

SPIKE-TOOTH FRACTURES

Areas of the airplane exhibiting "Spike-Tooth" fractures

<u>General Area</u>	<u>Description of Specific Area</u>	<u>Directionality</u>
<u>Front Spar -</u>		
	A. RBL 5 about 20.5" from top of Web	FWD: OUTBD
	B. RBL 6.8 about 35" from top of Web	FWD: slightly UP
	C. RBL 30.99 about 32.25" from top of Web	FWD
	D. RBL 37.99 about 38.3" from top of web	FWD: OUTBD
<u>Spanwise Beam #3 -</u>		
	1. Z-Stiffener Web flange 4" from far right of Web	UP & OUTBD
	2. 5" OUTBD of RBL 106, 22" below top of Web	AFT: INBD
	3. 4" OUTBD of RBL 91, 18" up from bottom of Web	AFT
REMOVED; TAKEN TO NTSB LAB 1/24/97 J. TRZIL	→ 4. 5" INBD of RBL 91, 41" up from bottom of Web	AFT
	5. 2" OUTBD of RBL 106, 14" below top of web	FWD
	6. 3" INBD of far right end of Web, 56" below top of Web	FWD
	7. 5" OUTBD of RBL 83.24, 29" up from bottom of web	FWD
	8. 2" INBD of RBL 91, 19" up from bottom of Web	AFT
<u>Spanwise Beam #2 -</u>		
	1. 3" INBD of RBL 75.9, 39" up from bottom of Web	AFT FWD/UP
	2. 5" OUTBD of RBL 98.58, 8"-12" up from bottom of Web	AFT FWD
REMOVED; TAKEN TO NTSB LAB 1/24/97 J. TRZIL	→ 3. 6" OUTBD of RBL 25.2, 6" up from bottom of Web	AFT ?
	4. Just OUTBD of LBL 11.31, 27.5" below upper Chord	FWD OUTBD/FWD
	5. 2.3" INBD of RBL 25.2, 13-14" up from bottom of Web (This one is detailed in NTSB Report # 96-141)	AFT
<u>Spanwise Beam #1 -</u>		
	• 8" INBD of RBL 75.93, 20" up from bottom of Web	EDS AFT AFT/OUT
<u>BLO Rib</u>		
	• 42" below top of Web & 18" from FWD edge	LEFT FWD OUTBD
<u>Rear Spar</u>		
	• LBL 16, 8" up from bottom of Web	FWD
<u>WCS Lower Panel</u>		
	• Between RBL 39-41, between S-9 & Midspar (upper surface of lower skin contains spikes)	UP
JFW II 1/24/97	• Intercostal at RBL 57.51 at approx. BS 1120 (between SWB #2 and Midspar)	?

"Spike-Tooth" Fractures Continued...

<u>General Area</u>	<u>Description of Specific Area</u>	<u>Directionality</u>
<u>Fuselage</u>		
• RF110	- AFT of Sta. 1720 between S-27R and 28R.	OUTBD to INBD penetration
• LF83	- Just AFT of Sta. 1860 between S-31L & S-32L.	INBD to OUTBD puncture
• LF82B	- Adjacent to Sta. 1620 at S-39L	INBD tear
• LF28C	- Just AFT of Sta. 2100 between S-27L & S-28L	INBD to OUTBD Slice/penetration

Misc.

REMOVED;
TAKEN TO
NTSB LAB
1/24/97

Left Landing Light Surround -

LARGER SIZE 19" (APPROX.)
SURROUND VS 16" (APPROX.)
INDICATES INBD. J. JRZIL
1/24/97

INBD or OUTBD?

CONFIRMED
JTRZIL
1/24/97

JFWII
1/24/97

JFWII
1/24/97

JR Straus 11/22/96
Lt 12/12/96

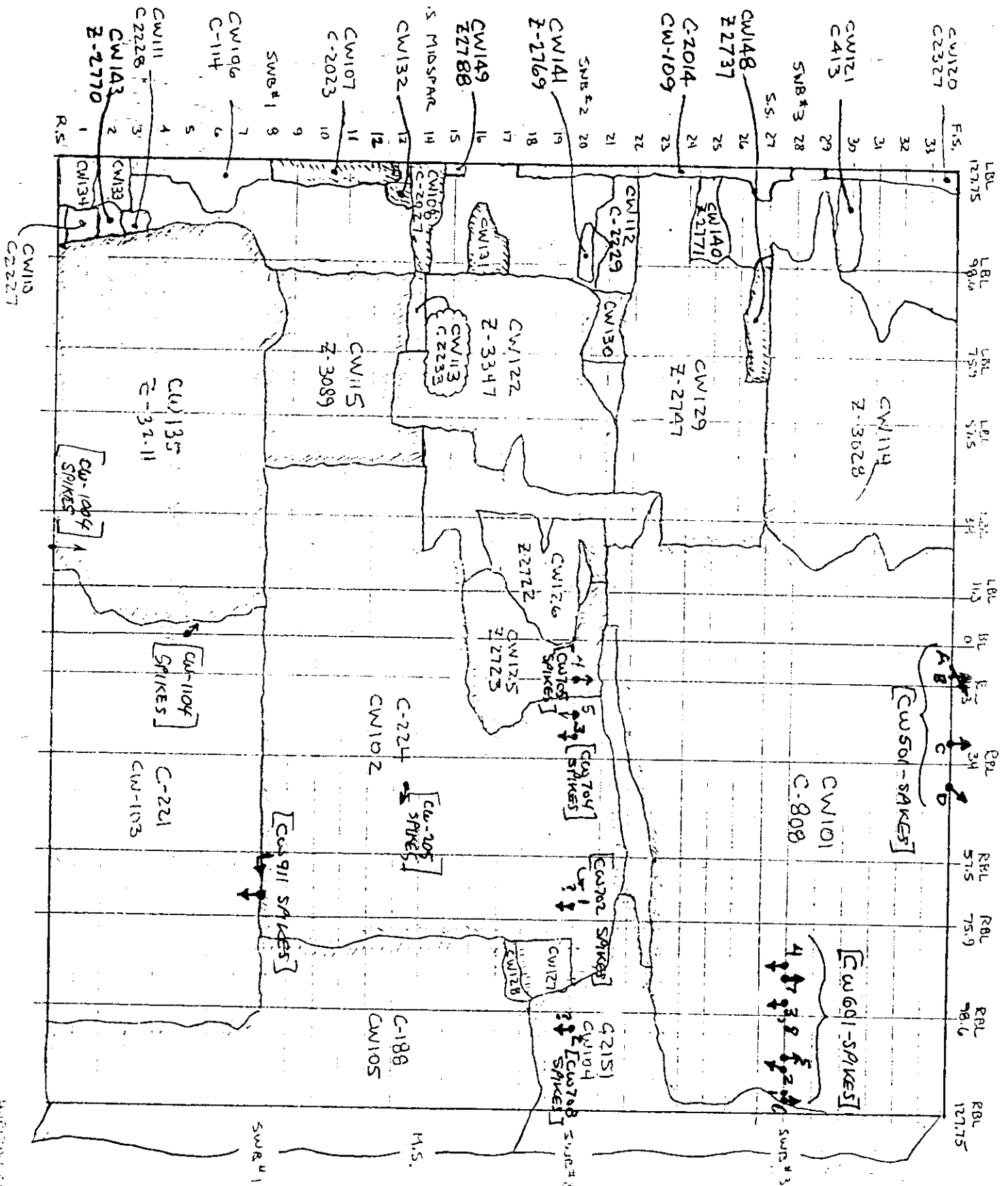
MIDSPAIR

• BETWEEN RBL 34 + 57
CW205

• RF 116 - FWD OF STA 1720 BETWEEN S-30R AND S-31R

OUTBD TO INBD.
PENETRATION

G. FLEIS 2/16/97



UPPER WING-CENTER SECTION

SEE PLAN

W. Street 10/26/96 J. TRILL

1/24/97

SUMMARY VIEW DOWN ON LOCATION OF SPIKES IN CWT

1/24/97

CW-102

10/26/96

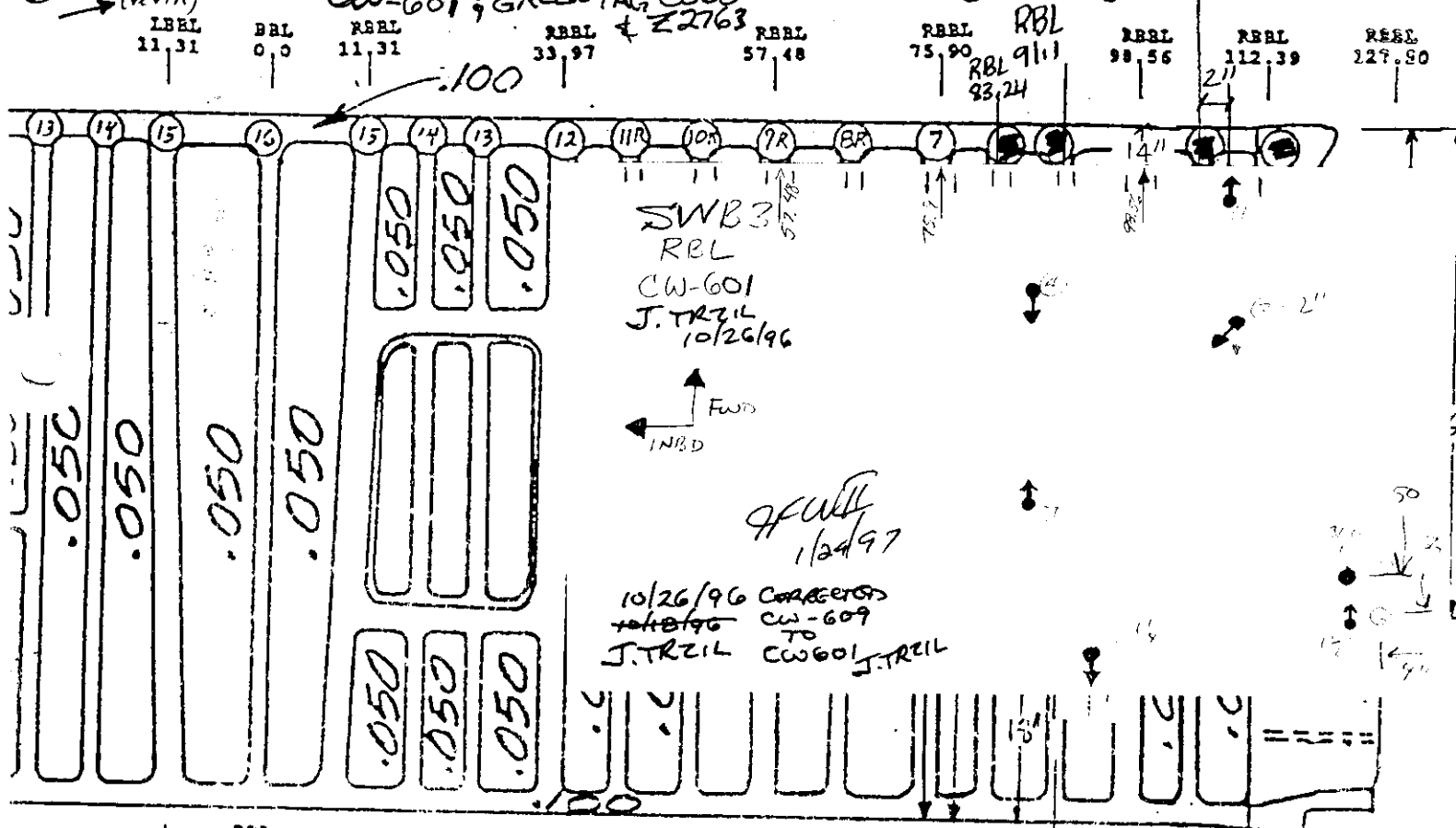
1/24/97

Spike-Tooth Fractures

Spanwise Beam # 3

CW 601
GREEN TAG C868

- ① On Z-Stiffener web flange 4" from Far right end of Web - Structure curled UP 22" below top of Web, and 5" OUTBD of RBL 106.2 Rivet Center Line - fracture curled AFT and INBD - 1.1" long and 1.5" wide
- ② 13" UP from bottom of web, 4" OUTBD of RBL 91.1 Rivet Center Line - Structure bent AFT 0.2" long
- ③ 41" UP from bottom of web, 5" INBD of RBL 91.1 Rivet Center Line - Structure curled AFT 2.0" long
- ④ 14" below top of web and 2" OUTBD of RBL 106.2 Rivet Center Line - Structure curled AFT 0.75" long
- ⑤ 3" INBD of Far right end of web and 56" from top of web - Structure not bent at all 0.5" long
- ⑥ 22" UP from bottom of web and 5" OUTBD of RBL 83.24 - Fracture curled FWD 1.1" long



GENERAL OBSERVATIONS [REFER TO FIRE & EXPLOSION GROUP NOTES]

- SPIKE AREAS
- GENERALLY CLEAN • FREE OF SOOT
- GENERALLY ASSOCIATED WITH TEARING AND CURLING ENDING IN SPIKED AREA
- OFTEN EVIDENCE OF RUB POSSIBLY METAL-TO-METAL TRANSFER

JR Straus 10/3/96
Rev A 10/6/96

PLAM NO 3

JOHN TRZIL
10/19/96
CORRECTED CW 609 TO CW 601
10/26/96 J. TRZIL

SPANWISE BEAM NO. 3
WEB DRW 65810277-3
DOOR DRW 65810778-1

UH 12/2/94

96A8001a

④

spiketooth fracture on SWB #3, RHS



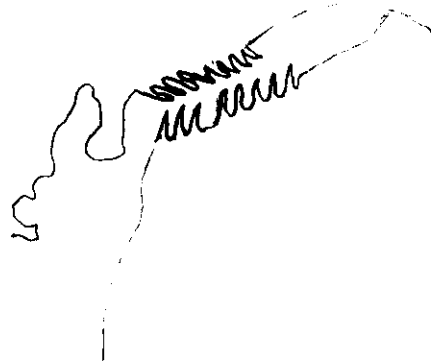
CW601
Tag C-868
10/21/96
cmshanson
AGREE/CONF/RMSO
J. TRILL
10/26/96

verified 12/12/04
44

Examples of "Spike-tooth" Fractures observed -

REFER TO FIRE & EXPLOSIONS
GROUP NOTES REGARDING
SPIKES

SWB # 2 - point ③

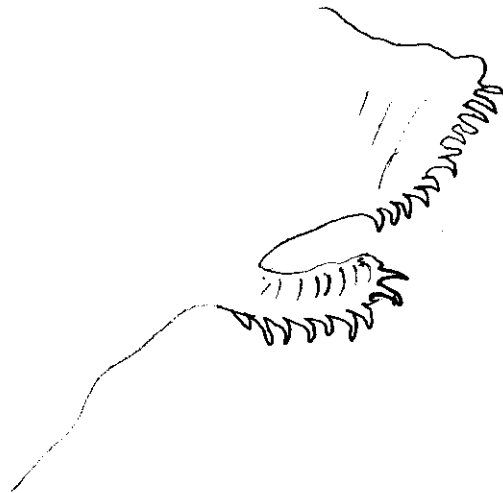


CW 704
YELLOW TAG

CORRECTED
10/26/96
J. TRZIL

verified 2H 12/2/96

SWB # 3 - point ④



⁶⁰¹
CW ~~609~~ ^{cmthompson}
GREEN TAG 10/21 AGREE/
CONFIRMED
C868 J. TRZIL
10/26/96

UH 12/2/96

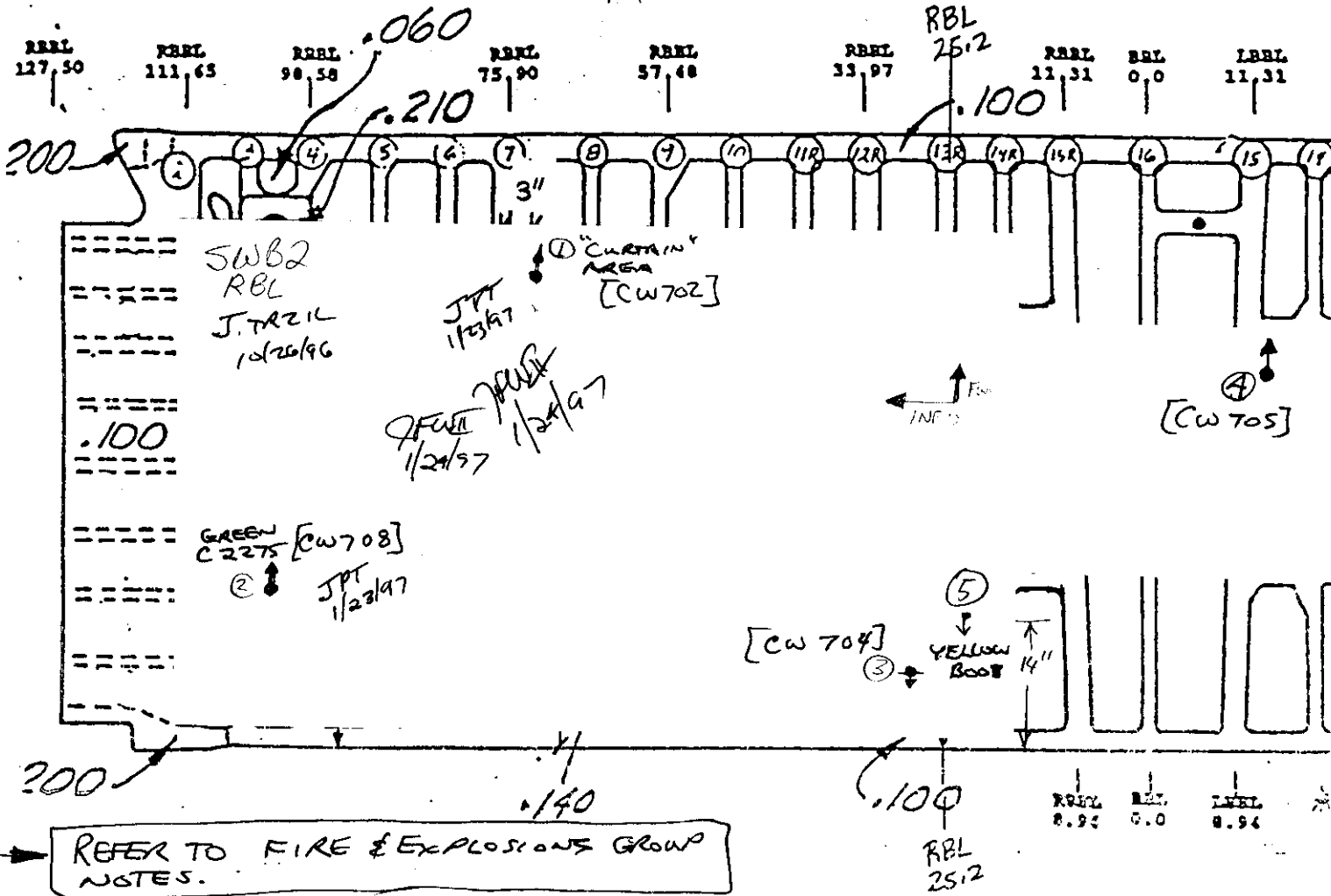
GCWII
1/24/97

Spike-Tooth Fractures

LII 12/12/96

Spanwise Beam #2

JFW 1/23/97



CW-702 3" INBD of RBL 75.9 Rivet Center Line, 38.5" UP from bottom of web. If web were flat, fracture would be oriented in ~~AFT~~ ^{FWD} direction, (1" long).

CW702 "CURTAIN" AREA [FBI TAG (WHITE) 827-8 8/27/96]

between 8-12" C. Thompson 10/1/16

CW-708 5" OUTBD of RBL 98.58 Rivet Center Line, 15.4" UP from bottom of web

Fracture 0.3" long, bent ~~AFT~~ ^{FWD}. [GREEN TAG C2275] CW708

CW-705 ④ JUST O'BD OF LBL 11.31 AND APPROX 27.5 IN. BELOW UPR CHORD AND AT TOP OF STRAP SPIKES 1 3/4 - 2 IN. LONG. SPIKES ORIENTED FORWARDED. [GREEN TAG C2170 SWB2] CW705

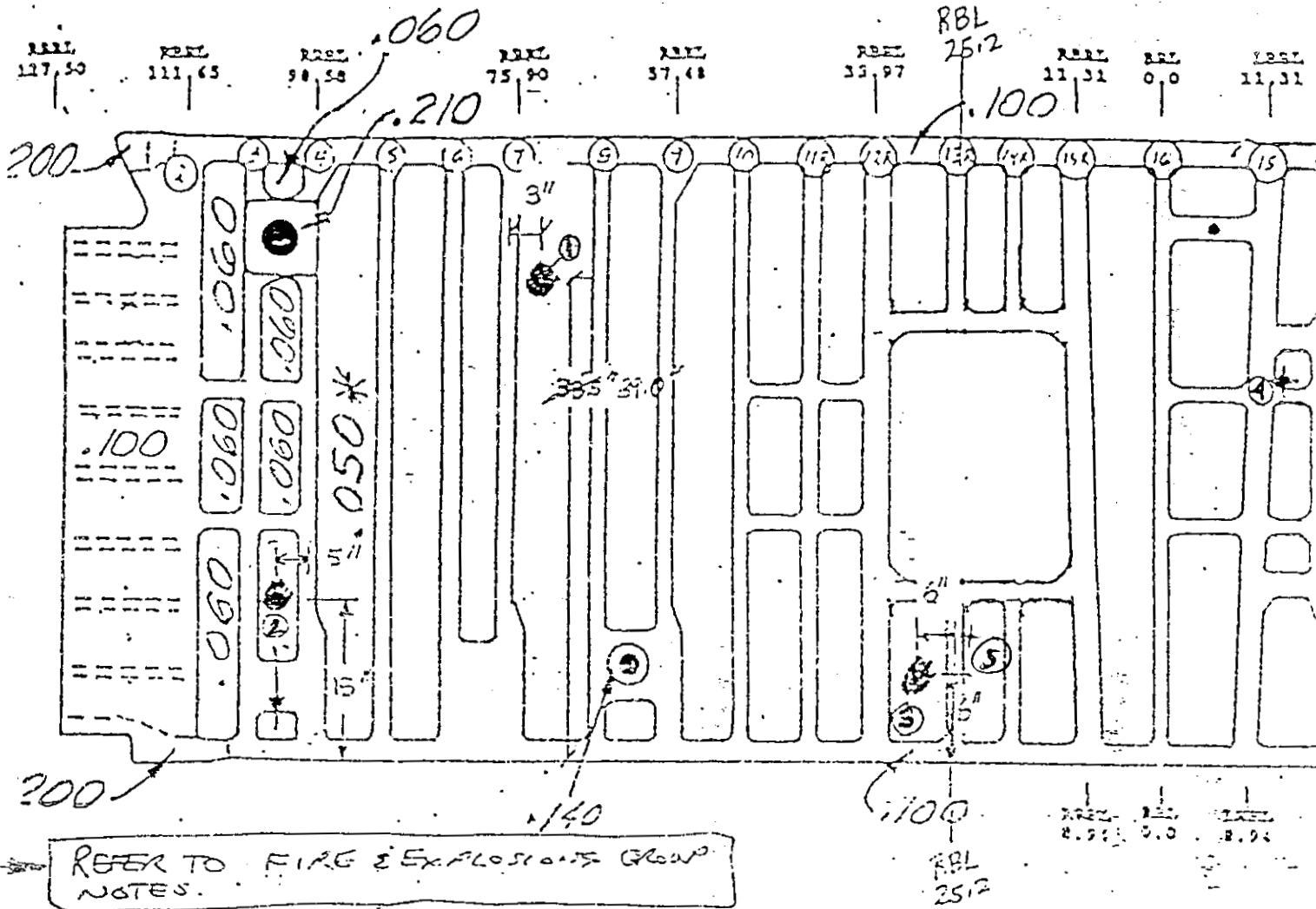
CW-704 ④ 6" UP from bottom of web, 6" OUTBD of RBL 25.2. [YELLOW TAG 8003] CW704

Fracture 0.7" long, no bending at fracture site but web is bent AFT. JR Strauss 10/3/96

SUMMARY OF LOCATIONS OF
Spike-Tooth Fractures IN

- ① CW 702
- ③ CW 704
- ④ CW 705
- ② CW 708

Spanwise Beam #2



REFER TO FIRE & EXPLOSIONS GROUP NOTES.

YELLOW TAG B003
CW-704

⑤ 13"-14" UP FROM BOTTOM OF WEB, 2" AND 3" INBD OF RBL 25.2
FRACTURES 1-3" LONG, CURLING AFT
THIS AREA IS DETAILED IN NTSB METALLURGIST'S FACTUAL REPORT # 96-141
G-FLEIS 10/30/96

JFW/f
1/24/97

LH 12/12/94
JFW II
1/23/97

CW - 702
8/19/96
J. TRZIL

39.0"

- ① 3" INBD of RBL 75.9 Rivet Center Line, 3875" UP from bottom of web.
If web were flat, fracture would be oriented in ~~AT~~ direction, (1" long)
FWD

"CURTAIN" AREA
[FBI TAG (WHITE)
827-8
8/27/96]

JFW II
1/23/97

LH 12/12/94

CW - 708
8/19/96
J. TRZIL

between 8-12" ^{extension}
10/16

- ② 5" OUTBD of RBL 94.58 Rivet Center Line, 754" UP from bottom of web.
Fracture 0.3" long, bent ~~AT~~ FWD

[GREEN TAG C2275]

JFW II
1/23/97

LH 12/12/94

CW - 704
8/19/96
J. TRZIL

- ③ 6" UP from bottom of web, 6" OUTBD of RBL 25.2. [YELLOW TAG B003]
Fracture 0.7" long, no bending at fracture site but web is bent. ~~AT~~ FWD
JRStrauss 10/3/96

JFW II
1/23/97

LH 12/12/94

CW - 705
8/19/96
J. TRZIL

- ④ JUST O'BD OF LBL 11.31 AND APPROX 27.5 IN. BELOW UPR CHGRD AND 19/19/96
AT TOP OF STRAP SPIKES 1 3/4 - 2 IN. LONG.
SPIKES ORIENTED FORWARD.
[GREEN TAG C2170 SWBZ]

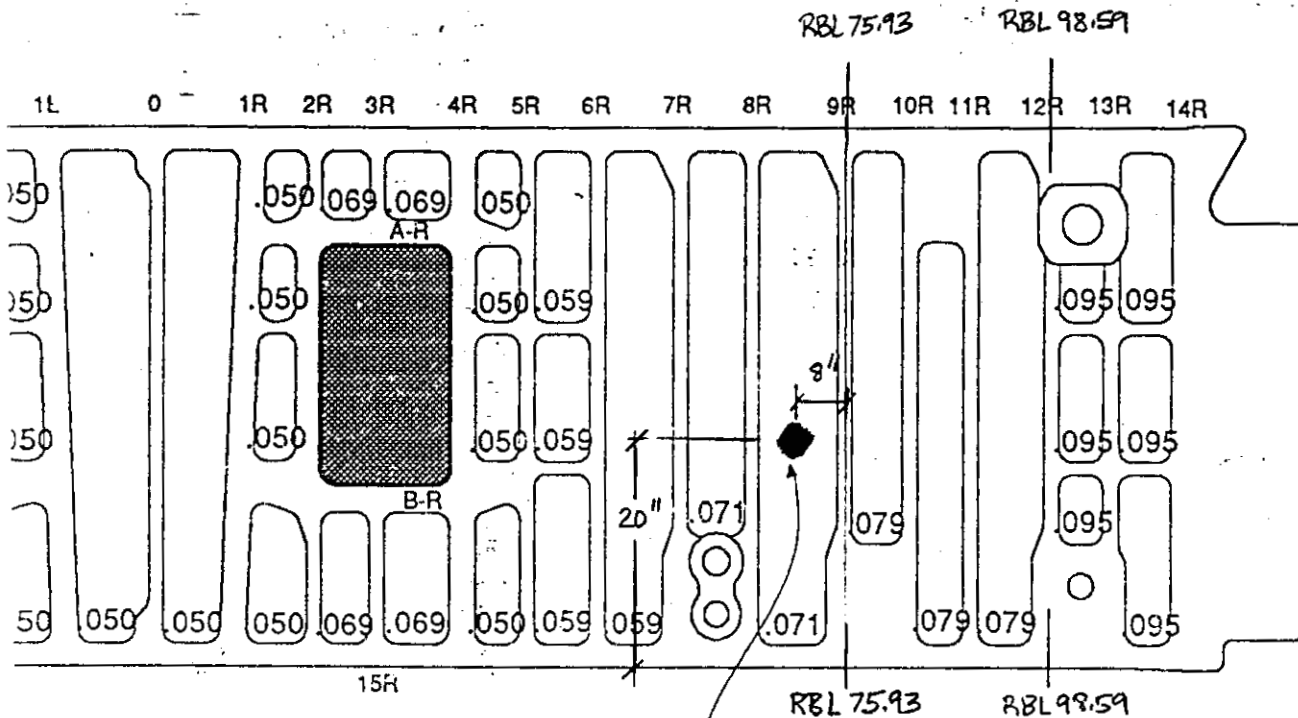
Spike-Tooth Fractures

CW-911

Spanwise Beam #1

ISE BEAM #1 ASSEMBLY STL / 65B01108-2 ASSY

REFER TO FIRE & EXPLOSIONS GROUP NOTES.



20" up from Web Bottom, 9" W.D of RBL 75.93
Fracture 3 1/2" Long, Curled AFT

CW-911

OFFILE	STIFF NO.	RBBL	PART. NO	PAD "T"	PAD "W"	EXTRUSION	MATL	PROFILE
ANGLE	1R	8.94 - 11.34	65B10770-2	.125	2.83	BAC1518-446	7178-T6511	"I" ANGLE
ANGLE	2R	17.27	65B10768-2	.125	1.62	BAC1518-446	7178-T6511	"I" ANGLE
ANGLE	3R	25.26	69B10952-2	.125	1.55	AND10137-1606	7075-T6511	"L" ANGLE
ANGLE	4R	34.00	65B10771-2	.125	2.83	BAC1518-446	7178-T6511	"I" ANGLE
ANGLE	5R	41.77	65B10766-2	.125	1.63	BAC1506-2369	7178-T6511	"J" ANGLE
ANGLE	6R	49.60	65B10766-2	.125	1.63	BAC1506-2369	7178-T6511	"J" ANGLE
ANGLE	7R	57.51	65B10769-4	.125	1.62	BAC1518-446	7178-T6511	"I" ANGLE
ANGLE	8R	66.65	65B10766-2	.125	1.63	BAC1506-2369	7178-T6511	"J" ANGLE
ANGLE	9R	75.93	65B10769-2	.125	1.65	BAC1518-446	7178-T6511	"I" ANGLE
ANGLE	10R	83.24	65B10766-1	.125	1.68	BAC1506-2369	7178-T6511	"J" ANGLE
ANGLE	11R	91.14	65B10766-2	.125	1.68	BAC1506-2369	7178-T6511	"J" ANGLE
ANGLE	12R	98.59	65B10769-2	.125	1.67	BAC1518-446	7178-T6511	"I" ANGLE
ANGLE	13R	106.20	65B10766-2	.125	1.68	BAC1506-2369	7178-T6511	"J" ANGLE
ANGLE	14R	112.39	65B10767-2	.125		BAC1506-2369	7178-T6511	"J" ANGLE
ANGLE	15R	25.26	69B10952-2	.125	1.55	AND10137-1606	7075-T6511	"L" ANGLE
ANGLE	A-R	HORIZ	65B10813-8	.125	2.74	AND10136-2408	7178-T6511	"I" ANGLE
ANGLE	B-R	HORIZ	65B10813-6	.125	2.78	AND10136-2408	7178-T6511	"I" ANGLE
ANGLE								

JCW II
11/24/97

JR Strau 10/3/96

REFER TO FIRE & EXPANSION GROUP NOTES REGARDING SPIKES

BLO RIB, WING CENTER SECTION - SWB #1 -> R.S.

A. REIMER
10/5/96
10/7/96

2 PIECES

LARGE RADIUS ~ BOWED LEFT 5" AT CENTER

SWB #1

R.S.

SKIN PART OF SHEAR TIE FRACTURED - EXCEPT FWD ONE.

CW-1103
Z-2749 GREEN

LH SIDE ~ SEE SKETCH
RH. ~ MEDIUM SOOT

LH SIDE LIGHT SOOT

MEDIUM SOOT LH SIDE

BENT RIGHT 90°

BENT LEFT 45°

2X6 PIECE MISSING

CHORD & WEB TWISTED/BENT RIGHT 90°

BENT LEFT 15°

LH SIDE VIEW (LOOKING RIGHT)

TAB BENT LEFT 30°

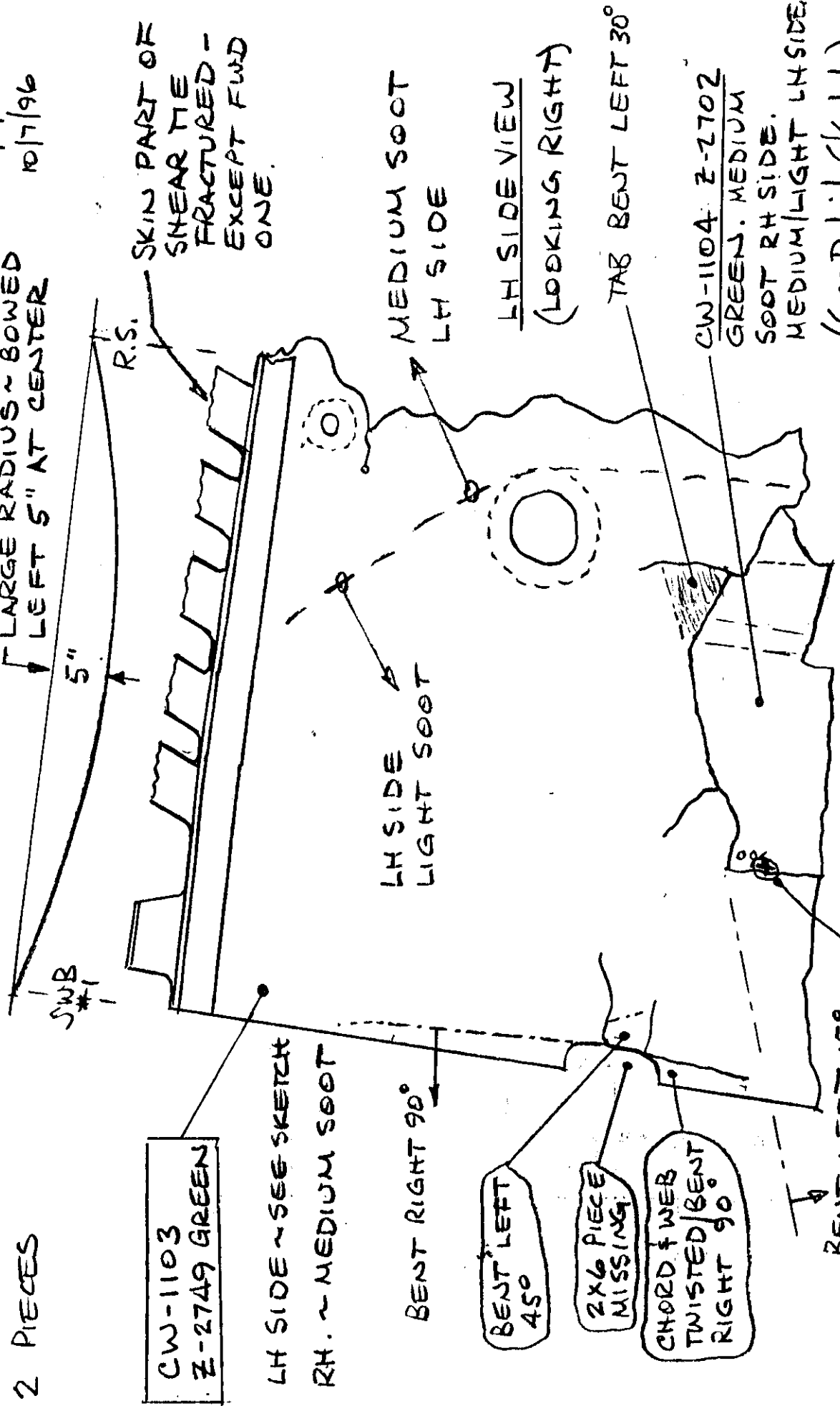
CW-1104 Z-2702 GREEN. MEDIUM SOOT RH SIDE. MEDIUM/LIGHT LH SIDE

(See Detail Sketch)

Spike-tooth fracture located 42" below top of web and 18" from the fwd edge, 0.5" long curled left.

JWT
12/2/97

C. Thompson
10/16/96



CW-1104, Z-2702
Green Debris Zone

REFER TO FIRE EXPLOSIONS
GROUP NOTES REGARDING SPIKES

BLO Rib, WCS,
SWB#1 to R.S.

69812932 bracket

"Medium Seaming" on Web
between stiffeners

Punctures in Web
- Same Spacing as rivets (1.5")

1.5"

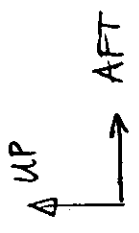
"Spike-Tooth"
Fracture -
Piece Curled
forward

IN PICTURE/
SKETCH, SPIKES CURVED
TO LEFT
RELATIVE TO
AFT
J. R. STRAUSS
10/15/96

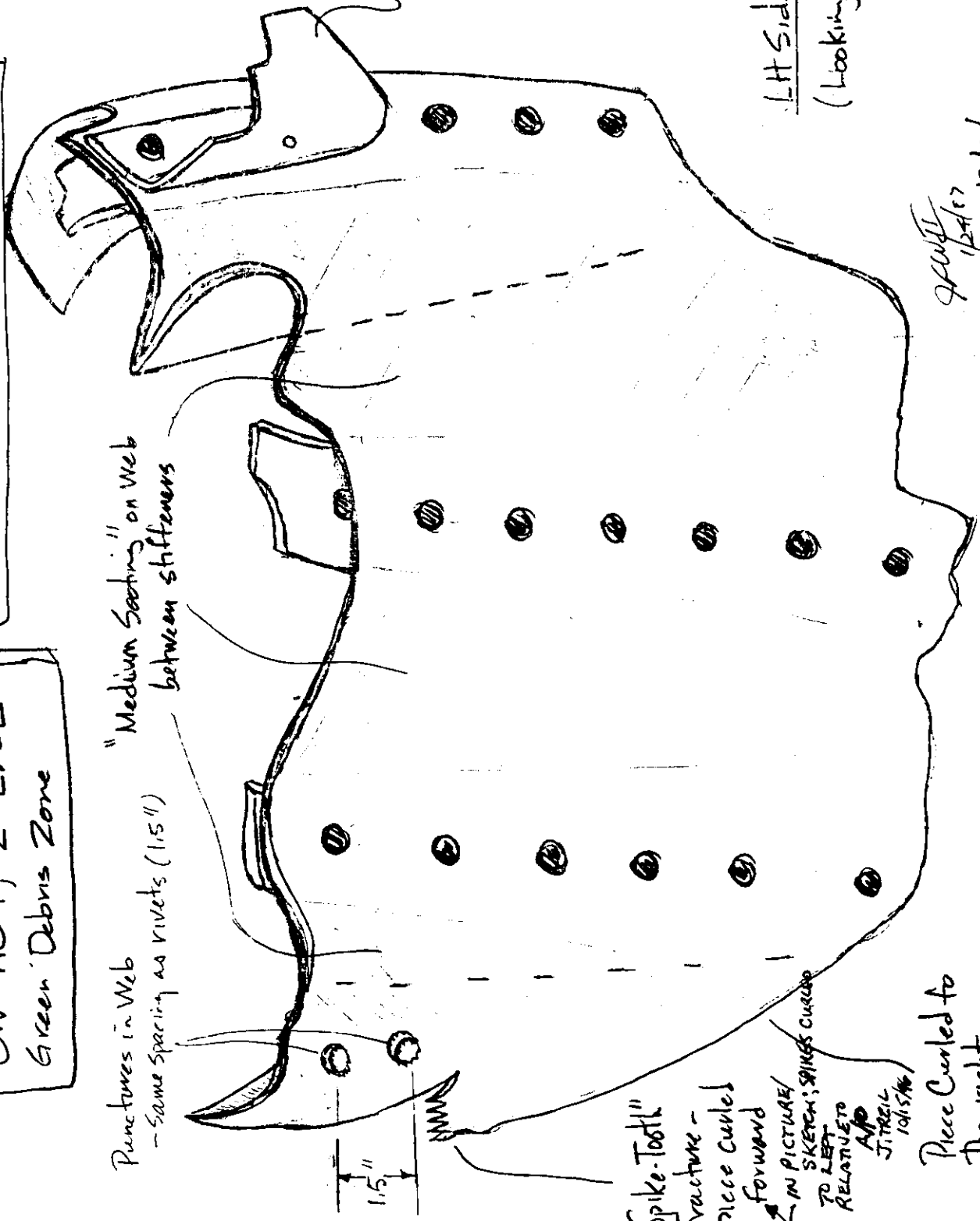
Piece Curled to
the right

L.H. Side View

(Looking Right and Slightly Down)



9/20/96
12/1/97
J.R. Strauss
10/18/96

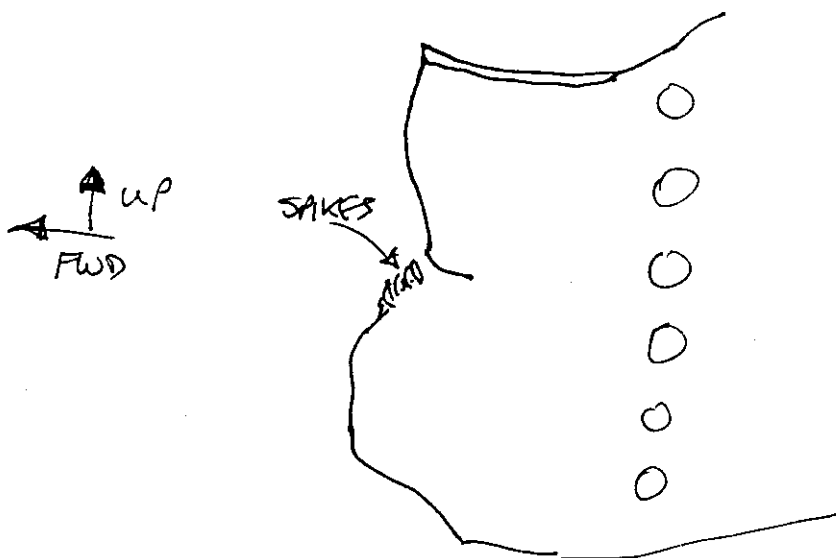


1048-96
J. TRZIL

CWT BLD CHORD R.S. TO SPWB1
GREEN TAG Z 2702 ; CW1104

FWD EDGE CURLED LEFT & UP
SPIKES COVER ABOUT $\frac{1}{2}$ IN. LENGTH

9FW II
1/24/97



CW612

22763

Green Field

Page 1 of 2

REFER TO FIRE & EXPLOSIONS GROUP NOTES REGARDING SPIKET.

Spanwise Beam #3, RBL 83,24

Skin bent FWD along dash line

12"

Web Curled AFT Above this line

31"

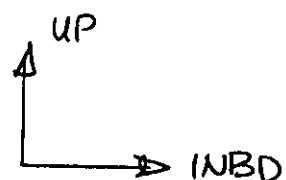
The web stiffener in this area DOWN is bowed FWD

Primer "Heat" discolored in web - No discoloration in web at stiffener location

"Spike-Tooth" Fracture in Curl Curled AFT

Web Curled AFT

Bottom of stiffener Twisted INBD

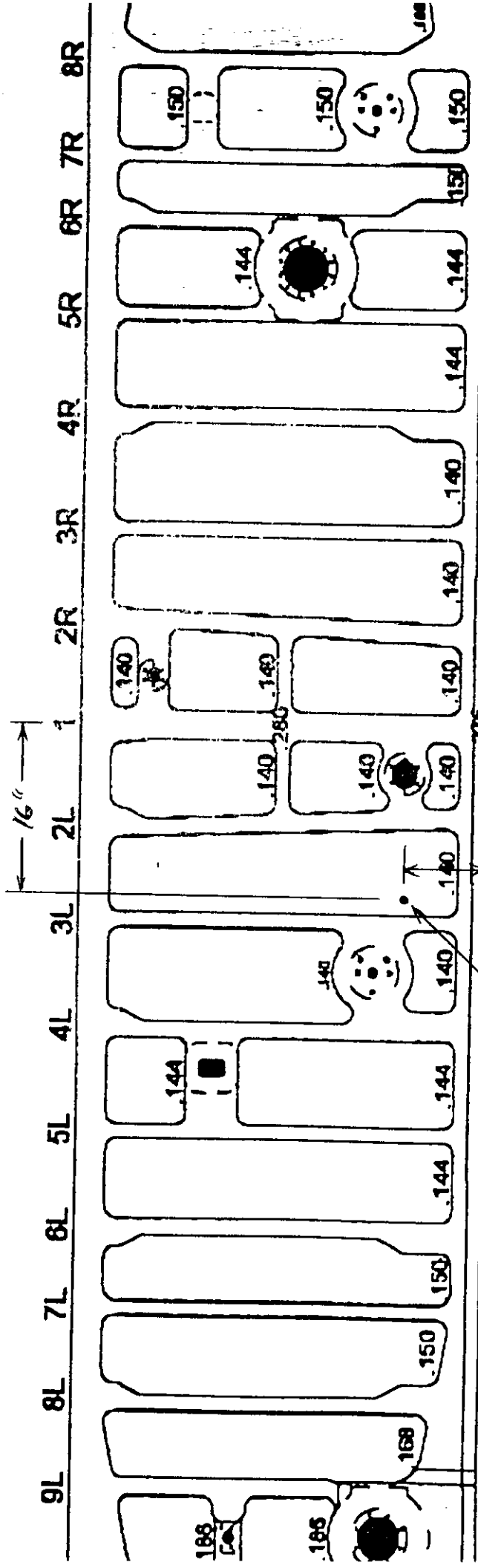


JR Straus 10/6/96

RBL 83.24 (Attaches to CW601)

View Looking AFT

747-100 REAR SPAR ASSEMBLY 65B01102-1 INSTL / 65B01102-2 ASSY



REAR SPAR SAIKE-TOOTH FRACTURE

CW-1004 - FRACTURE IS APPROXIMATELY 1" LONG AND CURLS FWD. LOCATION IS LBL 16, 8" UP FROM BOTTOM OF WEBB

G. FLERS
10/30/96
JFW/II
1/24/97

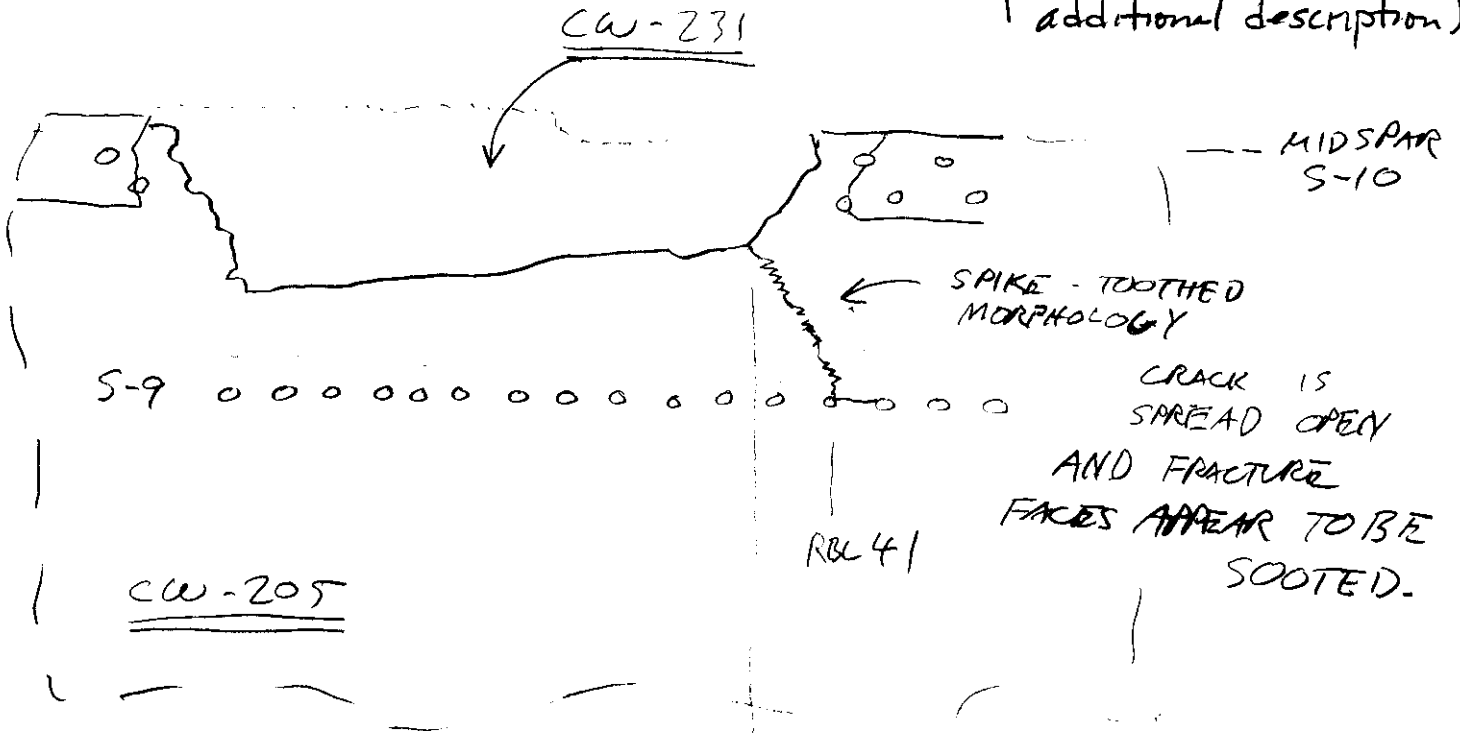
SPIKE-TOOTH FRACTURE IN
LOWER CENTER WING SKIN

LH 12/12/90

G. FLEIS

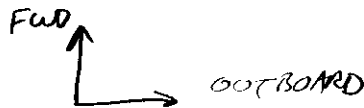
10/28/90

(See backside for
additional description)



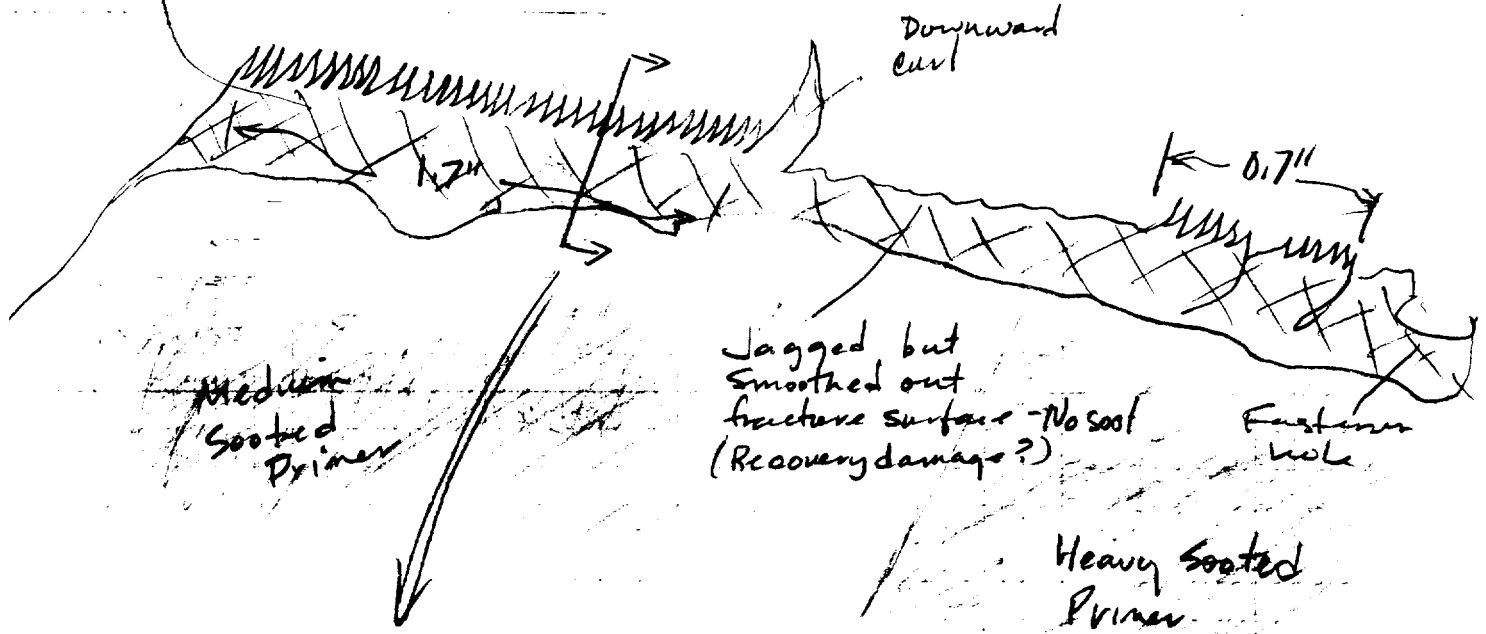
2FWII
1/29/97

VIEW LOOKING DOWN

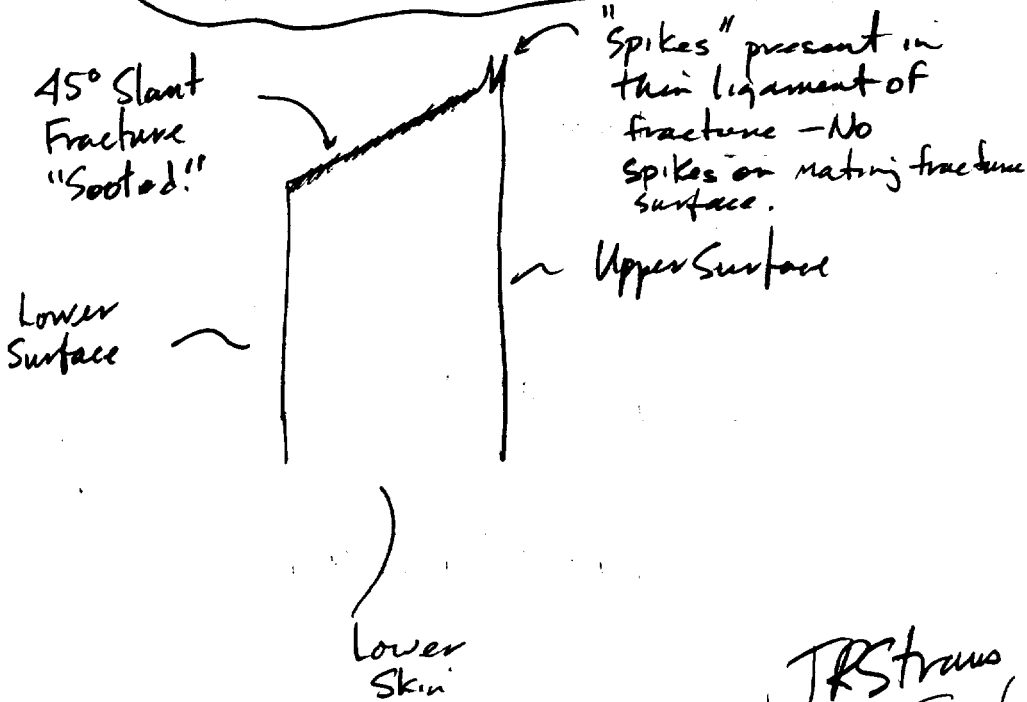


No primer heavily abraded off some sootings

View Looking Down on Upper Surface of Lower Wing Skin



Typical Cross Section through Spike-Tooth Profile



JR Strauss 11/13/96
JFW 1/24/97

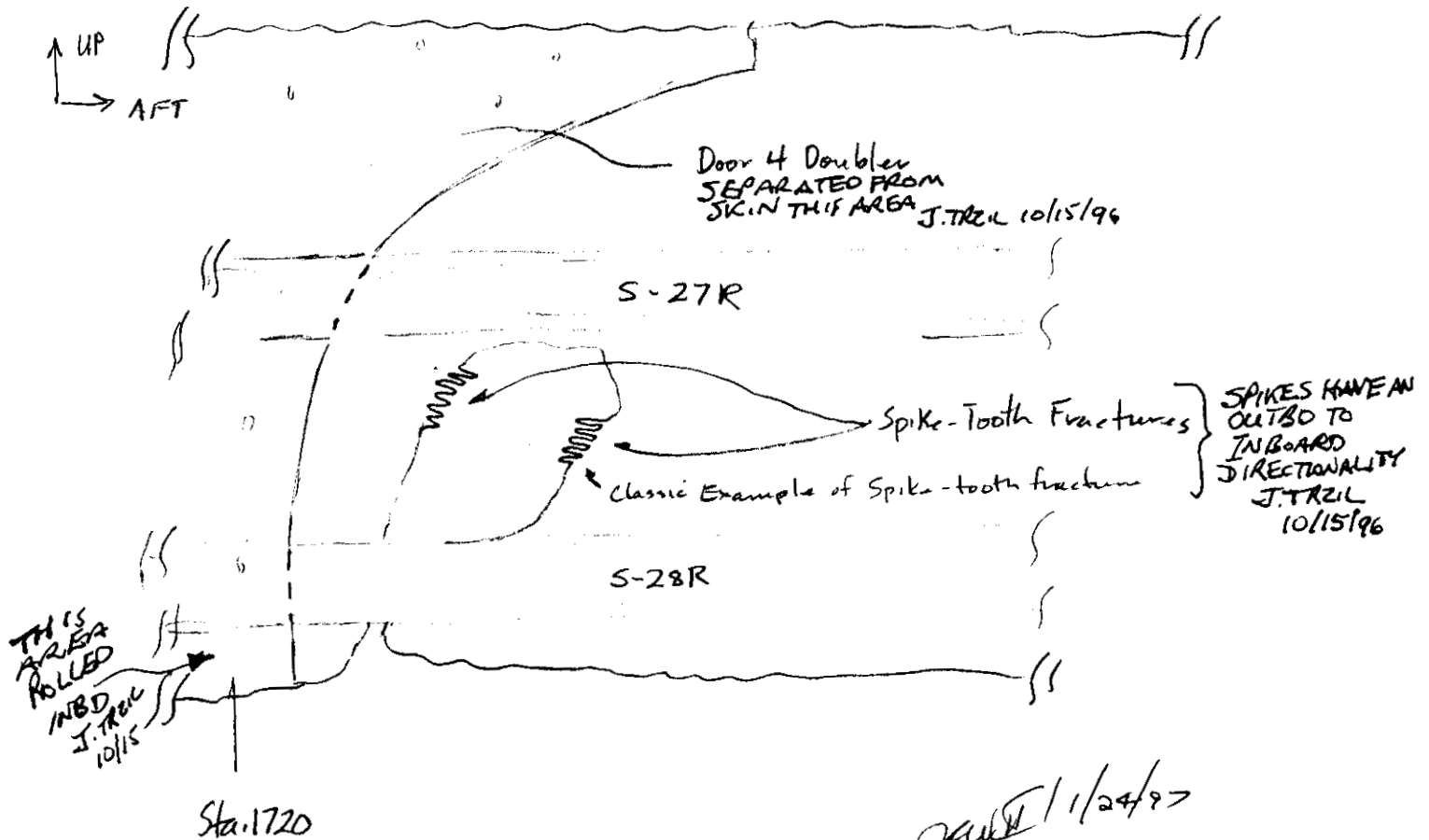
Additional Areas with "Spike-tooth" fracture Morphology.

→ REFER TO FIRE & EXPLOSIONS GROUP NOTES REGARDING SPIKES.

RF110 - Right Hand Fuselage Segment S-26R to S-28R,
(Gusset Zone) Sta. 1700-1760.

Hole in skin adjacent to right lower corner of door 4 doubler. Two areas (one classic) of spike-tooth fracture.

(Part was recently recovered - 9/21/96 and was cleaned by the FBI to the floor on 10/3/96)



JR Straus 11/24/97
JR Straus 10/4/96
Ltr 1412490

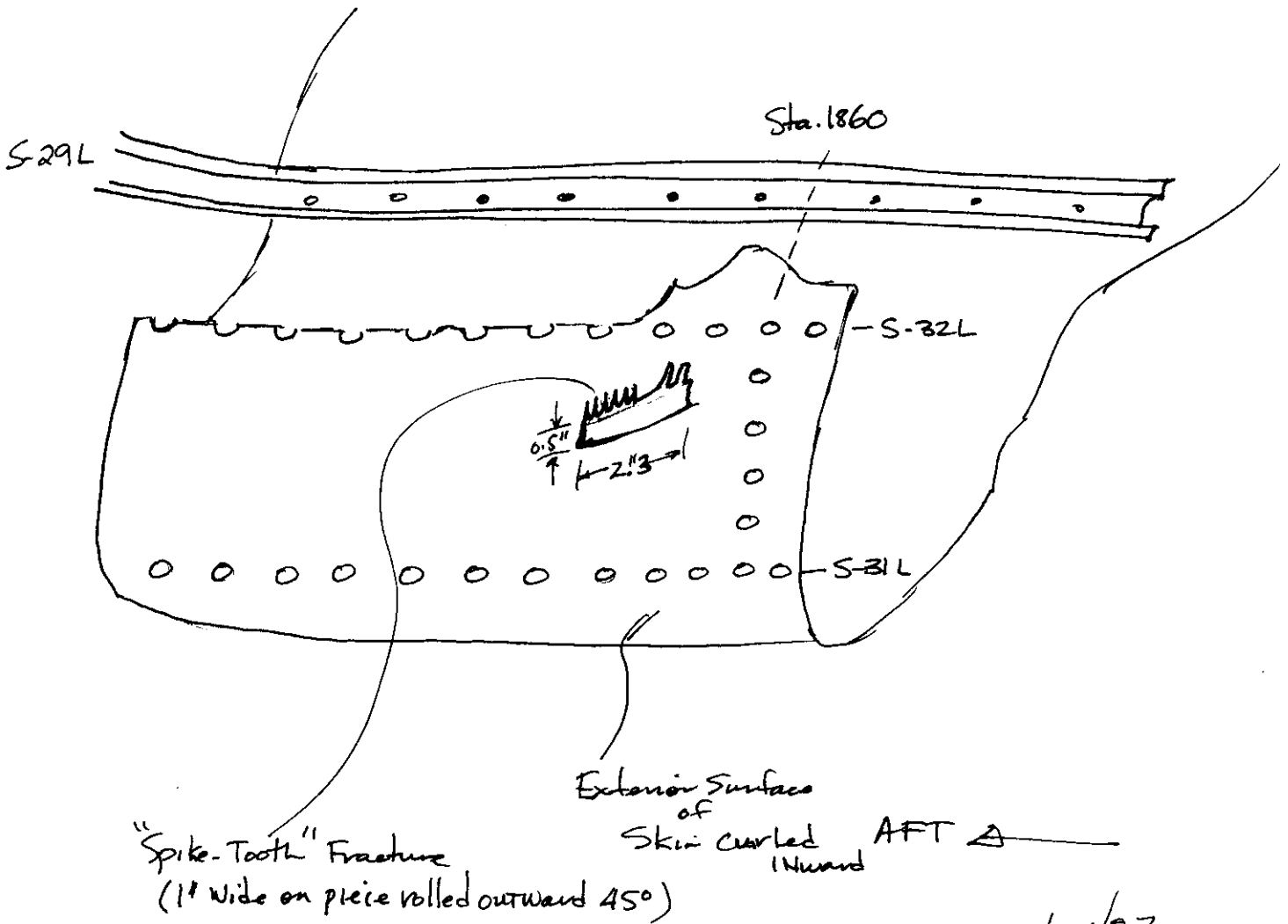
Additional area with "Spike-tooth" fracture morphology



REFER TO FIRE & EXPLOSIONS GROUP NOTES REGARDING SPIKES.

LF83 - Left hand fuselage segment, S-27L to S-32L, Sta. 1840-1880
Green Field - Tag Z3225, 10-2-96.

2.3" long ^{outward} puncture in skin at Sta. 1862-1864, 1 inch above S-32L. Puncture is approx. 1/2" wide. "Spike tooth" fracture covers approx. 1" of the puncture surface.



"Spike-Tooth" Fracture
(1" wide on piece rolled outward 45°)

Exterior Surface
of
Skin curled **AFT** Δ
Inward

QFW&E, 1/24/77
J.R. Straus 10/9/96

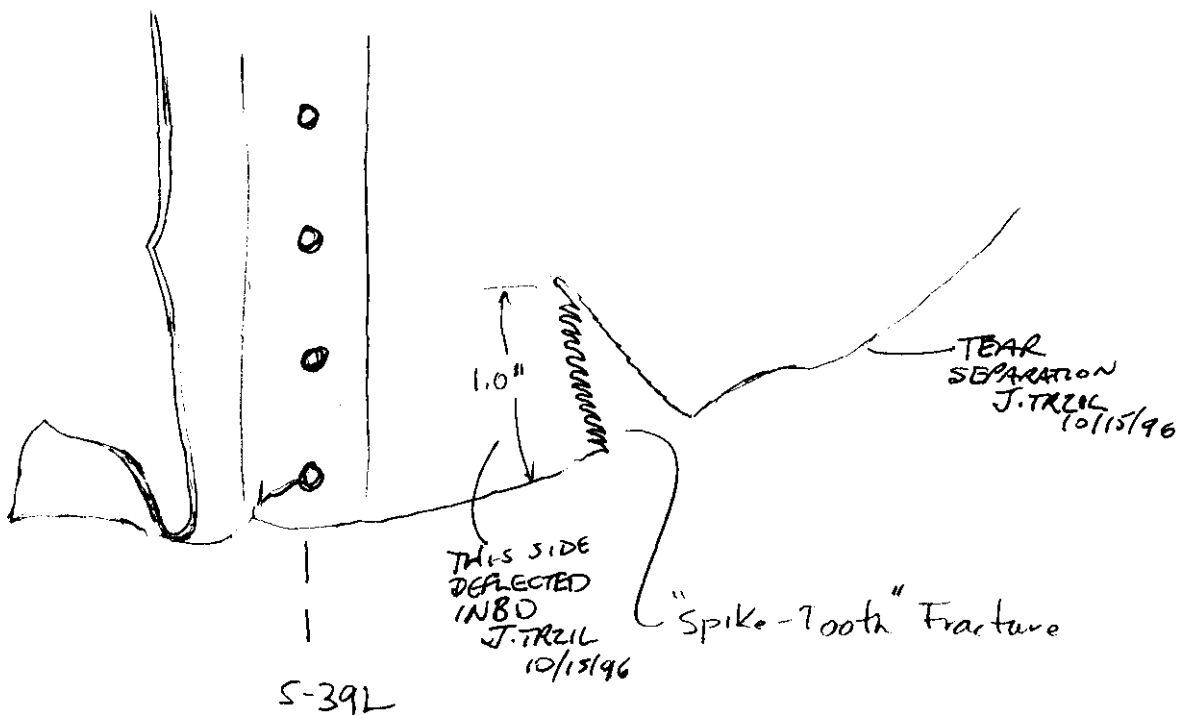
Additional Areas with "Spike-Tooth" Fractures

REFER TO FIRE & EXPLOSIONS GROUP NOTES REGARDING SPIKES.

LF 82B - Left Side Fuelage Belly Skin, Sta. 1580 - 1620, S-39L to S-41L.
(Green Zone)

Written up on 10/10/96.

Tear adjacent to Sta. 1620 at S-39L has a 1.0 inch tear with a "spike-tooth" fracture. Part has seen significant water impact damage. No evidence of direct impact with any object at the location of the tear.



JRK Strano 10/13/96

JEWFF
1/24/97

10-18-96
J. TRZIL

LF28 C

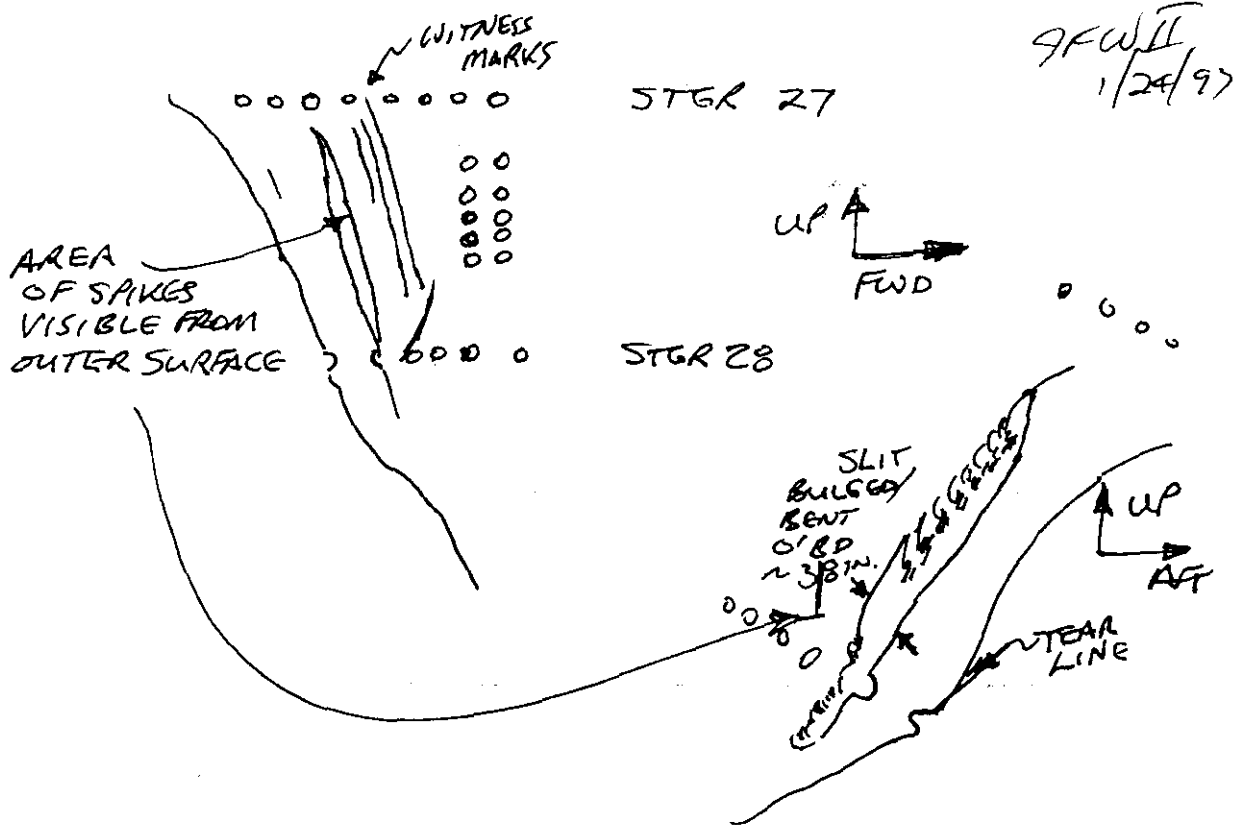
L/H FUSELAGE

GREEN
TAG
C-175

B STA 2020 TO ABOUT 2120

FROM JUST ABOVE WINDOWS TO STGR 29L/30L

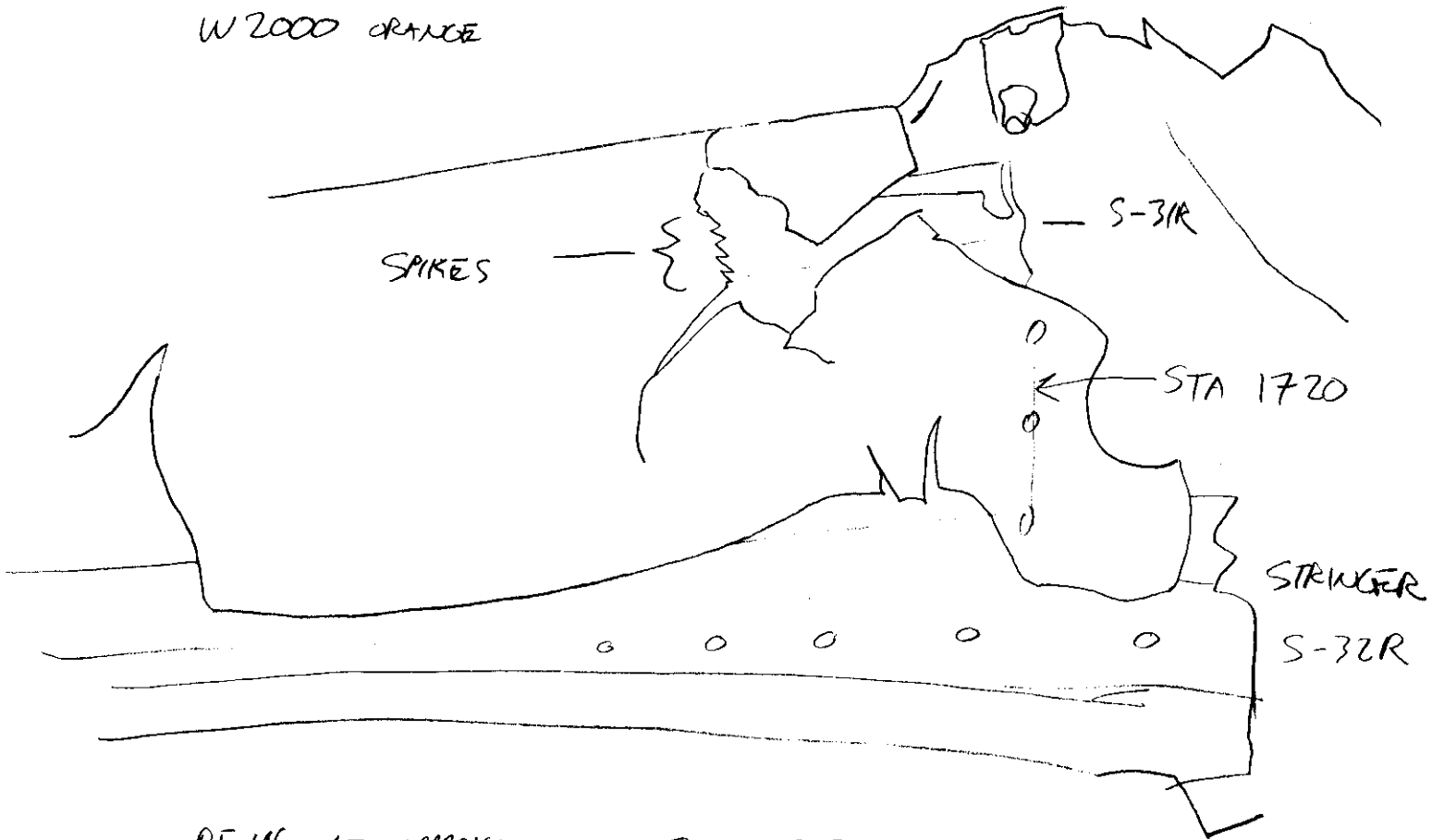
JUST AFT OF STA 2100 BETWEEN STGR 27L & 28L AND SLICING THROUGH AREA WHERE STGR 28L HAD BEEN THERE IS A RELATIVELY LONG (~7 INCHES) NARROW SLIT THAT ROLLS SLIGHTLY OUTBOARD FROM INSIDE. SCRAPE MARK(S) OF SIMILAR LENGTH BEAR WITNESS TO AN OBJECT HITTING INSIDE SURFACE AND PENETRATING. THE WITNESS MARK IS $5/8 - 3/4$ INCH FWD OF THE PENETRATION. THERE IS A SLIGHT UPPER AFT TO LWR FWD ORIENTATION OF THE SLIT LOOKING AT INSIDE SURFACE. SPIKES COULD ABOUT $3 1/2$ INCH LENGTH THEN DIMINISH TO JUST A TEAR FOR ABOUT $1 1/2$ INCH LENGTH THEN CONTINUE ABOUT $1 3/4 - 2$ INCHES. - NO EVIDENCE OF ANY HEAT DAMAGE ASSOCIATION. SEVERAL STGRS - ALL BUT STGR 23L FROM STA 2020 TO 2040 & 2050 TO 2100 ARE MISSING.



ADDITIONAL AREA WITH "SPIKE TOOTH" FRACTURE

RF 116

W 2000 CRANCE



RF 116 AT APPROXIMATELY STA 1717

JUST ABOVE STRINGER 31R

G. FLEIS

2-16-97

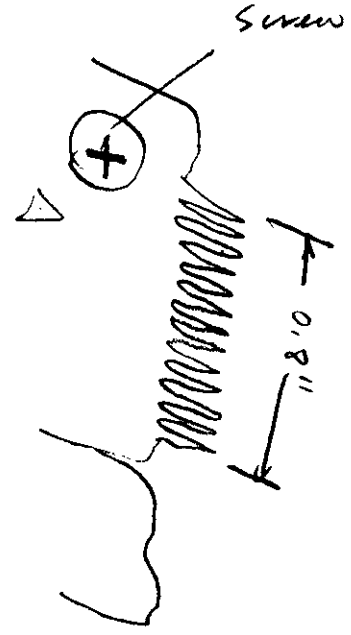
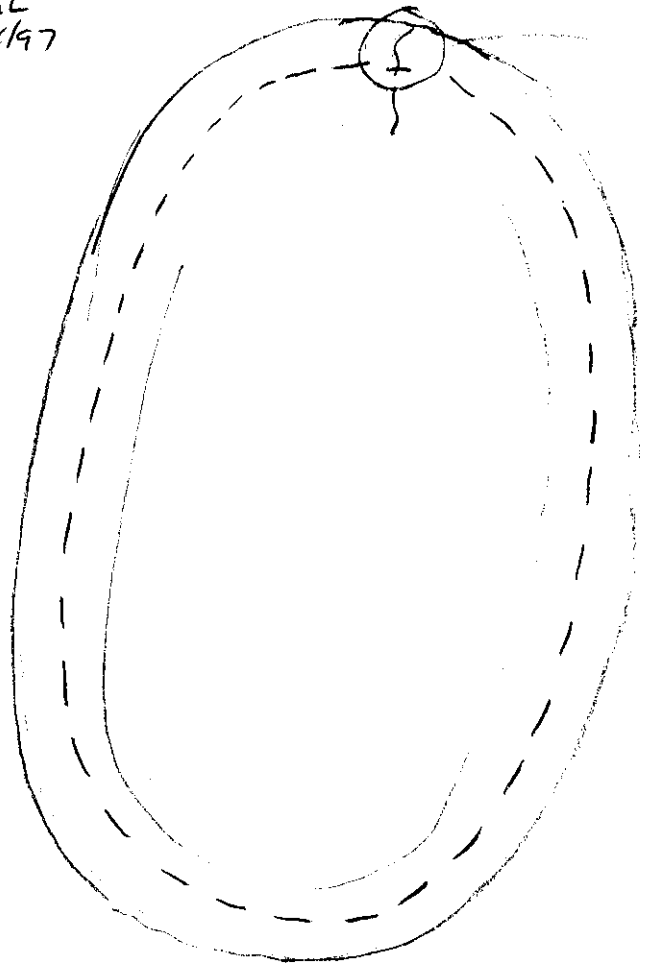
Additional Area with "Spike-Tooth" Fracture

No Tag

Left Landing Light - INBD ~~OUTBD?~~

BASED ON SIZE 19" SURROUND
VS. 16" APPROX FOR 0'BD JTRZIL
1/24/97

CONFIRMED
J. TRZIL
1/24/97



JFWII 1/24/97
JKStrauss 1/22/96

Additional areas with Spike-Tooth fractures

Wing Center Section Lower Intercostal at BL 57.51
and approx. BS 1120 (between SWB # 2 & Mid Spar).

There is no tag assigned. FBI Log # 9-24-96-16.

Intercostal is badly crushed and sooted. A portion
of the fuel fill tube is present. Spike-tooth fracture
on a bracket for the fuel fill tube. Spike-tooth
area approx. 0.4" in length.

Sketch not included.

JR Strauss 11/22/96

QFWII 1/24/97