Tech topic

Jet engine oil consumption

Understanding why rates vary and how to optimize consumption

Key insight

Mist volume is more than

10x

greater with labyrinth seals than carbon seals, creating a higher air velocity in the deoiler.

Introduction

Engine designers strive for balance in oil consumption rates. Too much consumption is costly to operators and usually requires larger oil tanks, which add unwanted weight. Too little consumption can adversely affect oil condition, system cleanliness and engine longevity. Two key factors of oil consumption are deoilers and seals, and their effect on oil degradation.

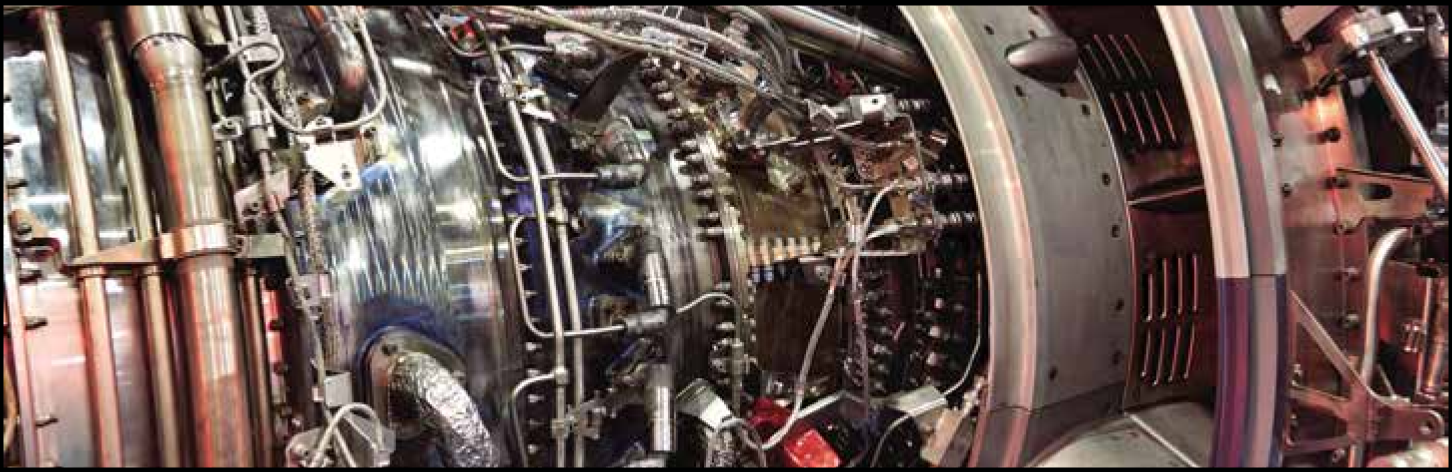
Oil performance and stability

To provide enhanced stability and effectiveness, oil companies blend additives into an oil's base. Additives protect the lubricant, but when they are sacrificed and consumed, the fresh additives contained in makeup oil counter this reduction. Fresh oil replaces the degraded oil lost overboard due to the inefficiency of the deoiler.

Oil consumed in commercial jet engine aircraft is typically replenished by topping off with fresh oil. When oil consumption is high, this "renewal" helps counter any buildup in acidity. When oil consumption is low, the effect is to reduce the oil replenishment rate, resulting in acidity increases over time.

In modern, high-efficiency engines, oil consumption is likely to be lower and oil system temperatures higher than in more mature engines. These factors adversely affect oil condition. In engines where the operating cycle is short and the volume/consumption rate is long — in the order of 400 hours — operators may want to consider periodic oil-health monitoring checks.

Jet engine oil consumption



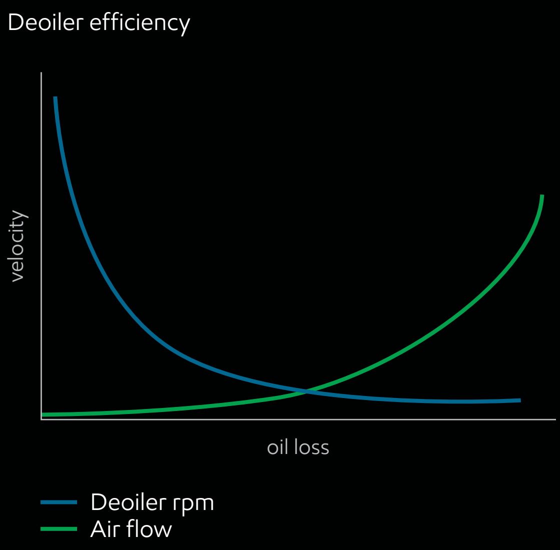
Importance of deoiler and seal efficiency

Some engines suffer from excessive consumption when there is no abnormal leakage while others have low consumption. Often, this is due to the efficiency of the deoiler (air/oil separator) and oil system seals. Rotating deoilers can be either in main bearing chambers or engine gearboxes.

In bearing chambers, air enters sumps through carbon or labyrinth seals and then mixes with lubricating oil supplied to the bearings. This creates a moving oil mist or vent air, which is cycloned in the deoiler. The deoiler recovers oil and directs air overboard. Mist volume is more than 10 times greater with labyrinth seals than carbon seals, creating a higher air velocity in the deoiler.

Gearbox installations allow for high deoiler rotational rates. As deoiler speed increases, oil loss decreases. Deoiler speeds on the main engine shafts are set by the engine operating cycle and can be very low, particularly on high-bypass turbofan low-pressure spools. This makes recovering very small droplets much more difficult.

Engines with carbon seals for oil sumps and deoilers installed in gearboxes usually have lower consumption than those using labyrinth seals and deoilers in main engine oil sumps. Labyrinth-seal clearances naturally increase as an engine ages. As this occurs — due to rubbing under vibration, gyroscopic torque, rough landings or any G-load factor — the engine airflow increases, resulting in even higher oil consumption. If seals are assembled and installed properly, and not abnormally worn or damaged, the high oil consumption is essentially due to inefficient deoilers installed on the engine air breathing system.



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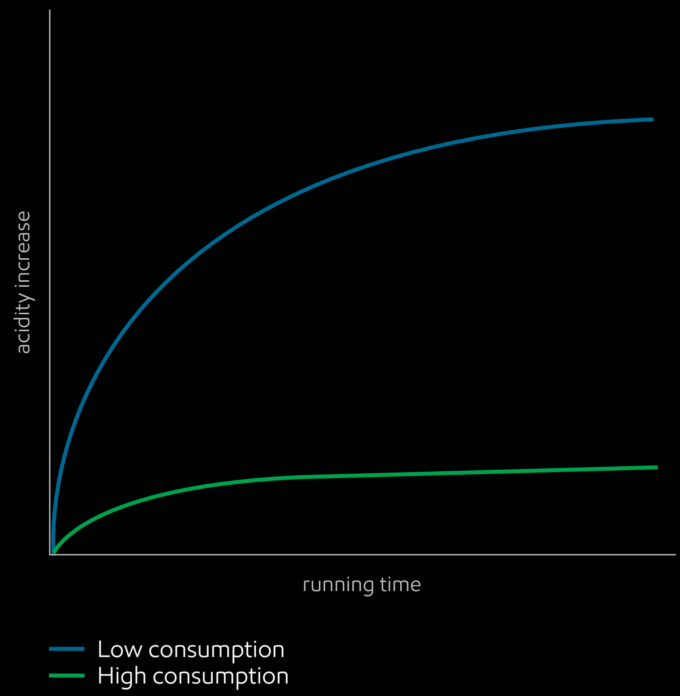
Oil degradation

Oil systems for commercial jet engines are rarely drained, but instead topped off with fresh oil (typically every day). Because of oxidative and thermal breakdown, engine system oil degrades. This manifests itself as increased viscosity, higher total acidity and limited oil performance. Oil degradation is a function of engine severity, which is determined by:

- Oil residence time in various regions of the engine during oil circulation
- Time in service
- Operating pressures
- Temperature

Oil system temperatures vary among engines and flight plans — including taxiing, take-off, landing and cruising. Low-time/high-cycle operations increase engine severity due to heat soak-back effects after shutdown.

Effect of oil consumption on level of deterioration



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