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APRIL 2023 • VOLUME 25 • ISSUE 3

MRO Management

Key elements

Component maintenance demand grows as parts availability falls

1

Maintaining the key elements

Aircraft component repair has had to increase at a time when parts availability has been a challenge. ***Bernie Baldwin*** discovers how some major MRO players have been dealing with that

2

1. New technologies have allowed companies like Lufthansa Technik to make certain new repairs economical for customers [All Lufthansa Technik photos, photographer: Sonja Brueggemann]
2 and 3. AAR has brought in technologies over the past 12-18 months such as cold spray technology and nano fusion

You are the weakest link, goodbye." This well-known catchphrase from a TV elimination quiz has driven its way into the everyday lexicon, often as a jovial put-down between friends.

The concept of a weak link does, of course, have a literal meaning which applies in many settings. And it certainly applies across the many thousands of components with mission-critical attributes which go to make up an aircraft.

Just as in every walk of life, when some components reach the end of useful operation they are replaced. Others receive attention to keep them operable. The first thing to be done is to determine defects which are causing a component to underperform, remembering that aircraft components can be mechanical or electrical.

"Tests can vary depending on the type of unit and the function the unit is intended to perform," notes Salim Khamze, director of operations and engineering at AAR. "Generally speaking, once a unit is received, the reason for removal is noted and a pre-test is performed. The technician will determine if the reason for removal/failure can be duplicated. If a defect is found, the technician follows the manufacturer's component maintenance manual (CMM) to perform troubleshooting and isolate the problem."

From there, any defective parts within the component are replaced or repaired. The component is then assembled, tested and inspected.

"When dealing with mechanical components, we ensure we have a thorough understanding of the component's operation," remarks Louis Mallette, SVP operations for AJW Technique. "This helps in the troubleshooting process where we identify potential wear or failure areas that could cause the reported problem. Visual and physical inspection and measurement play a key role, along with dynamic and stress testing, which includes over-pressure testing, vibration testing and environmental testing."

The process is similar for electrical and electronic components. "Here, we look to measure the electrical/electronic characteristics to assess whether the component meets the required operational specifications," says Mallette. "Once again, stress testing is key, as this can help identify latent failure in printed circuit boards and more. It is worth noting that components may operate perfectly well and pass all tests in the workshop environment at a steady 20°C, but we also need to replicate the actual aircraft operational environment as closely as possible to identify any latent and intermittent failures."

Alexander Nebauer, component and production engineer at Lufthansa Technik, says the spectrum of test requirements is almost as broad as the number of aircraft components inspected and repaired throughout the company's international network of component shops. "The employed tests range from very minor manual procedures, such as quick visual inspections, to comprehensive test rigs or robotic setups that fill entire workshops," he explains.

3

Test areas	For what type of component?	Problems test detects?	Plant? DFW, PAE or both*
Air cycle machine testing	Air cycle machines	Balance Performance	DFW
Fan testing	Electrical fan ventilation	Balance Flow performance Electrical current draw	DFW
Fuel shop testing	Fuel control boost pumps Thermal heating	Pressure control Fuel control Temperature control and performance	DFW
Heat exchanger testing	Heat exchangers	Flow Temperature control	DFW
Non-destructive testing	Applies to many types of parts Mag particle Dye penetrant Eddy current Composite Radome performance	Part flaws and cracks	DFW PAE
Drive unit testing	Inclusive of pneumatic and electrical parts PDU Thrust reverser Center drive unit Linear actuators Alternate flap drives	Stroke measurement Speed of actuation Load performance	DFW PAE
Pneumatic starter testing	Pneumatic starters	Load performance RPM variations	DFW

Table 1 *Test centre codes: DFW = Dallas/Fort Worth, Texas; PAE = Everett, Washington

"It makes sense to distinguish between off-the-shelf procedures in the OEM's CMM and more sophisticated test set-ups developed by our engineers and certified by the aviation authorities. One striking example of an in-house developed test procedure for mechanical components is our unique approach to check the structural integrity of Halon-filled onboard fire extinguishers."

▲ Pneumatic valve bench testing at ATS

Nebauer notes that this advance is an example of being able to make reductions in turnaround times with a new procedure. "Our innovative test procedure for these bottles was developed under a project aptly named 'EFFECT' (Extreme Fast Fire Extinguisher Check and Test) and introduced into daily operations in 2020," he adds. "Interestingly, this new test method drew inspiration from techniques usually employed to localised earthquakes in the crust of the Earth.

"Now, used on a much smaller scale, it enables our experts to detect even the smallest cracks in the ball-shaped metal pressure bottles filled with the environmentally harmful Halon extinguishing agent. Using the new procedure, the Halon stays inside the bottle at all times. This advantage not only significantly reduces the turnaround times – due to no longer necessary removing, handling and storing of the hazardous agent – it brings vast improvements with regard to sustainability."

Margus Graf, workshop manager at Magnetic MRO, reports that most of the tests carried out at their Component Maintenance Workshop relate to mechanical components to determine pressure loss or functionality. "For example, pressure tests are carried out for wheel and tyre assemblies and also escape slide inflatables to detect any leakages," he comments. "Besides leakage tests, functionality tests for brakes are carried out to make sure all pistons are moving freely and retracting to their original position. Batteries need to pass capacity tests in order to determine cells for which capacity is under limits and thus require replacement."

For the tests at ATS (Aviation Technical Services) to determine the cause of a problem on different component types, Trey Bryson, the company's SVP operations, points to the listing in Table 1 (above).

1

1. If a defect is found, the technician follows the manufacturer's component maintenance manual to perform troubleshooting and isolate the problem
2. Louis Mallette is SVP operations at AJW Technique

"Customers are more willing to accept repairs on piece parts due to the greatly reduced availability of new spare parts"

2

Addressing elements in current processes which could reduce turnaround times, Bryson reports that ATS invested during the pandemic to consolidate three component repair facilities and machine shops at its existing 138,000 sq ft location in Fort Worth, Texas, completing this activity in March 2022. "This investment included both the physical relocation as well as a commitment to invest in our employees, such as individuals being cross-trained on different component part product lines (accessories, structures, composites, machine shop) to best utilise labour resources and provide variety to workers.

"[The investment included] physical resources such as machine shop, heat treatment and autoclave ovens, which previously required outsourcing for some shops, now being available to all operations. ERP systems were consolidated to provide better visibility of customer repair orders and associated material planning.

"This includes internal detail on manufactured parts, use of DERs for out-of-scope repairs, defining minimum/maximum order parameters for purchasing, stocking USM (used serviceable material) for hard-to-find items required for exchanges and repairs, and utilising PMAs where customer programmes allow."

Bryson observes that shops such as ATS, which have direct control over most of their processes, will likely be "more successful in bringing lower turnaround times to customers. This is especially true as supply chain turmoil continues worldwide."

He continues: "Our other example relates to the ATS Machine Shop adopting 3D printing to manufacture two types of aids which have contributed to process improvements, including 3D printed shipping aids for shipping select component accessory parts.

"Parts targeted have a history of being damaged during return transit to the customer. The printed shipping aids are durable and lightweight, reducing the risk of shipping damage with negligible impact on shipping costs."

Other process improvements include 3D printed shop aids for quick and versatile small efficiency gains throughout the shop.

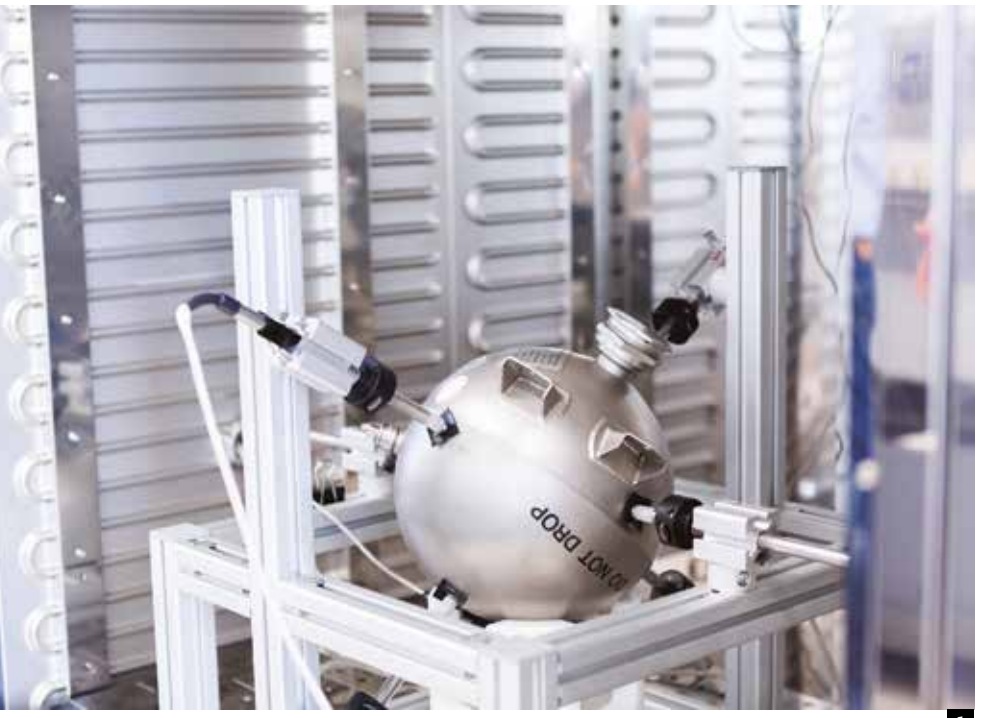
"Examples include 3D printing of specifically sized grids to allow for quicker damage/wear mapping, 3D printing alignment tools or small fixtures that speed the process of assembly, and combining 3D printing with our internal machining abilities," comments Bryson. "This allows us to proof out ideas more effectively for our PMA development team and interested customers."

For AAR's Khamze, the shortage of piece parts from OEMs has a very high impact on TAT (turnaround time) and OTD (on-time delivery). "Solutions to overcome long delays include creating more repair solutions for sub-assemblies, using alternative PMA parts when allowed by the customer, and using serviceable piece parts that meet CMM specifications," says Khamze.

Taco Vingerhoed, who is AAR's director commercial and business development, adds: "An effective and experienced sourcing team can make the difference in finding solutions for our customers. Our experience is that in most cases solutions are found to meet customers' needs."

AJW Technique's Mallette echoes Khamze's view that the main impact on turnaround time is spare part availability, primarily driven by the global supply chain fracture.

"As such, this has been one of our key focus areas," he says. "Using digital tools to better understand demand variation to predict future requirements enables us to allocate parts for those requirements well in advance, allowing us to mitigate the increase in lead times.



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"An effective and experienced sourcing team can make the difference in finding solutions for our customers"

"This dynamic forecasting using AI-supported digital tools captures our historical parts usage information at the lowest level and allows a detailed forecast to be constructed using a macro-level demand forecast at a component level. This is then fed to our supply chain team to ensure parts are provisioned as early as possible in the process. The information is updated on a real-time basis and, as a result, we have achieved fill rates of 90 per cent-plus, giving the team more time to focus on finding solutions for the remaining issues."

Magnetic MRO's Graf believes there is always room for improvement in processes to make reductions in turnaround times.

"Even if most of the improvements like automation or working in shifts are done, the fine tuning can be done by analysing the procedure to find possible bottlenecks or idle time, and the root causes behind them," he emphasises.

When aiming to develop new repairs in process areas such as welding, machining, coating and so on, new technologies come along which enable certain repairs to become economical, allowing them to be added to a company's portfolio.

Lufthansa Technik spokesperson Michael Lagemann provides an example. "Recently, we succeeded in making repairs economical in a field where many parts are usually deemed unsalvageable, namely our scarfing robot system. Having been thwarted a good bit by the Covid-related aviation crisis and a lack in demand, it is now in the process of introduction to daily service," he says. "Among other capabilities, the robot has already demonstrated its ability to repair certain types of damage to composite parts where most manual repair processes failed. One such example is the repair of damaged fan cowl doors."

AAR has brought in technologies over the past 12-18 months such as cold spray technology and nano fusion. "These are technologies that have enabled us to repair, rather than replace, expensive piece parts and sub-assemblies. These types of repair are growing rapidly and are improving," Vingerhoed remarks. "By using these new technologies, we can offer solutions to the customer on a lower price level."

At ATS, a Boeing 787 operator contacted ATS with a slat track repair requirement for the roller/wear surfaces as nothing was defined in the CMM for an allowable repair. While Bryson admits that the answer did not come from a new technology, he notes that ATS "utilised its decades of experience to develop our own repair which was approved by the OEM and airline. We did this in approximately two months and, combined with inventory support from Boeing, we stayed out ahead of the operator's maintenance check requirements and not delay aircraft."

In a similar vein, AJW Technique's Mallette believes that the processes used in the repair of components and their piece parts have not fundamentally changed in the past 12-18 months. "Essentially, we are still using the same techniques we have been for many years – welding, plating, machining and so on," he comments. "What has changed is the willingness of customers to accept repairs on piece parts due to the greatly reduced availability of new spare parts. To avoid excessively long turnaround times and the lead time for new spare parts, AJW Technique works with parts repair specialist vendors and the surplus market to offer our customers alternative solutions to component repair."

New technologies or not, MRO providers are proving themselves incredibly flexible and capable as they seek to ensure their airline customers can safely keep their aircraft in the air, earning revenue. In fact, in that aim for airworthiness they might arguably be considered the strongest link.

1. A scarfing robot system has demonstrated its ability to repair certain types of damage to composite parts where most manual repair processes failed
2. The ability to repair rather than replace is vital for MROs and customers

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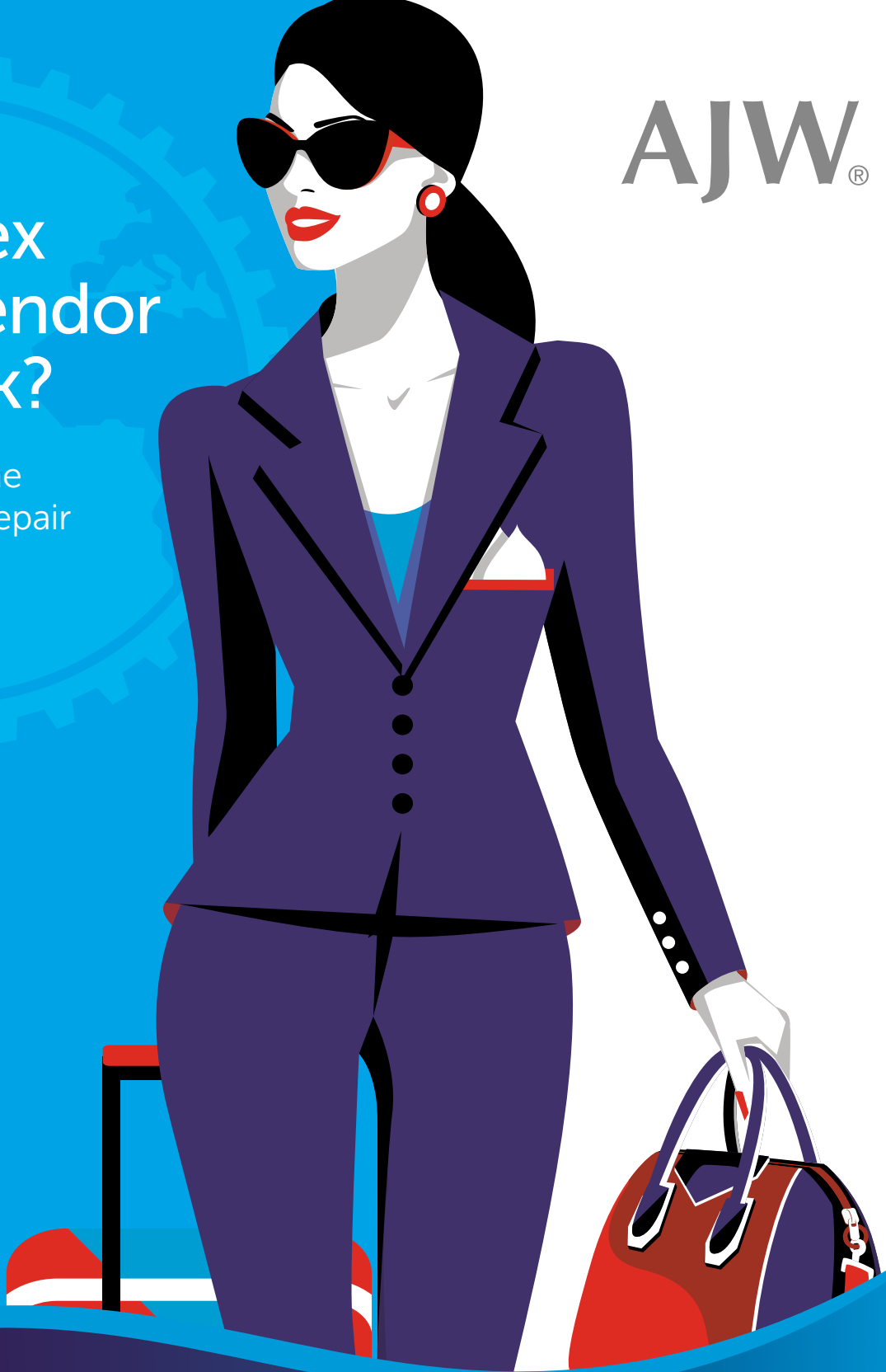

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