



Memorandum For Record

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Factual observations of the engines are noted below:

LEFT ENGINE

Examination of engine S/N LE-01455AX following recovery revealed it was broken between the first- and second-stage axial compressor rotors. The aircraft hardware attached to the forward and aft sections of the engine were removed to facilitate detailed inspection of the engine. The following observations of the engine were made.

Power Turbine Stage 2 Blades:

- All but four blades were missing, with the blade broke above the platform
- The four remaining blades were heavily damaged, with about half of the outer blade missing

PT Stage 2 Nozzle

- All but two vanes were missing
- The two remaining vanes were 180° apart
- There was rotational scoring on the aft ID platform

PT Stage 1 Blades:

- Numerous blades were missing
- Remaining blade were damaged mid span to tip

PT Stage 1 Stator:

- Vanes show significant trailing edge damage

Rear Turbine Support:

- Axial deformation on the aft flange of the engine at 7 o'clock
- Rear sump and PT rotors were out of axial alignment
- Four struts on the rear turbine support were damaged
- Aft flange was distorted and crushed forward over 120° arc, and was also out of round

Combustor Plenum:

- Crushed axially, in line with the aft flange distortion
- Deflected inward at 6 o'clock with tears present

Diffuser Housing:

- Deformed circumferentially inward (aft), exposing the compressor impeller through the forward split line over 180°, in line with the axial distortion
- Aft flange of the compressor vane case remained attached to the diffuser housing with the forward portion of the case missing

Axial compressor rotors Stages 2 -5 remained attached to the aft section of the engine.

Stage 2 Axial Compressor Rotor:

- Missing all blades
- All of the bolt attaching the stage 2 rotor to the stage 1 rotor were broken
- There was rotational scoring on the OD of the disk

Stage 3 Axial Compressor Rotor:

- All blades were missing
- There was rotational scoring on the OD of the disk

Stage 4 Axial Compressor Rotor:

- All blades were missing
- There was rotational scoring on the OD of the disk

Stage 5 Axial Compressor Rotor:

- All blades were fractured at the blade platform with 10 blades completely missing
- There was rotational scoring on the OD of the disk

Stage 5 Compressor Vane Assembly

- Rotational scoring was present on the forward ID platform
- Most of the vanes were missing
- Heavy damage to the remaining vanes with FOD

PT Shaft

- Was fractured approximately 1 inch forward of the stage 2 compressor rotor
- Rotational scoring on the OD of the shaft
- 45° angle on the fracture surfaces of the shaft
- The shaft was crushed inward over 180°

The forward section was comprised of the forward flange of the compressor case forward to the propeller with one of the three propeller blades remaining attached.

Compressor Case:

- Forward flange of the top half remained attached to the front frame
- Case aft of the flange was missing

- Stage 1 axial compressor rotor:
 - o Three complete blades missing
 - o Remainder of blades were missing at the platform

Inlet Guide Vanes:

- Intact but vanes missing from 11 – 2 o'clock

Front Frame:

- Inserts for AGB and N2 gearbox pulled out of frame
- All three engine mount pads appeared undamaged
- Aircraft mount was broken but remained attached to front frame
- Front frame broke at accessory gearbox mount
- Earthen debris in inlet of front frame
- Reduction gearbox remained attached

Accessory Gearbox

- Heavy damage with housing broke

The following miscellaneous parts were loosely attached to the engine:

- Fuel Control Unit
- N2 gearbox

Borescope Inspection

- Impeller blade leading edge damage
- Debris on the shroud
- Rotational scoring on the shroud
- Rotational scoring on impeller blades
- Trailing edge of first stage PT stator was damaged with nicks present on the remaining airfoil

RIGHT ENGINE

Examination of engine serial number (S/N) LE-30106A following recovery revealed it was broken between the inlet guide vanes(IGV) and the first-stage axial compressor. The aircraft hardware attached to the forward and aft sections of the engine were removed to facilitate detailed inspection of the engine. The following observations of the engine were made.

PT Stage 2 Rotor:

- 5 blades missing
- Half of the PT2 blades were broken at midspan
- All but 10 blades missing tip shroud

PT Stage 2 Nozzle:

- Trailing edge damage on vanes
- Rotational scoring on aft ID platforms

Rear Turbine Support:

- Strut damaged at 3 o'clock
- Rear frame crushed forward at 2 to 6 o'clock
- Hub appears to be in axial alignment

Combustor Plenum:

- Inward puncture at 12 o'clock
- Deformation inward at 10 o'clock and 3 to 6 o'clock

Diffuser Housing:

- Axial deformation from 12 to 3 o'clock

Compressor Case:

- Flange intact over 360° but missing forward of that flange

Axial compressor rotors Stages 1 -5 remained attached to the aft section of the engine.

Stage 1 Rotor:

- All blades missing
- Rotational scoring on forward face of disk
- Fracture surfaces at 45°
- PT shaft broke slightly aft of rotor 1 at 45°
- Bolts were sheered

Stage 2 Rotor:

- All blades missing
- Rotational scoring on the forward side

Stage 3 Rotor:

- All blades missing
- Rotational scoring on the forward side

Stage 4 Rotor:

- All blades missing with the exception of 8 dovetails remain

Stage 5 Rotor:

- Approximately 20 blades broke above platform, remaining blades damaged

Compressor Vane Stage 5:

- Heavy damage

Forward Section

The forward section was comprised of the forward flange of the compressor case forward to the propeller with one of the three propeller blades remaining attached.

Front Frame:

- Aircraft mount was broken remained attached to front frame
- Inserts pulled out for the AGB and N2 gearbox
- A portion of the stage 1 stator remained in the front frame
- IGV actuator was cracked
- Reduction gearbox remained intact and attached to front frame
- Earthen debris in inlet of front frame

Compressor Case:

- Top half of the compressor case flange remained attached to the front frame
- Compressor case aft of the forward flange was missing

Inlet Guide Vanes:

- Missing from 9 to 12 o'clock
- Remaining vanes were bent

Miscellaneous pieces

Accessory Gearbox:

- Drive spline was bent
- Mount flange was missing

Fuel Control was found loose among the debris

Borescope Inspection

- Diffuser vane leading edge damaged
- Debris in the diffuser
- Rotational scoring on the impeller and shroud from the inducer through the knee
- Nicks and trailing edge damage on the first stage PT stator
- Some second stage PT stator vanes were separated midspan
- There was rotational scoring on the aft OD platform of the second stage PT stator
- There were nicks on the 1st stage stator blades

Attachment 1 – Photographs



Figure 1: Honeywell Photograph. View of the engines and propellers.