Australian Government
Australian Transport Safety Bureau

# Engine malfunction involving Pilatus PC-12, VH-OWS

near Meekatharra Airport, Western Australia, 7 August 2017

**ATSB Transport Safety Report**
Aviation Occurrence Investigation
AO-2017-087
Final – 31 May 2018

Released in accordance with section 25 of the *Transport Safety Investigation Act 2003*

**Publishing information**

**Published by:** Australian Transport Safety Bureau
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**Addendum**

| Page | Change | Date |
|---|---|---|
| | | |
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# Engine malfunction involving Pilatus PC-12, VH-OWS

## What happened

At about 0219 Western Standard Time[1] on 7 August 2017, a Pilatus PC-12/47E aircraft, registered VH-OWS (OWS), taxied at Meekatharra Airport, Western Australia. The aircraft was operating as a Royal Flying Doctor Service (RFDS) air ambulance flight to Jandakot Airport, and had a pilot, two medical staff, and a patient on board.

At about 0227, OWS lined up and departed from runway 09. The night was clear with almost a full moon. At about 1,000 ft above ground level, when the pilot turned the aircraft to depart from overhead the airport, he noticed small beads forming on the outside of the windscreen. As there was no rain in the area, he shone a torch on the windscreen. The beads had formed into a steady stream of fluid moving up the windscreen, and noting its thickness, the pilot surmised that it was oil.

The pilot also knew that the aircraft's propeller shaft seal had been replaced during maintenance on the previous day. Before this flight, he had followed his normal routine of checking the engine oil quantity and found that it was indicating 'full'.

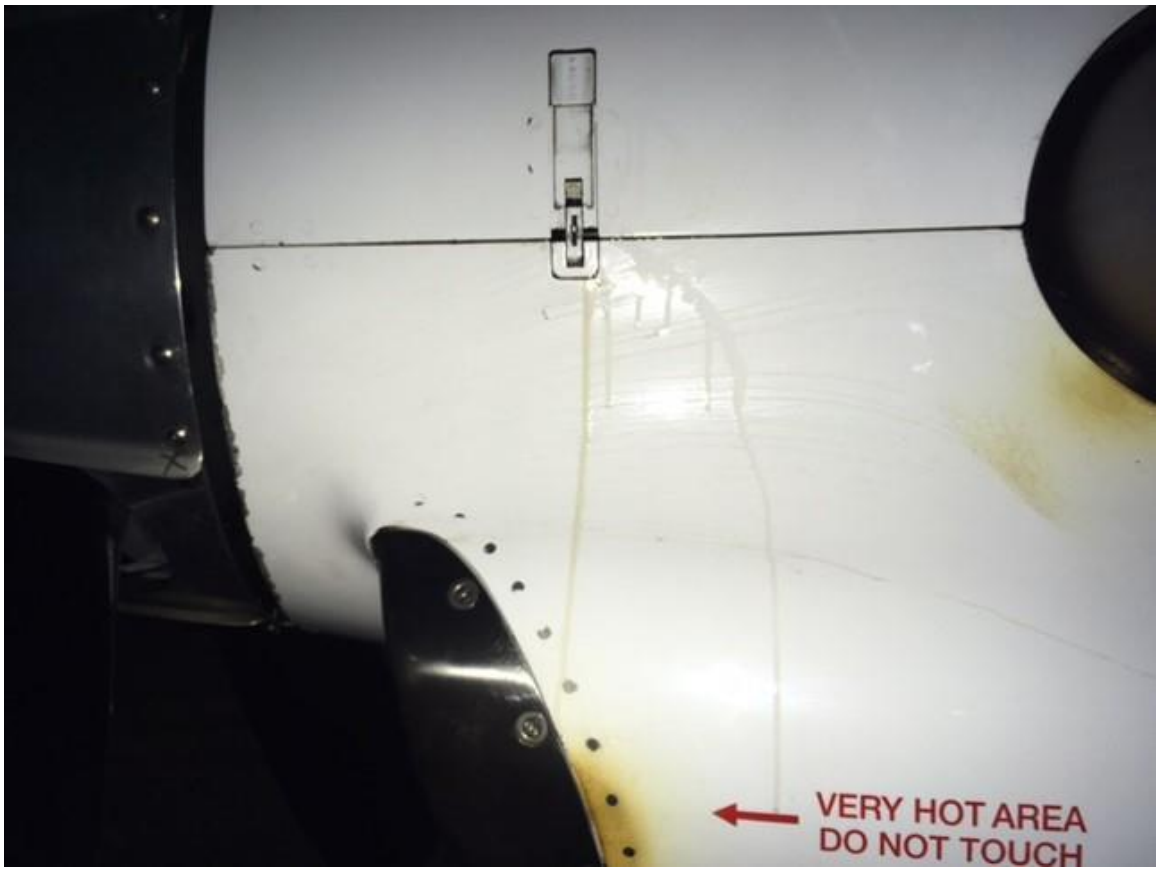
In assessing the situation, the pilot noted that all the engine parameters were in the normal range and he elected to return to Meekatharra Airport. He levelled the aircraft at an altitude of about 5,500 ft, and informed air traffic control of his intention to return for a landing on runway 09.

The pilot then conducted a wide descending circuit, slightly higher than normal to maintain glide capability in case the leak got worse and affected the engine's operation. The visibility through the windscreen had reduced and by the time OWS turned onto the base leg of the circuit, oil was streaming down the side windows. On the final leg of the circuit, the pilot saw the runway lights blurring 'like in heavy rain'. He conducted a normal landing, taxied to the parking bay, and shut down the engine. The aircraft was not damaged and no one was injured.

After landing, the pilot checked the aircraft and found oil on the engine cowling (Figure 1) and dripping/pooling on the tarmac. When the engine cowling was opened, a small amount of smoke could be seen coming from where oil had contacted hot engine parts.

[1] Western Standard Time (WST): Coordinated Universal Time (UTC) + 8 hours.

**Figure 1: Oil on the outside of the engine cowling**

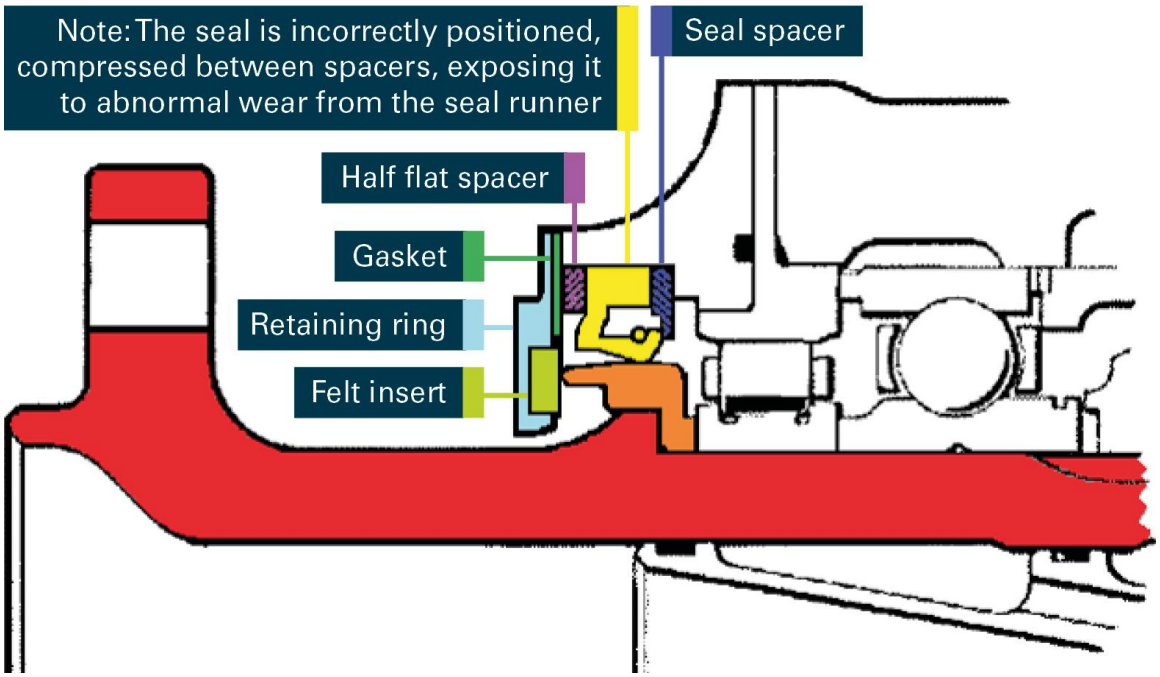



Source: RFDS

### *Propeller shaft seal replacement*

The aircraft operator (RFDS) investigated the incident and identified that the propeller shaft seal had been incorrectly assembled (Figure 2). The seal had been replaced at Jandakot on 6 August 2017 (the day before the incident) after which the aircraft had flown to Meekatharra, a flight of about 1 hour 40 minutes.

**Figure 2: Propeller shaft seal assembly at the time of the incident**



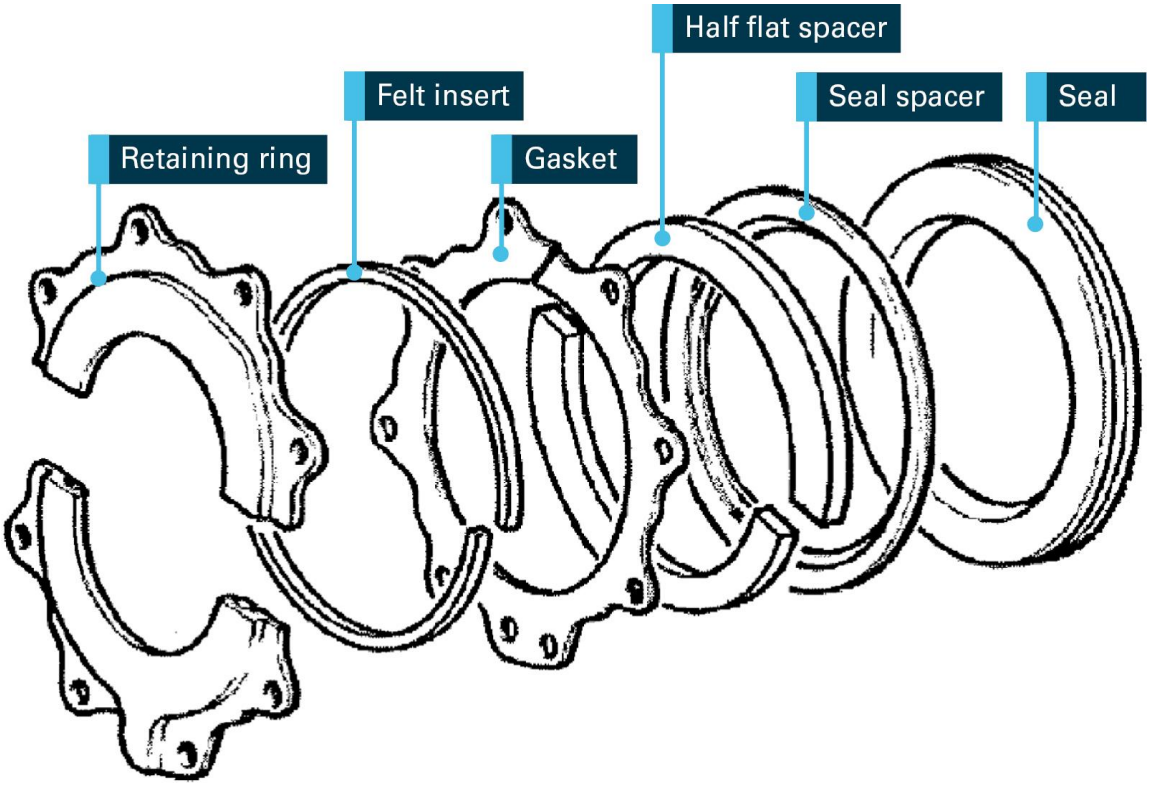

Source: Pratt & Whitney Canada, modified by the ATSB

The day before the occurrence, the on-call licensed aircraft maintenance engineer (engineer) at the Jandakot maintenance base was asked to check an engine oil leak on OWS. When he examined the engine, he found oil on the engine cowling and the forward part of the engine. Having removed the oil, he investigated further by running the engine three times without any further evidence of an oil leak.

The engineer then contacted the engineering manager to discuss the defect. Based on their experience and the signs of the oil leak, they decided that the engineer would replace the propeller's shaft seal.

When replacing the seal, the engineer assembled the parts in the order that he recalled from disassembly, and the diagram in the engine manufacturer's, Pratt & Whitney Canada (P&WC), illustrated parts catalogue (IPC). He recalled that the half flat spacer was located forward of the seal—the same as the IPC (Figure 3). After replacing the seal, he ran the engine and no oil leaks were evident.

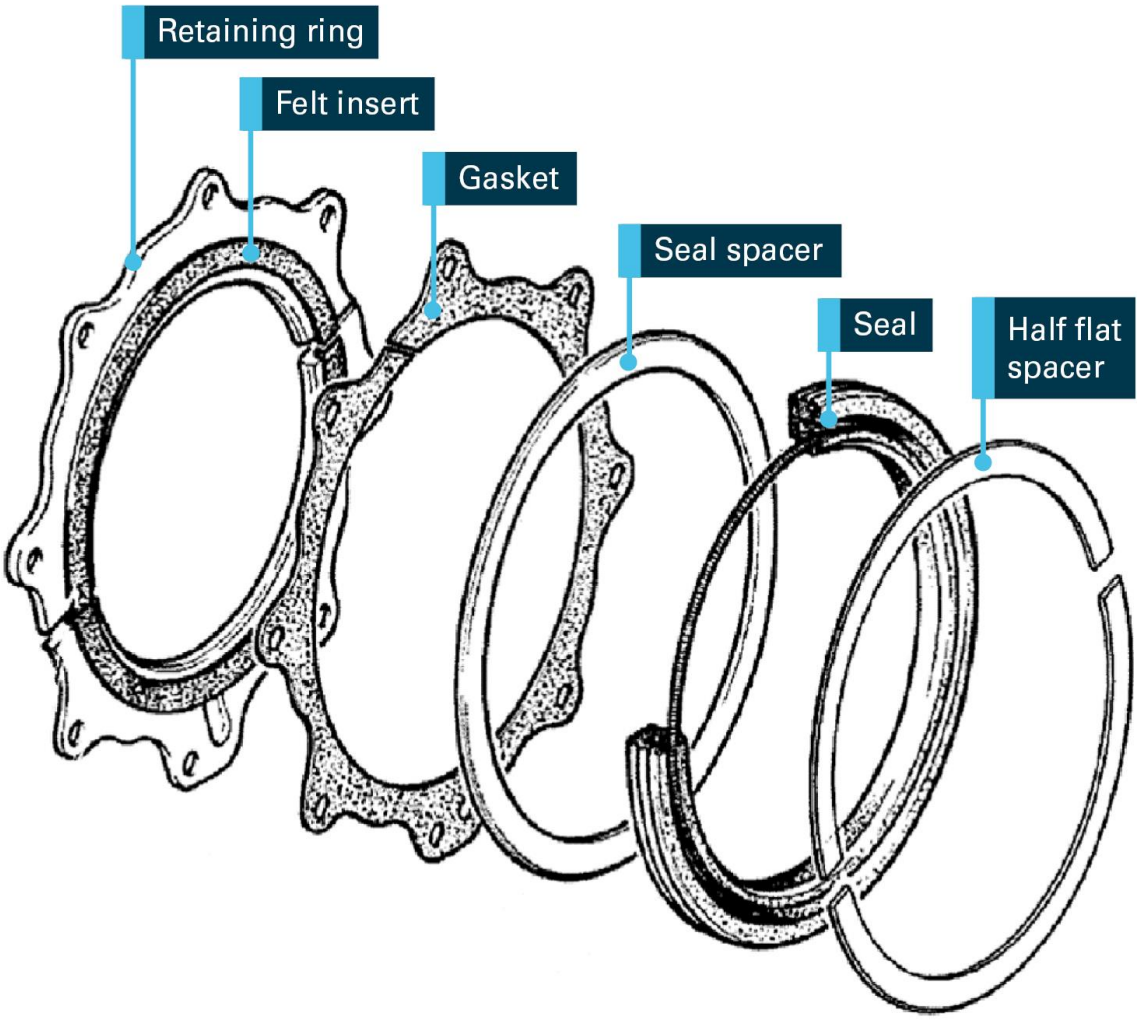
**Figure 3: Propeller shaft seal assembly parts diagram in the IPC**




Source: Pratt & Whitney Canada, annotated by the ATSB

The RFDS investigation found that the IPC was not intended to be used for seal replacement nor did it show the correct order of parts in the seal assembly. Only the P&WC engine maintenance manual (EMM) was intended to be used for maintenance, including propeller shaft seal replacement. The diagram in the EMM showed the half flat spacer correctly located aft of the seal (Figure 4). The EMM assembly procedure permitted the positions of the seal and the seal spacer shown in Figure 4 to be interchanged. In both configurations however, the half flat spacer was to be installed aft of the seal. The engineer had referred to the EMM but had not identified the discrepancy between the seal assembly diagrams in the IPC and the EMM.

**Figure 4: Propeller shaft seal assembly diagram in the EMM**




Source: Pratt & Whitney Canada, annotated by the ATSB

The RFDS investigation also identified that in the time leading up to the incident the engineer had worked extended work hours, and had had 4 days off in the previous 27 days. The engineer also indicated to RFDS that he had been feeling tired when replacing the seal as he had not slept well the previous night. He also indicated receiving a work-related phone call while replacing the seal which he believed was a distraction.

## Safety analysis

The oil leaked from the propeller shaft seal assembly because parts of the seal had not been assembled in the correct order. As the half flat spacer had been placed forward (instead of aft) of the seal, the seal was compressed and was pushed against the seal runner (Figure 2). In that configuration, the friction from the rotating seal runner resulted in abnormal wear of the seal allowing engine oil to leak.

When assembling the propeller shaft seal, the engineer had used the indicative diagram in the IPC instead of the diagram in the EMM, which showed the correct order of parts. He did refer to the EMM but did not notice that the assembly procedure and diagram in it were different to the diagram in the IPC. He also relied on his memory to recall the order in which the parts were removed, which may have been affected by fatigue associated with longer working hours and disrupted sleep.

## Findings

These findings should not be read as apportioning blame or liability to any particular organisation or individual.

- Shortly after VH-OWS took off from Meekatharra Airport the pilot saw oil leaking from the engine on to the windscreen. In response, he turned the aircraft back and safely landed at the airport.
- Engine oil leaked from the aircraft's propeller shaft seal as it had not been correctly assembled when replaced the previous day.
- When assembling the propeller shaft seal, the engineer used an indicative (but technically incorrect) diagram in the engine manufacturer's illustrated parts catalogue instead of the correct sequence detailed in the manufacturer's maintenance manual. He also relied on his memory of disassembling the seal, which may have been affected by fatigue associated with disrupted sleep and recent longer working hours.

## Safety action

Whether or not the ATSB identifies safety issues in the course of an investigation, relevant organisations may proactively initiate safety action in order to reduce their safety risk. The ATSB has been advised of the following proactive safety action in response to this occurrence.

### *Royal Flying Doctor Service*

The aircraft operator, RFDS, advised the ATSB that the following safety action had been taken:

- Maintenance engineers have been reminded that the use of memory, IPCs and engineering by comparison, are not suitable methods for conducting aircraft maintenance.
- The engineers have also been reminded to use the EMM and associated diagrams for the maintenance, including the propeller shaft seal assembly.
- Engineer's overtime is being monitored while a more permanent solution for workplace fatigue management is being considered.

### *Transport Canada*

Transport Canada, Canada's transport safety regulator, advised the ATSB of the following safety action, which it believes will mitigate future risk of this type of occurrence.

- Pratt & Whitney has initiated a manual revision for the IPC to add an illustration of the most current (post service bulletin) configuration of the seal assembly, and amend the EMM to add a caution in the reduction gearbox maintenance practices section.

## Safety message

Maintenance engineers should ensure that the appropriate technical documents are used for any maintenance task (Civil Aviation Safety Authority (CASA) maintenance poster *Check the data* also refers). In this occurrence, use of the inappropriate technical document resulted in the incorrect assembly of the propeller shaft seal, which then leaked.

The CASA publication *Safety Behaviours: Human Factors Resource Guide for Engineers*, notes that many maintenance engineers use personal sources of unapproved technical documents. A common problem faced by engineers is the requirement to follow procedures and time pressures to complete maintenance. A better understanding of these demands to complete the maintenance by operators and maintenance organisations could help them identify informal work practices and areas for improvement, including the use of appropriate technical documents.

# General details

## *Occurrence details*

| | | |
|---|---|---|
| Date and time: | 7 August 2017 – 0230 WST | |
| Occurrence category: | Incident | |
| Primary occurrence type: | Technical - Powerplant / propulsion - Engine failure or malfunction | |
| Location: | near Meekatharra Airport, Western Australian | |
| | Latitude: 26° 36.70' S | Longitude: 118° 32.87' E |

## *Aircraft details*

| | | |
|---|---|---|
| Manufacturer and model: | Pilatus Aircraft PC-12/47E | |
| Registration: | VH-OWS | |
| Operator: | Royal Flying Doctor Service of Australia (Western Operations) | |
| Serial number: | 1428 | |
| Type of operation: | Aerial Work – Emergency Medical Service | |
| Persons on board: | Crew – 2 | Passengers – 2 |
| Injuries: | Crew – 0 | Passengers – 0 |
| Aircraft damage: | Nil | |

# About the ATSB

The Australian Transport Safety Bureau (ATSB) is an independent Commonwealth Government statutory agency. The ATSB is governed by a Commission and is entirely separate from transport regulators, policy makers and service providers. The ATSB's function is to improve safety and public confidence in the aviation, marine and rail modes of transport through excellence in: independent investigation of transport accidents and other safety occurrences; safety data recording, analysis and research; and fostering safety awareness, knowledge and action.

The ATSB is responsible for investigating accidents and other transport safety matters involving civil aviation, marine and rail operations in Australia that fall within Commonwealth jurisdiction, as well as participating in overseas investigations involving Australian registered aircraft and ships. A primary concern is the safety of commercial transport, with particular regard to operations involving the travelling public.

The ATSB performs its functions in accordance with the provisions of the *Transport Safety Investigation Act 2003* and Regulations and, where applicable, relevant international agreements.

The object of a safety investigation is to identify and reduce safety-related risk. ATSB investigations determine and communicate the safety factors related to the transport safety matter being investigated.

It is not a function of the ATSB to apportion blame or determine liability. At the same time, an investigation report must include factual material of sufficient weight to support the analysis and findings. At all times the ATSB endeavours to balance the use of material that could imply adverse comment with the need to properly explain what happened, and why, in a fair and unbiased manner.

# About this report

Decisions regarding whether to conduct an investigation, and the scope of an investigation, are based on many factors, including the level of safety benefit likely to be obtained from an investigation. For this occurrence, a limited-scope, fact-gathering investigation was conducted in order to produce a short summary report, and allow for greater industry awareness of potential safety issues and possible safety actions.