

Turbine Gas Path Wash

When it comes to engine health, cleanliness is next to airworthiness. To prevent turbine engine corrosion and sulphidation, you should follow the manufacturer's washing recommendations.

'Corrosion' is the gradual destruction of materials (usually metals) by chemical reaction.

'Sulphidation' affects metallic components when they are exposed to compounds containing sulphur and sodium chloride within a hot environment – a regular occurrence during flight.

Every turbine engine has a maintenance manual that contains rinse or wash requirements to prevent sulphidation. These requirements must be followed, unless an operator has an alternate means of compliance stated in their approved maintenance programme.

Pratt & Whitney Canada (P&WC) publish recommended time periods between gas path washes based on geographical region. The entire New Zealand region is listed as a "salt-laden environment".

"To prevent damage, operators need to review the manufacturer's requirements and make sure their wash programme conforms," says CAA Air Transport Inspector (Airworthiness), Steve Shaw.

"Most manufacturers recommend the compressor (gas path) to be rinsed or washed after the last flight of the day to remove salt deposits when operating in a corrosive environment.

Vector is using the P&WC PT6A engine as an example here, because it is the most common small turbine engine in New Zealand fixed-wing aircraft, being used in everything from skydiving to air ambulance operations – CAA records show there are approximately 120 PT6A engines of various models in use in New Zealand.

However, the advice contained in this article can equally be applied to other turbine engine models, in both fixed-wing and rotary operations. As you'd expect, the manufacturer's instructions will differ from engine to engine, so it's important that you fully understand the maintenance requirements. For example, the Rolls-Royce M250 maintenance instructions specify both rinse and wash regimes.

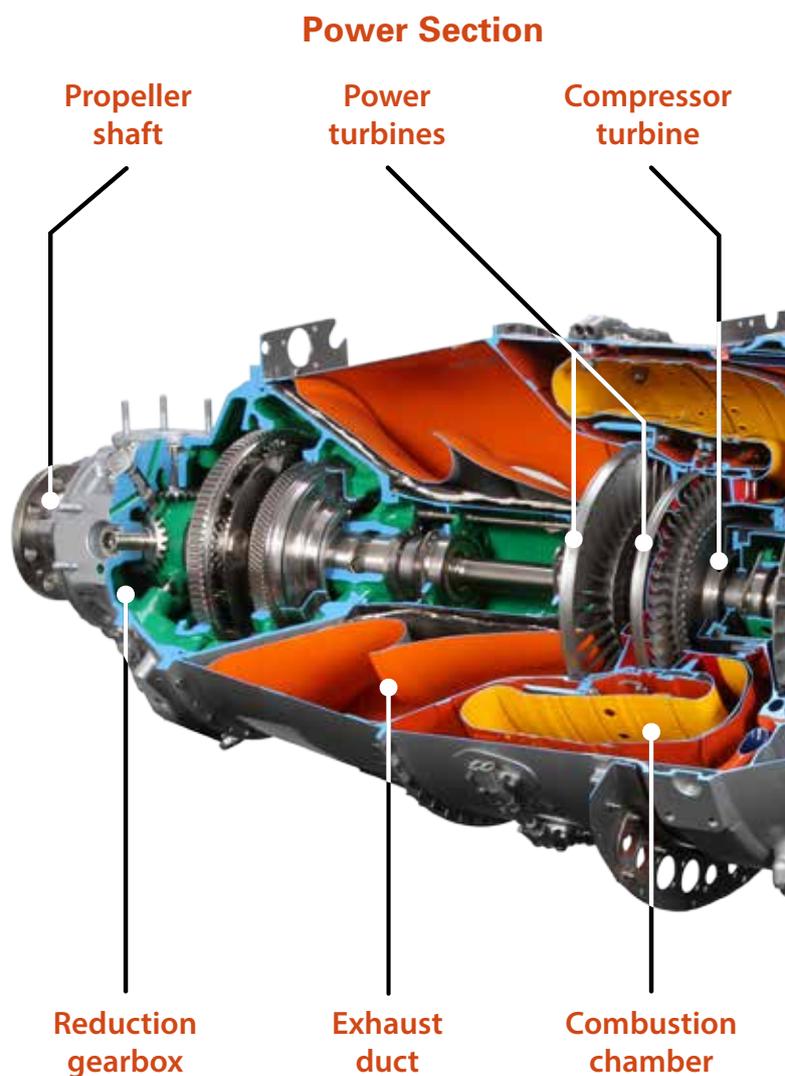
New Zealand's Pratt & Whitney representative, Stephan Heep, says some operators talk about 'compressor washing', but fail to realise that the compressor wash, and compressor turbine wash, are separate processes.

"Typically, you have two washing schedules. The external wash to remove corrosive elements from the engine's external surfaces, and the other in a broader sense, is the full gas path wash.

"I like to be a little bit cautious and use the terminology 'gas path wash', because then we know we're talking about washing the entire gas path, from inlet case through to the power turbine. Some operators get stuck on the fact they are doing a compressor wash, and neglect to wash the compressor turbine.

Washing Advice

Warren Hadfield, another CAA Air Transport Inspector (Airworthiness), is concerned about what a poor washing



Gas path of a PT6A: It's important that the compressor turbine in the very centre is washed.

Washing

technique and/or routine can result in. "There have been a number of engines damaged due to a lack of washing, or because the wash has been done incorrectly.

"Compressor washes should be done after the last flight of the day, followed by drying runs in accordance with the maintenance manual.

"There is a concern that some of those that are washing, are only washing the compressor part of the engine (the easy part), without washing the compressor turbine.

"All that does is move the salt into the interior part of the engine.

"We really want to stress the importance of following the manufacturer's recommendations, particularly regarding the compressor turbine and vane ring."

P&WC's Stephan Heep says the average PT6A engine ingests

more than 8,000 cubic feet of air in one minute. "In flying through a salt-laden environment, you get a build-up of salt deposits on the compressor rotating components, and corrosive elements, throughout the gas path."

"If you just rinse water on the compressor side, all you're doing is washing those salt deposits off the compressor and onto the compressor hot section – exactly where you don't want them!

"How often you wash the engine is something you're going to need to evaluate, based on the frequency recommendations in the maintenance manual, knowledge of your routes, and close monitoring of engine condition," says Stephan.

Blenheim-based Craig Anderson, Chief Pilot of Sounds Air, says the airline operates engines on an extended time before overhaul (TBO). They've run several engines right out to their limits, but haven't had any issues with corrosion.

Craig previously held the role of Chief Engineer at Sounds Aero Maintenance.

"Our PC-12s (Pilatus) are operating up in the higher altitudes, a lot of the time to Taupo. Even though that region is still classed as a highly corrosive area, it's completely different to the coastal environment at lower altitudes, where we operate the Caravans (Cessna). However, we still choose to wash the PC-12s on the same schedule as the Caravans.

"Our engines are washed daily, and our pilots are put through a maintenance training procedure as part of their initial type rating. The pilots certify their own maintenance, under company authorisation.

"When an engine comes in for a borescope inspection, we can see if it's been washed regularly."

The borescope is an optical tool, used for remote visual inspection. It consists of a tube, usually long and often flexible, a lens on one end and an eyepiece on the other.

A borescope inspection is required every 400 hours. However, Sounds Aero's C208 maintenance programme requires inspection every 300 hours – a prudent move given their operating environment.

"You can see the salt deposits building up on the compressor blades, even in the very early stages," says Craig.

Water Usage

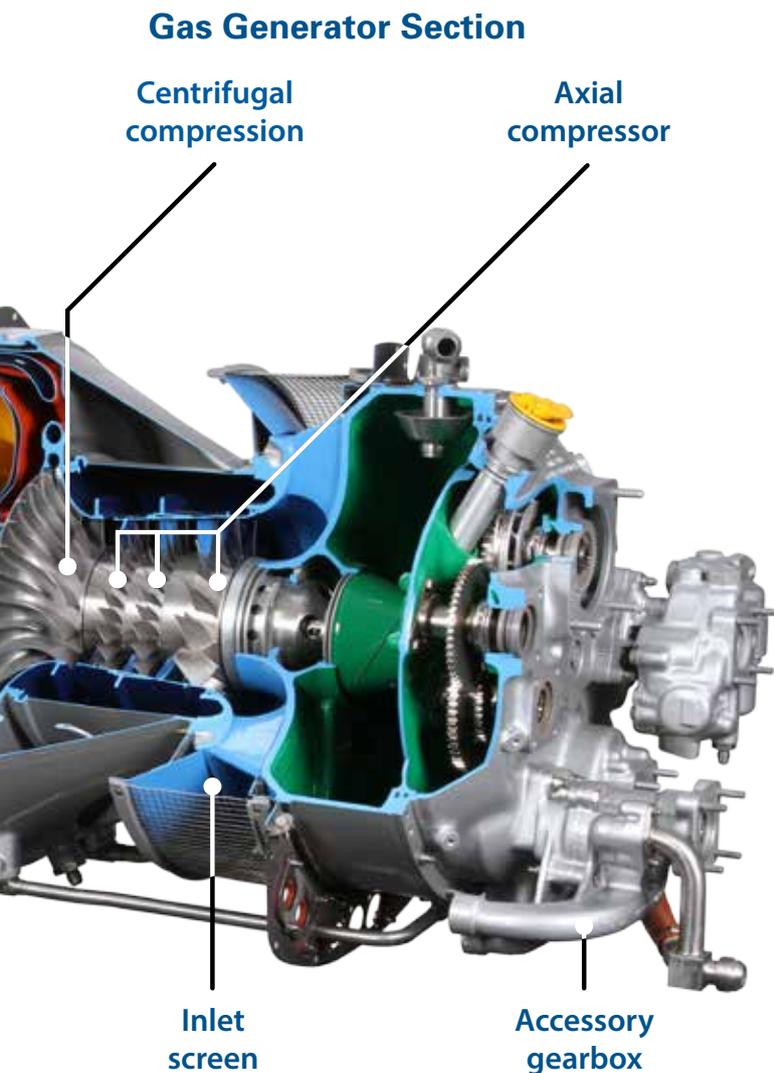
P&WC's Stephan Heep says the amount of water in the wash is also critical.

"Once again, when problems occur, it's normally a case of the operator not thoroughly reading the maintenance manual.

"I've seen examples of both ends of the stick, where they've used too much, or not enough, water. If you're on the 'too little' end, you may as well forget it; the wash isn't going to help.

"One customer I was working with had significant corrosion on their engine, and he swore up and down they were washing regularly.

Continued over >>



» Continued from previous page

"It turned out that he was using a five-litre garden sprayer bottle that probably put two litres of water through his engine in the 30-second motoring cycle. If you look in the maintenance manual, you need a flow rate of 7.6 to 11.3 litres per minute to effectively rinse the corrosion, including elements, from the gas path surfaces.

"Conversely, we've had operators who overdo it, and end up with contamination in the fuel control unit (FCU) because they've put copious amounts of water through without adequately isolating the P3 unit air to the FCU. That's why it's so important for the customer to review the maintenance manual, ascertain their wash rate, determine how to produce that amount of water, check the recommended amount of water is actually going through the engine, and most importantly, isolate the P3 line to the FCU," says Stephan.

Drying

Stephan Heep continues, "In the drying run, your aim is to get rid of any moisture sitting in joins and cavities to avoid corrosion.

"We see some operators following the washing process very well, but never doing the drying run, or taking a long time between the wash and drying run.

Craig Anderson from Sounds Air describes such an experience.

"I did some work with a Caravan operator in Dubai who had a lot of corrosion issues. It turns out they were washing the plane at night and then giving it a drying run in the morning. You don't want that salty water, that's mixed with sand, sitting in the engine overnight."

The Devil's in the Detail

"It's just as important to record what you're doing, as actually doing it. They go hand in hand," says Craig.

"Sounds Aero has an approved maintenance form for release-to-service that pilots can use to record their washing activities.

"At one stage, our pilots were doing the washes, but weren't recording them. If we have any issues downtrack, we need the ability to go back and identify why we're seeing what we're seeing.

"We used to record the wash on the flight or maintenance log, but that's very time-consuming and tedious for a job that's required daily.

"We've got an approved form now (the wash is a maintenance requirement so it needs to be released to service), so all the pilot has to do is write the registration, record their name and approval number, then sign it. That makes the paperwork very quick and easy." ■



Sounds Air pilot, Steve Love, performing a gas path wash. Make sure you follow the engine manufacturer's rinse or wash recommendations.

Photo courtesy of Sounds Air