Date of Accident: 24 August, 2014

Location: Coldfoot, AK

NTSB File No.: ANC14LA068

Aircraft: Ryan Navion A

Registration No.: N4827K

Serial No.: NAV-4-1827

Operator: Per the FAA registry:

Kirst Forest M.
[redacted]
Fairbanks, AK 99707

Written by: Dan Boggs
Air Safety Investigation Manager

Date: 25 September, 2014

Contents:

ACCIDENT SYNOPSIS

According to the NTSB preliminary report, "On August 24, 2014, about 1240 Alaska daylight time, a Ryan Navion A airplane, N4827K, was substantially damaged when it impacted terrain while maneuvering in Atigun Pass, approximately 15 nautical miles northeast of Coldfoot, Alaska. The airplane was operated by Kirst Aviation, Fairbanks, Alaska, as an on-demand sightseeing flight under the provisions of Title 14 Code of Federal Regulations Part 135. The commercial pilot and three passengers were seriously injured. Visual meteorological conditions prevailed, and a VFR flight plan was filed. The flight originated at the Fairbanks International Airport about 1003".

"According to witnesses, just prior to the accident, the airplane was observed flying slowly in a northerly direction, in the vicinity of Antigun pass at low altitude, following the contours of the surrounding terrain "like he was looking for game." The engine could be heard to be "running strong." Moments later the airplane was observed to impact sloping terrain at approximately 4,700 feet above mean sea level on the east side of the Dalton Highway, then slide about 35 feet across the loose rock of the slope".

"On August 26, 2014 two Federal Aviation Administration (FAA) safety inspectors from the Fairbanks Flight Standards District Office (FSDO) traveled to the accident scene to examine of the wreckage. The inspectors reported that they were unable to find any preaccident mechanical problems with the airplane. The airplane sustained substantial damage to the wings, fuselage, and empennage".

Aircraft Damage:	Destroyed.
Injuries:	4 on board, 1 fatal, 3 serious.

SUMMARY AND ANALYSIS OF FINDINGS

One propeller blade had deep gouges, scrapes, rotational scoring and had 6" of the tip missing. One blade was missing.

CONCLUSIONS

The damage to the propeller blade was indicative of power ON during impact.

There were no discrepancies noted that would preclude normal operation. All damage was consistent with impact damage.

PROPELLER TEARDOWN REPORT

Date of Investigation: 17 September, 2014

Location: Hartzell Propeller Inc.
Piqua, Ohio

Propeller Model: HC-D2MV20-7 with MV8433N blades

Representatives:

Dan Boggs	Hartzell Propeller Inc.
Jason Major	FAA
Fred Distad	Artic Aviation

General Comments:

This type propeller is a 2-blade single-acting, hydraulically operated, constant speed model. Oil pressure from the propeller governor is used to move the blades to the low pitch (blade angle) direction. Blade mounted counterweights actuate the blades towards the high pitch direction in the absence of governor oil pressure. The blades are of aluminum construction. The hub and blade clamps are steel. Propeller rotation is clockwise as viewed from the rear.

Installation Data: (Data reference the 30-inch station)

Low Pitch:	14.0 ± 0.2 degrees
High:	23.0 ± 0.5 degrees

Service History:

	S/N	Date of manufacture	TTSN	TSO
Hub	AVA428	2/29/2000	unknown	unknown
Blades	J41484	3/4/2000	unknown	unknown
	Missing			

Hub Serial Number: AVA428
Blade Model: MV8433N

S/N A:	J41484
S/N B:	missing

Blade Orientation:

A-B clockwise as viewed from the rear of the propeller.

"As Received" Condition:

See pictures on page 5.

The propeller was still attached to the engine. One blade was missing. The other blade was bent aft about midblade and wedged into the engine cowl. The last 6" of the tip was missing. The blade had signs of rotational scoring, gouges, and scrapes. There were large amounts of grease in the hub butt of the missing blade and the grease was not thrown out in a centrifugal pattern. A broken clamp bolt head was lying on top of the clamp of the missing blade side.

NOTE: The Tip that was missing from the blade still installed was found the next day at the accident site.

Spinner Dome:

The spinner dome was crushed on half of the dome.

Spinner Bulkhead:

The spinner bulkhead was intact; however there was a dent by one of the clamps that appeared to be from a clamp bolt or tool used on the clamp bolt. On the bottom side of the bulkhead were several fresh scrapes, gouges and scratches.

Propeller Cycling:

The propeller cycling was not possible due to impact damage.

Engine/Propeller Mounting:

The engine to propeller mounting was intact, however the mounting nut was not torqued down. The nut was removed with very little effort.

Blade/Clamp Rotation:

A: The blade rotated in the clamp approximately 5°.

B: The blade was missing.

Photo #1, propeller as received.

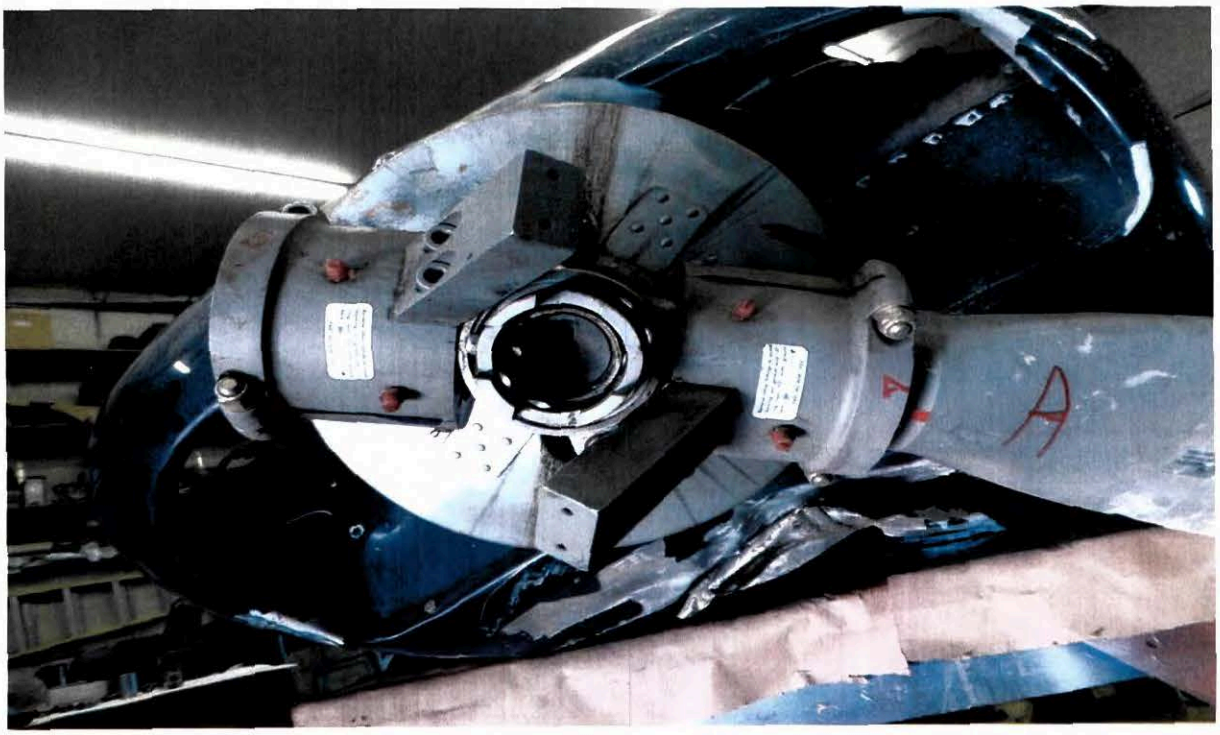

Photo #2, propeller as received.

Pitch Stops:

Low Pitch Stop: The low pitch stop was intact and unremarkable.

High Pitch Stop: The high pitch stop was intact and unremarkable.

Piston:

The piston was intact and unremarkable.

Cylinder:

The cylinder was intact, however the guide for the arm was fractured.

Diaphragm:

The diaphragm was intact and unremarkable.

Clamps and Counterweights:

The "A" clamp was intact; however one of the bolts was loose. The "B" clamp had two broken bolts and the flange of the clamp half was fractured during impact.

Clamp serial numbers:
A: 2974A
B: 3126A

NOTE: The clamp was sent out to an independent metallurgy facility for testing. The results are in the attachment to this report. The summary is the clamp failed for overload and not for fatigue.

Hub Unit:

The pilot tubes were fractured on both blades due to impact.
The mounting flange was intact and unremarkable.
Cylinder attachment was intact and unremarkable.
There were no impression marks from blade butts.

NOTE: The Hub unit was sent out to an independent metallurgy facility for testing. The results are in the attachment to this report. The summary is the hub unit failed for overload and not for fatigue.

Blades:

See pictures on page 7.

Blade # A

paint, camber side	- gouges, scrapes, rotational scoring.
paint, flat side	- scratched.
bend	- bent aft 90° midblade.
twist	- forward at midblade towards tip.
lead edge damage	- gouges, scrapes, dents, tip missing.
trail edge damage	- gouges, scrapes, dents, tip missing.
butt impression	- none.

Blade # B

Blade "B" was missing.

Photo #3, "A" propeller blade.

Photo #4, "A" propeller blade.

PHOTOGRAPHIC SUMMARY

NOTE: The following digital photographs are original and unedited and available on compact disc. The numbering sequence may not be chronological as some may have been deleted if out-of-focus, too dark, redundant, etc. Photos used in the text of this report are taken from photos on this list but may have been adjusted from the original. Modifications to images used in the report are limited to cropping, magnification, file compression, or enhancement of color, brightness, or contrast for the sole purpose to improve clarity of the report. No other alterations are permitted.

PHOTOGRAPH NUMBER	DESCRIPTION:
P1010477.JPG	propeller as received.
P1010478.JPG	propeller as received.
P1010479.JPG	propeller as received.
P1010480.JPG	propeller as received.
P1010481.JPG	clamp bolt.
P1010482.JPG	clamp bolt.
P1010483.JPG	diaphragm.
P1010484.JPG	cylinder.
P1010485.JPG	blade alignment with hub.
P1010486.JPG	blade alignment with hub.
P1010487.JPG	blade alignment with hub.
P1010488.JPG	blade alignment with hub.
P1010489.JPG	hub.
P1010490.JPG	"A" hub butt.
P1010491.JPG	"B" hub butt.
P1010492.JPG	spinner bulkhead.
P1010493.JPG	spinner bulkhead.
P1010494.JPG	spinner bulkhead.
P1010495.JPG	clamps.
P1010496.JPG	clamp.
P1010497.JPG	clamp.
P1010498.JPG	clamp.
P1010499.JPG	clamp.
P1010500.JPG	blade butt.
P1010501.JPG	blade.
P1010502.JPG	blade tip.
P1010503.JPG	blade.
P1010504.JPG	blade.
P1010505.JPG	blade.
P1010506.JPG	piston/cylinder.
P1010507.JPG	piston/cylinder.
P1010508.JPG	piston/cylinder.
P1010509.JPG	spinner dome.
P1010510.JPG	spinner dome.
P1010511.JPG	spinner dome.
P1010512.JPG	clamp fracture.

P1010513.JPG	clamp fracture.
P1010514.JPG	clamp fracture.
P1010515.JPG	bolt hole.
P1010516.JPG	bolt hole.
P1010517.JPG	misc. pic.
P1010518.JPG	found missing tip at accident site.
P1010519.JPG	found missing tip at accident site.
P1010520.JPG	8130. From Ottosen propellers.
P1010521.JPG	blade shank.

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TESTING CERT #2866.01

GE Aviation
S-400 Code 63311
Exp. 3/31/2017

Metallurgical Laboratory Report

Report to: Hartzell Propeller
[redacted]
Piqua, OH 45356
Attn.: Mr. Ron Stutsman

Date: 05-March-2015
P.O. No.: Verbal, Stutsman
Report No.: Met-5374

Report on: One (1) Cracked Clamp half submitted for fracture analysis.

Sample ID: Clamp S/N 3126A; P/N D-6831-1A; Hub Arm B

Test Method: The fracture surfaces were removed by saw cutting, cleaned ultrasonically in a non chlorinated, alkaline cleaner, followed by ultrasonic cleaning in acetone. The fracture morphology was characterized using stereo microscopy and Scanning Electron Microscopy (SEM).

Test Summary: The crack in this Clamp half section resulted from tensile overload of a ductile material. There was no evidence of fatigue cracking.

American Testing Services, Ltd.
[redacted]
Manager, Metallurgical Laboratory

American Testing Services, Ltd.

Metallurgical Laboratory Report

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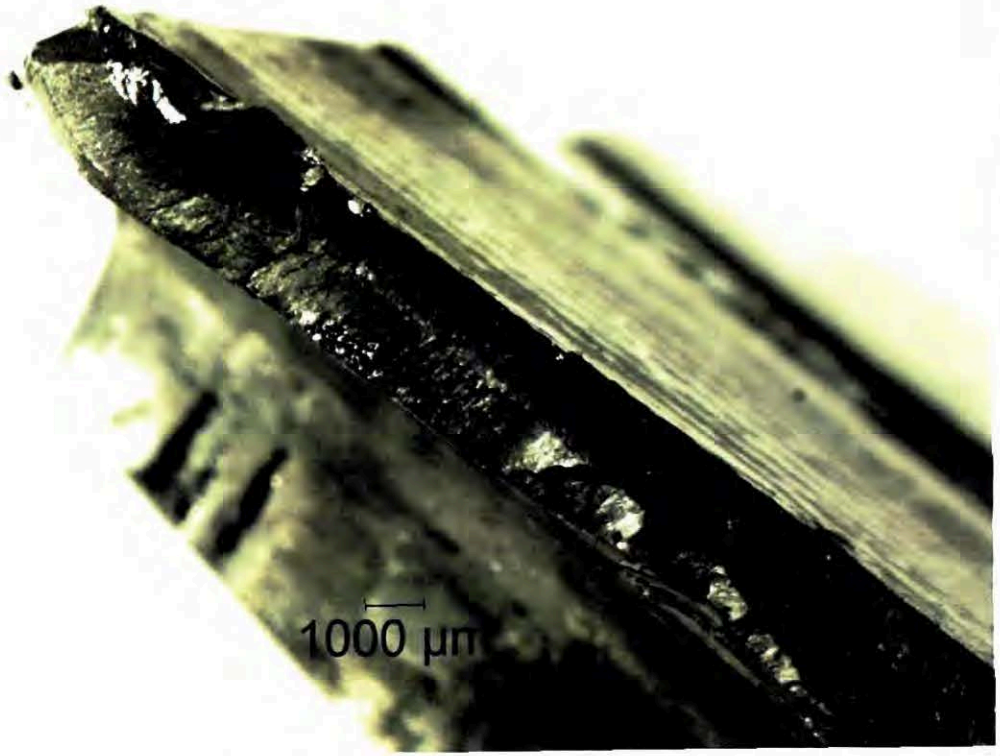
S-400 Code 63311
Exp. 3/31/2017

Report to: Hartzell Propeller
[redacted]
Piqua, OH 45356
Attn.: Mr. Ron Stutsman

Date: 05-March-2015
P.O. No.: Verbal, Stutsman
Report No.: Met-5374

Test Results:

The crack extends from the bolt hole region and is accompanied by a considerable amount of plastic deformation.



The fracture surface shows some obvious tearing as well as some smooth features and multiple origins stemming from the bolt hole surface. These features were examined using Scanning Electron Microscopy.

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S-400 Code 63311
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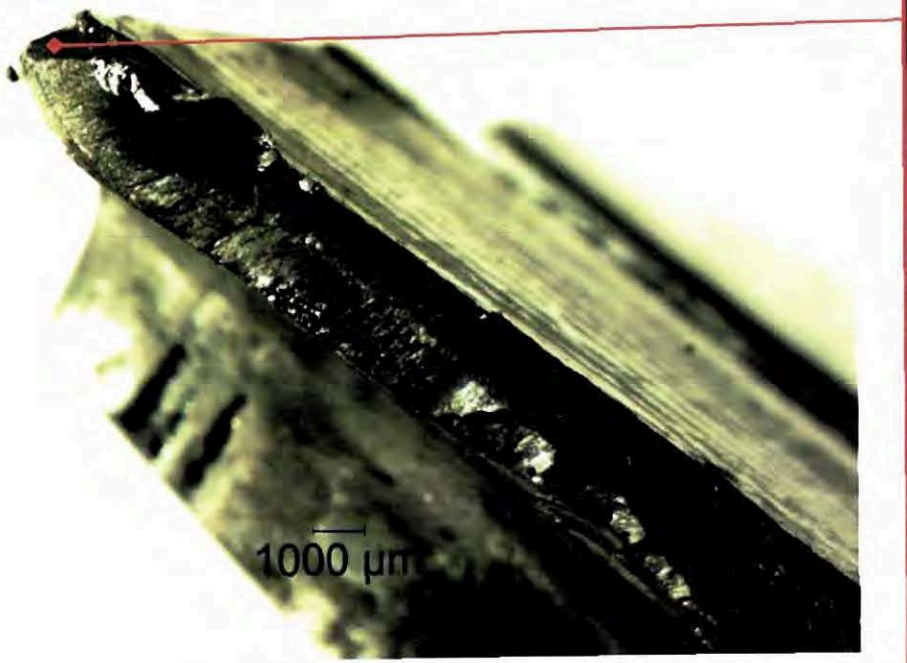
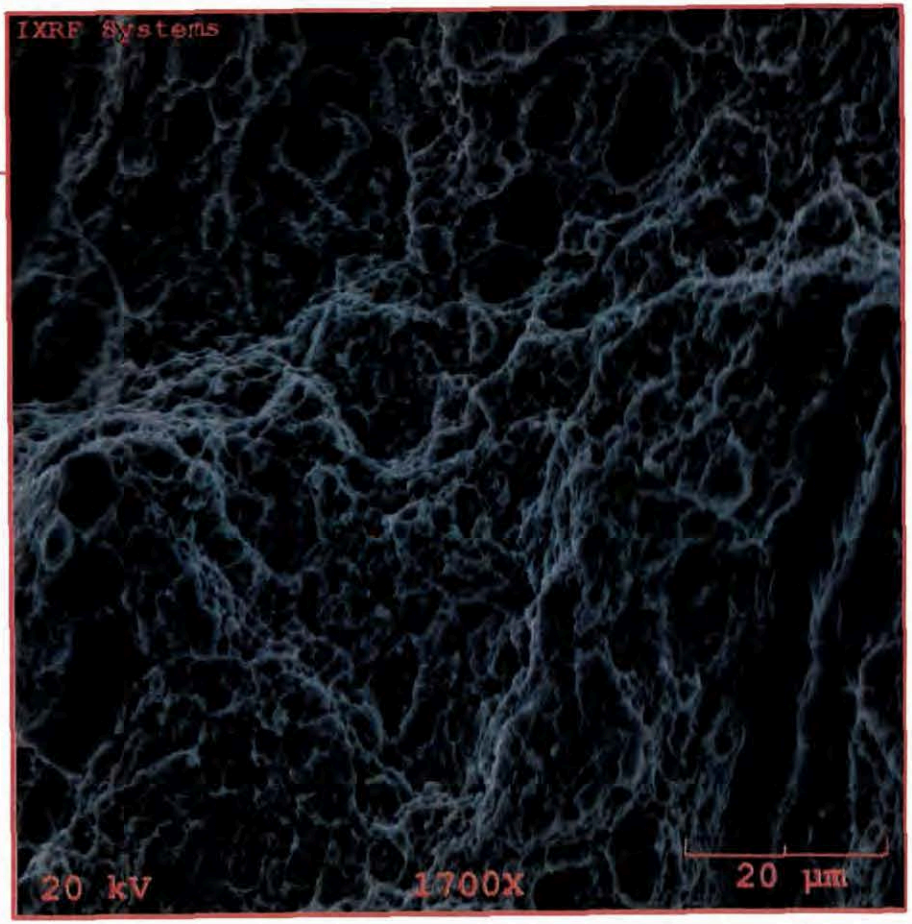
[redacted]
Piqua, OH 45356
Attn.: Mr. Ron Stutsman

Date: 05-March-2015
P.O. No.: Verbal, Stutsman
Report No.: Met-5374

Test Results:





This corner of the fracture surface displays mixed fine dimples due to microvoid coalescence and is indicative of single load event failure of a ductile material.

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Piqua, OH 45356
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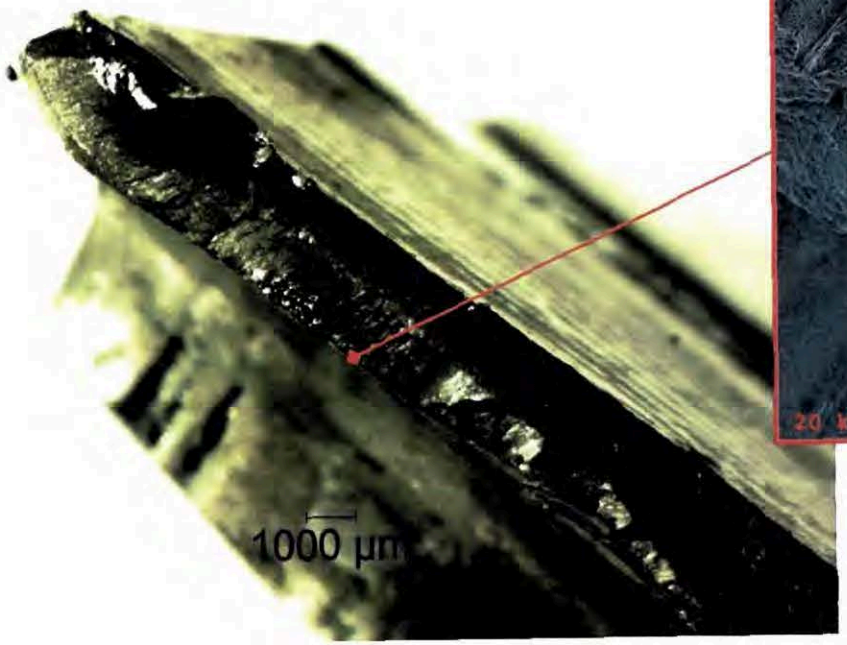
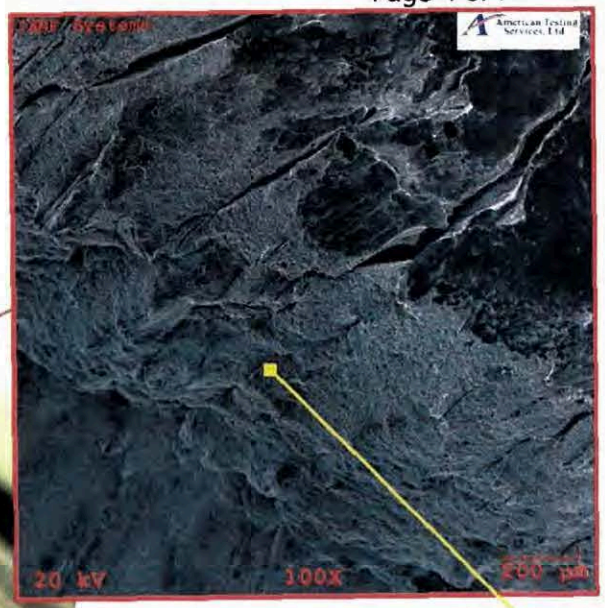
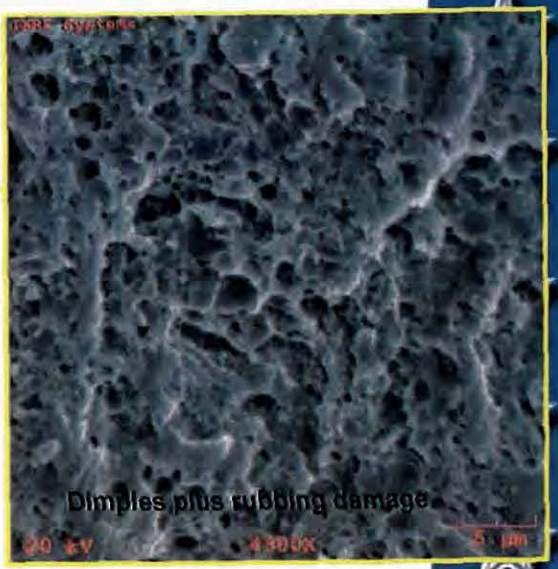
Report No.: Met-5374

Test Results:







This view, near the bolt surface and origin, shows what appears to be a collection of fine near surface dimples and an area above of rubbing damage. As a general rule the fracture face displayed considerable damage due to rubbing of the surfaces, making interpretation more difficult. Higher magnification imagery confirmed the presence of ductile overload.

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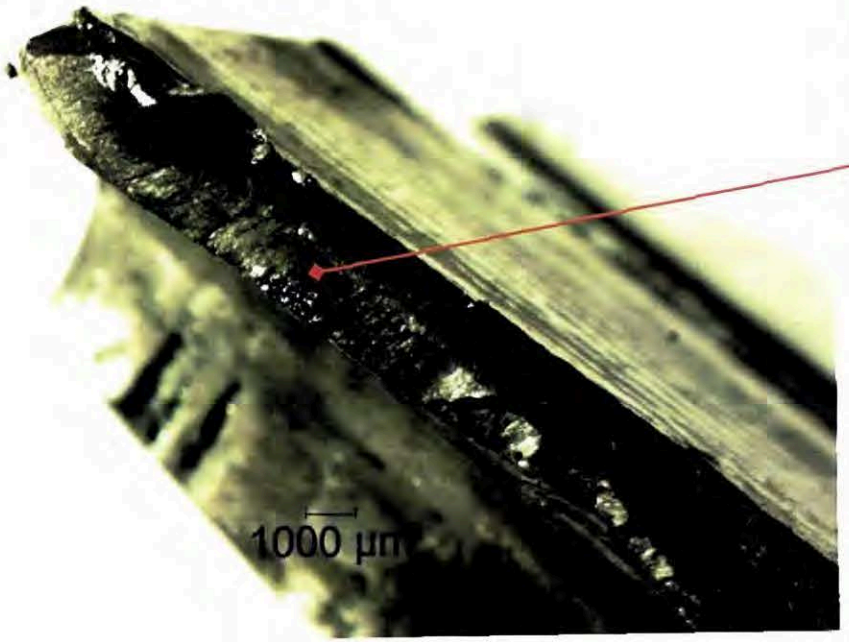

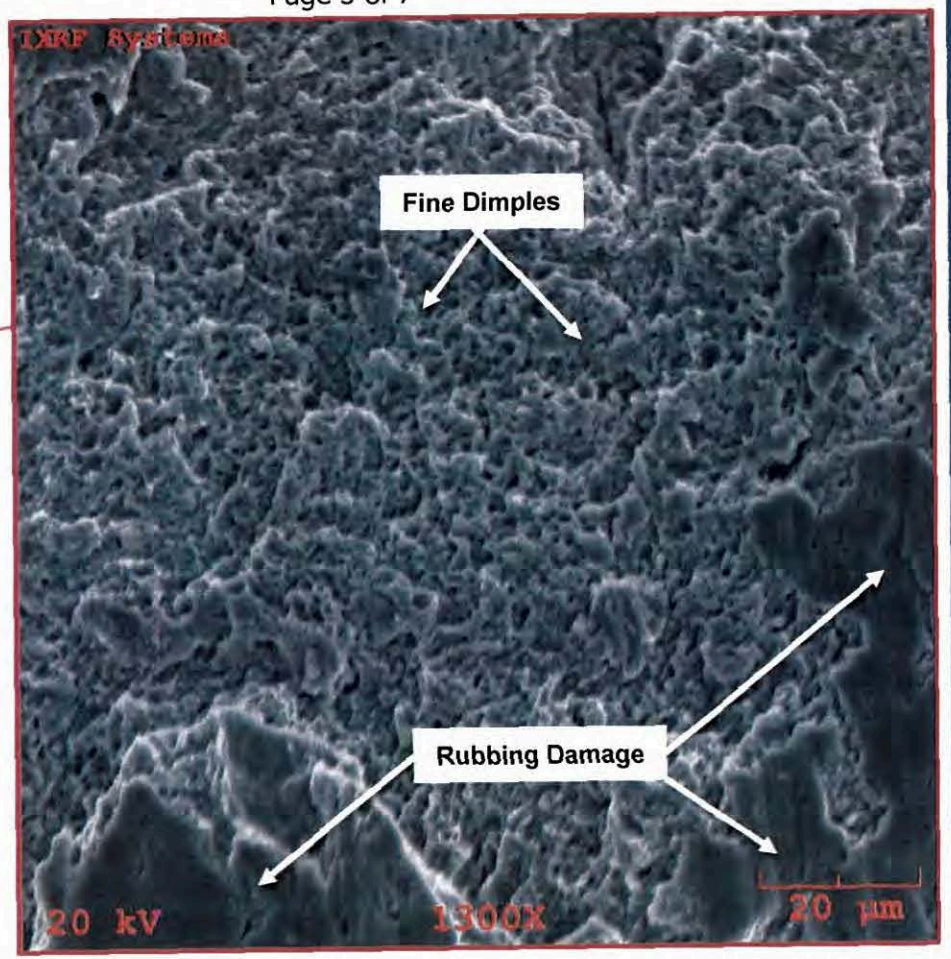

Just above this region of apparent rubbing damage the SEM examination, once again, confirms the presence of very fine shear dimples, indicative of ductile overload.

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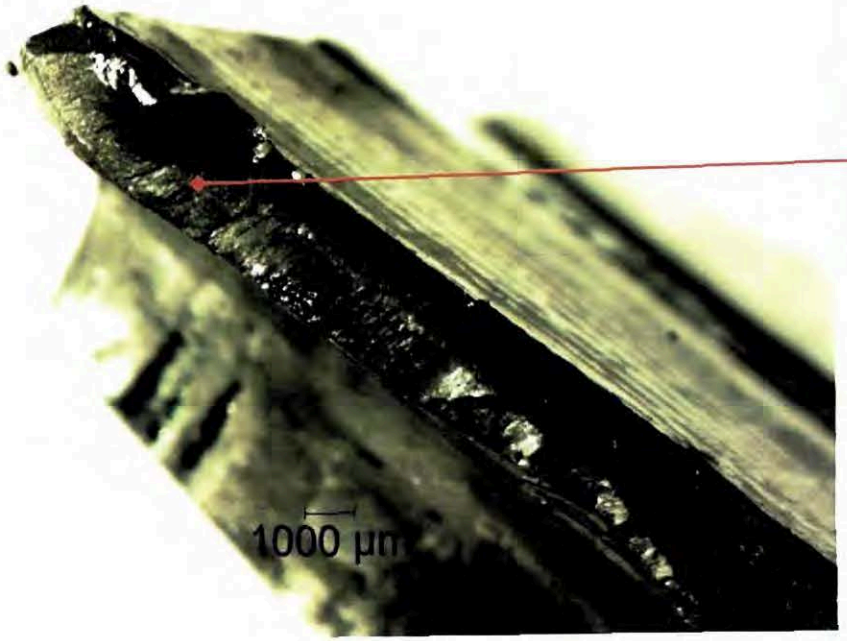
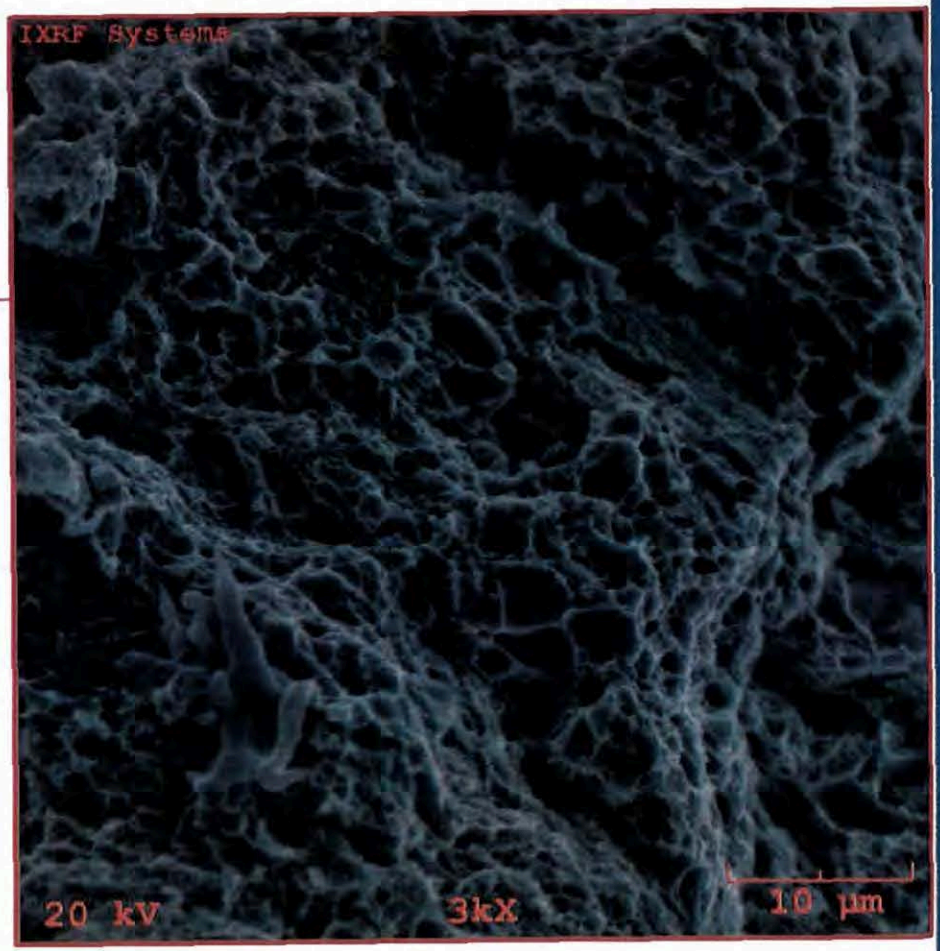
Piqua, OH 45356
Attn.: Mr. Ron Stutsman

Date: 05-March-2015
P.O. No.: Verbal, Stutsman
Report No.: Met-5374

Test Results:





This SEM image at approximately 3000x magnification clearly shows the fine nature of the dimpled structure developed across this fracture face.

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S-400 Code 63311
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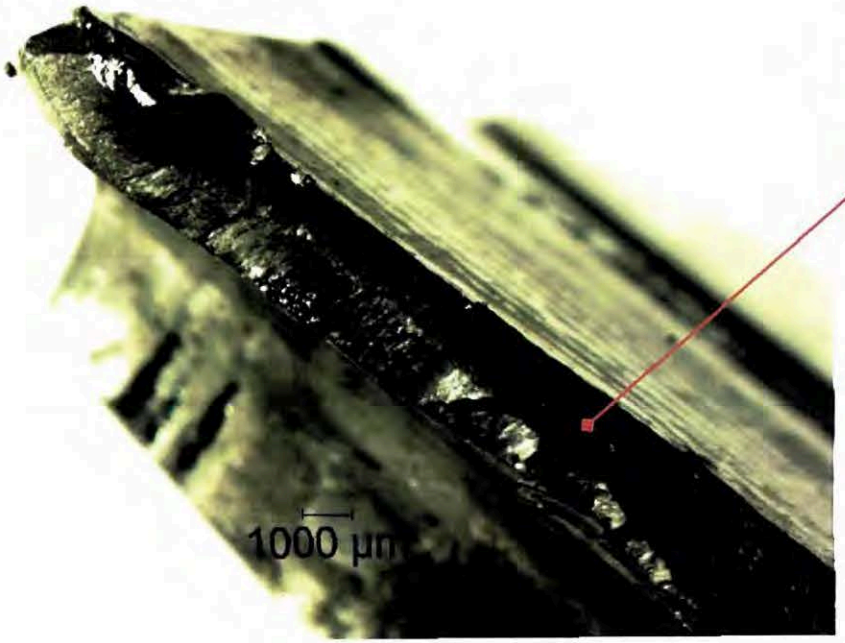
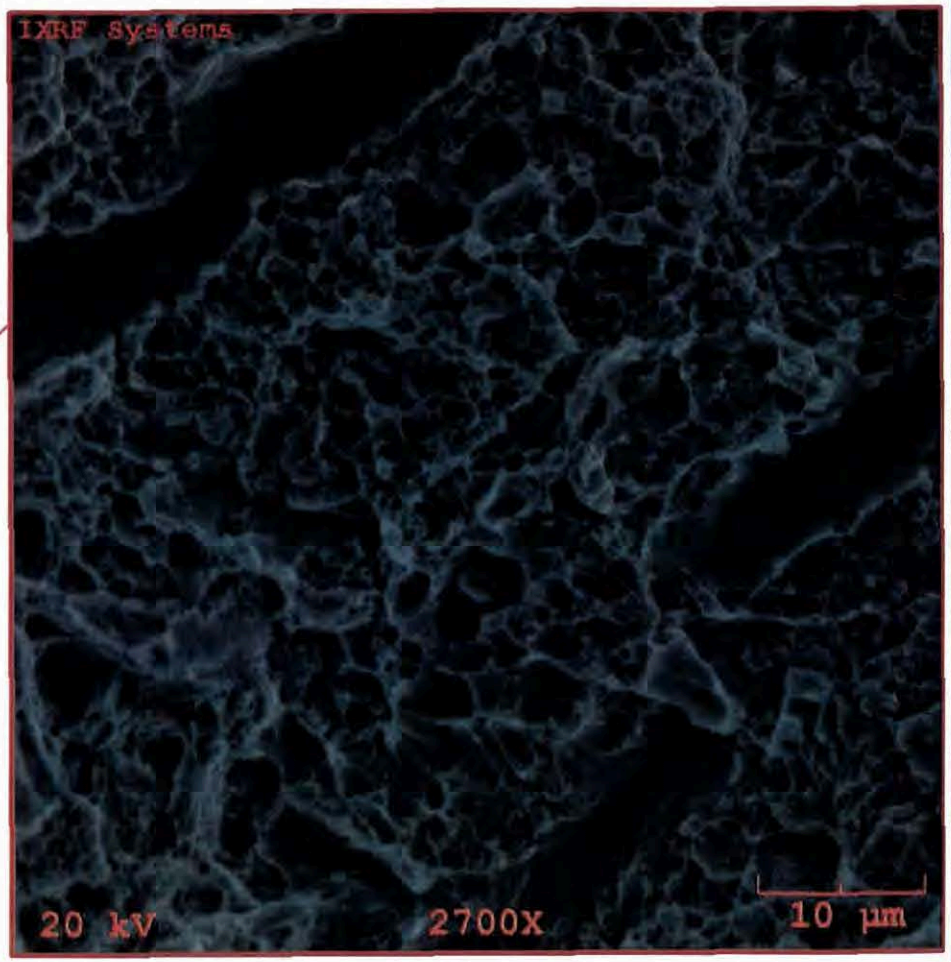
Report to: Hartzell Propeller
[redacted]
Piqua, OH 45356
Attn.: Mr. Ron Stutsman

Date: 05-March-2015
P.O. No.: Verbal, Stutsman
Report No.: Met-5374

Test Results:





This coarser region of the fracture face contained more ductile tearing and less rubbing damage. Smooth parallel features seen in the view at right are believed to be related to microstructural features in the quenched and tempered steel.

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Exp. 3/31/2017

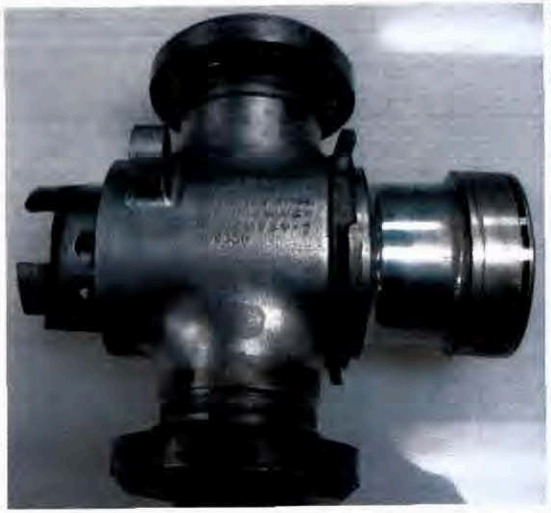
Metallurgical Laboratory Report

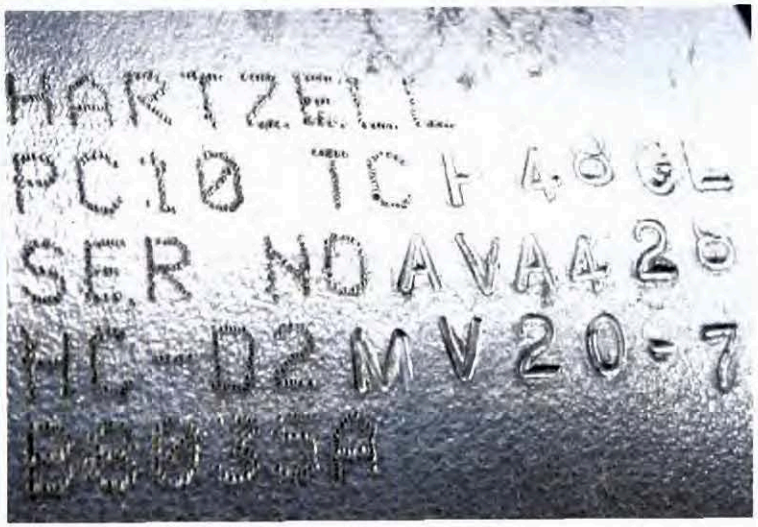
Report to: Hartzell Propeller
[redacted]
Piqua, OH 45356
Attn.: Mr. Ron Stutsman

Date: 09-March-2015
P.O. No.: Verbal, Stutsman
Report No.: Met-5381

Report on: One (1) two way hub for fractographic examination of Pilot Tubes.

Sample ID: Prop Model HC-D2MV20-7; Hub S/N AVA428; Pilot Tubes Marked A and B





Test Method: The fracture surfaces were removed by saw cutting, cleaned ultrasonically in a non chlorinated, alkaline cleaner, followed by ultrasonic cleaning in acetone. The fracture morphology was characterized using stereo microscopy and Scanning Electron Microscopy (SEM).

Test Summary: Both Pilot Tubes failed by overload. There was no evidence of fatigue cracking.

American Testing Services, Ltd.
[redacted]
Manager, Metallurgical Laboratory

Report to: Hartzell Propeller
[redacted]
Piqua, OH 45356
Attn.: Mr. Ron Stutsman

Date: 09-March-2015
P.O. No.: Verbal, Stutsman
Report No.: Met-5381

Test Results:

View of Pilot tube fractures, as received, and prior to removal for examination. Both tubes fractured immediately adjacent to the Hub face.

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GE Aviation
S-400 Code 63311
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Metallurgical Laboratory Report

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[redacted]
Piqua, OH 45356
Attn.: Mr. Ron Stutsman

Date: 09-March-2015
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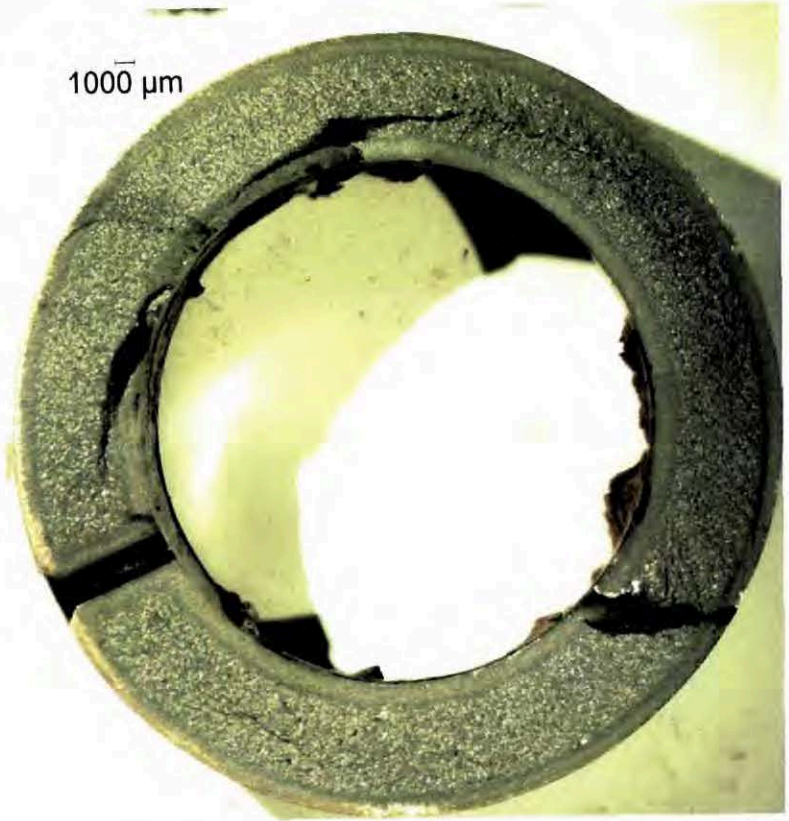
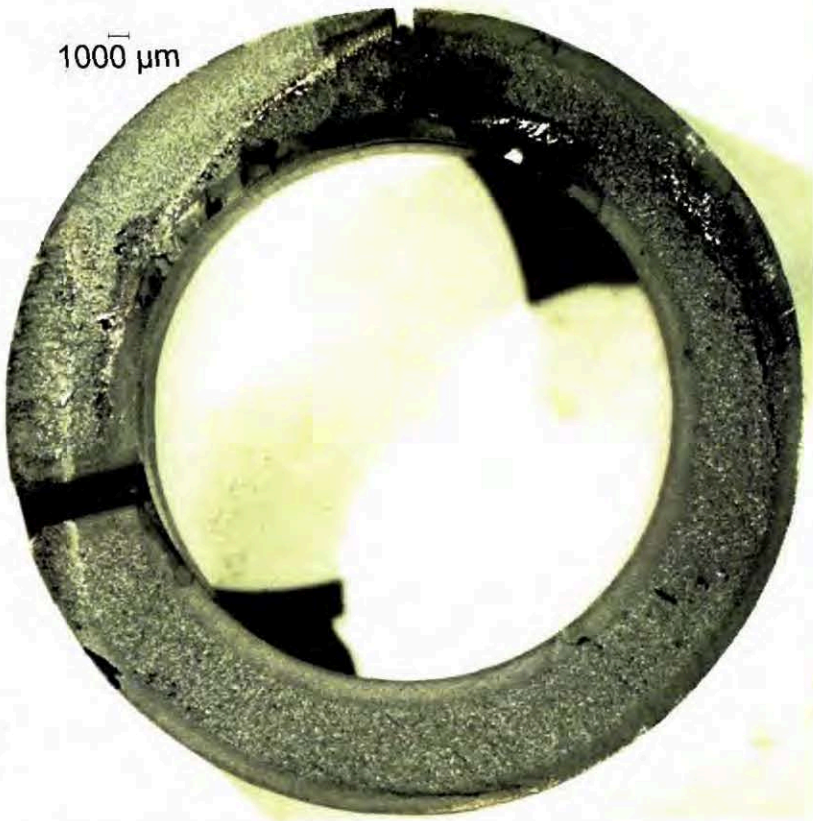
Report No.: Met-5381

Test Results:





Both fractured Pilot tubes exhibit similar features. The fractures show bright crystalline facets indicative of cleavage fracture of a high hardness, quenched and tempered steel. The smooth, well defined bands adjacent to the OD and ID surfaces are case hardened zones.

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Metallurgical Laboratory Report

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[redacted]
Piqua, OH 45356
Attn.: Mr. Ron Stutsman

Date: 09-March-2015
P.O. No.: Verbal, Stutsman
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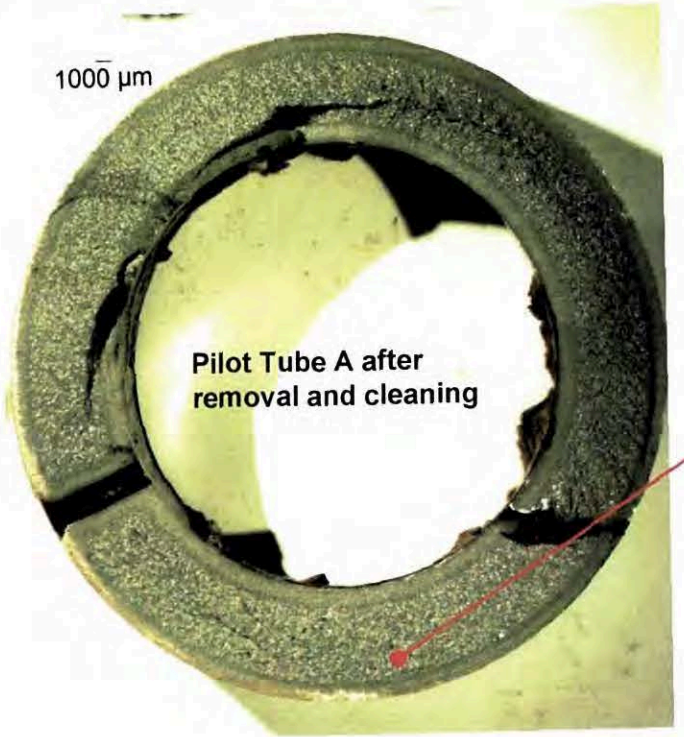
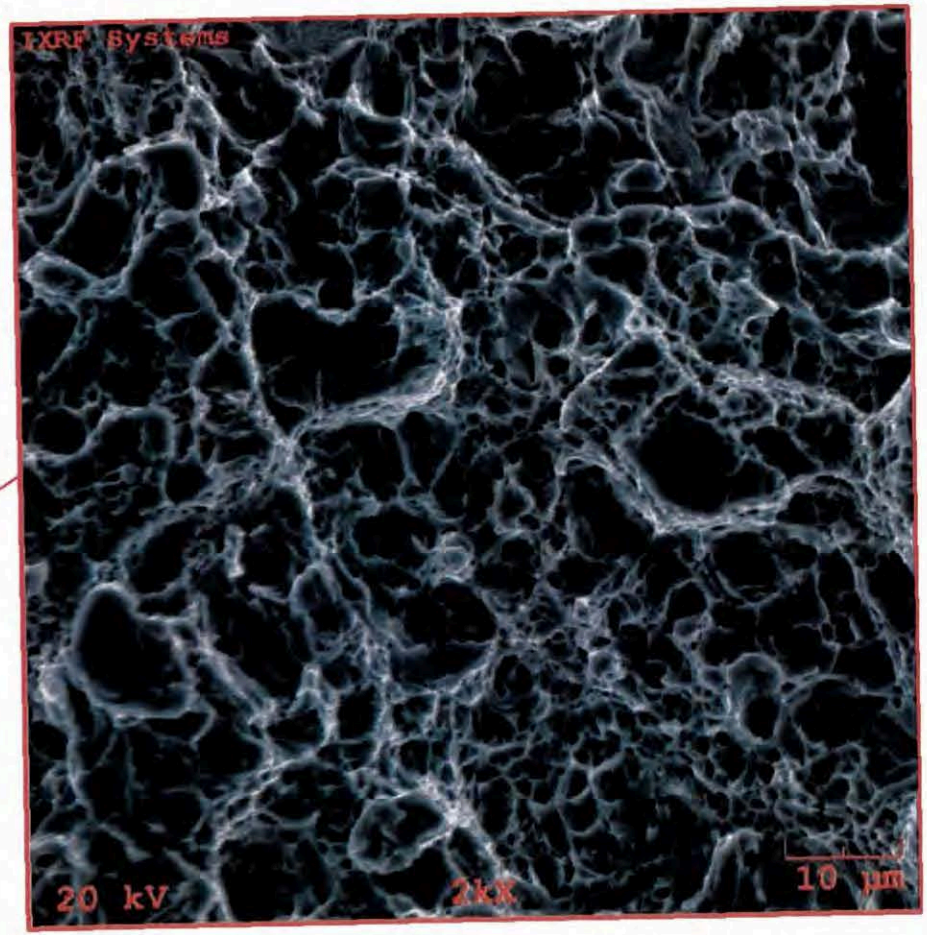
Test Results:





This fracture region is typical of many areas on the surface and displays a mix of microvoid coalescence and cleavage, both indicative of sudden overload.

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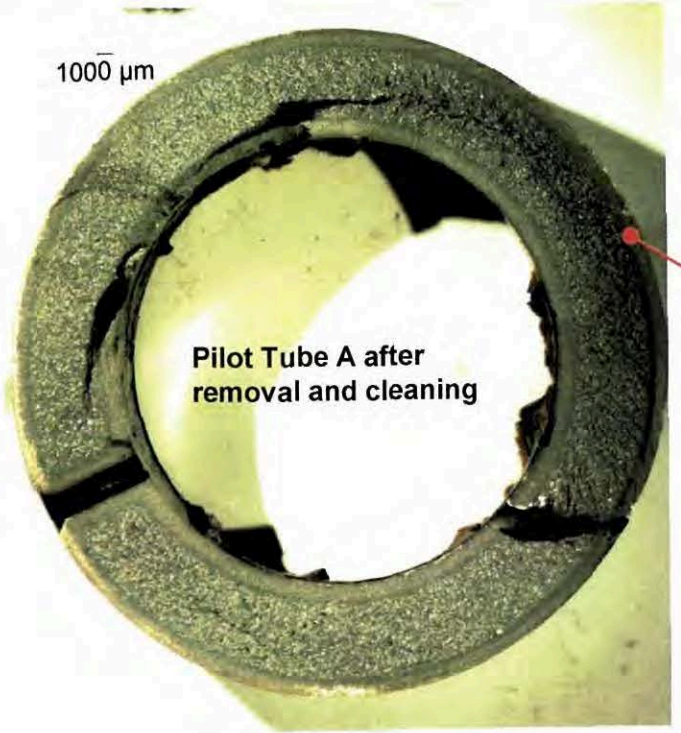
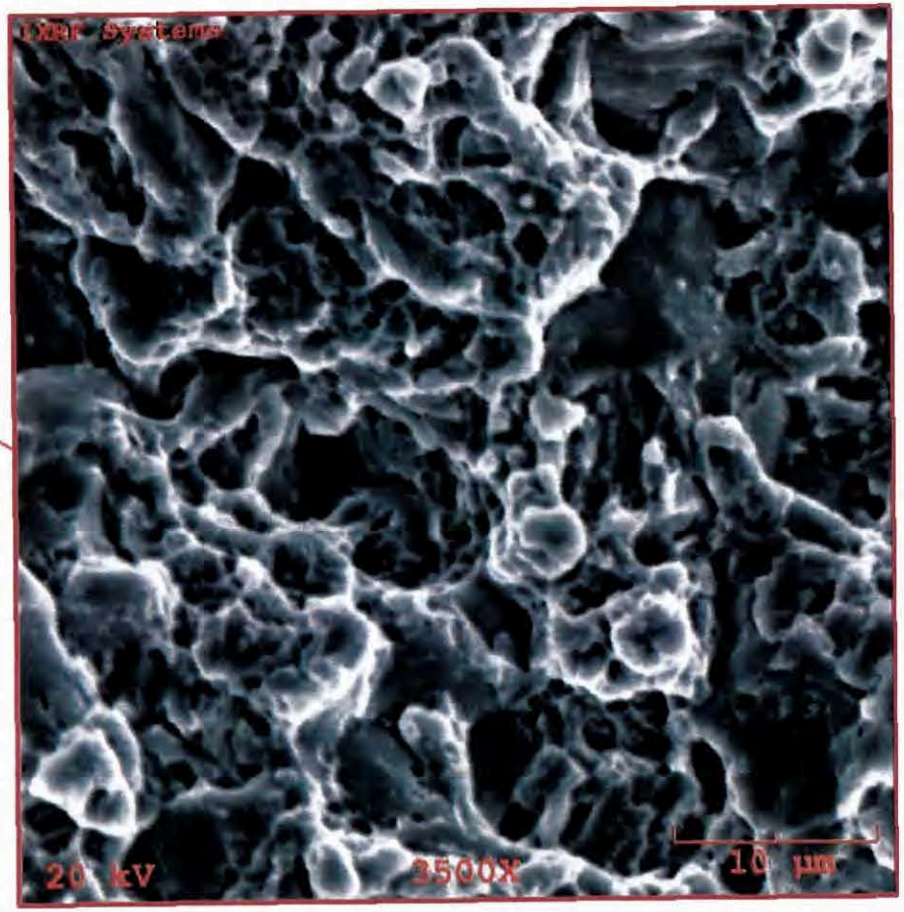
Metallurgical Laboratory Report

Report to: Hartzell Propeller
[redacted]
Piqua, OH 45356
Attn.: Mr. Ron Stutsman

Date: 09-March-2015
P.O. No.: Verbal, Stutsman
Report No.: Met-5381

Test Results:





The case hardened band, near the OD surface appears to have failed by a mix of fracture at the prior austenite grain boundaries and quasicleavage. Some microvoid coalescence is also visible. These case hardened bands would display less ductility than the softer core.

Metallurgical Laboratory Report

Report to: Hartzell Propeller
[redacted]
Piqua, OH 45356
Attn.: Mr. Ron Stutsman

Date: 09-March-2015
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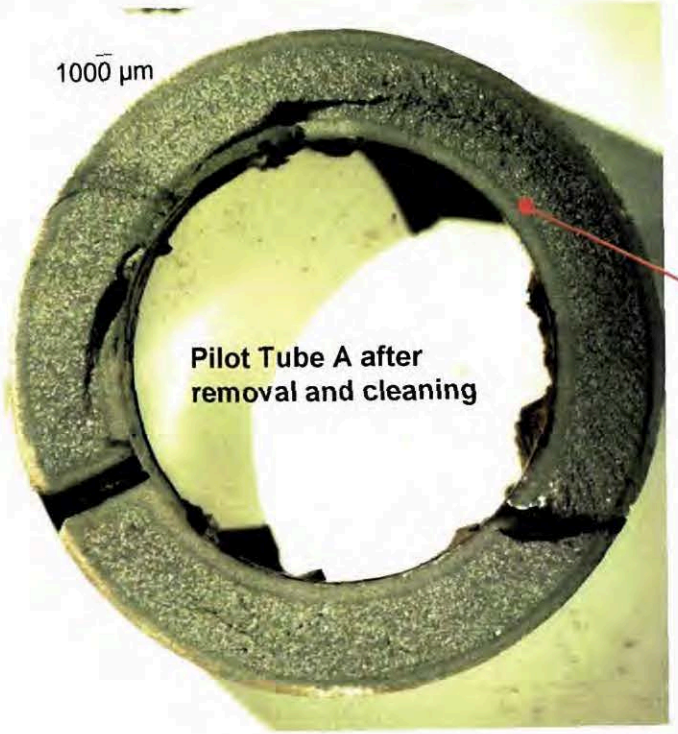
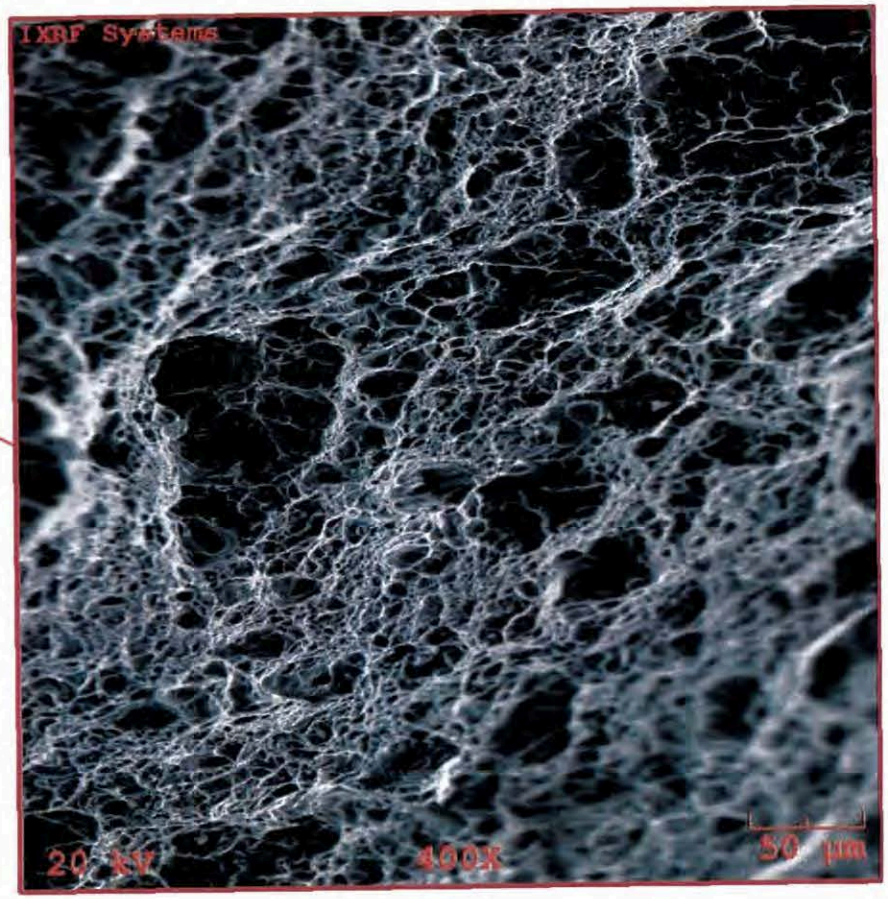
Report No.: Met-5381

Test Results:





The transition zone, just blow the inner case hardened zone, shows a mix of microvoid coalescence (dimples) and cleavage fracture. This zone is more ductile than the hardened case, as expected.

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Metallurgical Laboratory Report

AS 9100

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Date: 09-March-2015
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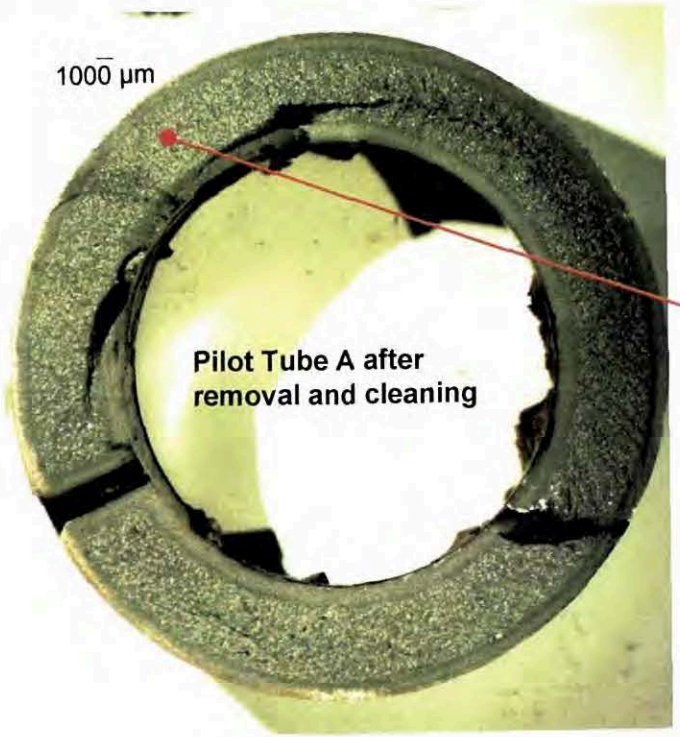
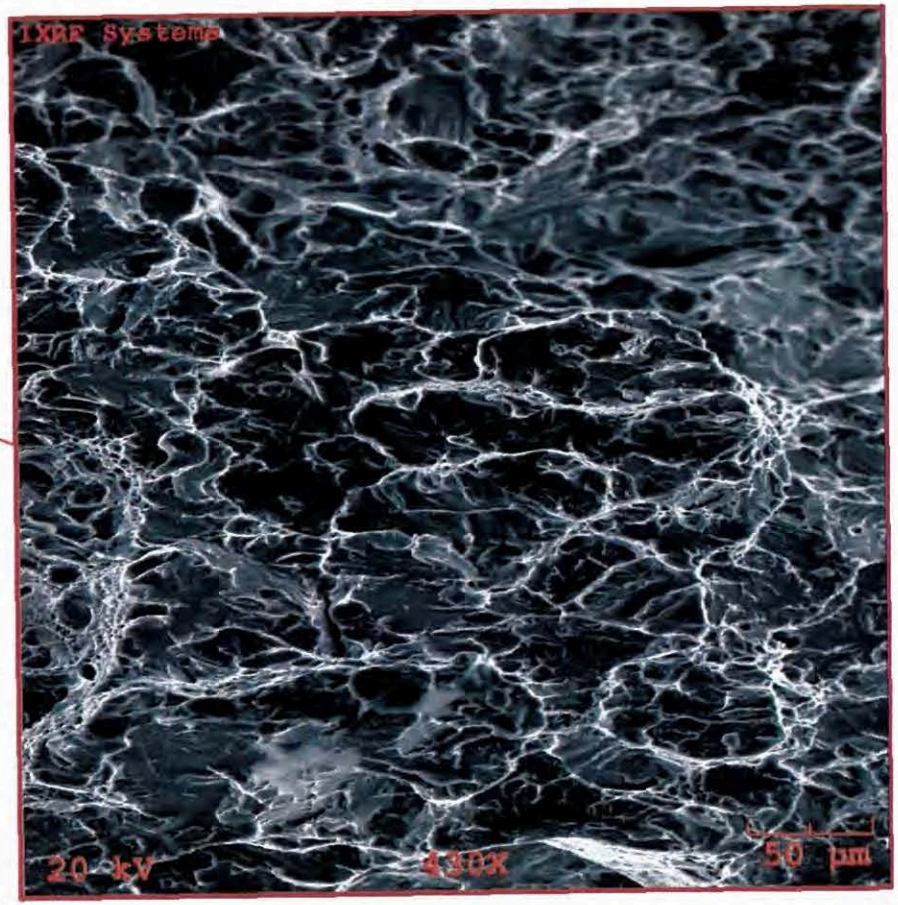
Report No.: Met-5381

Test Results:





This area of the fracture surface is predominantly cleavage fracture, indicating the crack front was moving quickly through this region.

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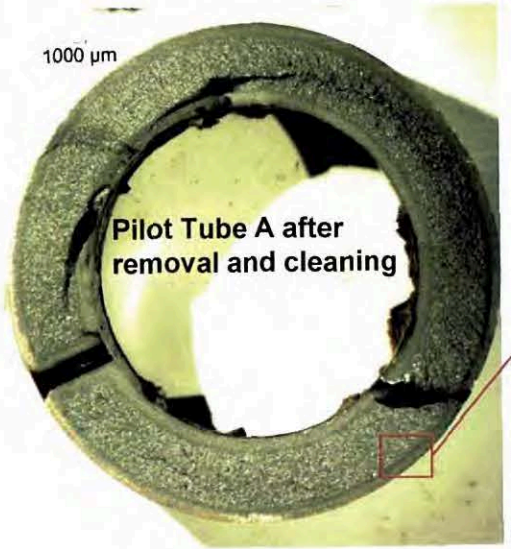
GE Aviation
S-400 Code 63311
Exp. 3/31/2017

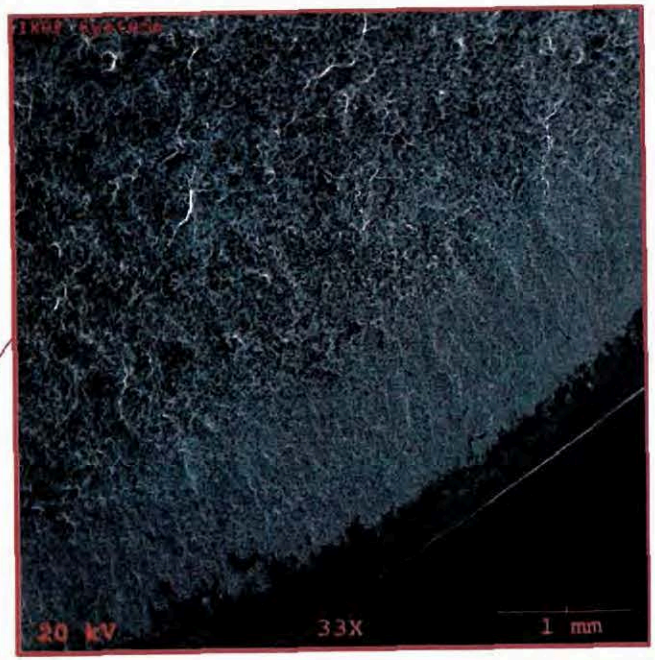
Metallurgical Laboratory Report

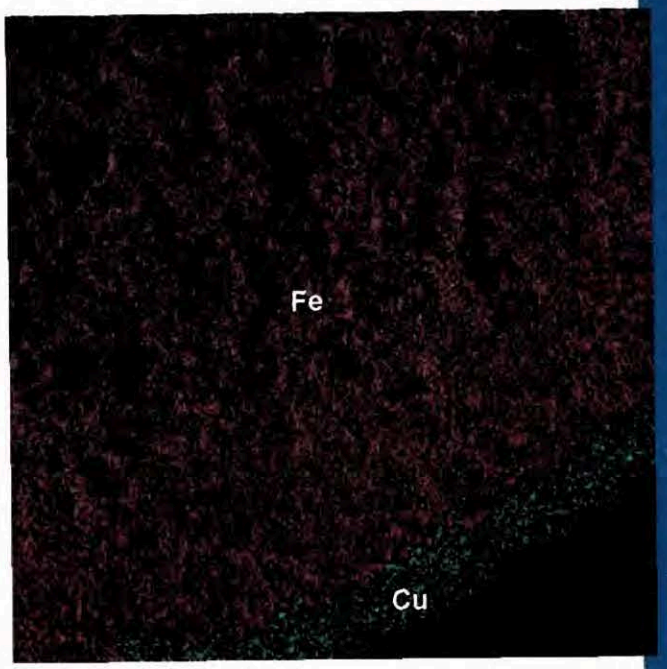
Report to: Hartzell Propeller
[redacted]
Piqua, OH 45356
Attn.: Mr. Ron Stutsman

Date: 09-March-2015
P.O. No.: Verbal, Stutsman
Report No.: Met-5381

Test Results:







Material transfer along a portion of the outer edge of the fracture surface was determined to be Copper. The Client reports that a bronze bushing may have come in contact with this surface after failure.

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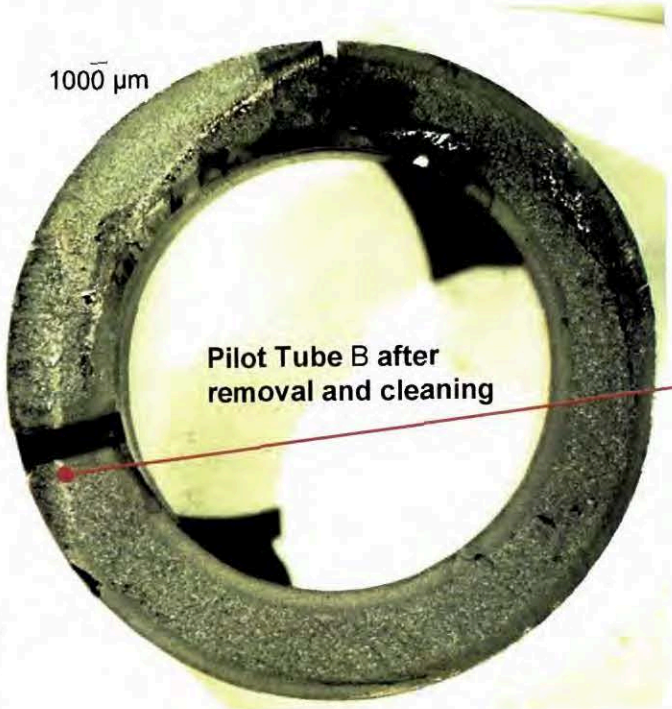

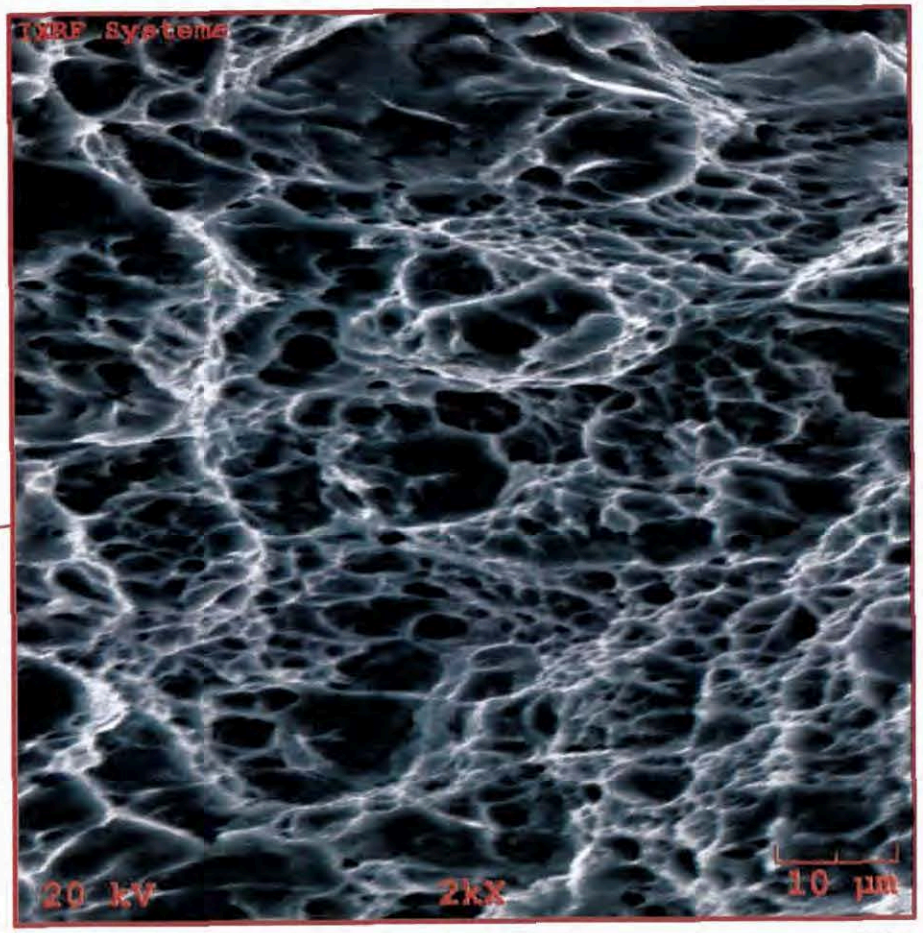

This fracture region is typical of many areas on the surface and displays a mix of microvoid coalescence and cleavage, both indicative of sudden overload.

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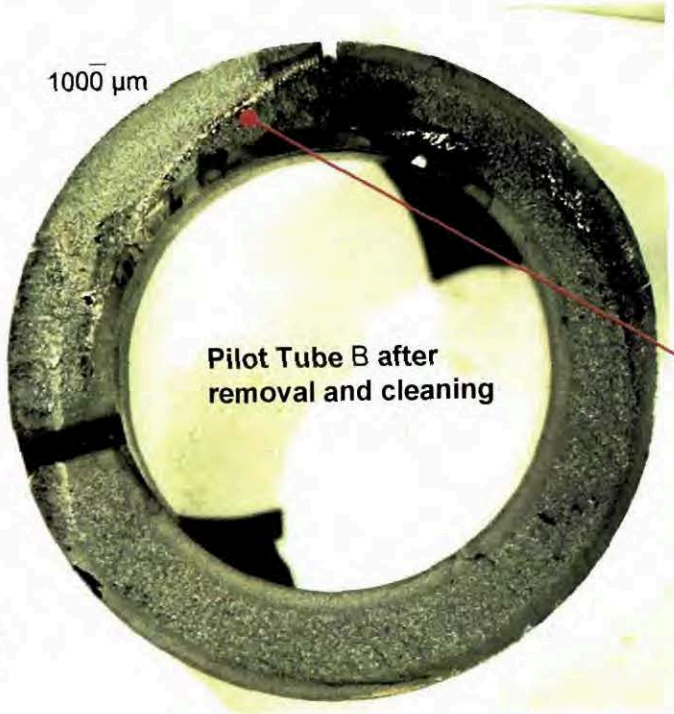
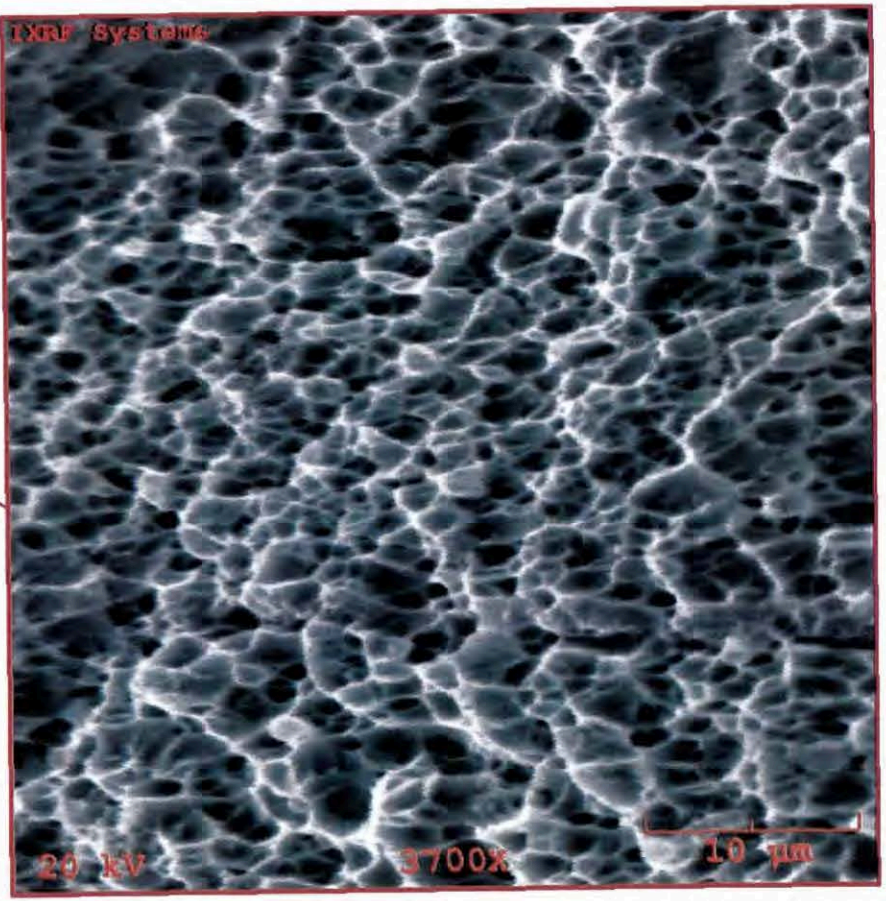
Test Results:





This area of the fracture face is comprised primarily of fine ductile dimples resulting from microvoid coalescence. Failure was by tensile/shear overload of a ductile material.

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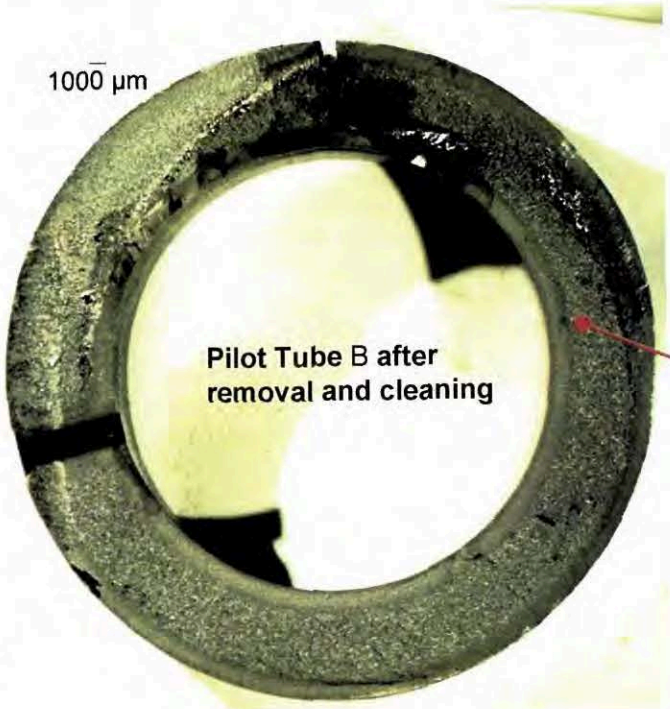

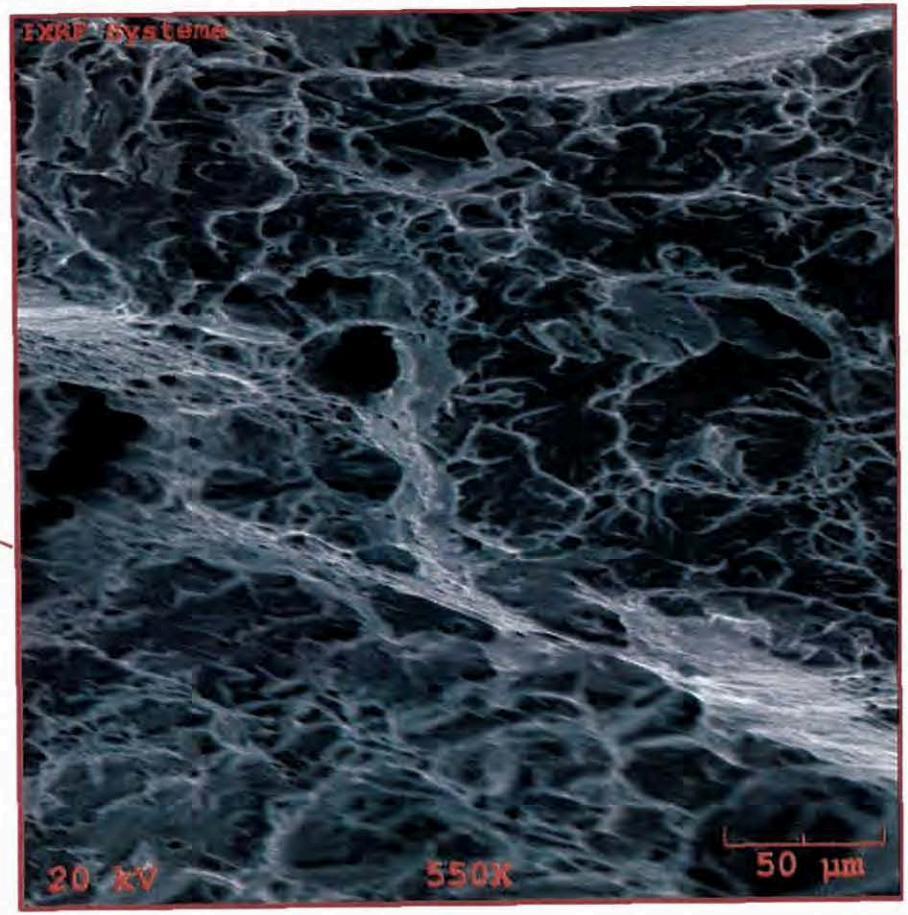

This region consists of coarse cleavage facets with some microvoid coalescence. The crack front was progressing quickly through this area.

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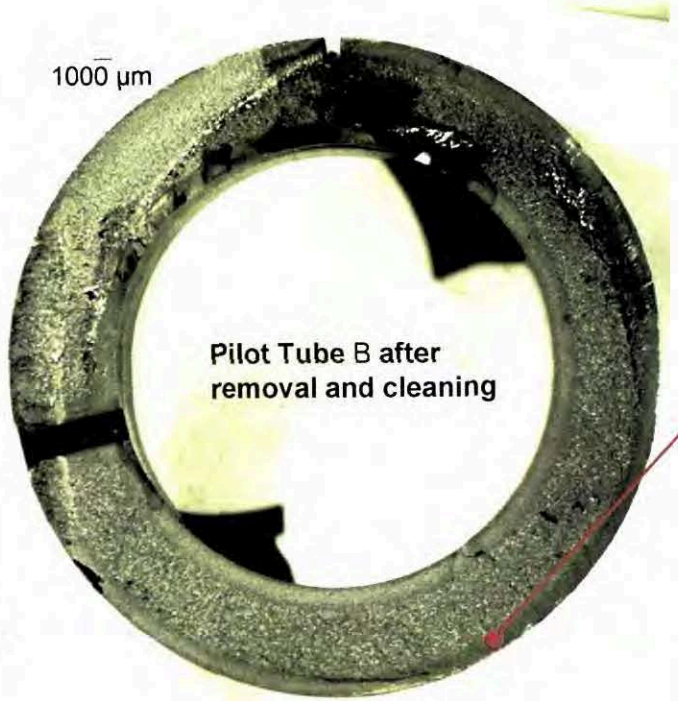

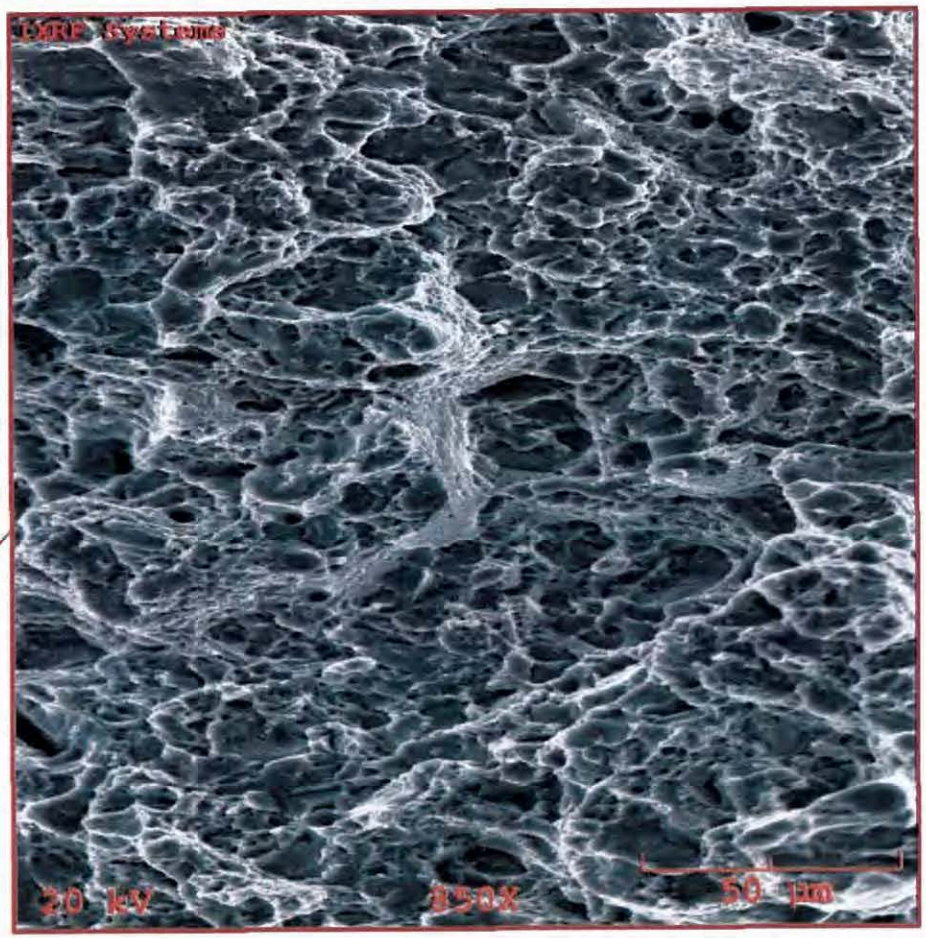

The outer case hardened zone has failed by intergranular separation and quasicleavage due to it's higher hardness and lower ductility.