

National Transportation Safety Board

Office of Aviation Safety

Washington, DC 20594



ERA24LA076

POWERPLANT FACTUAL REPORT

July 8, 2025

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A. ACCIDENT

Location: Walland, Tennessee
Date: December 28, 2023
Time: 1340 eastern standard time
Helicopter: Bell B206L-1, Registration Number N571CJ

B. POWERPLANT GROUP

Group Chair	Harald Reichel National Transportation Safety Board Washington, D.C.
Party Coordinator	David Riser Rolls-Royce Engines Indianapolis, Indiana

C. SUMMARY

On December 28, 2023, about 1340 eastern standard time, a Bell 206L-1 helicopter, registration number N571CJ, was substantially damaged when it was involved in an accident near Walland, Tennessee. The helicopter was operated by Whirl'd Helicopters, Inc. doing business as Scenic Helicopter Tours as a Title 14 Code of Federal Regulations Part 91 aerial observation flight.

The pilot reported the illumination of the engine chip light on his instrument panel and, soon after, the engine oil temperature and pressure indicated zero and the engine stopped producing power. He performed an autorotation to a field. The pilot and five passengers were not injured.

The initial field examination of the engine took place at Thoroughbred Aviation in Lexington, Kentucky, on January 30, 2024, with the Investigator-In-Charge providing oversight. A borescope examination of the 4th stage turbine wheel of the Rolls Royce (RR) engine through the exhaust collector support revealed that all the blades were intact; however, most of the blade shrouds were worn away. Additionally, it was noted that the rotation of the N1 rotor spool resulted in a corresponding rotation of the N2 rotor spool, consistent with a mechanical binding of the two spool shafts.

The engine was separated from the fuselage, boxed, and shipped to the Arrow Aviation Company, in Broussard, Louisiana where the representative from RR and the NTSB powerplant engineer examined the engine on April 30 and May 1, 2024.

An external examination of the engine revealed no un-containment, or fire damage.

The engine disassembly and examination revealed an un-torqued and loose No. 8 spanner nut. The nut locking crimp exhibited a witness mark consistent with a pry mark on the inner diameter surface consistent with a nut that was staked at a previous locking position. Rotational scoring was observed on the inside of the sump cover consistent with contact with the No. 8 spanner nut during engine operation.

The No. 8 bearing exhibited significant wear of the balls and inner ring resulting in loss of the forward shoulder of the inner raceway ring.

Rub damage on the power turbine support and 2nd stage turbine wheel was consistent with loss of axial and radial retention of the gas producer rotor during operation.

D. DETAILS OF THE EXAMINATION

1.0 Powerplant

1.1 Engine Description

The engine was a Rolls-Royce (RR) M250-C28B turboshaft ([Figure 1](#)), which consists of a gas producer and a power turbine with gearbox.

The gas producer consists of a single-entry centrifugal compressor directly coupled to a two-stage gas producer turbine. The compressed air from the compressor is diffused and then, via an external 180-degree compressor discharge tube system is directed into the combustor where it is mixed with fuel, producing hot gases that are directed onto the two-stage gas producer turbine.

The remaining gas exiting the gas producer turbine are then directed onto a two-stage power turbine before being exhausted. The power turbine drives the internal reduction gearbox, which features front and rear drive flanges that mate with the aircraft drives. The output shaft center line is located below the center line of the engine rotor.

The engine power is managed by a hydro-mechanical fuel control unit. The RR M250-C28B produces 500 shaft horsepower at takeoff.

The engine is of a modular design and a complete engine consists of three serialized major assemblies: the compressor module, the accessory gearbox module, the turbine module.

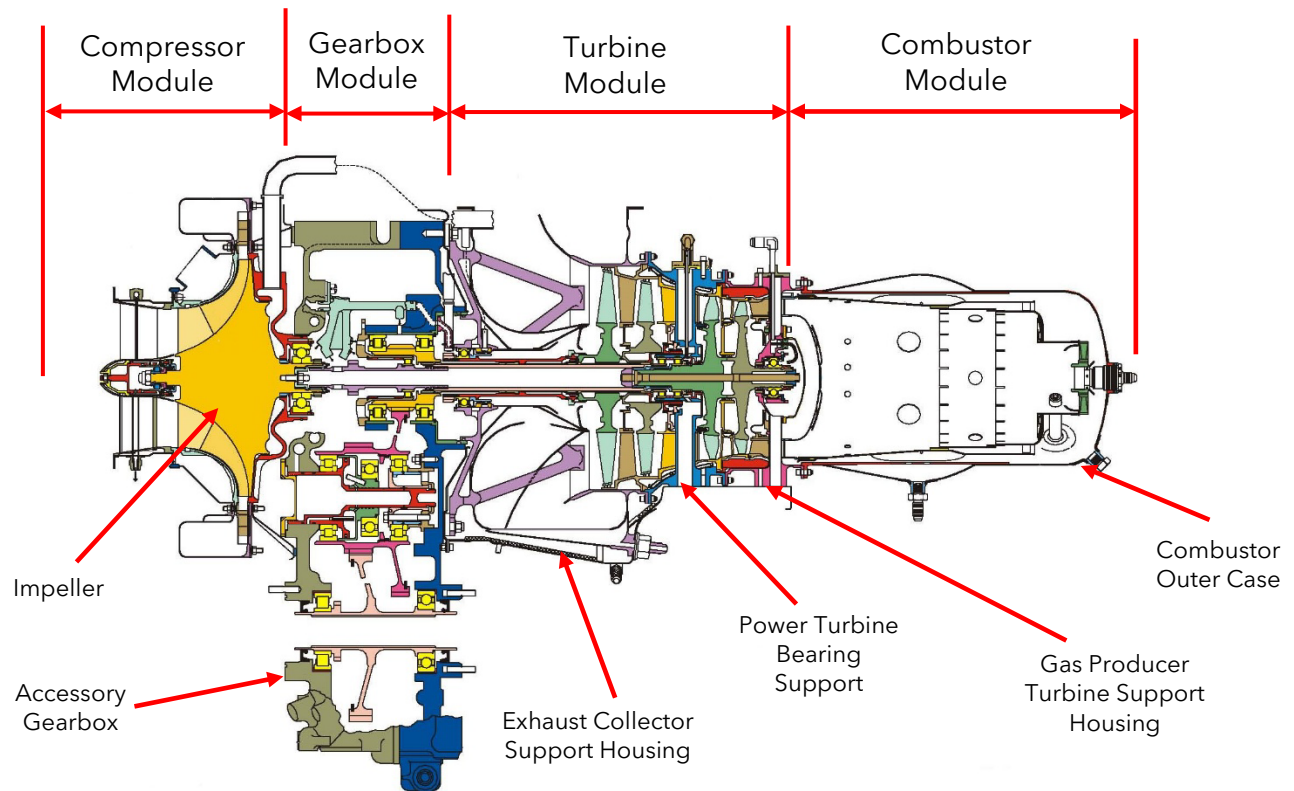


Figure 1 – Rolls Royce 250 Generic Cross Section - Courtesy Rolls-Royce

1.2 Engine History

The engine was a Rolls-Royce 250-C28B, part number (P/N) 6895000, serial number (S/N) CAE-860608. The time since new (TSN) at the time of the event was 13,378.7 hours. The engine was last repaired on July 27, 2021, by Action Aircraft.

The gearbox assembly was P/N 23057985 and S/N CAG-28103. According to the engine assembly record the gearbox assembly was installed on July 14, 2021, with the engine TSN of 12,823.3 hours.

The compressor assembly was P/N 23033191 and S/N CAC-28102. According to the engine assembly record the compressor assembly was installed on July 27, 2021, with the engine TSN of 12,823.3 hours

The turbine assembly was P/N 23033185 and S/N CAT-70036. According to the engine assembly record the turbine assembly was installed on July 24, 2019, with an engine TSN of 11,980.9 hours.

2.0 Engine Examination and Disassembly

2.1 General Condition

The engine was in a metal engine container which was opened in the presence of the NTSB ([Photo 1](#)). It was externally clean and intact ([Photo 2](#)). There was no evidence of an un-containment, external impact or fire.



Photo 1 - Rolls-Royce M250-C28B S/N CAE-860608 - As Received



Photo 2 - Externally Clean and Intact

The accessory gearbox (AGB) power takeoff (PTO) inner spline and starter/generator inner spline were intact and undamaged ([Photo 3](#)). The fuel pump/fuel control unit (FCU) and power turbine governor (PTG) were intact and undamaged ([Photo 3](#)). The AGB did not contain any oil; however, it was reported that 16 ounces of oil was drained from the AGB in the field, which is a normal oil quantity in the cavity. It was reported during the field exam that there was a coating of black paste and metallic debris found on the upper chip detector. The lower chip detector was clean of magnetic debris

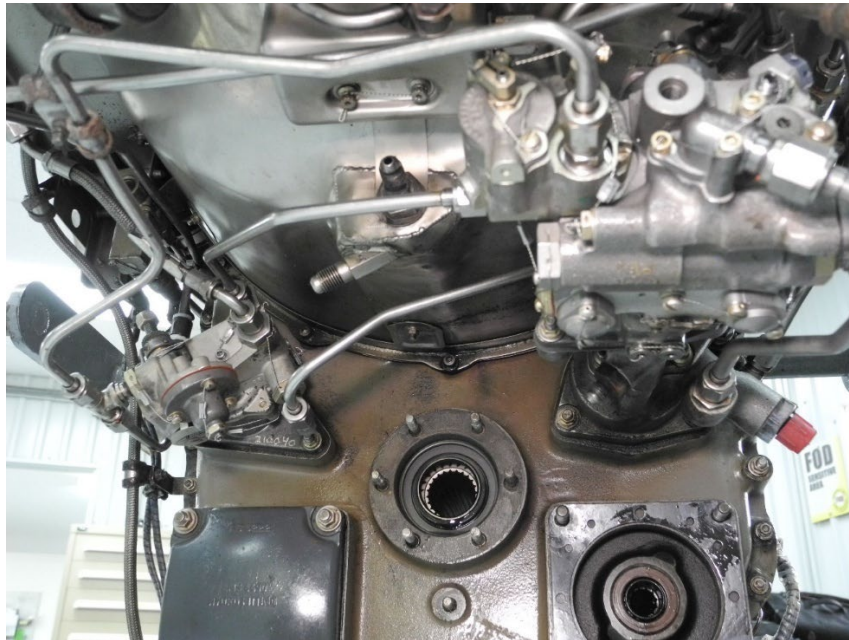


Photo 3 - Accessory Gearbox Splines, FCU and PTG - Undamaged

The engine oil filter ([Photo 4](#)) was removed and found to be clean and oil wetted.



Photo 4 - Engine Oil Filter - Clean

The leading edges of the impeller vanes ([Photo 5](#)) were intact and undamaged; however, they were coated with a black oily substance.



Photo 5 - Impeller Vanes Leading Edges - Undamaged

The exhaust collector was intact; however, the inner surfaces were sooty. All the blades of the 4th stage turbine wheel (2nd stage power turbine) were intact; however, most of the blade shrouds were rotationally abraded away, consistent with contact against 4th stage wheel tracks ([Photo 6](#)).

Shrouds
Abraded

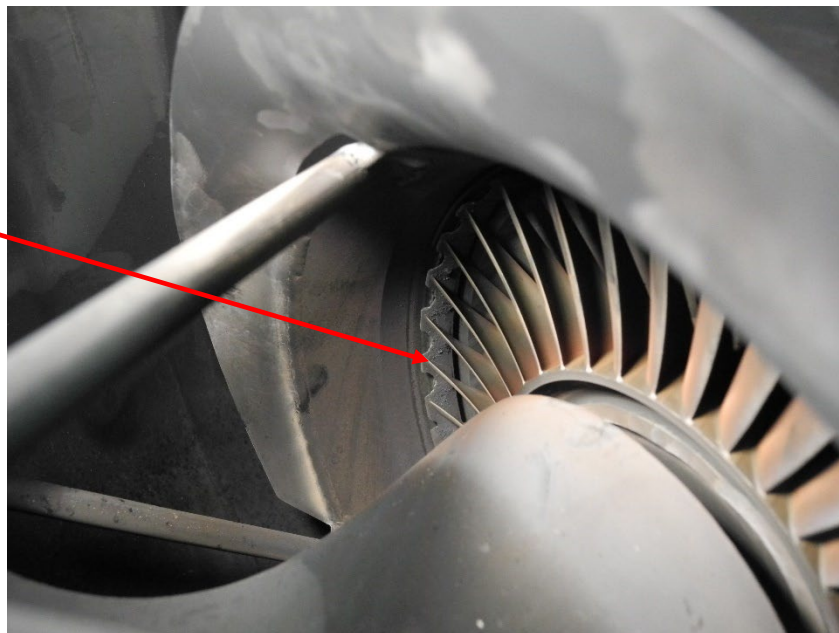


Photo 6 - 4th Stage Turbine Wheel

It was observed that when rotating either the gas producer (GP or N1) spool or the power turbine (PT or N2) spools, the other spool also rotated in unison, consistent with a mechanical interference between the two normally independent spools.

2.2 Compressor Module

The compressor module ([Photo 7](#)) was intact and undamaged and the compressor impeller turned freely and smoothly, consistent with the No.1 and No.2 bearings being undamaged. It was not disassembled further.

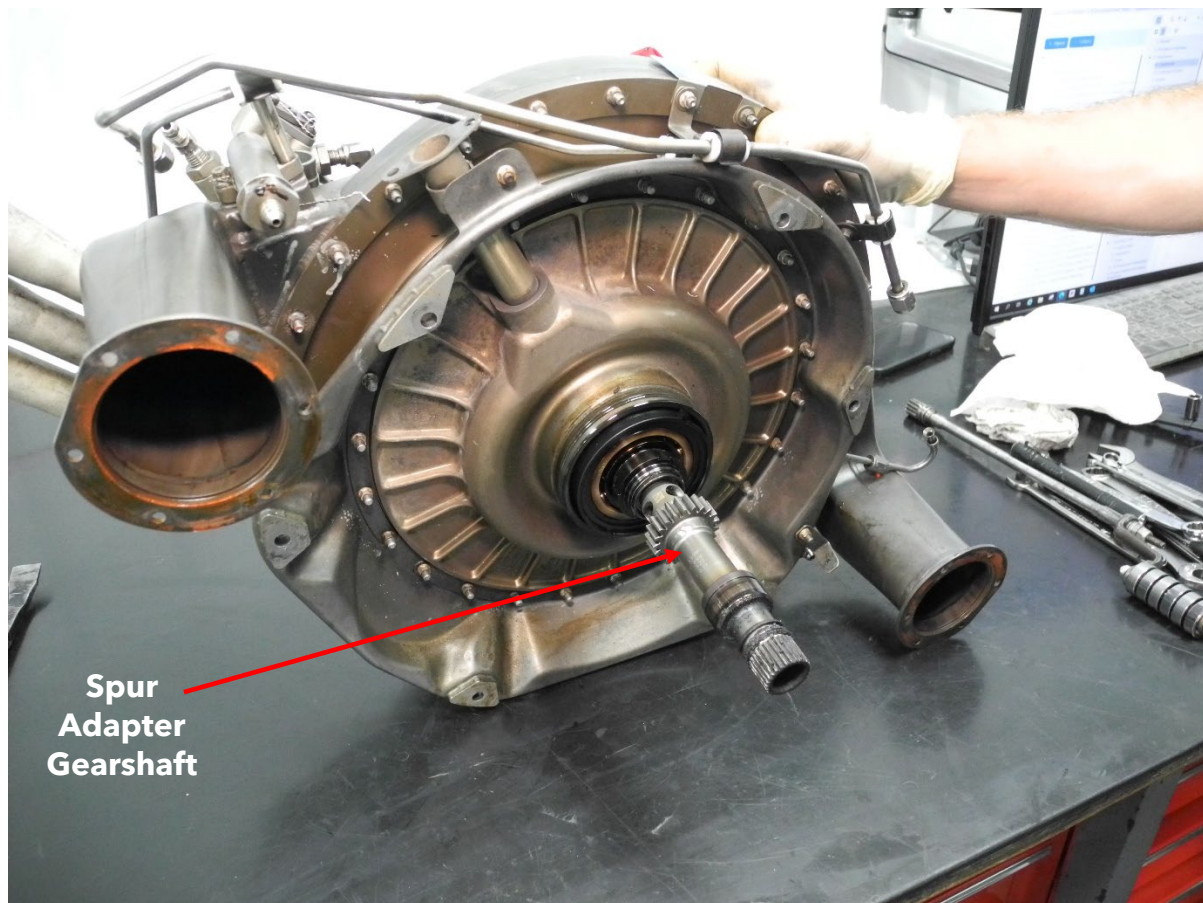


Photo 7 - Compressor Module - Undamaged

The spur adapter gearshaft (SAG) (Ref. [Photo 7](#) & [Photo 8](#)) was intact and undamaged. The No. 2-½ bearing inner race section of the SAG was intact and displayed minor wear, consistent with normal operation. The turbine-to-compressor coupling spline was intact. The aft SAG O-ring was present; however, it had disintegrated into coarse black paste. There was no evidence of an O-ring in the forward SAG O-ring groove. The RR Operation and Maintenance Manual 72-30-00

states that O-rings must be installed on both O-ring grooves to prevent carbon build-up in the engine.

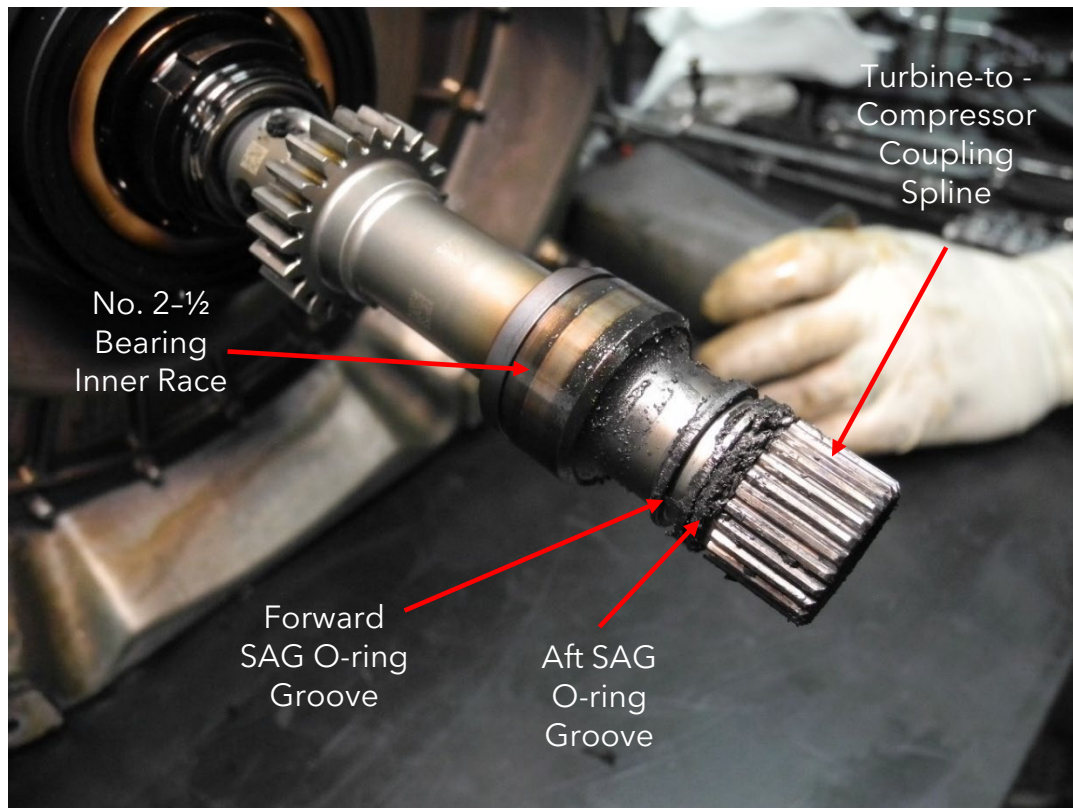


Photo 8 - Spur Adapter Gearshaft

2.3 Gearbox Module

The AGB was disassembled, revealing undamaged, oil wetted internal components ([Photo 9](#) & [Photo 10](#)).

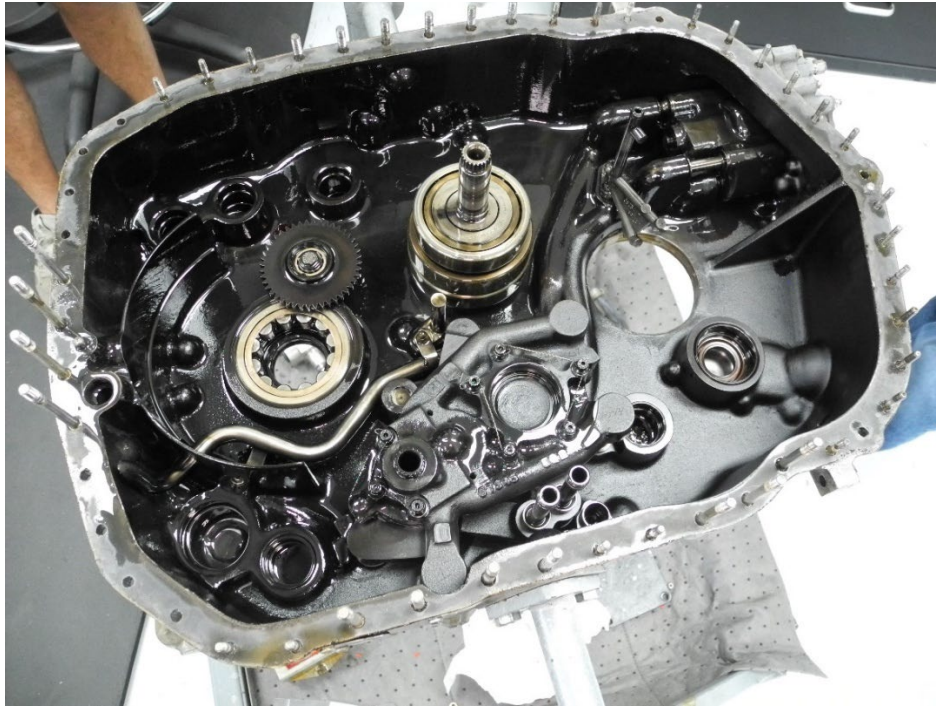


Photo 9 - AGB Housing - Undamaged Internal Components

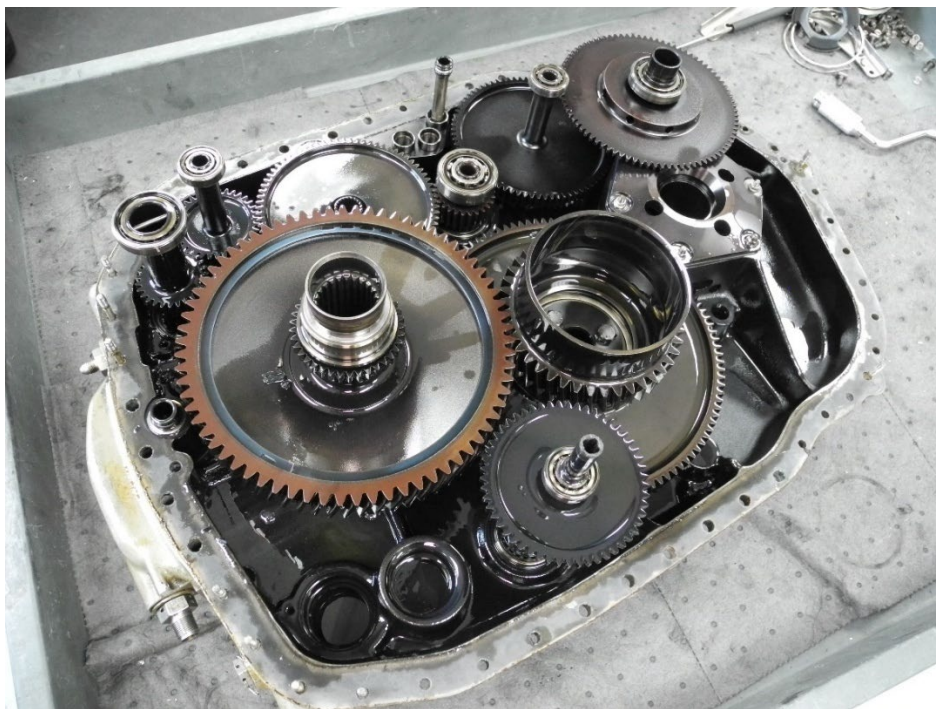


Photo 10 - AGB Cover - Undamaged Internal Components

The oil scavenge and pressure pumps were disassembled, revealing undamaged, oil wetted components ([Photo 11](#)).



Photo 11 - Oil Pumps - Undamaged

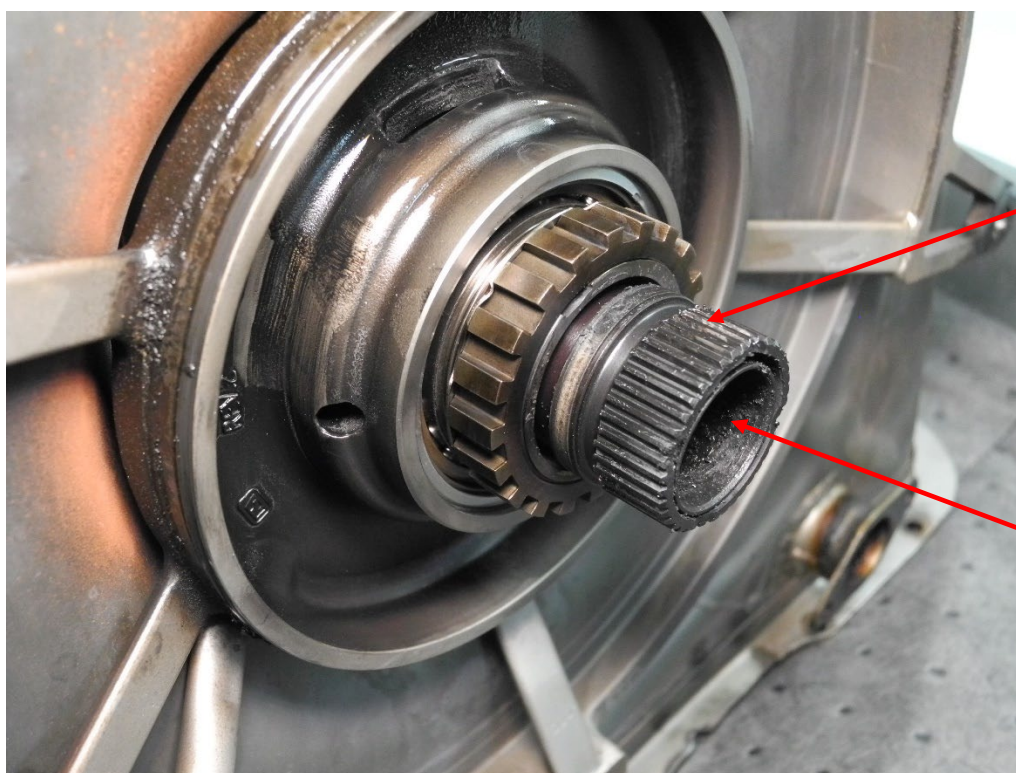
2.4 Turbine Module

2.4.1 Exhaust Collector Support Housing

The exhaust collector support housing was intact and undamaged; however, when it was separated from the AGB module ([Photo 12](#)) the power turbine-to-pinion gear coupling and the power turbine-to-pinion gear couplings could not be removed ([Photo 13](#)). The shafts could still be turned; however, they were restricted from being axially removed.



Photo 12 - Exhaust Collector Support Housing - AGB Side



Power
Turbine-to
Pinion Gear
Coupling -
Seized

Turbine-to-
Compressor
Coupling -
Seized

Photo 13 - Exhaust Collector Support Housing - Shaft Details

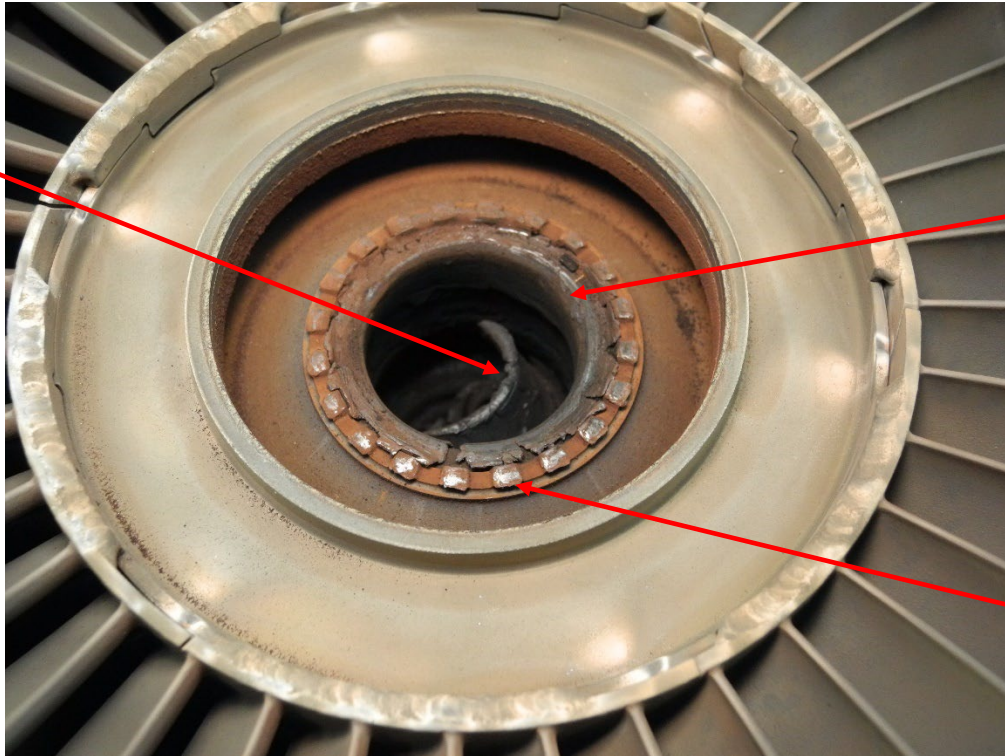
When the exhaust collector support housing was separated from the turbine module, the 4th stage turbine wheel could not be withdrawn ([Photo 14](#)) because the power turbine inner shaft was fractured and deformed ([Photo 15](#)) in an outward, petalled manner, locking the 4th stage turbine wheel in position. Additionally, a segment of the fractured and deformed turbine-to-compressor coupling was observed in the hollow power turbine inner shaft, and it could not be removed.

The 4th stage turbine wheel was intact; however, the curvic coupling mating it with the 3rd stage turbine wheel was rotationally smeared. Additionally, most of the blade shrouds were rotationally abraded away, consistent with contact against 4th stage wheel tracks (Ref. [Photo 5](#)). The shafts could still be rotated in the exhaust collector support housing; however, the No. 5 bearing was rough when rotated.



Photo 14 – 4th Stage Nozzle and Turbine in Exhaust Collector Support Housing

Turbine to
Compressor
Coupling -
Fractured

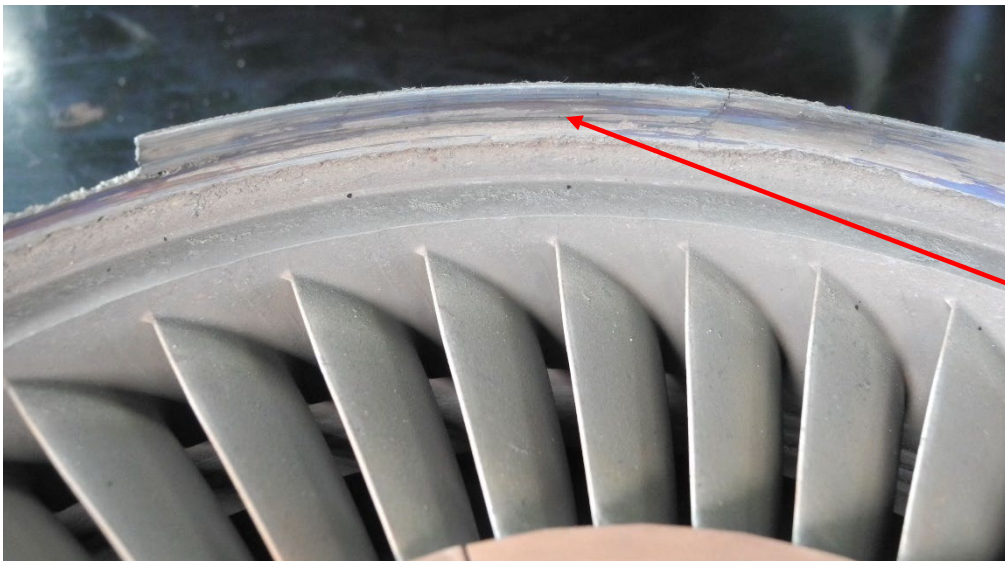


Power
Turbine
Inner Shaft -
Fractured
and
Deformed

4th Stage
Wheel Curvic
Coupling -
Deformed

Photo 15 - 4th Stage Turbine Wheel and Shaft Details

The 4th stage turbine nozzle was intact; however, it was rotationally scored on the 3rd and 4th stage turbine wheel tracks ([Photo 16](#)).



4th Stage
Turbine
Wheel Track -
Rotationally
Scored

Photo 16 - 4th Stage Turbine Nozzle - 4th Stage Turbine Wheel Track Rotationally Scored

2.4.2 PT Bearing Support

The PT bearing support (Photo 17) was intact; however, the 3rd and 1st stage turbine wheels could not be withdrawn because the turbine-to-compressor coupling and the power turbine inner shaft were fractured and deformed in an outward, petalled manner, locking the 3rd stage turbine wheel in position (Photo 18). The 3rd stage turbine wheel was intact; however, the curvic coupling mating with the 4th stage turbine wheel was smeared in a rotational manner (Photo 18). All the blades of the 3rd stage turbine wheel were intact.

The 2nd stage nozzle and wheel and 3rd stage nozzle were confined within this assembly and could not be examined. The No. 6 and No. 7 bearings could not be examined; however, they still could be rotated with moderate hand effort.

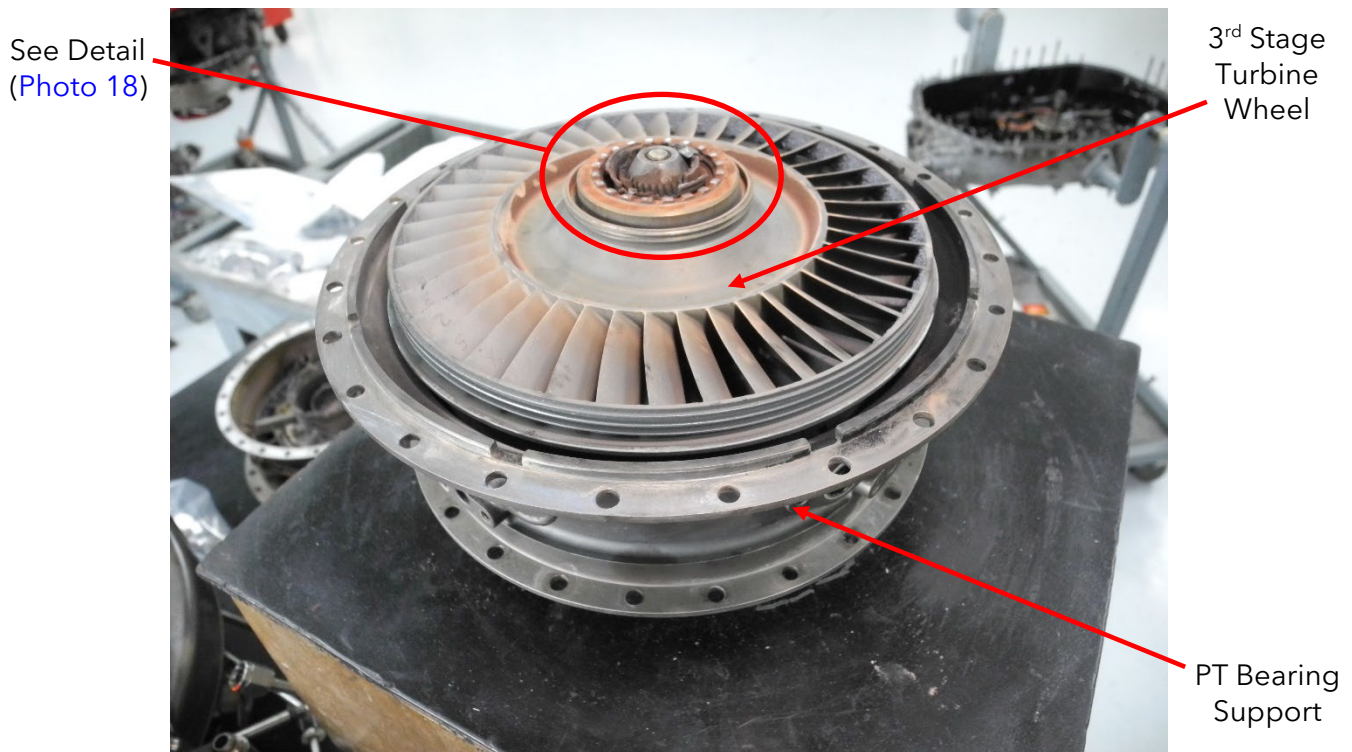


Photo 17 - PT Bearing Support - Forward Side

Turbine to
Compressor
Coupling -
Fractured

Curvic
Coupling -
Smeared

Power
Turbine Inner
Shaft -
Fractured and
Deformed

3rd Stage
Turbine
Wheel

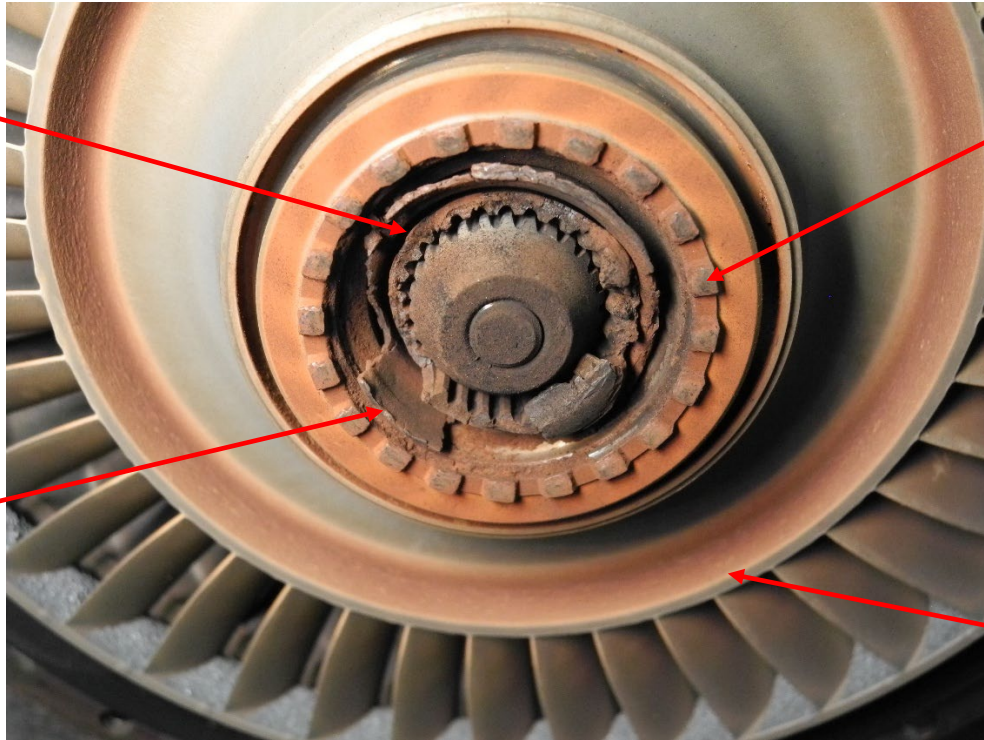


Photo 18 - 3rd Stage Turbine Wheel - Details

2.4.3 Combustor Module

The combustor outer case and the combustor liner ([Photo 19](#)) were intact and undamaged. The fuel nozzle was intact, undamaged and clean.

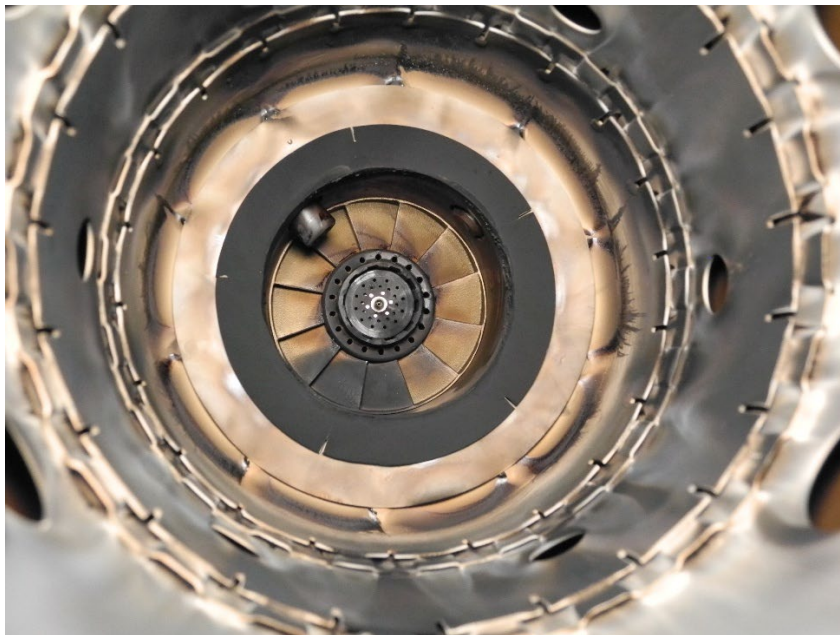


Photo 19 - Combustor Liner and Fuel Nozzle - Intact and Undamaged

2.4.4 GP Turbine Bearing Support

With the combustor removed, the GP turbine bearing support and the No. 8 bearing cavity could be examined ([Photo 20](#)). The No. 8 bearing cover was dry and coated with a layer of black sooty deposit.

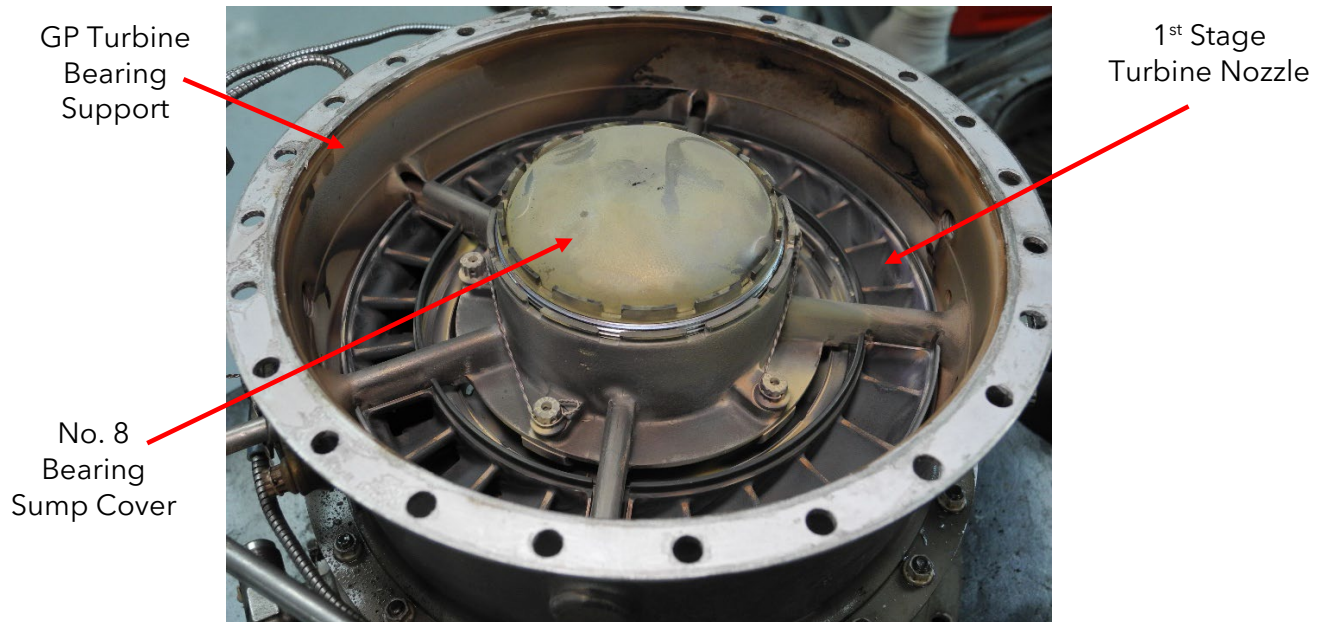


Photo 20 - GP Turbine Bearing Support and No. 8 Bearing Cover

The No. 8 bearing sump cover was removed revealing a dry cavity coated with a black residue ([Photo 21](#)).

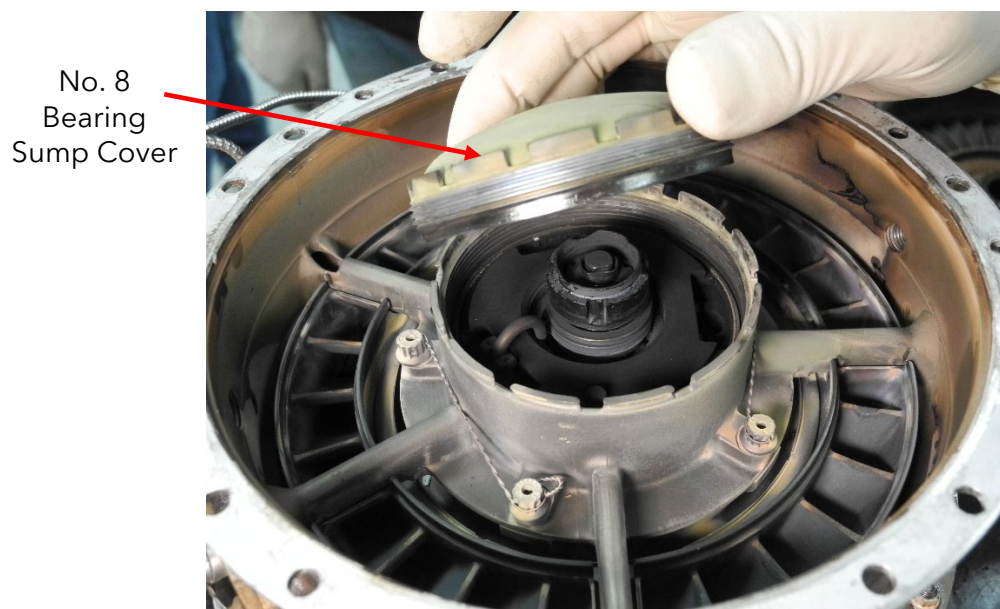


Photo 21 - No 8 Bearing Sump Cavity

An examination of the No. 8 bearing sump cover revealed a rotational score on the inside, consistent with contact against the No. 8 bearing spanner nut ([Photo 22](#)).

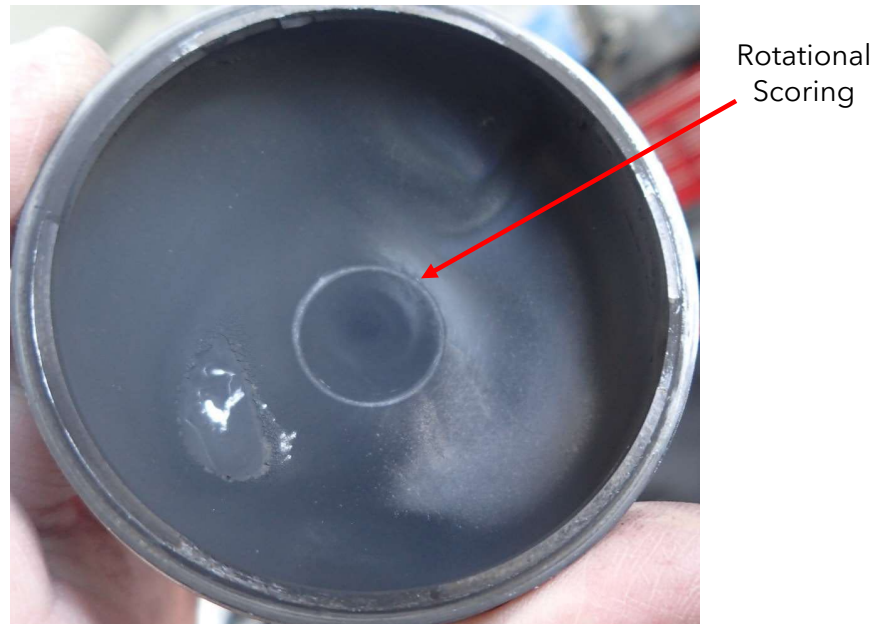


Photo 22 - No 8 Bearing Sump Cover - Inside View

The No. 8 bearing spanner nut was un-torqued and had backed out until the last approximately one thread ([Photo 23](#)).



Photo 23 - No. 8 Bearing Spanner Nut - Loose

The No. 8 bearing spanner nut was submitted to the Rolls Royce materials laboratory for examination ([Photo 24](#) & [Photo 25](#)) which revealed:

- a) The spanner nut exhibited two blended locations consistent with acceptable removal of prior crimps and one crimp.
- b) The crimp exhibited a pry mark on the inner diameter surface consistent with a nut that was staked at a previous locking position.
- c) The mark was oxidized consistent with exposure to engine operation.

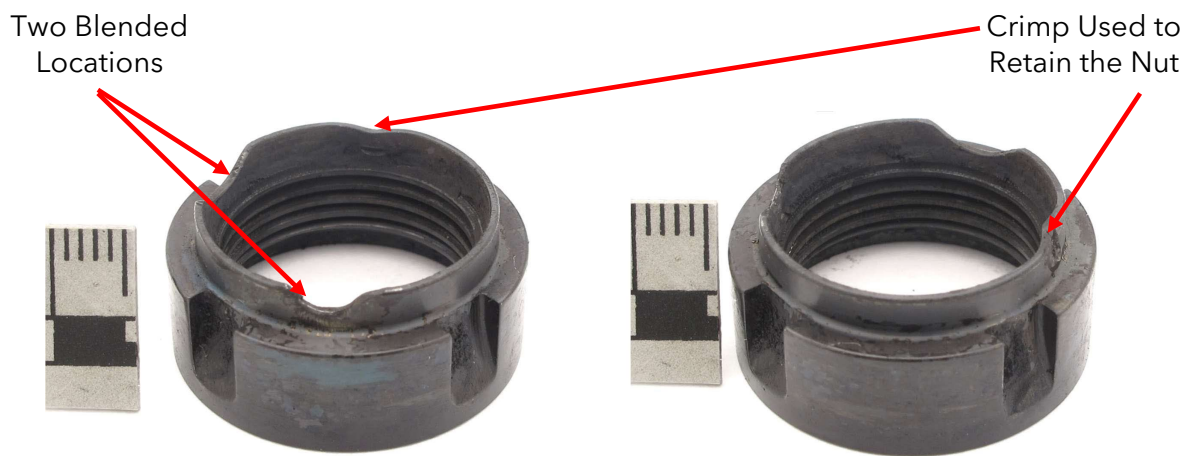


Photo 24 - Two Images of Spanner Nut (Rotated by 90°) (from RR Materials Lab)

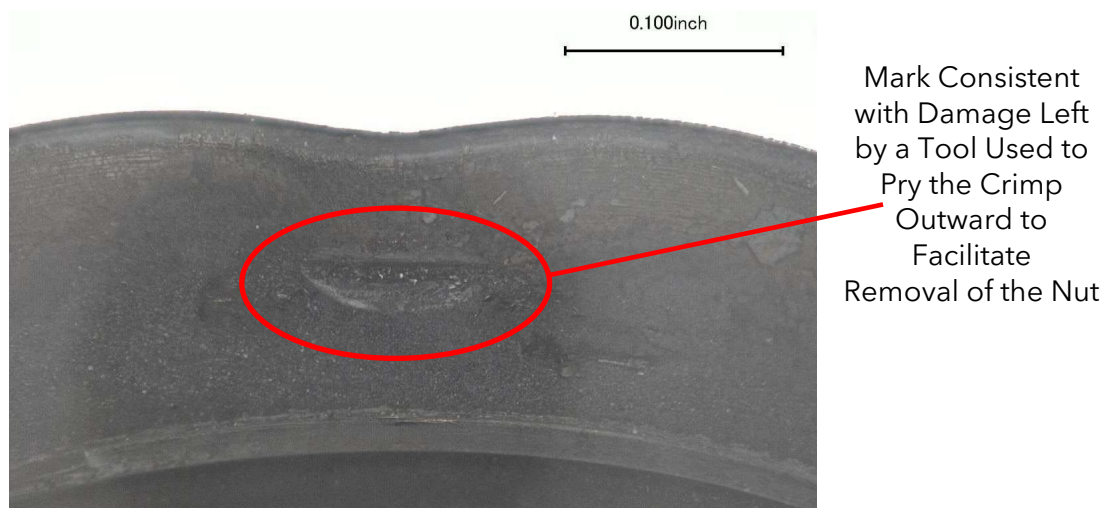


Photo 25 - Detailed View of Inner Diameter of the Spanner Nut Crimp (from RR Materials Lab)

Only a portion of the thermally distressed inner race remained ([Photo 26](#)). The inner ring exhibited rub damage resulting in the loss of the forward shoulder of the raceway and material transfer from the balls was observed on the bearing raceway.



Photo 26 - No. 8 Bearing Inner Race

The No. 8 bearing was thermally distressed, dry and coated with a black residue, consistent with coked oil and had disintegrated ([Photo 27](#)). The balls exhibited varying degrees of deformation, spalling, and skidding wear resulting in varying shapes and diameters. The outer ring raceway exhibited material deposits.



Photo 27 - No. 8 Bearing - Disintegrated

The gas producer turbine bearing support was removed, revealing the 1st stage turbine wheel (Photo 28) which was intact with all blades were present; however, the blade tips had been fractured from contact against the blade shroud, consistent with having lost axial and radial retention (Photo 29).

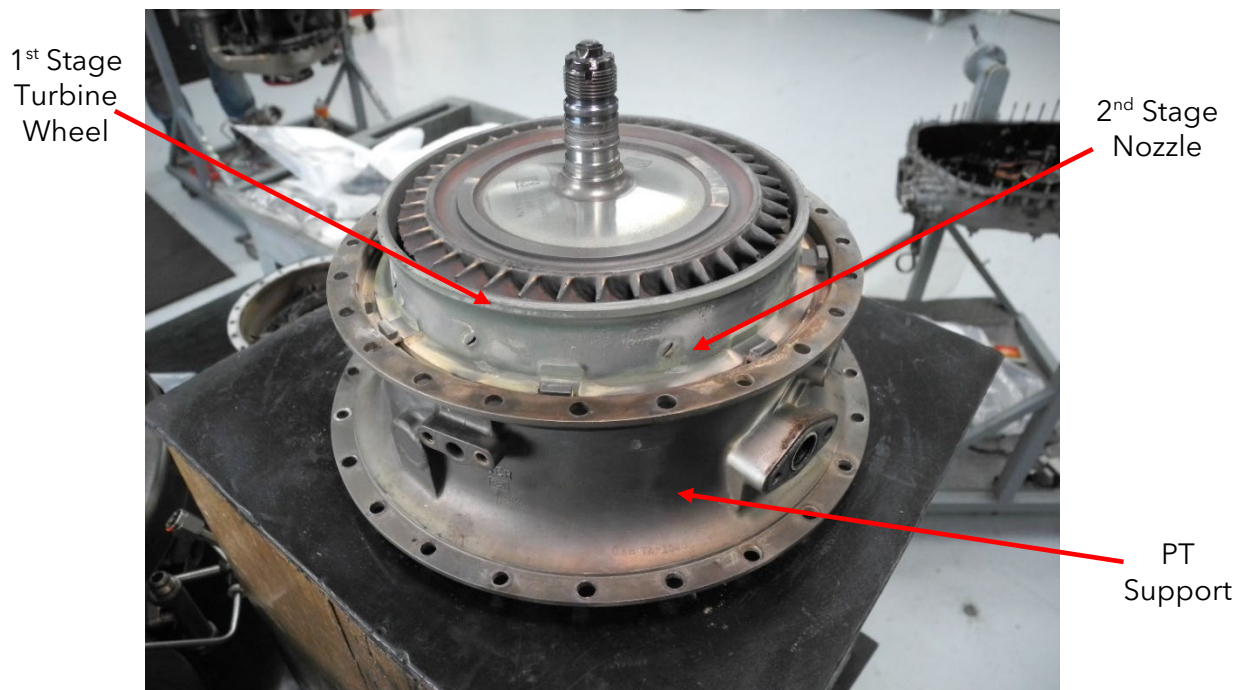


Photo 28 - PT Support - Intact

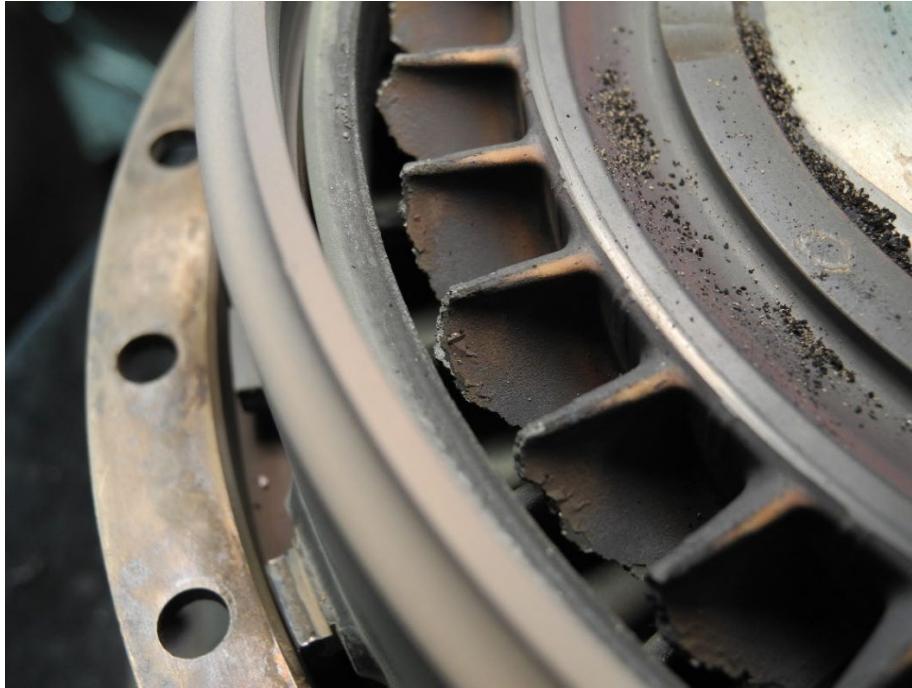


Photo 29 - 1st Stage Turbine Blades - Fractured Tips