NATIONAL TRANSPORTATION SAFETY BOARD
OFFICE OF AVIATION SAFETY
WASHINGTON, D.C. 20594

June 27, 2006

POWERPLANTS GROUP CHAIRMAN'S FACTUAL REPORT

NTSB ID No.: ANC-06-FA-018

A. ACCIDENT

Location:	Ketchikan, Alaska
Date:	January 25, 2006
Time:	1250 Alaska Standard Time
Aircraft:	Aero Vodochody L-39MS Registration N104XX

B. POWERPLANTS GROUP

Group Chairman:	Harald Reichel National Transportation Safety Board Washington, DC
Member:	Michal Vale Air USA Quincy, Illinois

C. SUMMARY

On January 25, 2006, about 1250 Alaska Standard time, an Aero Vodochody L-39MS airplane, N104XX, a surplus military warbird built in the Czech Republic, was destroyed by impact and post impact fire when it collided with the ground, and an occupied trailer home during an instrument approach/circle to land at the Ketchikan International Airport, Ketchikan, Alaska. The experimental airplane was being operated as an instrument flight rules (IFR) cross-country ferry flight under Title 14, CFR Part 91, by Air USA Inc., Quincy, Illinois when the accident occurred. The airline transport certificated pilot, the sole occupant received fatal injuries and eight persons on the ground received minor injuries.

The accident airplane pilot obtained two weather briefings on January 25, and departed for Bellingham, Washington, without filing a flight plan. Due to adverse wind conditions along the planned route, the pilot diverted to Ketchikan, and obtained an IFR en route clearance at about 1210 local. The pilot was cleared for the instrument landing system (ILS) approach to runway 11 at Ketchikan, and at about 1248, the pilot reported via radio to the Ketchikan Flight Service Station (FSS) that he had the airfield in-sight, and stated he would attempt to circle-to-land on runway 29.

A pilot-rated witness reported that he saw the airplane descend from the clouds, at about 200 feet above the waters of the Tongass Narrows, near Peninsula Point, which is about 2 miles from the crash site. The witness indicated that the visibility was about $^{3}/_{4}$ mile in wet blowing snow, and the wind at the time was from the northwest, about 30 knots. The witness said the airplane, with the landing gear down, descended on about a 20 to 25 degree angle at a high rate of descent to the surface of the water. The airplane struck the surface twice, each time gaining about 10 feet in altitude before skipping on the surface for a third time. The first two water impacts produced an extensive spray of water that obscured his view of the airplane. After the third impact the airplane then gained altitude and climbed out of his line of sight. After the water impact, other witnesses on shore reported seeing the airplane at treetop level over the town of Ketchikan, and hearing engine sounds, but then the engine stopped making any sound. The pilot was observed ejecting from the airplane; however the ejection sequence was incomplete and he struck the ground while still in his ejection seat.

The unoccupied airplane collided with the ground in a large open lot on an easterly heading, struck the western bank of Carlanna Creek, continued over the creek and struck a trailer home that was occupied by two persons, crashed into several unoccupied automobiles, and came to rest in another open lot against a hill.

According to Federal Aviation Administration (FAA) personnel, the airplane was issued a special ferry permit by an inspector with the Van Nuys Flight Standards District Office (FSDO), Van Nuys, California, on January 23, 2006, with the options to fly VFR/IFR day/night from Anchorage, Alaska, to Seattle, Washington. The ferry permit was signed by an FAA certificated mechanic, certifying that the airplane was safe for a ferry flight.

The Powerplant Group examined the engine on March 28-29, 2006 at the Temsco Helicopter hanger in Ketchikan Alaska. The examination of the engine revealed that there was no indication of pre-impact uncontainment, fire, case rupture, internal failure or bird strike. The outer corners of the leading and trailing edge of the fan blades were fractured with approximately $^{1}/_{3}$ of the material of each blade missing. The bending and fracture indications on the fan blades were opposite the direction of rotation. Two 1^{st} stage fan stator vanes at the 2 and 9 o'clock position were fractured near the outer span and were not found. All the supercharger and compressor blades had leading and trailing edge nicks and dents. All compressor stator stages had leading and trailing edge nicks and dents. All stages of turbine blades were undamaged.

D. DETAILS OF INVESTIGATION

D.1 Powerplant Information

D.1.1 Engine Description

The engine installed in N104XX was a Povazske Stroguarne DV-2 turbofan Model KTG U-27, Serial Number 90005. The engine was manufactured in Slovakia in 1990.

A 2-stage low-pressure turbine drives a cast aluminum 1-stage fan and a 2-stage supercharger (low pressure compressor) (See cross section Figure 1). A one stage high-pressure turbine drives the 7-stage high-pressure compressor. The first stage stator is a variable guide vane controlled by an actuator that is powered using fuel pressure. Power is extracted from the high-pressure rotor via a tower shaft and accessory gearbox, which is mounted on the bottom of the engine. The fuel pump and FCU, the oil pump, engine generator and hydraulic pumps, engine and aircraft accessories drives are mounted on the accessory gearbox. [1]

The engine fuel control system consists of a hydro-mechanical unit trimmed by an electronic limiting unit. The engine lubrication system is of a conventional type, is non-regulated and varies with the compressor rotational speed from 28 to 65 psi.

D.1.2 Engine History

At the time of the accident, the engine had accumulated 701 flight hours time since new (TSN) and unknown cycles since new (CSN).

The last inspection for the engine was performed by Air USA in Quincy, Illinois and was completed on January 20, 2005 and consisted of a 50 hour or 6 month aircraft inspection program. The inspections consisted of a series of scheduled inspections as required by the Approved Aircraft Inspection Program (AAIP) FAR 91.409 (F)(2). The powerplant portion of this inspection procedure includes of the following items:

Check engine oil condition and level
Check right and left-hand engine inlets and exhaust
Check for fluid leaks
Check for ease of rotation of engine cores
Accomplish an engine performance test

[1] All orientation and directional references such as top and bottom, front and rear, right and left, and clockwise and counter clockwise are made aft looking forward unless noted otherwise. ALF indicates ‘aft looking forward’. FLA indicates ‘forward looking aft’.

D.2 Observations at the crash site

D.2.1 Engine Location & Condition

The aircraft fuselage was found right side up in a 45-degree nose up attitude resting against the base of a steep hill. Most of the mid section of the fuselage was burned as far back as the empennage (Figure 2). The empennage and the vertical tail section were burned and charred. The cockpit was sheared and folded to the left. The resin of the bifurcated airframe composite inlet duct was burned away leaving only the loose fiber fabric.

Some cockpit instruments could be read. The engine exhaust temperature gauge (Figure 3) indicated approximately 630 degrees centigrade, which corresponds to a normal power setting. The engine oil pressure gauge (Figure 4) indicated approximately 2-1/4 kilopascals per square centimeter, which is within the acceptable range.

The engine was found in its installed location within the fuselage (Figure 5 & Figure 6). There was no evidence of an uncontained failure. The fan spinner was melted. The fan blades were severely torn and fractured on the leading and trailing edges. A portion of the outer bypass duct was melted.

The engine was removed from the fuselage and delivered to the Temsco Helicopter hangers in Ketchikan, Alaska for further examination.

D.3 Teardown Examination

D.3.1 Engine Examination

D.3.1.1 External Condition

The engine was on its left-hand side on top of a palette (Figure 7, Figure 8, Figure 9 & Figure 10). The external surfaces of the engine, accessory gearbox and external accessories were coated with soot (Figure 11). The right side of the engine sustained considerable damage consistent with an external fire. The outer bypass duct, between the fan case aft flange and in front of the rear bearing housing, was burned and melted on the right side of the engine (Figure 12). There was no evidence of an in-flight fire. The engine core was generally intact from the inlet case to the fan exhaust duct. A 1-foot long segment of the aircraft exhaust duct was still attached to the aft exhaust flange. Approximately half the circumference of this duct was buckled. The fan containment ring portion of the fan inlet consists of the metal cylinder of the housing wrapped with black fibrous material around the outside (Figure 13). This fibrous material was burned on the right side of the engine. The insulation on the electrical wires on the right side of the engine was melted. The right corner of the accessory gearbox was fractured but the gearbox was otherwise intact.

D.3.1.2 Fan

The fan blisk[2] was generally intact (Figure 14). The outer leading and trailing edge corners of all the blades were battered and fractured (Figure 15). Some of these fractures were jagged, sharp-edged and exhibited large material loss. The liberated pieces were not recovered. Twelve blades still had the mid chord portion of their tip still intact (Figure 16) but scored. Three blades were missing their tip (Figure 17). The entire spans of all the blades were battered (Figure 18). All displaced material on the fractures was deformed in the direction opposite of rotation (Figure 19). Approximately $^1/_3$ of the fan blade material of each blade was missing.

The fan could not initially be rotated but after the melted aluminum globs and other debris were removed from the duct it rotated smoothly by hand. The power turbine wheel also rotated in unison with the fan.

D.3.1.3 Fan Shroud

The fan shroud was intact. Heavy rotational scoring was observed at the 3 and 9 o'clock positions (ALF) [1] on the inner diameter of the shroud where the fan disk normally operates (Figure 20 & Figure 21). There were multiple intermittent scraping deposits at various angles of a metal consistent with the fan blade material from the inlet shroud front flange to just ahead of the fan plane (Figure 22).

The radius of the fan shroud was measured at 12 locations at 30° intervals. The fan flange was used as a fixture that a steel ruler was held against. The readings were made 3 times and showed repeatable values. The average values of the 3 measurements are in the chart below.

Angle (FLA)[1]	Radial Measurement
(Degrees)	(Inches – relative to fixture)
0-360 (top)	8.06
30	8.06
60	8.08
90	8.07
120	8.12
150	8.12
180 (bottom)	8.03
210	8.03
240	8.03
270	8.09
300	8.13
330	8.13

Table 1 – Fan shroud radius measurements

[2] A blisk is a contraction of a 'bladed disk'. The hub and blades are cast as one integral piece.

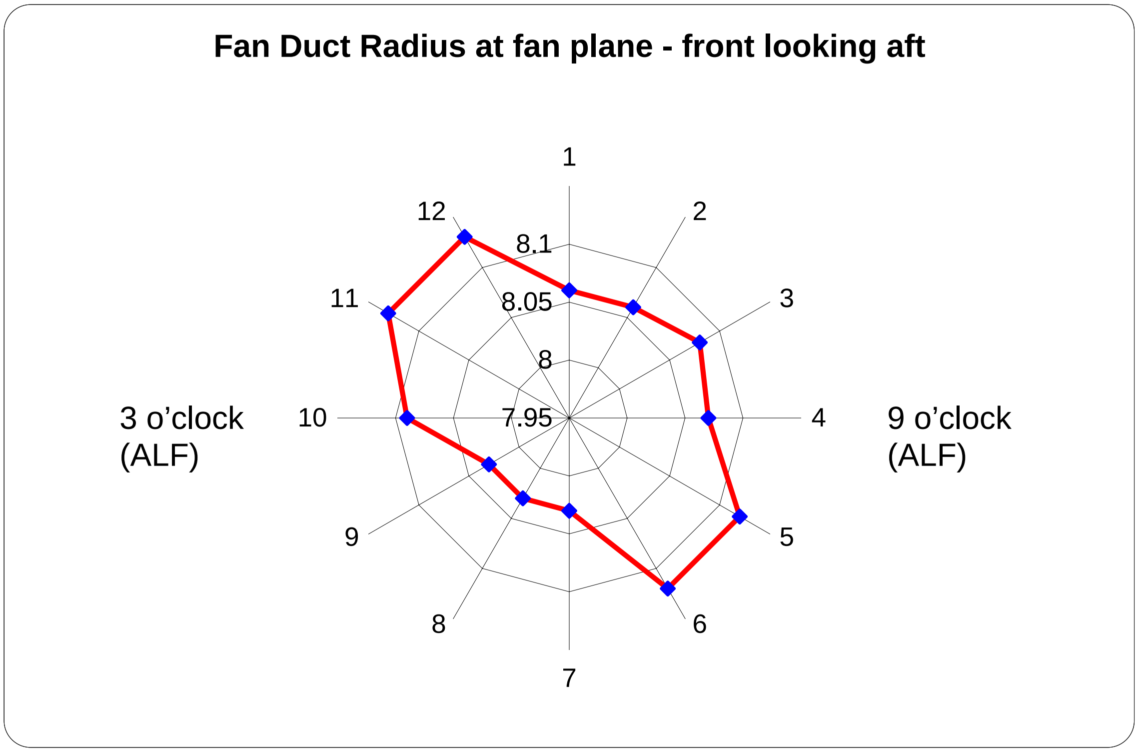

Table 2 – 'Radar' Chart of fan shroud diameter

A 'radar' type chart illustrates the ovality of the fan shroud from the data above.

D.3.1.4 1st Stage Stator Vanes

The leading edges of all the 1st stage stator vanes were torn near the outer platform (Figure 23 & Figure 24).

Two vanes located at the 2 and 9 o'clock locations were fractured. These vanes are firmly attached to the outer fan shroud via the platform feature and are allowed to float in the inner fan shroud using a dowel and hole system. The inner vane platforms have a dowel and the inner fan shroud pilots them with a hole and plastic sleeve arrangement.

Most of the vane at the 2 o'clock position was missing. The remaining outer platform had a ½ inch long jagged segment of the vane still attached (Figure 25). No remains of the inner vane platform were recovered. The plastic piloting sleeve on the inner fan shroud was still in its location.

Most of the vane at the 9 o'clock position was missing. The vane had fractured flush to the outer platform (Figure 26). No remains of the inner vane platform and dowel pin were recovered. The plastic piloting sleeve on the inner fan shroud was still in its location. There were impact marks on the outer surface of the inner fan shroud near the dowel pin piloting hole (Figure 27). The surface of the inner shroud of the missing vane at the 2 o'clock position did not exhibit these marks.

D.3.1.5 Supercharger Section

Approximately half of the first stage supercharger rotor blades were fractured at the mid span or less in a random pattern (Figure 25 & Figure 26). All the other blades were torn at the leading edge and some were bent in the direction opposite of rotation at their root. All the leading edges of the second stage supercharger stator vanes and rotor blades were torn.

D.3.1.6 Compressor Section

The variable guide vanes, levers and synchronizing ring could be moved by hand with some difficulty. Once detached from the mechanism, the variable guide vane actuator piston was free to move. The variable guide vane position indicator was at 20° (Figure 28), which corresponds to a normal engine power setting.

The high-pressure compressor case was intact except on the upper right quadrant that was burned. A hole was cut into the compressor case to allow visual examination of the variable guide vanes and the first stage compressor rotor. The trailing edges of several variable guide vanes were torn (Figure 29). The leading edges and trailing edges of the first stage compressor rotor were torn.

After the compressor rotor was accessed via the hole it could be rotated by hand.

All the blades of compressor rotor stages 2 to 7 were borescoped. All leading and trailing edges had sharp edged tears. All the vanes of the compressor stator stages 2 to 7 that were observed had sharp edged tears to the leading and trailing edges.

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D.3.1.7 Combustion Section

The combustor plenum did not have any ruptures or indication of thermal distress. The fuel manifolds and fuel nozzles were all in place and there was no indication of leakage or thermal distress. Several fuel nozzles were removed and examined. They were unremarkable.

A hole was cut into the combustor plenum and the combustor liner. No metal spatter was found in the combustor (Figure 30). The combustor liner appeared to be undamaged (Figure 31).

D.3.1.8 High-Pressure Turbine

The high-pressure turbine case was intact and the high-pressure turbine assembly was not disassembled. The high-pressure turbine nozzle was examined through the hole cut into the combustion chamber (Figure 32). The vanes appeared to be undamaged and there was no evidence of metal spray. The high-pressure turbine was examined using a borescope. The blades appeared to be undamaged and there was no evidence of metal spray.

D.3.1.9 Low-Pressure Turbine

The first stage low-pressure turbine nozzle and turbine were examined using a borescope. The nozzle appeared to be undamaged and had no metal spray. The first stage low-pressure turbine blades were intact, full length and straight.

The second stage low-pressure turbine nozzle and turbine were examined from the rear of the engine. The nozzle appeared to be undamaged and had no metal spray. The second stage low-pressure turbine blades were intact, full length and straight.

The rear of turbine bearing housing and aft cone were undamaged.

D.3.1.10 Fuel Control Unit

The fuel control unit was covered in soot but appeared otherwise undamaged (Figure 33). The fuel control input lever was in the 82° position (Figure 34), which corresponds to approximately a flight idle power setting. When the fuel control unit was removed from the engine, fuel ran out of the fittings. The fuel control input spline was intact and oil wetted and it rotated easily by hand (Figure 35).

The fuel filter it was removed and appeared to be clean and free of debris (Figure 36).

D.3.1.11 Oil Pump

The oil pump housing was fractured but contained residual oil. The oil filter was removed and its elements separated and examined (Figure 37). The filter elements were black and contained minor debris but were otherwise unremarkable (Figure 38). The oil chip detector exhibited signs of overheating but it contained no significant debris (Figure 39).

D.3.1.12 Airframe Exhaust Duct

There were multiple intermittent scraping deposits at various angles of a soft metal consistent with the fan blade material on the inside of the airframe exhaust duct (Figure 40, Figure 41 & Figure 42).

Harald Reichel
Aerospace Engineer

Figure 1 – Povazske Stroguarne DV-2 engine cross section

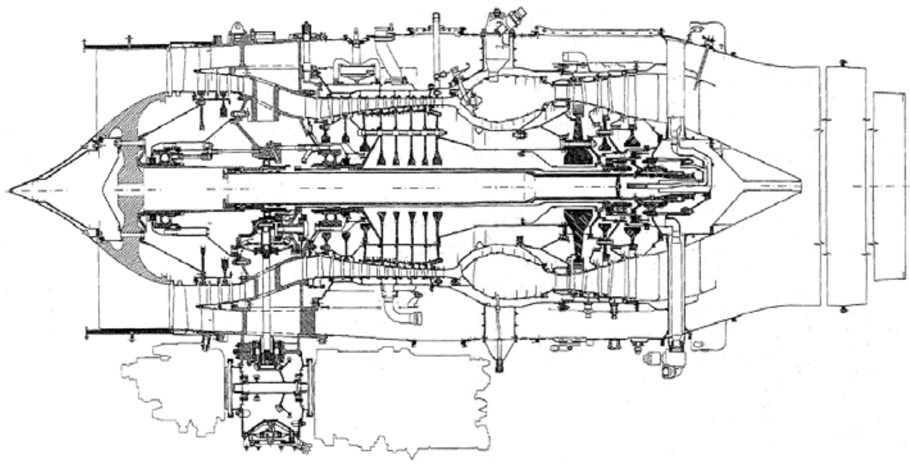

Figure 2 – Aero Vodochody L-39MS, N104XX – On-scene

Engine location

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Figure 3 – Engine temperature gauge

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Figure 4 – Engine oil pressure gauge

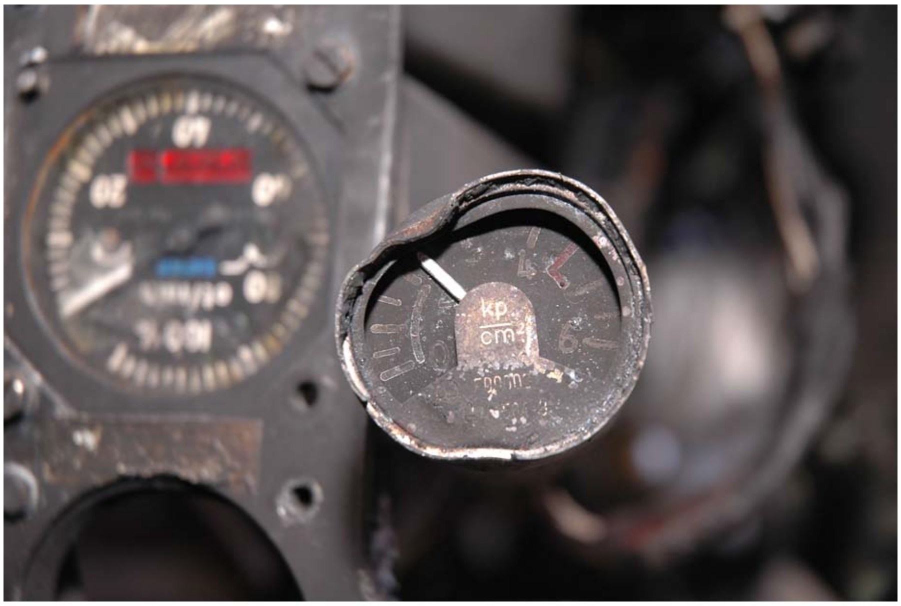

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Figure 5 – Povazske Stroguarne DV-2 engine–On-scene–Overall view

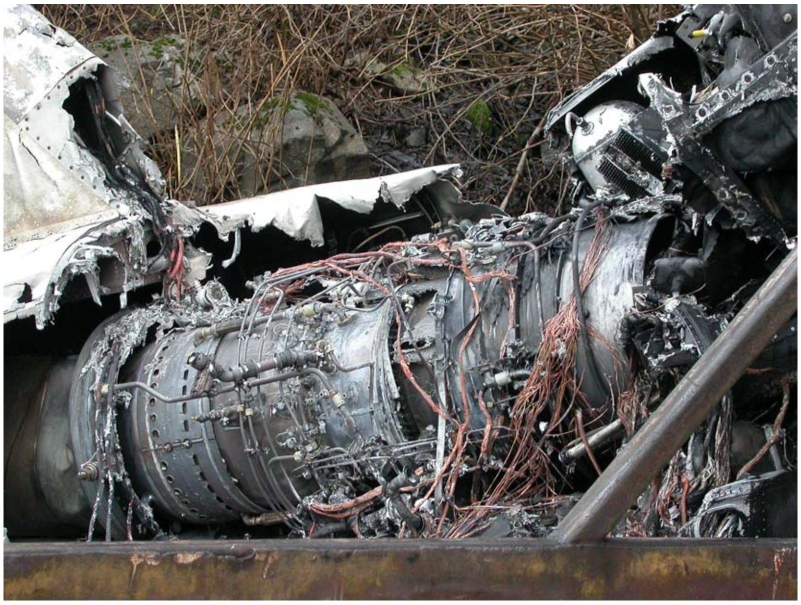

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Figure 6 – Povazske Stroguarne DV-2 engine–On-scene-Inlet

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Figure 7 – Povazske Stroguarne DV-2 engine – Top & left side

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Outer bypass duct melted

Figure 8 – Povazske Stroguarne DV-2 engine – Front looking aft

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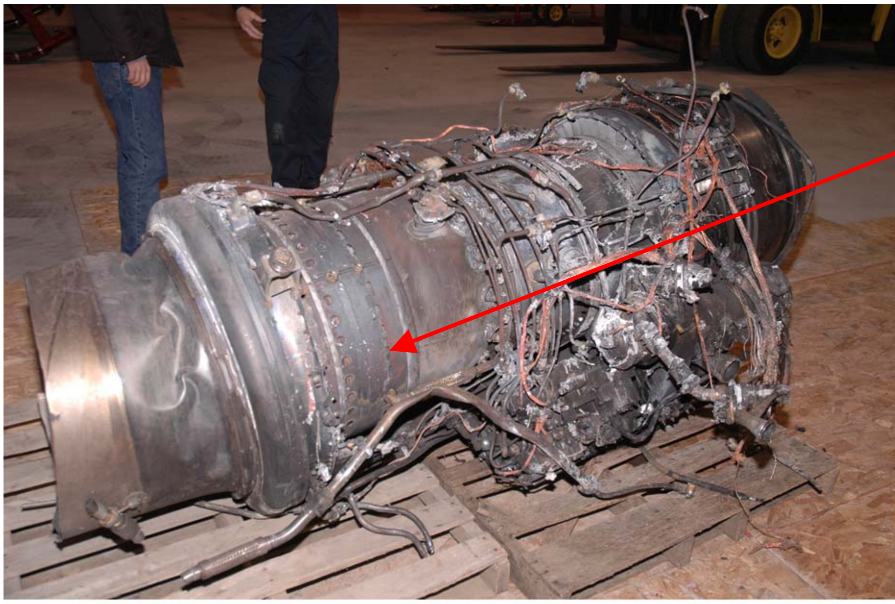
Figure 9 – Povazske Stroguarne DV-2 engine – Bottom & right side



Inner bypass duct is visible. Outer bypass duct melted

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Figure 10 – Povazske Stroguarne DV-2 engine – Aft view

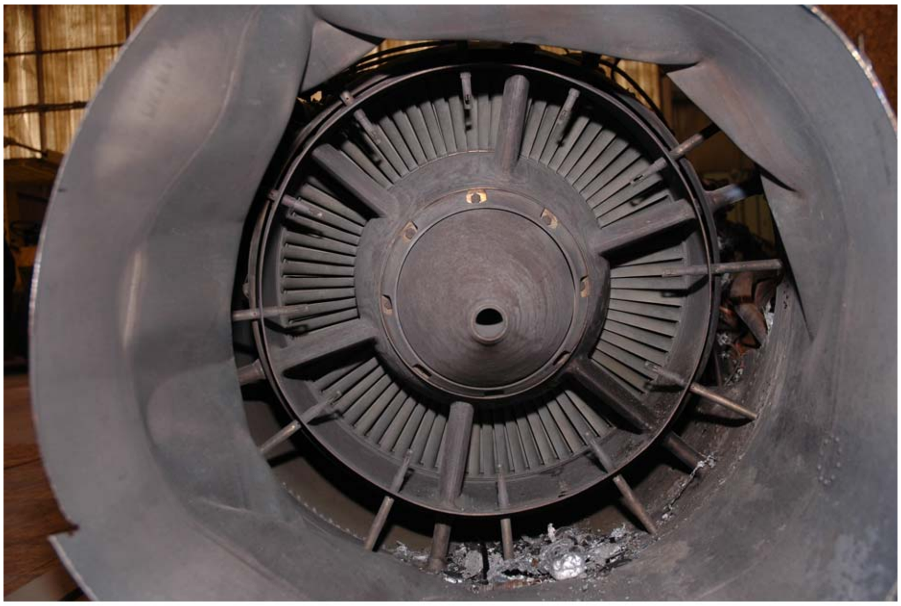

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Figure 11 – Povazske Stroguarne DV-2 engine – Sooting

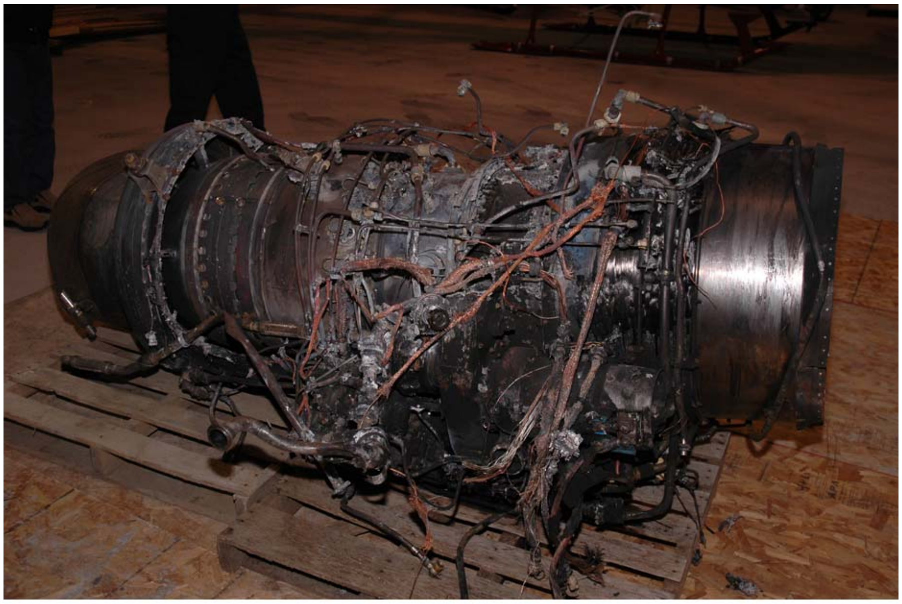

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Figure 12 – Povazske Stroguarne DV-2 engine – Top view

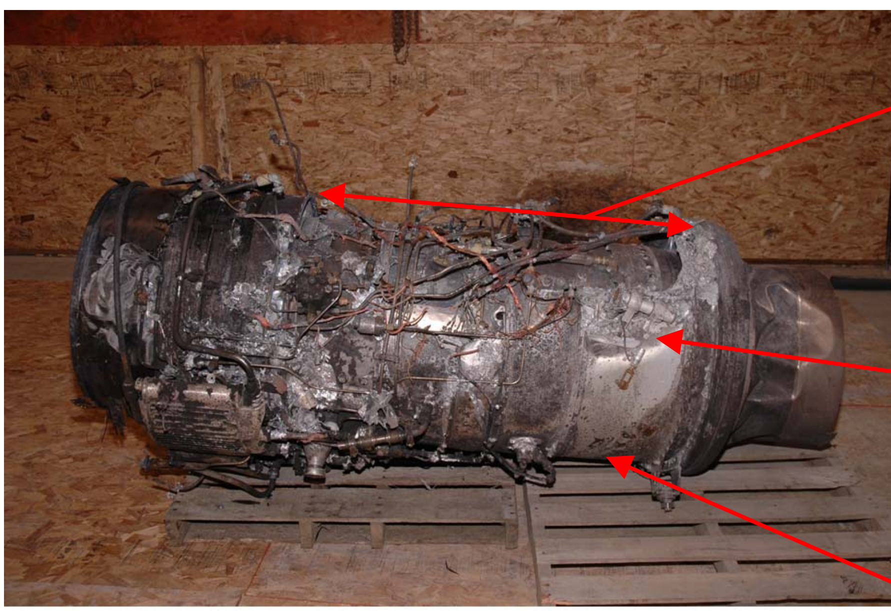

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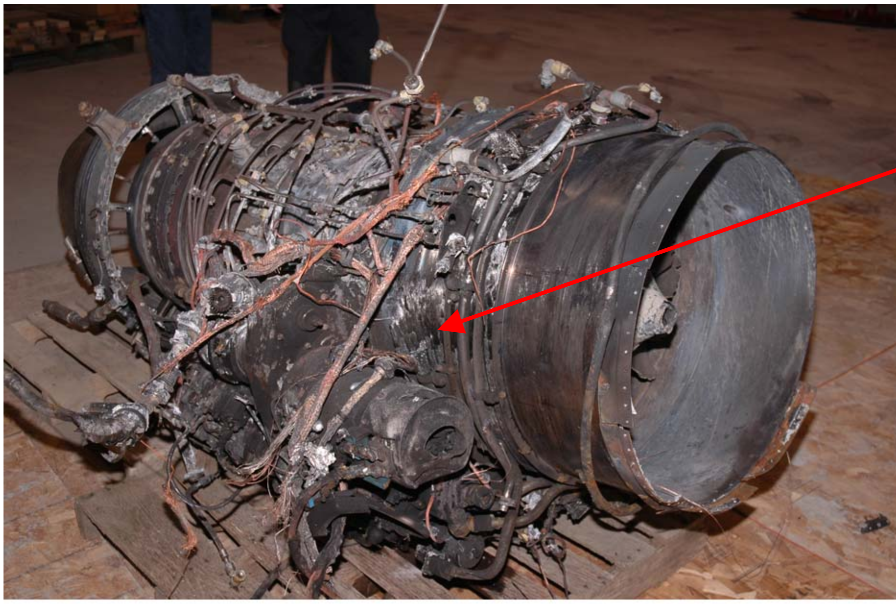
Figure 13 – Povazske Stroguarne DV-2 engine – Fan containment ring



Charred fibrous material

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Figure 14 – Fan blisk

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Figure 15 – Fan blisk

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Figure 16 – Fan blisk – chord segment intact

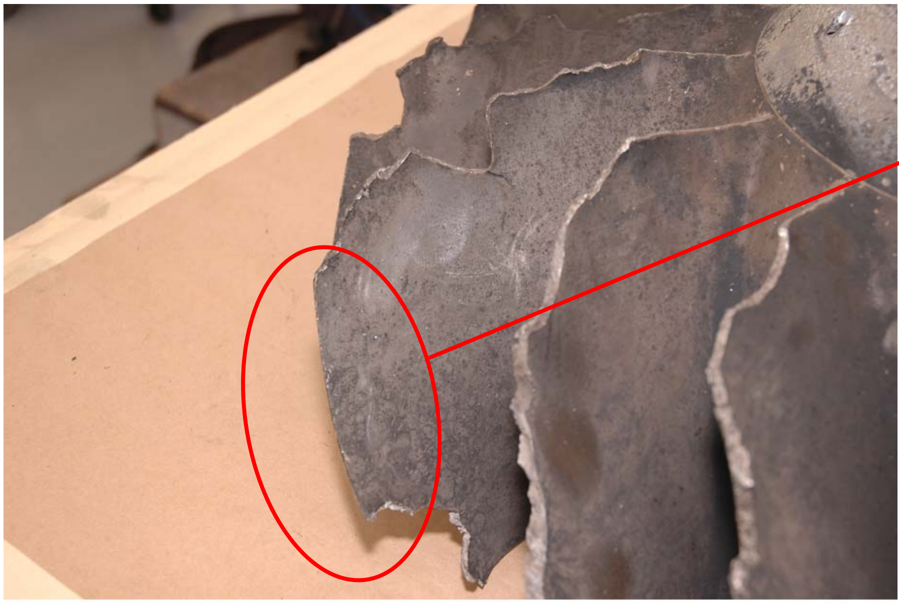

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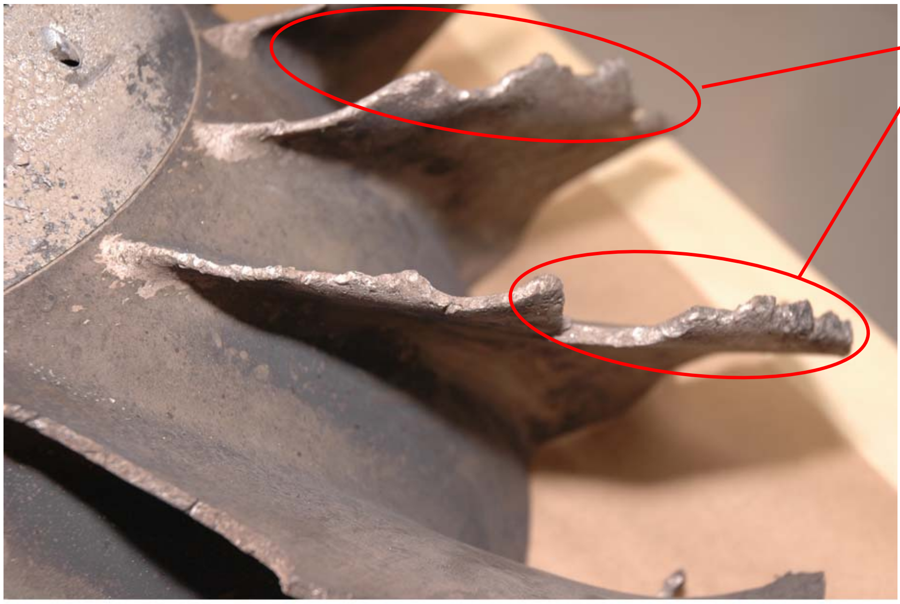
Figure 17 – Fan blisk – chord fractured



Complete chord at tip is missing

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Figure 18 – Leading edge battered on inner diameter of fan blade

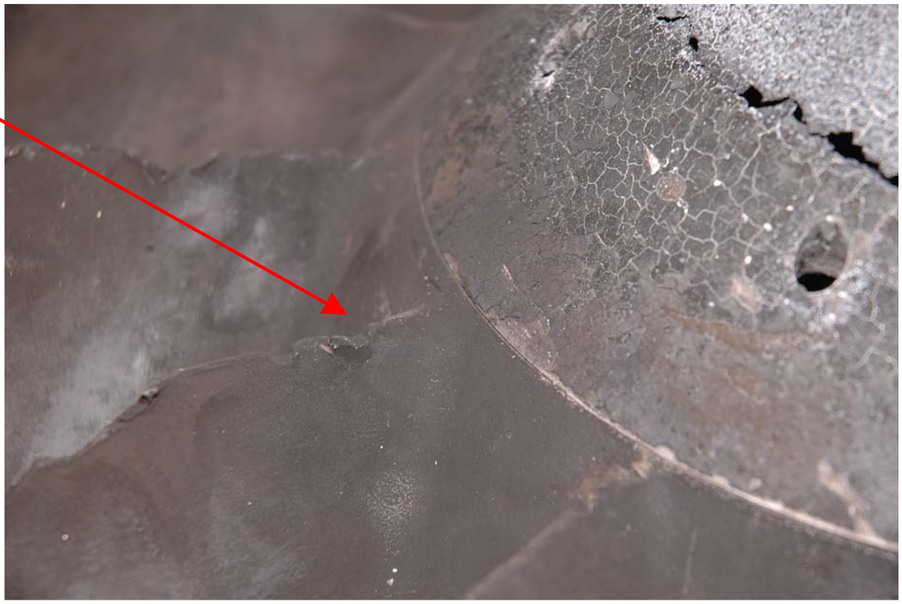

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Figure 19 – Fan blade material bent in direction opposite of rotation

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Figure 20 – Fan shroud – Rotational scoring at 3 o'clock position

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Figure 21 - Fan shroud – Rotational scoring at 9 o'clock position

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Figure 22 – Fan shroud – non-orthogonal intermittent bright metal deposits ahead of fan plane

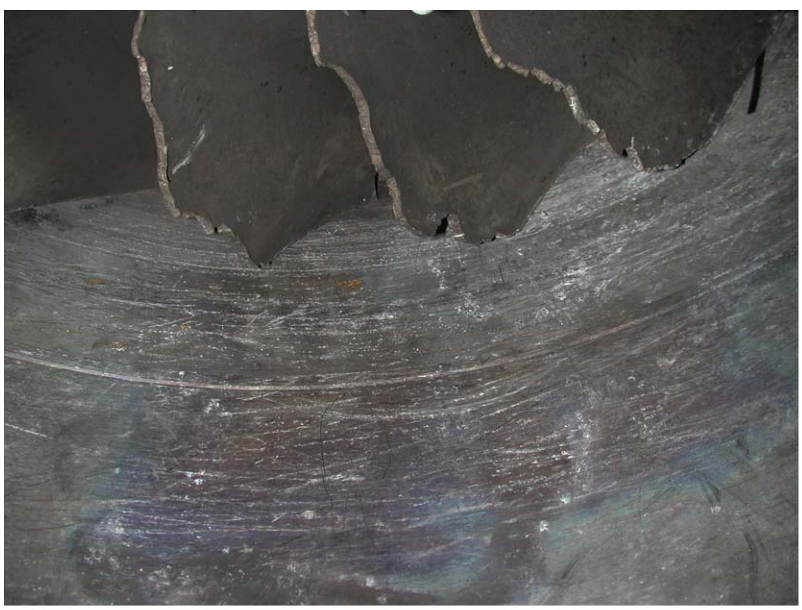

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Figure 23 – 1st stage stator vanes – Forward looking aft - Fan removed

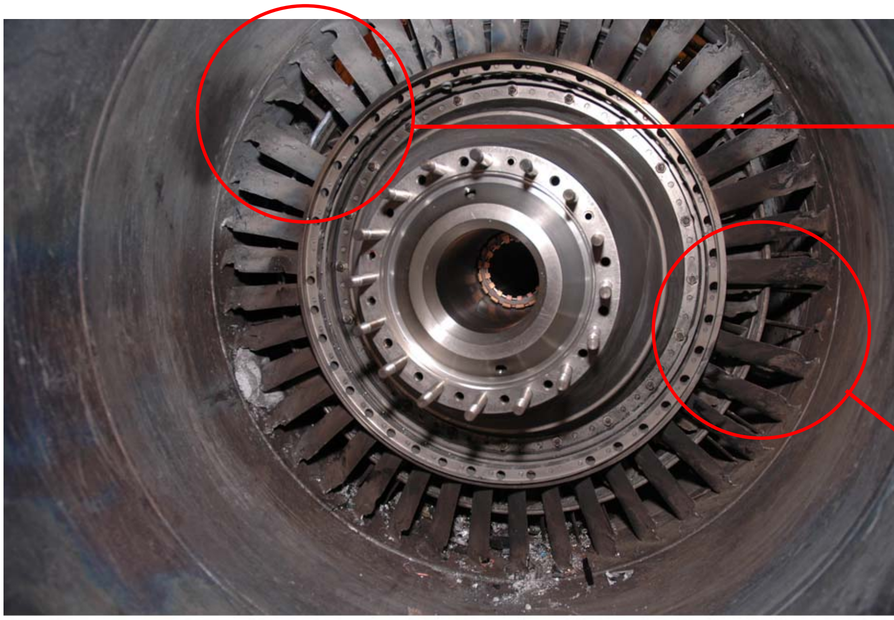

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Figure 24 – 1st stage stator vanes – Forward looking aft – Tears on outer spans

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Figure 25 – 1st stage stator vanes – Forward looking aft – detail of fractured vane 2 o'clock position

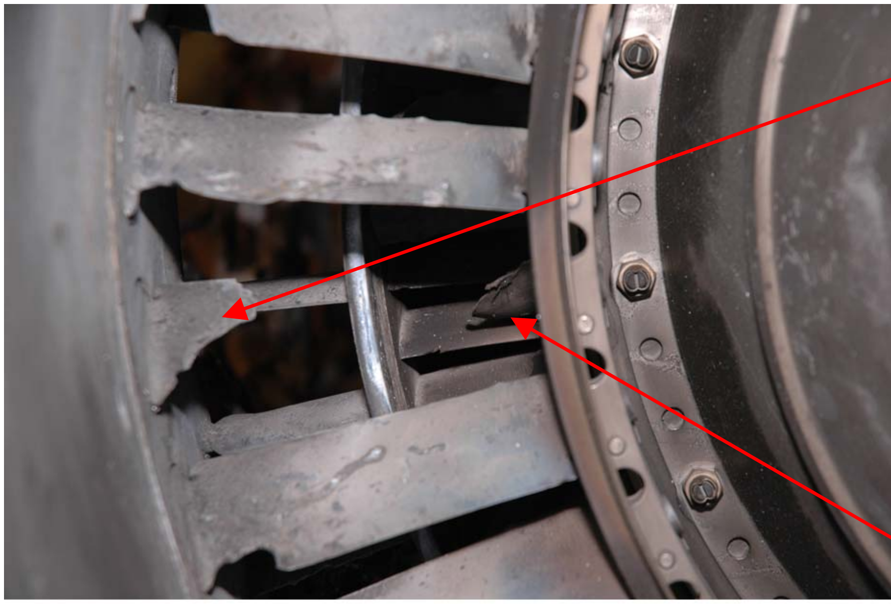

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Figure 26 – 1st stage stator vanes – Forward looking aft – detail of fractured vane at 9 o'clock position

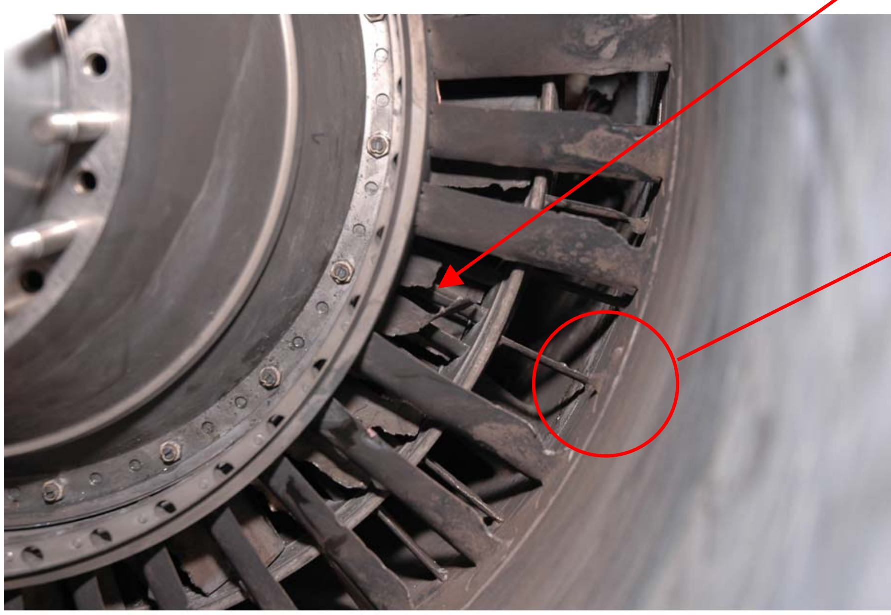

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Figure 27 – Inner 1st stage stator vane shroud at 9 o'clock position – impact marks

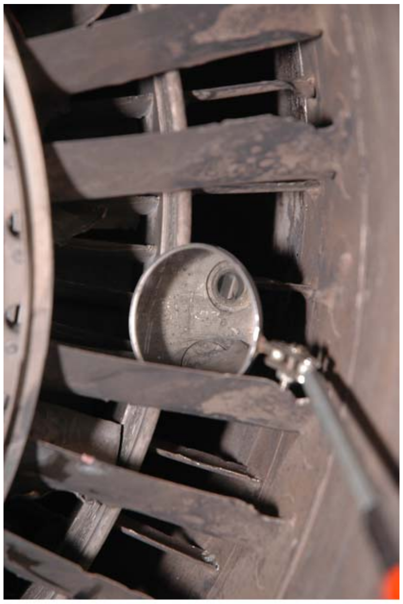

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Figure 28 – Variable guide vane actuator indicator

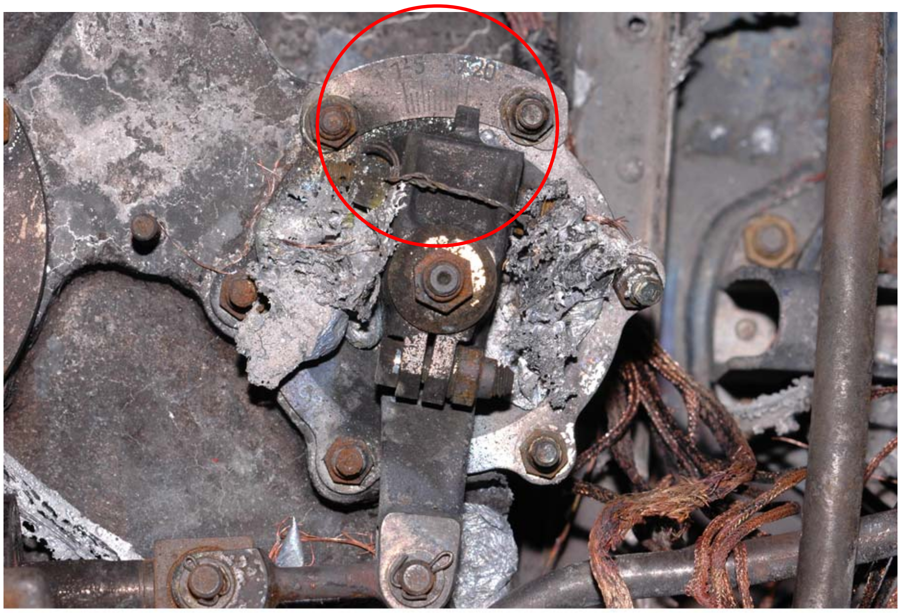

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Figure 29 – Typical vane and blade edge tearing

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Figure 30 – Combustor dome and fuel nozzle shrouds

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Figure 31 – Combustor liner

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Figure 32 – High pressure turbine nozzle

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Figure 33 – Fuel control unit

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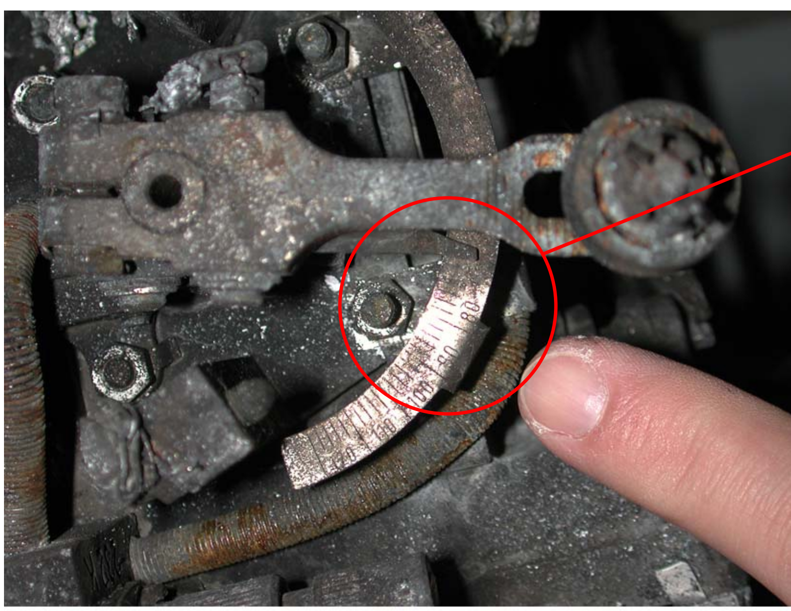
Figure 34 – Fuel control input lever – Lever and indicator moved for clarity



Bright scale location indicates no soot deposit.

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Figure 35 – Fuel control input spline

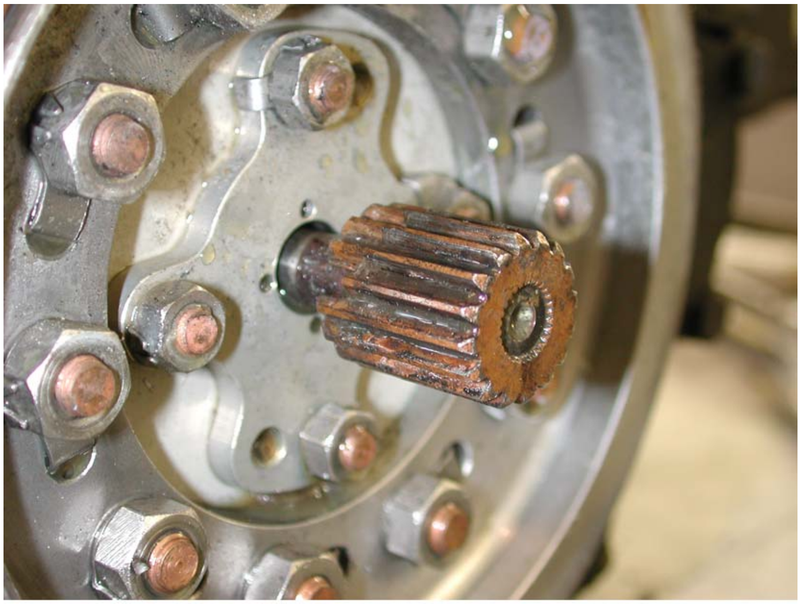

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Figure 36 – Fuel filter

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Figure 37 – Oil filter assembly

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Figure 38 – Oil filter element

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Figure 39 – Oil chip detector

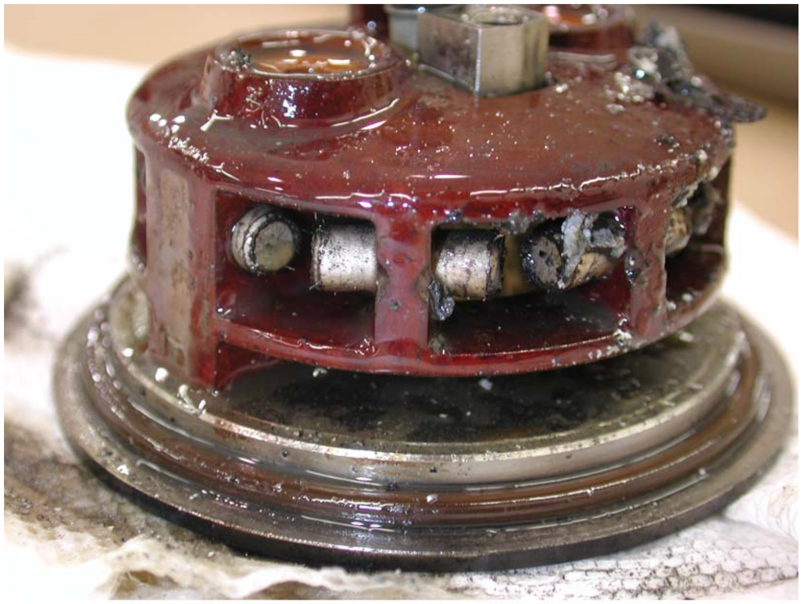

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Figure 40 – Airframe exhaust duct

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Figure 41 – Metallic scraping deposit indications

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Figure 42 – Metallic scraping deposit indications

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