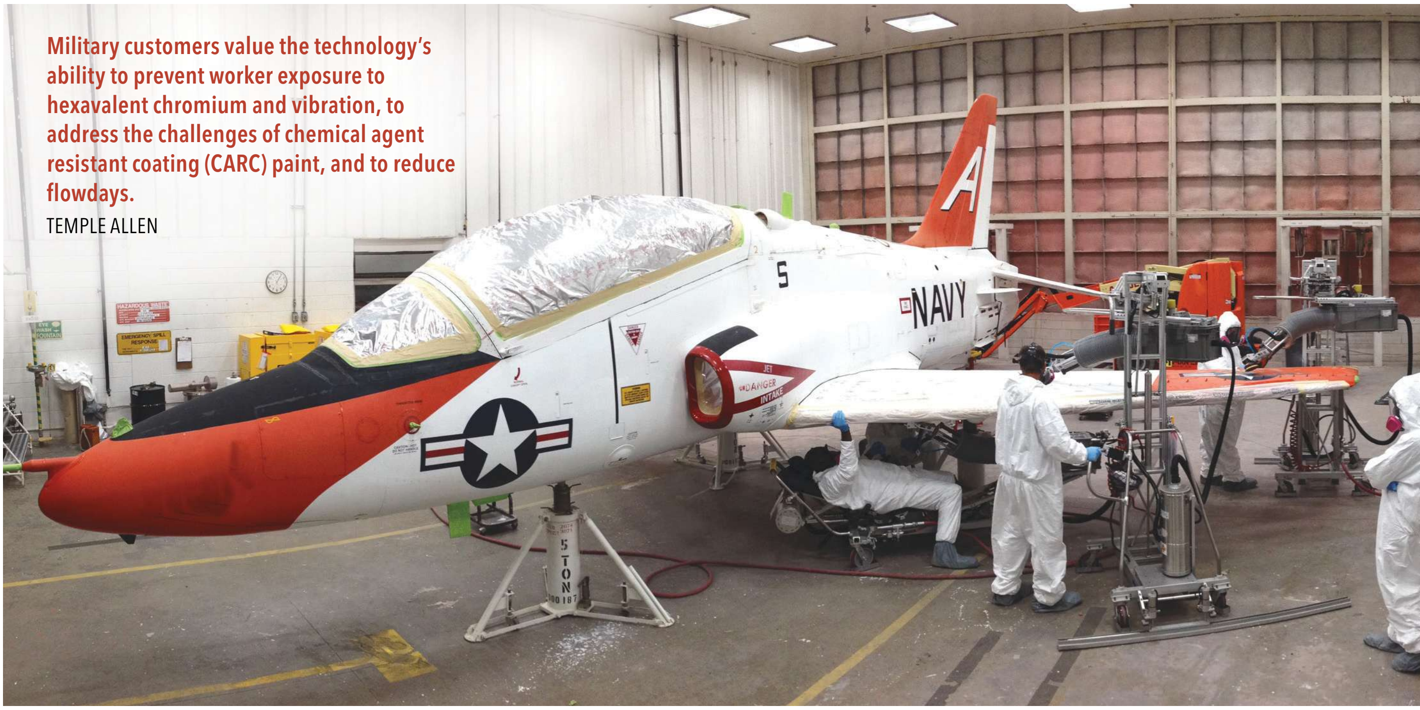

Military customers value the technology's ability to prevent worker exposure to hexavalent chromium and vibration, to address the challenges of chemical agent resistant coating (CARC) paint, and to reduce flowdays.
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Whole Lotta Sanding Going On

The technology will prevent exposure to vibration and dust, will help the operator sand faster and more consistently, yielding the best possible finish in the least amount of time.

By Robert Kent

Every aircraft, whether business, commercial, or military, is an expensive asset and downtime is expensive. Most aircraft are repainted about every seven years to inspect for corrosion and improve aesthetics. Besides full aircraft, parts such as nacelles, radomes, and flight controls are often removed for repair then repainted off-aircraft.

Composite aerostructures in particular require special care, as substrate damage is very costly. Composites are in progressively greater use on modern aircraft (787, A350) and there are 20,000 planes in the commercial fleet. Military aircraft, particularly the F-22, F-35, and C-17, have a significant share of composites as well. Prior to painting, every surface must be prepared so that the new paint will adhere properly.

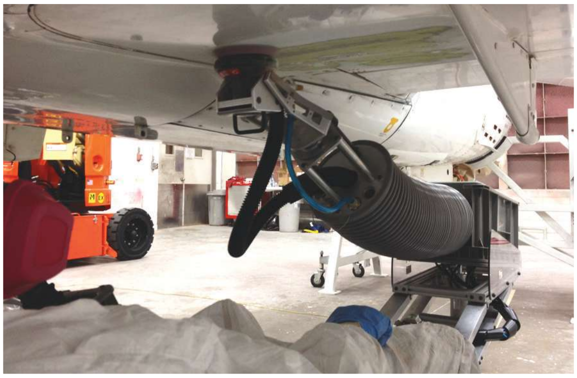
Currently, while some surface preparation tasks are performed with chemicals (aluminum fuselages are often stripped this way), all of the composite surfaces, and some of the aluminum ones, are abraded manually with random orbital sanders and coated abrasive discs. Sometimes the goal is to remove all the old paint (to reduce weight and/or inspect for corrosion) before new paint is applied, and sometimes the goal is just to reactivate the surface so the top coat will adhere well. Sometimes, vacuum systems are integrated into the process, facilitating dust collection at the source to minimize operator exposure.

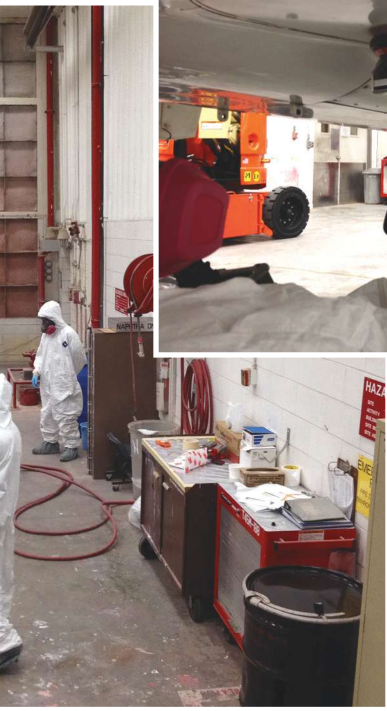
Both finish quality and material removal rate are driven by several factors, including abrasive type, tool speed, sweep rate, and contact pressure (a function of how hard the artisan is pushing and whether the sander is flat on the surface or tilted). Skilled artisans can accommodate these factors in real time — e.g. as an abrasive disc wears, an artisan can sweep more slowly or push harder. Ideally, every artisan would be sanding exactly the same way so the resulting finish is as consistent as possible.

Technical and ergonomic issues

One major challenge is that industrial-duty pneumatic sanders weigh a lot, particularly with attached hoses, and expose the operator to harmful vibration. Holding a heavy vibrating tool out in front of you, or up over your head, is an ergonomic nightmare. Aircraft are large enough that there is a lot of reaching involved, and awkward postures also contribute to the high injury rates in many shops. Injury risks include hand-arm vibration syndrome (HAVS) and repetitive stress injury (RSI). These lead to a high incidence of shoulder, arm, wrist, and hand surgeries, dramatically affecting the worker's quality of life, not to mention their overall productivity.

The sander's weight and vibration make it difficult for the artisan to keep the sander flat on the surface. A tilted sander leads





With the ability to position the technician in a more comfortable position, sanding operations with EMMA reduce worker fatigue and injury from repetitive stress injuries.

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to inconsistent material removal rate and a higher chance of gouging the part. Whenever part of the sander lifts off the surface, the vacuum seal (if the sander is connected to a vacuum) fails, spewing dust everywhere. Many aircraft paints and primers contain lead, cadmium, or hexavalent chromium, exposure to which is dangerous to people and the environment and regulated by OSHA, subjecting noncompliant shops to fines which can be significant. The ergonomic stress associated with manual sanding causes fatigue, which impacts process time, finish consistency, and schedule predictability.

It is important to note that these many challenges are not the fault of the personnel assigned to sanding — they're diligent and know exactly how a surface needs to look to be ready to take paint. Nor are they the fault of the sanding tools they are using, which are efficient and long-lasting. The real problem that needs fixing is that a human being has to hold the tool, orient it flat on the surface being sanded regardless of orientation, and apply pressure. Ergonomically, humans simply aren't built to do those things very well.

Solution: What would it look like?

A successful technology which can, and should, displace traditional aerospace maintenance sanding will prevent exposure to vibration and dust, will help the operator sand faster and more consistently, and allow them to stand or sit comfortably while allowing their experience to guide and control the sanding rate — yielding the best possible finish in the least amount of time.

By boosting productivity, such a technology will make each worker more valuable to the enterprise, and will also save on insurance costs, absenteeism, retraining costs, and cost of rework, repair, and scrap (CORRS). By making the sanding process faster and less expensive, such a technology can make it affordable to take off more of the old paint than current manual sanding operations, which could reduce weight by hundreds of pounds, and thus have a significant effect on fuel consumption. A major airline would save more than $5 million each year, and reduce CO2 emissions by 28,000 tons, if each plane in its fleet was 200 pounds lighter.

This calculation is based on fuel consumption; a reduction of 80 kg saves 4,400 gallons of fuel per year. 200 pounds is 91 kg, and thus would save 4,990 gallons/year on each of a typical large airline fleet's 500 planes (figures on fleet size of the top 10 U.S. airlines range from 1,189 (United) to 225 (UPS), and the top 10 average is 557 aircraft) — for a fleet-wide savings of $7,209,859 at today's jet fuel price of $2.89. Thus, the $5 million seems conservative as this would apply to a fleet of 347 aircraft.

One possible solution is the EMMA (Easily Manipulated Mechanical Arm) ergonomic sanding system from Temple Allen Industries in Rockville, MD. EMMA is an entirely pneumatic arm that wields sanders or other tools at the direction of an operator via a joystick interface. An auto-adjust feature allows EMMA's operator to dial in the appropriate sanding pressure for each operation, and the joystick allows the sander at the end of the arm to sweep back and forth at whatever speed generates the best resulting surface.

The free-rotating wrist on the end of the EMMA arm guarantees that the sander at the end is always flat on the surface being sanded, and thus the vacuum seal is maintained, abrasives last longer, and fewer paper changes are required. Productivity improvements drive some customers, while for others, ergonomic improvements and improved dust capture are the primary motivations for updating their processes.

The EMMA Belly System solves the greatest ergonomic challenge in surface preparation — sanding overhead. EMMA allows the operator to comfortably sand the belly of an aircraft, underneath a wing, or any other overhead horizontal surface. The operator sits in the adjustable reclining chair and controls the system via the joystick box.

Deployed widely throughout aerospace manufacturing operations, there are EMMA systems installed at Boeing, Airbus, Embraer, Triumph, and Spirit, among others. Units are also used for commercial and military de-paint operations at British Airways (all aircraft), Robins AFB (C-17s), and the U.S. Navy (T-45s). The military customers in particular value the technology's ability to prevent worker exposure to hexavalent chromium and vibration, to address the challenges of chemical agent resistant coating (CARC) paint, and to reduce flowdays. It also reduces process variance and the risk of damaging composite substrates.

There is a great deal of sanding required by aircraft maintenance operations, and it presents ergonomic, safety, and schedule issues which raise costs and threaten worker health. Using such a solution could capture some of the extra value the improved sanding productivity allows by getting planes back to their owners sooner, having taken off a few hundred pounds more of the old paint than they could have done otherwise. Airlines win, MRO contractors win, workers win, and the environment wins. **AMT**

For more information visit www.templeallen.com.