

FINAL INVESTIGATION REPORT



INCIDENT

ENGINE NO. 2 INFLIGHT SHUTDOWN (IFSD)

QATAR AIRWAYS

FLT QTR-6J, B-777-3DZ(ER) AIRCRAFT, REG NO A7-BEA

DIVERSION TO JIAP, KARACHI

ON 14TH JUNE, 2022

SCOPE

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ABBREVIATIONS

AGB	Accessory Gearbox
AIAP	Allama Iqbal International Airport
BASIP	Bureau of Aircraft Safety Investigation Pakistan
CRM	Crew Resource Management
DFDR	Digital Flight Data Record
h	Hour(s)
ICAO	International Civil Aviation Organization
IOU	Incident And Occurrence Unserviceability Report
JIAP	Jinnah International Airport
PCAA	Pakistan Civil Aviation Authority
201PSI	Pound Square Inch
R/W	Runway
s	Second (s)
UTC	Universal Time Coordinated

INTRODUCTION

This Incident was reported to Bureau of Aircraft Safety Investigation Pakistan (BASIP) by Pakistan Civil Aviation Authority (PCAA) vide Incident Occurrence and Unserviceability Report (IOU). This Incident was notified in accordance with International Civil Aviation Organization (ICAO) Annex-13. The investigation has been conducted by BASIP.

SYNOPSIS

On 14th June 2022, Qatar Airways Flight QTR-6J, Boeing 777-3DZ(ER) bearing registration A7-BEA, was operating a scheduled passenger flight from Allama Iqbal International Airport (AIIAP), Lahore to Hamad International Airport (HIA), Doha with 197 persons on board. The aircraft was cruising at Flight Level 380 and following the route G214 PG G665 ASVIB within Karachi FIR, with ASVIB as the planned exit point. The aircraft checked ASVIB at 0614 UTC.

While still in Pakistani airspace, the flight crew observed a progressive drop in oil pressure on Engine No. 2, which dropped below 10 Pound Square Inch (PSI) and remained low for approximately two minutes. This was accompanied by a rapid decline in oil quantity, indicating a significant oil loss. In response, the crew conducted an in-flight shutdown of Engine No. 2 and declared a “MAYDAY” to initiate a precautionary diversion to Jinnah International Airport (JIAP), Karachi. The aircraft landed safely on a single engine without further incident.

A post-landing inspection identified significant oil leakage around the Accessory Gearbox (AGB) area of the engine No.2. Subsequent teardown and laboratory analyses revealed that the oil leak originated from the AGB oil nipple. Investigation determined that thread wear and loss of preload at the oil nipple assembly led to its partial push-out and subsequent oil pressure loss. The failure mechanism traced back to an irregular assembly condition, caused by non-conforming housing thread depth and excess weld rework on the nipple component. These combined factors prevented correct seating and torque preload during installation, ultimately leading to progressive wear, oil loss, and engine shutdown. All corresponding timing are mentioned in Universal Time Coordinated (UTC).

SECTION 1 - FACTUAL INFORMATION

1.1. History of the Flight

1.1.1. On 14th June 2022, Qatar Airways Flight QTR-6J, Boeing 777-3DZ(ER) aircraft bearing registration A7-BEA, was operating a scheduled passenger flight from AllAP, Lahore, to HIA, Doha. The aircraft was cruising at Flight Level 380 with 197 persons on board, following route G214 PG G665 ASVIB through Karachi FIR, with ASVIB as the exit point. The aircraft checked ASVIB at 0614. While in Pakistani airspace, the flight crew observed a progressive drop in oil pressure on Engine No. 2 which fell below 10 PSI and remained there for approximately two minutes. Simultaneously, a rapid drop in oil quantity indicated significant oil loss. In response, the crew performed an in-flight shutdown of the affected engine and declared a precautionary diversion to JIAP, Karachi. The flight subsequently landed safely on a single engine without further incident. List of events as followed:

0614: The aircraft checked reporting point ASVIB in Karachi FIR.

0617: Tehran ACC informed Karachi ACC that QTR-6J had declared “MAYDAY”, was descending to Flight Level 280, and was diverting to JIAP, Karachi.

0619: QTR-6J declared “MAYDAY” to Karachi ACC due to emergency (EICAS caution message about low engine oil), while still in Tehran airspace.

0620: QTR-6J re-entered Karachi FIR south of ASVIB and was given a shortened route to JIAP, Karachi by the Area Radar Controller, as requested by the pilot. Same was executed by Approach controller to facilitate a faster and safer landing.

0709: QTR-6J landed safely on Runway (R/W) 25L at JIAP, Karachi.

0716: Fire services confirmed there was no oil spillage or smoke.

1.2. Injuries to Person(s)

1.2.1. No injury was reported to any person on board the aircraft or on ground. Details of Cabin Crew and passengers are as follows: -

Injuries	Crew	Passengers	Total in the Aircraft	Others
Fatal	Nil	Nil	Nil	Nil
Serious	Nil	Nil	Nil	Nil
Minor	Nil	Nil	Nil	Nil
None	14	183	197	Nil
Total	14	183	197	Nil

Table 1 Details of Injuries to Persons On-Board

1.3. Damage to Aircraft

1.3.1. Post-flight inspection identified oil leakage in the area surrounding the Accessory Gearbox (AGB) of engine No. 2. No other damage to the aircraft was observed apart from the noted discrepancy.

1.4. Other Damage

1.4.1. No other damages were reported.

1.5. Personnel Information

1.5.1. Not Applicable.

1.6. Aircraft Information

1.6.1. The aircraft was being maintained in accordance with the approved maintenance schedule.

Boeing 777	
Operator	Qatar Airways
Call Sign	QTR-6J
Registration Number	A7-BEA
Sector	Lahore - Doha
Aircraft Make & Model	Boeing & 777-3DZ(ER)
Year of manufacturing	2013
Manufacturer Serial Number	41779
Engine No.2	
Manufacturer	General Electric
Model	GE90-115B
Serial number	906904
Engine Hours	54,217
Cycles since new	7,983
Accessory Gearbox	
Part number	2115M71G05
Serial number	FIA0B3J3

Table 2 Aircraft Information

1.7. Meteorological Information

1.7.1. Meteorological Aerodrome Report (METAR) JIAP, Karachi: OPKC 140700Z 24010KT 5000 FU BKN020 34/22 Q1003 NOSIG

METAR JIAP	
OPKC	Station ID: Jinnah International Airport, Karachi
140700Z	Day : 14 Time: 07:00 UTC
24010KT	Wind Direction: Wind from 240° (west-southwest) at 10 knots
5000	Visibility is 5000 meters
FU	Smoke
BKN020	Broken clouds at 2,000 feet above ground level
34/22	Temperature: 34°C; Dew point: 22°C
Q1003	Altimeter pressure: 1003 hPa
NOSIG	No significant weather changes expected in the near future

Table 3 METAR, JIAP, Karachi

1.8. Aids to Navigation

1.8.1. Navigational aids for JIAP, Karachi are provided below. At the time of incident, no abnormality was reported.

TYPE OF AID	ID	Frequency	Hours of operation	Site of transmitting antenna coordinates	Elevation of DME transmitting antenna	Remarks
1	2	3	4	5	6	7
ILS/LOC CAT I 25R	IKC	110.1 MHz	H24	245413.26N 0670835.74E	-	-
ILS/LOC CAT I 25L	IQA	109.7 MHz	H24	245359.09N 0670820.43E	-	-
NDB	KC	271.0 kHz	H24	245523.80N 0670936.29E	-	Coverage 50NM
DVOR/DME (1°E/2020)	KC	112.1 MHz CH58X	H24	245443.06N 0671053.91E	40.84M	Coverage 200 NM
OM	KO	235.0 kHz	H24	245547.51N 0671449.66E	-	3.9 NM FM THRRWY 25R (Locator Outermarker)
MM	-	75.0 MHz	H24	245454.06N 0671117.40E	-	0.58 NM FM THRRWY 25R
GP/TDME 25R	IKC	334.4 MHz	H24	245447.28N 0671029.42E	-	-
GP/TDME 25L	IQA	333.2 MHz CH34X	H24	245433.50N 0671017.88E	30.90M	3° RDH 55 FT

Table 4 Radio Navigation & Landing Aids JIAP, Karachi

1.9. Communications

1.9.1. Communication frequencies for JIAP, Karachi are provided below. At the time of incident, no abnormality was reported.

Service designation	Call sign	Frequency	Hours of operation	Remarks
1	2	3	4	5
APP	Karachi APP	121.300 MHZ	H24	Secondary
APP	Karachi APP	121.500 MHZ	H24	Emergency
APP	Karachi APP	125.500 MHZ	H24	Primary
ATIS	ATIS	126.700 MHZ	H24	-
BS	Radio Pakistan	830.000 KHZ	HX	0130-1900 HR
BS	Radio Pakistan	1450.000 KHZ	HX	Variable SKED
GCA	Karachi Ground	118.400 MHZ	H24	Secondary
GCA	Karachi Ground	121.600 MHZ	H24	Primary
GCA	Karachi Ground	121.800 MHZ	H24	Vehicle
GCA	Karachi Ground	123.000 MHZ	H24	-
TWR	KARACHI Tower	118.300 MHZ	H24	Primary
TWR	KARACHI Tower	118.800 MHZ	H24	Secondary
TWR	KARACHI Tower	121.500 MHZ	H24	Emergency

Table 5 Communication Facilities JIAP, Karachi

1.10. Aerodrome Information

1.10.1. Aerodrome data of JIAP, Karachi is provided below. At the time of incident, no abnormality was reported.

Designations RWY NR	True bearing	Dimensions of RWY (M)	Strength (PCN) and surface of RWY and SWY	THR coordinates	THR elevation and highest elevation of TDZ of precision APP RWY	Slope of RWY/SWY
1	2	3	4	5	6	7
07L	74.29°	3200 x 46	54/R/C/X/U Concrete ACFT upto A310 are permitted	245416.90N 0670851.02E	THR 23.50 M / 77.10 FT	0.200% UP
25R	254.29°	3200 x 46	54/R/C/X/U Concrete ACFT upto A310 are permitted	245444.69N 0671040.84E	THR 30.40 M / 99.74 FT	0.200% Down
07R	74.29°	3400 x 45	87/R/B/W/T Concrete SWY bitumen	245402.15N 0670833.56E	THR 21.62 M / 70.93 FT	0.168% UP
25L	254.29°	3400 x 45	87/R/B/W/T Concrete SWY bitumen	245431.79N 0671030.20E	THR 27.25 M / 89.40 FT	0.168% Down
SWY dimension (M)	CWY dimension (M)	Strip dimension (M)	RESA dimension (M)	Arresting system	Obstacle Free Zone	Remarks
8	9	10	11	12	13	14
100 x 46		3930 x 300	180 x 120	-	-	-
100 x 46	60	3930 x 300	75 x 120	-	-	-
305 x 45	105	4126 x 300	180 x 120	-	-	-
301 x 45	60	4126 x 300	150 x 150	-	-	-

Table 6 Aerodrome Information – R/W Physical Characteristics JIAP, Karachi

1.11. Flight Recorders

1.11.1. Not applicable.

1.12. Wreckage and Impact Information

1.12.1. Not Applicable.

1.13. Medical and Pathological Information.

1.13.1. Although the Incident initially appeared to be of a technical nature, a medical

examination of the flight crew was conducted to eliminate the possibility of human factors contributing to the event and to verify compliance with the applicable aviation medical standards. The subsequent air-crew report confirmed that all members were medically fit to operate the flight.

1.14. Fire

1.14.1. There was no fire reported in the Incident.

1.15. Survival Aspects

1.15.1. Not Applicable.

1.16. Test and Research

1.16.1. Following this Incident, the AGB module was shipped to GE Aviation Wales for detailed teardown and metallurgical assessment.

1.17. Organizational and Management Information

1.17.1. Not Applicable.

1.18. Additional Information

1.18.1. Not Applicable.

1.19. Use of Effective Investigation Techniques

1.19.1. Not Applicable.

SECTION 2 – ANALYSIS

2.1. General

2.1.1. On 14th June 2022, Qatar Airways Flight QTR-6J, a Boeing 777-3DZ(ER) with 197 persons on board, was operating a scheduled flight from AllAP, Lahore to HIA, Doha. While in Pakistani airspace, the flight crew observed a progressive drop in Engine No. 2 oil pressure to below 10 PSI and a simultaneous rapid drop in oil quantity indicating significant oil loss. The crew performed an in-flight shutdown of the engine and declared a precautionary diversion to JIAP, Karachi, where the aircraft subsequently landed safely on a single engine.

2.2. Flight Operations

2.2.1. The flight crew identified abnormal oil pressure indications and took timely action per Flight Crew Operating Manual (FCOM). The “MAYDAY” declaration and decision to divert to the nearest suitable aerodrome JIAP, Karachi were in full compliance with operational standards.

2.2.2. Air Traffic Control provided timely coordination between Tehran ACC and Karachi ACC, ensuring minimal delay and priority handling. The aircraft was vectored directly for a single-engine approach and landed safely without secondary complications.

2.3. Aircraft

2.3.1. The Boeing 777-3DZ(ER) is powered by the GE90-115B turbofan engine, known for its high thrust and advanced technology. This engine’s design incorporates an Accessory Gearbox (AGB) mounted beneath the high-pressure compressor section, which is essential for driving multiple critical engine and aircraft accessories such as fuel pumps, oil pumps, hydraulic pumps, generators, and sensors.

2.3.2. Accessory Gearbox (AGB): -

2.3.2.1. The AGB is a mechanically driven gearbox attached at the 6 o’clock position of the engine core, receiving rotational power from the engine through a system of gearboxes and drive shafts. It distributes this mechanical energy to power engine accessories and supports essential functions during engine start and normal operation. The AGB also houses critical components like the fuel adapter assembly on its aft face.

2.3.2.2. Following the Incident, the AGB module was shipped to GE Aviation Wales for detailed teardown and metallurgical assessment. Visual examination revealed that the **oil nipple hole was misaligned with the connected oil supply tube**, evidenced by clamp marks that did not correspond to the nipple’s orientation.

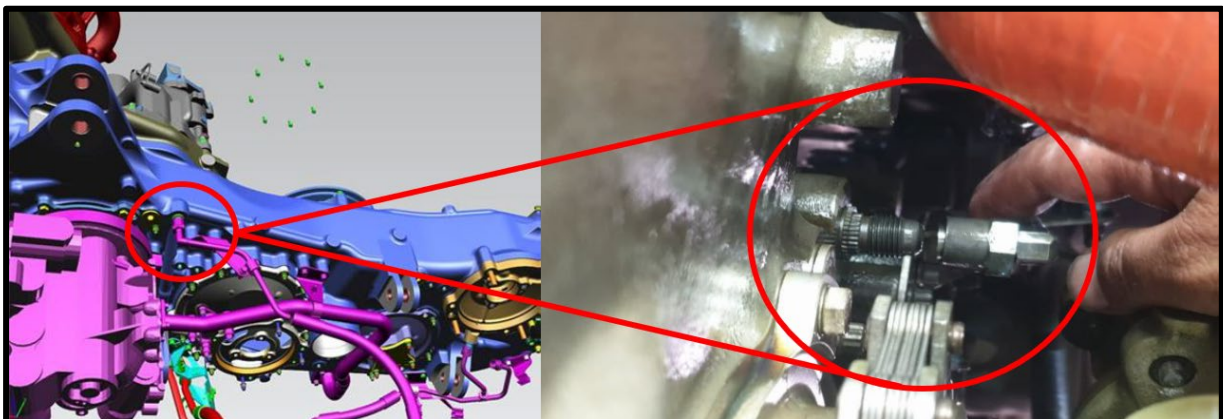


Figure 1 On-ground inspection found loose AGB oil Nipple

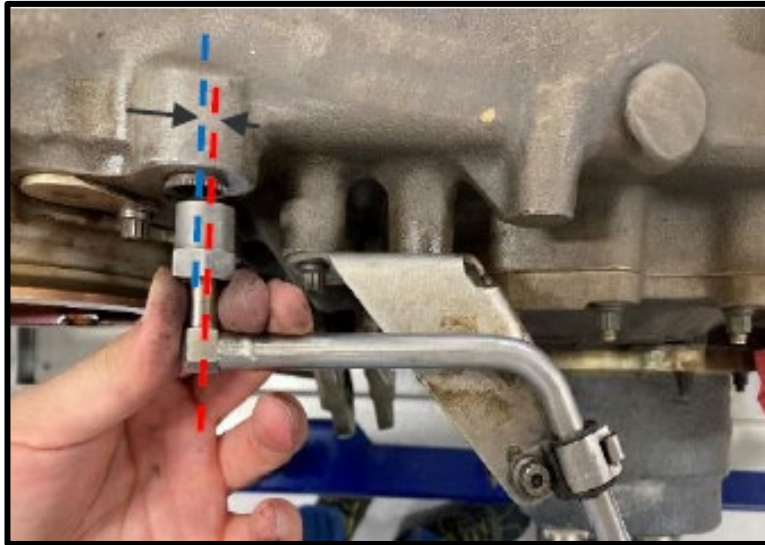


Figure 2 Oil Tube Misalignment 1/2

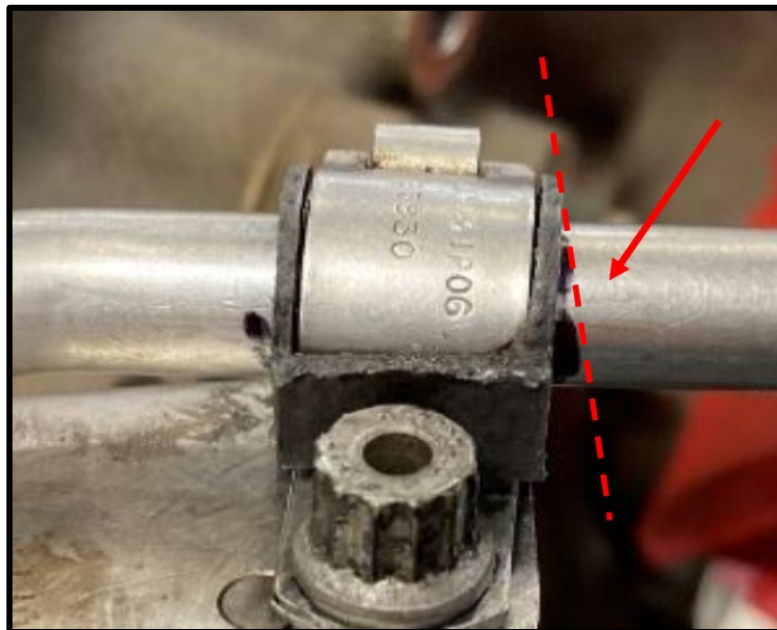


Figure 3 Oil Tube Misalignment 2/2

2.3.2.3. Severe thread damage was noted on both the nipple and the AGB housing, with axial wear visible through the full 360 degrees of thread contact.

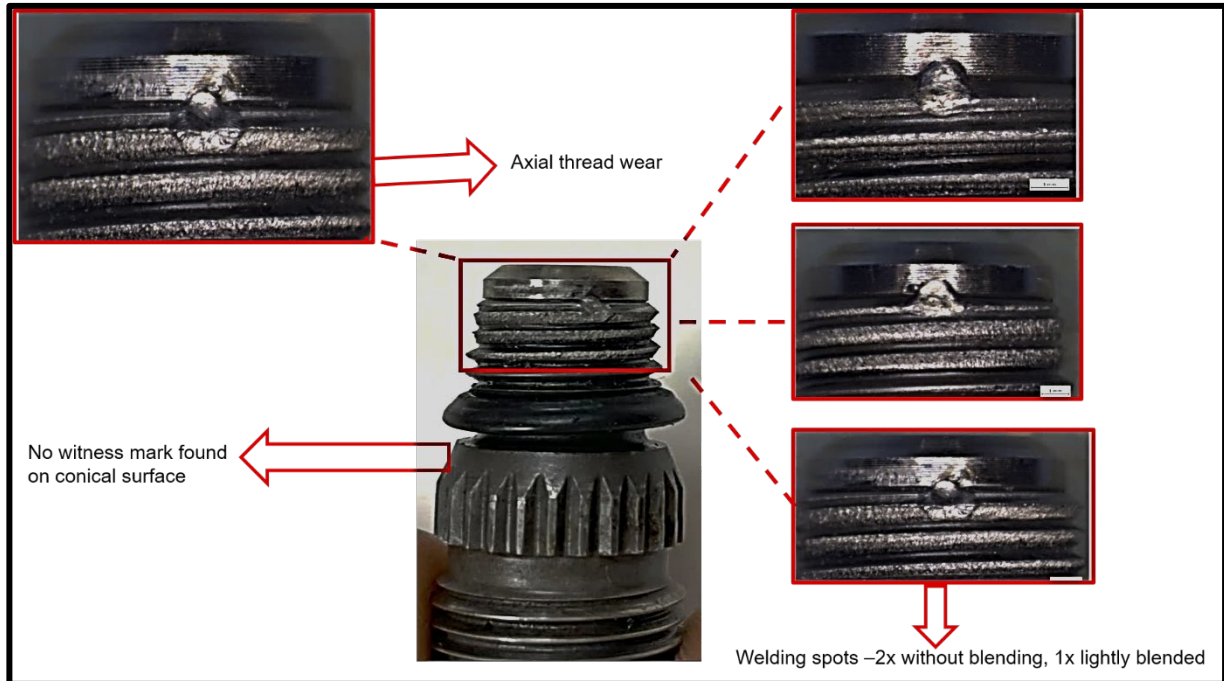


Figure 4 Axial thread wear and welding spots

2.3.2.4. Measurement of the AGB housing thread depth showed a non-conforming depth of approximately 13 millimetres, whereas the engineering drawing specified a minimum of 16 millimetres.

2.3.2.5. Furthermore, the oil nipple exhibited two unblended spot welds and one lightly blended weld, suggesting inconsistent rework during prior manufacture or overhaul. The conical seating surface on the nipple displayed no witness marks, confirming that the component had not properly contacted the seating surface to achieve the intended preload. Deformation of the O-ring was consistent with displacement and extrusion during operation.

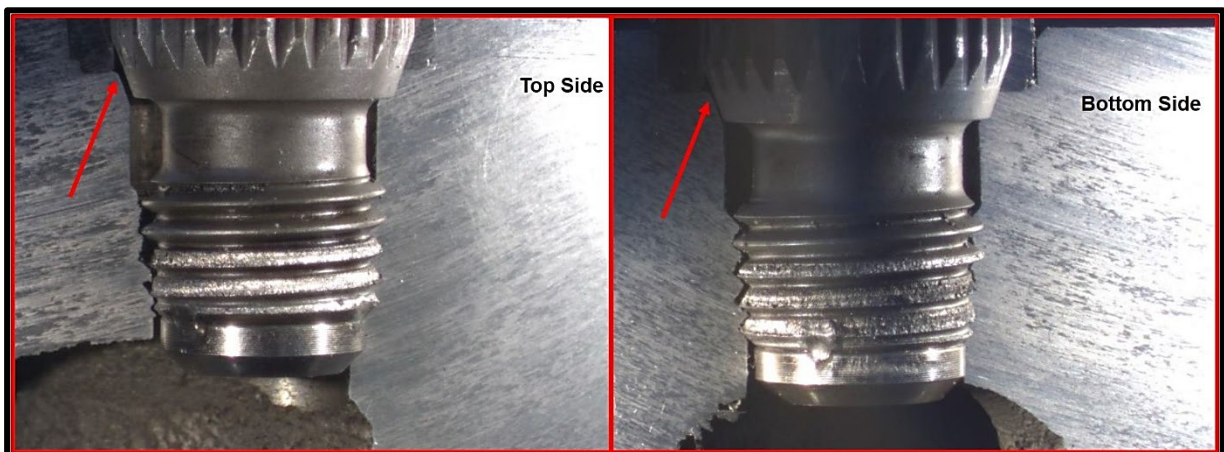


Figure 5 Arrows represents NO contact with Conical Shoulder

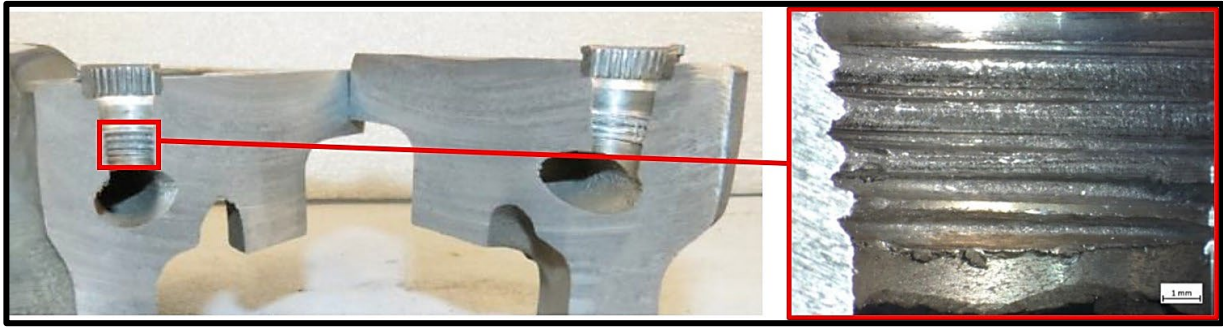


Figure 6 Axial wear on all threads

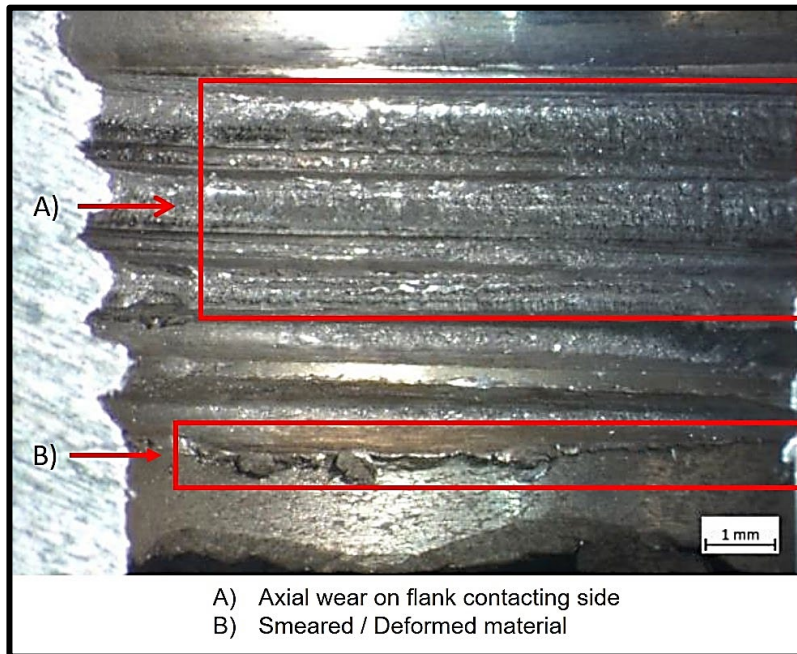


Figure 7 Axial wear on all threads and deformed material

2.3.2.6. Laboratory investigation confirmed axial thread wear throughout the circumference of the threaded area. Profilometric measurements quantified the loss of material consistent with fretting fatigue induced by cyclic vibration. Simulated assembly trials demonstrated that when a short-depth thread (13 mm) was combined with a weld-reworked nipple, full torque preload could not be achieved.

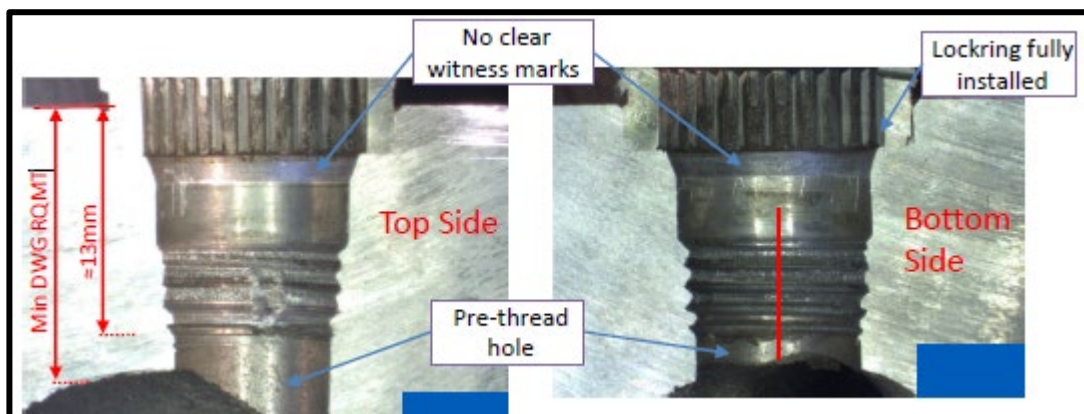


Figure 8 Non-conforming thread depth

2.3.2.7. Under these conditions, the **nipple seated on weld material rather than on the designed conical surface, leaving a small axial gap**. This lack of preload permitted micro-movement between the mating threads during engine operation, resulting in progressive thread wear and eventual axial displacement (“push-out”). Once the nipple moved sufficiently, the O-ring could no longer maintain sealing pressure, allowing oil to escape rapidly and causing a drop in system pressure.

2.3.2.8. The investigation determined that the in-flight shutdown resulted from loss of engine oil pressure caused by an AGB oil nipple push-out. **Detailed examination revealed that the oil nipple was irregularly assembled due to two underlying conditions: a non-conforming thread depth in the AGB housing and weld rework irregularities on the nipple component**. These factors collectively prevented correct preload during installation. In service, vibration and misalignment led to progressive axial wear of the threads, loss of retention, and eventual oil leakage.

2.3.2.9. Oil loss caused by AGB oil nipple push out due to thread wear, caused by irregular assembly of the oil nipple. The irregular assembly was caused by two factors, thread NC and Oil Nipple Design/weld rework. These two factors prevented the correct torque preload, leading to thread wear from thread loading not as per the design intent. Thread wear increased by tube misalignment.

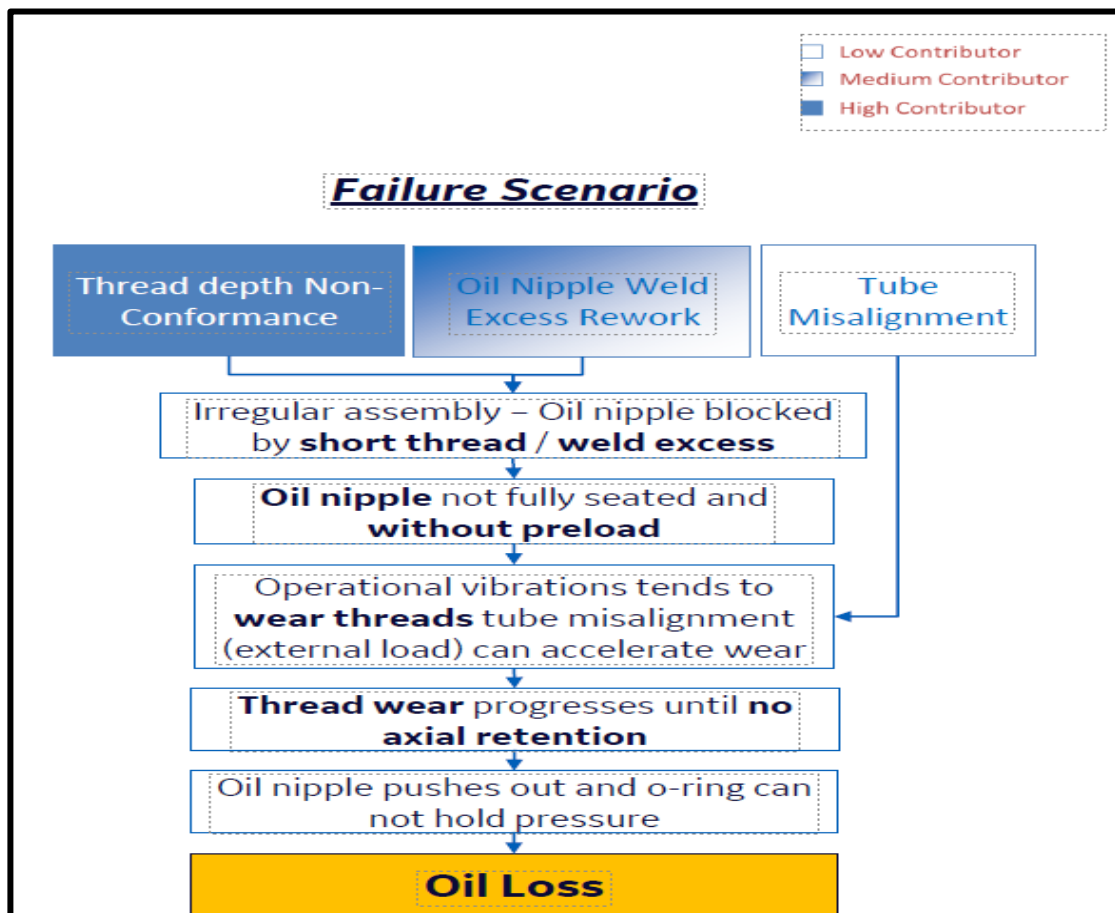


Figure 9 Failure Scenario

2.4. Human Factors

2.4.1. The crew’s recognition of abnormal engine indications, adherence to checklists, decision-making, communication with ATC, and execution of the diversion were appropriate and consistent with operator SOPs.

2.4.2. Human and organizational factors were, however, identified within manufacturing, overhaul, quality assurance, and engineering processes associated with the Accessory Gearbox (AGB) oil-nipple assembly whose failure precipitated the event.

2.4.3. Maintenance, Manufacturing and Overhaul Human Factors

2.4.3.1. **Process Control and Workmanship.** Evidence of a non-conforming AGB housing thread depth and excessive/unblended weld rework on the oil nipple indicates deficiencies in manufacturing/overhaul process control.

2.4.3.2. **Inspection and Verification Limitations.** Inspection processes relied on methods not capable of detecting absence of conical seating or preload.

2.4.3.3. **Engineering Documentation and Acceptance Criteria.** Existing engineering instructions and acceptance criteria did not ensure reliable detection of the combination of short thread depth and weld-induced obstruction.

2.4.3.4. **Assembly Practices.** Assembly personnel likely followed published torque and dimensional checks that were insufficient to detect irregular seating caused by weld rework or shallow threads.

2.4.4. Organizational and Supervisory Factors

2.4.4.1. **Oversight of Overhaul and Repair Processes.** Undefined / inconsistently applied acceptance criteria allowed variability in repair practices.

2.4.4.2. **Safety Information Dissemination and Corrective Action Timeliness.** Corrective measures relating to this failure mode had not yet been fully propagated.

2.4.4.3. **Flight Crew Human Factors.** The flight crew demonstrated appropriate situational awareness, decision-making, and adherence to emergency procedures.

SECTION 3 – CONCLUSIONS

3.1. Findings

- 3.1.1. On 14th June 2022, Qatar Airways Flight QTR-6J, a Boeing 777-3DZ(ER) with 197 persons on board, was operating a scheduled flight from AllAP, Lahore to HIA, Doha.
- 3.1.2. During flight oil pressure from Engine No. 2 began a progressive decline below 10 PSI oil quantity dropped rapidly.
- 3.1.3. Following the checklist procedures, the flight crew shut down Engine No. 2 and declared an emergency with a “MAYDAY” call, requesting immediate diversion to JIAP Karachi.
- 3.1.4. Tehran ACC and Karachi ACC provided well-coordinated routing and priority handling, facilitating the shortest track for an immediate landing at JIAP. The aircraft subsequently landed safely on Runway 25L at JIAP Karachi with no secondary damage.
- 3.1.5. On-ground inspection identified a **loose AGB oil nipple connection**. Visual examination indicated oil staining around the interface.
- 3.1.6. The **mechanical failure originated within the AGB oil nipple assembly**, which connects the oil system to the gearbox housing.
- 3.1.7. The AGB module was dispatched to GE Aviation Wales for comprehensive teardown and metallurgical evaluation. Visual inspection determined that the oil nipple bore was misaligned relative to the mating oil supply tube. Corresponding clamp witness marks indicated a **mismatch between the installed orientation of the nipple and the connected line**.
- 3.1.8. The **thread engagement depth was below design tolerance** (13 mm vs 16 mm), reducing the axial retention capability of the nipple.
- 3.1.9. The **weld rework irregularities on the nipple created uneven surfaces**, preventing the nipple from achieving full torque preload.
- 3.1.10. Lack of **proper preload caused axial movement, thread wear, and seal failure** during operation. This resultant oil loss led to pressure drop and in-flight engine shutdown.

3.2. Causes / Contributing Factors

- 3.2.1. **Cause**
- 3.2.2. Loss of engine oil pressure due to axial displacement (“push-out”) of the AGB oil nipple, resulting from progressive thread wear and inadequate axial retention.
- 3.2.3. **Contributing Factors**
- 3.2.4. Non-conforming thread depth in the AGB housing reducing axial engagement margin.
- 3.2.5. Excessive/unblended weld rework on the oil nipple preventing proper seating and torque preload.
- 3.2.6. Inspection methods (e.g., external height checks) incapable of detecting lack of preload or obstructed seating.
- 3.2.7. Assembly and inspection procedures not designed to detect this specific failure mode.

3.2.8. Misalignment of the oil supply tube increasing mechanical stresses and accelerating thread wear.

3.2.9. Organizational delays in field corrective action and insufficient oversight of repair/rework processes.

3.2.10. Lack of robust dimensional verification for critical threaded features during overhaul.

Note: Aviation Occurrence Category (System/component failure or malfunction (powerplant) SCF-PP

SECTION 4 – SAFETY RECOMMENDATIONS

4.1. Safety Recommendations

4.1.1. GE Aviation (OEM)

4.1.1.1. **Mandatory Inspection and Corrective Action.** Issue a Service Bulletin prescribing detailed inspection of GE90 AGB housings and oil-nipple assemblies for thread depth, weld condition, and axial wear, and mandating repair or replacement for any non-conforming units.

4.1.1.2. **Improved Assembly Verification Method.** Develop and promulgate an inspection/verification method capable of reliably confirming proper conical seating and **preload** (beyond external height checks) and require its use during all AGB assembly and acceptance inspections.

4.1.1.3. **Repair and Rework Limit Controls.** Define and enforce strict limitations and approved processes for weld rework on oil nipples, including revised engineering documentation and acceptance criteria for repaired components.

4.1.1.4. **On-Wing Screening Procedure.** Develop and provide operators with an on-wing quick-screening procedure to identify potentially non-conforming oil-nipple assemblies.

4.1.2. GCAA / Qatar Airways / Approved Maintenance Organizations

4.1.2.1. **Inspection Compliance.** Ensure compliance of OEM service Bulletins and all anomalies may be sorted with OEM.