218	219	220	221	222	223	224	225	226	227	228	229	230	231	232	233	234	235	236	237	238	239	240	241	242	243	244	245	246	247	248	249	250	251	252	253	254	255	256	257	258	259	260	261	262	263	264	265	266	267	268	269	270	271	272	273	274	275	276	277	278	279	280	281	282	283	284	285	286	287	288	289	290	291	292	293	294	295	296	297	298	299	300	301	302	303	304	305	306	307	308	309	310	311	312	313	314	315	316	317	318	319	320	321	322	323	324	325	326	327	328	329	330	331	332	333	334	335	336	337	338	339	340	341	342	343	344	345	346	347	348	349	350	351	352	353	354	355	356	357	358	359	360	361	362	363	364	365	366	367	368	369	370	371	372	373	374	375	376	377	378	379	380	381	382	383	384	385	386	387	388	389	390	391	392	393	394	395	396	397	398	399	400	401	402	403	404	405	406	407	408	409	410	411	412	413	414	415	416	417	418	419	420	421	422	423	424	425	426	427	428	429	430	431	432	433	434	435	436	437	438	439	440	441	442	443	444	445	446	447	448	449	450	451	452	453	454	455	456	457	458	459	460	461	462	463	464	465	466	467	468	469	470	471	472	473	474	475	476	477	478	479	480	481	482	483	484	485	486	487	488	489	490	491	492	493	494	495	496	497	498	499	500	501	502	503	504	505	506	507	508	509	510	511	512	513	514	515	516	517	518	519	520	521	522	523	524	525	526	527	528	529	530	531	532	533	534	535	536	537	538	539	540	541	542	543	544	545	546	547	548	549	550	551	552	553	554	555	556	557	558	559	560	561	562	563	564	565	566	567	568	569	570	571	572	573	574	575	576	577	578	579	580	581	582	583	584	585	586	587	588	589	590	591	592	593	594	595	596	597	598	599	600	601	602	603	604	605	606	607	608	609	610	611	612	613	614	615	616	617	618	619	620	621	622	623	624	625	626	627	628	629	630	631	632	633	634	635	636	637	638	639	640	641	642	643	644	645	646	647	648	649	650	651	652	653	654	655	656	657	658	659	660	661	662	663	664	665	666	667	668	669	670	671	672	673	674	675	676	677	678	679	680	681	682	683	684	685	686	687	688	689	690	691	692	693	694	695	696	697	698	699	700	701	702	703	704	705	706	707	708	709	710	711	712	713	714	715	716	717	718	719	720	721	722	723	724	725	726	727	728	729	730	731	732	733	734	735	736	737	738	739	740	741	742	743	744	745	746	747	748	749	750	751	752	753	754	755	756	757	758	759	760	761	762	763	764	765	766	767	768	769	770	771	772	773	774	775	776	777	778	779	780	781	782	783	784	785	786	787	788	789	790	791	792	793	794	795	796	797	798	799	800	801	802	803	804	805	806	807	808	809	810	811	812	813	814	815	816	817	818	819	820	821	822	823	824	825	826	827	828	829	830	831	832	833	834	835	836	837	838	839	840	841	842	843	844	845	846	847	848	849	850	851	852	853	854	855	856	857	858	859	860	861	862	863	864	865	866	867	868	869	870	871	872	873	874	875	876	877	878	879	880	881	882	883	884	885	886	887	888	889	890	891	892	893	894	895	896	897	898	899	900	901	902	903	904	905	906	907	908	909	910	911	912	913	914	915	916	917	918	919	920	921	922	923	924	925	926	927	928	929	930	931	932	933	934	935	936	937	938	939	940	941	942	943	944	945	946	947	948	949	950	951	952	953	954	955	956	957	958	959	960	961	962	963	964	965	966	967	968	969	970	971	972	973	974	975	976	977	978	979	980	981	982	983	984	985	986	987	988	989	990	991	992	993	994	995	996	997	998	999	1000	1001	1002	1003	1004	1005	1006	1007	1008	1009	10010	10011	10012	10013	10014	10015	10016	10017	10018	10019	10020	10021	10022	10023	10024	10025	10026	10027	10028	10029	10030	10031	10032	10033	10034	10035	10036	10037	10038	10039	10040	10041	10042	10043	10044	10045	10046	10047	10048	10049	10050	10051	10052	10053	10054	10055	10056	10057	10058	10059	10060	10061	10062	10063	10064	10065	10066	10067	10068	10069	10070	10071	10072	10073	10074	10075	10076	10077	10078	10079	10080	10081	10082	10083	10084	10085	10086	10087	10088	10089	10090	10091	10092	10093	10094	10095	10096	10097	10098	10099	100100	100101	100102	100103	100104	100105	100106	100107	100108	100109	100110	100111	100112	100113	100114	100115	100116	100117	100118	100119	100120	100121	100122	100123	100124	100125	100126	100127	100128	100129	100130	100131	100132	100133	100134	100135	100136	100137	100138	100139	100140	100141	100142	100143	100144	100145	100146	100147	100148	100149	100150	100151	100152	100153	100154	100155	100156	100157	100158	100159	100160	100161	100162	100163	100164	100165	100166	100167	100168	100169	100170	100171	100172	100173	100174	100175	100176	100177	100178	100179	100180	100181	100182	100183	100184	100185	100186	100187	100188	100189	100190	100191	100192	100193	100194	100195	100196	100197	100198	100199	100200	100201	100202	100203	100204	100205	100206	100207	100208	100209	100210	100211	100212	100213	100214	100215	100216	100217	100218	100219	100220	100221	100222	100223	100224	100225	100226	100227	100228	100229	100230	100231	100232	100233	100234	100235	100236	100237	100238	100239	100240	100241	100242	100243	100244	100245	100246	100247	100248	100249	100250	100251	100252	100253	100254	100255	100256	100257	100258	100259	100260	100261	100262	100263	100264	100265	100266	100267	100268	100269	100270	100271	100272	100273	100274	100275	100276	100277	100278	100279	100280	100281	100282	100283	100284	100285	100286	100287	100288	100289	100290	100291	100292	100293	100294	100295	100296	100297	100298	100299	100300	100301	100302	100303	100304	100305	100306	100307	100308	100309	100310	10031

## 5. DISCUSSION AND CONCLUSIONS:

### 5.1 DISCUSSION

Textron engineering apparently declined to approve or disapprove of this repair because of the edition of the wing tip fuel tanks that are not factory approved, because the wing tip tanks could adversely change the loading on the lower spar cap.

This analysis conservatively calculates the maximum moment the wing applies to the fuselage in both the maximum and minimum weight configuration. The addition of the wing tip tanks theoretically will reduce the maximum moment transferred into the spar.

This analysis shows that the blend out repair could be applied across the entire width of the lower spar cap and the cap still carry the ultimate loading calculated here in.

### 5.2 CONCLUSION

The repair documented here in, maintains compliance with CAR 3 loading and structural requirements.

The instructions for continued airworthiness in the referenced document must be maintained.  
No further repair of this spar cap is authorized.