

Accident / Incident Report

P&WC 8114 (11-98)

**Pratt & Whitney Canada**

A United Technologies Company

Report No.: 15-085

**Majestic Air LLC
Piper PA46-500TP, Aircraft Reg. No. N819TB
Saranac Lake, New York
August 7, 2015
PT6A-42A
S/N RM0122**

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I ANALYSIS

1.0 ACCIDENT SYNOPSIS

On August 7, 2015, a PPA46-500TP, Aircraft Reg. No. N819TB, collided with the terrain, shortly after take-off from Adirondack Regional Airport, Saranac Lake, New York. The pilot and three passengers were fatally injured. The aircraft was destroyed by impact and a post flight fire.

2.0 SUMMARY OF FINDINGS

The fractured propeller shaft and the torsional bending of the exhaust duct indicate the engine was producing power at impact.

The rotational signatures that were found on the compressor turbine vane, compressor turbine baffle, compressor turbine, 1st stage power turbine vane, and the 1st stage power turbine indicate they were rotating under power at impact with the terrain.

The bent 1st stage compressor rotor blades indicate the compressor was rotating under power during impact with the terrain. The ingested debris in the gas generator case also indicates engine operation during impact with the terrain.

There were no indications of any pre-impact distress found to any of the examined components.

DISCUSSION

Although the reversing lever guide pin bracket was installed inverted on the reduction gearbox mounting flange, a detailed propeller examination conducted by Hartzell Propellers showed the propeller was not in feather, indicating that the carbon block was in position and the inverted reversing lever guide pin bracket did not contribute to the event.

3.0 CONCLUSIONS

The engine exhibited contact signatures to its internal components characteristic of an engine producing power at the time of impact.

Excluding the inverted reversing lever guide pin bracket, the engine did not display any indications of any pre-impact anomalies or distress that would have precluded normal engine operation.



II FACTUAL INFORMATION

1.0 INVESTIGATION PARTICIPANTS

The powerplant investigation was performed on August 9, 2015 at the accident site in Saranac Lake, New York. The following individuals participated in the investigation as representatives of their respective organisations:

Robert Gretz	National Transport Safety Board (NTSB) Senior Air Safety Investigator
Michael McClure	Piper Air Safety Investigator
Jeff Davis	Pratt & Whitney Canada (P&WC) Investigator

2.0 ENGINE HISTORY

PT6A-42 S/N PCE-RM0122

Hours Since New: 1388.8 per the last logbook entry on July 7, 2015

Cycles Since New: Unknown

Hours Since Overhaul: Not Applicable (N/A)

Cycles Since Overhaul: N/A



3.0 ENGINE EXAMINATION

All positional references are in relation to view from aft looking forward. Upstream and downstream references are in relation to gas path flow from the compressor inlet to exhaust.

- 3.1 **External Condition:** The engine was attached to the aircraft with the engine mounts (Ref. Photos No. 1 & 2). The propeller and a portion of the front reduction gearbox had separated from the engine (Ref. Photo No. 3). Photos No. 4 & 5 show the top and bottom of the engine after it was removed from the airframe mounts. Photo No. 6 shows the fractured region of the front reduction gearbox and the fractured propeller shaft. Photo No. 7 shows the 1 bearing and 1st stage compressor rotor blades were exposed due to the post flight fire burning of the accessory gearbox housing and the inlet case. Portions of the propeller shaft and front reduction gearbox were attached to the propeller (Ref. Photo No. 8). Although the data plate was burnt, a magnifying glass was utilized to recover the engine serial number, PCE-RM0122 (Ref. Photo No. 9).



Photo No. 1, View of the engine attached to the aircraft

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Photo No. 2, View of the engine



Photo No. 3, View of the propeller and a section of the front reduction gearbox



Photo No. 4, A view of the top of the engine



Photo No. 5, A view of the bottom of the engine



Photo No. 6, A view of the front of the engine



Photo No. 7, A view of the rear of the engine



Photo No. 8, A view of the of the reduction gearbox components attached to the propeller



Photo No. 9, A view of the burnt data plate



3.1.1 External Cases

Reduction Gearbox: The gearbox housing was fractured at an angle from the propeller thrust bearing cover flange rearward to the mounting pads for the propeller governor and the tachometer generator (Ref. Photos No. 10 & 11). The bevel gearshafts for the propeller governor and tachometer generator drives were bent (Ref. Photos No. 12 & 13). A partial serial number “0122” was legible, painted on the gearbox housing (Ref. Photo No. 14).



Photo No. 10

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Photo No. 11



Photo No. 12



Photo No. 13



Photo No. 14



Exhaust Duct: The duct displayed torsional and compression bending (Ref. Photo No. 15).



Photo No. 15

Gas Generator Case: The case was bent and torn adjacent to left hand bleed valve port from external impact damage (Ref. Photo No. 16, red arrow). The exterior of the case was burnt, which was more pronounced at the bottom of the case (Ref. Photo No. 17). Some bent areas were also evident adjacent to the front drain valve (Ref. Photo No. 18, red arrow). Organic debris was evident in the bottom of the case after it was separated from the exhaust duct (Ref. Photo No. 19). The debris was ingested during impact with the terrain. The inside diameter was also discoloured from the 5-7 o'clock position from heat transfer as a result of the external post flight fire (Ref. Photo No. 19).



Photo No. 16



Photo No. 17

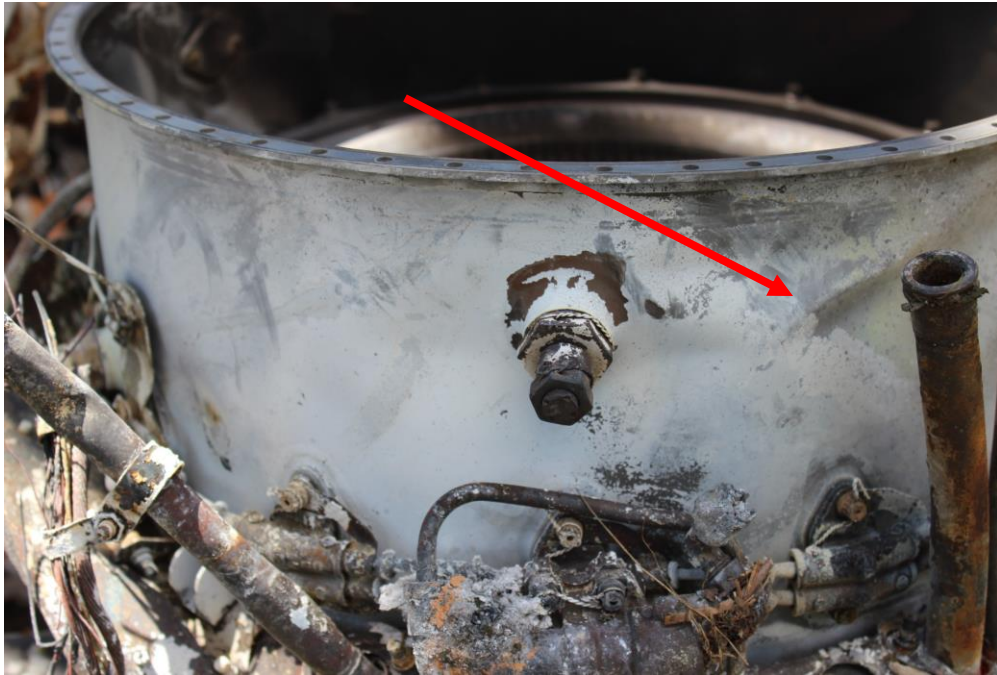


Photo No. 18



Photo No. 19



Accessory Gearbox: The accessory gearbox and inlet case were consumed in the post flight fire.

3.1.2 Power Control and Reversing Linkage: The front linkage was in place and secure (Ref. Photo No. 20). The wire rope was fractured during the separation of the propeller and front section of the gearbox separating from the engine (Ref. Photo No. 20, red arrow). The reversing lever guide pin bracket was installed inverted (Ref. Photo No. 21, arrow) and the carbon block was missing (Ref. Photo No. 21, yellow arrow). The reversing lever guide pin bracket (Ref. Figure 1, red arrow) retains the end propeller reversing lever (Ref. Figure 1, blue arrow) in position which keeps the carbon block engaged in the Beta ring. If the carbon block disengaged from the Beta ring, the propeller would have went into feather. The wire rope casing was fractured (Ref. Photo No. 22, red arrow) and the control terminal was fractured adjacent to the rear clevis (Ref. Photos No. 22, red oval & 23 blue arrow). The CAM box was recovered from the debris. The fuel control connecting rod was fractured (Ref. Photo No. 23, blue arrow) and the connection to the wire rope was fractured (Ref. Photo No. 23, red arrow).



Photo No. 20

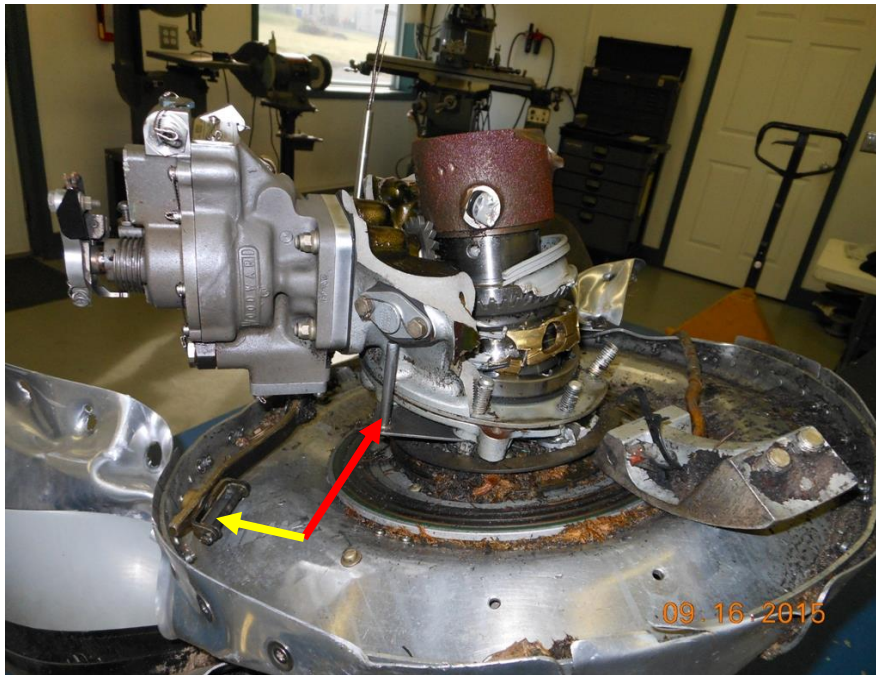


Photo No. 21, (Photo courtesy of Hartzell Propellers)

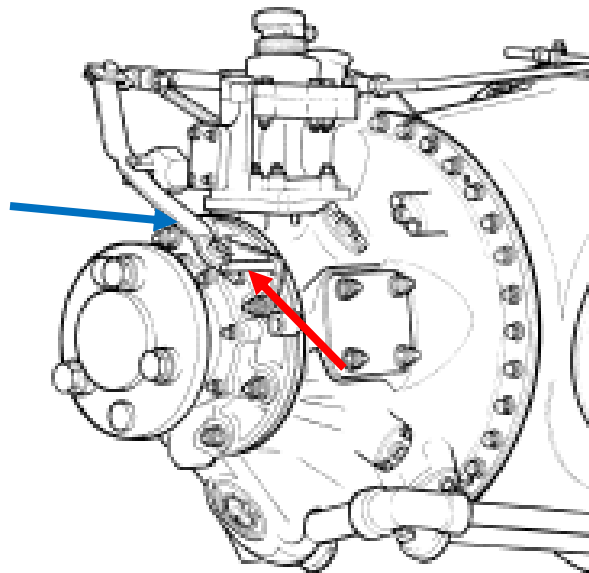


Figure 1

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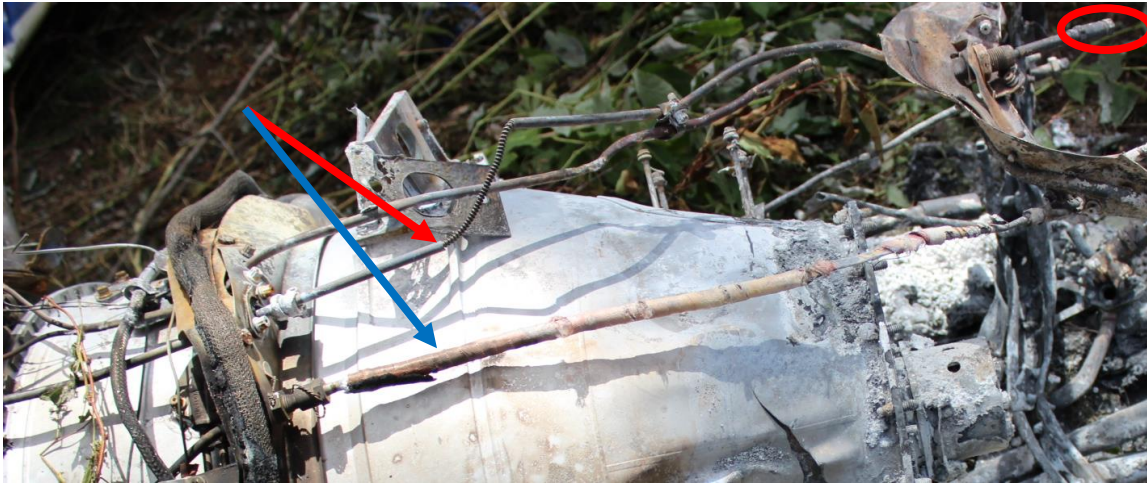


Photo No. 22

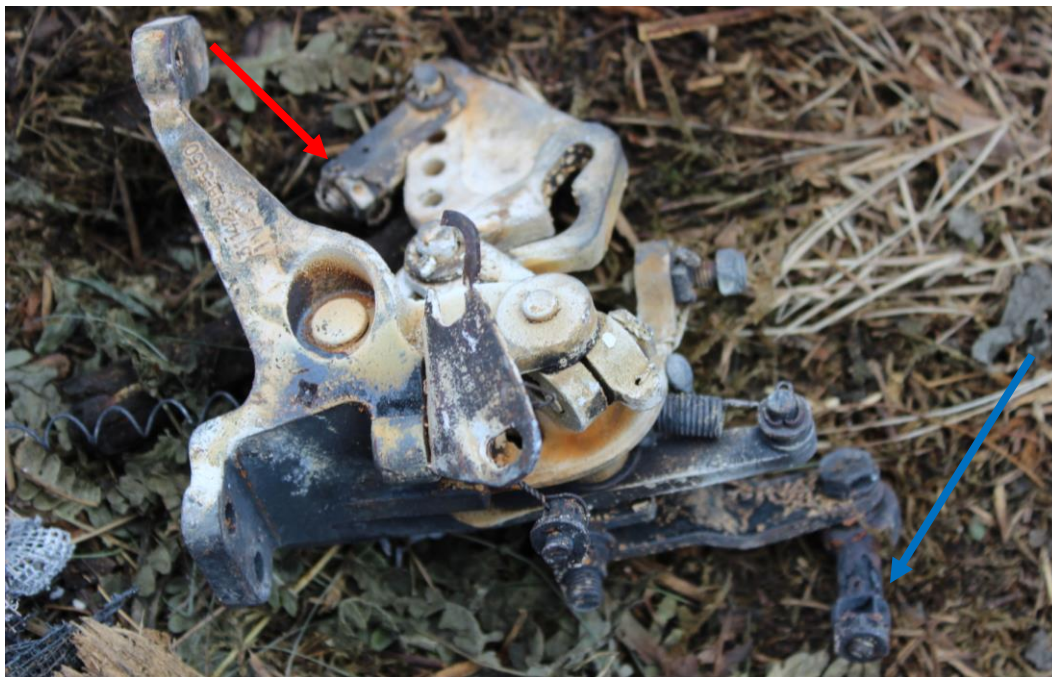


Photo No. 23



3.1.3 Pneumatic Lines

Compressor Discharge Air (P3): A section of the line was attached to the gas generator case. The burnt P3 air filter was recovered from the debris (Ref. Photo No. 25, blue arrow).

Power Turbine Control (Py): The line/fitting was fractured at the fitting for the propeller governor. The line attached to the torque limiter was complete to the centre fire seal. The line from the centre fire seal to the fuel control was in place with the fitting attached from the burnt fuel control (Ref. Photo No. 22, blue arrow).

3.1.4 Chip Detectors and Filters

Reduction Gearbox Chip Detector: The magnetic poles were covered with organic debris and some magnetic particles (Ref. Photo No. 24).



Photo No. 24

Oil Filter: Remnants of the oil filter and the burned P-3 air filter were recovered from the debris (Ref. Photo No. 25, red arrow).

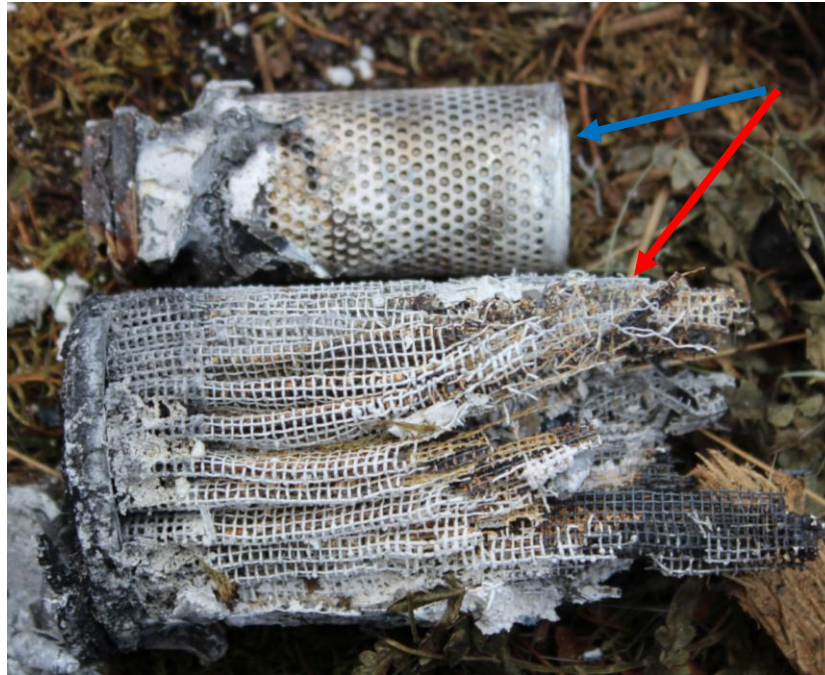


Photo No. 25

Fuel Filter: The fuel filter was destroyed in the post flight fire.

3.2 Disassembly Observations

3.2.1 Compressor Section

Compressor 1st, 2nd, and 3rd Stage Discs and Blades: The 1st stage blades were burnt and coated with burnt material (Ref. Photo No. 26). The blades exhibited impact damage, tearing and were bent opposite the direction of rotation (Ref. Photo No. 27). The 2nd stage blades, 3rd stage blades, and three discs were not accessed for the purposes of this investigation.



Photo No. 26

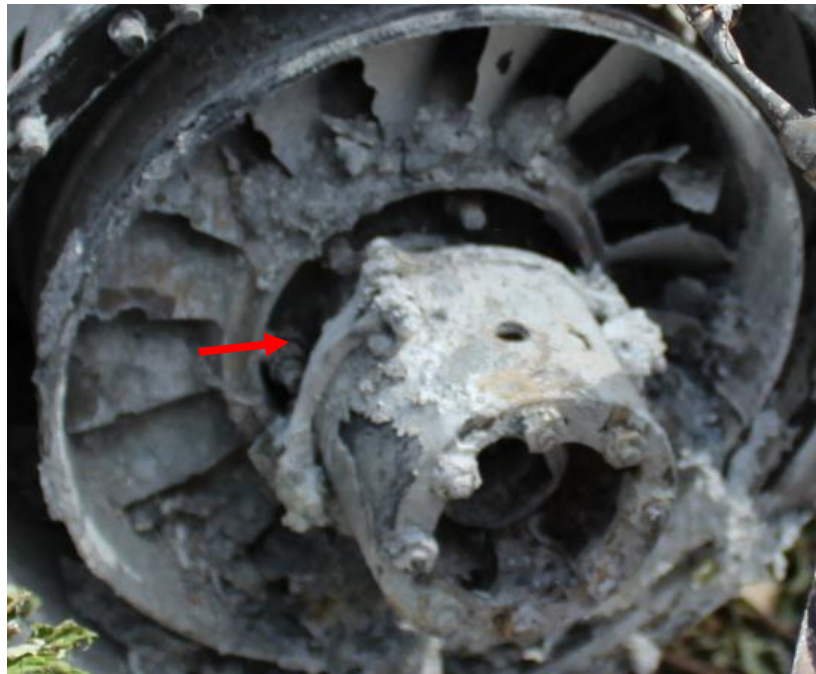


Photo No. 27



Compressor 1st, 2nd, and 3rd Stage Stators and Shrouds: The 1st stage shroud was coated with burnt material. The 2nd stage shroud, 3rd stage shroud, and the stators were not accessed for the purposes of this investigation.

Compressor 1st, 2nd, and 3rd Stage Spacers: The spacers were not accessed for the purposes of this investigation.

Centrifugal Impeller: The impeller was not accessed for the purposes of this investigation.

Centrifugal Impeller Shroud: The shroud was not accessed for the purposes of this investigation.

Front Stub Shaft: The shaft was not accessed for the purposes of this investigation.

No. 1 Bearing and Airseals: The stator air seal was consumed by the post flight fire (Ref. Photo No. 27, red arrow). The bearing and rotor air seal were in place but were not removed for the purposes of this investigation.

No. 2 Bearing and Airseals: The bearing and airseals were not accessed for the purposes of this investigation.

3.2.2 Combustion Section

Combustion Chamber Liner: The visible portion of the liner was unremarkable except for some discoloration between the 5-7 o'clock position (Ref. Photo No. 28).



Photo No. 28

Small Exit Duct: The duct was not accessed for the purposes of this investigation.

3.2.3 Turbine Section

Compressor Turbine Guide Vane Ring: The visible area of the vane airfoils were unremarkable, a rub was evident on the inner rim from 7 to 2 o'clock position from contact with the upstream side of the compressor turbine disk blades (Ref. Photo No. 29, red arrow). Compressor turbine air baffle exhibited two rubbed regions from the 9 to 3 o'clock position from contact with the upstream side of the compressor turbine disc and blades (Ref. Photo No. 30, yellow arrows).

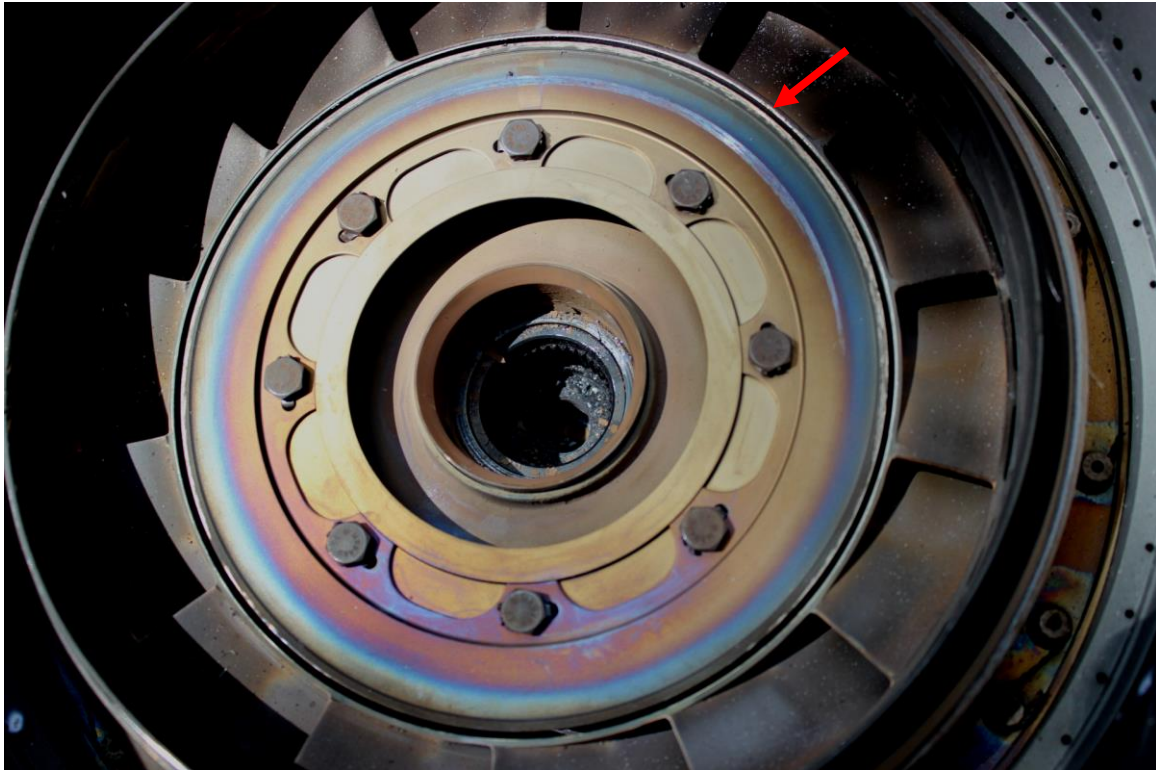


Photo No. 29

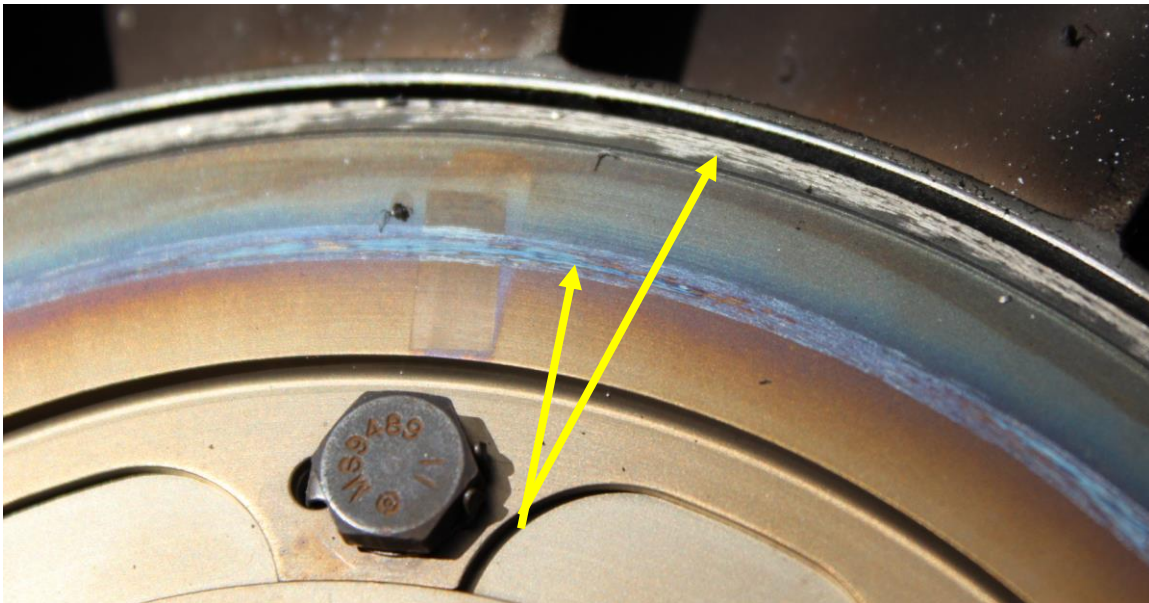


Photo No. 30



Compressor Turbine Shroud: The shroud exhibited a rub from the 9 to 10 o'clock position (Ref. Photo No. 31).



Photo No. 31

Compressor Turbine: The upstream side of the blades and retention rivets exhibited rubs from contact with the compressor turbine vane and air baffle (Ref. Photos No. 32 & 33, red arrows). The downstream side of the disc and blades exhibited a rub from contact with the upstream side of the power turbine vane and baffle (Ref. Photos No. 34 to 36, red arrows). The tooling anti-rotation lugs exhibit rubs from contact with power turbine baffle (Ref. Photo No. 37, red arrow). The region adjacent to disk retention bolt had rubbed with the centre of the power turbine vane baffle (Ref. Photo No. 37, blue arrow). The blade tips had rubbed with their respective shroud (Ref. Photo No. 38).



Photo No. 32

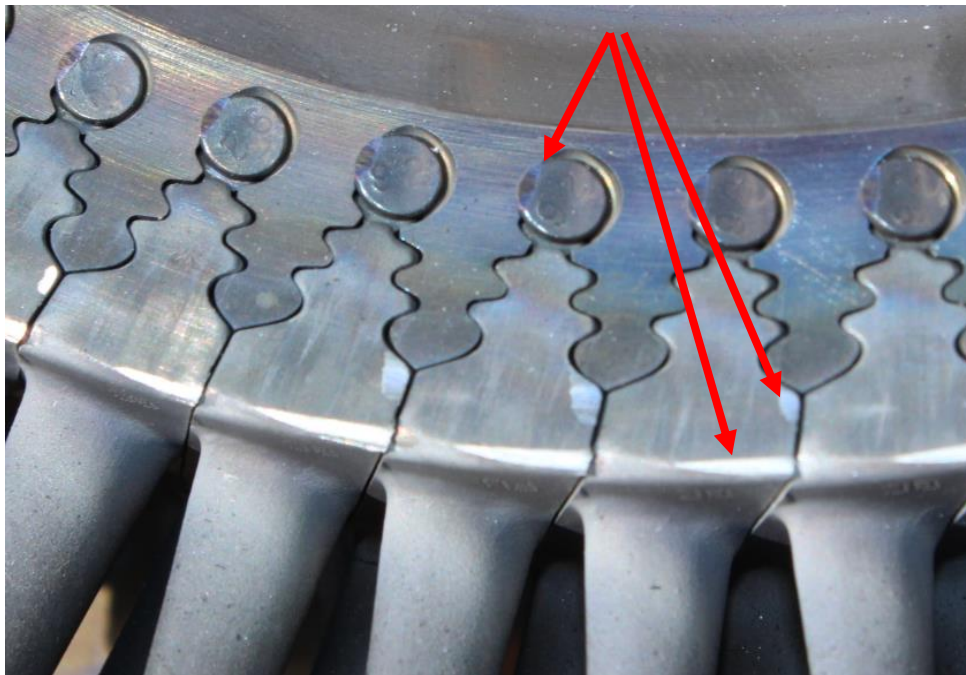


Photo No. 33

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Photo No. 34



Photo No. 35

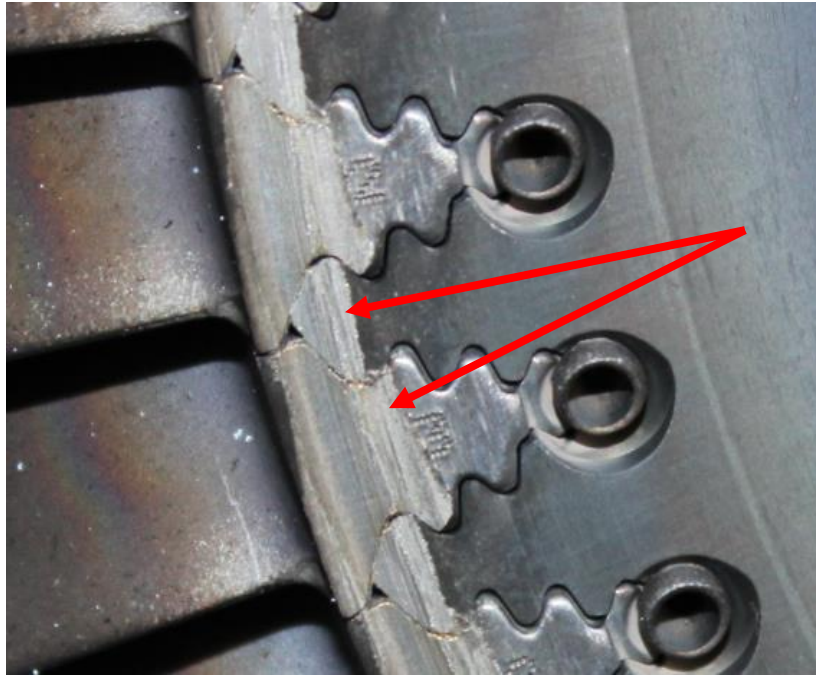


Photo No. 36

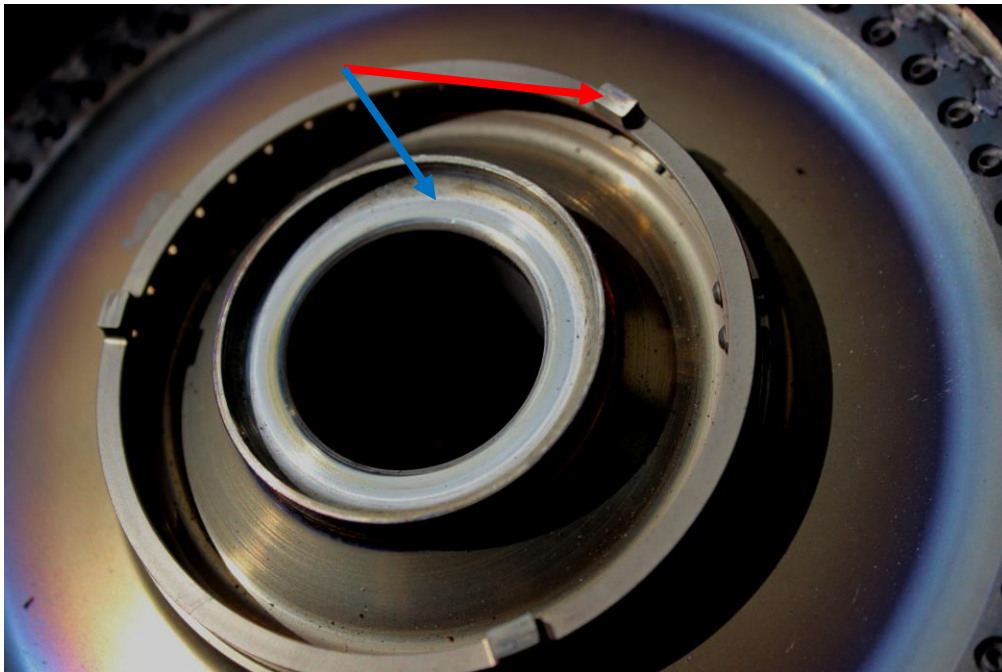


Photo No. 37



Photo No. 38

ITT Probes, Busbar, and Harness: The probes, busbar, and harness were all in place and secure (Photo No. 39, yellow arrows).

Power Turbine Housing: The housing was displaced rearward away from its mating flange with the exhaust duct (Ref. Photos No. 39 & 40, red arrows).

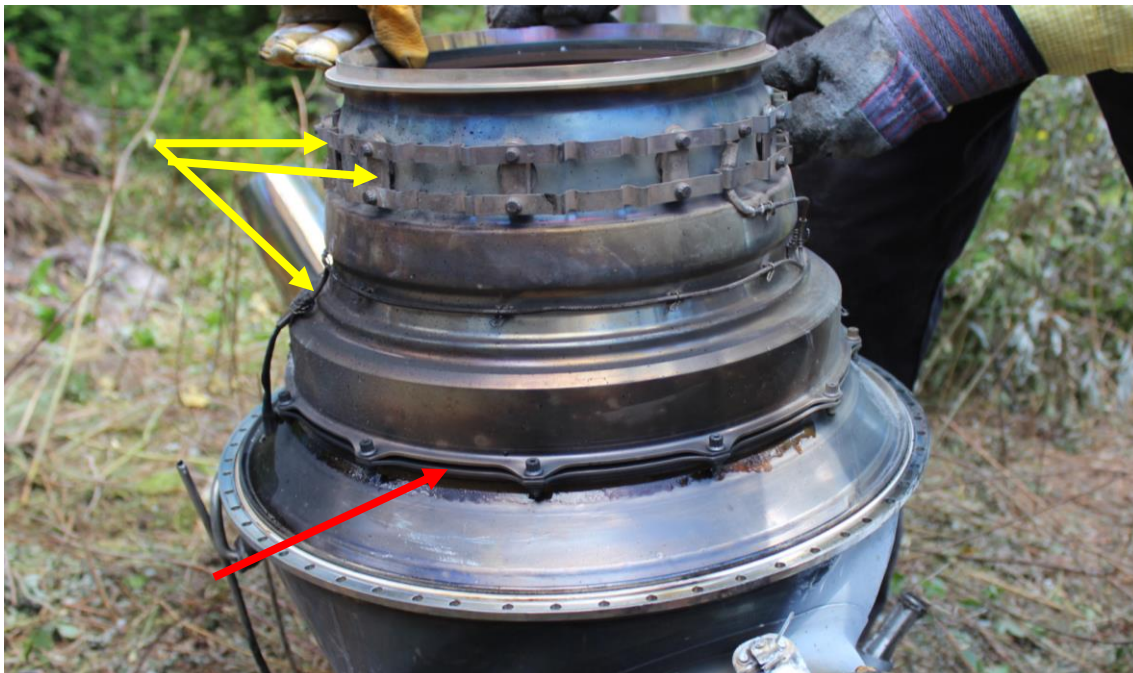


Photo No. 39



Photo No. 40

1st Stage Power Turbine Guide Vane Ring and Interstage Baffle: The inner rim of the upstream side of the vane was rubbed from contact with the compressor turbine blades and disc (Ref. Photos No. 41 & 42, red arrow). The region adjacent to the centre of the baffle exhibited a rub from contact with compressor turbine disc tooling lugs (Ref. Photo No. 43, yellow arrow). The centre of the baffle exhibited a rub from contact with the area of the compressor turbine disc adjacent to the retention bolt bore (Ref. Photo No. 43, blue arrow). The downstream side of the vane exhibited rubs on the outer rim and inner rim (Ref. Photos No. 44 & 45, red arrows). The inner rim was cracked at two locations and the trailing edge of several airfoils were missing (Ref. Photo 46). The outer diameter and inner diameter exhibited rubs from contact with the 1st stage power turbine disc (Ref. Photo No. 45, blue arrows). The centre of the baffle exhibited a rub from contact with the power turbine retention nut (Ref. Photo No. 45, yellow arrow).



Photo No. 41



Photo No. 42

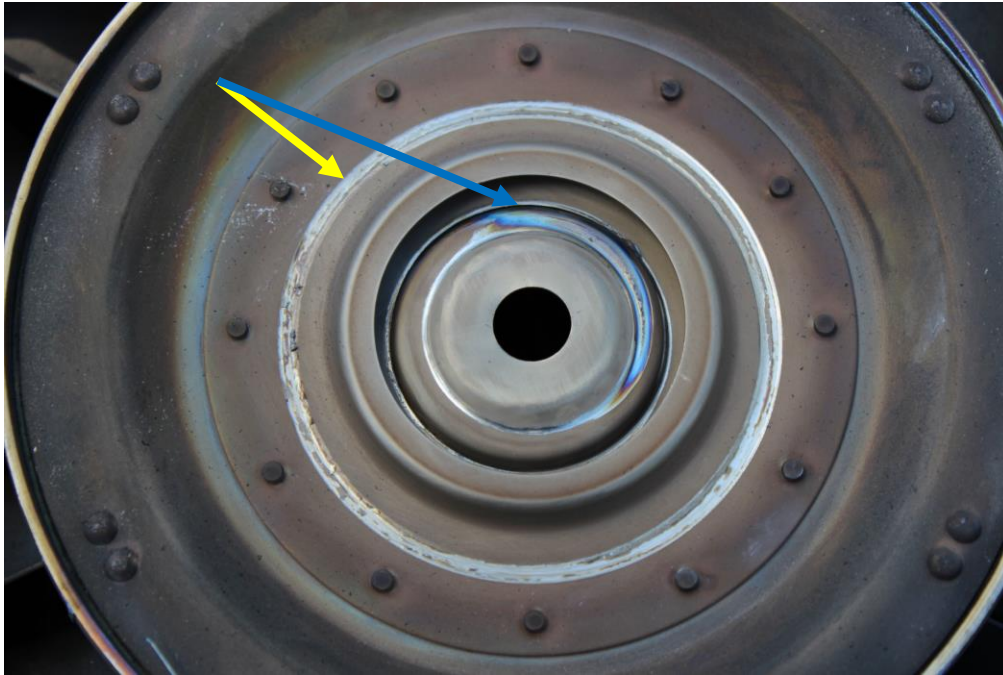


Photo No. 43



Photo No. 44

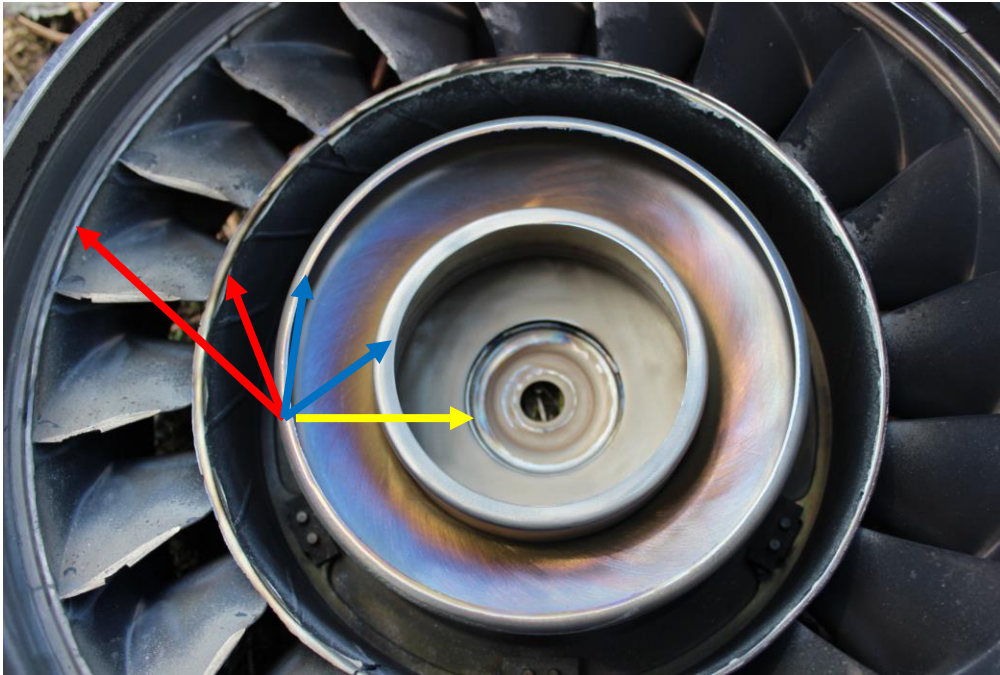


Photo No. 45



Photo No. 46



1st Stage Power Turbine Shroud: The shroud exhibited a rub from the 11 to 2 o'clock position from contact with its respective blades (Ref. Photo No. 47, red arrow).



Photo No. 47

1st Stage Power Turbine: The leading edge of the turbine blades exhibited rubs at the tip, at the root and on the platform from contact with the downstream side of the power turbine vane (Ref. Photos No. 48 & 49, red arrows). The disc displayed two rubbed regions, adjacent to the balancing rim and the rim adjacent to the cooling orifices from contact with the baffle (Ref. Photo No. 50, red arrows). The turbine retention nut exhibited a rub from contact with the centre of the baffle (Ref. Photo No. 51, red arrow). The blade tips had rubbed with the power turbine shroud (Ref. Photo No. 52).



Photo No. 48

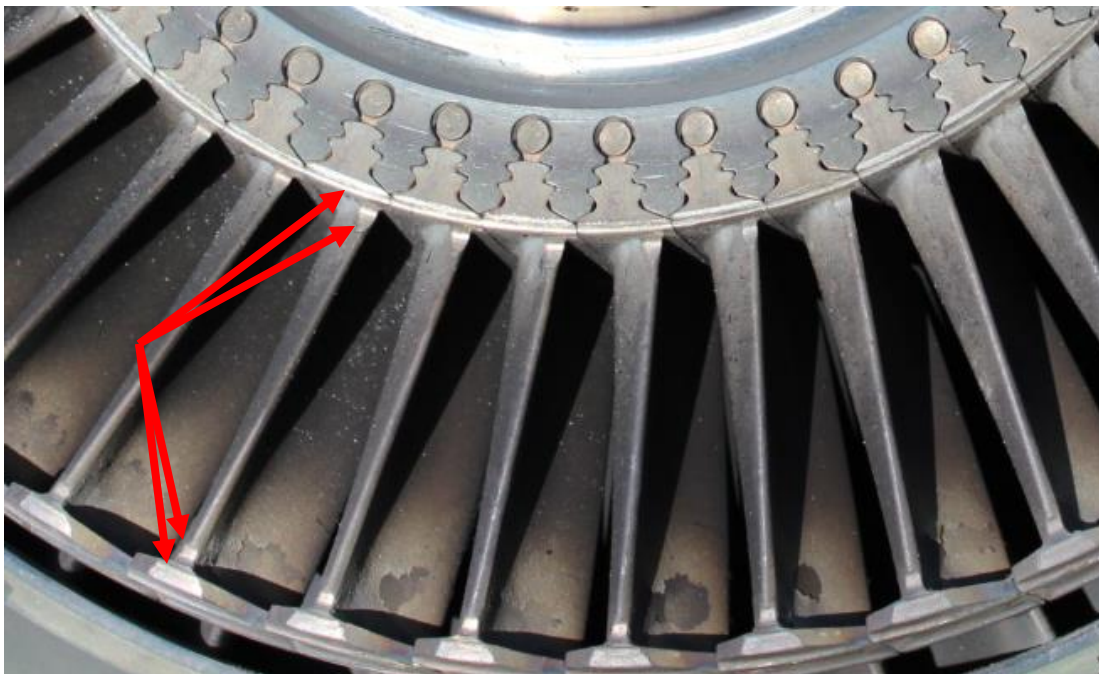


Photo No. 49

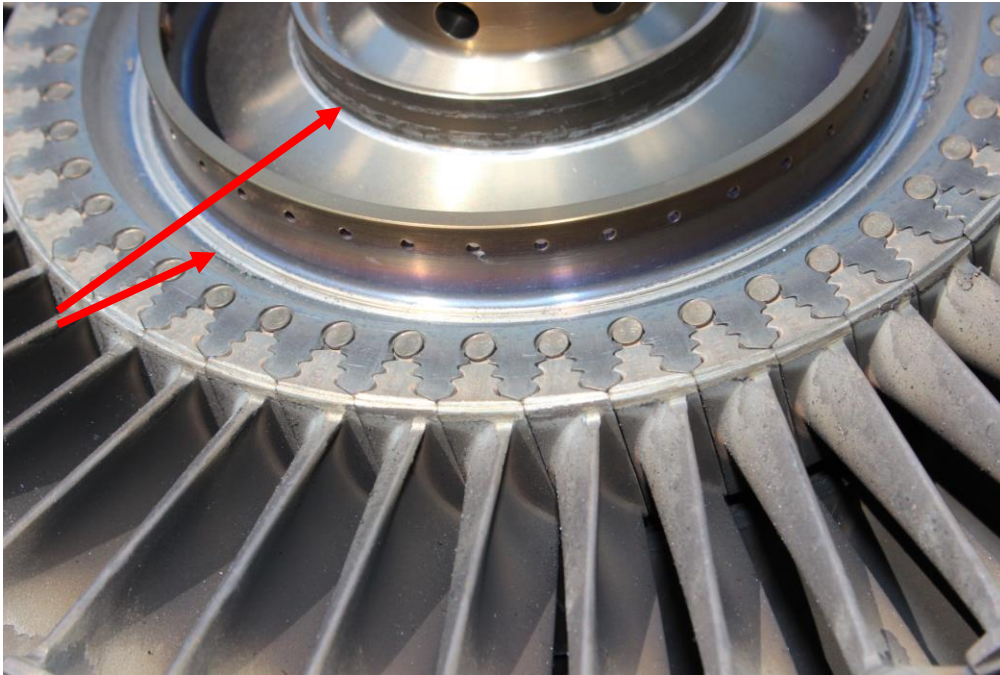


Photo No. 50

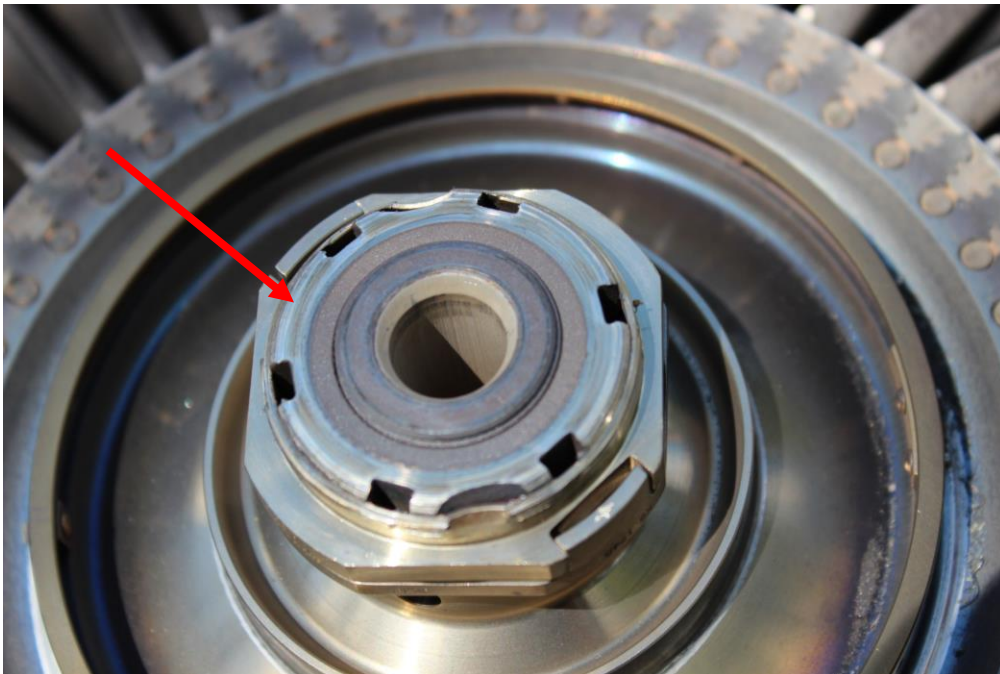


Photo No. 51



Photo No. 52

2nd Stage Power Turbine Guide Vane Ring and Interstage Baffle: The vane ring and baffle were not accessed for the purposes of this investigation.

2nd Stage Power Turbine Shroud: The shroud was not accessed for the purposes of this investigation.

2nd Stage Power Turbine: The turbine was not accessed for the purposes of this investigation.

Power Turbine Shaft and Shaft Housing: The shaft and housing were not accessed for the purposes of this investigation.

3.2.4 Reduction Gearbox

Rear Housing: The housing was not accessed for the purposes of this investigation.

1st Stage Sun gear: The sun gear was not accessed for the purposes of this investigation.

1st Stage Planet Gear Carrier: The carrier was not accessed for the purposes of this investigation.

1st Stage Planet Gears: The gears were not accessed for the purposes of this investigation.



1st Stage Ring Gear: The gear was not accessed for the purposes of this investigation.

Torque Meter: The meter was not accessed for the purposes of this investigation.

2nd Stage Sun Gear and Flex Coupling: The gear and coupling were not accessed for the purposes of this investigation.

2nd Stage Planet Gear Carrier: The carrier was not accessed for the purposes of this investigation but a portion of the carrier was visible due to the fractured front reduction gearbox housing (Ref. Photo No. 53, red arrow). The carrier was attached to the fractured propeller shaft.

2nd Stage Planet Gears: Viewing through the fractured front reduction gearbox, the gears were in place.

2nd Stage Ring Gear: The gear was not accessed for the purposes of this investigation but a portion of the gear was visible due to the fractured front RGB housing (Ref. Photo No. 53, blue arrow). The visible portion of the gear was in its respective position in the gearbox housing.

No. 5 Bearing: The bearing was not accessed for the purposes of this investigation but a portion of the bearing was visible due to the fractured front RGB housing (Ref. Photo No. 53, yellow arrow). The roller elements were in place.

Propeller Shaft: The shaft was fractured between the propeller sleeve and the 2nd stage carrier (Ref. Photo No. 53, green arrow and Photo No. 54, green arrow). The fracture surface displayed features consistent with a torsional overload fracture.

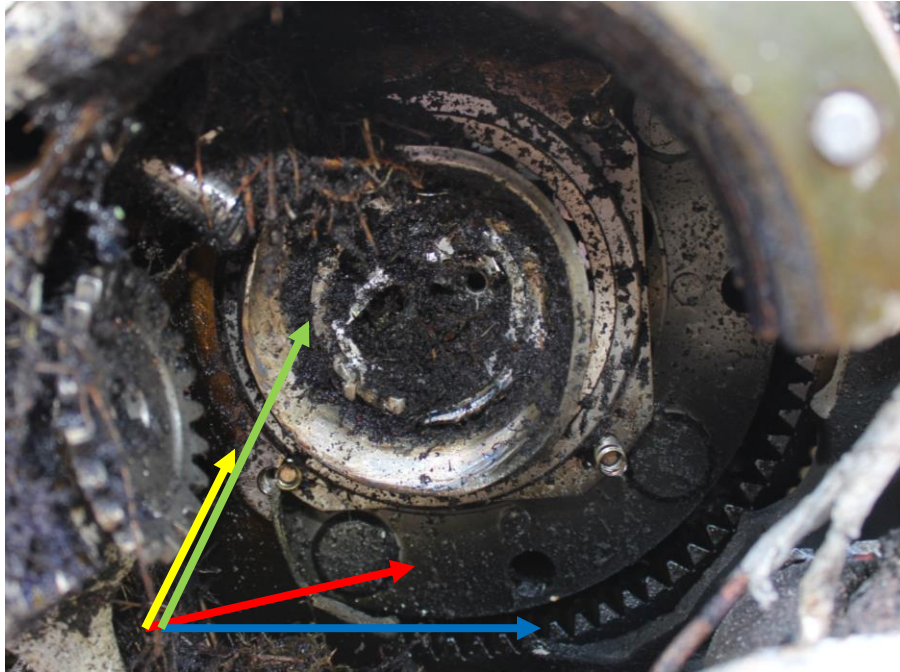


Photo No. 53



Photo No. 54



No. 6 Bearing: The bearing cage was bent and several of the ball elements were missing (Ref. Photo No. 55, red arrows).

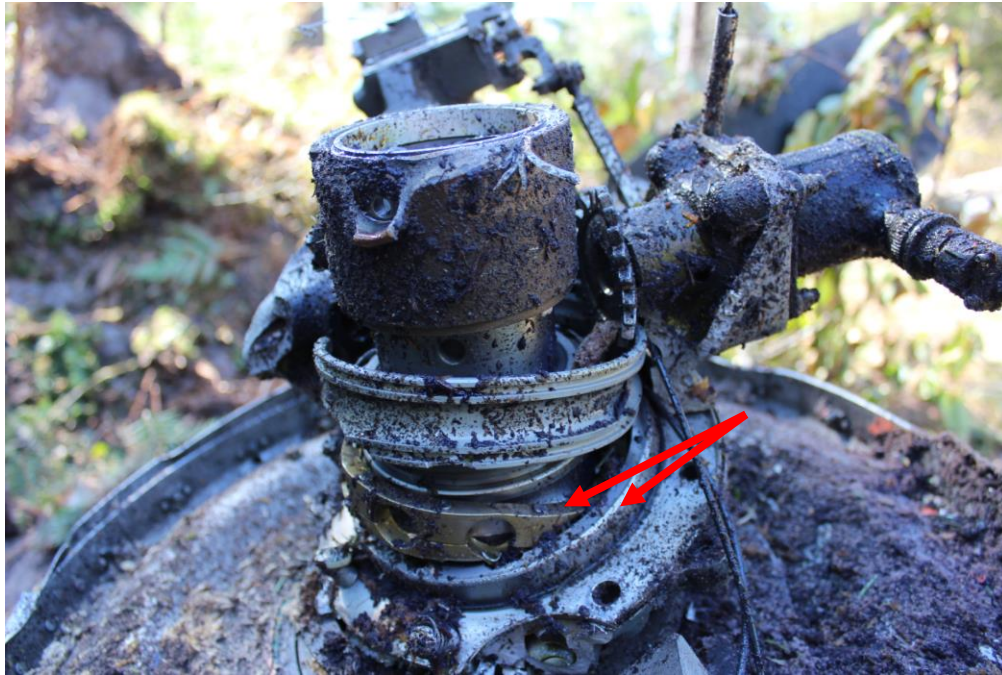


Photo No. 55

Forward Housing: The housing was fractured at an angle from the propeller thrust bearing cover flange rearward to the pads for the propeller governor and the tacho generator (Ref. Photos No. 10 & 11).

3.2.5 **Accessory Gearbox:** The gears shafts and some of the gear shaft bearings were recovered from the debris from the burnt gearbox and inlet case (Ref. Photo No. 56). No examination of the shafts and bearings was conducted due to their burnt condition.



Photo No. 56

3.3 Controls and Accessories Evaluation

3.3.1 Ignition System

Exciter Box: The exciter box was in place and secure. The exterior of the housing exhibited thermal distress from exposure to the post flight fire (Ref. Photo No. 57).



Photo No. 57



Ignition Leads: The leads were in place and secure. The leads were bent and thermally distressed.

Ignition Plugs: The plugs were in place and secure.

3.3.2 Fuel System

Fuel Heater: The heater was consumed in the post flight fire.

Fuel Pump: The pump was consumed in the post flight fire.

Fuel Control Unit: The unit was consumed in the post flight fire.

Flow Divider: The divider was in place and secure. The exterior was thermally damaged from the post flight fire (Ref. Photo No. 58).



Photo No. 58

Fuel Nozzles: The nozzles were in place and secure (Ref. Photo No. 59). Several of the fuel transfer tubes were bent and/or thermally damaged.



Photo No. 59

Torque Limiter: The limiter was in place and secured (Ref. Photo No. 60, red arrow). The PY line was in place and secured to the limiter.



Photo No. 60



3.3.3 Air System:

Compressor Bleed Valves: The right hand bleed valve was consumed in the post flight fire (Ref. Photo No. 61, red arrow). The left hand bleed valve was in place and thermally distressed from the post flight fire (Ref. Photo No. 61, blue arrow).



Photo No. 61

3.3.4 Oil System:

Propeller Governor: The governor was in place and secure on the front reduction gearbox housing (Ref. Photo No. 62). The exterior was partially coated with organic debris and some external impact damage was evident.



Photo No. 62

Overspeed Governor: The governor was in place and secure on the front reduction gearbox housing (Ref. Photo No. 63). The exterior was partially coated with organic debris and some external impact damage was evident.



Photo No. 63