# BUREAU OF AIRCRAFT SAFETY INVESTIGATION PAKISTAN

## FINAL INVESTIGATION REPORT


## SERIOUS INCIDENT

## ABORTED TAKE-OFF DUE TO ENGINE PROBLEM

| | |
|---|---|
| **Aircraft Type** | ATR 72-500 (72-212A) |
| **Registration** | AP-BKX |
| **Operator** | Pakistan International Airlines (PIA) |
| **Flight** | PK-580 Sector Karachi (OPKC) – Multan (OPMT) |
| **Date of Occurrence** | 27 June 2019 |
| **Location** | Karachi (OPKC) |
| **Classification** | Serious Incident |
| **Report Status** | Final Investigation Report |
| **Report Reference** | HQ BASIP/1000/423/Inv |
| **Date of Report** | 03 August, 2026 |
| This report is issued pursuant to Pakistan Aircraft Safety Investigation (PASI) Act, 2023, Air Safety Rules 2025 and ICAO Annex 13 | |

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## SCOPE

At Bureau of Aircraft Safety Investigation Pakistan (BASIP), investigations are conducted in accordance with Pakistan Aircraft Safety Investigation (PASI) Act, 2023, Air Safety Rules 2025, and International Civil Aviation Organization (ICAO) Annex-13.

The sole objective of the investigation and its final report is to prevent future accidents, serious incidents, and incidents of similar nature, without apportioning blame or liability. Accordingly, it is inappropriate to use BASIP investigation reports to assign fault or blame or determine liability, since neither the investigation nor the reporting process has been undertaken for judiciary or administrative purposes.

This report contains facts which are based on information that came to the knowledge of BASIP during the investigation up to the time of publication. Such information is published to inform the aviation industry and the public about the general circumstances of civil aviation serious incidents.

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# INTRODUCTION

This serious incident was reported to Bureau of Aircraft Safety Investigation Pakistan (BASIP) by Pakistan Airports Authority (PAA) vide Incident Occurrence and Unserviceability Report (IOU). This serious incident was notified to International Civil Aviation Organization (ICAO), Transportation Safety Board (TSB) Canada, Bureau of Enquiry and Analysis (BEA) for Civil Aviation Safety, France in line with Annex-13. The investigation has been conducted by BASIP. All corresponding timings are mentioned in Universal Coordinated Time (UTC).

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## SYNOPSIS

On 27 June 2019, ATR 72-500 aircraft AP-BKX, operated by Pakistan International Airlines (PIAC) as flight PK-580 from Jinnah International Airport (JIAP), Karachi to Multan International Airport (OPMT), Multan, experienced a No. 2 engine malfunction during the take-off roll at JIAP, Karachi. While the aircraft was accelerating for take-off, a loud bang was heard, and the No. 2 engine torque decreased from approximately 90% to 40%. The flight crew rejected the take-off, shut down the affected engine, and safely taxied the aircraft back to the parking stand. There were no injuries to the 38 persons on board and no damage to third-party property.

Metallurgical examination determined that the second-stage Power Turbine (PT2) blade fractures originated from leading-edge cracks caused by Type I sulphidation hot corrosion. The cracks propagated by fatigue and resulted in overload fracture of the blades, causing engine malfunction and secondary internal damage.

The investigation found that the failure mechanism was consistent with a known in-service PT2 blade degradation trend within the PW127 engine fleet. Although the occurrence engine incorporated SB 21876, subsequent service experience resulted in the issuance of SB 21917 and SIL PW100-188 to address continued PT2 blade distress. The investigation concluded that the rejected take-off resulted from PT2 blade fracture caused by sulphidation-induced fatigue cracking. No safety recommendations were issued as corrective actions had already been implemented by the manufacturer.

# ABBREVIATIONS

| | |
|---|---|
| **ATC** | Air Traffic Control |
| **ATCOs** | Air Traffic Controller |
| **ATPL** | Air Transport Pilot License |
| **BASIP** | Bureau of Aircraft Safety Investigation Pakistan |
| **BEA** | Bureau of Enquiry and Analysis |
| **CPL** | Commercial Pilot License |
| **CVR** | Cockpit Voice Recorder |
| **DFDR** | Digital Flight Data Recorder |
| **EDS** | Energy Dispersive Spectrum |
| **EMM** | Engine Maintenance Manual |
| **FO** | First Officer |
| **FOD** | Foreign Object Debris |
| **Ft** | Feet |
| **HF** | High Frequency |
| **ICAO** | International Civil Aviation Organization |
| **ILS** | Instrument Landing System |
| **IOU** | Incident Occurrence and Unserviceability Report |
| **JIAP** | Jinnah International Airport |
| **KGs** | Kilograms |
| **Km** | Kilometers |
| **kt** | Knot |
| **LE** | Leading Edge |
| **MCD** | Magnetic Chip Detector |
| **OPKC** | Karachi |
| **OPMT** | Multan |
| **P&WC** | Pratt & Whitney, Canada |
| **PAA** | Pakistan Airports Authority |
| **PASI** | Pakistan Air Safety Investigation |
| **PCAA** | Pakistan Civil Aviation Authority |

| | |
|---|---|
| **PIAC** | Pakistan International Airlines |
| **PT** | Power Turbine |
| **R/W** | Runway |
| **RFFS** | Rescue & Fire Fighting Services |
| **RGB** | Reduction Gearbox |
| **RTO** | Rejected Take Off |
| **SB** | Service Bulletin |
| **SEM** | Scanning Electron Microscope |
| **SOPs** | Standard Operating Procedures |
| **TE** | Trailing Edge |
| **T/W** | Taxiway |
| **TM** | Turbo Machinery |
| **TSB** | Transportation Safety Board |
| **UTC** | Universal Coordinated Time |
| **VHF** | Very High Frequency |
| **VMC** | Visual Meteorological Conditions |

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| **1.** | PAA – IOU Report dated | **Appendix A** |
| **2.** | ICAO – Initial Notification | **Appendix B** |

# SECTION 1 – FACTUAL INFORMATION

## 1.1. History of the Flight

1.1.1. At 1244, on June 27th 2019, PIAC Flight PK-580 operating from JIAP, Karachi to Multan, ATR72-500 aircraft, Registration No. AP-BKX started takeoff run from Runway (R/W) 25L of JIAP, Karachi.

1.1.2. While aircraft was accelerating for takeoff, the torque indicator showed 90%, a bang noise was heard, and the engine No. 2 torque dropped to 40%.

1.1.3. Takeoff was rejected, engine No.2 was shut down and aircraft taxied back to parking stand.

## 1.2. Injuries to Persons

1.2.1. No injury was reported to any person on board the aircraft or on the ground. Details are as follows:

| Injuries | Crew | Passengers | Total on Aircraft | Others |
|---|---|---|---|---|
| Fatal | Nil | Nil | Nil | Nil |
| Serious | Nil | Nil | Nil | Nil |
| Minor | Nil | Nil | Nil | Nil |
| None | 02 | 36 | 38 | Nil |
| **Total** | **02** | **36** | **38** | **Nil** |

*Table 1 Injuries Details*

## 1.3. Damage to Aircraft

1.3.1. All the 2nd stage PT blades of No.2 engine were fractured at different height and consequent secondary damages downstream the engine was observed.

## 1.4. Other Damage

1.4.1. No damage to third-party property or infrastructure was reported. Post incident R/W and Taxiway (T/W) inspections confirmed no Foreign Object Debris (FOD).

## 1.5. Personnel Information

### 1.5.1. Flight Crew

1.5.1.1. Both the Captain and the First Officer (FO) were rated on ATR 72-500 and had valid Air Transport Pilot License (ATPL).

| Captain | |
|---|---|
| **License type** | Air Transport Pilot License (ATPL) |
| **Medical date with status** | 31-10-25 |
| **Type of the aircraft flown** | ATR42/72 |
| **Total in Command (hrs)** | 3891 |
| **Grand Total (hrs)** | 10,666 |
| **Last Simulator Training:**<br>a) Date<br>b) Place of Training | a) 05-12-2024<br>b) OPIS – OPKC |

*Table 2 Captain Details*

| First Officer (FO) | |
|---|---|
| **Type of License held & No.** | Commercial Pilot License (CPL) |
| **Medical Date with Status** | 31-10-25 |
| **Type of the aircraft flown** | ATR42/72 |
| **Total in Command (hrs)** | 2749 |
| **Grand Total (hrs)** | 4087 |
| **Last Simulator Training:**<br>a) **Date**<br>b) **Place of Training** | a) 23 February 2025<br>b) OPIS – OPKC |

*Table 3 FO Details*

## 1.6. Aircraft Information

1.6.1. Aircraft and both Engine's details are as follows:

| | |
|---|---|
| **Aircraft Make & Model** | ATR72-500 |
| **Registration** | AP-BKX |
| **Year of Manufacture** | 2012 |
| **Manufacturer Serial No.** | 1037 |
| **Owner** | Celestial Aviation Trading 64 Ltd. |
| **Operator** | Pakistan International Airlines (PIA) |
| **Date of Induction** | 10 June 2015 |
| **Max Take-off Weight** | 22,800 Kilogram (kg) (50,265 lb) |
| **Max Landing Weight** | 22,350 kg (49,273 lb) |
| **Max Fuel Capacity** | Approx. 5,000 litres (≈4,000 kg usable fuel) |
| **Total Aircraft Hours / Cycles** | 12072/- |

*Table 4 Aircraft Details*

| Engine No 2 | |
|---|---|
| **Engine S No** | ED1507 |
| **Manufacturer** | Pratt & Whitney Canada |
| **Engine Type** | PW127M |
| **Date of Installation** | 30-05-2017 |
| **TSN / CSN** | 4505 / 3492 |
| **TSI / TSO** | NIL |
| **CSI / CSO** | NIL |

*Table 3 Engine No 2 Details*

## 1.7. Meteorological Information

1.7.1. The weather conditions prevailing at JIAP, Karachi on 27th June 2019 were reported as Visual Meteorological Conditions (VMC). Visibility was approximately 6 Kilometers (Km), with light to moderate south-westerly to westerly winds of around 8 knots (kt), gusting up to 18 kt. Cloud coverage consisted of few clouds at 2,500 feet (ft) and a broken layer at 3,500 ft, providing cloud bases well above the minimum requirements for departure. No precipitation, thunderstorm activity, or other significant weather phenomena were reported in the vicinity of the aerodrome. Based on the available meteorological information, weather conditions were conducive to normal flight operations and are not considered to have contributed to the occurrence.

1.7.2. Meteorological conditions were not a factor in the engine failure.

## 1.8. Aids to Navigation

1.8.1. Navigational facilities at OPKC were fully functional during the incident.

1.8.2. The aircraft navigation systems were serviceable and no technical anomaly / failure was documented before the incident flight.

## 1.9. Communications

1.9.1. **Onboard Communications –** On board communication equipment for communication on Very High Frequency (VHF) and High Frequency (HF), in accordance with the aircraft certification requirements was serviceable and no technical anomaly / failure was documented before the incident flight.

1.9.2. Communication facilities at OPKC were fully functional during the incident flight. Communications between the flight crew and ATC were clear and effective.

1.9.3. ATC coordination was timely and effective. Emergency services were promptly activated.

## 1.10. Aerodrome Information

1.10.1. Jinnah International Airport (OPKC), Karachi R/W 25L was in use. The aerodrome is equipped for Instrument Landing System (ILS) Approaches. Rescue and Fire Fighting Services (RFFS) were deployed as per established Standard Operating Procedures (SOPs). No abnormality in aerodrome infrastructure was reported.

## 1.11. Flight Recorders

1.11.1. The aircraft was equipped with a Digital Flight Data Recorder (DFDR) and a Cockpit Voice Recorder (CVR) in accordance with regulatory requirements.

1.11.2. Following the occurrence, the DFDR was removed from aircraft and forwarded to the designated facility for data download and analysis. The recorded flight data were subsequently examined to support the investigation and reconstruction of the event sequence

## 1.12. Wreckage and Impact Information

1.12.1. Not applicable.

## 1.13. Medical and Pathological Information

1.13.1. Not applicable.

## 1.14. Fire

1.14.1. No fire occurred during or after the incident. Cabin crew checks of the cabin and passenger windows confirmed no smoke, fire, or unusual odor during the incident.

## 1.15. Survival Aspects

1.15.1. All persons on board survived without injury. NITS briefing protocols were correctly applied. Post-flight debriefs confirmed no crew or passenger distress.

## 1.16. Tests and Research

### 1.16.1. Technical Background – Rejected Take Off (RTO) and Engine Shutdown

1.16.1.1. The aircraft was reported as airworthy prior to departure, as per the aircraft technical documents.

1.16.1.2. No 2 Engine oil pressure and scavenge filters have been removed several times due to pop out indication. Patch check of filters as per PW127 EMM 72-01-50, Para H

indicated presence of ferromagnetic and non-ferrous debris. The debris found remained with in allowable limit in all cases of patch check. Details are given in table below: -

| Engine TSN | Removal Date | Pressure filter 305924-01 | Scavenge filter 3059256-01 | Filter Hrs |
|---|---|---|---|---|
| 2958 | 29-09-2018 | PIA-036/18 | | 586 |
| 3442 | 08-12-2018 | | PIA-059/18 | 1069 |
| 4109 | 31-03-2019 | | - | 601 |
| 4131 | 03-04-2019 | | PIA-015/18 | - |
| 4478 | 23-06-2019 | | PIA-116/18 | 347 |
| 4478 | 23-06-2019 | PIA-110/19 | | 369 |

*Table 5 Oil Filter Patch Check*

1.16.1.3. No.2 engine has no prior defect trend related to the incident.

1.16.1.4. Engine Log book record indicated compliance of Service Bulletin (SB) 21876 (related to improved sulfidation resistance adding chromium coating on a portion of the leading edge of stage-2 LPT blades) by P&WC during manufacture of engine in March, 2017.

### 1.16.2. No.2 Engine Examination

1.16.2.1. Engine was removed from the aircraft and shipped to P&WC facility for shop inspection and strip examination. Findings of the shop inspection and failure mode analysis are as below.

1.16.2.2. **Visual Examination –** Visual examination through the exhaust duct revealed fracture of all the 2nd stage PT blades at different height. The seal ring was bent and out of its original position.

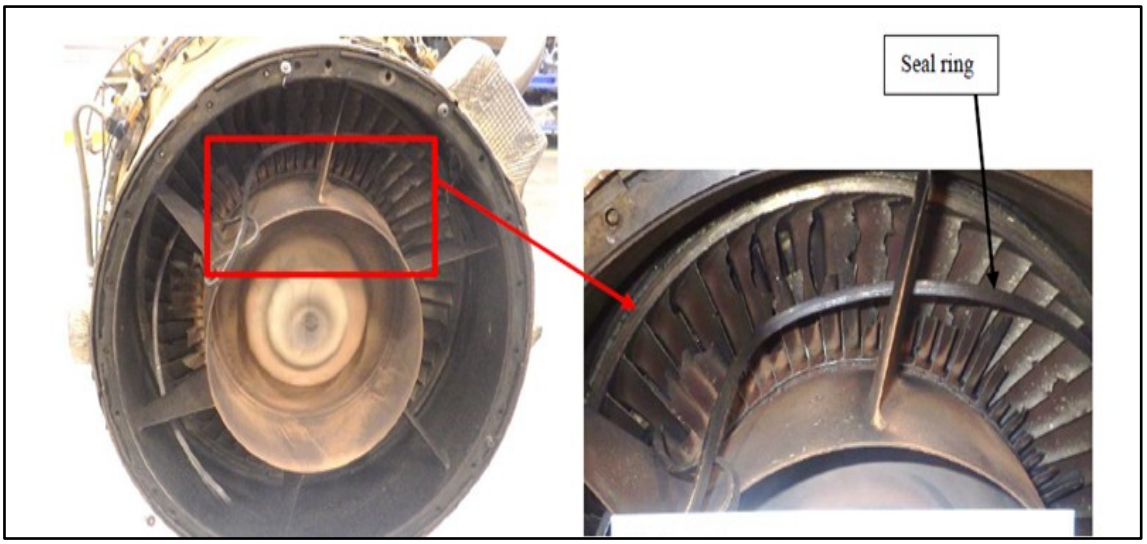


*Figure 1 Fracture 2nd Stage PT Blades at different height*

1.16.2.3. The Turbo Machinery (TM) Magnetic Chip Detector (MCD) showed fuzz material and the Reduction Gearbox (RGB) MCD was in dirty condition.

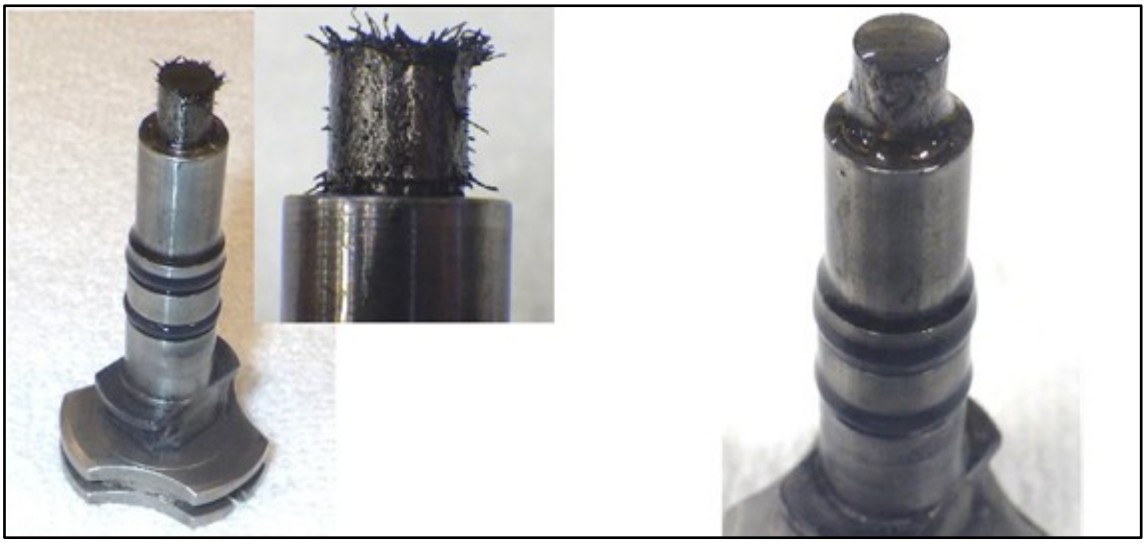

*Figure 2 TM MCD and RGB MCD*

1.16.2.4. The TM main oil filter showed entrapped debris (Yellow arrows).

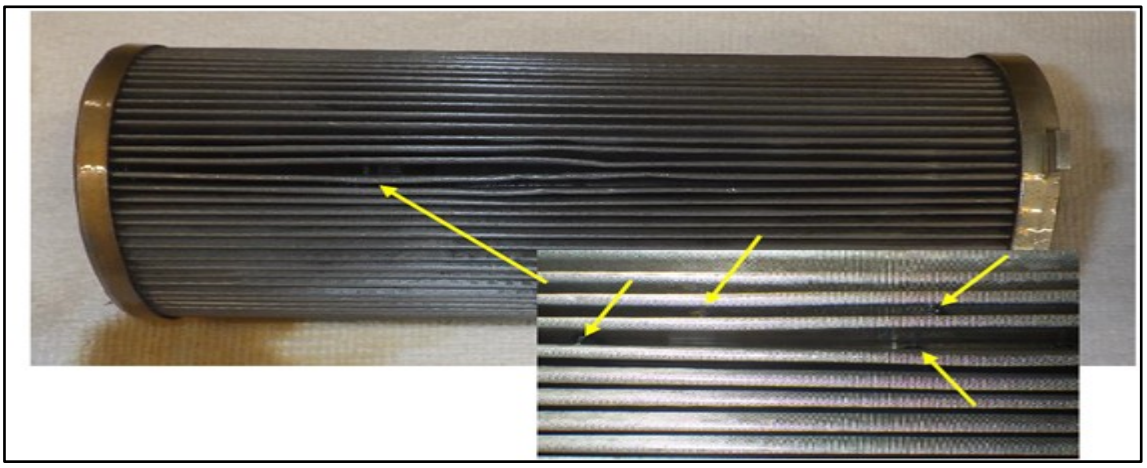

*Figure 3 TM Main Oil Filter*

1.16.2.5. Removal of the 2nd stage PT disk assembly showed that all the blades fractured at various height. The front face of the 2nd stage PT disk showed impact damages and rubbing on the platform. The root of the leading edge was machined/grooved by contact with the 2nd stage PT stator (red arrow).

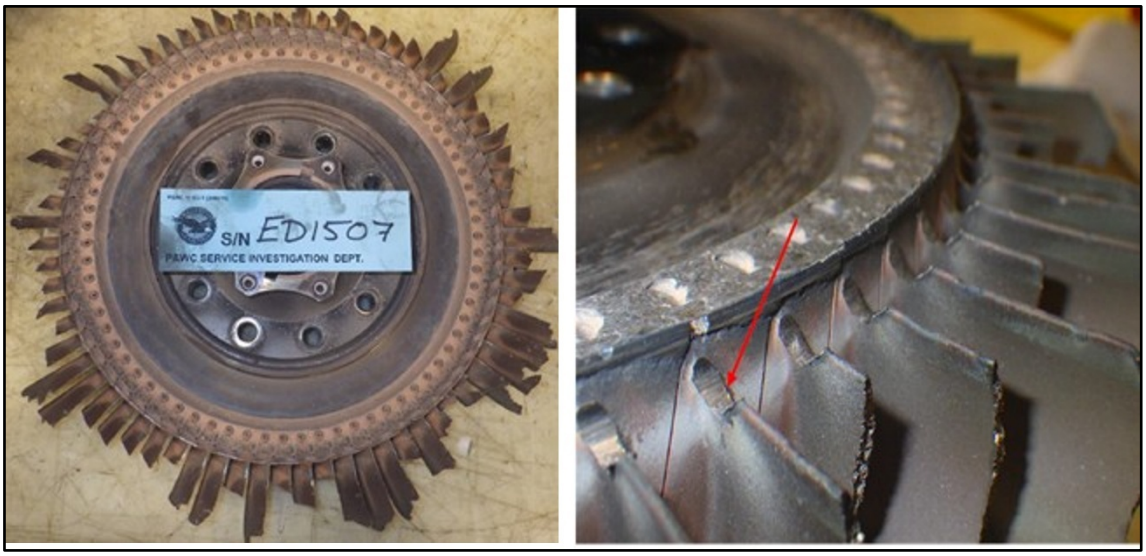


*Figure 4 2nd Stage PT Disc Assembly and Impact Disc*

1.16.2.6. The 2nd stage PT stator downstream side showed impact damages on the vanes (yellow arrows) and the inner ring was fractured and lost material due to contact with the 2nd stage PT disk assembly.

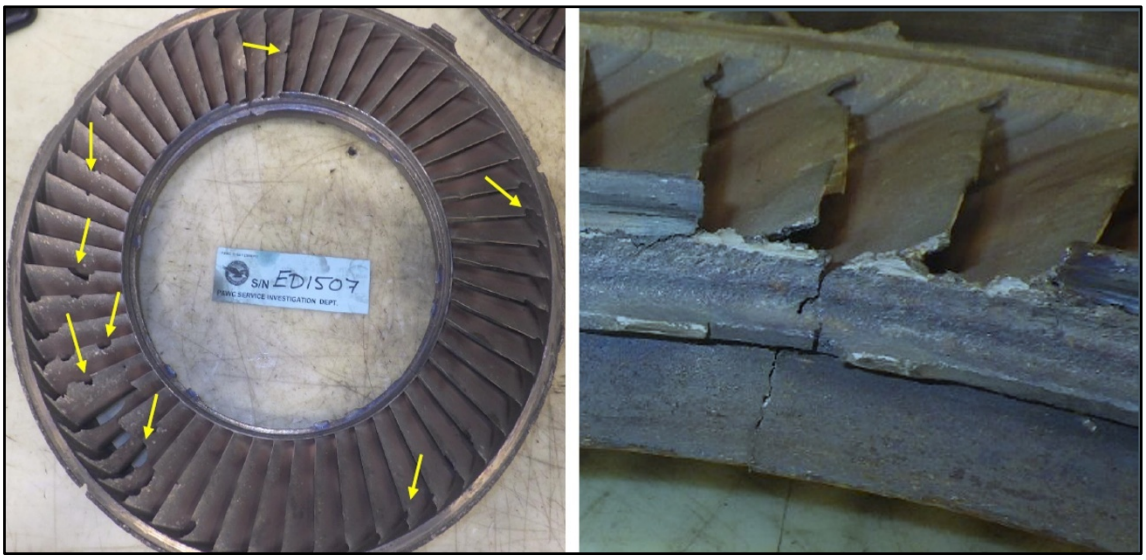


*Figure 5 2nd Stage PT Stator and Inner Ring*

1.16.2.7. The 1st stage PT blades showed impact damages on the trailing edge and rubbing at the Leading Edge (L/E) shrouds (red arrow).

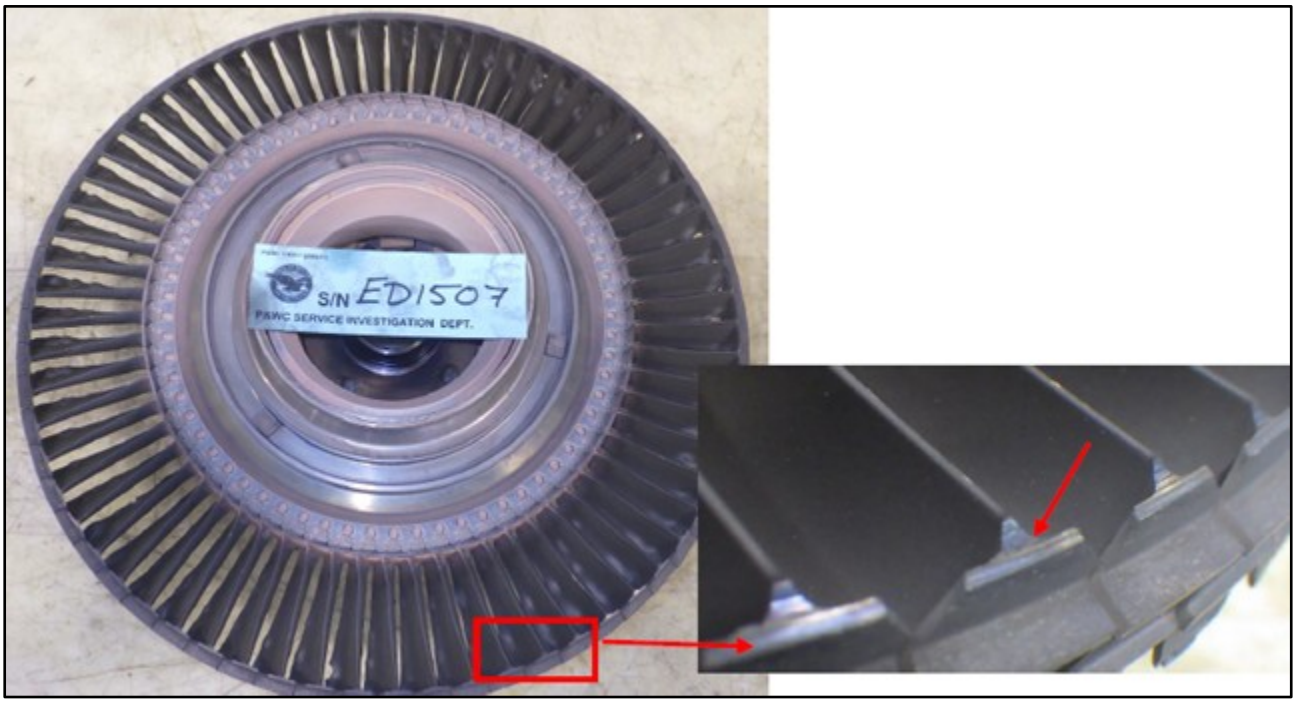


*Figure 6 1st Stage PT Blades*

1.16.2.8. Removal of the 1st stage PT stator showed no damage on the No. 6 & 7 bearing outer race (red arrows).


*Figure 7 No. 6 & 7 Bearing Outer Race*

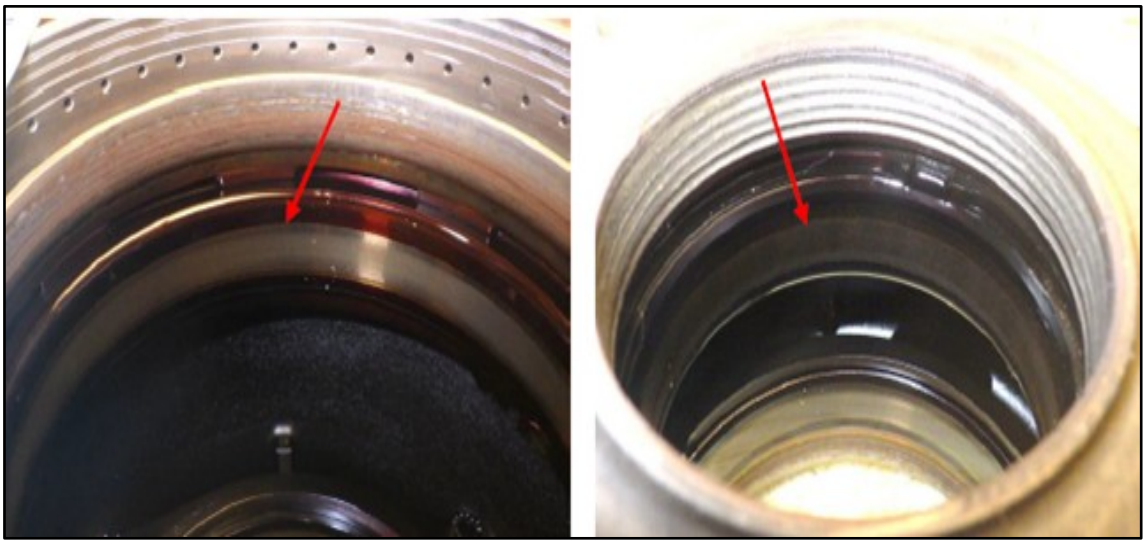

*Figure 8 No 6 and 7 Bearing Outer Race*

1.16.2.9. No spalling was observed on the No. 7 bearing rollers.

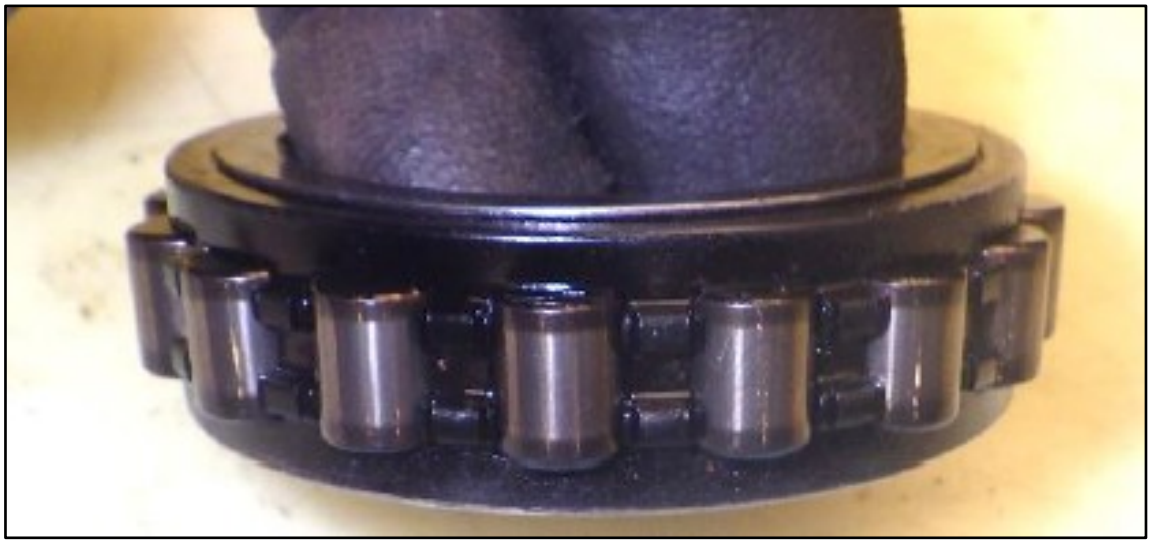

*Figure 9 No 7 Bearing Rollers*

1.16.2.10. The RGB was removed from the TM. Visual examination through the front inlet case showed rubbing of the LP impeller airfoil tips.

1.16.2.11. Removal of the PT shaft showed intershaft rubbing. No damage observed on the No. 2 bearing and the No. 1 bearing rotated freely.

Figure 10 PT Shaft


Figure 11 PT Shaft

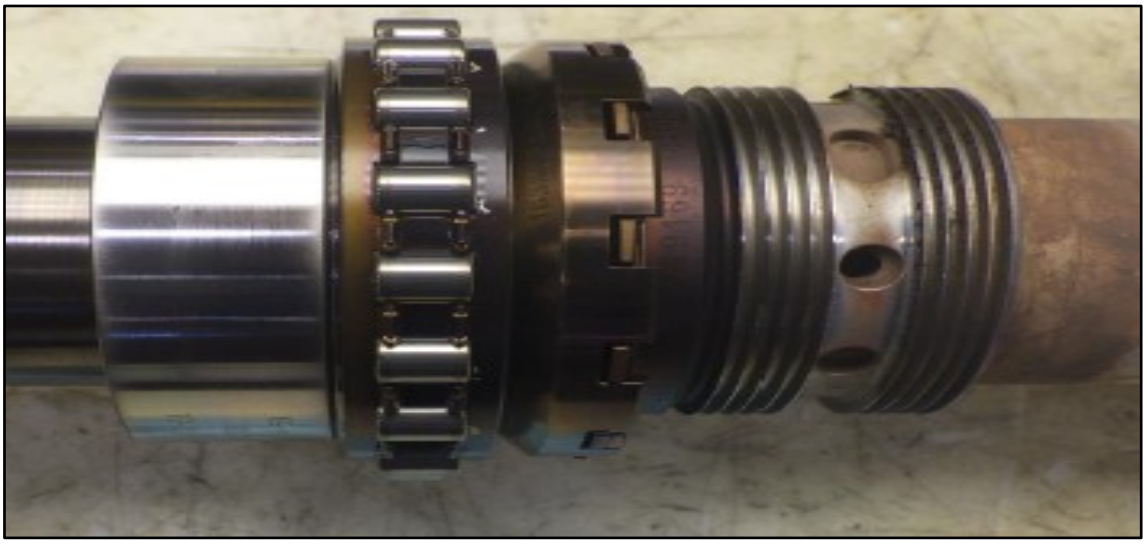

Figure 12 No1 and No 2 Bearing

### 1.16.2.12. Failure mode analysis of selected blades

1.16.2.12.1. The 2nd stage PT blades were arbitrary numbered and the blade No. 50 & 57 were selected for analysis.

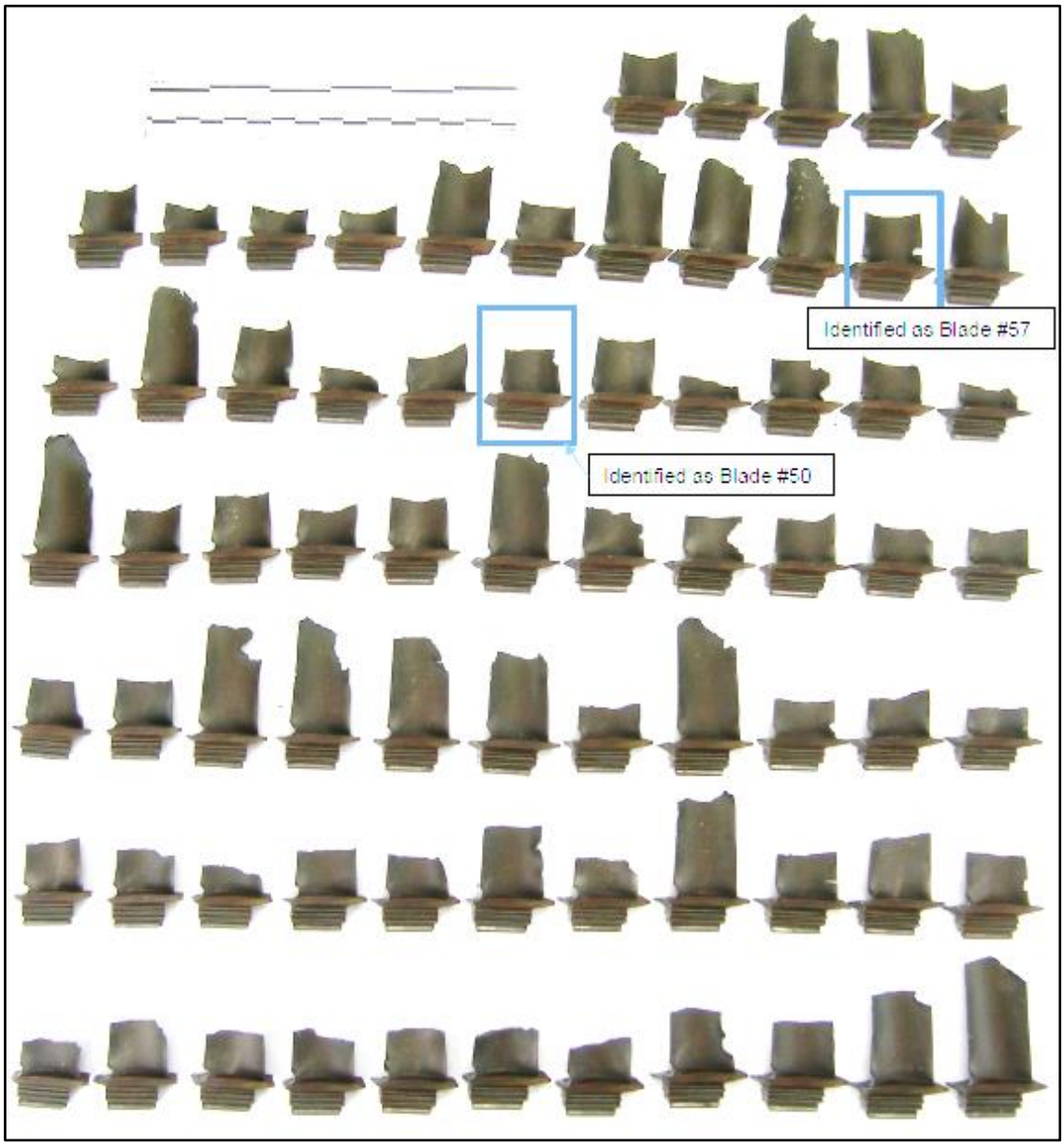


*Figure 13 2nd stage PT blades*

1.16.2.12.2. The 2nd stage PT blades No. 50 & No. 57 were fractured at 1.22". & 1.367" from the bottom of the root respectively. The L/E radius of the 2nd stage PT blades No. 50 & 57 were within drawing requirements.

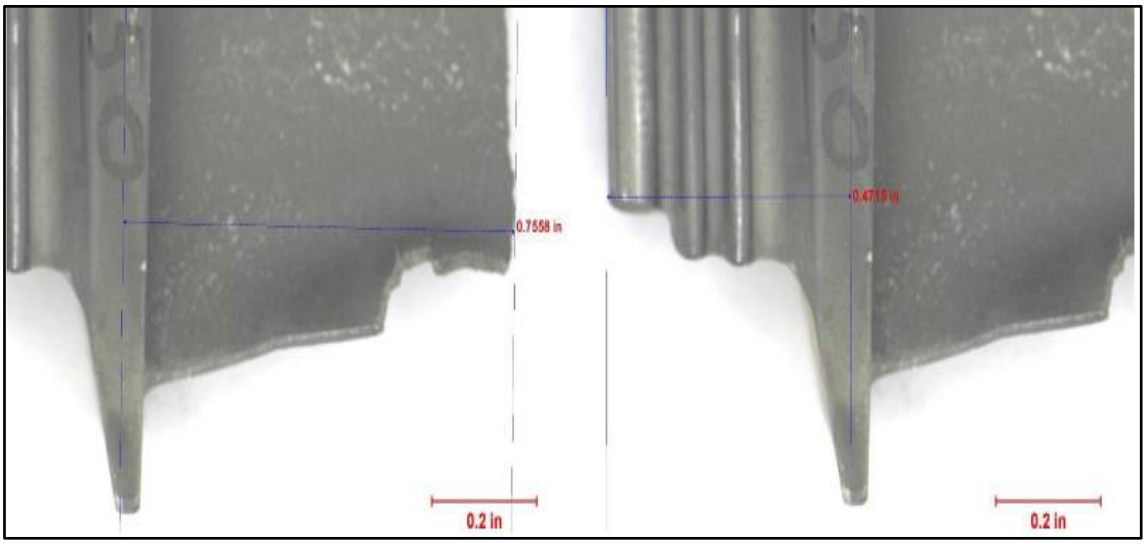


Figure 14 Fractured 2nd Stage PT Blade 50

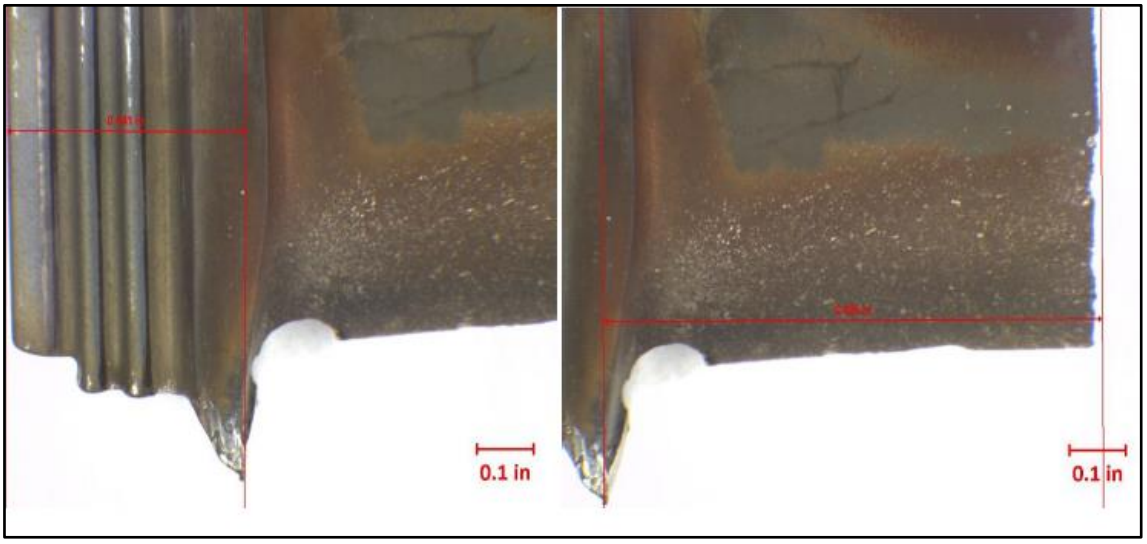


Figure 15 Fractured 2nd Stage PT Blade 57

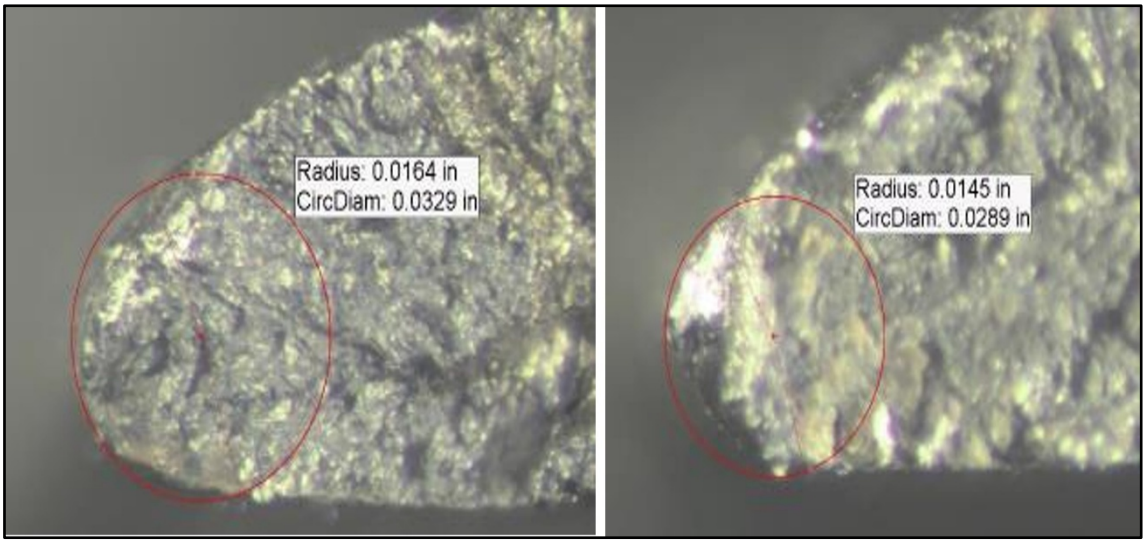


Figure 16 L/E Radius of PT Blade 50 and PT Blade 57

1.16.2.12.3. Magnified view of the blade No. 50 fracture surface revealed a dark grey color and smooth appearance at the L/E for approximately 0.050" into the blade. The smooth appearance at the L/E suggest a fatigue crack initiated from the L/E area and propagated throughout the trailing edge (T/E).

*Figure 17 Magnified view of the blade No. 50 fracture surface*

1.16.2.12.4. General Scanning Electron Microscope (SEM) view of the fracture surface of the 2nd stage PT blade No. 50 revealed flat facets consistent with fatigue crack propagation and intergranular topography. The yellow arrows showed the local fatigue crack propagation direction suggested by the observed river lines. The crack likely initiated at multiple locations along the leading edge. Higher magnification in the fatigue region showed evidence of fatigue striation (yellow bracket). The red arrow indicates the direction of crack propagation.

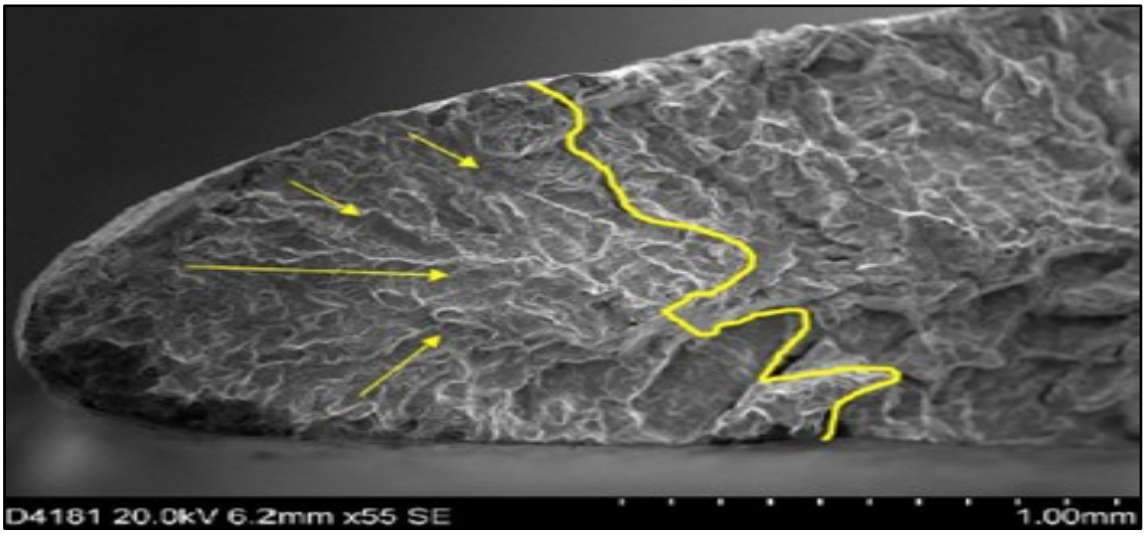


*Figure 18 SEM view of the blade No. 50*

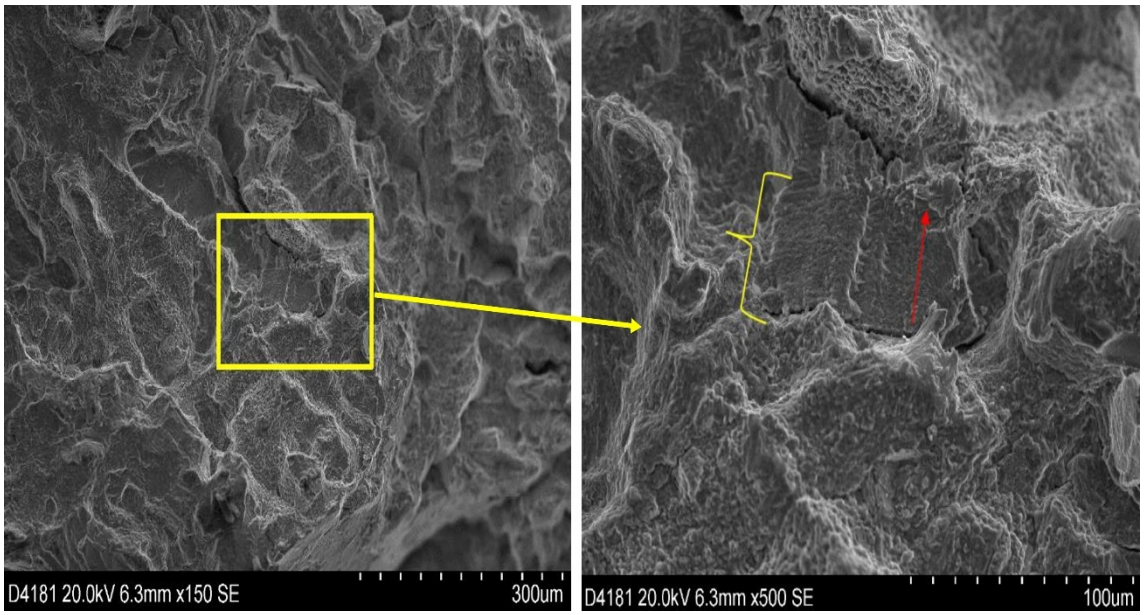


*Figure 19 Fatigue Striation*

1.16.2.12.5. The fracture surface of the blade No. 50 outside the dark grey colour was identified as ductile overload.

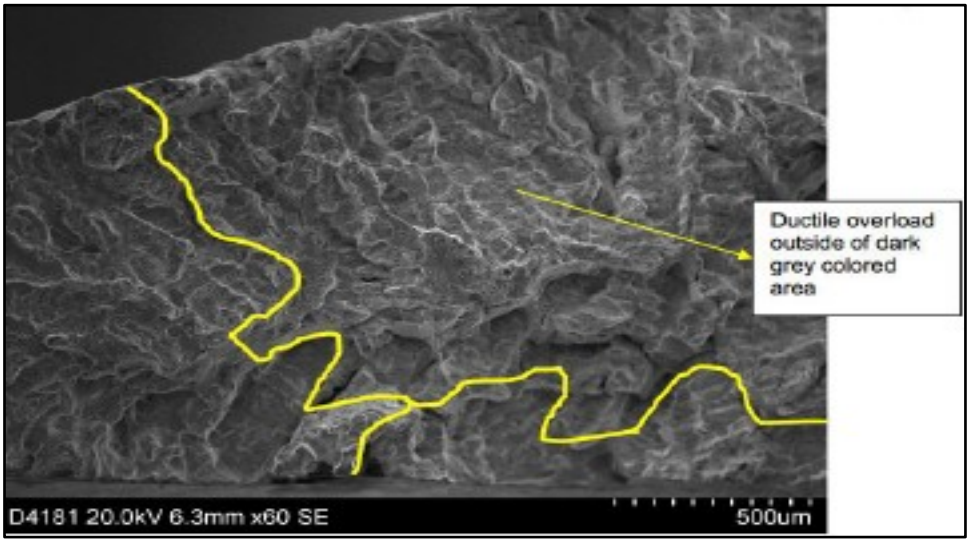


*Figure 20 Ductile Overload*

1.16.2.12.6. Magnified view of the 2nd stage PT blade No. 57 fracture surface revealed a dark grey color and smooth appearance at the L/E for approximately 0.160” into the blade. The smooth appearance at the L/E suggest a fatigue crack initiated from the L/E area and propagated throughout the T/E.

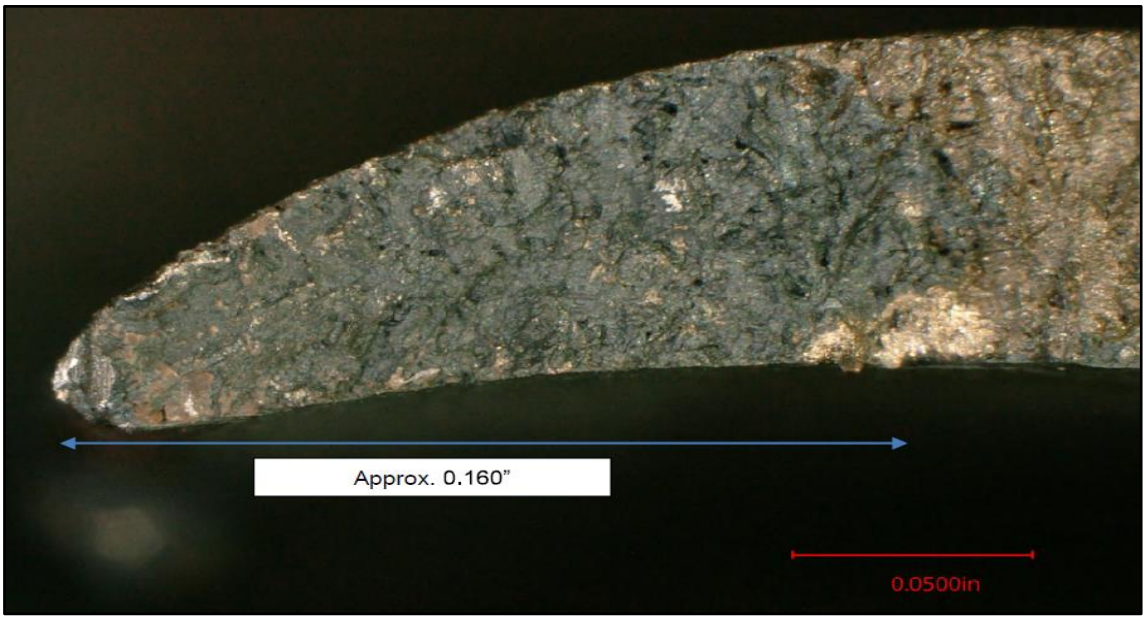


*Figure 21 Fatigue Crack Initiated from the L/E Area and Propagated Throughout the T/E*

1.16.2.12.7. Higher magnification SEM view of the 2nd stage PT blade No 57 in the dark grey coloured area showed evidence of fatigue striation (yellow bracket. The red arrow indicates the direction of crack propagation.

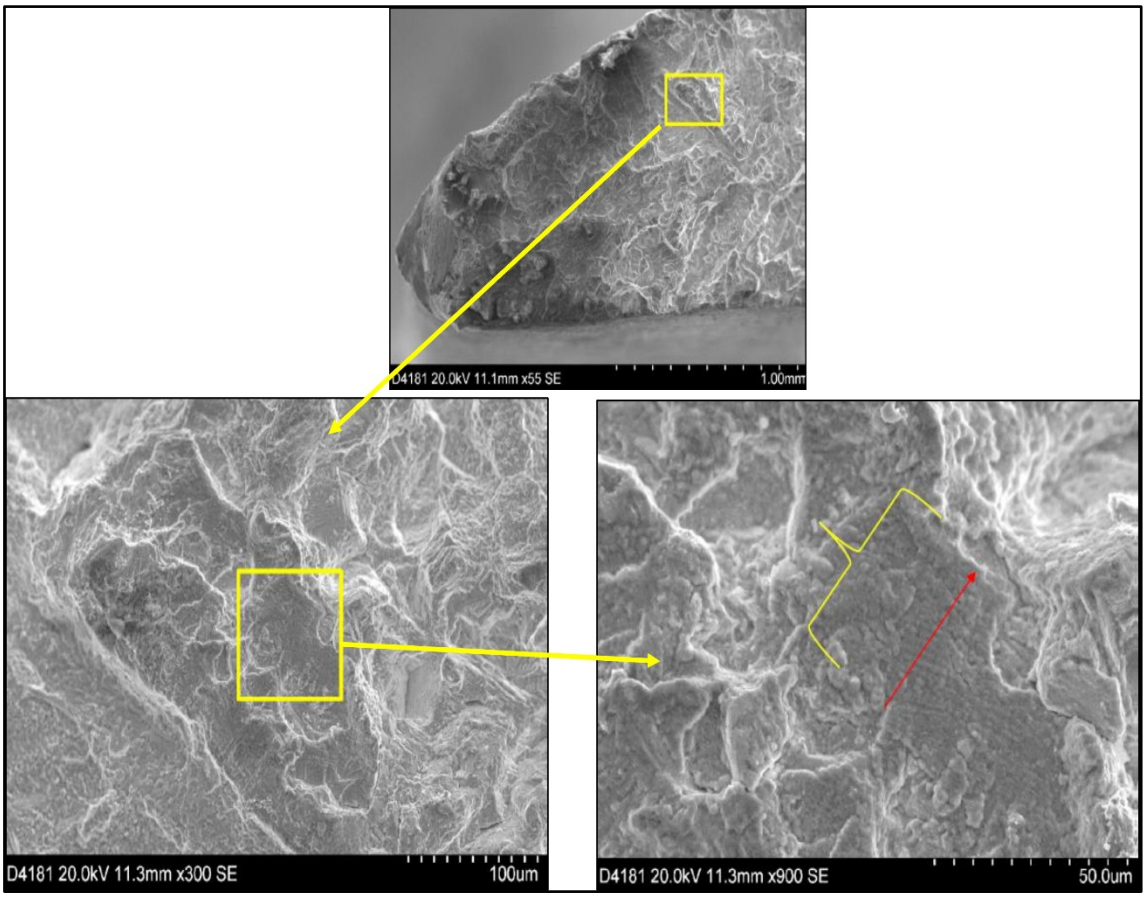


*Figure 22 Fatigue Striation and Direction of Crack Propagation*

1.16.2.12.8. Metallographic cross section of the 2nd stage PT blade No. 57 through the L/E and fracture surface origin area showed secondary parallel cracks initiation from the L/E

and extending into the blade (yellow rectangle). Energy Dispersive Spectrum (EDS) analyses using standardless and semi-quantitative method of the cross section along the L/E showed an elevated level of Sulphur and Chromium, indicative of Type I hot corrosion.

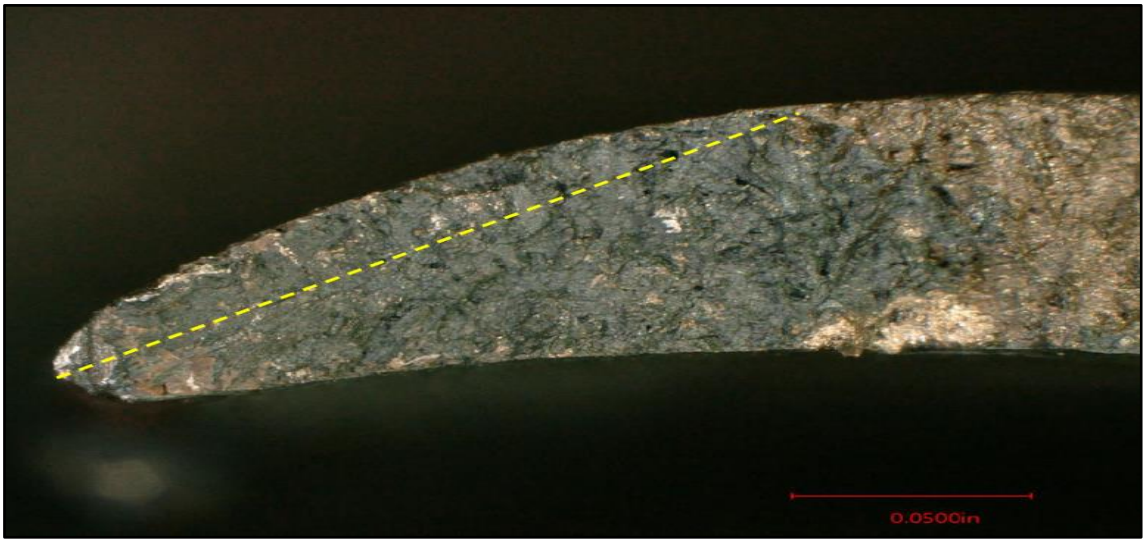


*Figure 23 Secondary Parallel Cracks*

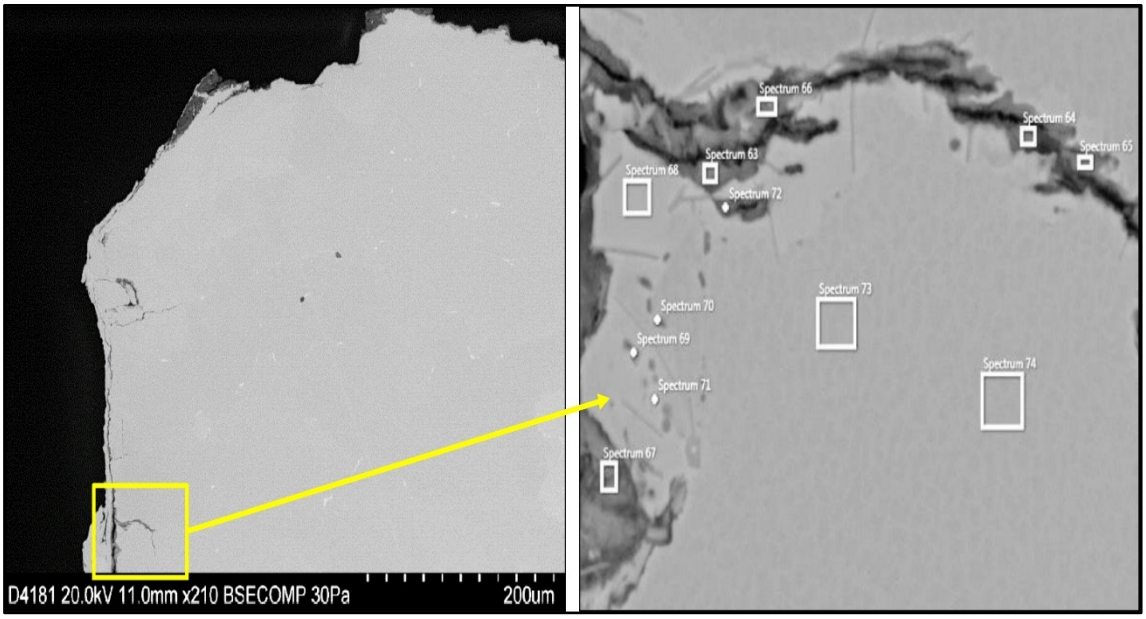


*Figure 24 Elevated Level of Sulphur and Chromium, Indicative of Type I Hot Corrosion*

| Spectrum Label | Spectrum 63 | Spectrum 64 | Spectrum 65 | Spectrum 66 | Spectrum 67 | Spectrum 68 | Spectrum 69 | Spectrum 70 | Spectrum 71 | Spectrum 72 | Spectrum 73 | Spectrum 74 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| C | 18.78 | 20.67 | 15.52 | 16.40 | 21.63 | 17.25 | 20.49 | 21.24 | 19.13 | 16.00 | 15.67 | 15.85 |
| O | 28.19 | 20.89 | 26.35 | 26.97 | 26.12 | 1.98 | | | | 18.04 | | |
| Al | 7.05 | 5.79 | 9.12 | 8.51 | 6.61 | 2.79 | 2.02 | 2.67 | 2.51 | 9.14 | 4.56 | 4.93 |
| S | 1.78 | | | 2.00 | | | 7.93 | 6.17 | 3.56 | | | |
| Ti | 1.17 | 0.92 | 1.17 | 2.09 | 0.75 | | 0.37 | 0.63 | | 0.98 | 0.54 | 0.45 |
| Cr | 21.18 | 13.47 | 12.63 | 16.42 | 8.44 | 2.07 | 11.30 | 10.25 | 4.92 | 10.15 | 9.50 | 10.36 |
| Ni | 18.97 | 34.41 | 30.50 | 21.92 | 28.99 | 71.63 | 54.06 | 59.04 | 67.12 | 40.20 | 64.26 | 64.86 |
| Nb | 2.88 | 1.47 | 2.34 | 3.60 | 6.14 | | | | | 1.79 | 1.97 | |
| Mo | | 2.38 | 2.37 | 2.09 | 1.33 | 4.27 | 3.82 | | 2.75 | 3.70 | 3.49 | 3.55 |
| Total | 100.00 | 100.00 | 100.00 | 100.00 | 100.00 | 100.00 | 100.00 | 100.00 | 100.00 | 100.00 | 100.00 | 100.00 |

*Table 6 Elevated Level of Sulphur and Chromium, Indicative of Type I Hot Corrosion*

## 1.17. Organizational and Management Information

1.17.1. P&WC is the manufacturer and type certificate holder of the PW127M engine and is responsible for the continued airworthiness support of the PW100 engine series.

1.17.2. Prior to the occurrence, P&WC had identified a number of in-service events involving distress and cracking of second-stage PT2 blades associated with sulphidation hot corrosion at the blade leading edge. To improve corrosion resistance, P&WC issued SB 21876 in July 2015 introducing PT2 blades with a chromium-coated leading edge. Subsequent service experience indicated continued PT2 blade distress, resulting in the issuance of SB 21917 in November 2017 to replace the SB 21876 blade configuration and SIL PW100-188 to inform operators of the observed trend and associated engine removals.

1.17.3. Metallurgical examination of the occurrence engine determined that the PT2 blade fracture originated from leading-edge cracks caused by Type I sulphidation hot corrosion, followed by fatigue crack propagation and overload failure. This failure mechanism was consistent with the PT2 blade degradation trend previously identified by P&WC within the PW127 engine fleet.

1.17.4. Following further service experience, P&WC issued SB 21959 in February 2021 introducing a modified PT2 blade design and enhanced coating system to improve sulphidation resistance and reduce blade stress levels. This service bulletin was issued after the occurrence.

## 1.18. Additional Information

1.18.1. Not Applicable.

## 1.19. Use of Effective Investigation Techniques

1.19.1. Standard ICAO Annex 13 compliant investigation procedures and techniques were applied. These included factual data collection, maintenance record analysis, crew interviews, technical system analysis and P&WC consultation.

1.19.2. Investigation techniques applied in accordance with ICAO Annex 13 included: factual data collection from Pakistan Civil Aviation Authority (PCAA) / PAA IOU report; ATC communications transcript review; post-landing inspection data and metallurgical evaluation by P&WC.

1.19.3. The metallurgical evaluation of the engine blades provided a comprehensive technical foundation for cause determination.

# SECTION 2 – ANALYSIS

## 2.1. General

2.1.1. On 27th June 2019, it was reported that an Aerospatiale ATR72 aircraft, bearing Registration No AP-BKX, experienced an aborted take-off following an abnormal engine indication during the take-off roll. The flight crew observed that the No. 2 engine torque indication reached approximately 90 % when a loud bang was heard, followed by a rapid decrease in No. 2 engine torque to approximately 40 %. The take-off was subsequently rejected, and the aircraft was brought to a safe stop.

2.1.2. Following the occurrence, the No. 2 engine was removed from the aircraft for detailed examination and investigation. The engine was transported to Pratt & Whitney Canada (P&WC) for teardown and technical analysis to determine the cause of the power loss and associated abnormal indications.

2.1.3. The engine investigation was conducted at the Pratt & Whitney Canada Service Centre facility in Saint-Hubert, Quebec, Canada, from 13 April to 16 April 2021. The examination and teardown activities were witnessed by representatives of the Transportation Safety Board (TSB) of Canada, acting on behalf of the BASIP, in accordance with the provisions of ICAO Annex 13 concerning participation and cooperation in accident and incident investigations. Moreover, the analysis examines the technical mechanism which lead to failure of 2nd stage PT blades of No.2 engine during the incident.

## 2.2. Technical Analysis

### 2.2.1. Failure Mechanism

2.2.1.1. Failure mode analysis of the selected blades indicated that the cracks observed on the Leading Edge (L/E) of the 2nd stage PT Blades occurred by sulphidation Type I hot corrosion.

2.2.1.2. The 2nd stage PT Blade fracture initiated from cracks at the L/E and propagated by fatigue up to final rupture by overload.

### 2.2.2. Secondary Damage

2.2.2.1. The rubbing observed on the 1st stage & 2nd stage PT blades platforms, LP Impeller and PT Shaft were secondary due to the unbalance generated by the 2nd stage PT Blades fracture.

## 2.3. Oil Filter Pop-out Incidents

2.3.1. Prior to the incident, several oil filter pop-out indications resulted in patch checks being conducted in accordance with the Engine Maintenance Manual (EMM). Ferrous and carbonaceous debris were identified; however, the quantities remained within the limits

specified by the EMM and no maintenance action beyond continued monitoring was required. The investigation did not identify evidence establishing a direct relationship between these findings and the subsequent 2nd stage PT blade fracture

## 2.4. Industry Trends and Service Bulletin Significance

2.4.1. The failure mechanism identified in the occurrence was consistent with a previously recognized in-service trend affecting 2nd stage PT blades. To address sulphidation-related degradation, P&WC issued SB 21876 in 2015 introducing a chromium coating on a portion of the blade leading edge to improve corrosion resistance. However, continued reports of PT2 blade distress and engine removals involving post-SB 21876 blades indicated that the modification did not fully eliminate the susceptibility to sulphidation-induced cracking.

2.4.2. As a result, P&WC issued SB 21917 in 2017 to replace the PT2 blade configuration introduced by SB 21876 and issued SIL PW100-188 to advise operators of the continuing trend and provide guidance on monitoring and inspection activities. The occurrence engine remained fitted with PT2 blades modified in accordance with SB 21876, and the observed failure mechanism was consistent with the degradation trend that prompted the issuance of SB 21917.

2.4.3. The occurrence took place on 27 June 2019, prior to the issuance of SB 21959 in February 2021. Consequently, the later design improvements incorporating a modified blade airfoil and enhanced coating system were not available at the time of the occurrence.

2.4.4. The investigation concluded that while SB 21876 was intended to improve resistance to sulphidation hot corrosion, service experience demonstrated that the modification was not fully effective in preventing 2nd stage PT blade cracking. The occurrence is therefore consistent with the known 2nd stage PT blade degradation trend identified by the manufacturer and addressed through subsequent design changes and service information.

## 2.5. Flight Crew and Operational Analysis

2.5.1. Flight crew RTO actions were in compliance with the company policy.

# SECTION 3 – CONCLUSIONS

## 3.1. Findings

3.1.1. The following findings are presented in accordance with ICAO Annex 13 requirements and reflect facts and safety-relevant conditions established during the investigation.

### 3.1.2. Flight and Occurrence Facts

3.1.2.1. The aircraft was airworthy and maintained in accordance with the approved maintenance program.

3.1.2.2. The flight crew were appropriately licensed, qualified, and medically fit to conduct the flight.

3.1.2.3. The aircraft commenced the take-off roll from R/W 25L at JIAP, Karachi, on 27 June 2019.

3.1.2.4. During the take-off roll, a loud bang was heard and the No. 2 engine torque decreased from approximately 90% to 40%.

3.1.2.5. The flight crew rejected the take-off, shut down the No. 2 engine, and taxied the aircraft back to the parking stand without further incident.

### 3.1.3. Technical / Metallurgical Findings

3.1.3.1. Metallurgical examination determined that the fracture of the second-stage Power Turbine blades originated from cracks at the blade leading edge. The cracks were caused by Type I sulphidation hot corrosion and propagated by fatigue until final overload fracture occurred. The resulting loss of blade integrity led to engine malfunction.

## 3.2. Cause / Contributory Factors

### 3.2.1. Cause

3.2.1.1. The aborted take-off occurred as a result of a fracture of the second-stage power turbine blade(s) in the PW127M engine. The fracture originated from leading-edge cracks caused by Type I sulphidation hot corrosion, which propagated by fatigue and culminated in overload failure of the blade(s).

### 3.2.2. Contributory Factors

#### 3.2.2.1. Susceptibility of the Second Stage Power Turbine Blade Configuration

3.2.2.1.1. The blade configuration installed on the incident engine remained susceptible to sulphidation-related leading-edge degradation despite incorporation of SB 21876.

### 3.2.2.2. Known in-service trend

3.2.2.2.1. Prior to the incident, P&W Canada had identified a continuing trend of second-stage power turbine blade distress involving post-SB 21876 blades and had issued SB 21917 and SIL PW100-188 as further mitigation measures.

Note: *Aviation Occurrence Category (ADREP Taxonomy)*

***SCF-PP (System/Component Failure or Malfunction –Powerplant)***

*Failure or malfunction of an aircraft system or component related to the powerplant.*

# SECTION 4 – SAFETY RECOMMENDATIONS

## 4.1. Safety Recommendations

| 4.1.1. | |
|---|---|
| **Addressed To** | **OEM (Pratt & Whitney, Canada)** |
| **Recommendation** | OEM (Pratt & Whitney, Canada) should continue to enhance the corrosion resistance and durability of second-stage Power Turbine (PT2) blades installed on PW127 series engines through improved coating systems and blade design modifications to mitigate sulphidation-induced hot corrosion and associated fatigue cracking |
| **Safety Rationale** | The investigation determined that the fracture of the second-stage PT blades originated from leading-edge cracks caused by Type I sulphidation hot corrosion, which propagated by fatigue and resulted in overload failure of the blades. The occurrence demonstrated that the blade configuration incorporating SB 21876 and 21917 remained susceptible to sulphidation-related degradation. |
| **Safety Action Taken by OEM** | Prior to completion of this investigation, OEM had already issued SB 21959 introducing an improved blade design and enhanced coating system intended to improve sulphidation resistance and reduce blade stresses. These actions address the safety deficiency identified during the investigation |

## END OF REPORT

Bureau of Aircraft Safety Investigation Pakistan (BASIP)
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