

REPAIR & OVERHAUL MAINTENANCE LEADERS

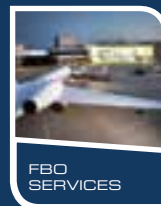
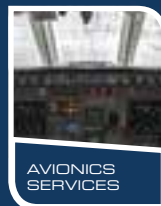
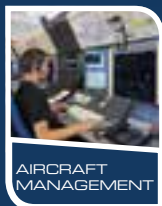


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Maximizing Return on Operations

Business jet activity is rising, according to the most recent TraqPak data from Argus, even as mandates for avionics equipage loom, and cabin and cockpit upgrade options proliferate. This makes the need for quality maintenance, repair and overhaul (MRO) assistance greater than ever. More than 250 companies in the U.S. and Canada are government authorized to provide MRO services, but “that does not guarantee knowledge or competency—it merely establishes a minimum standard,” noted Sarah MacLeod, executive director of the Aeronautical Repair Station Association.

Many service providers stand out for the higher standards they’ve established. These organizations enhance the value of ownership and the aircraft they care for. In fact, “an ongoing working relationship with an MRO lowers the

cost of operations,” said a representative from the Maintenance and System Technology Committee at the National Air Transportation Association (NATA). “And it really helps when the operator needs them at 2 a.m. on a weekend, when it’s 8 degrees outside, and the aircraft is AOG.”

That’s why even fleet operators that handle their own maintenance often turn to experienced providers for help. “Performing major inspections and upgrades isn’t an efficient use of our time and resources,” said Greg Hanelink, flight operations and maintenance director at corporate operator Stryker, which flies domestically and internationally. “That’s what I look for when working with a good MRO: reduced downtime.”

Here are key service areas where quality MRO makes a difference, with examples from some of the industry’s leading providers.

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LINE MAINTENANCE

Whether you're operating a fly-by-wire business jet or an aging airframe, mission readiness depends on the quality of inspections and repairs, attention to squawks, and other routine maintenance. Proper care requires the knowledge, experience and contacts that the best MRO services bring to line maintenance work.

Such services all share one core philosophy: "Safety is first in everything we do," said Gregory Schmidt, president and CEO at Pentastar Aviation, a Michigan-based MRO founded more than 50 years ago as the flight department for Chrysler Corporation. Today, with Class 3 and Class 4 Airframe approvals, the independent company's A&Ps (airframe & powerplant technicians) are approved to work on airframes from OEMs including Bombardier, Dassault, Embraer, Gulfstream and Textron, and engines from General Electric, Honeywell, Pratt & Whitney and Rolls-Royce.

Quality maintenance is rarely the least-expensive option, but top providers work hard to make sure it's the best value. Pentastar's facility and 24/7 service at Oakland County International Airport (PTK) in Waterford, Mich., convenient to major flyways, draws customers "who've become much more price- and time-sensitive," said Schmidt. "There is much more scrutiny of aircraft-owner expenses," he added, noting, "We have risen to the challenge."

Top-notch line maintenance starts with thorough knowledge of—and good relationships with—OEMs whose products the

"Safety is first in everything we do."

MROs service. That's the route Constant Aviation took when it opened in 2005 as a pioneering Embraer Legacy service center. "We didn't want to just dip our toe in the water," said Stephen Maiden, president and CEO of the Cleveland-based company. "We spent a lot of time, resources and money to train and validate our people in the services we wanted to provide." Starting with fewer than 20 employees, Constant now has more than 500 and it supports aircraft including Bombardier Challengers, Global Expresses, Gulfstreams, Citation Xs, Learjets, Embraer Phenoms and Hawkers. "We took the same careful approach when we added these 'niche' airplanes, training our teams for a year before we took on work," Maiden said.

Maintaining aircraft efficiently requires a well-managed supply of rotatables, replacement parts and spares. MROs are only as good as their parts departments, and their systems for tracking inventory. West Star Aviation augments the extensive parts departments at its Alton, Ill., headquarters and Grand Junction, Colo., facility with an avionics spares program that minimizes downtime. Customers can "swap out while their unit is being repaired or overhauled," said

Debi Cunningham, vice president, marketing and interior design, for the company, which was founded in 1947.

West Star is approved to work on Challenger, Citation, Embraer, Falcon, Gulfstream, Hawker and Learjet business jets, as well as on turboprops, including King Airs and Piaggios. The company is about to open an MRO facility in Chattanooga, Tenn., which will also have an extensive parts inventory. (West Star has an Aspen, Colo., location, as well.)

A network of facilities can provide a backstop for jet owners while they're on the road, or keep scheduled maintenance on track, ensuring that customers are covered wherever they fly. UK-based Gama Aviation, with MRO facilities across Europe, and in Asia and the Middle East, recently expanded its service network into the U.S.

"We're strategically positioning ourselves in key areas in the U.S.," said Dennis Richey, the company's executive vice president for engineering. Gama now has facilities in 10 U.S. locations, including all major metropolitan areas as well as Las Vegas, all open to "drop-in retail customers, as well as our managed aircraft," Richey said. Established in 1983, Gama, a full-service charter management company, provides maintenance on aircraft from OEMs including



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Bombardier, Dassault, Embraer, Gulfstream and Textron Cessna Citations, as well as Beechcraft King Airs.

MRO providers can also create domestic or global service networks through longstanding relationships with vetted affiliates in selected locations. Innotech Aviation, a Bombardier Global and Challenger completions and refurbishment specialist, supports customers around the world, though its sole MRO facility in Montreal.

"We send experts on location to assist our customers, and we're connected to [maintenance] partners throughout the world," said Robert Brooks, vice president and general manager at Innotech, which was founded in 1955. Additionally, the company recently opened a sales office at the UK's Stanstead Airport to enhance its responsiveness to overseas clients. When a European customer with a Global XRS completed by Innotech had a towing incident in the Maldives, the company's technicians were sent to assist. (Ultimately, the owner chose to have the aircraft flown to Innotech for the repair, Brooks noted.)

CUSTOMER CONTACT



ELLIOTT AVIATION

“We put the right people on it to prevent delays.”

status reports, and “if we see anything that could affect the schedule, we put the right people on it to prevent delays,” said Mark Wilken, Elliott’s vice president for avionics and operations. The project manager serves as the point of contact customers can reach anytime. With the recent overhaul of its parts department, Elliott can also instantly inform customers of all their choices in new, repaired or overhauled replacement parts and components.

INNOVATECH AVIATION

Founded in 1936 and still owned by the Elliott family, the company has full-service facilities at its headquarters in Moline, Ill., and in Des Moines, Iowa, and Minneapolis. Known for its expertise in Beechcraft King Airs, it is an authorized service center for the turboprop twins, as well as for Beechjet/Hawker 400XPs, Daher and Phenom aircraft. Elliott also maintains Challengers, Citations, Falcons, Learjets and Premiers.

It’s not unusual for owner representatives to be at an MRO during heavy maintenance events or for refurbishments or completions. Jet Aviation St. Louis, a major completions and refurbishment center, provides well-equipped offices for the reps at its facility, as well as access to its entire complex. “Customers can go to the airplane, they can walk into our back shops—we don’t hide anything,” said Aaron Kreissler, Jet Aviation’s director of sales for MRO and completions.

Jet Aviation is headquartered in Basel, Switzerland, and in addition to its U.S. hub in St. Louis and a maintenance facility in Boston/Bedford, it has MRO hubs in Basel, Dubai and Singapore. Founded in 1967, the company is approved to provide MRO services by all major airframers, and for engine maintenance by Honeywell, General Electric, Pratt & Whitney, Rolls-Royce and Turbomeca. A full-service charter management company, Jet Aviation also operates more than 24 FBOs around the world.

The importance of customer contact multiplies as fleets grow. Gama Aviation provides maintenance for major fleet operators, including Wheels Up, and such clients’ aircraft may register “multiple squawks a day,” said Gama’s Richey. Gama provides these clients with real-time data critical not only for tactical operations, but also for “strategic support—it helps with fleet planning,” Richey said. The information “allows the customer to assess how many aircraft they actually need.”

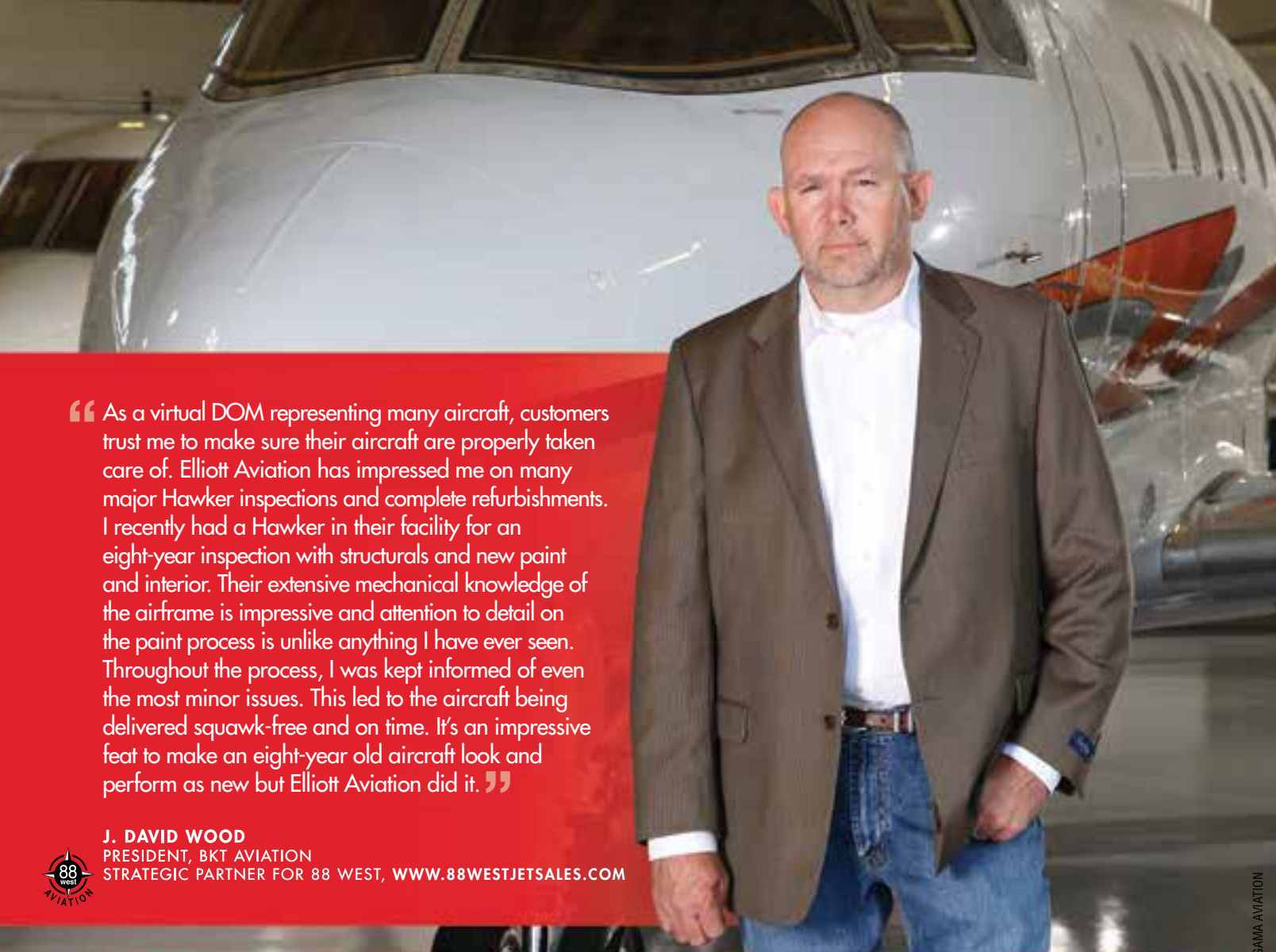
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Owners’ and operators’ teams are deeply involved in their aircraft’s MRO activities: monitoring progress, approving recommendations, signing off on work and more. Leading providers have processes and tools to ensure customers have quick, easy access to the people and information they need to track their projects 24/7, from anywhere in the world.

Duncan Aviation is known for the many STCs (supplemental type certificates) it has developed for aftermarket installations, putting its retrofit and refurbishment services in high demand. The MRO’s myDuncan mobile app allows customers to monitor project status from any computer or smartphone. “Team leaders and the project manager can send the customer photos of parts, damage or repairs, and get approvals on the fly,” said Dennis VanStrien, airframe services sales rep at Duncan’s Battle Creek, Mich., facility. Customers can control levels of access—for example, designating which individuals have squawk approvals.

Founded in 1956, Duncan has full-service MRO facilities at its Battle Creek headquarters, and in Lincoln, Neb., and Provo, Utah, and offers avionics service and engine rapid-response teams in more than two dozen additional U.S. locations. It maintains airframes including Challengers, Citations, Embraers, Falcons, Globals, Gulfstreams, Hawkers, King Airs and Learjets; and it is factory authorized to work on Honeywell, General Electric, Pratt & Whitney, Rolls-Royce, Williams and Hamilton Sundstrand engines.

Making sure projects remain on schedule is an important part of the job. Like many leading providers, Elliott Aviation employs dedicated project managers. They oversee each project, review daily



“ As a virtual DOM representing many aircraft, customers trust me to make sure their aircraft are properly taken care of. Elliott Aviation has impressed me on many major Hawker inspections and complete refurbishments. I recently had a Hawker in their facility for an eight-year inspection with structurals and new paint and interior. Their extensive mechanical knowledge of the airframe is impressive and attention to detail on the paint process is unlike anything I have ever seen. Throughout the process, I was kept informed of even the most minor issues. This led to the aircraft being delivered squawk-free and on time. It's an impressive feat to make an eight-year old aircraft look and perform as new but Elliott Aviation did it. ”

J. DAVID WOOD

PRESIDENT, BKT AVIATION

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INTERIOR DESIGN



Whether for a total refurbishment or a green completion, any business jet airframe can be a canvas for creating a customized interior to meet the needs of the most demanding owner or operator. Top MROs have the interior-design talent, tools and engineering teams required to create and certify state-of-the-art cabins and cockpits, while meeting tastes running “from mild to wild, and everything in between,” said Elliott Aviation’s Wilken. Elliott uses an Envision 3D modeling system to help customers see what their interiors and paint schemes will look like while they’re still in the planning stages. With the 3D system at the company’s Moline Paint and Interior Design Center, interiors specialists can instantly simulate how materials, color schemes and finishes would look in the cabin, helping customers get exactly what they want.

The team at Innotech’s design showroom in Montreal specs interiors for refurbishment and completion projects with materials, color swatches and renderings it presents to clients based on their preferences. Computer modeling also plays a role in developing interior-design plans. “We start with a virtual airplane, so that when clients walk into a real airplane, they have a better idea of how it will look,” said Brooks. Innotech also sends its designers to automotive, boat and yacht trade shows and other venues “outside the aviation world, where our customers circulate, to bring new creature comforts” to the cabin, he said. “We want to stay close to their DNA.”

West Star Aviation’s design centers at its Alton and Grand Junction facilities contain “everything you could possibly want to put together a great interior,” said Cunningham, including vast selections of woods, leathers, fabrics, plating and other sample

“From mild to wild, and everything in between.”

materials for customers to consider. Many clients involve their own designers, who work on owners’ homes and offices, in such projects, and West Star’s design teams work closely with them, educating them on the flammability, crashworthiness and other standards that materials must conform to in the aviation world. When customers don’t have the time to visit a West Star design center, “we’ll bring samples, color swatches and interior plans to their location at their convenience, Cunningham said. “That’s just part of being customer oriented.”

Clients at Pentastar, the Michigan-based MRO, often use significant maintenance events as an opportunity to upgrade their aircrafts’ interiors. Pentastar has long provided outsourced interior-design services, but in response to customer demands, brought its preferred interior-design firm in house two years ago.

Last year Pentastar opened its Aircraft Interior Design Studio. “Now we’re able to complement the expertise we’ve always had in maintenance, with minimal downtime for customers,” said Schmidt. “People can literally taxi right up to our design facility.” The center is stocked with samples of wood, leathers, carpeting, sidewalls and other materials, “and we can have all the choices available to see and touch in a comfortable, well-lit environment.”

constant

AVIATION



MRO Facilities

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Las Vegas, NV
Cleveland, OH

AOG Hubs

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REFURBISHMENTS & COMPLETIONS

MROs' teams of master craftsmen, artisans, A&P technicians and avionics and interior specialists can turn old airframes into like-new aircraft, or provide completions for green aircraft at a quality level even OEMs can't match.

The ability to refurbish legacy aircraft is exemplified by Elliott Aviation's new Beechjet 400E program. The company performs total refurbishments of Beechjet 400A/Hawker 400XPs with Garmin 5000 flight decks (the first field installations) and roomier, lightweight interior shell, with Gogo Biz and an Avod (audio/video on demand) system and enhanced comfort that "blows away a comparably performing new aircraft," said Elliott.

MROs can also reconfigure aircraft to meet new mission requirements, providing options for customers who are updating aircraft they own or plan to purchase. "Sometimes customers want something different—a floor-plan change, for example," said Cunningham at West Star Aviation.

As part of a complete refurbishment, West Star recently reconfigured a Falcon 2000 to create a 13-passenger interior in what is typically an eight- to 10-passenger jet. The project required moving bulkheads and making structural modifications. West Star's in-house engineering group and on-staff DER (designated engineering representative) provided support. Such a change "had only been done one other time—at the OEM facility," Cunningham said.

With the complete range of services they offer, major MROs can ensure total quality control and attention to detail. Jet Aviation St. Louis, renowned for its refurbishments as well as completions of

"We're like a dream factory for new airplanes."

green Bombardier aircraft, custom builds and upholsters its seats and makes sure they meet customer approval. "We have the owner sit in the first [prototype] article to make sure the contact on the back of the legs, the bolstering and the firmness are correct," said Kreissler.

MROs also make sure the interiors they install are easy to remove for inspections and access. "We build them very maintenance friendly and easy to disassemble," Kreissler noted. He added that Jet Aviation keeps extra carpet, seat leather and other materials on hand, "so if there's any damage, we can build up a new seat or cut a new carpet for them."

MRO refurbishment services extend beyond aircraft interiors to major airframe work, an imperative capability for maintaining current fleets. "You've got a lot of equipment 20 and 30 years old whose operation at this age wasn't contemplated at the time of production," said Frank Publiski, vice president of maintenance, at Pentastar Aviation. He cited a recent GII airframe refurbishment that required removing the wings, and said Pentastar has become expert at skin replacement, wing demating, and tail removal in refurbishing aging airframes.

MROs that perform green completions are approved by OEMs because they can provide a level of customization and quality

the manufacturer can't equal. "We're like a dream factory for new airplanes," said Brooks at Innotech, which has performed completions on more than 150 Bombardier Challengers and 50 Globals. He cited the "chandeliers" that designers recently created for a Global in conjunction with Swarovski Crystal: they appear as three-dimensional fixtures hanging from the headliners. "We came up with the solution using crushed crystals and manufactured it in house," said Brooks.

The company applies this same capability to refurbishments. "The cross knowledge base from completions to MRO is extremely valuable," said Brooks. "We're installing state-of-the-art options—some of which we designed—right out of Bombardier's options catalog." Not only do such upgrades increase the utility and owners' enjoyment of the aircraft, noted Brooks, but they "will increase the value of your airplane, and the value will improve with the pedigree of the company doing the refurbishment."

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AVIONICS & COMMUNICATION



“We create solutions of value, from tip to tail.”

Options for meeting looming regulatory mandates, opportunities to install upgrades that improve safety and efficiency, and expanding cabin-connectivity choices make avionics and communication solutions a key area of MRO expertise today. Leading MROs track regulatory mandates around the globe and develop STCs that permit them to retrofit the latest avionics and communications products. Providers like Elliott Aviation serve on the dealer advisory boards of major avionics and electronics manufacturers, so these MROs know what's in the pipeline, helping customers plan ahead. Elliott's Wilken noted his company creates many of its avionics and communication-equipment STCs in partnerships with the OEMs, ensuring optimum performance and minimal installation downtime. Elliott has performed more than 200 Garmin G1000 panel retrofits in King Airs, for example, experience that enables it to promise to complete projects in 15 working days and to pay customers \$3,000 per day for any additional downtime.

To remain in the forefront as a solutions developer, Constant Aviation has an R&D team that consists of engineers, avionics technicians, and sales-staff members that tracks regulatory mandates along with new technologies and products, to “create solutions of value, from tip to tail,” said Maiden. Constant offers STCs for installations of ADS-B, FANS, CPDLC and datalink systems that comply with all regulatory mandates, and can

perform them at either of its Cleveland facilities (CLE and CGF), or its Birmingham, Ala., or Las Vegas repair stations.

Duncan Aviation remains among the most prolific STC developers. “Because of our ODA [organization designation authorization] capabilities, a lot of manufacturers approach us about developing STCs” that compete with OEM avionics retrofit programs, said Gary Harpster, an avionics sales rep at Duncan's Lincoln facility. Among popular upgrades are its ADS-B solutions for Citations and Hawker 800-series jets, and FANS and synthetic vision systems for Falcon 900s. Duncan also invests in educating operators about available upgrades. It is conducting NextGen seminars around the country in partnership with avionics OEMs “so operators can better understand and plan for the upcoming mandates,” Harpster said.

MROs are also answering the demand for cabin connectivity, even as potential solutions proliferate. “We went from Gogo and Inmarsat, to five or six connectivity options now, and more coming as other satellite systems come on line,” said David Loso, Jet Aviation's avionics sales manager, who also serves as chairman of the Aircraft Electronics Association. Loso noted that proper installation of these systems often requires more than an A&P. “The actual configuration of these routers is a science and requires somebody with an IT-networking background,” he said. Jet Aviation provides its technicians with the requisite training.



Completions



Maintenance



Paint

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COMPLETIONS - MAINTENANCE - PAINT



LIVERY & PAINT



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Doubling as fashion statement and protective barrier, an aircraft's livery deserves exemplary attention—especially today, when reformulated, environmentally friendly paints require precise application in prescribed conditions. Meanwhile, computerized scheme designs and new application processes have expanded the possibilities for aircraft livery. Leading MROs have all sides covered in providing these services.

As part of its Bombardier completions offering, Jet Aviation St. Louis paints green aircraft fresh from the assembly line, and no buyer is more demanding than an airframer. Jet Aviation provides computer-generated, full-color renderings of designs for client approval. Its artists can also create sophisticated decals and custom airbrushed logos.

Aircraft in for repainting receive the same level of quality. To prep these aircraft for their new livery, Jet Aviation has developed an FAA-approved, environmentally friendly alternative to the strip-and-paint process.

Superior providers recognize that every step in the operation is critical to a quality outcome. "Prepping is as important as painting," said West Star Aviation's Cunningham. West Star's facility in Grand Junction can accommodate aircraft as large as a Gulfstream G650 and incorporates such technology as vari-drive compressors, which supply compressed air for smooth, steady paint application. But well before heading for the paint booth, West Star's in-house designers provide a variety of renderings to clients as they refine the scheme. Once the customer selects colors, techs spray them out on metal, to show clients how they would appear on an aircraft.

While most clients still prefer livery that doesn't call attention to the aircraft, the major MROs are up to any creative challenge. Gama Aviation's Oxford paint facility was recently tapped to create a scheme

“Painting an aircraft is a chemical reaction.”

on a Challenger 601 for a promotion for Cadbury honoring Prince George's first birthday. The shop has also produced special liveries for a Beechcraft King Air 200, Bombardier Challengers and helicopters.

Innotech Aviation's paint facility has its own water-treatment plant with multiple filtration systems and carbon walls, as well as equipment to capture emissions. "When we paint an airplane, our VOC [volatile organic compound] discharge is less than [that of] a Mack truck driving down the road," said Richard Shaw, a regional sales manager for Innotech. Shaw also pointed out that Canada doesn't tax MRO services, and that current exchange rates make the costs attractive to U.S. customers.

The paint facilities at these MROs are almost as sophisticated as the aircraft they serve. Painting an aircraft "is a chemical reaction," explained Elliott Aviation's Wilken, and requires "precise temperature and humidity control, and filtration systems for dust." Elliott's paint shop and in-house design staff can create paint schemes to suit any taste.

A recent paint scheme on a King Air 350 air ambulance operated for a children's hospital in New Zealand illustrates the MRO's capabilities. Aimed at putting its young passengers at ease, the fanciful scheme uses 22 colors in a bold tableau of people and astronomical images.

Price quotes from paint shops can vary greatly, Wilken noted, adding, "Price is what you pay, value is what you get. Compare facilities, not just prices."

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AOG: DOWNTIME



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Whether it happens at home or on the road, an unexpected AOG (aircraft on the ground) situation is the bane of aircraft operations. Quality MRO providers are committed to getting clients back in the air quickly, whatever the problem and wherever they are.

"It used to be rare for someone to need a passport, but now all our engine guys need passports," said Mike Bernholtz, Duncan Aviation's engine turbine sales manager at its Lincoln facility. The company's engine rapid-response teams are at more than a dozen facilities across the U.S., and with passports in hand, can be dispatched worldwide for service calls. Duncan also has road teams that respond to airframe-related AOGs, as well as technicians on call to address avionics issues. Additionally, Duncan's AOG app provides the phone number of the nearest Duncan facility/service team based on a client's need. The app can use the client's phone's GPS data to locate the nearest available engine, airframe or avionics AOG assistance.

Constant Aviation has enhanced its AOG service through its recent merger with Lone Star Aviation, which adds more than 60 technicians in over 20 locations to provide support for grounded aircraft. "We plan to have the single-largest AOG network in the country," said Maiden. Constant is also building up its parts department so needed components for grounded aircraft are available quickly. The company has \$48 million in owned or consigned parts in house. "Almost all of the parts tie into our core fleet types," said Maiden, "so when someone needs a starter generator or avionics component, all we have to do is go to the shelf."

As a full-service charter management company, Pentastar Aviation realizes the problems AOGs cause and takes proactive maintenance steps to minimize occurrences. "We know the importance of having aircraft up and running," said Schmidt.

"Now all our engine guys need passports."

Nonetheless, AOGs occur, and Schmidt points to another advantage Pentastar's full-service model can offer when they do: "If someone has an unexpected maintenance event, we can easily fill a charter request and keep things moving when their airplane is down."

Gama Aviation takes a different proactive approach to minimizing AOG disruptions: the company positions AOG teams where customers are likely to fly. In winter months, Gama stations technicians in Puerto Rico, the Bahamas and South America. "That plays a big part in reducing the duration of an AOG," said Richey. Gama can also call on its worldwide team for AOG assistance anywhere. Scott Corbett, a Gama base-maintenance manager in the Middle East, cited a client's U.S.-registered Global that recently had an AOG in Amman, Jordan. "A Learjet flew with an engineer and part from the UK, we sent support technicians from the Middle East who replaced the part, and we got [the Global] back in the air within 24 hours," he said.

Jet Aviation also has a global-service network to call on, along with the assistance its MRO hubs in Basel and Singapore can provide. The company has three mobile service trucks at its St. Louis base that will travel up to 500 miles, and puts technicians on aircraft for AOG service farther afield. "We've been as far as Costa Rica," said Kreissler. "We'll go out and support any AOG—not just our clients' airplanes."

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Aircraft Sales

1963



Lincoln, Nebraska

1963



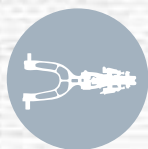
Fuel Services

1966



Avionics & Instruments

1978



Accessories

1979



Paint

1981



Engines

1981



Interiors

1984



Parts Consignment

1985



Avionics Satellites

1992



Aircraft Acquisition

1998



Battle Creek, Michigan

2000



Engine RRT

2010



Provo, Utah

2017, 2025, 2040...



Future innovations to be determined by your requests.

