NATIONAL TRANSPORTATION SAFETY BOARD
Office of Aviation Safety
Washington, D.C. 20594

June 10, 2009

POWERPLANT GROUP CHAIRMAN'S FACTUAL REPORT

NTSB No: DCA-08-MA-098

A. ACCIDENT

Location:	Columbia Metropolitan Airport, South Carolina
Date:	September 19, 2008
Time:	2353 eastern daylight time
Aircraft:	Global Exec Aviation Learjet LR-60, Registration Number N999LJ, Serial No. 314

B. POWERPLANTS GROUP

Safety Board Group Chairman:	Jean-Pierre Scarfo Powerplant Lead Engineer Washington D.C.
Federal Aviation Administration Members:	Jerry Morgan Aviation Safety Inspector Charleston, West Virginia Flight Standards District Office
	Charlie Monola Aviation Safety Inspector Charleston, West Virginia Flight Standards District Office
	Bruce Brooker Aviation Safety Inspector Charleston, West Virginia Flight Standards District Office
Pratt & Whitney Canada Member:	Jeff Davis Service Investigation Bridgeport, West Virginia

C. SUMMARY

On September 19, 2008, about 2353 Eastern Daylight Time, N999LJ, a Learjet LR-60 operated by Global Exec Aviation, crashed during takeoff from Columbia Metropolitan Airport (CAE), Columbia, South Carolina. The airplane, which had been cleared for back taxi and takeoff on runway 11, ran off the end of runway 11 on the takeoff roll. Of the 4 passengers and 2 crewmembers on board, 4 were killed and 2 received serious injuries. The airplane was destroyed by impact forces and post-crash fire. The flight was operated under 14 *Code of Federal Regulations* Part 135 and was en route to Van Nuys Airport (VNY), Van Nuys, California.

D. DETAILS OF THE INVESTIGATION

1.0 ENGINE INFORMATION

The accident airplane was powered by two Pratt & Whitney Canada (P&WC) PW305A turbofan engines, left-hand (No. 1) engine, serial number (SN) CA0484 and right-hand (No. 2) engine, SN CA0487.[1] The PW305A engine is a dual spooled turbofan engine featuring concentric low-pressure and high-pressure rotors. The inner shaft supports a single stage fan driven by a 3 stage low-pressure turbine and the outer shaft supports a high-pressure compressor consisting of 4 axial stages and one centrifugal stage, driven by a two stage high-pressure turbine. The combustion section consists of an annular ring. The PW305A turbofan engine has a maximum takeoff thrust of 4,679 pound flat-rated up to 93°F (34°C).[2]

All directional references to front and rear, right and left, top and bottom, and clockwise and counterclockwise are made aft looking forward (ALF) as is the convention. The direction of rotation of the engine is clockwise. All numbering in the circumferential direction starts with the No. 1 position at the 12:00 o'clock position, or immediately clockwise from the 12:00 o'clock position and progresses sequentially clockwise ALF.

2.0 Engine Examination

Both engines were removed from the airplane and shipped to the P&WC engine services facility in Bridgeport, West Virginia for disassembly and examination. Representatives from the Federal Aviation Administration (FAA) and P&WC convened at the Bridgeport facility on February 3, 2009 to witness the examination. The examination was completed on February 4, 2009 and a detailed report of findings was provided to the Safety Board by P&WC. See Attachment 1 for details of the examination.

Jean-Pierre Scarfo
Aerospace Engineer
Powerplant Lead Engineer

[1] Engines are numbered aft looking forward.
[2] Flat-rated to a specific temperature indicates that the engine will be capable of attaining the rated thrust level up to the specified temperature.

Attachment 1

Pratt & Whitney Canada Service Investigation Accident/Incident Report No. 08-128

Global Exec Aviation
Learjet 60 & Reg. N999LJ
Columbia, SC
September 19, 2008
Engine Model PW305A
S/N CA0484 Left-Hand
S/N CA0487 Right-Hand

Report No. 08-128

Written By: [redacted]

Jeff Davis
Investigator
Service Investigation Department

Approved By: [redacted]

- or:

G. Masciotra
Manager
Service Investigation Department

Date of Issue: **28 April 2009**

Distribution: **Elaine Summers (TSB), Robert Swaim (NTSB), Jean-Pierre Scarfo (NTSB), Jerry Morgan (FAA), John Wyzykowski, Denis Marchand, Ron Ortuso, Peter Boyd, Tim Blaskovich, Henry Teichman, Ted Furman, File 08-128**

Accident/Incident Report

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I ANALYSIS

1.0 ACCIDENT SYNOPSIS

On September 19, 2008, a Learjet Model 60 (N999LJ) overran runway 11 while departing Columbia, South Carolina. The airplane continued beyond the runway threshold, through the approximately 1,000 foot long runway safety area. The airplane impacted airport lighting, navigation facilities, perimeter fence, and concrete marker posts. The airplane then crossed a roadway, and came to rest on an embankment on the far side of the road. The aircraft was destroyed by an extensive post-crash fire. Four of the six people on board were fatally injured. The engines were forwarded to Pratt & Whitney Engine Services for investigation.

2.0 SUMMARY OF FINDINGS

The left-hand engine's low-pressure and high-pressure compressors were rotated manually and rotated freely. It could not be determined if the dents on two 1st stage blades of the high-pressure compressor rotor were pre existing or if they occurred during the event. The soot covered, heat discolouration, melted, obliterated, and damaged components were attributed to the external fire. The organic debris found in the combustor suggests the engine had rotation during the event in order to ingest the organic debris. The fuel shut off plunger pin did not exhibit any scoring on the face indicating the fuel shut off valve had not been activated by turbine displacement.

The right-hand engine's low-pressure compressor was capable of being rotated manually when the engine was suspended from a hoist. The high-pressure compressor was not capable of rotation. It could not be determined if the dents on the fan blades were pre existing or if they occurred during the event. The soot covered, heat discolouration, melted, obliterated, and damaged components were attributed to the external fire. The organic debris found in the combustor suggests the engine had rotation during the event in order to ingest the organic debris. The fuel shut off plunger pin did not exhibit any scoring on the face indicating the fuel shut off valve had not been activated by turbine displacement.

3.0 CONCLUSIONS

The presence of debris in the gas path suggests the engines were running at impact but no indication of the power being produced could be ascertained due to the lack of rotational signatures.

The investigation of the engine components revealed no pre-impact anomalies or distress which could have prevented the engines from producing power prior to the event.

II FACTUAL INFORMATION

1. INVESTIGATION PARTICIPANTS

The powerplant investigation was performed on February 3 & 4, 2009 at Pratt & Whitney Engine Services in Bridgeport, West Virginia. The following individuals participated in the investigation as representatives of their respective organisations:

Jerry Morgan	Aviation Safety Inspector Federal Aviation Administration
Charlie Monola	Aviation Safety Inspector Federal Aviation Administration
Bruce Brooker	Aviation Safety Inspector Federal Aviation Administration
Jeff Davis	Service Investigation Pratt & Whitney Canada Corp.

2. LEFT HAND ENGINE HISTORY

PW305A S/N CA0484

Hours Since New: 108.3

Cycles Since New: 123

Hours Since Overhaul: N/A

Cycles Since Overhaul: N/A

3. ENGINE EXAMINATION

All positional references are in relation to pilots 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 received in a shipping container and was opened with FAA oversight. The engine displayed fire damage that was more pronounced on the front and upper sections of the engine (Ref. Photo No. 1 & 2). The Engine Data Plate's surface was burnt, but the engraved information was legible. The engine serial number was confirmed to be CA0484.

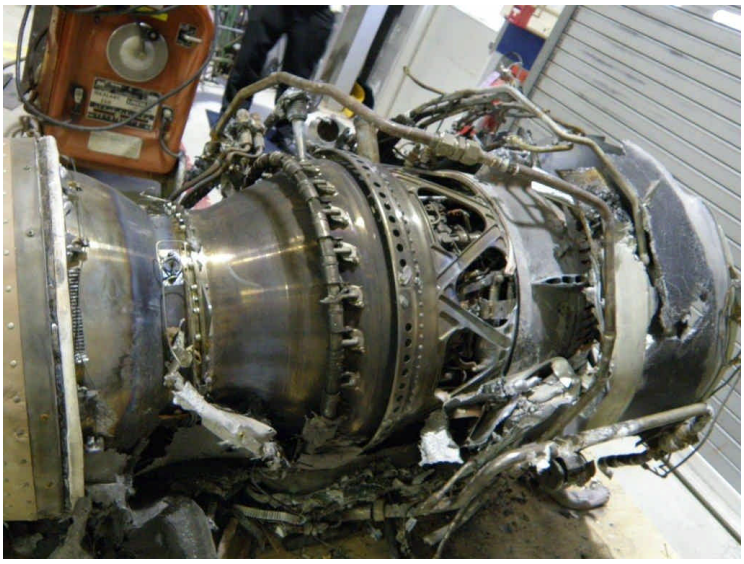

Photo No. 1

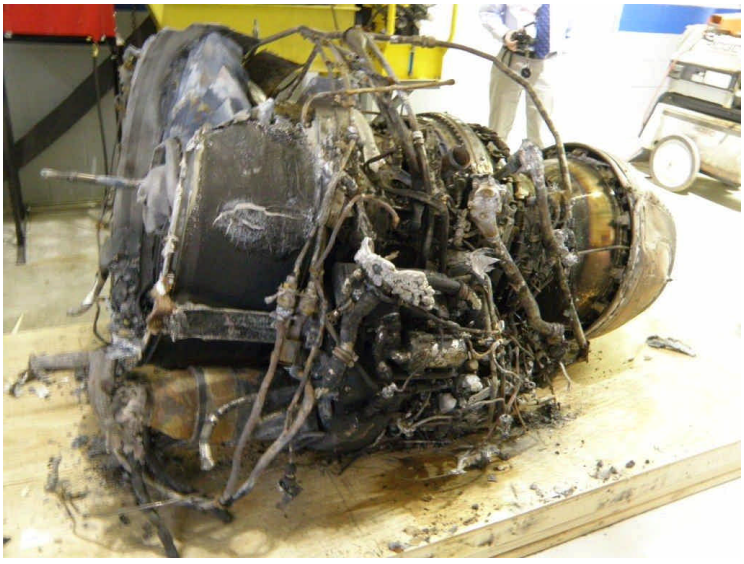

Photo No. 2

3.1.1 External Cases

Fan Case: The internal lining of the case had mostly disintegrated from fire damage (Ref. Photo No. 3). The area from the 10-12 o'clock position of the case had disintegrated; the remaining portion of the case was distorted and discoloured. The Kevlar containment wrap had delaminated from the case and had disintegrated from the 10-12 o'clock position.

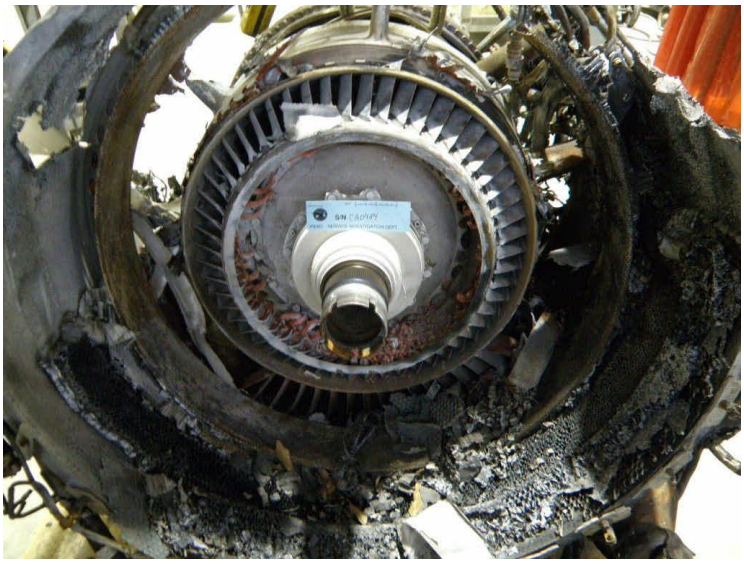

Photo No. 3

Intermediate Case: The outer portion of the case had disintegrated from the fire, including portions of two struts. The inner struts were intact. The coating on the remainder of the case was burnt, stained and partially covered with a black soot residue.

Exhaust Duct: The exhaust duct was unremarkable in appearance.

Outer and Inner Bypass Ducts: Only small portions of both ducts remained at the 6 o'clock region of the engine.

Accessory Gearbox: The gearbox was covered with a black soot residue and had some coating damage.

3.1.2 Fuel Shut Off Valve Cable/Linkage

The linkage and cable were complete. The fuel shut off valve housing was distorted/damaged from the fire. The plunger pin was removed from the exhaust duct and did not show any contact with the low pressure turbine retention nut. This would indicate there was no rearward displacement of the low-pressure compressor shaft and the shut off valve did not actuate.

Photo No. 4

3.1.3 Pneumatic Lines, Oil Lines, Electrical Harness, and Fuel Lines

The pneumatic, oil, and fuel lines exhibited some dents and fire damage. The lines were structurally intact and all the fittings and mountings were secured. The electrical wiring harnesses had deteriorated exterior insulation and several of the connectors exhibited some melting from the fire.

3.1.4 Chip Detectors and Filters

Accessory Gearbox Chip Detector: The magnetic poles were surrounded with a dark black compound (most likely solidified oil).

Oil Filter: The filter was oil coated and had sustained heat damage.

Fuel Filter: The filter was dry and had sustained heat damage.

3.2 Disassembly Observations

3.2.1 Low-Pressure (LP) Compressor Section

LP Compressor Fan: The low-pressure compressor rotated freely by hand pressure. The majority of the nose cone had disintegrated from fire damage (Ref. Photo No. 5). The fan had a dark gray coloured soot residue on the blades (Ref. Photo No. 5). There was no foreign object damage noted to the leading edge of the blades. The blade tips displayed very light witness marks from contact with the abradable fan shroud and are considered normal.

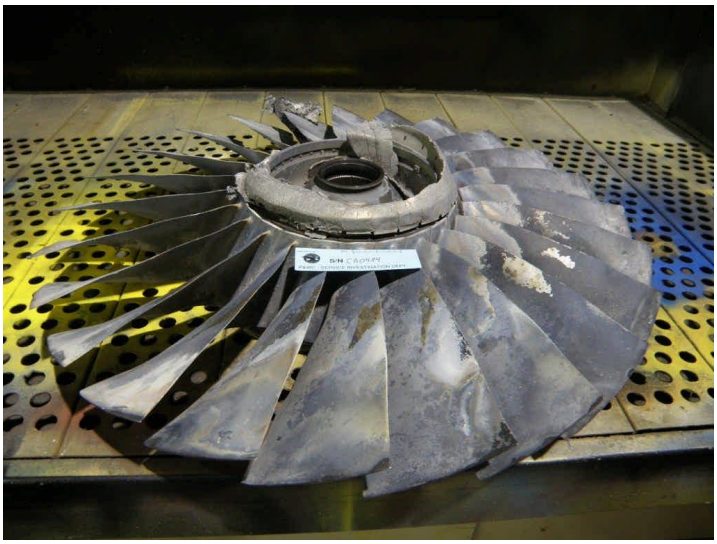

Photo No. 5

Fan Exit Stator: The majority of the airfoils were disintegrated except from the 3 to 5 o'clock position (Ref. Photo No. 6, Red Arrows). The upper regions of both the inner and outer shrouds were disintegrated.

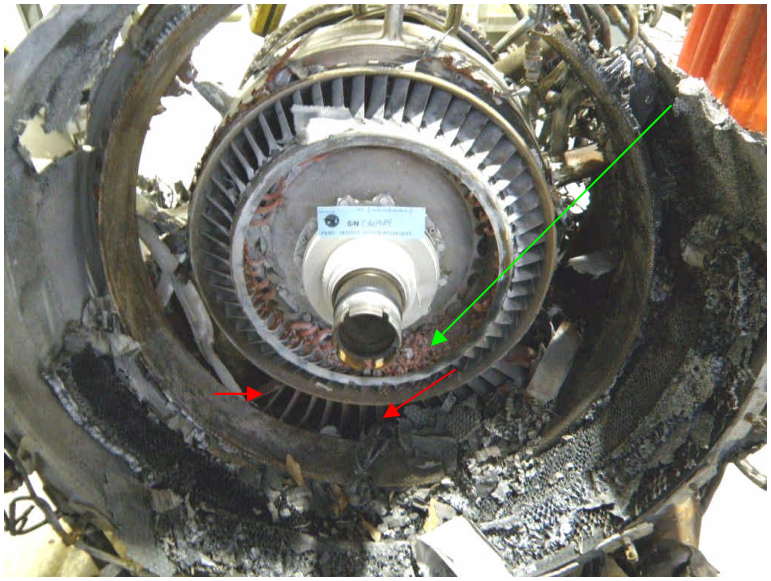

Photo No. 6

Compressor Core Stator: The stator had a greyish coloured residue and was intact except the rubber grommets on the inner shroud had deteriorated (Ref. Photo No. 6, Green Arrow).

LP Compressor Shaft: The shaft was unremarkable in appearance.

No. 1 Bearing: The No. 1 bearing was oil wetted, and rotated freely by hand.

No. 4 Bearing: The bearing was oil wetted and rotated freely.

3.2.2 High-Pressure (HP) Compressor Section

Variable Inlet Guide Vanes: The vanes were found in an open position (Ref. Photo No. 7). Both sets of vanes could not be actuated by hand. The linear stator vane actuator was removed; the inlet and 1st stage variable guide vanes were actuated by hand. The inlet guide vanes were covered with a black soot residue and had a greyish coloured splatter on most of the vanes.

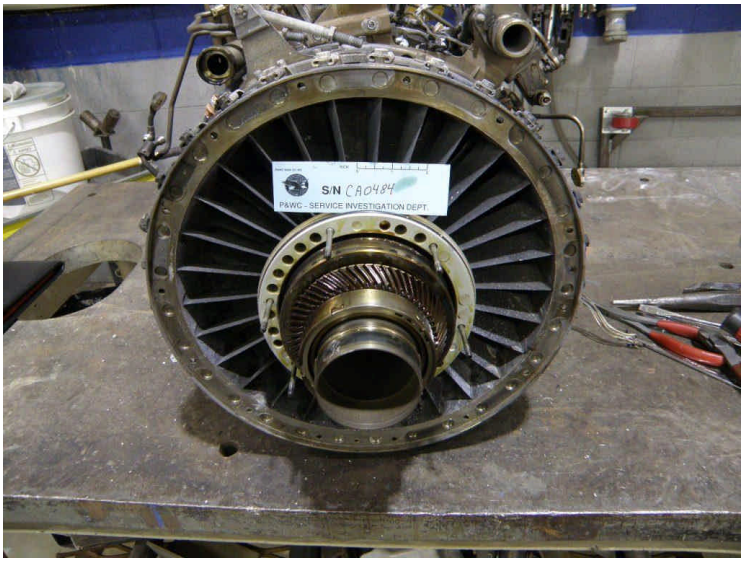

Photo No. 7

1st Stage Compressor Rotor: The rotor exhibited two dented blades (Ref. Photo No. 8). The blades were covered with a black soot residue and had a greyish coloured splatter on several of the airfoils.

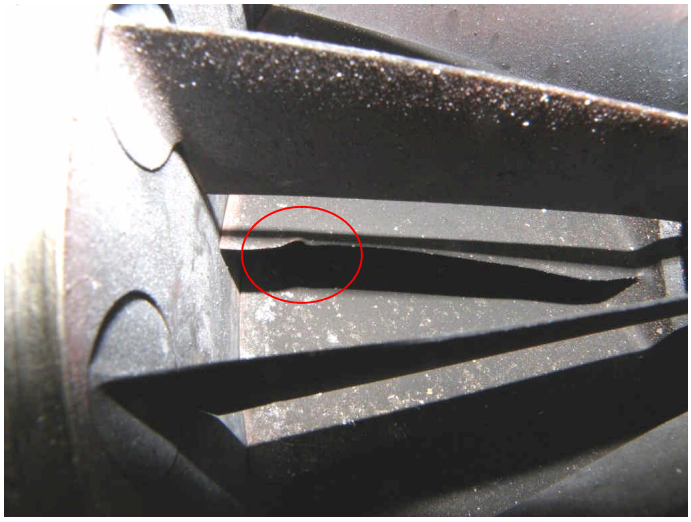

Photo No. 8

1st Stage Variable Guide Vanes: Not accessed.

HP Compressor Front Case: The case was stained and did not exhibit any obvious defects.

HP Compressor Rotor Assembly: Not accessed.

Compressor Stator Segment Assembly and Stator: Not Accessed.

Centrifugal Impeller: The impeller was not removed from the compressor. No rubs or impact damage was evident on the visible areas between the impeller and the shroud. The back face of the impeller was lightly stained/coated with a thin oil film.

Impeller Shroud: No rubs or impact damage was noted on the visible portion of the shroud.

Compressor Rotor Stub Shaft: Unremarkable.

No. 2 Bearing: Bearing was oil wetted and appeared in good condition. The bearing was not removed.

No. 3 Bearing: The bearing was oil wetted and rotated freely.

3.2.3 Combustion and Gas Generator Section

Gas Generator Case: Covered with a black soot residue.

Combustor Case: Covered with a black soot residue. The case appeared to be in good condition with no evidence of being penetrated. There was a significant amount of sand between the combustion chamber liner and the case, with several particles adjacent to the low-pressure turbine housing flange (Ref. Photo No. 9).

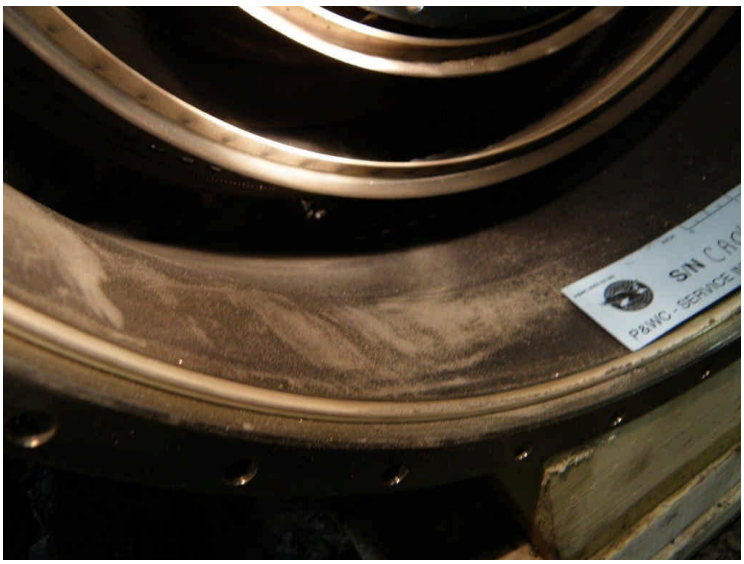

Photo No. 9

Combustion Chamber Liner: The liner was covered internally with a black residue. The liner was not removed for the purposes of this investigation.

3.2.4 Turbine Section

1st Stage HP Turbine Guide Vane Ring: Oil staining/residue was evident on the baffle (Ref. Photo No. 10). The vane and outer shroud had numerous sand particles adhered to the surfaces. The components were in good condition.

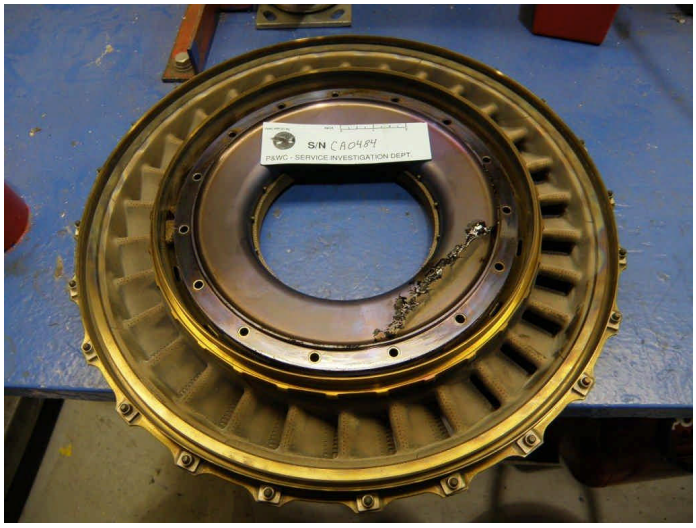

Photo No. 10

1st Stage HP Turbine Shroud: Unremarkable.

1st Stage HP Turbine: The components were in good condition. There was sand between the front cover and the disk (Ref. Photo No. 11).

Photo No. 11

2nd Stage HP Turbine Guide Vane Ring: Unremarkable.

2nd Stage HP Turbine Shroud: There was a minor rub at 8:30 o'clock position of the shroud.

2nd Stage HP Turbine: Unremarkable.

ITT Probes, Busbar, and Harness: The probes and busbar were unremarkable. The harness displayed heat distress but was intact.

LP Turbine Housing: The housing exhibited some external discolouration but appeared to be in good condition with no evidence of being penetrated.

3rd Stage LP Turbine Guide Vane Ring, Interstage Baffle, and Shroud: There was some sand trapped in the vane baffle.

3rd Stage LP Turbine: Unremarkable.

4th Stage LP Turbine Guide Vane Ring, Interstage Baffle, and Shroud: Not accessed.

4th Stage LP Turbine: Not accessed.

5th Stage LP Turbine Guide Vane Ring, Interstage Baffle, and Shroud: Unremarkable.

5th Stage LP Turbine: Unremarkable.

3.2.5 Accessory Gearbox Internal

Not disassembled.

3.3 Controls and Accessories Evaluation

3.3.1 Ignition System

Exciter Box: Both boxes were blackened and one was bulged from exposure to the fire (Ref. Photo No. 12).

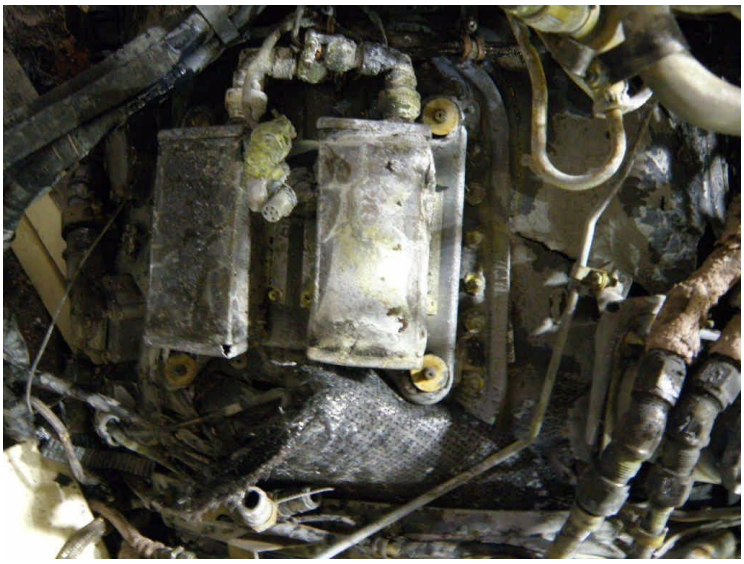

Photo No. 12

Ignition Leads: The leads were intact and exhibited damage from fire exposure.

Ignition Plugs: Not Removed.

3.3.2 Fuel System

Fuel Heater: Intact with black soot and some external damage from the fire.

Fuel Pump: The pump was not removed but the visible area was blackened with soot.

Fuel Control Unit: The control was blackened with soot, the servo valves and data plate showed some melting of the housing.

Fuel Start/Dump Valve: Blackened with soot and distorted from the fire.

Fuel Nozzles: The nozzles were not removed; the fuel transfer tubes were intact.

3.3.3 Air System:

Compressor Bleed Valve Solenoid: The valve was discoloured but was in good condition.

P2.5 Compressor Bleed Valves: The valves were in the open position and were discoloured.

P2.8 Compressor Bleed Valve: The valve was in the open position and was discoloured.

Linear Stator Vane Actuator: The actuator was discoloured and the wiring coating was melted.

Anti-icing Solenoid: The solenoid was discoloured.

3.3.4 Electronic Engine Control: The EEC showed severe damage from exposure to fire. The unit was removed at the crash site and was forwarded to Hamilton Sundstrand for memory data extraction. The condition of the unit was such that it could not be powered up to enable the data extraction. The memory devices were removed and attempts were made to read the data using a data reader. The devises could not be read indicating the memory device was damaged internally.

4. RIGHT HAND ENGINE HISTORY

PW305A S/N CA0487

Hours Since New: 108.3

Cycles Since New: 123

Hours Since Overhaul: N/A

Cycles Since Overhaul: N/A

5. 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.

5.1 External Condition

The engine was received in a shipping container and was opened with FAA oversight. The engine displayed extensive fire damage. The fan case, intermediate case, bypass ducts, and the accessory gearbox housing were completely obliterated by the event fire (Ref. Photo No. 13-16). The engine data plate was not received with the engine.

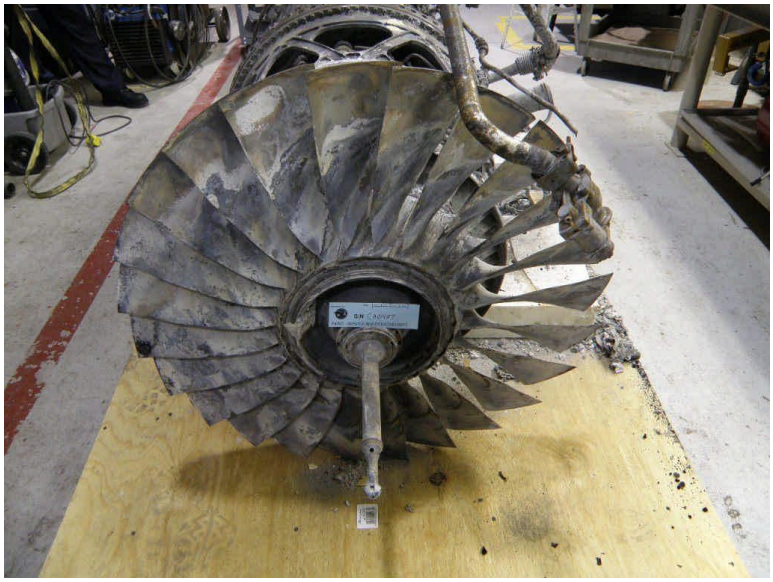

Photo No. 13

Photo No. 14

Photo No. 15

Photo No. 16

5.1.1 External Cases

Fan Case: The case was completely obliterated by the fire.

Intermediate Case: The case was completely obliterated by the fire.

Exhaust Duct: The rear faring of the case was bent and was externally discoloured from the fire (Ref. Photo No. 17). There was no evidence of any impact damage on the gas path exposed surfaces.

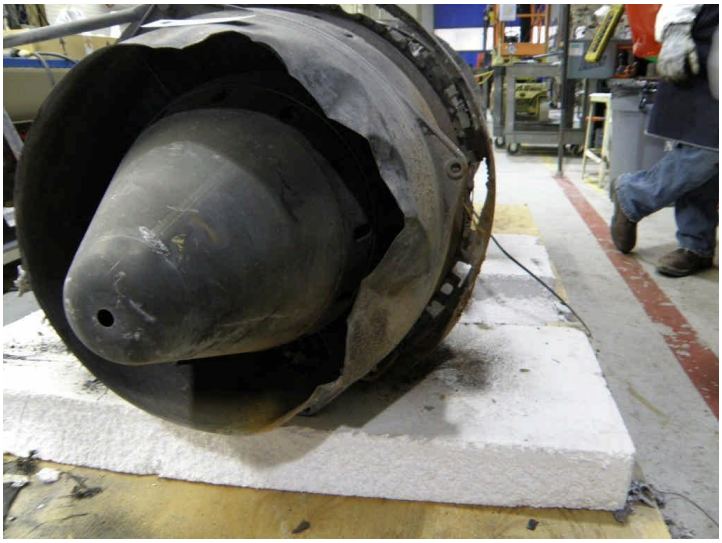

Photo No. 17

Outer and Inner Bypass Ducts: The ducts were completely obliterated from exposure to the fire.

Accessory Gearbox: The case was completely obliterated from exposure to the fire.

5.1.2 Fuel Shut Off Valve Cable/Linkage

The linkage and cable were complete. The fuel shut off valve housing was distorted/damaged from the fire. The plunger pin was removed from the exhaust duct and did not show any contact with the low pressure turbine retention nut. This would indicate there was no rearward displacement of the low-pressure compressor shaft and the shut off valve did not actuate.

5.1.3 Pneumatic Lines, Oil Lines, Electrical Harness, and Fuel Lines

The pneumatic, oil, and fuel lines were bent, showed dents and fire damage. Several of the mountings were loose as a result of the loss of the intermediate case and the accessory gearbox. The electrical wiring harnesses had deteriorated exterior insulation and several of the connectors exhibited some melting from the fire.

5.1.4 Chip Detectors and Filters

Accessory Gearbox Chip Detector: Not received.

Oil Filter: Not received.

Fuel Filter: Not Received.

5.2 Disassembly Observations

5.2.1 Low-Pressure (LP) Compressor Section

LP Compressor Fan: All of the blades were discoloured. Two blades exhibited impact damage (Ref. Photo 18). One blade exhibited impact in the downstream direction. The other blade showed impact damage in the downstream direction (Ref. Photo No. 19) and impact damage in the upstream direction (Ref. Photo No. 20). Three blades also exhibited minor impact damage to the trailing edge of the blades. The blade tips exhibited very light rubbing witness marks.

Photo No. 18

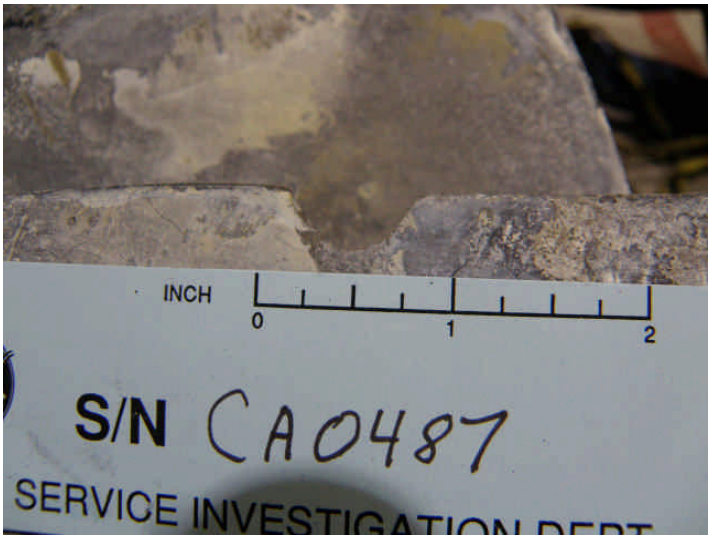

Photo No. 19

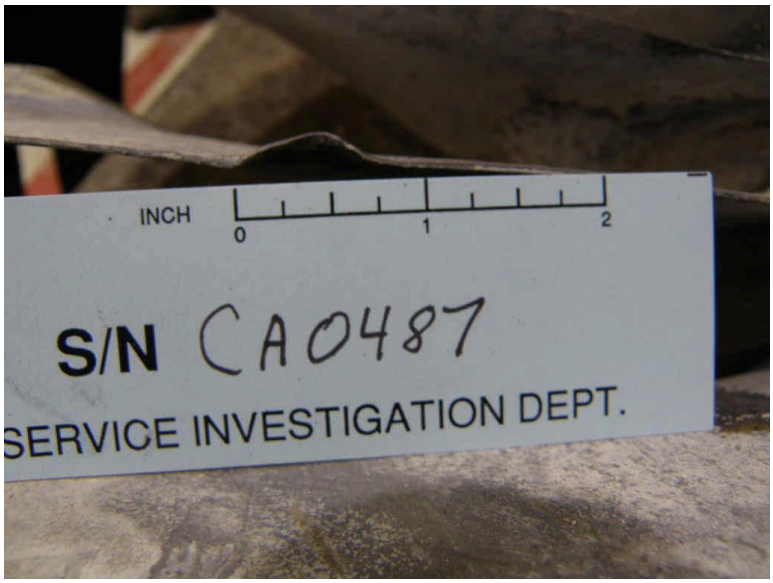

Photo No. 20

Fan Exit Stator: The stator was completely obliterated from exposure to the fire.

Compressor Core Stator: The stator was intact except the rubber grommets were completely obliterated from the fire. The stator was discoloured from the fire (Ref. Photo No. 21).

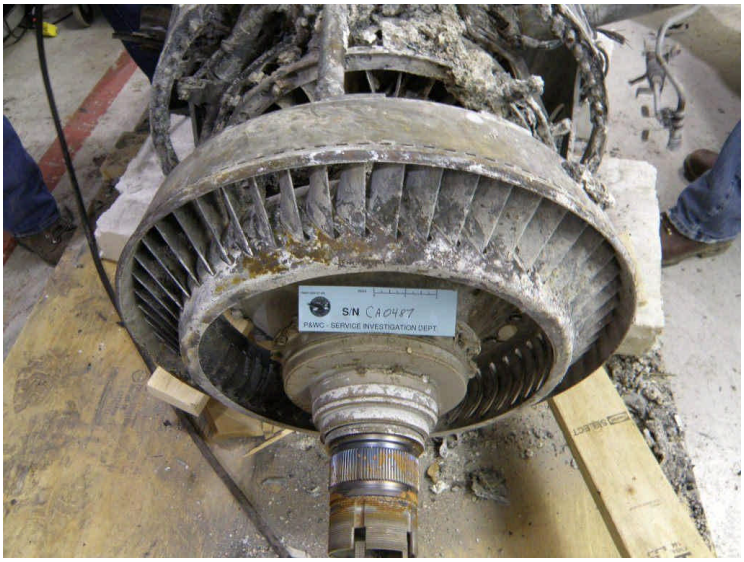

Photo No. 21

LP Compressor Shaft: The fan assembly splines and nut threads were corroded. The coating was discoloured and pealing at the centre section of the shaft (Ref. Photo No. 22).

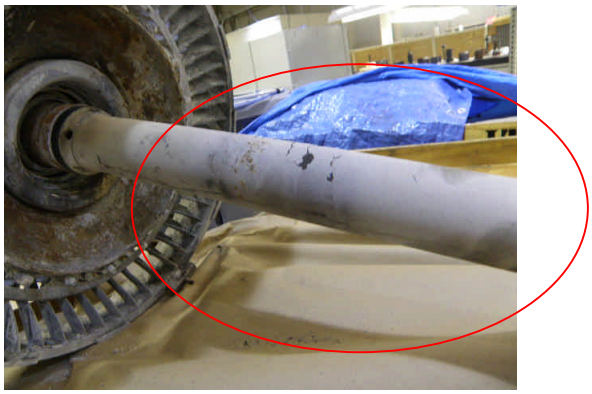

Photo No. 22

No. 1 Bearing: The bearing was not accessed but was not capable of being manually rotated in the housing.

No. 4 Bearing: The bearing was oil wetted and rotated freely.

5.2.2 High-Pressure (HP) Compressor Section

Variable Inlet Guide Vanes: The vanes were in the open position. Several of the airfoils were distorted from the fire and melted/burnt debris was evident (Ref. Photo No. 23 & 24).

Photo No. 23

Photo No. 24

1st Stage Compressor Rotor: The visible portions of the blades were intact with no apparent distortion noted.

1st Stage Variable Guide Vanes: Not Accessed.

HP Compressor Front Case: Discoloured from the fire and exhibited melted debris adhered to the case at several locations.

HP Compressor Rotor Assembly: Not Accessed.

Compressor Stator Segment Assembly and Stator: Not Accessed.

Centrifugal Impeller: The impeller was not removed from the compressor. No rubs or impact damage was evident on the visible areas between the impeller and the shroud. The back face of the impeller was coated with ash/dirt from the fire.

Impeller Shroud: No rubs or impact damage was noted on the visible portion of the shroud.

Compressor Rotor Stub Shaft: The shaft was intact and the coating exhibited discolouration from the fire.

No. 2 Bearing: The bearing was not removed but burnt dry in the fire. The bearing would not rotate manually.

No. 3 Bearing: The bearing was lightly oil wetted and manually rotated freely.

5.2.3 Combustion and Gas Generator Sections

Gas Generator Case: The case was intact but was discoloured from the fire (Ref. Photo No. 25)

Photo No. 25

Combustor Case: The case was intact but was discoloured from the fire and was not penetrated. Organic matter was observed between the case and the combustion chamber liner (Ref. Photo No. 26).

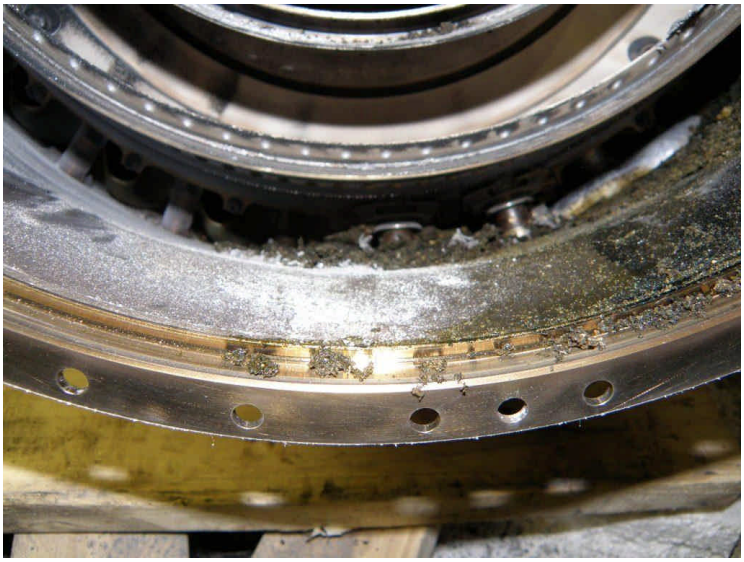

Photo No. 26

Combustion Chamber Liner: The liner was covered internally with a black residue. The liner was not removed for the purposes of this investigation.

5.2.4 Turbine Section

1st Stage HP Turbine Guide Vane Ring: The vane ring segments were in good condition. The vane baffle discoloured from the fire and oil stained from the 1-5 o'clock position.

1st Stage HP Turbine Shroud: The shrouds had no apparent operating damage but exhibited some oil staining and residue from the fire.

1st Stage HP Turbine: The turbine had some oil staining (Ref. Photo No. 27) and sand was noted between the front cover and the disk (Ref. Photo No. 28).

Photo No. 27

Photo No. 28

2nd Stage HP Turbine Guide Vane Ring: The vane ring surface exhibited residue from the fire.

2nd Stage HP Turbine Shroud: The 2nd stage shroud exhibited a minor rub at the 7:00 o'clock position.

2nd Stage HP Turbine: The turbine and blade surfaces were coated with a residue from the fire. The blade tips exhibited a light rub from contact with the shroud rub.

ITT Probes, Busbar, and Harness: The probes and busbar were unremarkable. The harness was damaged by the fire.

LP Turbine Housing: The housing exhibited some external discolouration but appeared to be in good condition with no evidence of being penetrated. There was some molten material from the fire adjacent to the exhaust duct flange.

3rd Stage LP Turbine Guide Vane Ring, Interstage Baffle, and Shroud: The vane ring, baffle and shroud were coated with residue from the fire.

3rd Stage LP Turbine: The turbine and blades exhibited some staining from the residue from the fire.

4th Stage LP Turbine Guide Vane Ring, Interstage Baffle, and Shroud: Not disassembled.

4th Stage LP Turbine: Not disassembled.

5th Stage LP Turbine Guide Vane Ring, Interstage Baffle, and Shroud: The vane ring and baffle were not disassembled. The shroud exhibited minor rubs in the honeycomb.

5th Stage LP Turbine: The blades exhibited minor tip rubs with the shroud. The disk was unremarkable.

5.2.5 Accessory Gearbox Internal: The gearbox housing and cover were obliterated by the fire. Only one internal gearshaft was received with the engine.

5.3 Controls and Accessories Evaluation

5.3.1 Ignition System

Exciter Box: Not received.

Ignition Leads: The leads were damaged by the fire.

Ignition Plugs: The plugs were not removed for the purposes of this investigation.

5.3.2 Fuel System

Fuel Heater: The heater was discoloured from exposure to the fire.

Fuel Pump: The control exhibited a burnt appearance from exposure to the fire.

Fuel Control Unit: The control exhibited a burnt appearance form exposure to the fire.

Fuel Start/Dump Valve: The valve was discoloured and distorted from the fire.

Fuel Nozzles: The fuel nozzles were not removed. The fuel manifold outer tubes from 9-3 o'clock positions were obliterated from the fire and the centre of two of the inner fuel manifold tubes were also obliterated from the fire (Ref. Photo No. 29).

Photo No. 29

5.3.3 Air System:

Compressor Bleed Valve Solenoid: The valve was discoloured but was in good condition.

P2.5 Compressor Bleed Valves: The valves were in the closed position and could not be actuated by hand. The valves were discoloured.

P2.8 Compressor Bleed Valve: The valve was in the open position and was discoloured.

Linear Stator Vane Actuator: The actuator's outer housing was completely obliterated from the fire.

Anti-icing Solenoid: The solenoid was discoloured.

5.3.4 Electronic Engine Control: The EEC showed severe damage from exposure to fire. The unit was removed at the crash site and was forwarded to Hamilton Sundstrand for memory data extraction. The condition of the unit was such that it could not be powered up to enable the data extraction. The memory devices were removed and attempts were made to read the data using a data reader. The devises could not be read indicating the memory device was damaged internally.