



NATIONAL TRANSPORTATION SAFETY BOARD

Office of Aviation Safety
Washington, D.C. 20594

November 23, 2021

STRUCTURES

Group Chairman's Factual Report

CEN20LA175

**Appendix B – Textron M&P Report PN 114-810023-1
(16 pages)**



May 21, 2021

**IN REPLY REFER TO:
L-175-21-046**

Clint Crookshanks
Aerospace Engineer (Structures)
National Transportation Safety Board
(303) 373-3508

**RE: 1984 Beech 1900; Serial number: UB-12; REG: N31704
Location: San Antonio, TX; D/A: 05-08-20**

**Textron Aviation Report Title: Examination of a damaged MLG Drag Leg Assembly
p/n 114-810023-1**

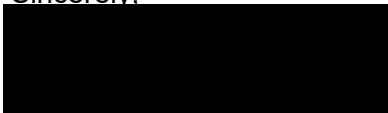
Report No: 21-359-034

Dear Mr. Crookshanks,

The NTSB has permission to release report 21-359-034 to the public docket.

If further assistance is required, please contact me or another member of our Air Safety Investigations Department.

Sincerely,



Casey Love
Air Safety Investigator
Textron Aviation Air Safety Investigations



Material & Process Engineering Report

Report Title: Examination of a damaged MLG Drag Leg Assembly p/n 114-810023-1 on Beechcraft 1900C, S/N UB-12, N31704

Report No.: 21-359-034

Date: April 4, 2021

Revision: -

ECR No.: 086252

To: C. Love

Prepared by: Ali Eftekhari

cc:

Checked by:

Approved by: Bret Vogel

(See Electronic Signature Sheet)

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Subject Information

P/N:	114-810023-1	Model:	1900C
Part description:	MLG Drag Leg Assembly	A/C:	UB-12, N31704
Part Serial Number:	ARC31209-5	TTA:	
Part Model Number:		Landings	

Summary

A damaged left hand MLG drag leg assembly, p/n 114-810023-1 with a fractured upper drag leg arm p/n 114-810026-1 from model 1900C, N31704 was submitted to M&P for examination. Ameriflight, LLC records indicate TSO – 7.1 hours / 8 cycles – Overhaul date 02-14-2020 for P/N 114-810023-1 / S/N ARC31209-5. The purpose of this examination was to determine the cause of the upper drag leg arm fracture.

Upon completion of the examination the following conclusions were reached:

1. The subject upper drag leg arm p/n 114-810026-1 was broken into two pieces with fracture area showing bending/twisting.
2. The fracture surface displayed overload features. There were no evidence of fatigue or corrosion that would have contributed to the part fracture.
3. Part thicknesses near the fracture area were consistent with the engineering drawing requirements.
4. Chemical composition conformed to the engineering drawing requirements for 7075 aluminum alloy plate per AMS-QQ-A-250/12 and microstructure was typical for 7075 aluminum alloy in the heat treated condition.
5. Mechanical properties of the broken upper drag leg arm were low and did not satisfy 7075-T6 requirements per the engineering drawing. The electrical conductivity also did not correspond to the typical values expected for 7075-T6. The material does not conform to any of the standard tempers for 7075 plate

Background

During a landing mishap on May 8, 2020 the drag leg assembly p/n 114-810023-1 on the left hand MLG of M1900C-UB-12 sustained damage, with the upper drag leg arm p/n 114-810026-1 being broken into two pieces. Figure 1 shows the location of the drag leg assembly on a model 1900C aircraft. Beechcraft engineering drawing specifies 1.500" thick 7075-T6 aluminum alloy plate per QQ-A-250/12 for the fabrication of the broken upper drag leg arm p/n 114-810026-1. The outside surface of the upper drag arm to receive chemical film plus one coat of polyamide epoxy primer per finish code P01C01.

On March 4, 2021 a meeting was held at Textron Aviation M&P lab and a box containing the damaged parts from M1900C-UB-12 was opened at presence of FAA, Air safety and M&P personnel with other FAA and NTSB personnel participating virtually; reference Figures [2-3].

M&P was authorized to perform destructive testing.

Results of Examination

The as-received sections of the left MLG is shown in Figure 3; the upper drag leg arm p/n 114-810026-1 was broken into two pieces fwd of a stiffening web as shown by red arrows. Figures [4-5] show inbd and outbd bending/twisting of the flange and the web near the fracture area of the broken upper drag leg arm. The actuator attach holes on both INBD and OUTBD views displayed deformation of the bushings and the corresponding holes. The paint and primer were cracked and peeled off from the part surfaces near the fracture area; reference Figure 6.

Figure 7 shows visual appearance of the fracture area on both the top and the bottom fragments. As seen in both views, the top flange displayed larger bending and twisting than the lower flange. The web fracture appeared as shear overload with some areas showing rubbing. Fracture areas near the bottom and the top flanges were sectioned for further examination; reference Figures [8 and 9].

Figure 8 shows SEM examination results of the fracture surface near the bottom flange. The fracture surface showed no evidence of corrosion/oxidation damage; an area of rub marks was present on the outer edge of the inbd flange. Away from the rubbed area the fracture surface displayed overload features.

Figure 9 shows SEM examination results of the fracture surface near the top flange. The fracture surface appeared in good condition with no evidence of corrosion/oxidation damage. Likewise, an area of rub marks was present near the outer edge of inbd flange. The fracture surface displayed overload features elsewhere. SEM examination of a suspect thumbnail area indicated no fatigue and displayed features similar to a fracture under a compressive load with some deformed metals extending over the flange top edge.

A cross sections was prepared from location XX in Figure 9 to examine microstructure. The microstructure was typical for 7075 series aluminum alloy in the heat treated condition. The thumbnail feature appeared as compressed metal; reference Figure 10.

Material Conformity

Electrical conductivity measurement on the upper drag leg arm p/n 114-810026-1 indicated higher values near the fracture area and lower readings farther away; reference Figures [6 and 11]. The conductivity measured (38.5 - 42.1) % IACS vs. (30.5 – 36.0) % IACS typical for 7075-T6 aluminum alloy plate per AMS2658.

A section of the fwd flange as shown in Figure 6 was cut and sent to Arrow Laboratories for tensile testing and chemical composition analysis.

A sub-size tensile specimen was prepared from the least bent area of the fwd flange with test results shown in Table 1; both tensile and yield strength appeared lower than the specification requirements for 7075-T6. To validate the tensile strength of the broken upper drag leg arm p/n 114-810026-1, two more tensile specimens were fabricated from the least damaged area on the opposing fracture piece as shown in Figure 11. Consistent with previous results, the tensile strength and yield strength were lower than the specification requirements. Tensile properties of the upper drag leg arm were not consistent with any of the standard tempers for 7075 plate.

Table 1 Tensile properties of the Upper Drag Leg Arm p/n 114-810026-1
Arrow Lab report # e57vc439 and 639

p/n 114-810026-1	Tensile strength (ksi)	Yield strength (ksi)	% Elongation in 1-inch
Specimen #1 in Figure 6	59.8	42.2	15
Specimen #2 in Figure 11	48.4	28.8	16
Specimen #3 in Figure 11	48.9	28.7	16
Requirement; 7075-T6 plate per AMS-QQ-A-250/12	77.0 min	67.0 min	6 min
7075-T7651 plate per AMS-QQ-A-250/24	71.0 min	61.0 min	5 min
7075-T7351 plate per AMS-QQ-A-250/12	69.0 min	57.0 min	6 min
7075-0 plate per AMS-QQ-A-250/12	40.0 max	21.0 max	10 min

Chemical composition results for the upper drag leg arm p/n 114-810026-1 are shown in Table 2. Chemical composition of the broken part conformed to the 7075 aluminum alloy plate per AMS-QQ-A-250/12.

Table 2 Chemical Composition of the Upper Drag Leg Arm p/n 114-810026-1
Arrow Lab report # e57vc439

Element	Chemical Composition (wt %)	
	Upper Drag Leg Arm p/n 114-810026-1	Requirements 7075 aluminum alloy per AMS-QQ-A-250/12
Zinc	5.2	5.1 – 6.1
Magnesium	2.4	2.1 – 2.9
Copper	1.5	1.2 – 2.0
Chromium	0.18	0.18 – 0.28
Manganese	0.14	0.30 Max.
Iron	0.20	0.50 Max.
Silicon	0.08	0.40 Max.
Titanium	0.02	0.20 Max.

No other examinations were performed.

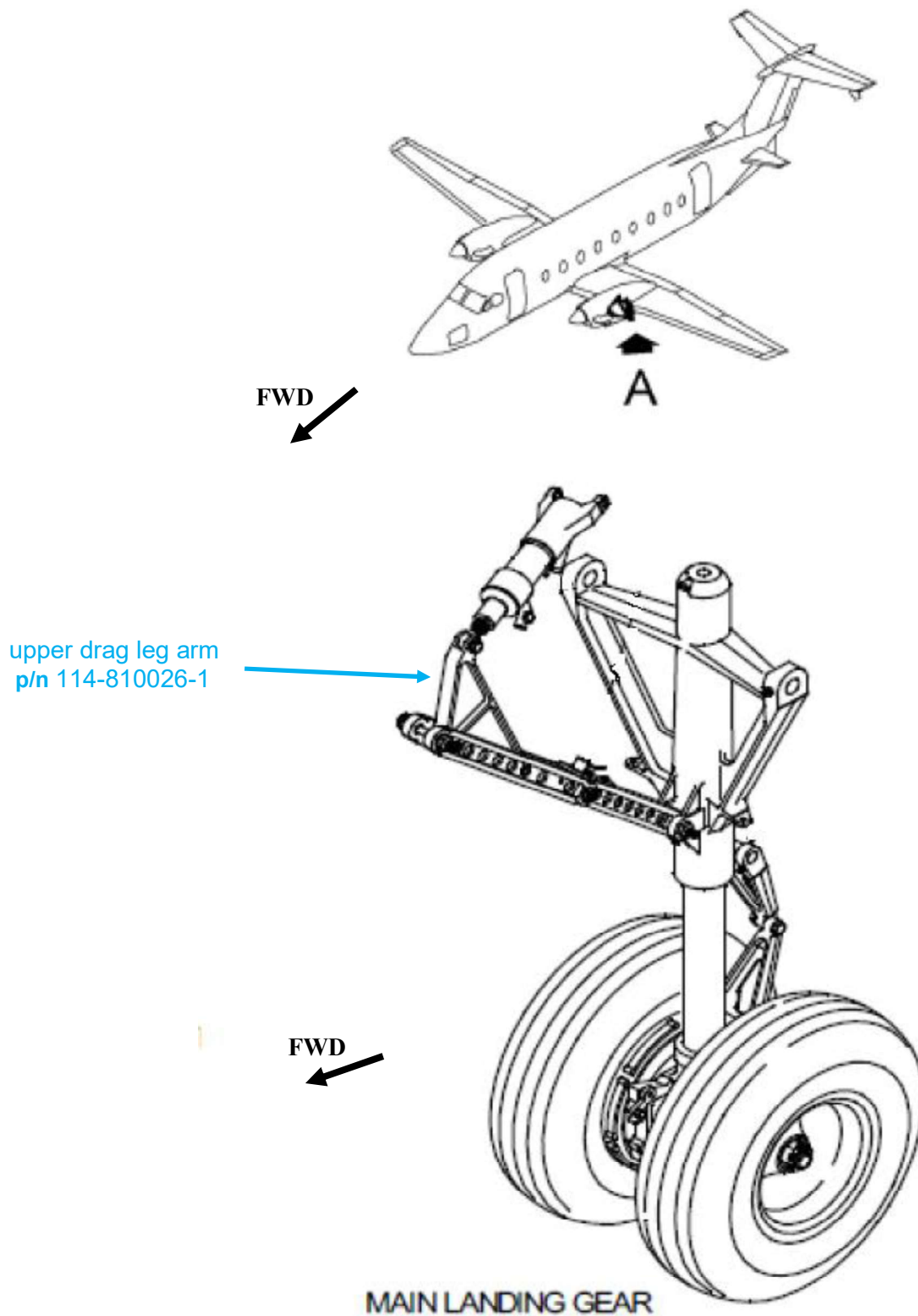


Figure 1 View from the Illustrated Parts Catalog showing location of the upper drag leg arm p/n 114-810026-1 on the left MLG of Model 1900C aircraft. The as-received parts are shown in Figure 2.



Figure 2 A box containing the damaged parts was brought to the M&P lab for examination.



Figure 3 View showing contents of the box in Figure 2. The upper drag leg arm p/n 114-810026-1 was broken into two pieces fwd of a stiffening web as shown by red arrows. Magnification: x0.3.

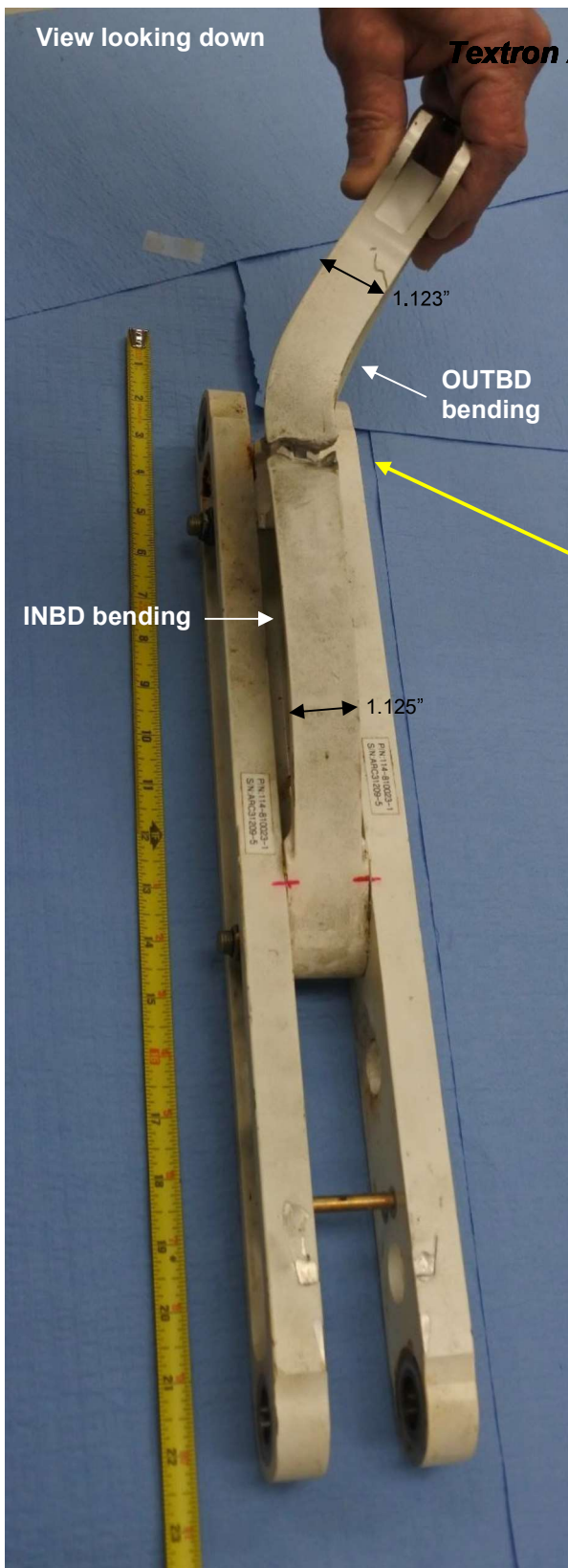


Figure 4 View showing inbd and outbd bending of the fractured upper drag leg arm. The flange width measured approximately 1.123" to 1.125" vs 1.120 +/- 0.010" required by the engineering drawing. Magnification: x0.2 and x1.7.

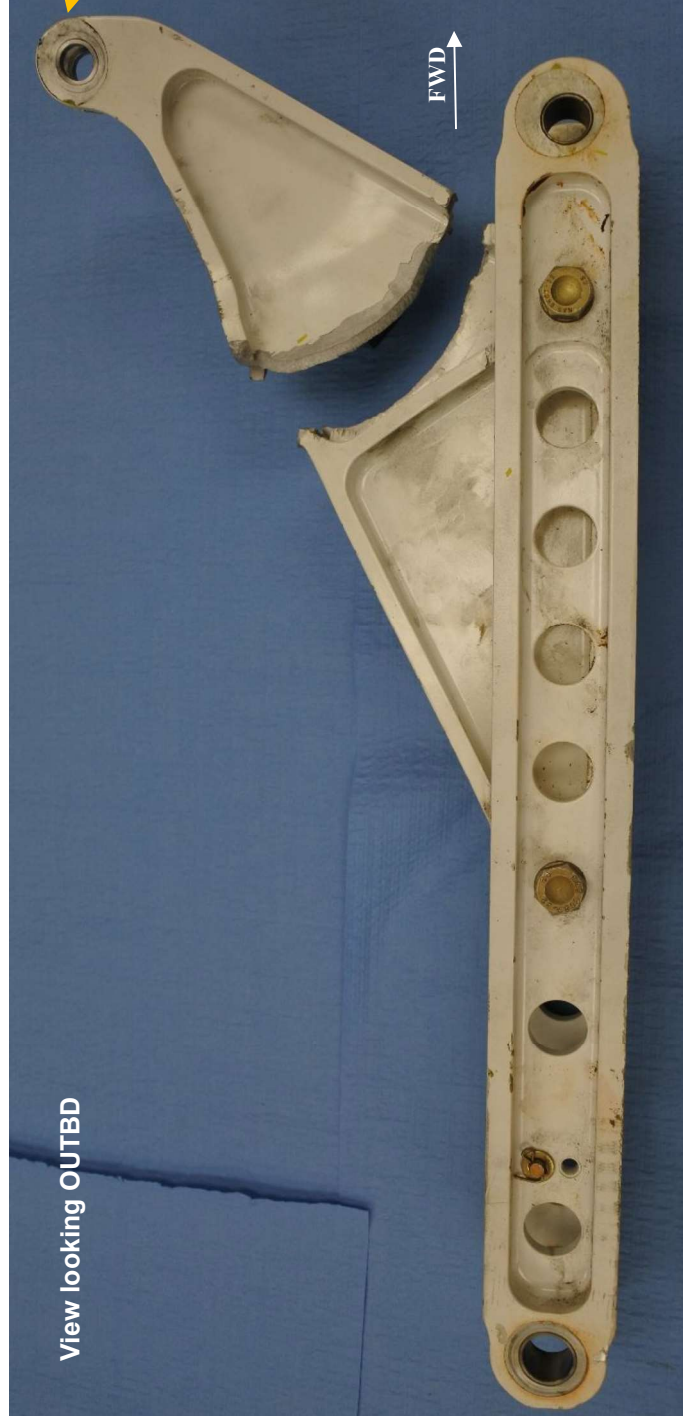
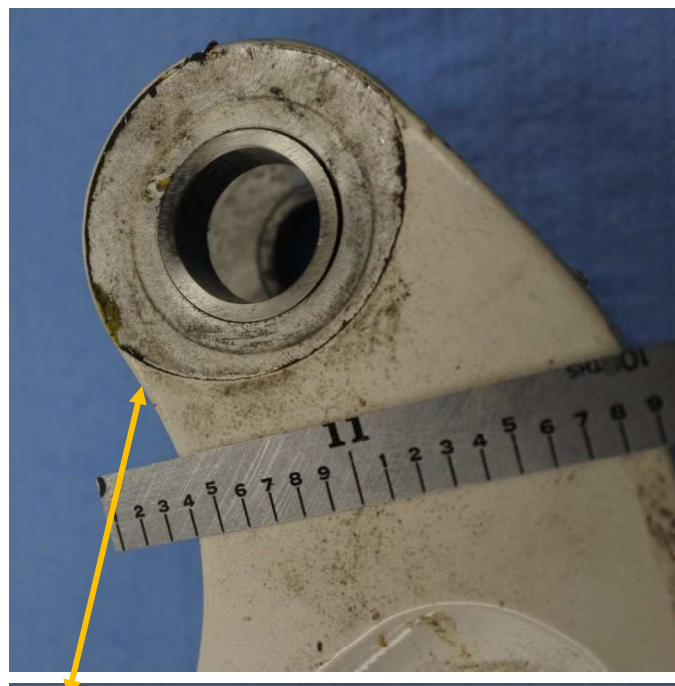
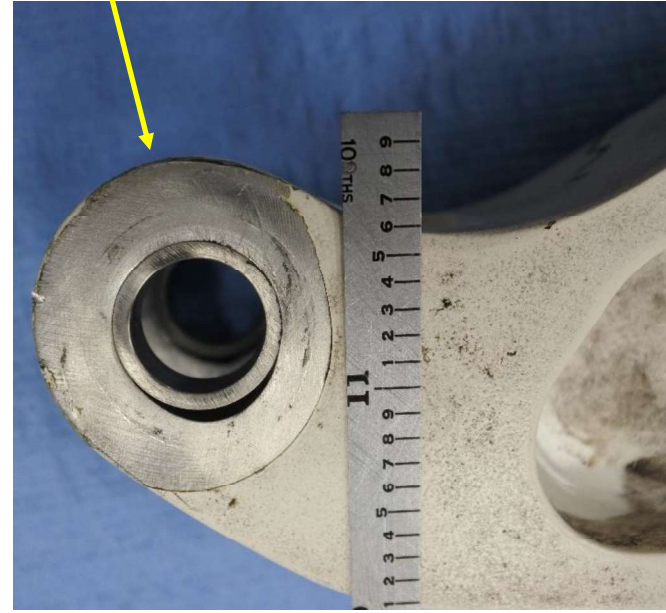


Figure 5 INBD and OUTBD views of the broken upper drag leg arm from Figure 4. As shown both holes were enlarged, and the corresponding bushings were deformed. Flange thicknesses were approximately 0.287" to 0.290" vs. 0.28 +/- 0.03" required. Web thickness measured 0.180" approximately vs. 0.18 +/- 0.03" required. Magnification: x0.4 and x1.5.

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Examination of a damaged MLG drag leg Assy, p/n 114-81003-1 M1900C

Printed On 04/09/2021



Figure 6 The paint and primer were cracked and peeled off from the part surfaces near the fracture area. Electrical conductivity measured higher near the fracture area, 42.1 % IACS. The typical electrical conductivity for 7075-T6 plate is 30.5 – 36.0 % IACS. Black arrow depicts tensile specimen location on the flange. Magnification: x1.1.

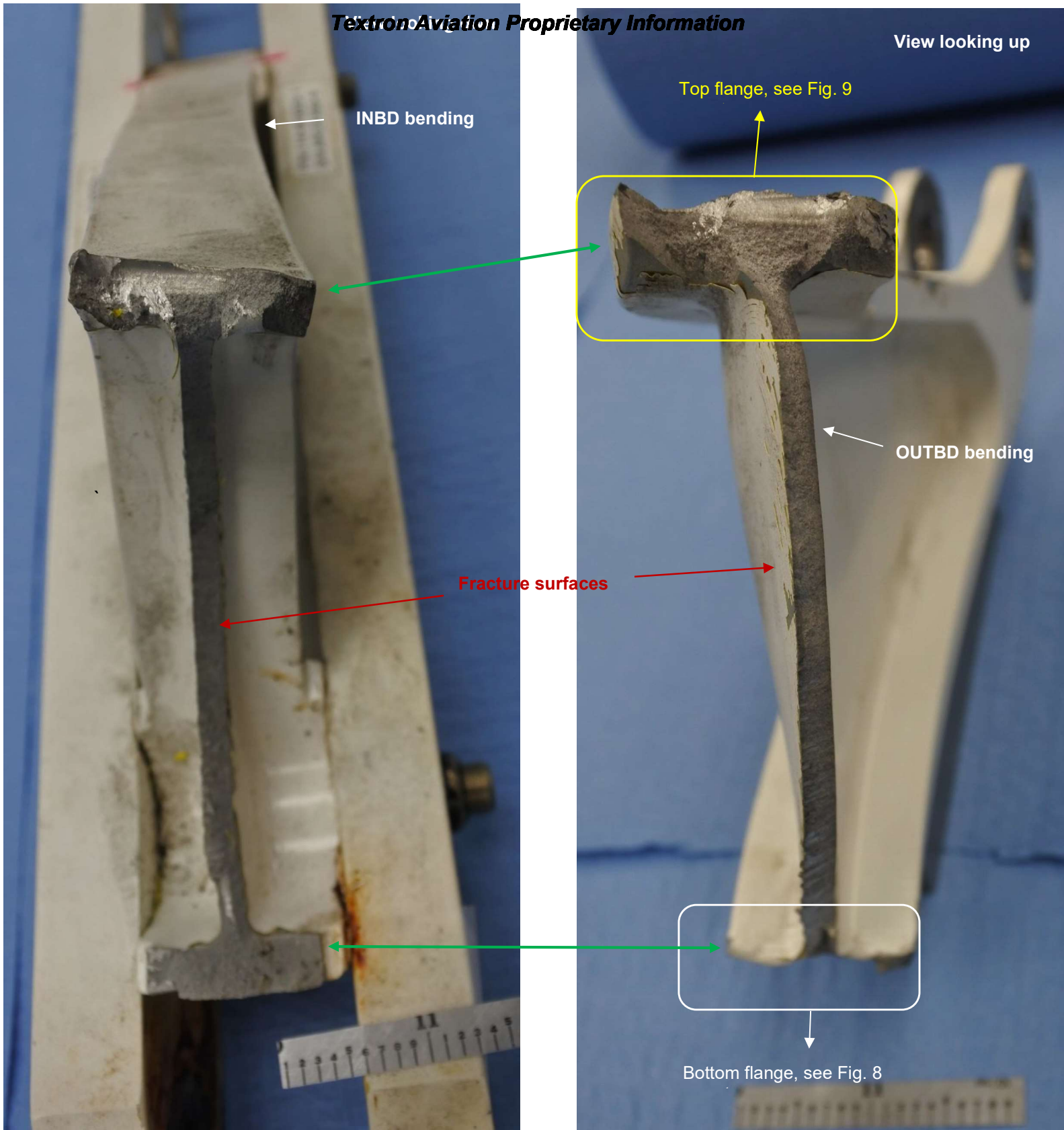


Figure 7 View showing the fracture area on both the top and the bottom fragment. Unlike the bottom flange, the top flange displayed large bending and twisting. The web fracture appeared as 45° shear overload with some areas showing rubbing. Magnification: x1.4 and x1.3.

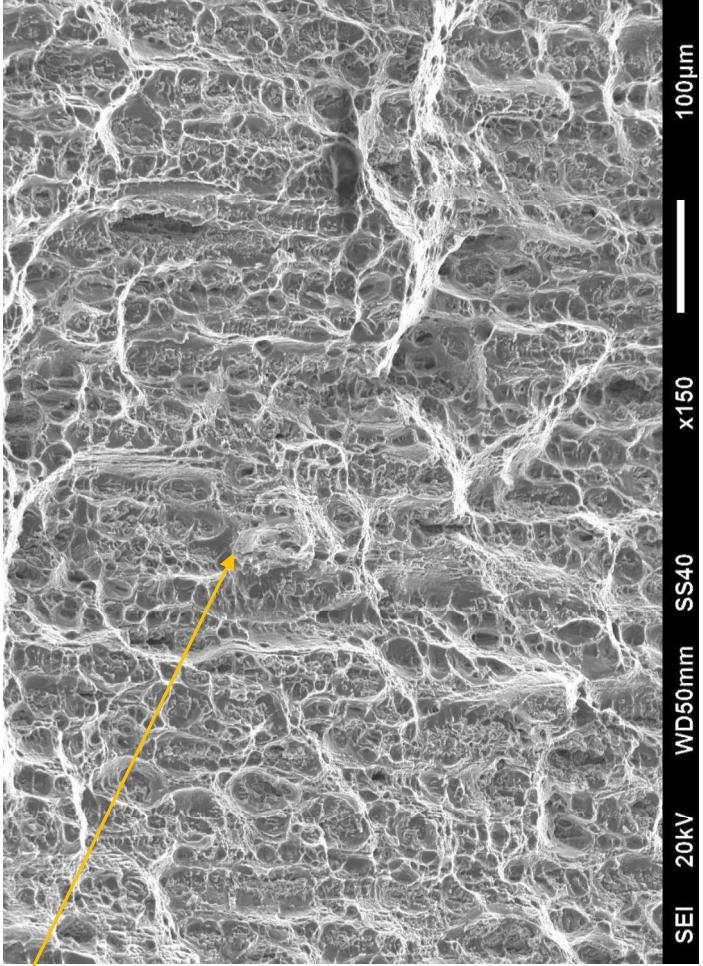
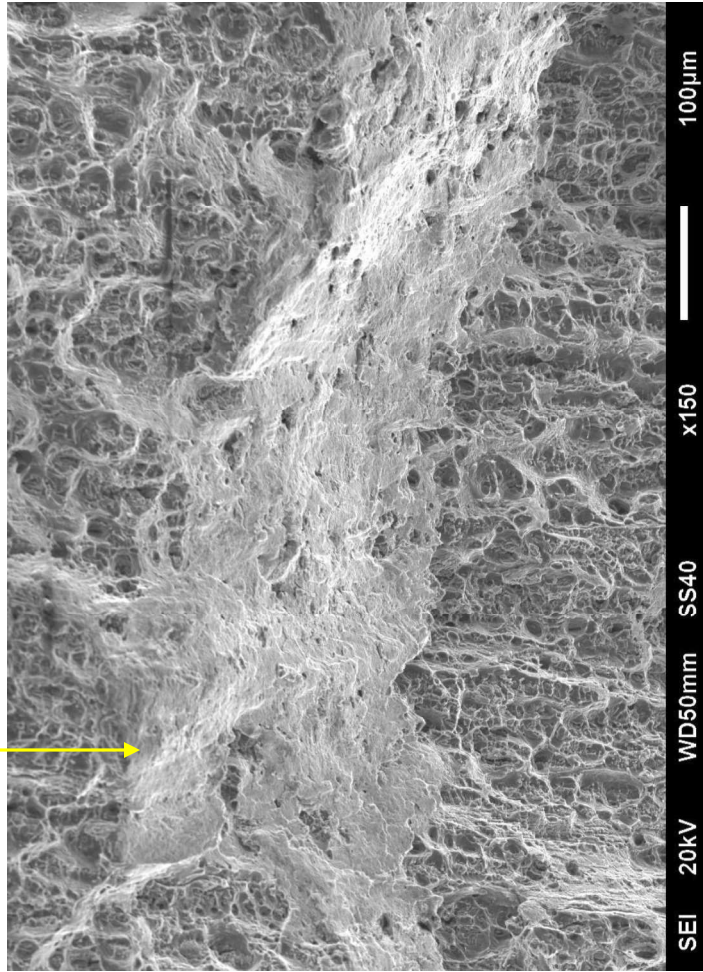
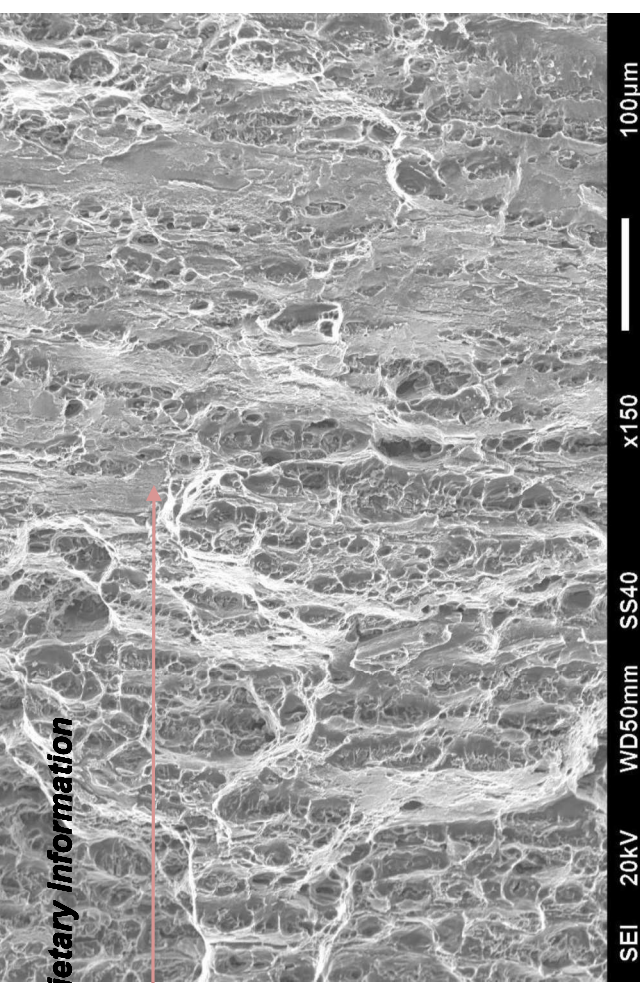
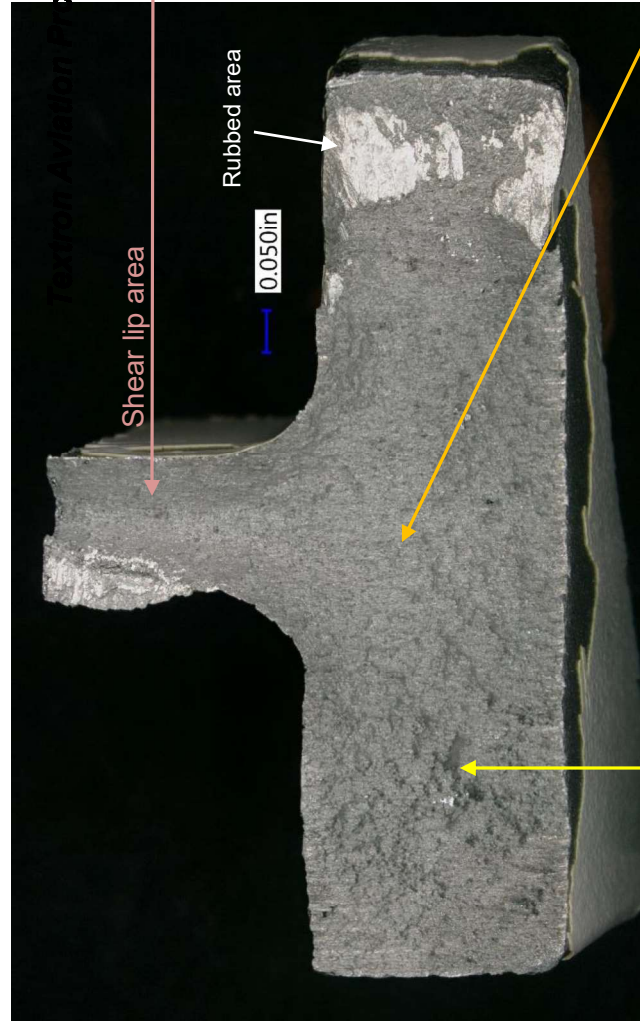


Figure 8 View of the fracture surface on the bottom flange in Figure 7. Fracture surface features represents an overload fracture. Magnification: x6 and x150.

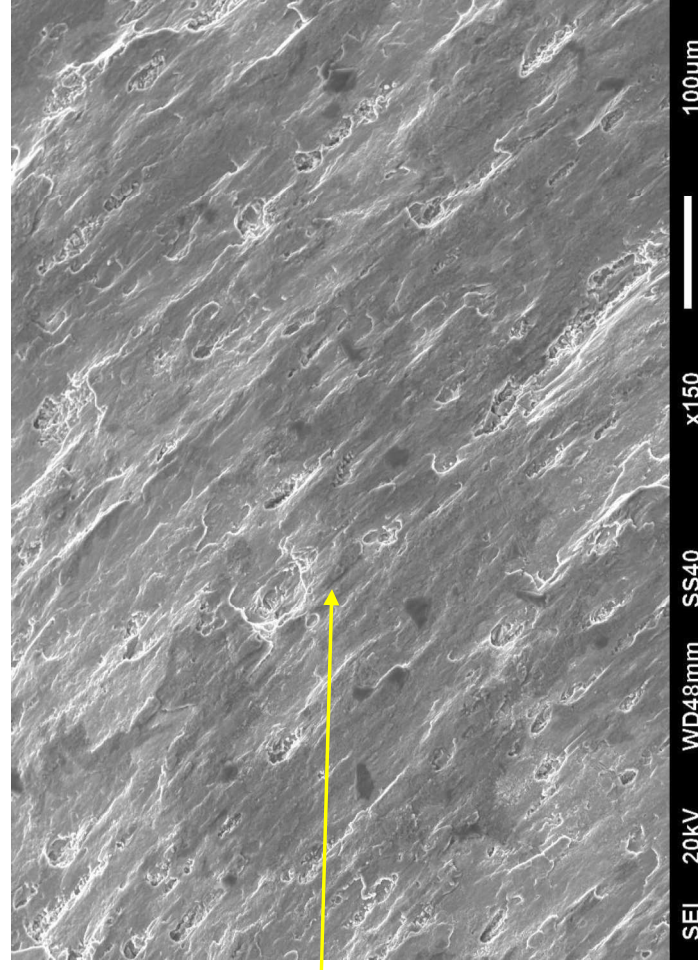
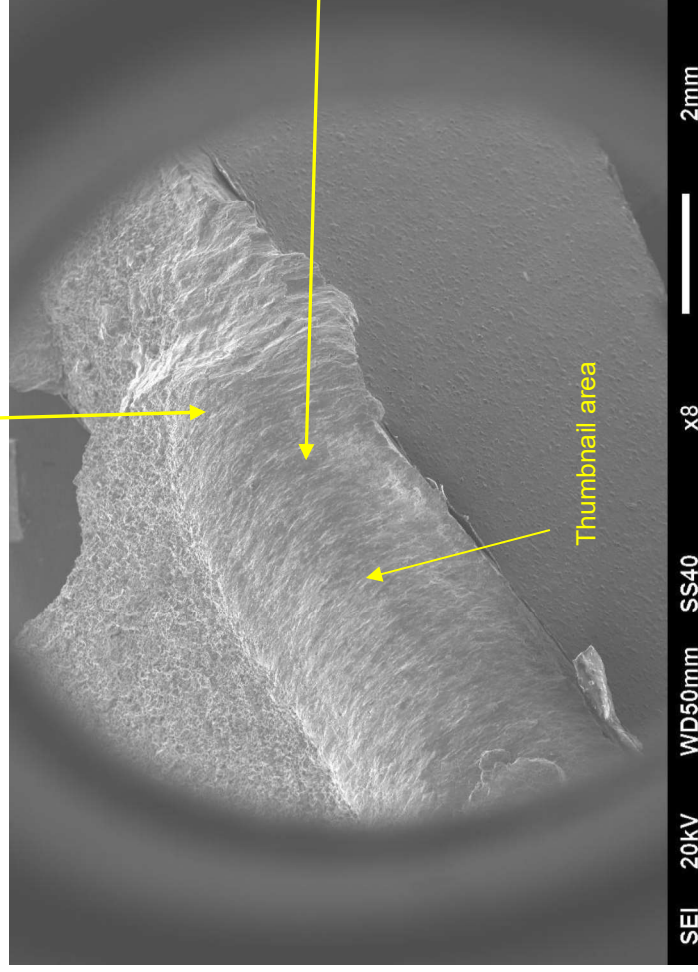
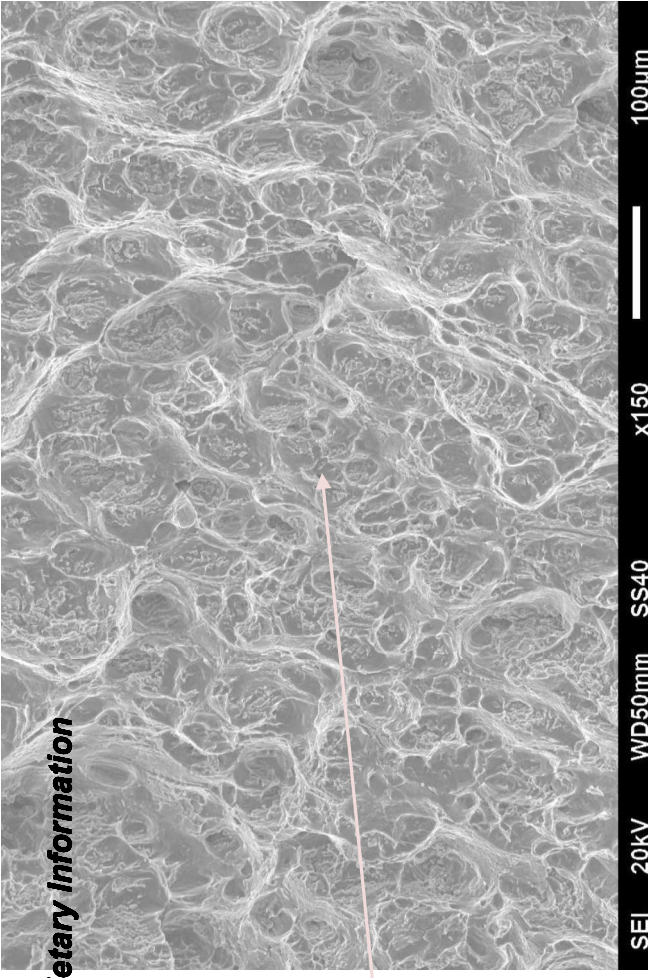
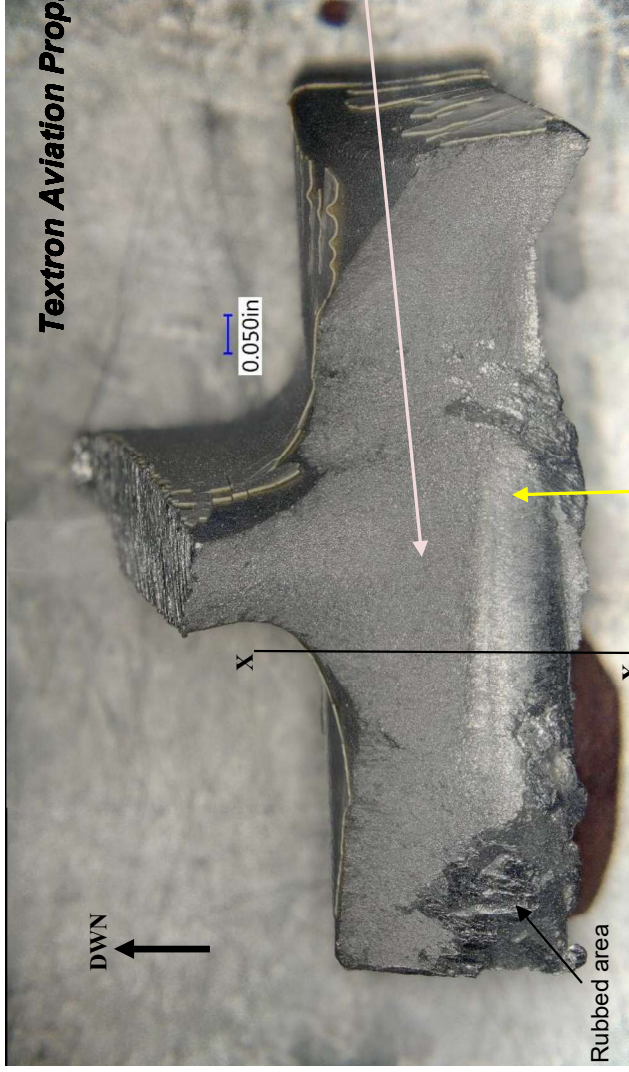


Figure 9 View of the fracture surface on the top flange in Figure 7. An area resembling a thumbnail shape near the top surface was visually suspected as a fatigue fracture; further examination revealed a rubbed surface. The fracture surface displayed overload features elsewhere. XX represents a cross section cut. Magnification: x5; x8 and x150.

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Examination of a damaged MLG drag leg Assy, p/n 114-810033-1, M13000C

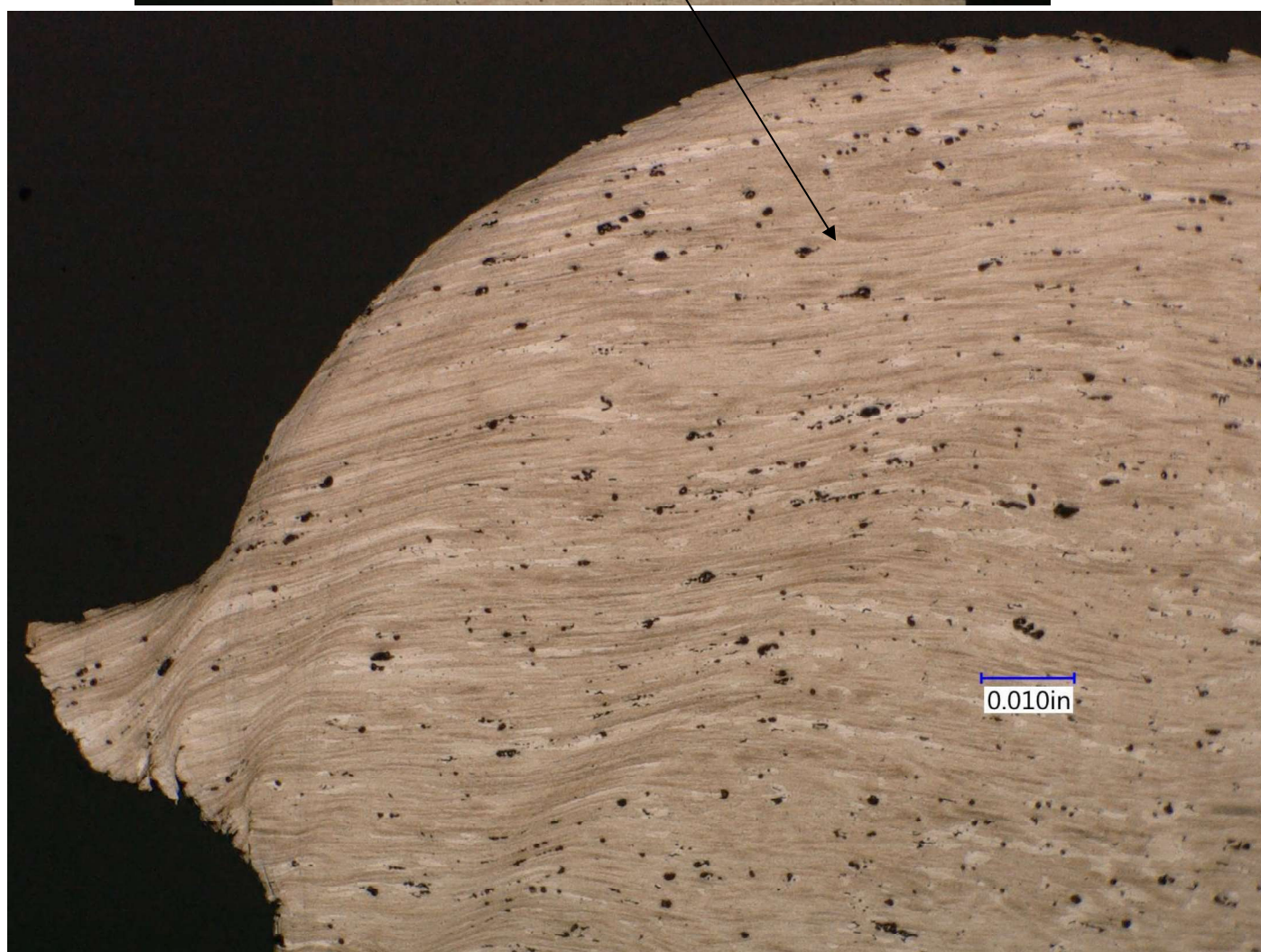
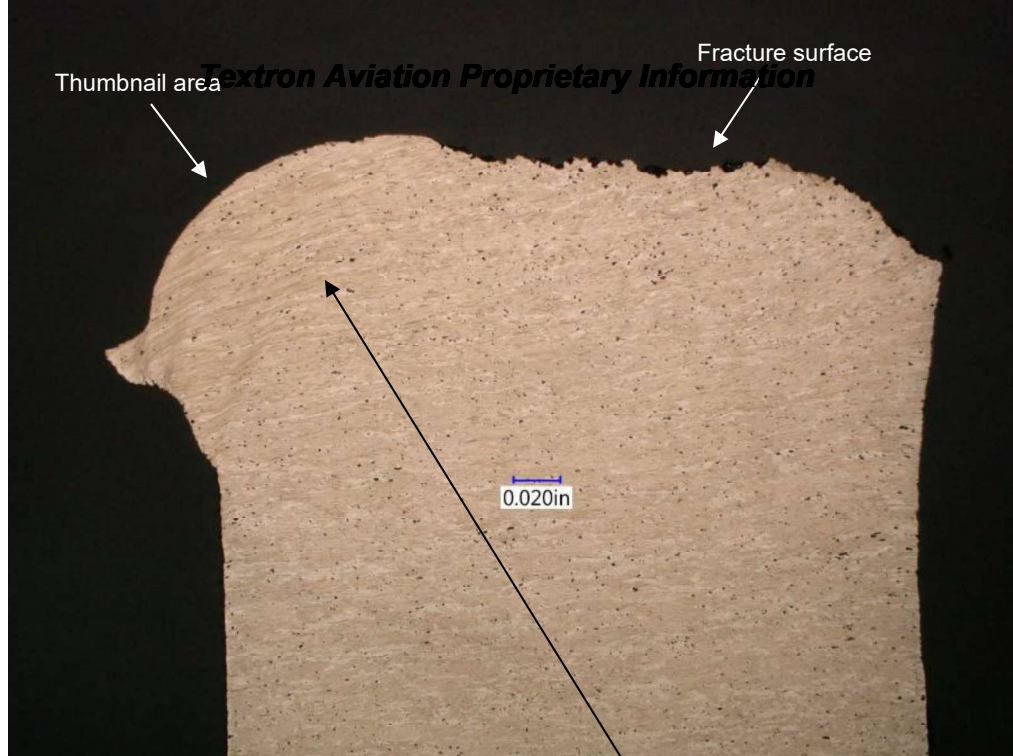


Figure 10 Cross section through location XX in Figure 9. Microstructure was typical for 7075 aluminum alloy plate in the heat treated condition. The thumbnail area indicated an area of compressed metal. Etchant Keller's. Mount index No. 4424. Magnification: x14 and x60.

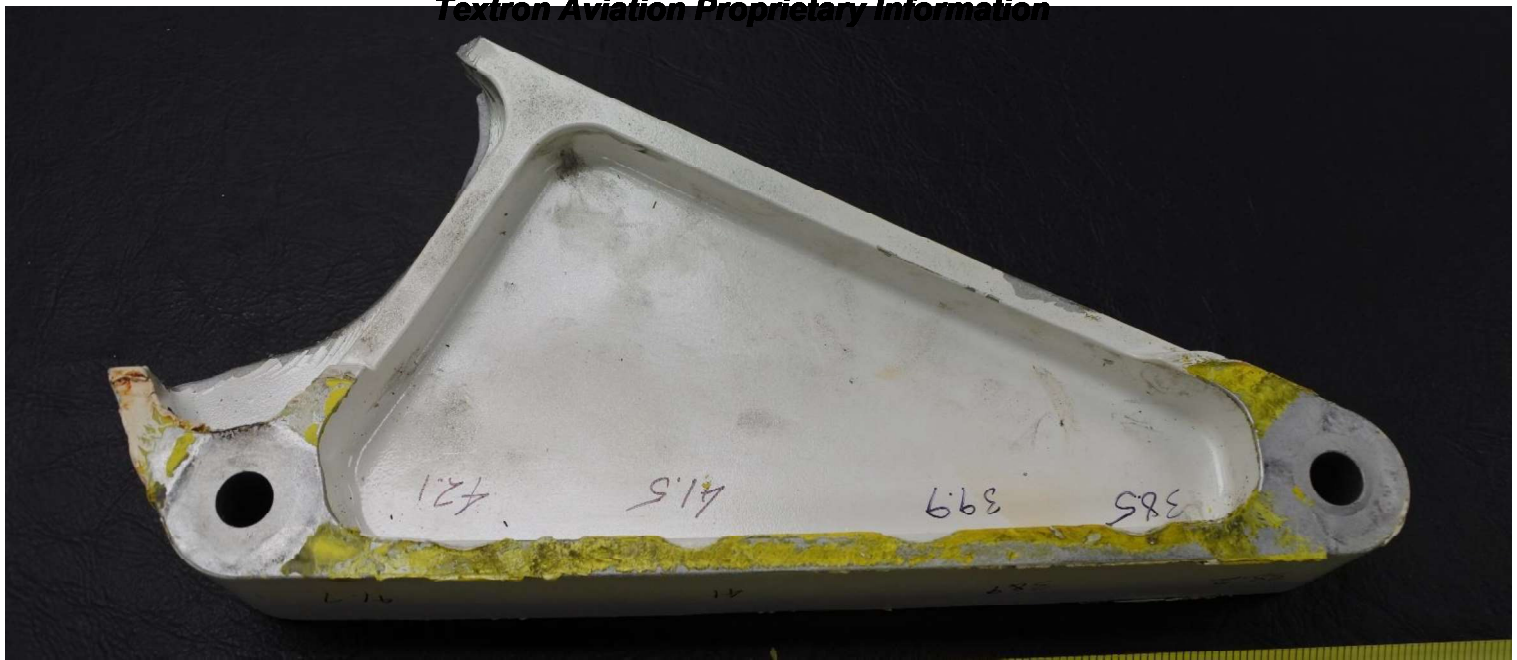


Figure 11 View of the opposing fractured piece showing location of the two new compact tensile specimens on the bottom flange. Consistent with previous conductivity measurements in Figure 6 the conductivity was higher near the fracture area and lower away from it; measurements indicated (38.2 to 42.1) % IACS in the area between the two holes. Black arrows depict location of the two new tensile specimens.