SERIOUS INCIDENT

Aircraft Type and Registration:	1) ATR 72-212 A, G-OATR 2) ATR 72-212 A, G-ORAI
No & Type of Engines:	2 Pratt & Whitney Canada PW127M turboprop engines
Year of Manufacture:	1) 2019 (Serial no: 1580) 2) 2019 (Serial no: 1599)
Date & Time (UTC):	1) 29 June 2020 at 1320 hrs 2) 22 July 2020 at 1110 hrs
Location:	Guernsey Airport, Guernsey
Type of Flight:	Commercial Air Transport (Passenger)
Persons on Board:	1) Crew - 6 Passengers - 50 2) Crew - 4 Passengers - 42
Injuries:	1) Crew - None Passengers - None 2) Crew - None Passengers - None
Nature of Damage:	None
Commander's Licence:	1) Airline Transport Pilot's Licence 2) Airline Transport Pilot's Licence
Commander's Age:	1) 51 years 2) 61 years
Commander's Flying Experience:	1) 10,009 hours (of which 3,460 were on type) Last 90 days - 17 hours Last 28 days - 0 hours 2) 5,500 hours (of which 4,500 were on type) Last 90 days - 34 hours Last 28 days - 7 hours
Information Source:	Aircraft Accident Report Form submitted by the pilot and further enquiries by the AAIB

Synopsis

Two separate cabin smoke events were reported while starting the engines on different aircraft in the operator's fleet. The operator concluded that low utilisation of the aircraft and a high amount of airborne salinity resulted in corrosion forming on the P2.5/P3 engine air switching valve, sufficient to prevent it from fully closing. With the valve partially open, contaminated air from the engine was able to enter the cabin.

Safety action has been taken by the operator to help prevent corrosion forming on the valve and to amend the engine start procedure to reduce the risk of contaminated air entering the environmental control system.

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History of the flight

G-OATR

As a result of the coronavirus pandemic, the utilisation of the operator's fleet had reduced significantly. In line with the engine manufacturer's recommended practice for running the engines, the operator scheduled their aircraft to fly at least every 14 days. G-OATR had last flown 10 days prior to the event.

G-OATR was scheduled to fly from Guernsey Airport to Southampton Airport. The crew started both engines and the aircraft was pushed back from the stand. As the tug was being detached from the aircraft, the flight crew received a call from the Senior Cabin Crew Member (SCCM) who stated that there was a "faint haze or smoke" in the cabin. Shortly afterwards the SCCM reported that its intensity was increasing. There was no smoke or haze visible in the cockpit.

The commander turned off the cabin air recirculation fans when he was first alerted of smoke in the cabin and when he was informed that the intensity was increasing, he shut down both engines. The co-pilot reviewed the QRH for an applicable checklist, however, there was no procedure for 'smoke on ground'. The flight crew and the SCCM agreed to rapidly disembark the passengers through the rear cabin door and a PAN call was made to ATC informing them of this decision. Once all the passengers had disembarked, the crew departed via the cabin door and liaised with the AFRS who were on scene.

G-ORAI

Following the G-OATR event, the operator suspected that the low utilisation was affecting the performance of the Environmental Control System (ECS). In response, the operator decreased the maximum interval between flights from 14 to 7 days.

G-ORAI had last flown five days prior to the event. As in the previous event on G-OATR, the SCCM reported a slight haze or smoke in the cabin after both engines had been started and the aircraft had been pushed back. The commander informed ATC that there would be a rapid disembarkation of the passengers, which took place after the engines had been shut down and the propellers stopped rotating.

Aircraft information

The ATR 72-600[1] is a twin-engine, short-haul regional aircraft fitted with Pratt & Whitney Canada PW127M turboprop engines. Pressurised air from the engine compressor is used for sealing bearing cavities, assisting in engine oil scavenging, providing internal engine cooling and cabin pressurisation.

Footnote

[1] Marketing name for the ATR 72-212A with a specific equipment fit including PW127M engines.

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Air pressurisation system

During normal operation, pressurised air is taken from an intermediate stage of the compressor, known as P2.5 air. During engine start there is insufficient P2.5 air pressure available, therefore a spring-loaded air switching valve allows air from a different compressor stage (P3 air) to pressurise the system. Once the engine high-speed rotor speed (NH) reaches 40-45%, P2.5 air pressure is high enough to overcome the spring force and close the valve. If P3 air continues to be used above 45% NH (ie the valve remains open) then high oil consumption and temperature can result, as well as an oil smell in the cabin and smoke in the exhaust.

The P2.5/P3 air switching valve consists of a piston which slides inside a sleeve and reacts against the large spring (Figure 1). A piston ring seals the gap between the piston and the sleeve. When P2.5 air pressure is lower than the spring force, the valve opens allowing P3 air to flow into the rear inlet case. Once P2.5 air pressure overcomes the spring force, the valve closes, isolating P3 air and allowing P2.5 air to enter the rear inlet case. The air switching valve components are manufactured from various alloys of corrosion resistant steel.

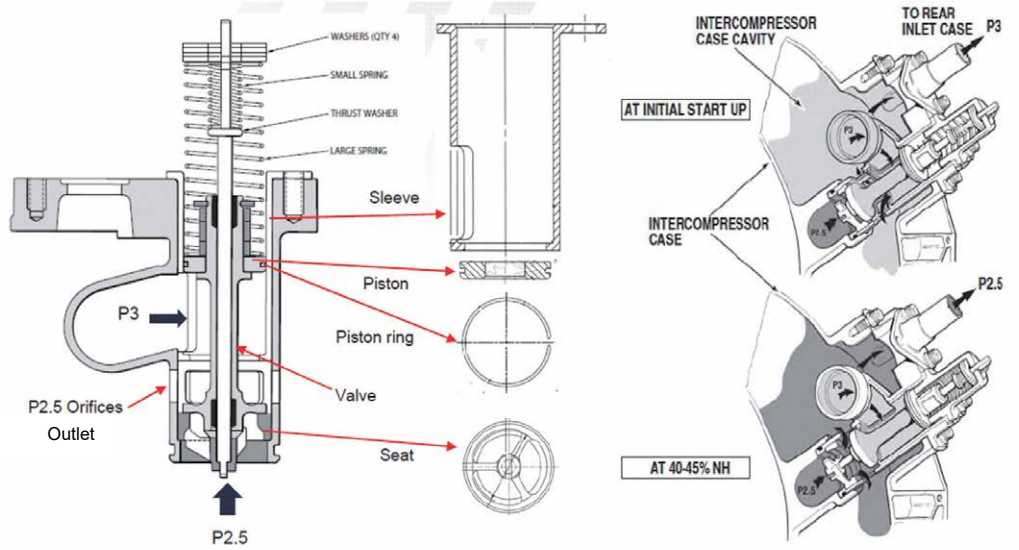

Figure 1

P2.5/P3 air switching valve
(Image used with permission of Pratt & Whitney Canada)

Aircraft examination

After each event the engines were run at 80% power with the bleed air system and ECS selected ON; smoke and haze were observed in the cabins on both occasions. The P2.5/P3 air switching valves on all four engines were examined and found to be either stiff to move or seized. The valves were disassembled, and corrosion was found on the pistons and sleeves (Figure 2).

The corroded components were replaced, and the valves operated normally during the subsequent ground runs with no oil smells or haze in the cabin.

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Figure 2

Corrosion found on piston and sleeve inner bore
(Images used with permission of the operator)

Operator's actions

Frequency of operating the engines

As G-ORAI had not flown for five days prior to its event and still experienced a problem, the operator further reduced the interval between flights to three days. If an aircraft did not fly within three days, then engine ground runs would be required to ensure the correct function of the air valves and the ECS. The operator also introduced a new inspection of the P2.5/P3 air switching valve every 42 days and a replacement of the piston ring every 100 days.

In addition, the engine manufacturer has amended the Engine Maintenance Manual (EMM) to include an inspection of the valve following any period of storage (irrespective of duration and environment) and to replace the valve during overhaul. They have also initiated a redesign of the P2.5/P3 air switching valve, which will consider the materials used in the valve assembly.

Engine start procedure

The procedure for a normal engine start requires the bleed air system and ECS to be selected ON. The engine manufacturer provided a "No Technical Objection" to a request from the operator for the engines to be started with the bleed air system and ECS selected OFF. This will allow time for the engines to come up to speed and stabilise before demanding air for the ECS. The operator has introduced this procedural change, which is applicable to all engine starts, either for flight or maintenance.

Conclusion

The operator determined that the smoke and haze in the cabin was due to the partial seizing of the P2.5/P3 air switching valves, which allowed oil vapour to enter the ECS. Corrosion was found in all the valves, which probably resulted from the reduced utilisation of the aircraft due to the corona virus pandemic, and the aircraft being parked and operated from an airfield close to the sea where there was a relatively high level of airborne salinity.

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Safety actions

Following the events on G-OATR and G-ORAI, the following safety actions were taken:

The operator:

- Introduced a requirement for engine ground runs to be carried out on aircraft that have not flown for three days to ensure the correct operation of the bleed air system and ECS.
- Introduced an inspection of the P2.5/P3 air switching valves every 42 days and replacement of the piston ring every 100 days.
- Issued a 'Notice to Crew' to require flight crews and maintenance personnel to start the engines with the bleed air system and ECS selected OFF.

The engine manufacturer:

- Updated the EMM to include an inspection of the P2.5/P3 air switching valves following a period of storage, irrespective of duration and environment.
- Issued a requirement to replace the P2.5/P3 air switching valves during engine overhaul.
- Initiated a redesign of the P2.5/P3 air switching valve, which will consider the materials used in the valve assembly.

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