

**Report No: VA07070501**

**Structural Substantiation Report**

**Raytheon S35 Bonanza S/N 7333,  
Floor Panel Alteration**

By:

Peter Blount  
Richard May

7 July, 2005

**TABLE OF CONTENTS**

<b>TABLE OF CONTENTS.....</b>	<b>2</b>
<b>1. INTRODUCTION.....</b>	<b>3</b>
<b>2. REFERENCES.....</b>	<b>3</b>
<b>3. MINIMUM MARGINS OF SAFETY .....</b>	<b>3</b>
<b>4. APPLICABLE FEDERAL AVIATION REGULATIONS (FAR'S).....</b>	<b>4</b>
<b>5. REVIEW OF STRUCTURE .....</b>	<b>4</b>
<b>6. MATERIAL PROPERTIES.....</b>	<b>5</b>
<b>7. STRUCTURAL ANALYSIS.....</b>	<b>5</b>
<b>8 APPENDIX A .....</b>	<b>8</b>

## 1. Introduction

This report substantiates an alteration to replace original plywood (pine) floor panels with composite honeycomb material (Gillfloor 4017) made by McGill Corporation.

## 2. References

1. Rourke Equations for Stress, 5<sup>th</sup> Edition
2. Mark's Engineering Handbook, 10<sup>th</sup> Edition
3. McGill Corporation Product Data Sheet

## 3. Minimum Margins of Safety

The following is a summary of margin of safety calculations made in this report

Unit	Failure Mode	M.S. <sup>1</sup>	Pg.
Gillfloor	Face Sheet Tension	+0.06	6
Gillfloor	Bending	+1.09	8
Gillfloor	Distributed Loading	+0.61	8
AN526-8 Screw/ NAS1834 Insert	Fastener Pull Through	+ HIGH	8
Gillfloor	Fastener Shear Out	+ HIGH	8

<sup>1</sup> Margins of safety higher than + 2.0 are reported as "+ High"

## 4. Applicable Federal Aviation Regulations (FAR's)

The following table is a summary of FAR's pertinent to this modification.

FAR	Title
23.301	Loads
23.303	Factor of Safety
23.305	Strength and deformation
23.307	Proof of structure
23.321	Load factors
23.601	General design
23.603	Materials
23.605	Fabrication methods
23.607	Fasteners
23.613	Material strength properties

## 5. Review of Structure

This alteration involves the replacement of original pine plywood material floor panels with composite honeycomb panels.

The original floors were made from 0.250 inch thick pine plywood. The replacement (alteration) floor panels are made from 0.295 inch thick Gillfloor 4017T panel material. The planform dimensions for the replacement panels were made by using the original plywood panels as cut and drill templates.

The Gillfloor 4017T panel is a unidirectional S-2 Glass reinforced epoxy face sheet with aramid (Nomex) honeycomb core. This Gillfloor material meets other aerospace manufacturers specifications such as; McDonnell Douglas, Embraer, and BAe.

## **6. Material Properties**

Material strength properties for this report are obtained from two sources as follows:

1. McGill Corporation Product Data Sheet (Ref ) for Gillfloor 4017 material.
2. Mark's Handbook 10<sup>th</sup> Edition Pg 115 for strength properties of pine plywood material.

## **7. Structural Analysis**

The following pages present the load and stress calculations used to substantiate this installation.

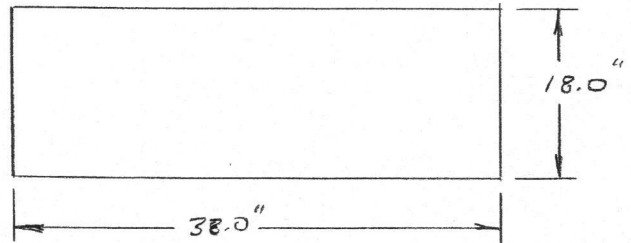
1/3

S-35 BONANZA (S/N 7333) - SUBSTITUTE CABIN FLOORBOARD ANALYSIS.

GILLFLOOR 4017T (.295" THK) SUBSTITUTED FOR .25" THK PINE PLYWOOD

1.0 FACE STRESSES

AFF SEAT FLOORBOARDS ARE LARGEST PIECE IN A/C, MEASURING APPROX 38" WIDEX 18" LONG ASSUME BOARD IS SIMPLY SUPPORTED ALL AROUND 2, 170# PAX STANDING ON FLOOR. A/C PULLING LILT LOAD  $\rightarrow 3.89 (1.5) = 5.79$  (Ultimate Load FAR 23.303)  
 $2 (170#) (5.79) = 1938#$  TOTAL



PER ROULKE (5th ED) P 386  $a = 38.0"$   
 $b = 18.0"$   
 $\frac{a}{b} = \frac{38}{18} = 2.111$   $\alpha = .1135$   $\beta = .6216$

1.1 PLYWOOD - TENSION SIDE OF FLOOR

$\sigma_{max} = \frac{P a^2}{c^2} = \frac{.6216 \left( \frac{2.83 \text{ PSI}}{[18.0][38.0]} \right) (1938#) (18.0^2)}{.25^2} = 9119 \text{ PSI}$   
 MARKS HBK 10th CB P 6-115 - WESTERN WHITE PINE  
 $M.S. = \frac{9700 \text{ PSI}}{9119 \text{ PSI}} - 1 = 7.06$

ENGR.	P. BLDUNT	4-18-0	REVISED	DATE	S-35 BONANZA A/C
CHECK					S/N 7333 - SUBSTITUTE
APR					CABIN FLOOR ANALYSIS
APR					[REDACTED]

## 1.2 PLYWOOD - COMPRESSION SIDE OF FLOOR

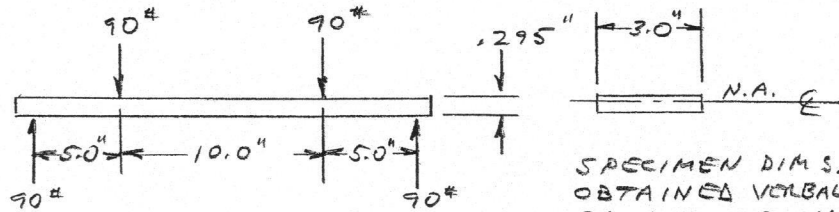
COMPRESSION SIDE ALSO @ -9119 PSI AT ULT LOAD.  
 ✓ ULT CRUSH STRENGTH OF PINE (MARKS)

$$MS = \frac{5040}{9119} - 1 = -.45 \text{ IF FLOOR WILL COLLAPSE}$$

$$AT \left( \frac{5040}{9119} \right) (5.79) = 3.159$$

## 1.3 GILL FLOOR

LONG BEAM BENDING MIN REQUIREMENT FOR  
 40177 GILLFLOOR = 180#. 20" x 3" x .295"  
 SPECIMEN TESTED IN 4-PT BENDING PER  
 ASTM C393



SPECIMEN DIMS.  
 OBTAINED VERBALLY  
 FROM GILLFLOOR  
 REP. ARE TYPICAL  
 FOR ASTM C393  
 TYPE TESTS

$$M_{max} = 90# (5.0") = 450 \text{ IN LB}$$

$$C = \frac{.295}{2} = .148"$$

$$I = \frac{bh^3}{12} = \frac{3.0 (.295")^3}{12} = .00629 \text{ IN}^4$$

$$\sigma = \frac{MC}{I} = \frac{450 (.148)}{.00629} = \pm 10552 \text{ PSI}$$

CAN'T TELL WHICH FACE WILL FAIL FIRST  
 FROM THIS, BUT PROBABLY THE UPPER (COMP.)  
 FACE SINCE THE TENSILE STRENGTH OF S-GLASS  
 IS APPROX 450,000 PSI.

ENGR.	P. BLOUNT	4-18-02	REVISED	DATE	S-35 BONANZA (CONT)
CHECK					
APR					
APR					

1.4 COMPARISON ↓ GILLFLOOR

$$MS = \frac{10552 \text{ PSI}}{5040 \text{ PSI}} - 1 = 1.09$$

↓  
PLYWOOD

∴ UPPER (COMP) FACE OF BOTH FLOOR MAT'L'S WILL PROBABLY FAIL FIRST, HOWEVER, GILLFLOOR WILL WITHSTAND  $\frac{10552}{5040} = 2.09$  X THE FACE STRESSES OF PLYWOOD.

1.5 GILLFLOOR FACE STRESSES @ 4LT LOAD.

$$10552 \text{ PSI} = \frac{.6216 (q)(18.0^2)}{.295^2} \quad q = 4.56 \text{ PSI}$$

$$MS = \frac{4.56 \text{ PSI}}{2.83 \text{ PSI}} - 1 = 1.61$$

(OR GILLFLOOR WILL WITHSTAND  $\frac{4.56}{2.83} (5.79)$ )  
= 9.18 g

**Fastener Loading**

The floor panels are well secured along the perimeter using the original factory fastener locations. This alteration uses a flush insert potted into the honeycomb panel. The insert head diameter is approximately 0.50" diameter which is greater than the original fastener head diameter used to install the plywood panel.

By inspection of the fastened joint design, the installation is of greater strength than the original panel installation.

M.S. = + HIGH-----

ENGR.	P BLOUNT	4-18-05	REVISED	DATE	S-35 BONANZA (CON.T)	
CHECK						
APR						
APR						



## 8 APPENDIX A



M.C. GILL CORPORATION

Product Data Sheet

HIGH-PERFORMANCE COMPOSITE PRODUCTS SINCE 1945

### Gillfloor™ 4017T Panel

March 2001

#### Description

Gillfloor 4017T is a light weight aircraft flooring panel made from unidirectional S-2 glass® reinforced epoxy facings bonded to aramid honeycomb core.

#### Applications

Type 1: Heavy traffic areas, such as aisles  
 Type 2: Light traffic areas, such as under seats.  
 Type 3: Heavy traffic areas; freighter aircraft - upper and lower deck.

#### Features

- Fatigue and corrosion resistant - proven service life.
- Very high impact facings.
- High strength-to-weight ratio.
- Service temperature range: to 180°F.

#### Specifications

- McDonnell Douglas specification BZZ 7002 Types 1 thru 3.
- Embraer MEP 15-031.
- BAe MAT 003.
- FAR 25.853a - fire resistance.

#### Construction

	Type 1	Type 2	Type 3
Adhesive:	Epoxy	Epoxy	Epoxy
Core:	9 pcf	5 pcf	9 pcf
Facings:	.015/.015	.015/.015	.030/.015

#### Availability

Thickness: .400".  
 Length: 144" (to 168" on special order).  
 Width: 36", 42", 48", 60", 72".



## Properties of Gillfab 4017T Typical Average Values

Property	Test Method	Unit	Type I	Type II	Type III
Weight	BZZ 7002	lb/sq ft (kg/sq m)	0.655 (3.20)	0.505 (2.47)	0.771 (3.76)
Thickness	BZZ 7002	inches (mm)	0.400 (10.2)	0.392 (10.0)	0.397 (10.1)
Sandwich Peel	AMS-STD 401	in-lb(N-m)/3 in width	60 (6.8)	42 (4.8)	57 (6.4)
Sandwich Peel, Humidity Aged	AMS-STD 401	in-lb (N-m)/3 in width	52 (5.9)	36 (4.1)	103 (11.6)
Long Beam Flexural Ultimate Load Facing Stress Deflection	AMS-STD 401	lbs (N) ksi (MPa) inches (mm)	271 (1,205) 39.1 (270) 0.768 (19.5)	247 (1,099) 32.7 (225) 0.815 (20.7)	612 (2,722) 38.8 (268) 0.436 (11.07)
Flatwise Compressive Strength	AMS-STD 401	lb/sq ft (kPa)	2,030 (13,996)	961 (6,626)	2,150 (14,824)
Insert Shear	BZZ 7002	lbs (N)	1,875 (8,340)	1,680 (7,473)	2,061 (9,168)
Impact Strength	BZZ 7002	in-lb (N-m)	>320 (36.2)	>320 (36.2)	138 (15.59)
Flatwise Tensile	BZZ 7002	lb/sq in (kPa)	1,781 (12,280)	1,509 (10,404)	N/R
In-Plane Shear	BZZ 7002	lb/in (kg/m)	415 (7,411)	385 (6,875)	631 (11,268)
Flammability - 60 Second Self-Extinguishing Time Burn Length Drip Time	FAR 25.853	seconds inches (mm) seconds	0 2.1 (53.0) 0	0 1.3 (33.0) 0	3.66 1.50 (38.1) 0
Flammability - 45 Degree, 30 Second Self-Extinguishing Time Afterglow Penetration	FAR 25.853	seconds seconds ---	0 0 None	0 0 None	0 0 None
Smoke Density Flaming	DMS 1500	D <sub>s</sub>	187	153	193

N/R = Not Required

M.C. Gill Corporation gives no warranties, expressed, implied or statutory, or otherwise, as to the description, quality, fitness, capacity, or any other matter, of the properties described. The data given represents minimum values to be expected. Through additional testing of each lot it is possible to verify that the product exceeds the tabulated values. It is recommended, however, that prospective users evaluate the materials to determine their suitability for the users' specific requirements. Values are given on the condition that the user assumes all risk and that responsibility for any loss or damage caused by or resulting from the use of such information is disclaimed by M.C. Gill Corporation.

M.C. Gill Corp.  
4056 Easy Street  
El Monte, CA 91731-1087 USA  
626-443-4022 info@mcgillcorp.com

M.C. Gill Europe Ltd. - Insoleq  
23 Enterprise Road, Balloo Industrial Estate South  
Bangor Co-Down BT19 7TA, Northern Ireland  
+44 (0) 2891 470073 sales@mcgillcorp.com

[www.mcgillcorp.com](http://www.mcgillcorp.com)

© M.C. Gill Corporation. All rights reserved.



# Report No: VA07070501



M.C. GILL CORPORATION  
 4056 Easy Street  
 El Monte, California 91731  
 Telephone: (626) 443-6094  
TEST REPORT

CUSTOMER : COMTEK ADVANCED  
 CUSTOMER NO : 203060  
 P.O. NO. : 12150  
 SPECIFICATION : COMPS-028 REV. H TYPE 5  
 PRODUCT CODE NO. : 4017T295x48x78BB-6

DATE : 02-07-03  
 QTY.PCS : 1308  
 SHIPPER NO. : CO-064153  
 LOT NO. : 03-064153/1  
 DESCRIPTION : 0.295x48x78

PROPERTY	REQUIREMENT	RESULT
Weight, PSF.	0.51 Maximum	0.50
Thickness, Inches	0.295 ± .010	0.297
Warpage	0.025 Maximum	0.000
LONG BEAM BENDING, DRY LOAD LB.	180 Minimum	184; 182; 183; 181; 181 avg= 182
Deflection @ 100 Lbs. Inch.	1.52" Maximum	1.43; 1.43; 1.46; 1.45; 1.47 avg= 1.45
Drum Peel, Dry In.-Lbs. / 3 In. Width BACK SIDE	30 Minimum	51; 54; 53; 58; 50 avg= 53
Flammability 45°Angle Test Self-extinguish time, sec. Penetration Glow Time, sec.	15 Maximum None 10 Maximum	0.0 None 0.0
FLAMMABILITY (60 Second Vertical) Self-extinguish Time, sec. Burn length, inch. Drip-extinguish Time, sec.	15 Maximum 8 Maximum 5 Maximum	1.7 2.2 0.0

We hereby certify that material shipped on the above shipment number conforms to all specification requirements called out or referenced on the above Purchase Order. Records for this material are on file and will be made available to the buyer or government upon request.

DOUG SMITH  
 (DSMITH@MCGILLCORP.COM)

M.C. GILL CORPORATION  
 Authorized Signature

QUALITY CONTROL DEPARTMENT

F704 - 2/99  
 C:\MSW4017T\COMPS-028 REV H TYPE 5.doc Printed 02/07/03

---

**Standard Tolerances**

---

Thickness:	± .010"
Length:	+0.5", -.062"
Width:	+0.5", -.062"
Warpage:	<.025"/ft. @ 0.4" thickness

---

**Alternative Gill Products**

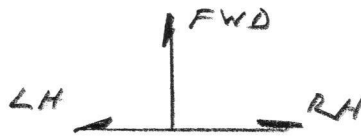
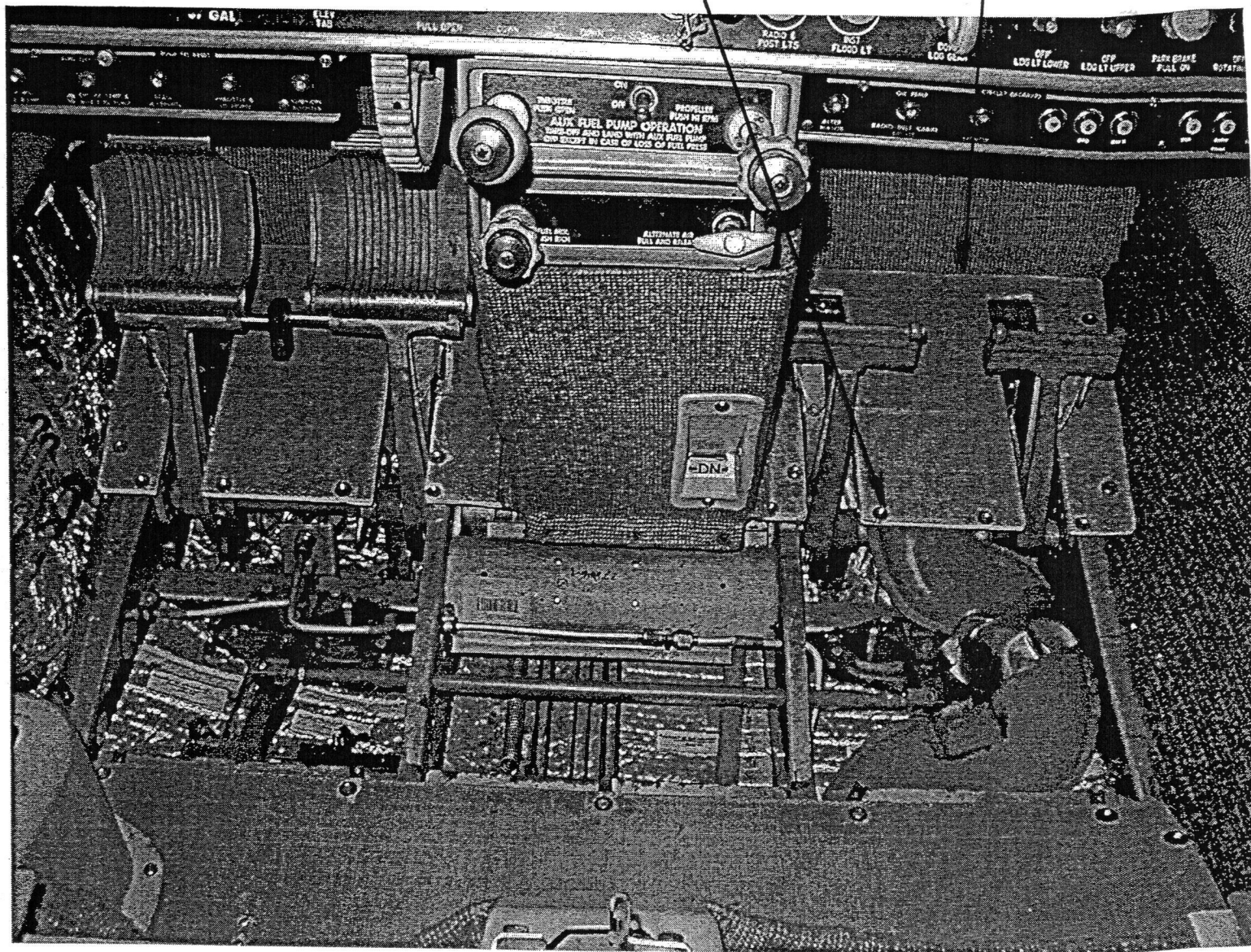
---

Product Number	Difference
Gillfab 4017L	Qualified to Lockheed LAC-C-28-1386. Total panel thickness is .375".
Gillfab 4017, Ty 1 and 2	Qualified to BAe MAT 003. Both types have .015"/.015" facings. Ty 1 has 9 pcf Nomex® core. Ty 2 has 5 pcf Nomex core. Note: The last three numbers of the drawing call-up indicate overall panel thickness, e.g., MAT 003-1-280 is .280" thick and MAT 003-2-655 is .655" thick.
Gillfab 4509	Unidirectional carbon, reinforced phenolic facings for reduced weight, lower smoke generation, and greater rigidity. Qualified to McDonnell Douglas Dwg. 7954400.



GILL FLOOR PANEL (GILL COMPOSITE AB 295X48X  
781/8 #, P/N 40177295X48X78BB-6, SHT #420494  
.295" THK) REPLACING PINE PLYWOOD PANEL - TYP  
ENTIRE FLOOR, FWD & AFT COCKPITS.

POTTED INSERT, P/N NAS1834-3K300  
POTTED INTO FLOOR PANELS W SCOTCH-HELP  
DP 100FR ADHESIVE - TYP



BEECH S-35 S/N 7333 - FWD COCKPIT FLOOR

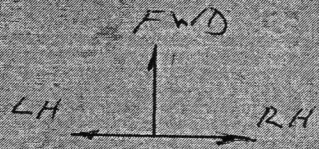
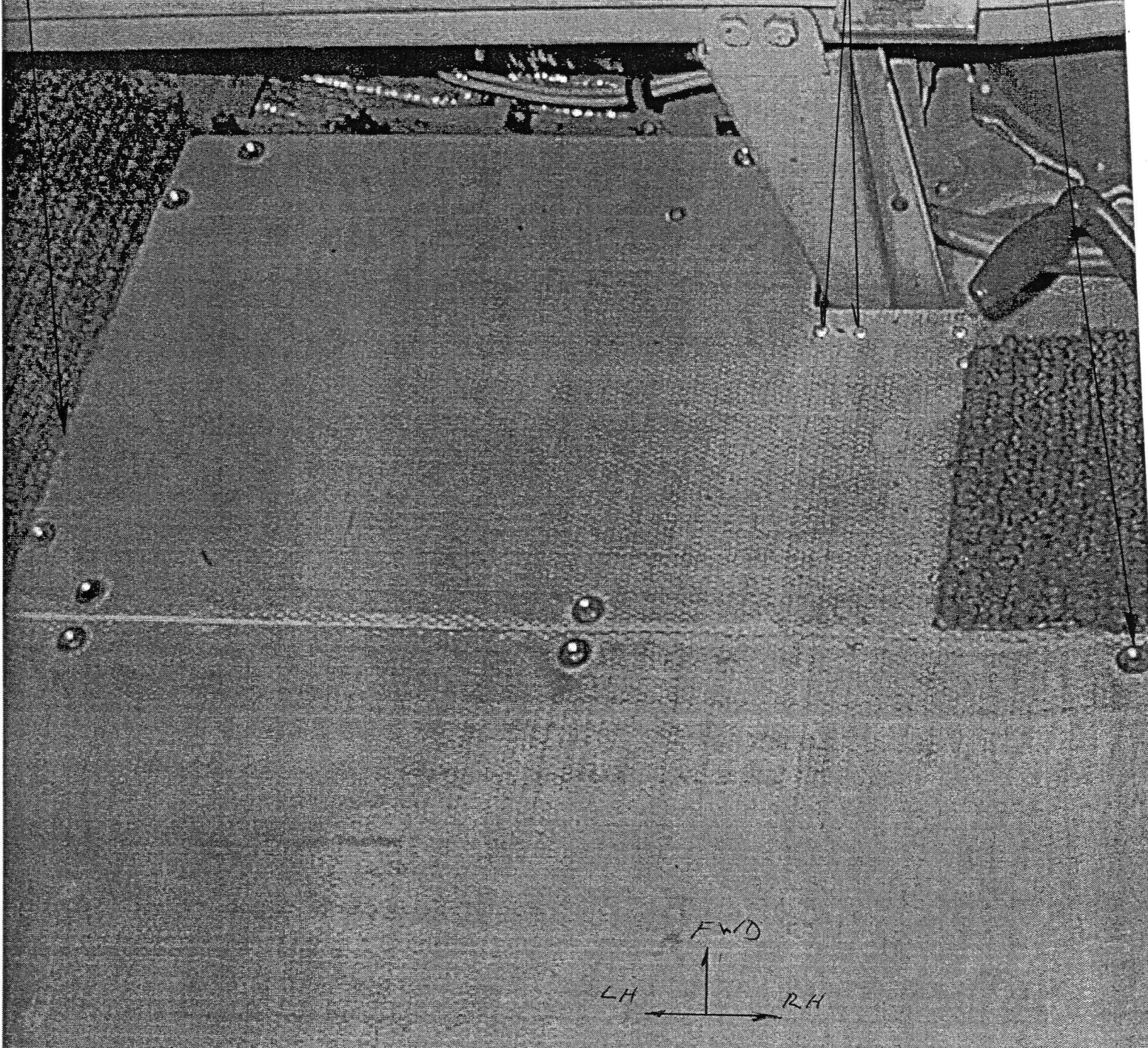
VA07070502 REV 1  
SHT 10FB 7/7/05

GILLFLOOR PANEL - REF

NAS 1834-3K300 INSERT - REF

ANNAS 470 RIVET HOLDING TINNEMAN

BLIND NUT (SECURES CARPET) TYP

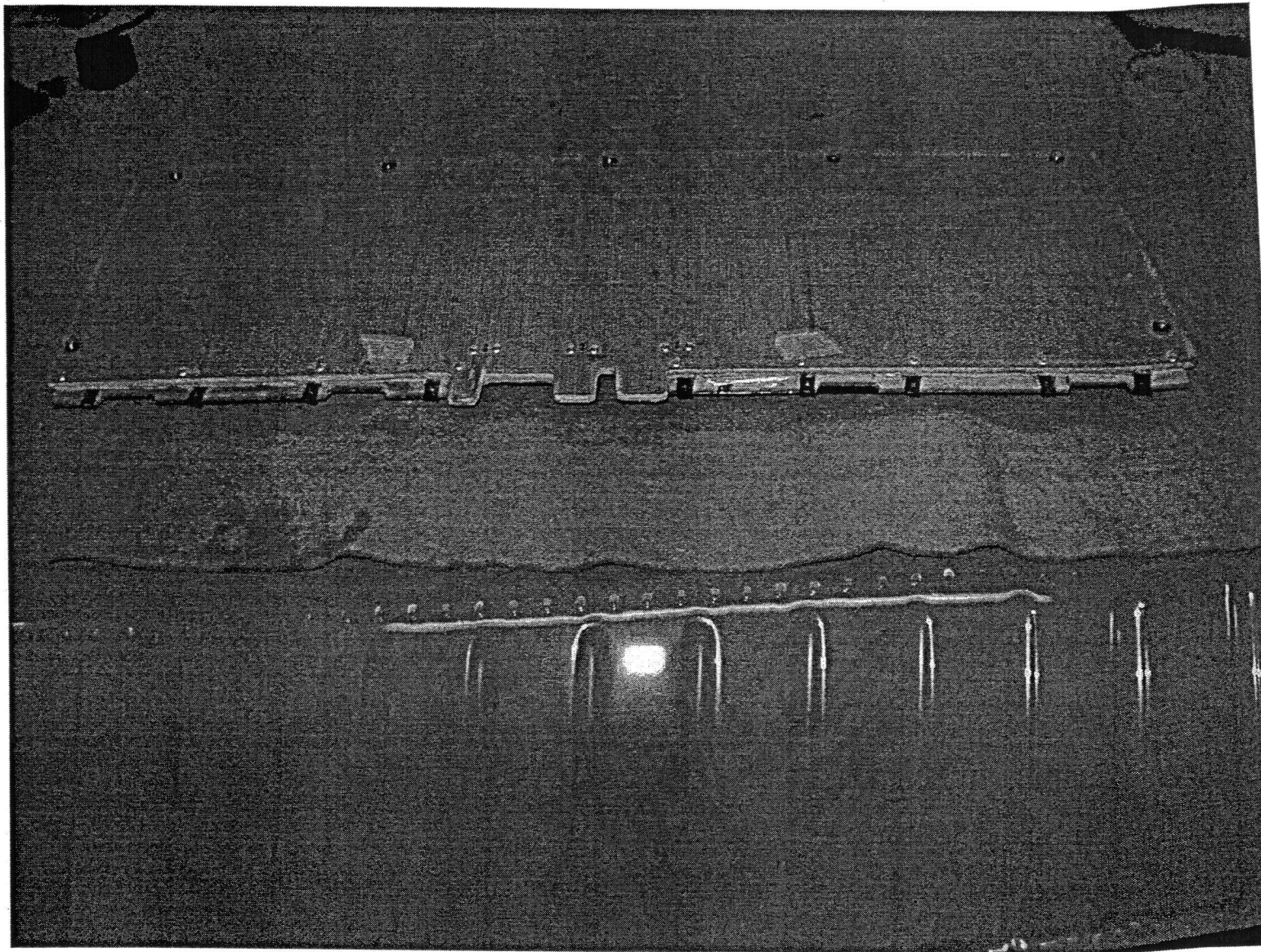


BEECH 5-35 S/N 7333 - AFT

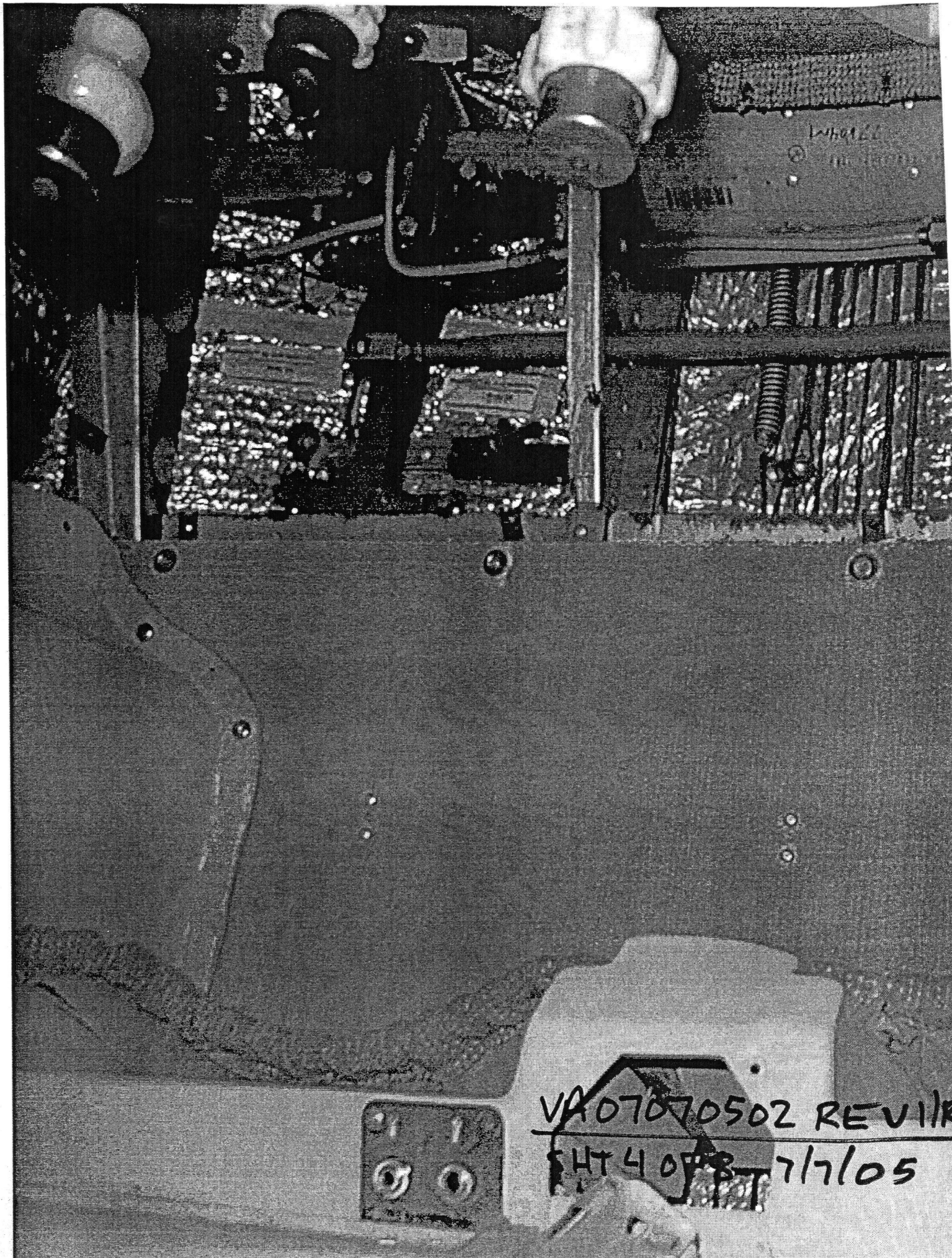
COCKPIT FLOOR

VA07070502 REV 11R

SHT 2 OF 8 7/7/05

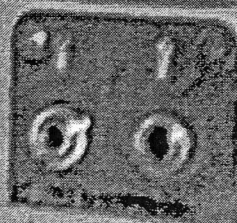


VA07070502 REV 11  
SHT 3 OF 8 7/7/05

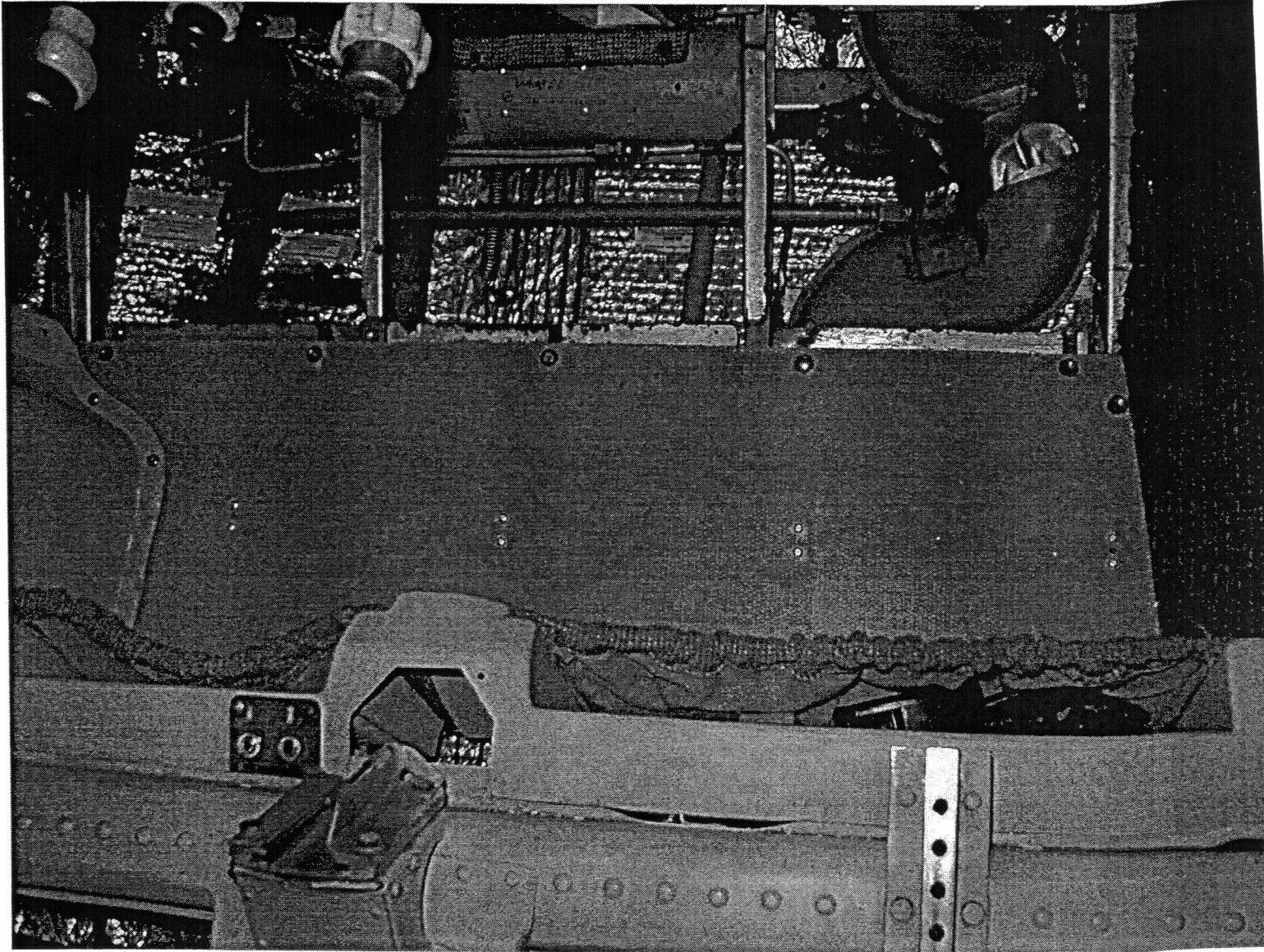


WHEEL

VA07070502 REV 1/R  
SHT 4078 7/7/05







VA07070502 REV 11R  
SHT 5 OF 8 7/7/05

VA07070502 REVI  
6 OF 8 7/105

37 GAL

ELEV  
TAB

FULL OPEN

DOWN

PUSH TO RESET

PROBING  
& SENSING

CRS HD TEMP &  
AUX FUEL PUMP

STALL  
WARNING

INBOTTLE &  
LD WORN

IGNITION  
BOOSTER

ENGINE  
FUEL OPEN  
AUX FUEL  
SHUT-OFF AND  
OFF EXCEPT IN C

FUEL MIX  
JSH RICH

VA07070502 REV 11

SH 70F8 7/7/05