

# National Transportation Safety Board

Office of Aviation Safety

Washington, DC 20594



ENG23LA034

## **POWERPLANT FACTUAL REPORT**

July 9, 2025

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## **A. ACCIDENT**

Location: Rochester, Minnesota  
Date: January 24, 2023  
Time: 1:42 central daylight time  
Airplane: Lancair Legacy, Registration Number N707MM

## **B. POWERPLANT GROUP**

|                   |                                                                            |
|-------------------|----------------------------------------------------------------------------|
| Group Chair       | Harald Reichel<br>National Transportation Safety Board<br>Washington, D.C. |
| Party Coordinator | Alexandre Gauthier<br>Pratt & Whitney Canada<br>Longueuil, Canada          |

## **C. SUMMARY**

On July 20, 2023, at about 1:42pm local time, a Lancair Legacy airplane, registration number N707MM, powered by a single Pratt & Whitney Canada PT6A-42 turbo-propeller engine experienced an uncontained engine occurrence while enroute from the Rapid City Regional Airport (KRAP), South Dakota to the Rochester International Airport (KRST), Minnesota. The pilot declared an emergency, started a gliding descent into KRST, and made a successful landing without power. The airplane was operated as a Title 14 Code of Federal Regulations (CFR) Part 91 flight. The pilot and passenger reported no injuries.

A post flight inspection of the airframe revealed minor impact marks on the wing leading edges from exiting engine debris. A further inspection of the engine revealed an exit hole in the engine. The exhaust ducts exhibited pock marks, consistent with released internal rotating engine parts. An inspection made through the exhaust duct revealed that all the 2<sup>nd</sup> stage power turbine (PT) blades were fractured near the blade platform.

The engine was shipped to the Pratt & Whitney Canada facility in St. Hubert, Quebec, Canada where it was torn down and examined on July 16<sup>th</sup> to 18<sup>th</sup>, 2024. The findings were:

- The engine was in poor overall condition with missing surface protective paint and surface corrosion noted throughout the external and internal surfaces of the engine.
- The teeth of the reduction gearbox (RGB) 1<sup>st</sup> stage sun gear were entirely missing in the plane of the mating gear teeth of the 1<sup>st</sup> stage planet gears. The gear teeth of the three planet gears were also battered and fractured.
- All the blades of the 2<sup>nd</sup> stage PT were fractured near the root. The fracture surfaces of all the blades exhibited only evidence of tensile overload. The 2<sup>nd</sup> stage PT hub was intact.
- All the blades of the 1<sup>st</sup> stage PT were fractured at various span heights. The fracture surfaces of all the blades exhibited only evidence of tensile overload. The 1<sup>st</sup> stage PT hub was intact.
- The magnitude and type of damage observed on the 1<sup>st</sup> and 2<sup>nd</sup> stage PTs is consistent with a PT overspeed event.
- The PT shaft was fractured between the PTs.
- All the compressor turbine (CT) blades were present; however, they were thermally eroded at the tips. The CT hub was intact.
- The fuel control unit (FCU) was tested and was very close to nominal production calibration.

A review of the engine purchase document revealed that the operator knowingly purchased the engine in unserviceable condition, The log entry indicated that only a periodic inspection had been performed before flight, which consisted of an examination of the engine controls and rigging mechanism, a functional test and inspection of the ignition and chip detector systems, and servicing of oil and fluids filter inspection. Inspection of the RGB gears is not part of the 200-hour inspection.

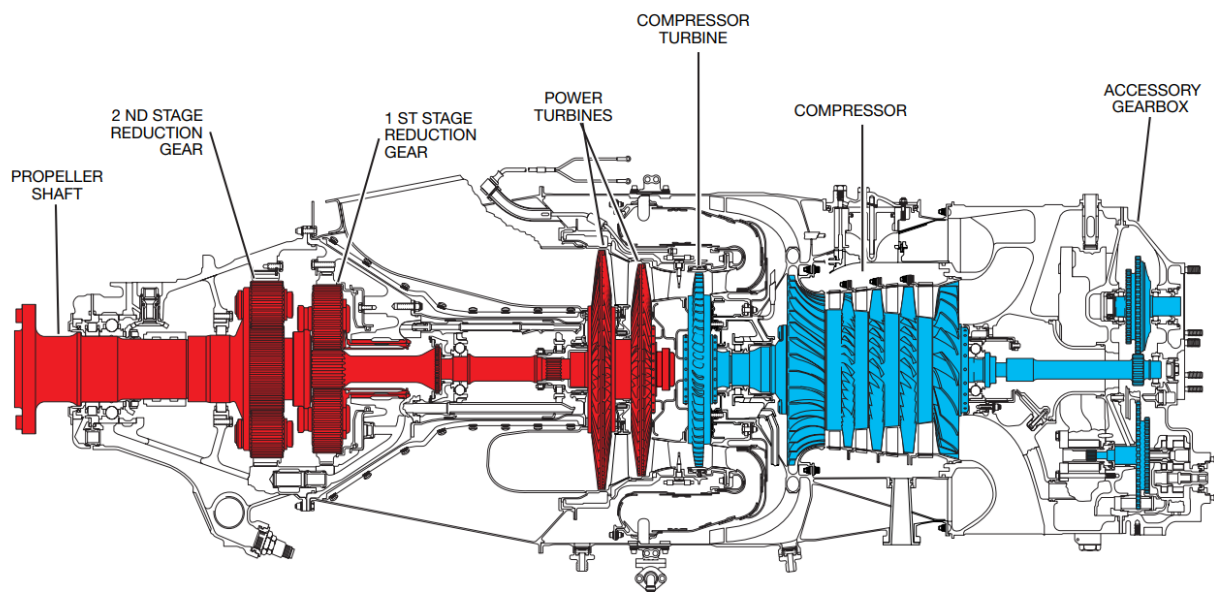
## **D. DETAILS OF THE EXAMINATION**

### **1.0 Powerplant**

#### **1.1 Engine Description**

The Pratt & Whitney Canada (P&WC) PT6A-42 engine (**Figure 1**) is a 2-spool turbo-propeller engine. The gas generator (GG) spool consists of a 4-stage axial and single stage centrifugal compressor driven by a single stage compressor turbine (CT). The combustion chamber is a reverse-flow annular type. A power or propeller (Ng) spool consists of a two-stage free turbine power turbine (PT) which drives the

propeller through a 2-stage planetary RGB. The constant-speed, variable pitch propeller is a single-acting type and is hydraulically controlled. The engine power management system consists of a hydro-mechanical fuel control unit (FCU), which governs the GG spool, and a propeller governor (CSU), which governs the PT spool.



**Figure 1** - P&WC PT6A-42 Engine

## 1.2 Engine History

The engine data plate indicated that the engine was model number PT6A-42 and serial number (S/N) PC-E 94119 and was manufactured on July 1, 1987. Further, the dataplate indicates that it was originally manufactured for the Beechcraft corporation and was installed on a King Air 200.

At the time of installation, the engine had accumulated a total time since new (TTSN) of 9,437.1 hours, a time since overhaul (TSO) of 3,543.7 hours and a time since hot section inspection (TSHSI) of 1,749.0 hours. The cycles accumulated since new (CSN) was 9,355, since the last overhaul (CSO) was 4,088 and since the last hot section inspection (CSHSI) was 2,129.

According to the purchase document, the engine was purchased on December 24, 2022, from Leasco, which is the engine leasing and sales group within P&WC. The purchase document stated that the engine was sold as an unserviceable engine. The time since overhaul (TSO) of the purchased engine was 3543.7 hours, which was 56.3 hours before the basic P&WC recommended TBO of 3600 hours; however, TBO life is variable, depending on the continuing airworthiness plan of an operator.

A one-page logbook of the engine service and maintenance record was obtained from the operator which indicated that a 200-hour routine and periodic inspection had been performed on the engine, which consists of an examination of the engine controls and rigging mechanism, a magnetic chip detector and ignition systems inspection and functional test, fluids filter check and servicing of oil. The engine was filled with 10 quarts of oil. The engine was installed on the airplane on July 8, 2023, 12 days before the event. An inspection of the RGB gears is not part of the 200-hour inspection.

## 2.0 Engine Disassembly & Examination

### 2.1 General External Condition

The engine was in a standard cardboard engine container which was opened in the presence of the NTSB (**Photo 1**).

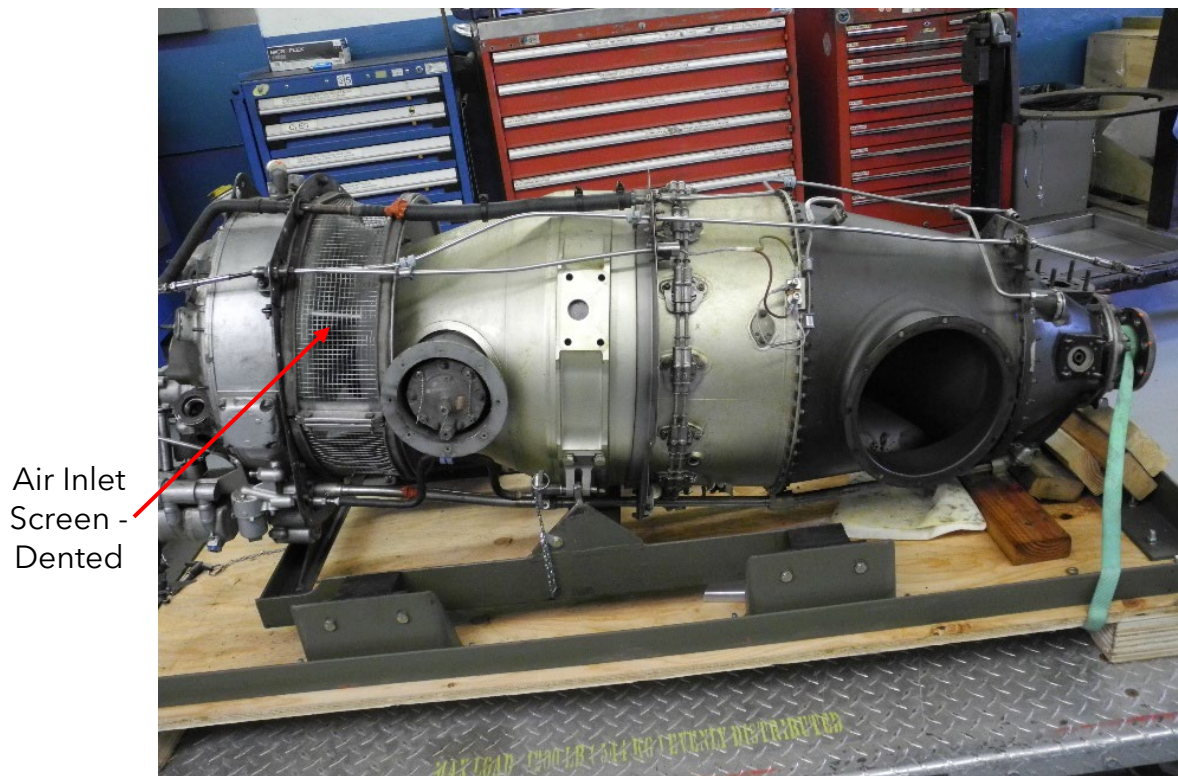


**Photo 1** - Engine in Shipping Container - As Received

The front of the engine was not properly secured to the metal support frame with fasteners but rather was strapped to the frame. The engine (**Photo 2**) was intact; however, was in generally poor condition. The protective paint on the RGB was not present (**Photo 3**). The accessory gearbox (AGB) coating had flaked off on about 80% of the surface (**Photo 4**). There was surface corrosion noted on many external and internal parts.

The engine inlet screen was intact; however, it was deformed in two locations.

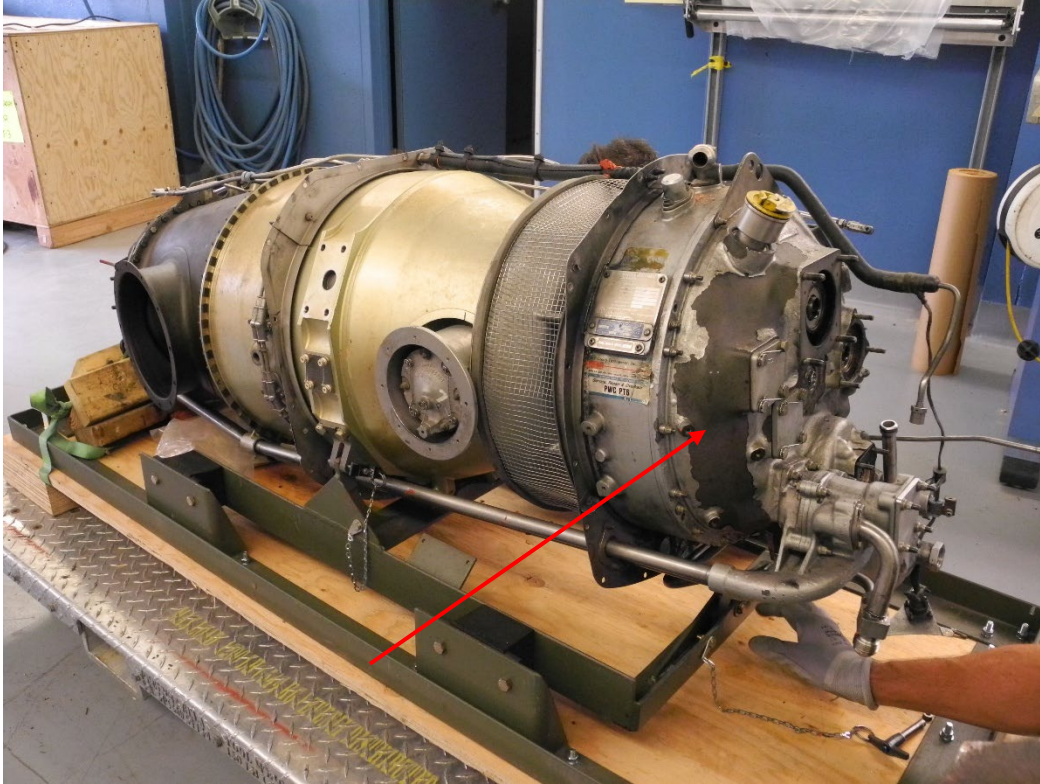
The inlet case was intact and undamaged. The exhaust case was intact; however, the inner diameter of the exhaust stacks exhibited numerous impact dents.



**Photo 2** - PT6A-42 S/N 94119 - Right Side View



**Photo 3** - PT6A-42 S/N 94119 - RGB Missing Silver Colored Protective Coating



**Photo 4** - PT6A-42 S/N 94119 - AGB with Corroded and Missing Silver Colored Protective Coating

Of the accessories, only the oil and scavenge pump, oil/fuel heat exchanger and P3 filter housing were still attached to the engine. An additional box, reported to have been shipped separately later, contained the other accessories (**Photo 5**) that were reported to be on the engine at the time of the accident. Below is a list of those components:

- A Honeywell FCU P/N 244768-13-11-12, S/N B12347
- A Sundstrand fuel pump P/N 025323-300, S/N 9555
- A Woodward propeller CSU P/N 8210-024H, S/N 1818601
- A Woodward overspeed governor P/N 210638, S/N 1718255F
- A Vickers electric generator, tachometer P/N 50-389057 -1, S/N 13336
- A GE generator tachometer P/N 2CM9AAH4, S/N J0952
- A Pratt & Whitney engine management cambox.
- A torque limiter P/N 3244707-6, S/N A80341

Only the FCU was examined and tested.

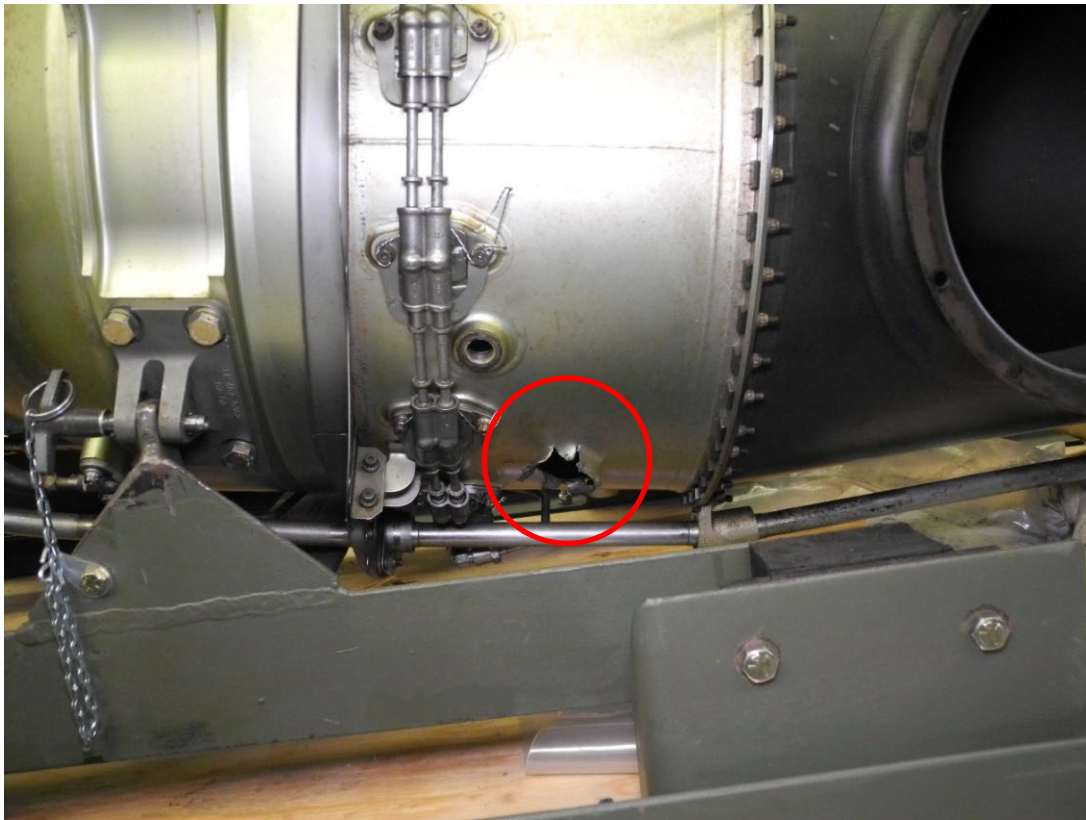


**Photo 5** - Contents of Separate Box

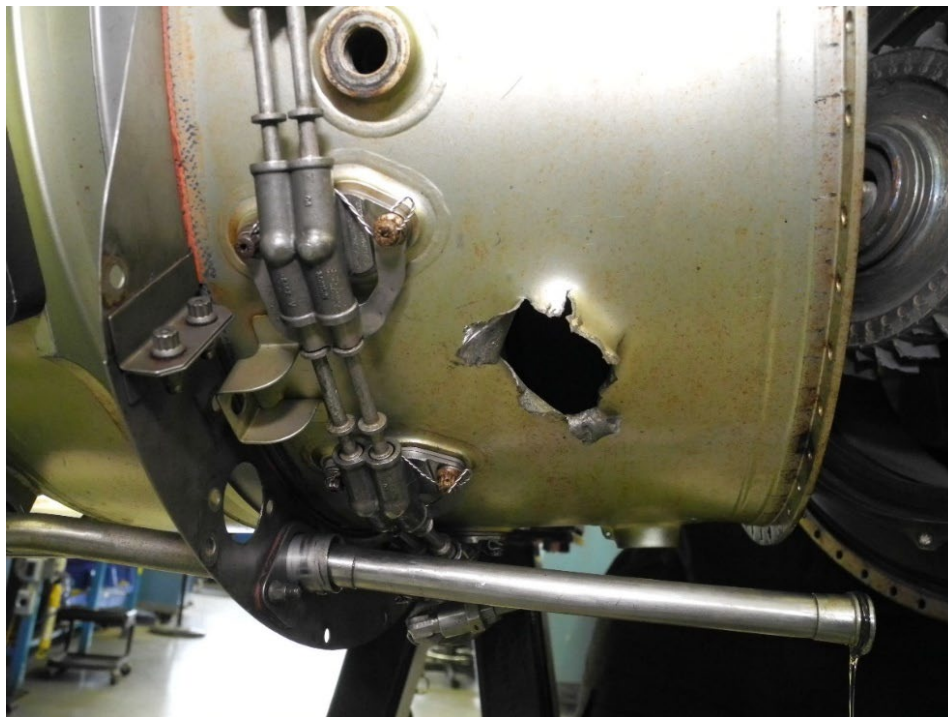
The GG case was intact; however, a hole, approximately 1-½ inches in diameter was observed at the 4:30 o'clock location<sup>1</sup>. The hole was in the plane just aft of the 2<sup>nd</sup> stage PT wheel and the case skin featured an outward petaling, consistent with a particle directional trajectory from inside out (**Photo 6** & **Photo 7**).

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<sup>1</sup> 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. All numbering is in the circumferential direction starting with the No. 1 position at the 12:00 o'clock position or immediately clockwise from the 12:00 o'clock position and progressing sequentially clockwise aft-looking-forward (ALF).

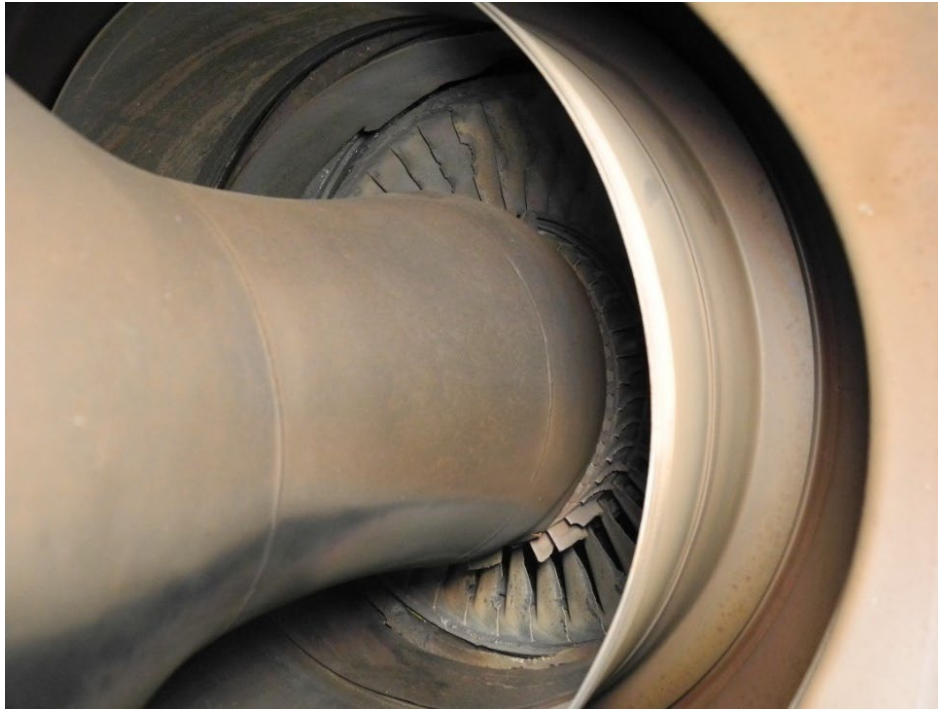


**Photo 6** - Hole in the GG Case



**Photo 7** - Details of Hole in GG Case - Note Petalling

The 2<sup>nd</sup> stage PT wheel, visible through the exhaust duct, was inspected revealing the loss of all the blades near the roots (**Photo 8**). The 2<sup>nd</sup> stage PT nozzle was intact; however, it was impact damaged.



**Photo 8** - 2<sup>nd</sup> Stage PT Wheel - All Blades Fractured

The oil tank was empty, and the drain plug was not present. Approximately 1 pint of oil was drained from the AGB. The RGB chip detector was not present. The oil filter was removed and examined, revealing many small magnetic chips (**Photo 9**).



**Photo 9** - Oil Filter and Magnet Containing Metal Chips

The RGB oil screen was filled with metal chips (**Photo 10**).



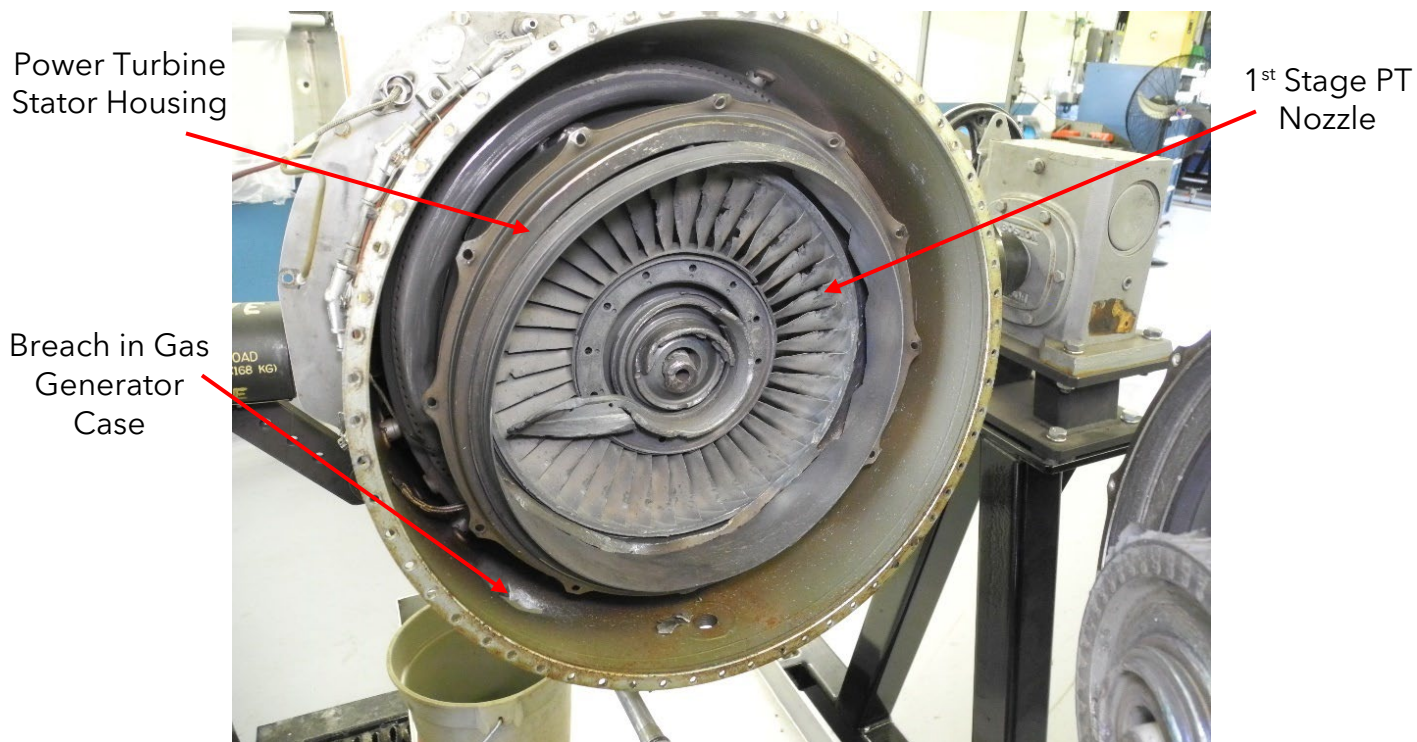
**Photo 10** - RGB Oil Screen - Heavily Contaminated with Metal Chips

A grinding noise was heard when the propeller shaft (PT spool) was turned; however, there was no corresponding rotation of the PT wheels, consistent with internal mechanical failure.

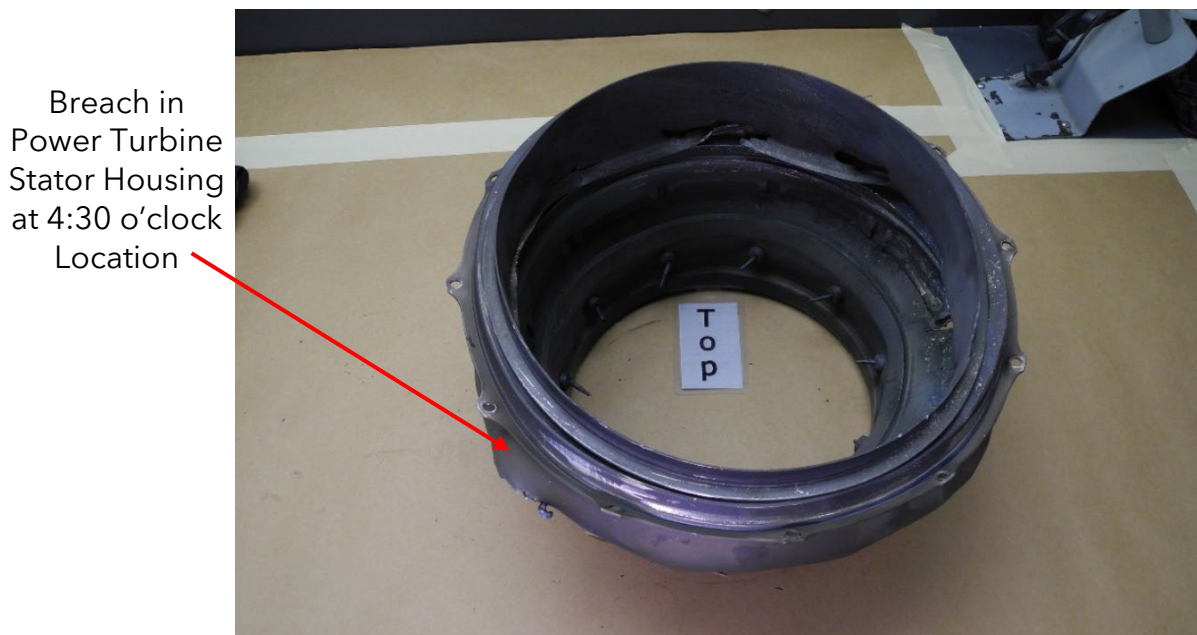
When the GG spool was turned with some effort via the starter generator spline and a grinding noise was heard and then the spool seized. After the engine was split at the 'C' flange, the PT spool was free to turn.

## **2.2 Power Turbine Module**

The 'C' flange was separated revealing fractures of all the 2<sup>nd</sup> stage turbine blades at the root. Only tensile overload features were observed on the fracture surfaces. The 2<sup>nd</sup> stage turbine hub was intact; however, it was thermally distressed, rotationally scored, and battered (**Photo 11**). The 2<sup>nd</sup> stage PT nozzle was deformed and thermally distressed. The PT stator housing (**Photo 12**) was deformed, internally battered and was breached at the 4:30 o'clock location (**Photo 13**) consistent with the breach location on the GG case.



**Photo 11** - Engine Split at 'C' Flange Revealing Damage to PT Rotors and Nozzles



**Photo 12** - Power Turbine Stator Housing - ALF as Installed



**Photo 13** - Power Turbine Stator Housing - Breach in 2<sup>nd</sup> Stage PT Plane

All the 1<sup>st</sup> stage PT blades were fractured at varying span lengths (**Photo 14**). The 1<sup>st</sup> stage rotor hub was intact; however, it was battered and thermally distressed. The drive spline was intact and undamaged.

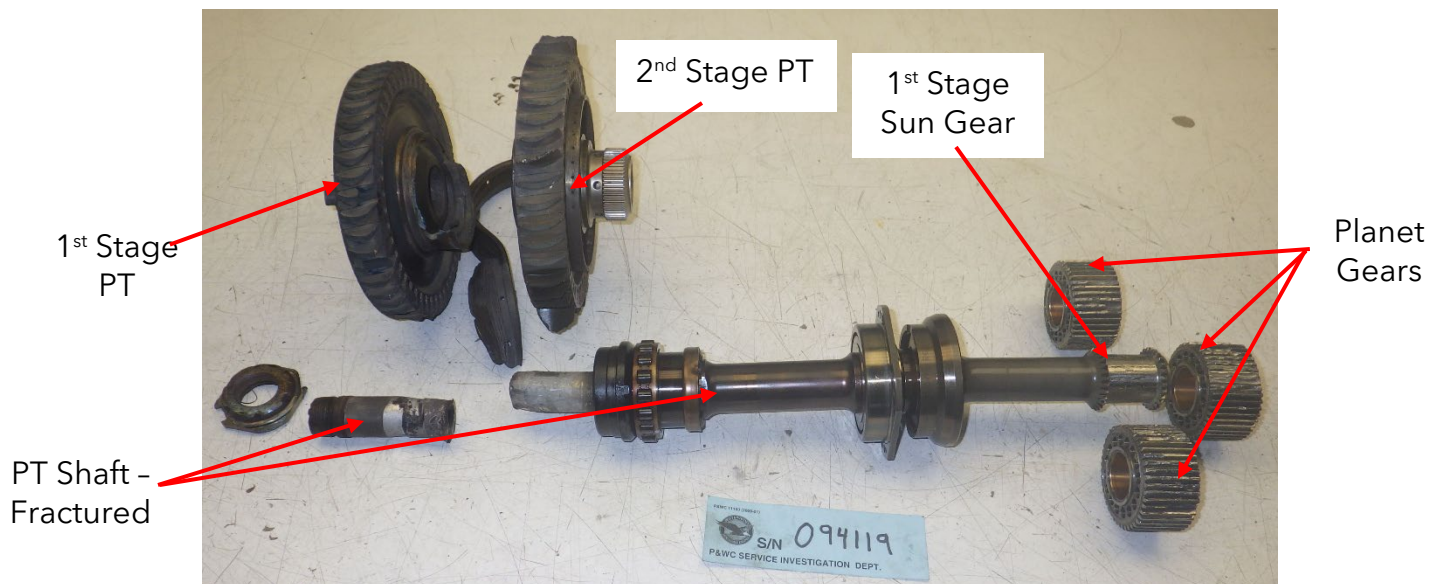


**Photo 14** - 1<sup>st</sup> Stage PT Rotor

The PT shaft housing (**Photo 15**) was intact; however, the No. 3 bearing support was deformed and skewed. The Nos. 3 and 4 bearings were undamaged and oil wetted. The PT shaft was twisted, fractured, deformed and impact damaged (**Photo 16**).



**Photo 15** - PT Shaft Housing

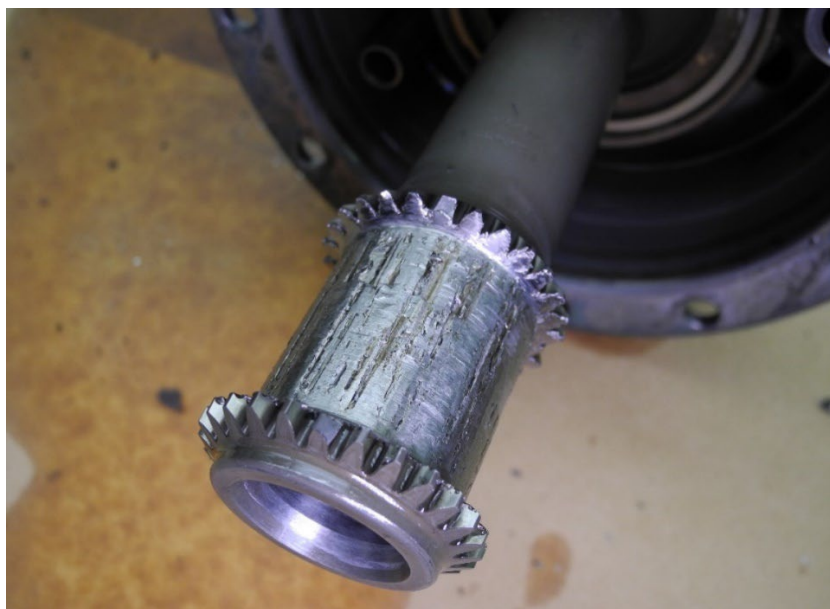


**Photo 16** - PT Assemblage Overview

### 2.2.1 Reduction Gearbox

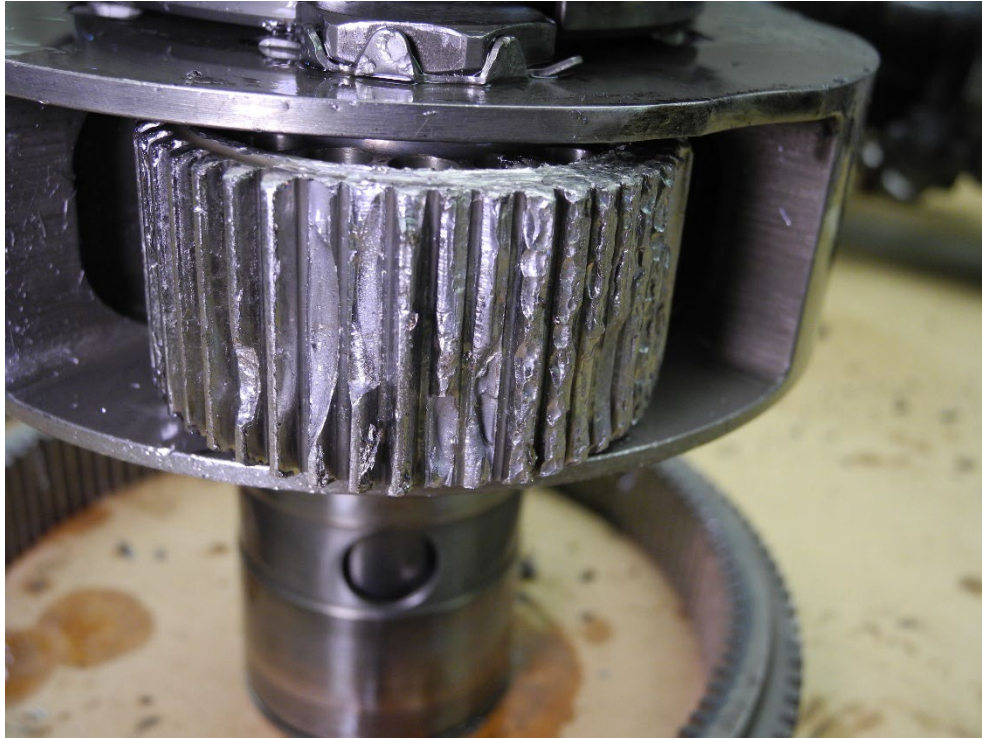
The RGB rear housing was fractured through 360 ° at the mounting flange location with the front housing.

The 1<sup>st</sup> stage reduction sun gear shaft gear teeth were ground away in the location of the mesh plane of the planetary gears (**Photo 17**).



**Photo 17** - 1<sup>st</sup> Stage Sun Gear - Teeth Ground Away

The gear teeth of the three planet gears were heavily spalled, and damaged (**Photo 18** & **Photo 19**). All the parts were oil wetted.



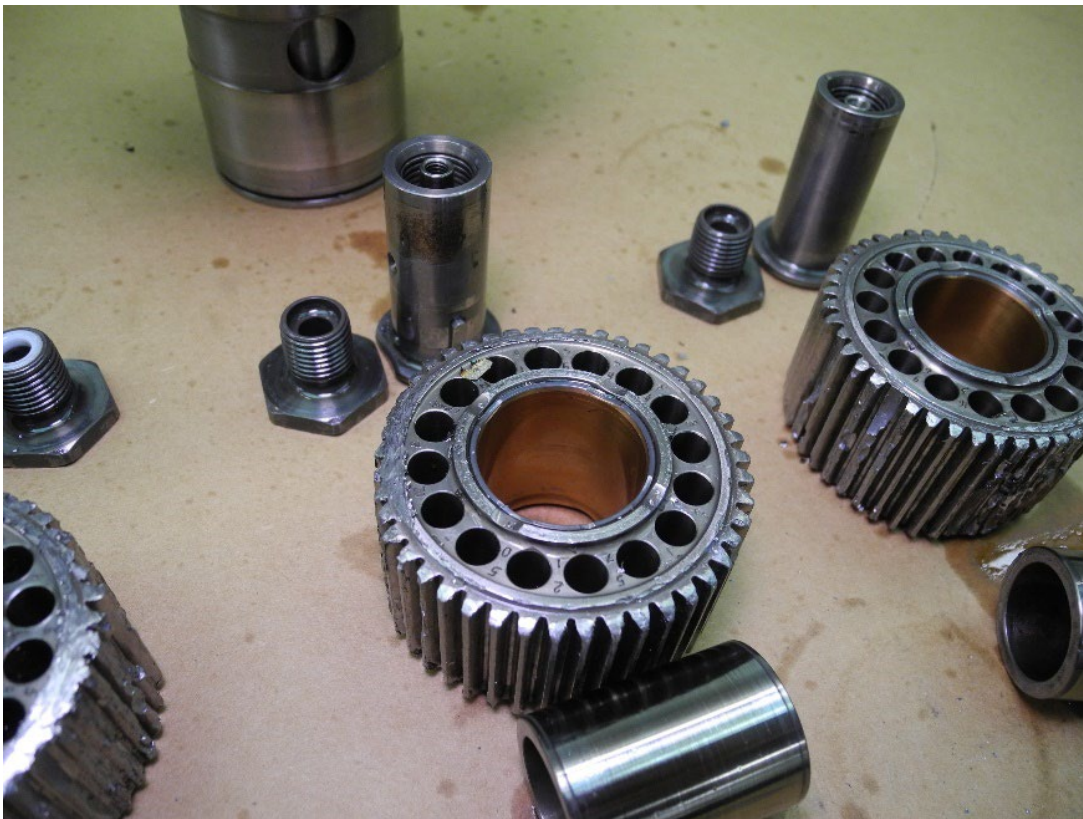
**Photo 18** - Spalled, Fractured and Deformed Planet Gear Still Installed in the Carrier



**Photo 19** -Planet Gears and Carrier

The three 1<sup>st</sup> stage planet gears were still free to rotate. An examination of the journals of all three gears revealed undamaged and oil wetted bushings and shafts (**Photo 20**). The 1<sup>st</sup> stage planetary gearset, consisting of the sun gear and three planet gears are manufactured as a matching set which may not be mixed. The sun gear was P/N 3028455, S/N 73E009. The planetary gears were P/N 3049216-01 and S/N's 76E118, 76E103, and 76E122. According to P&WC engineering, the set was sold as new in 2003.

No logbook was available to ascertain the installation date or total time of operation of the 1<sup>st</sup> stage planetary gearset.



**Photo 20** - Planetary Gears Bushings and Shafts - Undamaged

The 2<sup>nd</sup> stage sun gear, planet gears and ring gear (**Photo 21**) were intact, undamaged and oil wetted.



**Photo 21** - 2<sup>nd</sup> Stage Reduction Gear Assembly - Undamaged

The RGB front housing was intact. The propeller shaft rotated smoothly once the 1<sup>st</sup> stage gears were released.

### 2.3 Gas Generator Case

The GG case was intact; however, it had a hole, approximately 1-½ inches in diameter at the 4:30 o'clock location in the plane of the 2<sup>nd</sup> stage PT. The inner surface of the case just forward of the diffuser pipes was corroded (**Photo 22**).

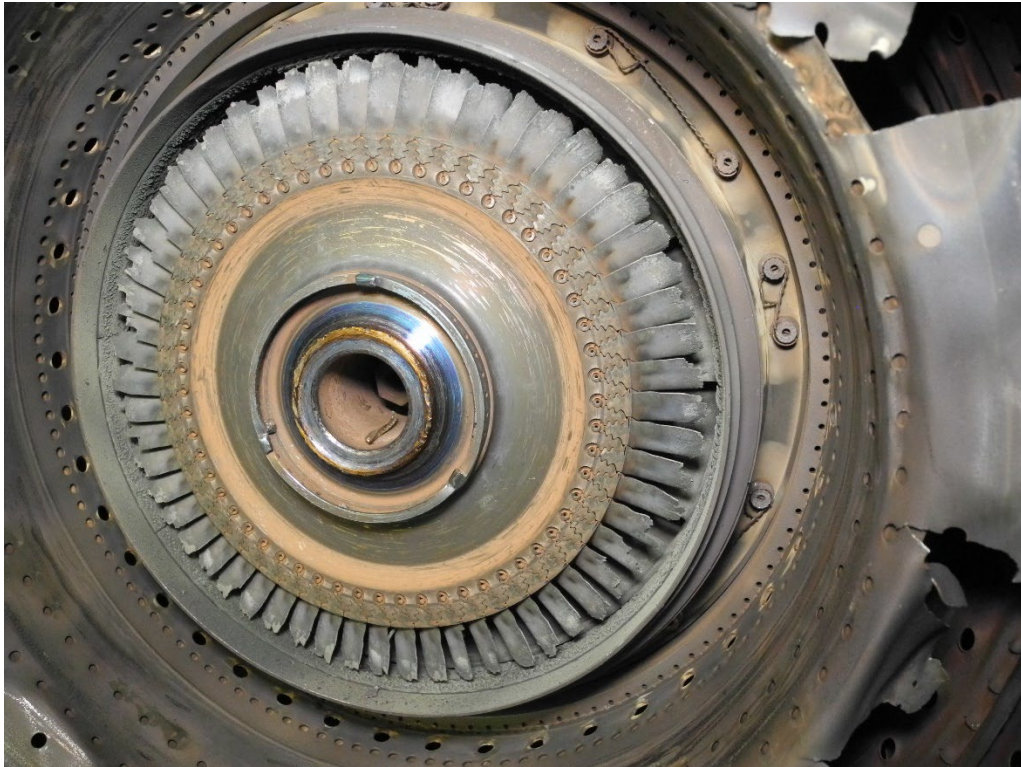


**Photo 22** - Hole in GG Case - Inside View

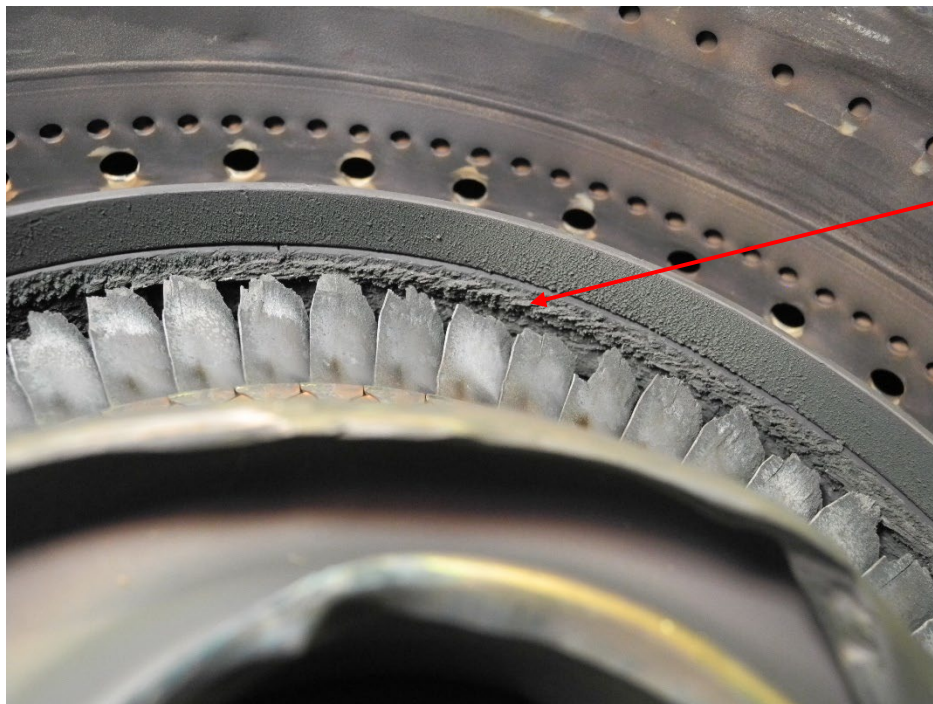
The combustor was intact; however, it was dented and deformed from contact against the displaced PT stator housing. The fuel nozzles were present, and the spray tips were all clean.

### 2.4 Compressor and Compressor Turbine (CT)

The CT was intact; however, the blade tips were all thermally eroded (**Photo 23**). The CT shrouds exhibited a thick layer of metal deposit (**Photo 24**), consistent with liberated material from thermally distressed CT blades. The CT nozzle was intact and consistent with an operational condition.



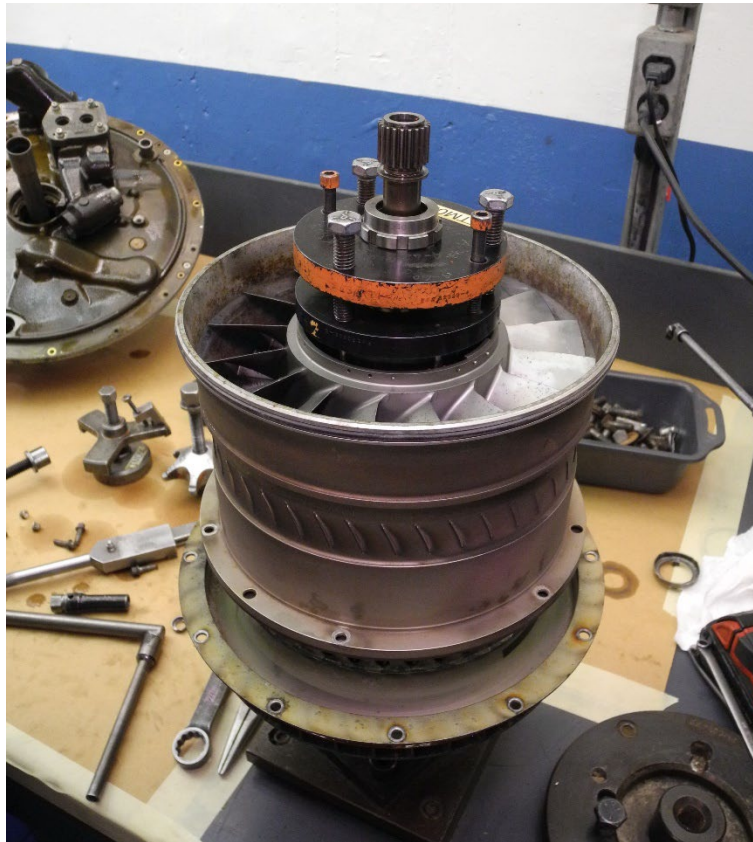
**Photo 23** - CT - In-situ



Re-Solidified  
Metal  
Deposits on  
the Shroud

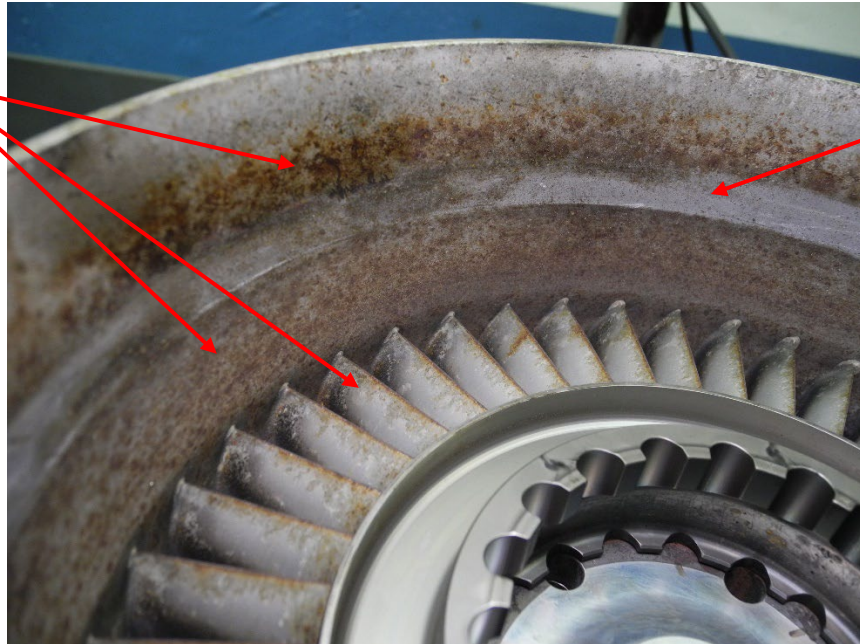
**Photo 24** - CT Shroud - Coated with Re-Solidified Metal Deposits

The compressor housing was intact and undamaged. The compressor stack (**Photo 25**) was intact and undamaged; however, it was extremely dirty and surface corrosion was noted throughout (**Photo 26**). It was noted that rubbing of the axial compressor blades tips against their shrouds caused a cleaning of the surface corrosion, consistent with the corrosion being present during the operation of the engine. All axial rotors and stators were intact.



**Photo 25** - Compressor Stack - Intact but Dirty and Corroded Surfaces

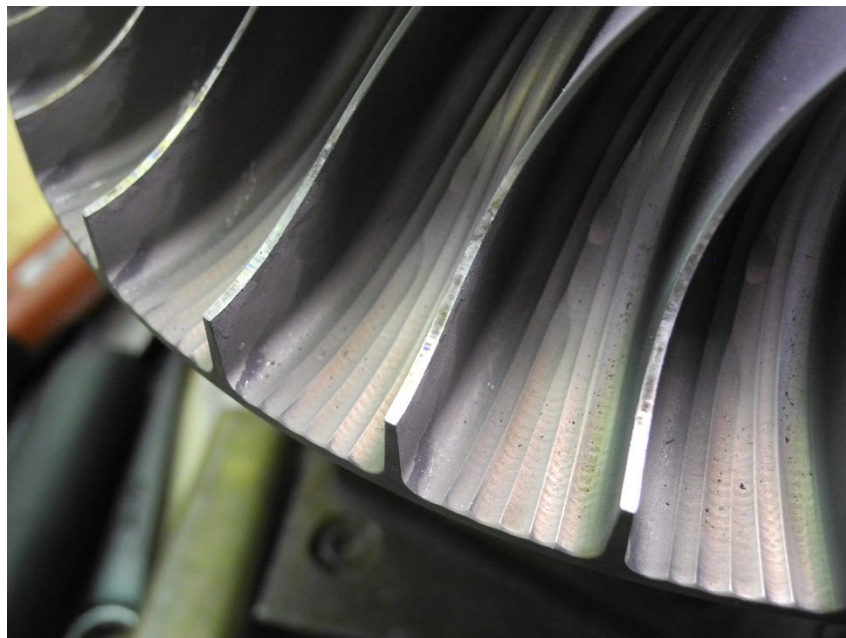
Heavy  
Surface  
Corrosion on  
Shrouds and  
Compressor  
Blades



Rubbing of the  
Compressor  
Blades  
Cleaned some  
of the  
Corroded  
Surfaces

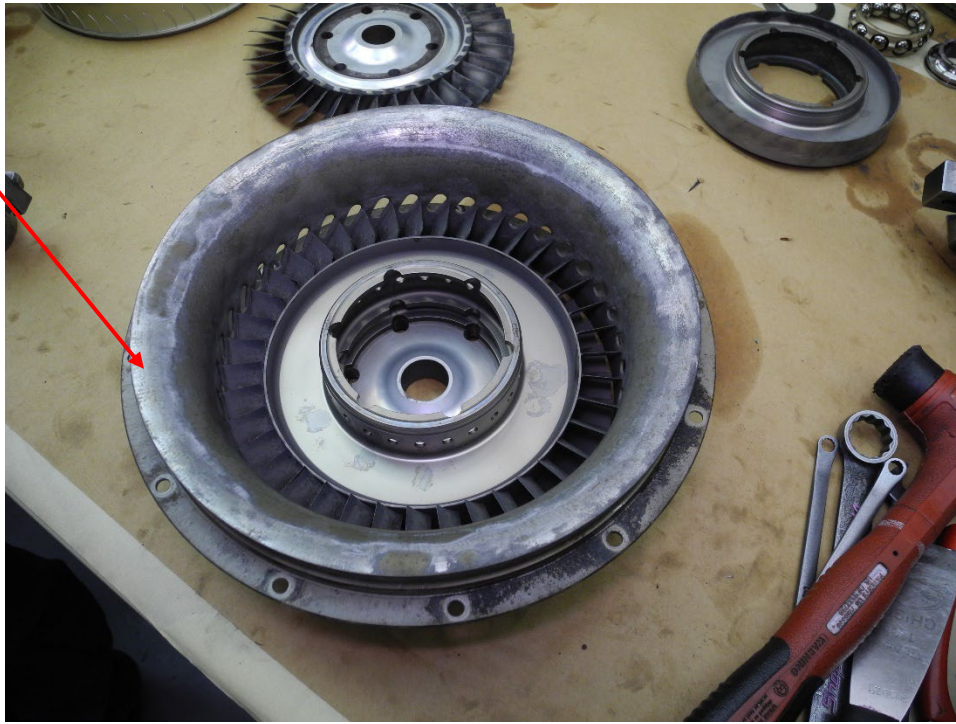
**Photo 26** - 2<sup>nd</sup> Stage Compressor Blades and Housing

The centrifugal compressor impeller was intact; however, the vane shroud lines were rotationally scored, consistent with contact against the impeller shroud during operation (**Photo 26**). The impeller shroud was rotationally scored, predominantly near at the exducer (**Photo 27**).



**Photo 27** - Impeller Vanes Shroud Lines - Rotationally Scored

Rotational  
Scoring  
near the  
Exducer



**Photo 28** - Impeller Shroud - Rotational Scoring near Exducer End

The air inlet and oil tank housing were intact and undamaged.

## **2.5 Accessory Gearbox (AGB)**

The AGB was intact and undamaged. All the accessory drive splines rotated smoothly in unison with the rotation of the AGB coupling shaft, so the AGB was not disassembled further.

## **2.6 Fuel Control Unit (FCU) Testing**

When the FCU was separated from the fuel pump the polymer splined connector sleeve between the FCU and pump was found to be intact and undamaged. The FCU was then transferred to the fuel lab at the PWC facilities in St. Hubert for a full functional test procedure (FTP) test. The as-received FCU exhibited only slight variations from the factory calibration due to permissible field adjustments. Minor adjustments returned the FCU to the component maintenance manual specifications.

No other control components were tested.