

The short-haul passenger market recovery is driving the demand for CFM56 and V2500 engines. The resulting increase in engine shop visits means there is a healthy demand for parts and engine leases. How engine lessors are addressing challenges and bridging market gaps is examined.

# Narrowbody engine market activity

**B**y the end of 2022 there were about 15,000 narrowbody aircraft in passenger service. Most are 737 and A320 family types. The next generation (NG) 737 MAX and A320neo fitted with CFM LEAP and Pratt & Whitney GTF engines make up a smaller number of the narrowbody fleet. While 737 Classic (CL), and New Generation (NG) types, that are equipped with CFM56-3C/-7B engines; the A320ceo family of aircraft have CFM56-5B and V2500 engines.

During 2019 the number of engine shop visits (SVs) for CFM56-3C/-5B/-7B and V2500-A5 engines totalled 3,904. The number of SVs are forecast to rise to 3,292 in 2023, and 84% of 2019 levels.

A result of the increasing number of SVs is higher demand for replacement engine parts and used serviceable material (USM) upwards. The high number of engine SV deferrals during the pandemic translates to the current low availability of slots and long lead times.

Rebounding passenger traffic means that both CFM56 and V2500 engines are now highly sought after. The demand for these engines is increasing further because of production delays for new aircraft, and a reported shortage of replacement parts for LEAP and GTF engines. The combination of these issues is generating a requirement for flexible engine-leasing solutions.

The ability for narrowbody engine lessors to address the various delays that are compounding the reduction in supply is examined here.

## AJW

AJW has been trading for 91 years. The company primarily focuses on aircraft engine spares and services. AJW at any one point has more than 1,000 aircraft under its contractual services and ad hoc sales. An early focus for the

company was to buy tired and unserviceable engines, including the CFM56-3 and RB211-535 and PW2000 which now qualify as legacy engines. Many engines were bought for teardown on a consignment basis at this time.

“This service grew into acquiring newer assets, and assets acquired by AJW’s capital instead of on a consignment basis. The leasing arm developed as a result and had more than 30 engines in its fleet at its highest point. We class ourselves as a narrowbody engine lessor, with a focus on CFM56-5B/-7Bs and V2500s. But having said that, our portfolio always has CF6 family engines that power the 767 and 747 types, plus PW4000s, and RB211-524/-535 family of engines. There was a point in time where we offered PW2000s to United Airlines,” explains Wasim Akhtar director of engines at AJW.

AJW tears down its narrowbody engines after lease expiry. However, its widebody assets are remarketed to vendors that deal in that market space. AJW does not perform engine teardowns in-house, and contracts this to specialist teardown companies around the world.

Teardown and part overhaul times and costs have increased significantly post-Covid. There are instances of engine teardown costs more than doubling in price since the start of the pandemic. “In addition to the turnaround time, issues are difficulty in getting slots and the lack of materials. The higher costs are a big factor when considering buying a teardown engine.”

According to Akhtar, the high costs are driven partly by wages and financing because the skill set and tools needed to disassemble and ‘de-flange’ an engine have not changed. There is no certification cost requirement to tear down aircraft engines. Engine disassembly times have increased from 60 days to 90 since the start of the

pandemic. There are many reasons for the delays, which can vary or be unique to individual teardown facilities. One such example is a lack of building material used to construct the wooden crates that ship parts to customers and repair shops.

High-demand tier-one items, such as fan blades, are sent immediately to a repair facility once the engine is dismantled. Slower-selling material is put in storage as removed (AR) and will be sent to the repair facility after a customer order has been received for the part. It can be uneconomic to invest in repairs for parts that are not going to be sold for a long time. If an item remains on the shelf for 18-36 months, it will then be classed as tier-three level material.

Because the rate of repairs was much lower than it should have been during the pandemic, there is now a shortage of material. Companies did not want to invest in material that would spend a lot of time sitting on the shelf.

“There needs to be strategic depth and understanding of the market to know when SVs are happening and which parts are sought after,” adds Akhtar. “When you tear down an asset, whether an engine or airframe, you typically know which parts sell straight away. These items are sent to the repair station and shipped directly to the customer.”

Tier-one parts include life limited parts (LLPs), low pressure turbine (LPT) and high pressure turbine (HPT) blades, and other ‘hot section’ and high value items. Some original equipment manufacturer (OEM) repair stations do not want to take delivery of repair items such as fan blades before June 2023. By then, turnaround times of four months will apply, meaning parts will be ready in October 2023. Turnaround times average four to six months.

Rather than completing a performance restoration requiring a \$4-5



investment, AJW sees the value in the metal. The lessor prefers to tear down a tired engine with good LLPs and sell it for spares. This is partly driven by lease rents below pre-Covid levels, and current high levels of competition from other lessors.

## AJW leasing

At the pandemic's height, about 40% of the narrowbody passenger fleet remained in active service. Of these, the majority were 737NGs, meaning demand for the CFM56-7B remained fluid. Nonetheless, AJW Leasing needed to readjust and renegotiate its CFM56-7B terms away from dry-leasing agreements to PBH-style agreements.

"Lessees were only paying us when they were flying. When their aircraft were on the ground, they would only pay a bare minimum base rent, which was a fraction of the original base rent agreements. All the -5Bs and V2500s were taken off lease because customers did not want to keep them as they were not flying," adds Akhtar.

Returning engines were inspected sooner than planned for, and any damage was rectified to keep them in serviceable condition. Despite not knowing exactly when the engines would be required, it was expected that demand for the assets would return at some time in the future. Lessors that did not complete these maintenance tasks at the time are now facing difficulties in completing the outstanding tasks. Included with the lack of available maintenance slots is a reluctance from some maintenance, repair & overhaul (MRO) organisations to complete limited workscopes. Recent

high demand means that if slots do become available, the MRO will often prioritise the most lucrative jobs.

"We have acquired engines that are strong, have 10,000-plus engine flight cycles (EFC) remaining, and are fresh from a performance restoration. But our main area of expertise is to acquire assets which have 2-3 years life and 2,000-5,000EFC remaining. The demand has definitely picked up for these short-term leases," adds Akhtar. "However, some airlines now have a requirement for engines with significant EFC remaining. Recently a major lessor approached us wanting a couple of engines with 10,000-15,000EFC remaining. Many of these lessors deal with new or nearly new aircraft and place them with airlines for a very long period of time."

There are more 737NGs than A320ceo family aircraft in passenger service. This helped create a greater demand for CFM56-7Bs when operations restarted after the pandemic. According to Akhtar, the newly acquired -7B assets will be placed on lease in a short period of time, while placing a -5B can take three to six months.

Demand for V2500 engines is resilient. A number of V2500s was operating through the pandemic, and there was an uptick in leasing demand because of an outstanding airworthiness directive (AD) related to the high pressure turbine (HPT) hub. This meant that many engines had to be put through an SV. Lease rates for V2500s at the time were a little higher than for the -5B. Most of the hub ADs have now accrued, and lease rates are now more consistent and where they were expected to be.

"The CFM56-7B is back to pre-Covid

*The CFM56-7B has been relatively active during the health crisis. Lease rates for the -7B are still behind 2019 levels, but are improving. The high number of forecast engine shop visits moving forward is promising for CFM56-7B engine lessors.*

levels in terms of utilisation, the -5B is not too far behind, and utilisation of the V2500 is improving. We acquired three V2500s last week and we have already got a couple of parties wanting to look at taking these engines," explains Akhtar.

There are a lot of people bidding on any narrowbody engine marketed for resale. Competition is fierce and there are a lot of people who want to spend cash because they know a lot of SVs must happen over the next few years. The engines are needed for operators, lessors and for part-out material.

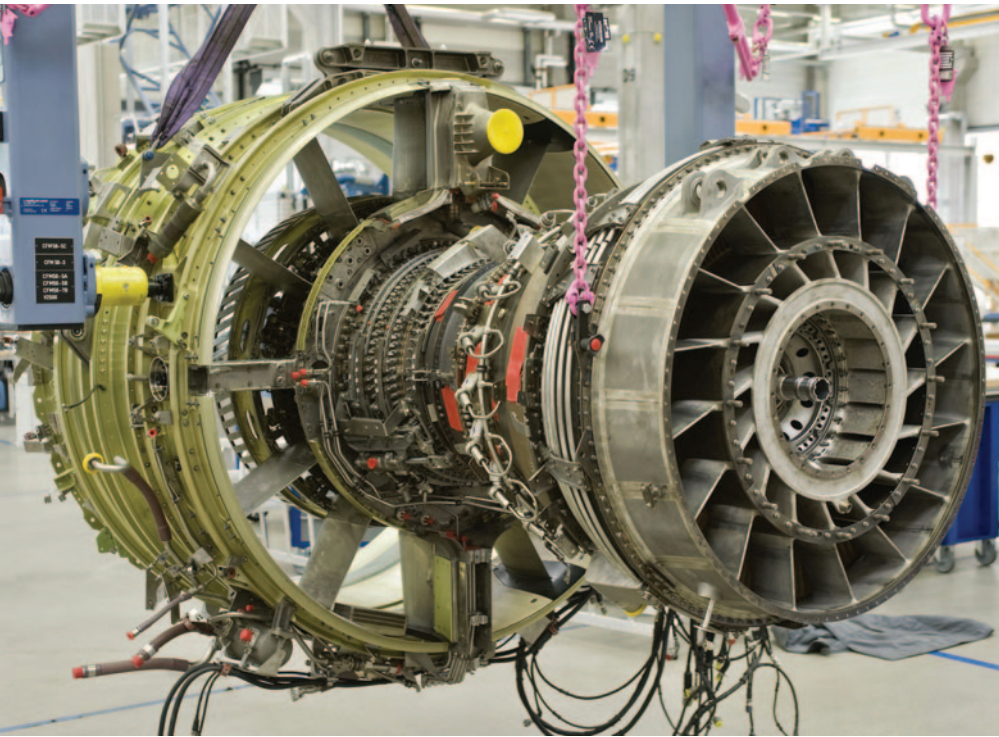
"The SVs have to happen because new-generation A320neo and 737 MAX aircraft will not account for the majority of narrowbodies until 2030. This will be when the LEAP and GTF engines will overtake the CFM56 and V2500 in terms of in-service number. Nevertheless, we expect CFM56 and V2500 SVs to peak in 2025. Then we will see a gradual decline in this number," explains Akhtar.

Shortages in material and protracted SV turnaround times mean that engine lease rates are rising. When engine availability drops, the lease demand improves along with lease rent. SVs are accruing and the requirement for green-time engines is increasing to cover them. There is also a requirement for engines to cover the delay in new aircraft deliveries. Recently carriers have extended leases on legacy aircraft to mitigate against delays for new aircraft deliveries. The result is a requirement for lease engines with sufficient time remaining to take them to the end of the extended lease term, when the new aircraft are delivered.

In the next 16 to 24 months, CFM56-5B/-7B and V2500 lease rents are expected to be return to 2019 levels. The leasing market is helped further because many operators are still not prepared to make the investment needed for an SV. Lease demand for popular narrowbody engines is expected to remain for the next 10 years.

## APOC

APOC is a leasing, trading, aircraft part-out, and component specialist. The Dutch company started out buying narrowbody airframes for teardown. Later it started specialising in A320 and 737NG engines and landing gear.



Recently APOC began trading in widebody landing gear.

Engine-wise, the company specialises in CFM56-3/-5A/-5B/-7B and V2500-A5 engines on a green-time basis. “We rarely send engines to the shop. Once they become unserviceable, we tear them down, then overhaul the parts before selling them,” explains Anca Mihalache vice president engine trade and leasing at APOC.

Before marketing the engine for lease, APOC’s engineering department completes an engine evaluation. This determines the number of EFC remaining, allowing lease terms to match an operator’s rates of utilisation. Exhaust gas temperature (EGT) margins and LLP condition, including their remaining life, are part of the evaluation. The engine is dismantled for spares on completion of the lease.

“During the pandemic we acquired a sizeable number of green-time engines for part-out. The distressed purchase price meant it was possible to decrease prices slightly at the time. Yet narrowbody engine prices did not fall much below 2019 levels,” adds Mihalache.

Originally the strategy was to lease the engines, and then dismantle them for parts. However, APOC increasingly began buying engines for the purpose of dismantling them to meet high demand for engine material at the time.

For example, an engine with 500-1,000EFC remaining would be torn down for parts. Recently the demand for leasing time-continued engines has been improving, partly because of the long waiting times for SVs. Returning passenger traffic and constraints in capacity mean that some carriers are

under pressure to source immediate solutions.

“We have transacted 19 engines since March 2019,” adds Mihalache. “The entire lease fleet of engines has been flying for more than 18 months. Only one engine came back during the pandemic, and it was immediately sent to a new lessee. It is sometimes better to pay a premium and buy an engine attached to a lease. This eliminates the risk of having an underutilised engine sitting on the ground off lease.”

It is now making more economic sense to sell mature engines at a piece-part level, despite high demand for lease engines. The result is that it is increasingly difficult to acquire narrowbody engines with significant green time remaining. The high number of SV deferrals increased overhaul intervals and consumed green time, thereby creating shortages.

“Delays are increasing further because of the inability of engine shops to procure parts. The shops are buying more inventory to mitigate against shortages, and this is creating competition for some parts. APOC has sourced engines for several clients in the past. Now we are sourcing engines for ourselves so that we can offer even more parts,” explains Mihalache.

Unplanned engine lease extensions are difficult because APOC leases engines until they become unserviceable or the LLPs expire.

The characteristics of a typical green-time lease are a maximum of three years, with 3,000-4,000EFC remaining. Some carriers prefer engines capable of a longer EFC life over a longer lease term. According to Mihalache, during the

*Lease demand for narrowbody engines is increasing as a result of protected shop visit turnaround times. Delays in new aircraft production is also a factor that is driving demand for engine leases.*

pandemic the typical lease duration fell to just 1-2 months because of elevated uncertainty and low passenger traffic. Now the typical green-time lease term is returning to a pre-pandemic level.

Some flag carriers are now leaning towards leasing recently overhauled engines to match high utilisation levels and prolong the interval between SVs.

“The advantage of a green-time lease is the flat fee,” Mihalache adds. “The maintenance reserves are low because the engine is never going to be put through an SV. This mitigates against operator risk because we know that the engine will be unserviceable by the end of the lease.”

The requirement for maintenance reserves is to cover against the possibility of unplanned maintenance events, and to ensure that the operator is taking good care of the engine, enabling it to reach its planned service goals. The age of the engine means there is no operator requirement to invest in non-mandatory upgrades.

## Engine types

High passenger traffic combined with the grounding of the 737 MAX created strong residual values for the 737NG before the pandemic. The result was the completion of a resurgence of legacy 737 Classic P-to-F conversions.

Engine SV forecasts show that 284 CFM56-3Cs went through an SV in 2019. In 2020 this number fell to 128; a 55% year on year (YoY) decline. Despite rallying to 136 in 2021, the number of CFM56-3C SVs fell again in 2022 to 104. It is forecast that there will be 104 CFM56-3C SVs in 2023.

“The CFM56-3 revival was a surprise to many people. We were on that wave, and we had some good engines, and we did very well with them. Now the total CFM56 market is very active and pricing has probably doubled compared to 2019,” explains Mihalache.

The number of CFM56-3C SVs will decline throughout the decade, despite a slight uptick forecast for 2025 and 2026.

Market values for the CFM56-3 series are significantly less than the CFM56-7B series. The legacy engines are trading for \$100,000 to \$2 million, compared to \$1-7 million for the newer series.

Success of the CFM56-7B is attributable to the high number of 737-800 P-to-F conversions. The powerplant was needed for the Aeronautical Engineers Inc (AEI) and the Boeing Converted Freighter (BCF) 737-800 freighters.

AEI redelivered 31 737-800SF cargo conversions in 2022. The same year Boeing redelivered its 100th 737-800BCF conversion since the beginning of the programme.

A320ceo CFM56-5B and V2500-A5 powerplants were less in demand at this time, partly due to the limited A321 and A320 passenger-to-freighter (P-to-F) conversion activity. Having two powerplant alternatives spread across the Airbus narrowbody P-to-F programmes dilutes this market further.

“Demand for -7B engines is decreasing a little, but this is normal in January,” Mihalache adds.

CFM56-7B values are close to pre-pandemic levels. Companies at the time held on to material, including hot sections, adding resilience to the market and maintaining values. Increasing MRO output means that there are good levels of liquidity in the -7B parts market. Transactions for material exposed to the market happen quickly.

In 2019 the CFM56-7B accounted for 1,654 engine SVs and the highest in this

cohort. By 2020 the number had dropped by 25.5%, totalling 1,232, then increasing to 1,400 in 2021. In 2023 the number of CFM56-7B SVs will total 1,679, exceeding 2019 levels. Throughout 2024-2026 the number of SVs for the type will be about 1,575 annually.

Some CFM56-7B parts are out of production and are no longer available, so shortages in labour and raw materials mean that OEMs are focusing on newer parts under warranty. As a result, OEMs are active in buying legacy material to fulfil their airline parts contracts.

It is also difficult for engine lessors to get refurbished parts back from overhaul shops. It is difficult to forecast how long these delays will last. Despite reported backlogs, however, lead times will fall after newly trained mechanics become more proficient.


There were 932 SVs carried out for CFM56-5B in 2019, and the second lowest in this group of narrowbody engines. In 2020 there were 499, representing a 46% drop YoY. In 2022 the number increased to 808, just 124 fewer than before the pandemic.

Demand for V2500 parts was especially low during the pandemic.

“We expected V2500-A5 demand would return, and in late 2021 it suddenly came from nowhere,” says

Mihalache. “The V2500 is popular with many European operators, with its utilisation on routes longer than three hours in duration. The re-opening of borders in Europe meant lots of people were travelling on holiday during the summer. We went from high levels of V2500 part availability to low levels very quickly. Now, there is very little on the market, and purchase prices are rising steeply.”

There were 1,034 SVs for the V2500-A5 in 2019, a number only surpassed by the CFM56-7B in this category. By 2020 the number had dropped by 37% to 656. In 2023 the forecast number of SVs for the V2500-A5 will be 835, and progress to 906 in 2025. They will then decline afterwards.

The high-thrust V2500 is an integral part of the A321 P-to-F conversion programmes. There is now greater demand for lower thrust-rated engines, although its recovery is lagging behind that of the CFM. The reason for the recent surge in demand for V2500 powerplants is because of returning passenger traffic in Europe where many V2500-powered aircraft are located. 

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