

# V2500 technical support providers

There are about 1,400 aircraft in operation with V2500 engines. A global survey of six major levels of support identifies the major providers.

**T**his survey summarises the major aftermarket and technical support providers for the International Aero Engines (IAE) V2500 family of turbofan engines. It is grouped into six sections covering the services offered by each provider.

1. Line maintenance and in-service operational support (see table, page 33);
2. Engine management (see first table, page 34);
3. Engine provisioning (see second table, page 34);
4. Engine components (see third table, page 34);
5. Shop visit maintenance (see first table, page 35);
6. Specialist repairs (see second table, page 35).

Companies listed in most or all of the six sections are 'one-stop-shop' service providers for the V2500 family. This means that they provide most, if not all, the technical support services that a third-party customer would require. The tables show the range of services that the V2500

overhaul shops are capable of offering. Unlike other engine original equipment manufacturers (OEMs), IAE does not own and operate specific overhaul facilities, relying instead on those owned and operated by each of its partners. These facilities, which are fully authorised to perform complete V2500 overhauls, include: MTU's facilities in Hannover, Germany and Zhuhai, China; Pratt & Whitney's (PW) 'Global Service Partner' (GSP) facilities in Columbus, GA and Christchurch, New Zealand; Rolls-Royce's facilities in East Kilbride, Scotland and Montreal, Canada (from 2008); and IHI in Tokyo, Japan.

V2500 overhaul and repair work is also supported at three non-shareholder shops: Lufthansa Technik in Hamburg, Germany; Jet Engine Overhaul Complex (JEOC) in India; and EGAT in Taipei, Taiwan.

Several airlines have performed their own module removal work with a view to eventually becoming full maintenance facilities. Indeed, Egyptair, Saudi Arabian Airlines and Turkish Technic have set up shops at their main bases to work on V2500 engines.

IAE reports that more than a quarter of the fleet is under an IAE maintenance programme. This is growing, and is likely to increase to 50% by 2010 given that 95% of new airline orders now specify an IAE maintenance programme.

"Most operators are locked into power-by-the-hour (PBTH) agreements," observes Wayne Pedranti, project manager at Total Engine Support (TES-UK). "This is how IAE decided to sell this engine, although many lessors did not opt for PBTH, and neither did United, a very large operator."

IAE recently launched V2500Select, which encompasses everything, including traditional fleet-hour agreement (FHA) services. IAE underwrites all the risk, in contrast to typical third-party FHAs which can contain many exclusions. IAE has also coupled these services with certain upgrades to target reliability and fuel burn, which it calls 'SelectOne'.

With the V2500Select programme, all elements of engine product risk and cost relating to scheduled and unscheduled events are transferred to IAE. Technology retrofit upgrades can also be included for the life of the programme, and optional services are available for no excess cost.

"The major problem engine shops are dealing with is excessive wear on the third-stage high pressure compressor (HPC) blades," observes Pedranti. "These have a mid-span clapper shroud which is driving engines off. There is now a modification for that, which replaces the worn part with a new designed blade. Other problems include combustor distress, and an airworthiness directive (AD) specifying inspections and removals for the second-stage high pressure turbine (HPT) air seal. Other than that, there are not really many other factors driving these engines off-wing."

## V2500 overhaul market

In terms of shops performing full V2500 overhauls, MTU Maintenance has done 852 individual engine visits: 28% of 3,000 overhaul contracts so far logged by Flightglobal's ACAS aviation database.

The shop with the next largest number of V2500 visits is Rolls-Royce's (RR) East Kilbride facility with 350 of the 3,000 visits, accounting for 12% of the market. Next is MTU Maintenance's Zhuhai facility with 308, followed closely by PW's Columbus, Georgia facility with 304, and independent Lufthansa Technik with 262.

The ACAS database lists IAE with

*Despite the V2500 being operated in large numbers, the support market is shared by relatively few players. MTU Maintenance & Rolls-Royce perform about 40% of shop visits.*



214 engine overhaul contracts, although these would be assigned to any of the IAE partner shops, from RR, PW, MTU and IHI. Also listed are PW's joint ventures with Air New Zealand in Christchurch, New Zealand and with Turkish Technic in Istanbul, Turkey. These have 84 and 52 of the 3,000 visits respectively.

The other OEM partner, IHI, has overhauled 176 V2500s according to ACAS.

Although these numbers are only approximate since many contracts fall into the 'unknown' category, it is clear that the OEM partner shops or joint ventures (such as Turkish Technic) account for at least 85% of all V2500 engine visits.

Looking at the V2500 overhaul market share by specific contract, the biggest single V2500 overhaul contract was awarded by jetBlue to MTU in Hannover. The total number of engines in this case is 206, according to ACAS. The next biggest customer is United Airlines, with its fleet of 188 V2500s overhauled by PW's Columbus facility. The latter is in addition to United's own 'Ted' low-cost subsidiary, with another 116 engines. Next comes US Airways with 156 V2500s and TAM with 88; both fleets go to MTU Maintenance in Hannover. The largest in-house V2500 overhauler is Air India with 96 engine overhauls, and the largest customer for RR's East Kilbride facility is British Airways, with 66 V2500 visits.

### Major providers

Bill Montanile, vice president of sales at Pratt & Whitney Global Service Partners (GSP), continues to see 'steady growth' in V2500 engine overhaul, and forecasts more than a 20% increase, due mostly to increased numbers of V2500-A5s.

He observes that operators continue to approach engine maintenance from multiple perspectives. "We continue to see IAE establishing FHAs with its customers, while GSP customers continue primarily to seek maintenance service agreements and also request maintenance support on a transactional basis."

The highest geographic demand for V2500 overhauls, according to Montanile, comes from the Americas, with just over 40% of total demand. Europe follows at 25%. Operators in the Asia-Pacific and China region equally share the remaining volume. "Over the next five years we anticipate growth in all these regions, with Europe and Asia Pacific reflecting a growth rate slightly higher than the Americas and China."

Montanile does not foresee any particular surge in shop visits. "Our worldwide shop visit forecast indicates a continuing growth in overhaul volume of

### V2500 LINE MAINTENANCE & IN-SERVICE OPERATIONAL SUPPORT

	On-wing maintenance	Line maintenance	Hospital repair/ Quick turn repairs	On-wing support	AOG/field services	Borescope inspection
EgyptAir Jet Engine Overhaul Complex, India	Yes	Yes	Yes	Yes	Yes	Yes
Lufthansa Technik	Yes	Yes	Yes	Yes	Yes	Yes
MTU	Yes	Yes	Yes	Yes	Yes	Yes
Rolls-Royce Aero Engine Services	Yes	Yes	Yes	Yes	Yes	Yes
Sabena Technics	Yes	Yes	Yes	Yes	Yes	Yes
SAS Technical Services	Yes	Yes	Yes	Yes	Yes	Yes
Turkish Technic	Yes	Yes	Yes	Yes	Yes	Yes
United Services	Yes	Yes	Yes	Yes	Yes	Yes

8-9% each year until 2010, and then a modest increase to 12% as new engines begin to come off-wing for their initial shop visits. The V2500 fleet is achieving first-run removal intervals of 30,000 flight hours (FH) or more in some cases."

In January 2008 PW signed a joint venture with Turkish Technic to build a new engine overhaul facility in Istanbul, which will overhaul CFM56 and V2500 engines. This facility, 'Pratt & Whitney Turkish Technic Aircraft Engine Maintenance Center', will receive its first V2500 in 2009, and will overhaul up to 200 engines per year once fully operational. This will be PW's third V2500 engine overhaul centre, with other locations in Columbus, Georgia, USA and Christchurch, New Zealand.

As well as its main V2500 overhaul facility in Hannover, MTU Maintenance has commissioned a V2500/CFM facility in Zhuhai, China. This 50:50 venture with China Southern centres around a \$200 million facility to address the growing V2500 market in the Asia Pacific region.

MTU has also built up full V2500 hot-section airfoil repair capabilities for HPT and low pressure turbine (LPT) blades and vanes with its recently developed high-temperature braze repair process. The company also performs crack repairs for the LPT vanes, given its experience as an OEM designing and manufacturing the LPT. MTU also conducts full LPT blade and compressor repairs at its joint venture in Malaysia, Airfoil Services AB (ASSB), in conjunction with Lufthansa Technik.

MTU spokesperson, Katia Diebold-Widmer, observes that some operators prefer long-term, cost-per-hour agreements, while others choose a fixed price contract, or conventional 'time and materials' which can either be exclusive or non-exclusive. "We do see a trend towards more long-term agreements. This is due to the current market dynamics, where many start-ups and low-fare

carriers outsource engine MRO work. Moreover, there is an increased demand for spare engine support as fewer spare engines are being ordered due to more aircraft being leased rather than being assets owned by operators themselves.

Diebold-Widmer adds that based on the V2500-A5 active fleet worldwide, most visits will be in the Americas (30% North America and 12% South America), followed by Western Europe (22%) and China (12%). "While overall figures will remain relatively similar in the future, the largest growth, from 6% to 12%, will be in India due to very large orders with Kingfisher/Deccan and IndiGo."

MTU reports that the total number of full overhaul shop visits will be about 800 during 2008. This will grow to close to 1,000 by 2012 as a result of the increase in V2500-A5 shop visits. Meanwhile, MTU anticipates that shop visits on V2500-A1 and V2500-D5 will be roughly constant.

Arguably the only true independent with a 'total' V2500 capability is Lufthansa Technik (LHT). The company performs its full engine overhaul in the Hamburg engine facility, while engine component and blades are overhauled in its ASSB joint venture with MTU in Malaysia. LHT overhauls up to 80 V2500s annually at its Hamburg shop. Maintenance covers all areas including B3 (disassembly, assembly, cleaning, non-destructive testing and inspection) and C3 (specialist high-technology repairs involving outside vendors).

Services include: routine tasks, repairs, modifications, testing, FAA-approved PMA (parts manufacturing approval) parts, FAA-, DER-, and EASA-part 21J design organisation approved repairs. Specific repair techniques include: HPC blade-tip plasma spraying, combustion chamber fuel nozzle guide repair, HPT stage-one duct segment coating replacement, LPT knife-edge seal plasma repairs, and diffuser case flange replacement. LHT is approved by EASA

**V2500 ENGINE MANAGEMENT**

	Maintenance management & check planning	ADs/SBs management	Documentation management	Health/condition monitoring
Aeroturbine/AerCap	Yes	Yes	Yes	Yes
EgyptAir	Yes	Yes	Yes	Yes
Evergreen Aviation Technologies	Yes	Yes	Yes	Yes
GA Telesis	Yes	Yes	Yes	Yes
IASG	Yes	Yes	Yes	Yes
IHI	Yes	Yes	Yes	Yes
Jet Engine Overhaul Complex, India	Yes	Yes	Yes	Yes
Lufthansa Technik	Yes	Yes	Yes	Yes
MTU	Yes	Yes	Yes	Yes
Pratt & Whitney GSP	Yes	Yes	Yes	Yes
Rolls-Royce Aero Engine Services	Yes	Yes	Yes	Yes
Sabena Technics	Yes	Yes	Yes	Yes
SAS Technical Services	Yes	Yes	Yes	Yes
Turkish Technic	Yes	Yes	Yes	Yes
Total Engine Support, UK	Yes	Yes	Yes	Yes
United Services	Yes	Yes	Yes	Yes

**V2500 ENGINE PROVISIONING**

	Short-term leasing	Medium- & long-term leasing	Engine pooling	Sale & leasebacks
Aeroturbine/AerCap	Yes	Yes	Yes	Yes
AAR Engine Sales & Leasing	Yes	Yes	Yes	Yes
Engine Lease Finance	Yes	Yes	~	Yes
GA Telesis	Yes	Yes	~	Yes
Lufthansa Technik	Yes	Yes	Yes	Yes
MacQuarie AirFinance	Yes	Yes	~	Yes
Rolls-Royce Partners Capital	Yes	Yes	Yes	Yes
Willis Lease Finance	Yes	Yes	Yes	Yes

**V2500 ENGINE COMPONENTS**

	QEC repair	QEC build-up & engine dressing	LRU repair	LRU pooling & logistics
Aeroturbine/AerCap	Yes	Yes	Yes	Yes
AirLiance Materials	~	~	~	Yes
IHI	Yes	Yes	Yes	Yes
Lufthansa Technik	Yes	Yes	Yes	Yes
MTU	Yes	Yes	Yes	Yes
Pratt & Whitney	Yes	Yes	Yes	Yes
Rolls-Royce	Yes	Yes	Yes	Yes
Sabena Technics	Yes	Yes	Yes	~
SAS Technical Services	Yes	Yes	Yes	~
THY Technic	Yes	Yes	Yes	~
Tradewinds	~	~	~	Yes
Unical	~	~	~	Yes

and the FAA to replace the V2500's number-three bearing in situ without the removal of the engine core.

LHT also provides aircraft on the ground (AOG) airline support teams (ASTs) for on-wing tasks that include borescope inspection, blending, fan blade repair and blade exchange. V2500 teams are located in Tulsa, Oklahoma; Hong

Kong; India; and Frankfurt.

With some very large A320 orders recently placed by operators in India, this region will become a significant overhaul market, so overhaul shops for V2500s are already being planned. In 2007, National carrier Indian's Jet Engine Overhaul Centre (JEOC) in Delhi renewed its status as an FAA-approved 'foreign repair

station'. This allows Indian to continue to repair and overhaul engines, including the V2500 for third-party customers, in addition to A320s.

In Taiwan, Evergreen Aviation Technologies (EGAT) recently signed an engine overhaul agreement with Indian low-fare carrier, Go Air. The first V2500-A5 engine was overhauled for an Indian carrier in February 2008. EGAT's facilities include two engine shops for assembly, disassembly and testing of aircraft engines, and a 120,000lbs thrust test cell.

In the Middle-East, EgyptAir's Maintenance & Engineering division is finalising a new engine shop. This facility will be capable of processing 40 engines per year. EgyptAir will conduct up to B3-level service for the V2500-A1 and -A5 engines. Its workshop will have a test cell capable of handling engines up to 100,000lbs thrust.

**Aftermarket perspectives**

Abdol Moabery, chief executive officer at GA Telesis, observes that aftermarket V2500 leasing opportunities are hampered due to the scarcity of available engines. "Many potential customers say they are tied up under a spare engine support programme directly with the OEM, which makes it difficult for us to do engine leasing on the V2500.

"There are probably only a handful of companies which lease V2500 engines. Major lessors include Engine Lease Finance, Aeroturbine, AAR, Willis Lease Finance, Rolls-Royce Partners Capital, and MacQuarie AirFinance.

"We do find whole engines here and there. Last year our target was to acquire a certain number of V2500s, but we only secured 25% of this," says Moabery.

"We are involved in parts and component repairs," he continues. "We supply parts for the V2500 and we repair external components, including quick engine change (QEC) accessory and buyer furnished equipment (BFE), such as actuators. The parts we sell come mainly from part-outs. For example, when we have an engine that comes back off lease, we may decide that the cost of putting it back into leasable condition is not commensurate with the economic value of parting it out. We will then simply disassemble the engine and sell the parts back. In most cases the OEM is the biggest customer, in particular, MTU and Rolls-Royce. We do not have many choices; we are either selling to MTU or Rolls-Royce. But one of them will usually buy the parts because there is not much competition."

Moabery says the main players involved in V2500 leasing opportunities include: PW's surplus sales group; Aeroturbine; AirLiance Materials; GE

## V2500 SHOP VISIT MAINTENANCE

	Hot-section inspection	Module change	Module overhaul	Full overhaul	Mods & upgrades	Disassembly/build-up	On-site test cell	Specialist processes (HVOF/plasma)
EgyptAir, Egypt	Yes	Yes	Yes	Yes	Yes	Yes	Yes	~
Evergreen Aviation Technologies, Taiwan	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
IHI, Tokyo, Japan	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Jet Engine Overhaul Complex, Delhi, India	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
MTU Maintenance, Germany	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
MTU, Zhuhai, China	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Pratt & Whitney GSP, Columbus, GA	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Pratt & Whitney GSP, New Zealand	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Rolls-Royce, Montreal, Canada	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Rolls-Royce, East Kilbride, Scotland	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Lufthansa Technik	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Turkish Technic	Yes	Yes	Yes	Yes	Yes	Yes	Yes	~

## V2500 SPECIALIST REPAIRS

	Fan blade repair	Vanes & stator repair	Compressor blade repair	Turbine blade repair	Combustor repair	Casing repair	Seals repair	On-site DER authority	PMA parts approved
Airfoil Technologies	Yes	Yes	Yes	~	~	Yes	~	Yes	~
Airfoil Services, Malaysia	~	~	Yes	Yes	~	~	~	Yes	~
Chromalloy	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	~
GKN-Chemtronics	Yes	~	Yes	~	~	Yes	~	Yes	~
IHI	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	~
MTU	~	Yes	Yes	Yes	Yes	Yes	Yes	Yes	~
Honeywell Aerospace	Yes	Yes	Yes	~	~	Yes	Yes	Yes	~
Lufthansa Technik	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Pratt & Whitney	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Rolls-Royce	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Turbine Overhaul Services, Singapore	~	Yes	Yes	Yes	~	~	~	Yes	~

Aviation Materials; AAR; Unical; and Trade Winds Aviation Services.

Moabery predicts more V2500-A5s will come to the market from airlines that actually own them as a result of some of the 'liquidity requirements' that he sees airlines facing in 2008. "The amount of commercial debt available in the market has reduced, so when airlines do not have access to capital this is when the sale and leaseback market flourishes."

Moabery believes the pending MD-90 retirements from China and Saudi Arabia will result in some V2500-D5 aftermarket activity. As for the older V2500-A1-powered aircraft, he says they will definitely reach the stage of part-out, so engines will be coming to the market on the -A1 side as well.

"Both CFMs and V2500s are holding their values, with it being a sellers' and lessors' market," says Moabery. "Market prices and values are staggering. Used and half-time engines are going for 70-85% of the OEM catalogue list price."

"The V2500 maintenance market is relatively flat, with slow growth," says Kevin Michaels, principal at AeroStrategy management consultants. "The V2500 overhaul market is currently worth \$1.08 billion a year: comprising \$300 million spend for the -A1 variant; \$660 million for the -A5; and \$110 million on the -D5. The older -A1 variant is steadily declining. The main trend is market growth to more than \$1.5 billion by 2012, coming exclusively from the -A5, which will approach \$1.2 billion."

Michaels apportions \$240 million of the market to North America; \$130 million to China and Asia-Pacific; and \$215 million to Western Europe. In five years he predicts North America will account for a \$410 million spend; Western Europe \$256 million; and China, Asia Pacific and India \$290 million. In particular he envisages the Indian market itself approaching \$100 million by 2012.

Michaels believes the overall PMA penetration in the V2500 is less than

the industry's average of 2.8%. "It will certainly be a target for PMA providers and manufacturers, because it is such a popular engine with a highly fragmented supplier base. Challenges remain, though, because incumbent OEMs are relatively strongly positioned on the supply side."

TES-UK's Pedranti agrees. "It may take at least 10 years for the aftermarket to open up. The engine is still in production, and IAE, like RR, is keeping a very tight control over it. While more PMA parts are starting to enter the market, few shops will use them. Maybe MTU, and LHT, but not the RR or P&W shops. There will eventually be more PMA activity on the V2500, but never at the level of the JT8D. As long as these engines are under the fleet-management programmes, there is no economical driver for the 'second' market." 

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