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MARCH 2017

AMT AIRCRAFT MAINTENANCE TECHNOLOGY

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COVER PHOTO courtesy of Marino Boric. This model of an Airbus concept plane using bionic structure design is printed of aluminum and magnesium.

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DEPARTMENTS

INTRODUCING *AMT* MAGAZINE'S **CAREER DEVELOPMENT NEWSLETTER**

This month, *Aircraft Maintenance Technology – AMT* Magazine launches our new AMT Career Development Newsletter

If you are one of the 40,000 plus subscribers to our print or digital magazine you already know that we regularly provide feature articles on education, training, workforce and career related topics. And if you are also one of the 30,000 plus subscribers to our *AMT* Daily Newsletter you know you will also see a few training news items every day.

OK, before you say, *hey not another email in my inbox* … let me explain why we decided to do this newsletter. In the 2016 *AMT Magazine* Readership Survey, you, our readers told us your top two critical issues were in this order: Training on the complexity of aircraft today, and recruitment and retention of employees. This shouldn't be a huge surprise to any of us.

Over the years I have become involved in several industry initiatives relating to aircraft maintenance education, training and workforce development, and regardless which segment of the industry or the position of the people I speak with the words training and workforce are always mentioned.

We understand how important education and training is in our industry and we decided to take additional steps to cover these critical topics.

Last year we added the Education and Training channel to our website www.aviationpros.com. Now we have a dedicated page for current news and articles relating to these topics. Just click on the Education and Training button on the home page navigation bar and start reading.

The new *AMT* Career Development Newsletter is designed to bring you current news and relevant articles on education, training, professional development, new technologies, tips for job seekers, and the occasion job opportunity directly to you. We plan to begin with sending the newsletter two times each month.

It's important to note these new offerings are not only meant for students. Although important to students and the next generation of aviation professionals, education, training, professionalism, and career development is applicable to nearly any age person working at any level in our great industry.

Check out the Education and Training channel on www.aviationpros.com and while you are there select the Subscribe button on the home page, select the E Newsletter Subscribe Button and you will find the subscription form for the new *AMT Magazine* Career Development Newsletter. If you are reading this column in our digital magazines simply follow this link for more information. Ron

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TEXTRON AVIATION
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NOT YOUR GRANDFATHER'S COAT OF PAINT

As aerospace coatings grow ever more sophisticated there's a need as never before to train the technicians to apply the stuff right

By Jerome Greer Chandler

As anybody who's been around for any length of time in this business can attest there's been a visual and material revolution in the application of aerospace coatings of late. One of the leaders of the pack is Sherwin-Williams Aerospace, formulator of sophisticated, even stunning, coatings for everything from general aviation aircraft to commercial jets.

As those coatings grow ever more sophisticated there's a need as never before to train the technicians to apply the stuff right.

To that end "We conduct about six internal training courses per year" in the company's Andover, KS, headquarters says Richard Giles, global technical services and training manager for Sherwin-Williams Aerospace.

You just don't walk into one of the two-day sessions in Andover, "The training requires an application form ahead of time," says Giles. "Applicants write a formal description of why they're attending and the products of interest, so that we get an idea of why they're actually there."

JEROME GREER CHANDLER is a two-time winner in the Aerospace Journalist of the Year competition's Best Maintenance Submission category; he won in 2000 and 2008. His best-seller 'Fire and Rain' chronicles the wind shear crash of Delta Flight 191 at DFW. Chandler's passion for aviation safety is more than professional. It's personal. Two of his relatives have perished on commercial airliners, one of them in the infamous Braniff Electra crash of 1959.

SURFACE PREPARATION is a key factor when it comes to aerospace coatings training; the finished product is only as good as its foundation.

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Training costs vary a great deal says Giles, depending on a trainee's needs. Maybe it's new technology, perhaps a new generation of materials. "Each training course is tailored to [their] needs."

Flexibility is in, rigidity out when it comes to devising paint shop training efforts. Giles says, "We don't have a rigid training course per se, because when we have four or five trainees signing up for our internal courses, they may have specific issues. What we don't want to do is make these particular guys aware of paint issues they will never, ever see."

In addition to the half-dozen or so fixed sessions in Andover, Sherwin-Williams trains at any customer loca-

SHERWIN-WILLIAMS AEROSPACE coatings training involves both hands-on application and techniques, as well as classroom style learning of trends, system reviews, and safety instruction.

MUCH OF aerospace coatings training involves the skill of properly applying exterior coatings – which includes primers, primer surfacers, color (or topcoat), and clearcoats.

SHERWIN-WILLIAMS AEROSPACE

tion. It's not unusual for a company to have two or three shifts. In such cases "It's impossible to gather the paint shop [crew] and bring them to our facility. We take our toolbox of tricks and information and go to [them]."

SO, WHAT'S NEW?

That bag of tricks covers a wide array of new materials, new technologies, and the techniques to make them work right.

The aerospace coating's industry demands the latest technology. Example: non-chromium pretreatments and primers for the exterior of all classes of aircraft. Sherwin-Williams offers both chrome and non-chrome technology aerospace paints for the exterior of the aircraft. While chromium-based coatings are still used to protect interior structure, Sherwin-Williams has shifted its aerospace emphasis to multi-coat basecoat/clearcoat systems.

> "We focus on the issues and the products, so that **they walk away with a great deal more information than they walk in with."**
>
> — *Richard Giles*

The move has released the inner artisan in paint shop personnel. "The livery, the [visual] design of the aircraft is becoming very bold," says Giles. "Straight lines are out of fashion. Free space is in. Usually, many colors are involved in the same aircraft frame." Doing it right today "takes a different approach, a different understanding."

Micas play an important part in bringing new liveries to life. "The mica is a very small translucent disc, which emits light at different levels and angles, and has a very pleasing visual effect," says Giles, one rich with depth and texture. It will reflect several different colors at one time.

You can bring out such pleasing colors via a two-stage application of basecoat/clearcoat. But to extract the very best visual effect lots of operators and OEMs are choosing a three-stage approach says Giles. "The three-stage system produces a very vibrant color palette, very often a light color, a mica white," he says. "It requires a white coating be laid down on top of a prepared surface. Then the

mica itself, then the clear coat. So, there are three layers to that system."

Traditional acrylic coatings are the easiest aerospace coatings to apply, and Sherwin-Williams offers a comprehensive selection of this technology. They're still "very popular" says Giles. These conventional solid, metallic and mica coatings are used even where VOCs are not an issue. Giles says acrylics remain "very user-friendly."

Either way, getting the application right remains paramount. Wringing the best from aircraft coatings can be, ah, "demanding," says Giles. It all starts with getting the basic principles right.

"It's not a 'black art,'" he says. "Once you have these principles in place, application of all aerospace coatings, including the new micas, tend to be relatively easy."

- First, make absolutely sure you understand your client's expectations. Commercial aircraft operate under decidedly different downtime constraints than business aviation or general aviation aircraft.

"We always start and go back to the fundamentals: is the surface properly prepared? Is the equipment set properly? Are they mixing the product properly?"

— Julie Voisin

- Don't scrimp on equipment, and make sure employees know how to use it. Giles says you should "make sure the paint is conditioned to room temperature. We shake [it]. We make sure the components of the material are added accordingly to the product data sheet. We allow the material to 'induct' … or sweat. This makes them chemically homogeneous."
- Each training course has the trainee help assemble the spray gun, making sure the fluid rate and the air pressure are right. Then instructors have the trainee spray a panel and check to make sure the paint pattern leaves neither runs nor exhibits dry spray spots. "Ninety-nine percent of the time [trainees] are amazed that

RICHARD GILES, Sherwin-Williams technical and training manager, reviews the different systems recommended for the different types of general, business, commercial, and military aircraft.
SHERWIN-WILLIAMS AEROSPACE

they can apply a membrane of paint that looks glossy," says Giles — but without glitches.

Giles' colleague, Julie Voisin, is Sherwin-Williams Aerospace's global marketing manager. To his list of must-do's she adds some basic A, B, Cs for success. "We always start and go back to the fundamentals: is the surface properly prepared? Is the equipment set properly? Are they mixing the product properly? ... That's a big part of the training program. Because if you do the fundamentals right it has a direct correlation as to how that final finish looks."

All of this is simple in its principle, demanding in its execution. Giles believes Sherwin-Williams' far-flung training courses "are very descriptive," The idea is not just to check the box on the employee's work record to indicate he showed up but to render the course relevant "so that it has a big impact on their lives. We focus on the issues and the products, so that they walk away with a great deal more information than they walk in with." ***AMT***

AEROSPACE COATINGS TRAINING PROGRAM

Here's a rundown of this year's remaining **Aerospace Coatings Training Program** in Andover. You can sign up via the Internet by going to www.swaerospace.com.

- April 18-19th
- July 18-19th
- September 19-20th
- November 7-8th

ELLIOTT AVIATION'S Jeff Solberg preps a Blackhawk engine installation on a King Air B200. ELLIOTT AVIATION

ENGINE OVERHAUL OR UPGRADE?

For the King Air 200, B200 and B200GT there are options

By Mike Saathoff

Engines on an aircraft are almost always the most expensive component to maintain. When an engine is timed out, some aircraft owners don't have any options other than to overhaul their current engines. For the King Air 200, B200, and B200GT, however, there are several options to upgrade for more speed, decreased time to climb, and better performance.

THE TIMES & INSPECTIONS

Regardless of the model of engine that is on your aircraft, the intervals are 1,800 hours for hot sections and 3,600 hours for overhaul. If you are unfamiliar with the process, a Hot Section Inspection is not a full overhaul and does not incur near the cost. During a Hot Section Inspection, all hot section engine components are inspected to make sure they can generate enough power for efficiency and safety. This includes turbine blades, compressor inlet, CT shroud segments, and more.

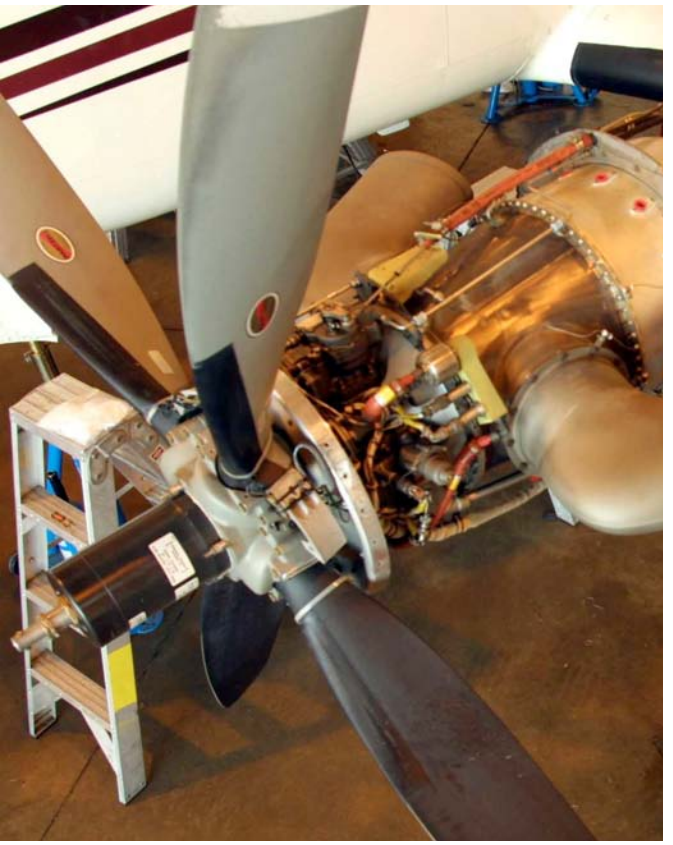
During an engine overhaul, all portions of the engine are disassembled, cleaned, inspected, reassembled, tested (ensure the facility you will be using has an appropriate test cell to run the engine off wing through all parameters), and shipped back to the installation agency. The engine consists of four major sections as follows: Accessory Gearbox, Gas Generator section, Power

Section, and Reduction Gearbox. Engine accessories that will also be overhauled at that time are as follows: fuel control unit, fuel pump, fuel nozzles, fuel flow divider, fuel oil heater, constant speed governor, heated tubes, and ignition unit. During the overhaul, any mandatory service bulletins can be embodied. It is also a time when any optional service bulletins may be reviewed and completed if a customer elects to do so. Service centers at that time will also make recommendations of the bulletins that will benefit the customer. This is also a time when the engine mounts should be changed, engine hoses reviewed for life limit and changed if needed. A reputable service center will be able to explain to you and guide you through any items that must be done, as well as optional items that could be done at that time because of access and convenience.

OVERHAUL OR UPGRADE

If your engine is due for overhaul, it can be difficult to navigate all of the options, especially if it is your first time going through the process. When starting the project, it is important to know what engines you currently have on your aircraft. This can vary based on the serial number of your airplane and whether it has already been upgraded or not. However, a general guideline is the King Air 200 was built with a PT6A-41, the B200 was built with a PT6A-42, and the B200GT was built with the PT6A-52. Once this is identified, it is important to work with a service center, preferably an authorized service center, who can manage your project throughout the entire process.

Working with an experienced service center provides you many benefits, the first being pricing. Since service centers provide dozens of engine overhauls each year, they have negotiated the best prices with both engine overhaul facilities and engine providers. In addition, they will be able to provide you with all pricing options and help weigh your cost-benefit analysis. They can also complete the engine removal and reinstallation in the most efficient and cost-effective manner. They can complete any other work you need during your downtime such as airframe inspection, paint, interior, or avionics upgrades. If a problem arises, the MRO facility has the ability to fix numerous engine issues and obtain the appropriate level of support with the overhaul or engine supplier. They will also stand behind the project, including honoring warranty issues.



ENGINE OVERHAUL FACILITY CHECKLIST:

- ❑ Give me a report of what was wrong with my engine
- ❑ Fly me to see their facility and review my engine during the inspection progress
- ❑ Have a good relationship with the MRO
- ❑ Are they responsive to my questions
- ❑ Have a good name in the industry
- ❑ Reveal turn time
- ❑ Provide loaner engine availability and price
- ❑ Have a field service response team
- ❑ Provide warranty hours and calendar limits
- ❑ Have the ability to do repairs
- ❑ Be able to use overhauled, repaired, or used parts to reduce cost

If you are overhauling/upgrading for the first time, make sure to review the needs for your aircraft. Would you like to go faster, decrease time to climb, or increase performance? If the answer is yes to any of those questions, you should explore your upgrade options. The current available options are the PT6A-42, the PT6A-61, and the PT6A-52. Each option has different pricing and performance capabilities. Review the overhaul quote cost and ballpark estimate out-the-door costs and compare them to all of your upgrade options. In some cases, it may be more economical to upgrade. These comparisons can be done easily with a competent and trustworthy MRO representative.

CHOOSING WHO WILL OVERHAUL YOUR ENGINE

If you have weighed all of your options and decide an overhaul is the best decision for your aircraft, it is important to fully understand what facility is going to be right for you. There are a few factors to consider. Do you want a Pratt & Whitney approved facility? Are you OK using a facility that Pratt & Whitney does not support? Are you comfortable using PMA parts, or do you only want to use OEM parts? Does the company you are using have a long-standing history and good reputation?

As you can see there are many factors to consider when choosing an engine service center.

WORKING WITH A SERVICE CENTER

If you have decided that you would like to work with an authorized service center, it is recommended to get at least two to three quotes and compare all items on the quote, not just price. This will ensure that you are making a fair comparison.

When you are faced with the challenge of overhauling or upgrading your engines, your options can seem overwhelming. With a little bit of education and some guidance from an authorized service center, you can go into the process better informed with less surprises. ***AMT***

MIKE SAATHOFF has over 20 years of experience in corporate aircraft maintenance. He has held several service technician and quality control positions with Elliott Aviation and currently serves as the Director of Sales Operations & Engine and Accessory Sales. He has an Airframe and Powerplant and Inspection Authorization license with the FAA.

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HOW IT WORKS:

A COLLABORATIVE PARTNERSHIP

Both Boeing and ANA cite the intense cooperation as being vital to the Dreamliner's development and successful integration into fleets worldwide

By Ronald Kuhlmann

WHEN IT COMES TO SAFETY AND MAINTENANCE ISSUES, even the most dedicated competitors in the airline industry become willing collaborators and this sense of common purpose extends to manufacturers as well. Almost every airliner built in the last half century has been given life by a launch customer that took the risk of being first off the blocks with a new design or model upgrade.

However, when looking at the development relationship for the B787 between Boeing and All Nippon Airways (ANA, NH), one finds a paradigm on steroids that continues to this day.

BOEING BIAS

ANA has been a Boeing operator for 50 years and has operated every aircraft type except the B707 and B757, so the relationship was strong to begin with. Beginning in 2002, ANA was part of a group that decided to green-light the 787 project. Two years later, in mid-2004, ANA placed its first order for 50 of the aircraft — the first non-U.S. carrier to commit. ANA also established a permanent team, residing in Seattle, to work with Boeing on the development of the aircraft and its entry into service.

Anyone following aviation will be well aware of the problems that ensued between that first order and entry of the airplane into service. Originally planned for spring 2008, ANA did not receive its first aircraft until September 2011 and the first commercial service was launched on October 26.

And then in January 2013, the aircraft was grounded due to fires related to its lithium-ion batteries. (Having been invited for the first flight from San Jose, I was amongst those rerouted due to the grounding.) All in all, one might call this whole process a bit rocky. And through it all, as the launch customer and largest operator, ANA worked unstintingly with Boeing to correct the problems and bring the aircraft up to its promised potential. Both Boeing and ANA cite this intense cooperation as vital to the aircraft's development and successful integration into fleets worldwide.

ANA was also working with Boeing as it began to expand the program to include the -9 and -10 variants. The two companies adopted a slogan "working together" that symbolized the joint effort to fashion an innovative aircraft by using input from both the manufacturer and the user.

PROMISE REALIZED

And it has paid off over time. In mid-2015 ANA took delivery of its 50th 787, a -9 model. That record of 50 aircraft in less than five years makes ANA the largest customer and operator of the 787 series. With its growing fleet, much of the potential foreseen when the aircraft was developed, has come to fruition. Trans Pacific routes to San Jose, Seattle, and Mexico are viable because of the aircraft's smaller size and favorable operating economics.

DREAMLINER INSIDE ANA facility in Tokyo.

Compared to the B767 that it is primarily replacing, fuel costs are down by 20 percent and the wing's higher aspect ratio boosts efficiency by another 7 percent. By eliminating bleed systems from the engines they have achieved higher power ratings and greater reliability.

When it receives its first -10 aircraft, ANA will be the first airline to operate all three variants which bring network advantages by being able to more accurately align supply with demand across 787 routes. The initial route for the -10 is yet to be determined.

Rolls-Royce, maker of ANA's 787 engines, is being tasked with the production of a higher thrust engine which will boost the aircraft's capabilities. (The corrosion issue that arose in 2016 has been fully addressed by RR.)

STRAIGHT FROM THE MAN IN CHARGE

Noboru Okada, the airline's manager for engineering planning and administration, says that his experience and that of his team, has been as expected, but with lots of initial systems problems — and of course the delays. But he notes that many such difficulties were within normal bounds for a launch customer and many of those hurdles were less bothersome due to the unique relationship between ANA and Boeing.

Due to its carbon fiber construction, ultrasound is a valuable tool in finding damage that may not be visible on the surface. And the use of that material has resulted in a 20 percent cost savings with regards to structure — primarily through the absence of corrosion.

Also due to the size of the fleet and accumulated experience with the 787, ANA has improved and upgraded systems over time so that the present dispatch reliability for the Dreamliner fleet is well above 99 percent. And given the newsworthiness of early problems with the 787, Okada says that overall, in retrospect, the teething problems with the 787 have been on a par with the airline's triple-sevens, an aircraft with a much longer service record.

MULTI-USE AND POPULAR

ANA uses its 787 fleet on doth domestic and international routes, with the domestic models having a higher density seating configuration. For the -8, of the 36 aircraft, 25 are configured for international service and, as of the delivery of the 50th unit, almost all of the -9s were in a long-haul configuration. The ratio for the -10 remains undecided.

In domestic use, aircraft operate an average of six cycles per day while international usage is 12 to 13 hours per day. The aircraft's larger windows, advanced LED lighting, higher humidity, and lower pressurization level have all made the 787 a customer favorite at ANA as well.

So, the word from those who know is that after a rough start, the 787 series has delivered with regards to reduced operational costs, simpler maintenance, and high customer satisfaction. It was a bet that has paid off richly. ***AMT***

RON KUHLMANN has spent his entire life in the aviation industry. Beginning with a 30-year career at Swissair, he moved to an aviation consulting firm which eventually was absorbed by Unisys Transportation. He has written for numerous aviation publications and has been a speaker at industry events, including being the keynote speaker for Lufthansa Systems' global meeting in Berlin.

GAME OVER FOR GERMS AND SHARKS IN THE SKY

By Marino Boric

On the outside of an aircraft, paint has to protect the fuselage and look pretty. New characteristics include fighting bateria on the inside and increasing speed.

IN THE lab at Mankiewicz.
IMAGES COURTESY OF MANKIEWICZ

MARINO BORIC graduated with a university degree as an aeronautic engineer, and acquired degrees in business development/trade and commerce and in journalism. He is a civil and military pilot and has built experimental aircraft. As a journalist, he specializes in aviation and propulsion and travels worldwide, flight-testing UL, LSA, Experimental, and certified aircraft. He is writing for U.S., European, and Chinese media companies.

The Germany-based paint specialist, Mankiewicz has delivered paint solutions for aircraft exteriors and interiors for decades. Paint has evolved over the time and is increasingly delivering functions not known before. On the aircraft skin, paint has the task to protect the fuselage and to look pretty; inside the fuselage, paint has to fulfill similarly, but varying functions — all depending on the location. With a new antimicrobial, FST Coating Mankiewicz now has declared a war on germs inside the aircraft. The new antimicrobial paint is a hidden detail which is of increased importance in this globalized — travel – world and is getting the attention of aircraft operators and of passengers. This was the reason for AMT European Correspondent to visit Mankiewicz and a production facility in Hamburg, Germany.

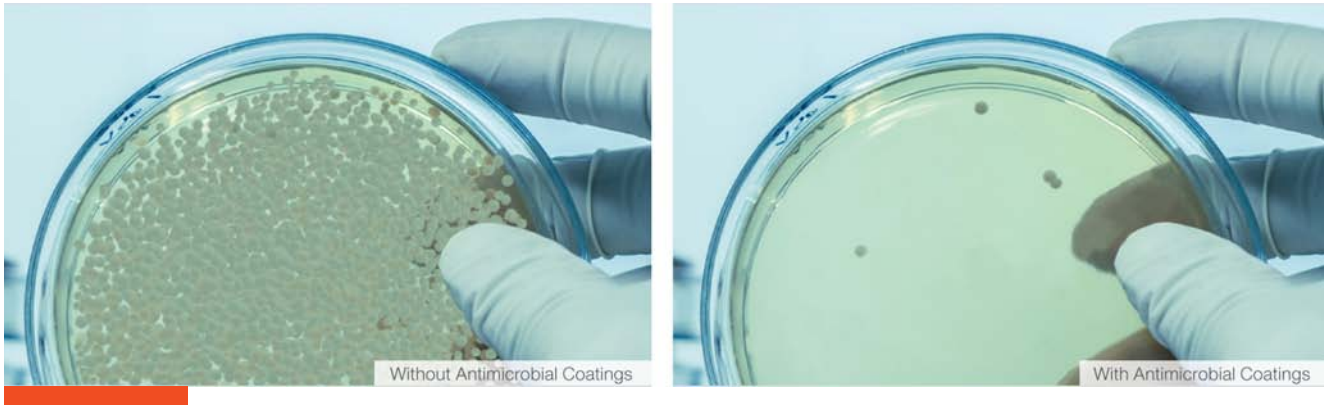
The main reason for the *AMT* visit is the information that the company is presenting at the upcoming Aircraft Interiors Expo (AIX) in Hamburg (April 2-4): its antimicrobial FST coating with a demonstration of effectivity in the reduction of bacterial growth.

BACTERIA IN THE AIRPLANE, IS THIS A PROBLEM?

Let's think about your last airline travel. Do you have an approximate idea of how many people have used the restroom before you went there, on a local flight? No, you probably don't. Let's recap your last transcontinental or transoceanic flight — things now look even worse, don't they? Have you ever thought about how many germs may accumulate on a single flight with more than 100 travelers using (multiple times) each toilet?

A REMEDY IS AVAILABLE

Well, not many travelers think about this issue but at Mankiewicz specialists worked to find a remedy to this invisible problem. According to Mankiewicz, it is the only supplier which has implemented an antimicrobial coating system for aircraft



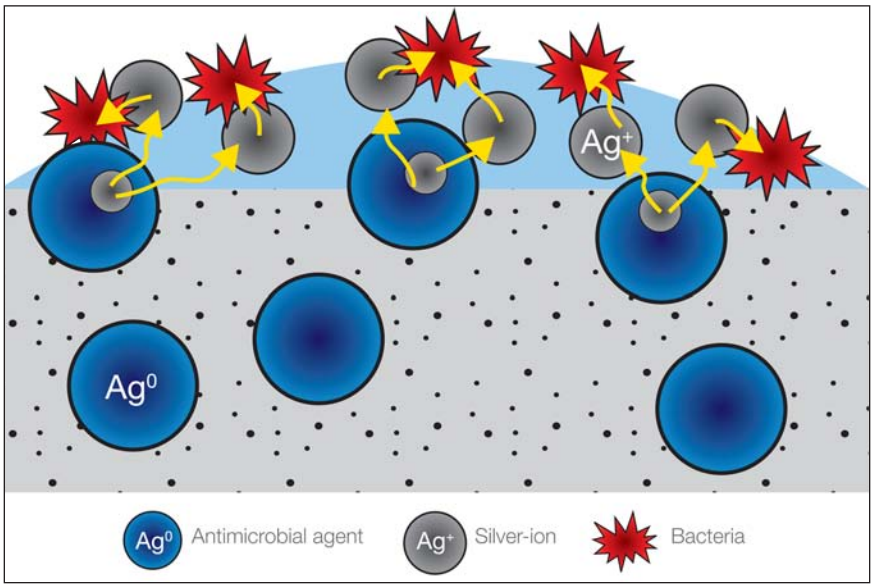
MANKIEWICZ ANTIMICROBIAL coatings comparison.
PHOTOS PROVIDED BY MANKIEWICZ

interiors which at the same time fulfills the stringent fire, smoke, and toxicity (FST) demands of the aviation industry, and has a proven long-term effect. The manufacturer claims that the antimicrobial efficacy of the coating is proven in empirical and practical long-term tests.

According to the manufacturer, this coating doesn't have any toxic side effects as it inhibits the growth of the bacteria not by means of chemical (toxic) substances but by use of technology based on natural silver — a natural product — which is chemically not modified and is harmless to humans.

The application and repair of the water-based coating are according to Mankiewicz easy as it consists of a single paint layer which is chemically and mechanically resistant. As the antimicrobial technology is included in a normal topcoat layer the treatment is not adding weight to the aircraft structure. This product is available as a textured or smooth topcoat with a wide color range.

With this antimicrobial coating, the costs of disinfection are reduced — not eliminated — and fewer cleaning cycles are needed. It reduces the smell in toilets but regular cleaning is still required to remove dirt and fat. The antimicrobial coating can be used in all hygiene sensitive areas throughout the entire cabin, not only in lavatories.



This product is according to the manufacturer also conceivable for applications on other parts of the aircraft interior like armrests, folding tables, seats and wall fairings, etc.

Design style and effects are important to airlines, and as they change over time it is useful to mention that this coating can also be used for the BFE (buyer furnished equipment) and for the retrofit market.

ALREADY IN USE

This antimicrobial coating is already being used in lavatories by Boeing on the entire 737 aircraft fleet and is an option for Airbus A350 lavatories (Airbus AIMS 04-08-005, B/E LCMS 501 approvals).

SHARKS IN THE SKY

It is a fact that airplanes are every day more sophisticated and their price is not rising accordingly with the technological developments, mainly because the airlines are under tremendous cost pressure. This situation is aggravated by the fact that customers and the industry have understood that it is essential to reduce the carbon footprint whenever possible.

In the aviation industry, there are many ways of reducing costs and the carbon footprint. This is achievable with lighter airframes, more efficient turbines, and more efficient aerodynamic properties of aircraft. Savings in the field of aerodynamics translate almost directly into fuel savings and better performance.

From the very beginning, designers tried to improve airflow around the fuselage and the wings. Improvements

of the boundary layer airflow are especially delicate on the wings where slight improvements usually result in huge benefits. The reverse side of the medal is that improvements of the wings aerodynamic properties are a difficult, long, and delicate process. For decades airflow specialists have tried to improve the flow of the air around aircraft trying to reduce drag by channeling the air along the body of the aircraft. What sounds easy, is, in reality, difficult and many projects failed because the transfer process from ideas and calculations to real airplanes didn't work too well in everyday use.

Recently, the bionic design — implementation of solutions learned from nature — gave an additional push to aerodynamic design research improvements. So it came as no surprise when Airbus selected Mankiewicz, amongst others, as a partner for the development of a highly functional sharkskin paint.

LEARNING FROM NATURE

Sharks are successful hunters, and they are fast — faster than a prayer. One thing that makes them so fast is their special skin which consists of many riblets. Riblets are microscopic, µm thin, longitudinal ribs on the shark scales which optimize sharks' swim (flow) resistance. The shark riblets impede turbulence creation transversal to flow direction of the water, which minimizes resistance. Something similar, but with a different medium, air instead of liquid, may bring huge benefits to aircraft.

The long-term trial carried out within the frame of European Union research project "Clean Sky" tried to transfer known biological structures into technical processes and, finally to aircraft surface, in this case, to paint. In the research project "Multifunctional Coatings," which started in Summer 2011, Mankiewicz, Airbus, Lufthansa, the German Fraunhofer Institut für Fertigungstechnik und Angewandte Materialforschung (IFAM) and other project partners have entered a cooperation to study the resistance of these surfaces in-flight.

Two areas on a conventional aircraft wing were coated with a new paint and tests were performed in flight. In focus of interest included the resistance of new structures (e.g. environmental impact) and the longevity of the product and its price/benefit relation.

A MICRO-STRUCTURED PAINT FILM AS A SOLUTION

Mankiewicz engineers developed a specific UV-curing paint system with a very small content of a volatile solvent which complies with the aviation industry requirements. For this purpose the new paint system is dirt-repellent, UV-stable, and extremely resistant to abrasions and erosion. A new method was developed for application of the micro-structure paint: The riblet microstructure is minutely transferred onto the paint by "simultaneous stamping and curing." The paint is applied by means of a silicon sheet carrying a negative of the riblet structure and is immediately UV-cured. Thereafter, the silicon sheet is removed. The results of the ongoing tests were very promising, so much so that the project partners have decided to continue. There is a challenge to find an effective way of coating something as huge and complex as an airplane.

The final target is an accurate, fast, and efficient process which will allow painting of relevant parts of the aircraft with this sharkskin effect paint. Current calculations predict over 1 percent of fuel savings. The painting process is now being further optimized and new application techniques are in the final stage of development and the project partners have apparently found a way to economically and profitably apply the sharkskin paint on large aircraft surfaces. **AMT**

With a sharkskin effect paint, **current calculations predict over 1 percent of fuel savings.**

GOT SAFETY CULTURE?

Every worker should know their particular jobs and be able to talk about how their job performance affects overall attention to worker and flight safety

By Dr. Bill Johnson

Capitalizing on selected questions, used for discussion in an FAA Airworthiness Inspector's Human Factors Workshop, Dr. Bill Johnson helps you to be introspective as you reconsider your corporate safety culture.

The mere thought of another Ph.D. writing about "Safety Culture" could cause you to flip to the next article in this *AMT* magazine. Don't do that! Try a couple more paragraphs.

Look for definitions of safety culture. There are many. The good news is that the definitions are redundant, containing the same words and concepts. Safety culture, like organizational culture, is founded on an organization's shared beliefs, attitudes, values, and commitment regarding the importance of safety at every level of the organization. A strong safety culture requires unilateral knowledge and commitment. Every person in the organization should be able to express, with varying levels of detail, their personal commitment and job/task related contribution to worker safety and safe flight.

While definitions of safety culture are abundant safety culture is intangible. It is not an object or a written policy. An organization cannot "hold up and show" their safety culture. While intangible, an organization's safety culture is manifested by employee attitude and behavior. It is visible based on how corporate leaders from every level of management demonstrate their understanding of culture and their commitment to safety. Demonstrated commitment can include training programs, voluntary reporting with a just culture, establishment of formal measures to identify and manage hazards, and sufficient equipment and procedures to enhance continuing worker and flight safety.

AVIATION SAFETY INSPECTORS CONSIDER SAFETY CULTURE DURING HUMAN FACTORS TRAINING

Regulatory compliance is one of many ways to ensure safety. A primary role of the FAA Airworthiness Aviation Inspector is to ensure that the regulated entity, any certificate holder, follows the rules. FAA's Compliance Philosophy helps the ASI to work with you to ensure compliance. Of course, mere compliance does not guarantee a quality safety culture. Your FAA Inspector is not a safety culture assessor. However, an insightful ASI can work with you to help identify challenges and solutions before they evolve to a noncompliance or an undesirable event.

All FAA Airworthiness ASIs take a three-day maintenance human factors course. FAA is one of the few regulators that offers such a course for its workforce. This author sees the course as one of many demonstrated FAA Flight Standards management commitments to organizational safety culture. The mere existence and support of the three-day class shows that FAA management sees the importance of the maintenance human factors topics. The class is a tangible demonstration of safety culture.

The course covers the usual maintenance human factors fundamentals, like human error, communication, fitness for duty, failure to use technical procedures, event investigation, voluntary reporting, and more. The course is structured around the PEAR Model, standing for People, the Environment on which they work, the Actions that they perform, and the Resources necessary to complete the work. Yes, the Dirty Dozen is included.

There is considerable discussion throughout the course proceedings. Average aviation years of experience for this class are always greater than 25. Thus, experience and aviation wisdom ensure powerful story telling. One unit of the course considers safety culture by looking at demonstrated ways to consider an organization's commitment to safety (aka, safety culture). Here are a few sample ASI questions and expected company answers.

VOLUNTARY REPORTING QUESTION

ASI Question: **Show me the published written "Just Culture" policy and steps for voluntary reporting**

Sample Excellent Corporate Answer: Here is the policy. It is part of our Aviation Safety Action Program, or a similar reporting method. It clearly explains the voluntary reporting process and how such reports are processed. It delineates a timely just culture decision-making process that protects workers who make mistakes. It makes it clear that blatant procedural noncompliance, reckless behavior, unfitness for duty, or falsification of records, and other actions are not protected by the policy and not immune from regulatory or corporate punitive action. This program has been instrumental in identification and management of hazards and risk before it becomes an undesirable event. To maximize the value

of this voluntarily reported information we publish a quarterly newsletter of significant reports. In addition we use voluntary reports as discussion items for shift change and other safety meetings. We are working on a program to push this information to worker mobile phones.

HUMAN FACTORS TRAINING QUESTION

ASI Question: **Show me the course outlines for your maintenance human factors training**

Sample Excellent Corporate Answer: We have three courses for maintenance human factors. One is a two-hour introduction for new hires. The second is an eight-hour course for all employees. That course includes about two to four hours of computer-based training of fundamentals. It is followed by a four-hour event investigation and discussion class, with an instructor. Our third class is the two-hour recurrent training which includes information from our voluntary reporting, other event-based reports, and any description of new practices/procedures. It is aligned with the EASA recurrent training requirements and takes place on a 24-month recurring basis.

All employees, managers, and executives must take the human factors training. Our instructors are usually promoted from the maintenance or maintenance training ranks. Usually they have a college degree and an Airframe and Powerplant Certificate but neither are firm requirements. All HF instructors must have taken a train-the-trainer class and some human factors training outside of our organization. We encourage our HF trainers to attend at least one human factors related meeting at least annually.

SHIFT TURNOVER QUESTION

ASI Question: **Show me your shift turnover practices/process**

Sample Excellent Corporate Answer: Of course, the shift turnover question is somewhat dependent on the size and complexity of the shop/location. Our various departments match the turnover to meet their specific requirements. There is no one size fits all. In most cases we have designated lead mechanics who have the responsibility to document the status of jobs from one shift to another. They have the responsibility and are given sufficient shift overlap time to convey the status of all tasks that transfer from one shift to the next. If there are complex procedures in progress, the lead mechanic can ask personnel from the outgoing shift to stay on to ensure proper handover. There is a shift turnover office at the worksite where the meetings take place for every turnover. Job cards are used as the primary documentation for job status. We have documentation to ensure that all appropriate handover communications are clearly discussed and documented accordingly. Incoming workers are required to check the last task performed prior to the shift change. In our company the management and the workers recognize that shift change, or within shift task turnover, presents a hazard. We treat shift and task turnover very seriously.

SAFETY CULTURE QUESTION

ASI Question: **What evidence do you have to indicate that your company has a positive safety culture?**

Sample Excellent Corporate Answer: You can ask any worker on this floor and you will get an answer to this question. We have had a lot of training about risk assessment. The training is backed up with newsletters, signage, and plenty of heart felt talk from company leadership. Every worker knows their particular jobs and can talk about how their job performance affects overall attention to worker and flight safety. We celebrate accident-free worker safety as much as we celebrate schedules and maintenance quality performance. When a worker sees or perceives a serious issue they are encouraged to report the potential hazard immediately. We have seen management rush to buy new equipment when workers identify potential safety risk. Voluntary reporting on safety-critical matters is always perceived as a positive step toward continuing safety in our departments and for the company at large. As workers we appreciate the quest for continuing safety. We get it!

SIZE MATTERS FOR A SAFETY CULTURE

The FAA Aviation Safety Inspectors human factors class includes inspectors from the airlines, larger repair stations, and small general aviation organizations. That diverse group of inspectors knows that one size safety culture does not fit all. Large organizations have multiple shops and locations to manage and there may even be a designated person to manage activities that foster culture. Small shops have fewer people and fewer resources to help cultivate the right culture. Size does matter but that is OK. As stated at the outset the key words include: shared beliefs, knowledge, values, and commitments where every person in the organization can express their personal commitment and demonstrated contribution to worker safety and safe flight. Got safety culture? **AMT**

DR. WILLIAM B. JOHNSON is the FAA Chief Scientific and Technical Advisor for Human Factors in Aircraft Maintenance Systems. His comments are based on nearly 50 years of combined experience as a pilot/mechanic, an airline engineering and MRO consultant, a professor, and an FAA scientific executive.

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PRAGMATISM: A GLOBAL PERSPECTIVE

Duplicative oversight activities have been reduced through bilateral agreements but the purpose of such agreements is rapidly eroding

THE RUSSIAN FEDERAL AIR TRANSPORT AGENCY (FATA) recently revised its equivalent to 14 CFR part 145. The update allows FAA, EASA, and TCCA-certificated repair stations and approved maintenance organizations to perform maintenance on Russian-registered aircraft without additional certification. Given the current political climate, any praise for the Russian government will likely raise eyebrows but this enlightened change in policy represents a global mindset that all national aviation authorities (NAAs) should embrace.

Since the economic boom of the early 1990s, nations have increasingly exercised their ICAO obligations to directly regulate civil aviation. Indeed, that is exactly what the Chicago Convention intended by requiring signatories to implement international standards for the safe operation and continued airworthiness of aircraft across a vast array of jurisdictions. But in 1944 there were only 52 signatories and a handful of NAAs directly regulating civil aviation; now there are 191 signatories and 160 NAAs.

Most special conditions, or quasi-special conditions created by guidance, **do not improve aviation safety and only increase the burden on both regulators and industry.**

This explosion of regulatory jurisdictions has profoundly impacted the aviation maintenance industry because each state where an aircraft is registered is responsible for ensuring its continued airworthiness. When one state does not find the certification of another "acceptable," (a concept known as validation) it forces maintenance providers — both large and small — to obtain certification from multiple authorities. The burden of obtaining multiple approvals is compounded by the hassle and expense of duplicative compliance audits by numerous jurisdictions. More importantly, there's no added safety value.

Duplicative oversight activities have been reduced through bilateral agreements but the purpose of such agreements is rapidly eroding. Bilateral agreements are supposed to recognize the equivalency of regulatory systems; however, the burgeoning use of special conditions threatens to undermine that purpose. Most special conditions, or quasi-special conditions created by guidance, do not improve aviation safety (e.g., MAG Change 6's parts documentation requirements) and only increase the burden on both regulators and industry.

The success of the aviation industry requires regulators to embrace a global mindset, to contemplate the underlying purpose of bilateral agreements, and revaluate whether global aviation safety and security really needs each nation to create an independent system under its ICAO responsibilities. The Russian government's revision of FRP 145 (now FRP 285) acknowledged that it could independently certificate approved maintenance organizations (AMOs) but recognized that a majority of maintenance providers are already certificated by the FAA, EASA, and/or TCCA. If those systems work, why make it any more complicated — or expensive — to work on Russian aircraft? Perhaps the Russian's lesson in pragmatism won't get lost in political rhetoric. **AMT**

ARSA SYMPOSIUM – PUTTING REALITY BEFORE RHETORIC

Every March, the Aeronautical Repair Station Association brings the aviation world to the nation's capital for its Legislative Day & Annual Repair Symposium. Just as this edition of *AMT Magazine was delivered to readers,* members of the maintenance community were arriving in Washington, D.C., to look through the political bluster toward commonsense policy.

Keep tabs on what's happening, see what you missed and learn how it matters to you by visiting (and bookmarking) arsa.org/symposium.

RYAN M. POTEET is senior associate of Obadal, Filler, MacLeod & Klein, P.L.C. advising clients in international aviation safety regulation and government affairs. He serves as regulatory affairs director for the Aeronautical Repair Station Association.

AMT AIRCRAFT MAINTENANCE TECHNOLOGY

EDUCATION, TRAINING AND CAREER DEVELOPMENT

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The Industry forecast predicts hundreds of thousands of aircraft technicians will be required to maintain aircraft over the next 20 years.

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THE THOR Team: Detlev Konigorski, Gunnar Haase, and Andreas Poppe. THOR is an acronym for 'Test of High-tech Objectives in Reality'.
AIRBUS

By Marino Boric

ADDITIVE MANUFACTURING:

HOW AIRBUS IS PRINTING THE FUTURE

3D PRINTING IS A KIND OF A MAGIC WORD IN this moment in all development departments, all around the world, in all industry fields. 3D printing is promising things in aviation we could even not dream of just few years ago. We are definitively on the cusp of a new era in aviation and few new paradigm-shifting technologies are changing the world of aviation in a way not seen before. 3D printing and similar technologies seem to be to be an answer on many, even not yet made questions.

The innovative Additive Manufacturing — AM, also called 3D-printing technology is shaping the future of aircraft component manufacturing. Airbus is using AM and 3D-printing not only in proto-

THOR FIRST flight. THOR is a small-sized, pilotless aircraft made using additive manufacturing.
AIRBUS

typing, but is also using it for parts manufacturing. *AMT* was able to visit the Airbus facility in Hamburg, Germany where *AMT* received an insight into 3D Printing and AM from Peter Sander, Airbus Emerging Technologies & Concepts, Germany.

First parts produced with 3D printing are beginning to appear on a range of the Airbus aircraft — from the next-generation A350 XWB to in-service jetliners, from the cornerstone A300/A310 family to the Atlantic Bird 7 satellite, Atlante UAV and THOR testbed. Thor is an acronym for 'Test of High-tech Objectives in Reality.'

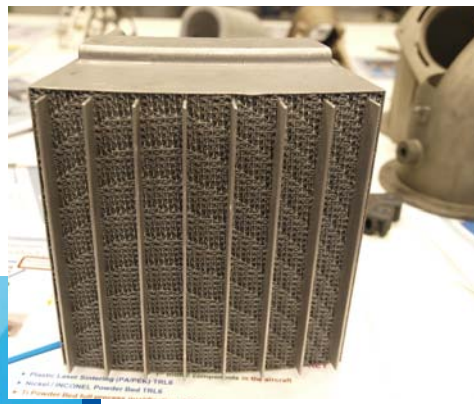
For the A350 XWB aircraft, Airbus already has produced a variety of brackets, made of plastic and metal, whose material and structural properties have been tested and validated, and are now incorporated, or will be, on the company's fleet of developmental aircraft.

3D-printing makes it simpler to produce very complex shapes: an electron or laser beam is used to model the desired material according to a computer-generated design. Therefore, parts designed for and manufactured by AM can have a natural and topologically optimized shape, which would be impossible to achieve from a solid block of material. AM parts are lighter, faster to produce, and case by case ultimately much less expensive than conventional ones, because of unneeded tooling for example.

ADVANTAGES OF 3D PRINTED PARTS ARE MANY

Improved lead time (up to 75 percent), non-recurring cost savings through repeal of tooling (up to 90 percent), less energy use (up to 90 percent), weight reduction (up to 55 percent), and the reduced number of manufacturing process steps (now 50 percent compared to a milling process) are a few of the advantages. To this quantifiable savings there are many less quantifiable factors that are important like: Functional integration of features such as cooling channels, possibility to manufacture high-complex parts like hydraulic manifolds, considerable parts reduction (even up to 90 percent), and shortened R&D time. There is even the important possibility to manufacture highly customized products.

"We are on the cusp of a step-change in weight reduction and efficiency — producing aircraft parts which weigh 30 to 55 percent less, while reducing raw material used by 90 percent," says Peter Sander to us. "This game-changing technology also decreases total energy used in production by up to 90 percent compared to



ADDITIVE MANUFACTURING provides the possibility to manufacture high-complex parts.
MARINO BORIC

traditional methods." To his words 3D-printing is a real paradigm change as all involved in the production process have to learn that for the first time less use of material makes the part cheaper and more ecological. In the past, extreme lightweight construction, meant huge development/manufacturing investment and the lightweight part was more expensive than a standard one, because the design and manufacturing was (and still is) more complex (more tools used, smaller radius machining, greater precision) thus more expensive.

According to Sander, despite several parts already being manufactured by use of AM and have found their way in serial production, the industry is still exploring the technology limits and is learning what is doable. "Doable" doesn't compulsory mean that the designers have yet completely understood why the printed parts have better properties; now a new design software is being developed for this new technology in a kind of a reverse engineering process. 3D-printed parts (most of them) are not yet price competitive with conventionally produced parts but this is an ongoing process and with higher numbers and better/faster machines the price break-even point will be reached soon. This is just a matter of time, but in the next two years this point is likely to be reached. The industry is right now investing billions in new production facilities that will be able to deliver bigger parts, and right now the parts dimensions are limited not by the technology but by the size of the machines.

HOW DOES THE TECHNOLOGY WORK?

AM, additive manufacturing, "grows" products in thin layers, from a very fine base material powder which is laser welded, instead of producing parts by means of mechanical removal of material. Base materials used in the AM process can be metals or plastics; the last one is used in a similar 3D-printing process.

Both processes basically consist in adding thin layers of material in incremental stages from a (lowering) base to the top. 3D-printing allows producing very complex shapes, therefore, parts designed for and manufactured by AM can have a natural and topologically optimized shape. Data is delivered to the "printer" directly from computer-aided design (CAD) information.

The 3D-printing currently being used and developed by Airbus uses variations of two different building principles: Fused Deposition Modelling and Laser Beam Melting.*

BIONIC PARTITION, LEARNING FROM NATURE

Combining the principles of nature's design with AM, the Bionic Partition shows a paradigm change in generic part design. The Bionic Partition is currently one of the most ecologically efficient aluminum components available. This is achieved by reducing the weight of that structure by 45 percent, by fulfilling all 16G impact requirements of that kind of cabin structure. One of these Bionic Partitions in an A320 leads roughly to a reduction of 10 tons CO^2 a year.

This is an important improvement in the process of reducing the environmental footprint of the aircraft and also in reducing an airline's operational costs. The new approach as illustrated by the Bionic Partition could be very useful in the design of customized parts in all areas of the cabin. In the future, it may be possible to use the same methodology to design and manufacture larger parts up to complete airframes, as shown in the Airbus Concept Cabin.

PETER SANDER, VP Airbus Emerging Technologies & Concepts, Germany with Bastian Schäfer with the Bionic Partition at Airbus in Hamburg.

Future aircraft could be built using a bionic (or bio-mimetic) structure that mimics the bone structure of birds or the structure of plant leaves like the Indian water rose. A bone is at the same time light and strong.

By using bionic structures, the fuselage would have the needed strength, but could also make the most of extra space where required. This will not only reduce the aircraft weight and fuel burn, but also would offer the opportunity to add, now not practicable elements, such as oversize doors and big panoramic windows.

Peter Sander explains that the applications of 3D-printing technology in aircraft component manufacturing are just beginning to be realized. "The aircraft of the future will have a "bionic" fuselage, composed of complex parts printed using AM," he concludes. "This dream will come true."

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A310 PLASTIC seat bracket.

FDM - Fused Deposition Modelling

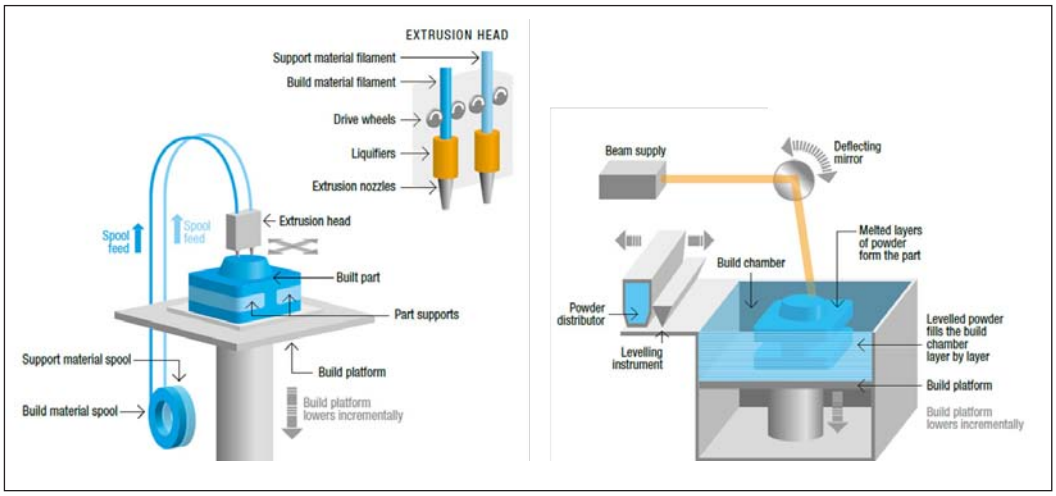
FDM is used to manufacture plastic parts. 3D objects are built by printing fine layers of liquefied building material filament onto a building platform that fuse with the layer beneath. At the same time a support material is printed in order to allow printing of the building material further up the object of features that hang from the main structure. The build platform moves down incrementally to print the following layer. Once finished, the printed support parts are removed.

LBM: Laser Beam (Powder Bed) Melting*

Airbus uses variations of powder bed melting for metallic materials such as titanium alloys.

3D objects are built by a fine layer of powdered building material leveled over the building platform, which is then exposed to a high powered laser (or electron) beam which welds (fuses) fine metallic powder particles together, joining them to the preceding layer to become the final "printed" 3D part. The welding occurs in small squares that don't have to lay close to each other — usually are displaced all-over a welding — horizontal — layer to prevent creation of tension inside the built part. Non-melted powder remains in place and acts as a support for features further up the object that protrude from the main structure. The build platform moves down incrementally to 'print' the following layer. Once finished the remaining non-melted powder is removed and recycled.

**Laser Beam Melting (LBM) The industry standard term, chosen by the ASTM F42 standards committee, is laser sintering, although this is acknowledged as a misnomer because the process fully melts the metal into a solid homogeneous mass. The process is also sometimes referred to by the trade names DMLS or LaserCusing. A similar process is Electron Beam Melting (EBM), which as the name suggests, uses an electron beam as the energy source.*



FDM PROCESS used for plastic on left. LBM process used for metal on right.
AIRBUS

3D-Printing Spares

Airbus is also working toward spare part solutions with 3D technology, which is ideal for on-demand production of cost-effective, out-of-production aircraft spare parts. In February 2014, the first "printed" component — a small plastic crew seat panel — flew on an Airbus A310.

The flight crew rest compartment bracket installed on the A350 is an example of a titanium, bionic AM component. Sander said to *AMT* that the lead time for such a part can be as little as one day, if the component is based on an existing design; redesigned parts can be produced in less than two weeks.

The Ramp-Up Phase

3D-printing is being progressively integrated into new design and manufacturing in the supply chain, starting small but steadfast in the fields of prototyping, tooling, and on-demand production. Airbus has teamed up with major 3D-printing stakeholders to cover the process end-to-end, ensuring the production of certifiable structural components based on consistent tested material properties and meeting the requirements of a rigorous certification process.

AM in the Line: Print and Go

Beyond its use to build parts that are already flying, Airbus Group is looking at using AM technology to avoid outstanding work during the manufacturing process. "Each time we have a missing part at assembly level it causes a significant disturbance and costs money for us to recover. AM can be used to manufacture missing and non-standard parts fast in low quantities," says Airbus' Bernard Duprieu. (His project team is developing a workshop capable of manufacturing customized parts in less than 24 hours.)

FINAL COMMENT

The ultimate goal of AM is the reduction of cost and weight of aircraft parts, making aviation even more efficient, achieve set CO^2 emission goals and provide vital growth to the industry. AM/3D-printed parts provide significant advantages in terms of reduced weight, production lead time, and simultaneously reducing waste, energy consumption, and as a consequence the environmental impact. ***AMT***

CHARLES E. TAYLOR PROFESSIONAL AMT AWARD RECIPIENTS — WHERE ARE THEY NOW?

Recipients exemplify the true spirit of the Aerospace Maintenance Competition: sharing of knowledge, learning, camaraderie and giving back to the industry

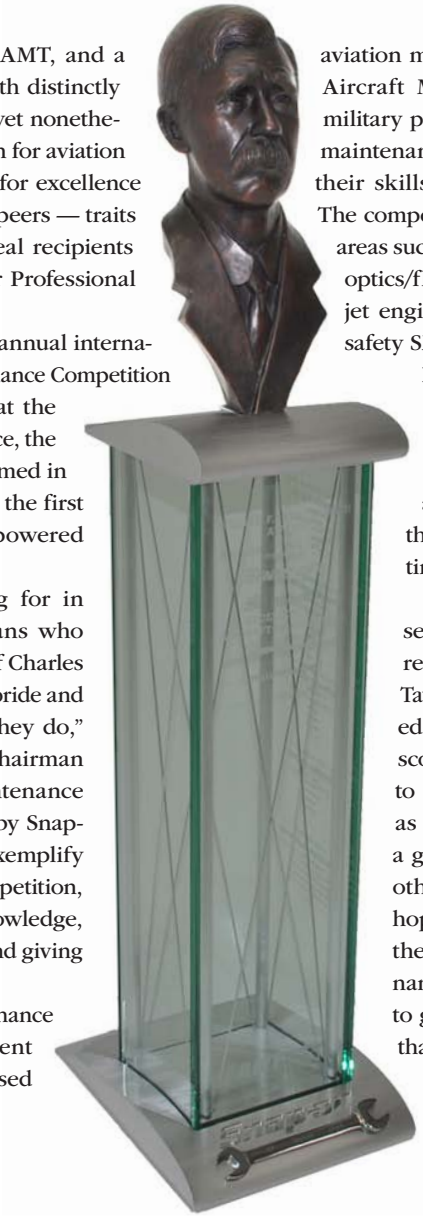
By Steve Staedler

A soldier, an airman, an AMT, and a student. Four people with distinctly different backgrounds, yet nonetheless, they share a passion for aviation maintenance, the drive for excellence and the respect of their peers — traits that made them the ideal recipients of the Charles E. Taylor Professional AMT Award.

Presented during the annual international Aerospace Maintenance Competition Presented by Snap-on at the MRO Americas conference, the Taylor AMT Award is named in honor of Charles Taylor, the first aviation mechanic in powered flight.

"What we're looking for in recipients are technicians who embody the true traits of Charles Taylor and demonstrate pride and professionalism in all they do," says Ken MacTiernan, chairman of the Aerospace Maintenance Competition Presented by Snap-on. "These recipients exemplify the true spirit of the competition, and that's sharing of knowledge, learning, camaraderie, and giving back to the industry."

The Aerospace Maintenance Competition is an event that gives teams of licensed aviation maintenance technicians (AMT), Aircraft Maintenance Engineer (AME), military personnel, and qualified aviation maintenance students the chance to test their skills against those of their peers. The competition includes 24 challenges in areas such as avionics, safety wiring, fiber optics/flight control rigging, hydraulics, jet engine troubleshooting, workplace safety SMS, and other tasks.



Last year, the AMC attracted a record 51 teams from around the world. Teams have 15 minutes to accurately complete each assigned task; teams that finish their tasks in less than the allotted time received higher scores.

With hundreds of competitors, selecting the Taylor AMT Award recipients is no easy task. The Taylor AMT Award was first presented in 2012; the AMC expanded the scope of the competition last year to create a student-focused award as well. Award recipients receive a gold-plated Snap-on wrench and other prizes. MacTiernan says he hopes that recipients can leverage the award to further their maintenance careers and use it as a means to give back to the industry — and that's exactly what's occurring with many of the past winners.

STEVE STAEDLER is a senior account executive at LePoidevin Marketing, a Brookfield, WI-based business-to-business marketing firm that specializes in the tooling and aerospace industries. Staedler has been covering aeronautical maintenance for nearly 10 years; is a former newspaper reporter and retired master sergeant from the U.S. Air Force Reserve, where he worked maintenance and public affairs. He can be reached at steve@lepoidevinmarketing.com; (262) 754-9550; or www.lepoidevinmarketing.com.

STAFF SGT. DALLAS MCLEOD – U.S. ARMY TEAM APACHE (2016)

Dallas McLeod knew early on that he was headed for a career in maintenance.

"I've been a mechanic all my life," says the 31-year-old U.S. Army staff sergeant stationed at Joint Base Langley Eustis in Virginia. "I grew up with an older brother who was a mechanic by trade, so I just followed in his footsteps."

Following high school, McLeod enrolled at WyoTech in Laramie, WY, to study automotive repair. After working in the industry for a few years, he was feeling ready for a shift in his career — and then he saw a television commercial for the U.S. Army.

"I always wanted to join the Army, and the time was right to do it," he says. "I didn't want to work on cars anymore. Aviation intrigued me, so I started looking at helicopters."

McLeod attended his first AMC with Team U.S. Army in 2015. He didn't really know what to expect that first year, but after completing the first few events, he calmed his jitters and performed well. The team returned last year, funding the trip to Dallas themselves.

"For us, attending the AMC is all about meeting people in the industry and building those relationships with your peers throughout the aviation community. That's what we were looking forward to the most," he says.

DALLAS MCLEOD won the award in 2016.
SNAP-ON

When his name was called as the Charles E. Taylor Professional AMT Award winner during the awards ceremony, McLeod says he was shocked.

"I didn't think I did anything special. Having been there the year prior I was much more relaxed and interacted more with the other teams and had

BRANDON DUBBERLY as a student at Eastern Florida State College won the Charles E. Taylor Professional AMT Award in 2015.

fun with the judges," he said. "But when they called my name I was kind of awestruck.

"I'm very honored to be part of such prestigious history with the Taylor Award, and definitely would enjoy returning to the AMC, even if I'm not part of a competing team but because of the atmosphere and what it promotes."

Now in his ninth year of military service, McLeod plans to make a 20-year career with the Army. He now trains younger soldiers on Apache maintenance.

"The biggest thing I tell my soldiers is to treat the aircraft as something that you were going to be flying on every day," he says. "Make sure you're looking at the proper books and using the proper tools. Take pride in what you do and everything will come naturally."

BRANDON DUBBERLY — EASTERN FLORIDA STATE COLLEGE (2015)

Growing up in the shadow of NASA's space program in Cape Canaveral, FL, Brandon Dubberly figured he might make it a career someday. His first step was enrolling in Eastern Florida State College to study aerospace technology. It was there in his senior year when a teacher suggested he and a few other students consider forming a team to enter the Aerospace Maintenance Competition.

"I believe this was the first time anyone from our school attended," Dubberly says. "Our teacher thought it was a good idea for students to get involved — he was right."

As a person who "loves to turn wrenches and constantly learn," Dubberly, 29, found the AMC to be a perfect venue for him. The team practiced as much as they could before making the trek down to Miami, the location of the 2015 AMC. He thought the team did OK considering they had never been to the competition before. At the awards ceremony, Dubberly said he had no idea he was being considered for the Taylor Award … until his name was called.

"They called out Brandon, and then kind of fumbled my last name," he says with a chuckle. "It hit me like a ton of bricks. I was all teary-eyed, and so was our teacher, Mr. Fletcher. I was pretty happy they even noticed who I was among all those competitors.

"I really enjoyed the competition and the work we did there. I guess it was just my enthusiasm for getting my hands on stuff that stood out to the judges."

Dubberly graduated with honors in August 2016 and is now working as a mechanical technician for a contractor under Lockheed Martin at the Kennedy Space Center. He's involved in building the new Orion spacecraft that will be part of the Exploration Mission 1 (EM-1), a planned three-week mission that will take the Orion thousands of miles beyond the moon. His ultimate goal is to go back to school and earn an operations management degree and continue to advance in his career.

"I've always felt if you're going to manage something, you should know what you're talking about," he says. "I'd much rather get the experience as a technician first and then run the show because you'll have the respect of your peers. You'll be one of those managers who has been down in the trenches."

Dubberly looks back at his experience at the AMC with great pride and a place he really started his career.

"The event is great for students; can't be any better for someone about ready to graduate," he says. "It got me exposure to industry professionals, and some people even handed me their business cards to call them about jobs.

"I also gained so much respect for Charles Taylor. I read the book on him that was assigned to us — I ate that up. It was really cool to learn about him, and winning the Taylor Award, it's such an honor."

GEOFF HYATT — VIRGIN AUSTRALIA (2014)

Like many young people, Geoff Hyatt faced a crossroads when determining his career path. For Hyatt, it was either attend a traditional four-year university course, or head off to a technical school and earn a trade certificate in aviation.

He ended up making a decision … with a little help from his brother's friend.

"My brother's best mate, he's an avionics engineer, and at the point I was figuring out what I wanted to do, I thought going to earn my trade certificate was a better way of going about it," Hyatt says. "I thought I'd like the aviation route better than going to university, and possibly wasting four years. I liked what my brother's mate did and decided to go that way,

GEOFF HYATT won the award in 2014 and still works at Virgin Australia.

and now I work with him. He's on my crew and I see him all the time!"

That fateful decision was almost 20 years ago. Today, Hyatt, 39, and his brother's best mate work together as avionics engineers at Virgin Australia in Melbourne, Australia. It's his strong work ethic that helped Hyatt earn an invitation to join a team of fellow Aussie technicians and enter the 2014 AMC in Las Vegas.

"I agreed to go with a lot of trepidation," he says. "I was very nervous and concerned that I wouldn't be able to perform on stage and do my thing. But it turned out to be one of the best things I've ever done."

Due to logistics, Hyatt's team didn't get a chance to train together prior to the competition. But he did seek out advice from other Aussie technicians who had been to the AMC to gain insight on what to expect. All in all, Hyatt felt he and the team did all right — and so did the judges.

When his name was announced as the Taylor Award winner, Hyatt was pleasantly surprised.

"I wasn't expecting it; I had no inkling I was in the running for it, but what a rush of adrenalin walking down to accept the award," he says. "To come away with the Taylor Award is something that will be with me for the rest of my career."

Hyatt says he's made great new friends from the AMC, and offered up this advice for future participants.

"If you're going to the competition fresh, just trust your training," Hyatt says. "It doesn't matter if you win or lose, just being there and meeting other people and learning from each other is so valuable. The trials and tribulations you go through in the industry, you learn from others that it's going on in the other side of the world too. Being able to network and share experiences with others is great, and that's what the AMC gives you."

KEVIN MEREDITH – U.S. AIR FORCE (2012)

When 29-year-old Kevin Meredith looks back at the 2012 AMC, the one thing that stands out for him was the concept of teamwork.

"I was the engine guy in that competition from my team, but we had never touched this specific engine in the event before," Meredith says. "The training you get in the Air Force, you rely on your team to accomplish things. You help each other out and do what we need to do to succeed. There's a lot more moving parts and people to maintenance,

much more than just the nuts and bolts that go in it."

In 2012 Meredith was an aerospace propulsion journeyman stationed at Charleston AFB in South Carolina. Charleston AFB entered two teams in the AMC; Meredith's team ended up taking third in the military category. He says one of the challenges his team faced is that they had never worked on many of the systems that were represented in the various events — but they turned that hurdle into a success story.

"That was one of the best parts and made it a lot of fun in that we really got to test our skills and abilities as far as maintenance went," Meredith says. "We had never touched many of these things before, but we viewed it as 'now let's see how good we really are.'"

During the awards ceremony that year, MacTiernan announced the creation of the Charles E. Taylor Professional AMT Award. As he spent a few minutes talking about the it and listing the qualities and characteristics that the award exemplifies, Meredith's teammates had an idea of who would be the first to receive the prestigious honor.

"Ken starts talking about the award and the guys behind me are saying, 'hey, he's talking about you,'" Meredith recalls. "I just laughed it off, and sure enough 30 seconds later Ken asked if there was a Senior Airman Kevin Meredith here. I was just blown away. There are some 150 competitors here and to be selected for the Taylor Award was really an honor."

Meredith has cross-trained into a new career field, becoming a flight engineer on the giant C-5 Galaxy. He also left active duty and joined the Air Force Reserve. It's this constant strive to learn from others that keeps pushing Meredith to expand his horizons and explore new opportunities.

"It's almost cliché but always stands out in my mind — one of the first lines in The Great Gatsby is 'just remember that all the people in this world haven't had the advantages that you've had,'" Meredith says.

"That's so true. Never take anyone for granted around you and always learn from everyone around you, because you don't know what they've been through.

"Even if you've done something since 3 years old, you have to take a step back, slow down, and watch the guy next to you because he could be doing it better than you." ***AMT***

AS SHOWN in 2012, Senior Airman Kevin Meredith with USAF Col. Robert Miglionico and the Golden Wrench from Snap-on.

TOP TIPS FOR ELECTRICAL SYSTEM TROUBLESHOOTING

Keep in mind that just because the alternator went off line, it doesn't mean the aircraft's alternator itself has failed. The real issue could well be something else under the cowling.

By Tim Gauntt

THE ELECTRICAL SYSTEM OF A PISTON-ENGINE AIRPLANE may seem simple enough, but therein lays the problem — it's not. Aging wiring, connectors, batteries, and issues with other components can play havoc on not only the system's performance, but also a technician's ability to find and fix a problem.

As the director of product support for Hartzell Engine Technologies (HET), hardly a day goes by where we don't get a call or email from a technician needing help weeding the gremlins out from under a customer's cowling.

Many times, at least according to the technician's diagnosis, the problem stems from a faulty alternator — especially if the pilot sees that little red light in the panel light up. But, in many cases, when we bench test these "failed" alternators we find that they're actually working fine.

The problem is simply that not enough troubleshooting was done before pulling the alternator off the airplane. Keep in mind that just because the alternator went off line, it doesn't mean the aircraft's alternator itself has failed. The real issue could well be something else under the cowling.

There are a number of things, which may look like alternator problems that aren't. Unfortunately, any of these issues will often lead to a "failure" indication. So if there's a charging system issue, complete the following basic troubleshooting steps to the entire system before removing the aircraft's alternator.

Even before they go out to the customer's airplane, the first thing I tell technicians to do is to go to HET's website and watch our short video on electrical system troubleshooting. You can find it at: www.youtube.com/watch?v=RocpYr5dmys.

ALTERNATOR TROUBLESHOOTING TIPS

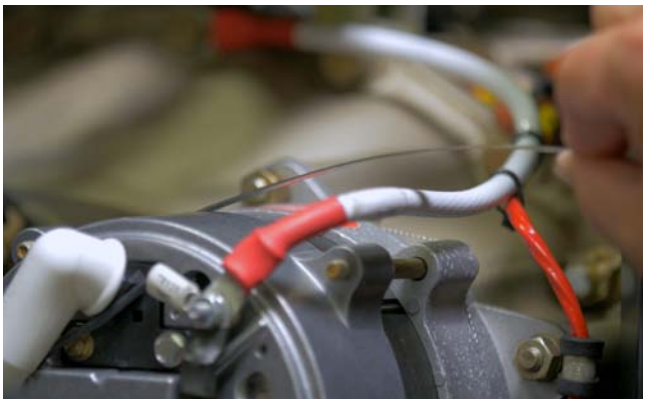
As you will see in the video, an experienced mechanic can perform 95 percent of the steps to troubleshoot a piston-engine aircraft's alternator using a flexible steel scale (not stainless) and a calibrated Volt/Ohm Meter (VOM).

ALL IMAGES COURTESY OF HARTZELL ENGINE TECHNOLOGY

The first step is to switch on the aircraft's Master and use the VOM to record the DC bus voltage for further troubleshooting reference.

Next, with the aircraft's Master and Alternator switches both on, place the metal scale on the alternator chassis. Energizing

the aircraft's alternator circuit while the unit is not running creates an electromagnet, so when you hold the scale against the housing you will get a light magnetic "tug".



But, even if there is a tug you still need to verify that the aircraft's alternator can carry a load. To do this, run the engine with the typical electrical load, connect a VOM to the B+ terminal and measure the voltage with respect to the ground. For 12- or 24-volt systems, if this is less than 13.5 or 25.5 volts respectively, when above 1,500 rpm, the alternator output is low.

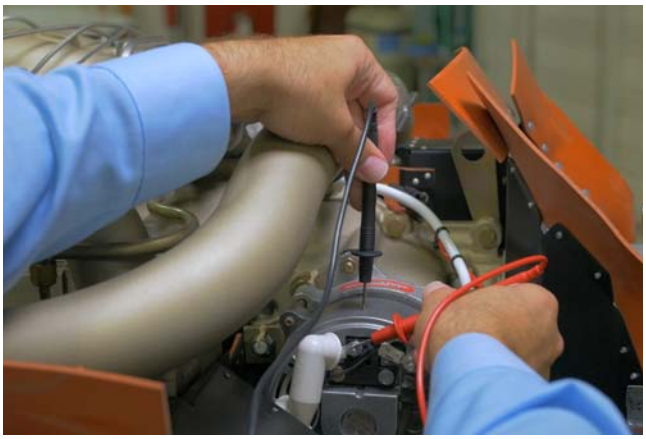
An experienced mechanic can perform 95 percent of the steps to troubleshoot a piston-engine aircraft's alternator using a flexible steel scale (not stainless) and a calibrated Volt/Ohm Meter (VOM).

If that does check out OK, switch the VOM to AC volts and verify a maximum of 1 volt AC into the bus. Failure of either of these tests would be cause to remove the alternator.

If there is no tug, then the alternator may well be working correctly and the problem could be a faulty voltage regulator, wiring, or an alternator field circuit, which leads to several other troubleshooting steps to help identify the issue:

1. While the engine is not running, verify field (F1) input voltage, which should be the approximate bus voltage. If not, check the regulator and associated connections, conductors, breakers, and switches.
2. Verify the l field resistance. With the F1 and F2 (if provided) field terminals isolated, measure for a resistance of approximately 4 to 8 ohms or 8 to 12 ohms depending on whether it's a 12- or 24-volt system (respectively). If it's not, remove the belt or alternator, if gear-driven, and slowly rotate the output shaft by hand. If the resistance is high, not steady or infinite (using a calibrated VOM), you may have bad brushes, slip ring contamination, or an open rotor. If the resistance is "0": The field circuit is shorted, which makes the rotor suspect.

3. Perform a "full fielding" test on the alternator. With the alternator field isolated from the regulator, connect a jumper from the B+ alternator output to the field terminal. This will provide full bus voltage directly to the field. Make sure no electrical equipment is "on." Connect a VOM to the bus and run the engine. Since the only variable now is alternator rpm, the alternator DC voltage should smoothly follow the throttle as engine rpm is increased and decreased.



COMMON VOLTAGE REGULATOR PROBLEMS

After testing and acceptance of the alternator, if the problem with the charging system still hasn't been found, look at the voltage regulator next. Most aircraft voltage regulators used today are solid-state and no longer have the trouble-prone contact points and coils. As such, regulator maintenance, other than basic adjustments are minimal. Typically, today's regulators either work or they don't.

Unfortunately, as regulators have become more sophisticated and sensitive they are also more prone to providing false indications. These solid-state regulators along with glass cockpit warning systems are providing faster, but not necessarily better, information to the aircraft's pilot and mechanic.

VOLTAGE REGULATOR TROUBLESHOOTING TIPS

Verify both the input and output voltage of the regulator. The input voltage should be approximately the same as the bus voltage. A drop of more than 0.5 volt would indicate an issue upstream of the regulator. If the drop between the input and the output of the regulator is beyond 1.5 volts, it's a safe assumption that the regulator has a ground issue or internal fault.

Remember the solid-state design? Even a momentary, inadvertent alternator field short-to-ground can destroy the regulator.

NOISE IN THE HEADSETS

Another common electrical system problem that can drive a technician to distraction is static or "noise" in the headsets. If your customer reports this problem, the best first step is to confirm AC output by setting the VOM to AC volts and measuring the bus voltage. The maximum should be 1 volt AC. A higher reading is a good indicator of a leaking diode.

Of course, these are just some very basic troubleshooting tips to aid aircraft maintenance technicians in eliminating the cost and aircraft downtime associated with the dreaded no-fault-found alternator. For a complete troubleshooting flow-chart, click here: http://hartzell.aero/wp-content/uploads/2015/10/Alternator-Trouble-Flowchart.pdf.

Electrical systems are complex and can be affected by any number of problems. If you've followed these steps and still have not found the cause, give us a call at (+1-334-386-5400, option 2) or contact us via the web: (hartzell.aero/contact/) — the aircraft alternator experts at HET are here to help. **AMT**

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TEACHING MOMENTS

Training is a foundation, and mechanics must be trained to know where to find answers (i.e., maintenance manuals)

By Stephen Carbone

Many years ago, in Elmont, NY, I sat in Sister Margaret Cyanide's 8th grade class. Teaching moments were simple then; 'education' and 'training' were synonymous. With an arm like Nolan Ryan, Sister Cyanide could launch a chalk saturated eraser at me, the missile defying the laws of physics as it greased past students with bare millimeters of clearance to smack me above my ear, leaving an indelible chalk mark on my dark hair, proof to my Mom that her youngest child had committed some misdemeanor.

Folks, I've been off the radar for several months; I moved and now my job is to instruct industry people, international certificate holders, FAA inspectors, and NTSB investigators about various aviation safety topics. I meet lots of good people; good discussions abound; lots of 'career stories', both good and bad.

In my nondestructive inspection (NDI) class the other day, I was talking to the students about the five areas of concentration when certifying, contracting, or surveilling NDI-certified specialists: environment, documentation, calibration, training, and personnel. Each area of concentration commands certain individual attention, yet they are often intertwined, e.g. documentation includes calibration procedures, training records, and personnel certifications.

But of these five, it has always been my experience that training sees the greatest abuses; not necessarily in NDI, but in other forms of instruction. Let's face it, training records are easy to confuse and receive the least attention from overseers. But I've always been attracted to them; whether as an accident investigator, an airline auditor, or air operator inspector, I have found that certificate holders often hide training anomalies in plain sight. And kinda like Khan Noonien Singh, I say, "They task me, and I shall have them."

EDUCATING AND TRAINING

But, first: what's the difference between educating and training? Some may argue: they're the same. But in high school, did we receive driver's education or driver's training? In many cases, both; driver's education was a stand-up class with an instructor; we were often tested on lessons … while testing our teacher's patience.

But training is personal; it often involves face-to-face interaction, more responsibility on behalf of both parties, even when training to drive a car.

Teaching my sons to drive required patience and a superior knowledge; I didn't tell Chris to read chapter seven or give Dan a multiple choice on what to do at the Stop sign. For good or bad, I taught them how to drive, then sat back and let them chauffer me around to get used to the reins.

And, so, is training; giving the 'student' a chance to experience the task before leaving him/her to do it themselves, always being within earshot should questions arise.

But training is also a one-time event; we don't retrain … beyond requalification or recertification, that is. But I've been discovering over the last six months that, in the strange Land of the Training People, everyone has different views on what qualifies as training, with no limits on what is to be demonstrated. Many wanna-be instructors suddenly assume a Tim Allen voice and, instead of "more power," use the mantra of "more training," like it should be fitted with a turbocharger. I've been going back and forth with those who are convinced that we should stuff 5 pounds of training in a 1-pound bag, which is equivalent to the other metaphor used with similar bags.

Training is a foundation from which the greater experience evolves. It gives the 'student' a chance to experience the task before leaving him/her to do it themselves.

TRAINING IS FAMILIARIZATION

Training is familiarization; that's why we coin the term 'FAM' classes. Training is a foundation from which the greater experience evolves. When I trained mechanics on the DC-10 Gross Flow check, I demonstrated the tasks … then went back to Memphis. If they had questions, the newly trained mechanics would either reference the maintenance manual or review the work package; I didn't give them my phone number. If there was a variation from one tail number to the next, these mechanics would go to the manual. And that's what training is: a foundation.

And that brings me back to paragraph four's point, about hiding training anomalies. For example, a Part 145 repair station is contracted to work on an operator's aircraft, either for a Part 121 air carrier or a Part 135 air taxi, each with a Continuous Airworthiness Maintenance Program (CAMP). Now, per the FAA, the repair station (RS) must work on that operator's aircraft per their CAMP, meaning they must follow, e.g. the maintenance manuals provided or approved/accepted procedures. This doesn't mean the RS mechanic has to memorize the operator's General Maintenance Manual, but must be trained to know where to find answers and in what resource. This might require four to eight hours of indoctrination training; it's a general FAM course in, possibly, numerous customers' CAMPs.

This should not, however, be the basis for accelerated training, a kind of one-training-fits-all model. FAM indoctrination training allows the RS mechanic to understand where he/she can reference information that applies to all the operator's (or operators') CAMP questions. But it doesn't apply to, e.g. Phase check training; one phase check does not resemble the others; they must be trained to separately. Look at a small commuter aircraft whose phase checks are broken into several phases, e.g. flight controls, engines, etc. Because a large portion of the phase checks are redundant does not allow for the checks' tasks to be treated equally. A heavy inspection of engines doesn't prepare one for a heavy inspection of flight controls; you can't rig the two ailerons the same way you rig the two elevators.

Unfortunately, in my experience, many inspectors don't look for these sleight-of-hand tricks any certificate holder can pull; there are others, but this example gets the point across. Times are changing; experienced instructors are teaching inspectors, investigators, and their industry allies what to look for to boost aviation safety … particularly, their safety.

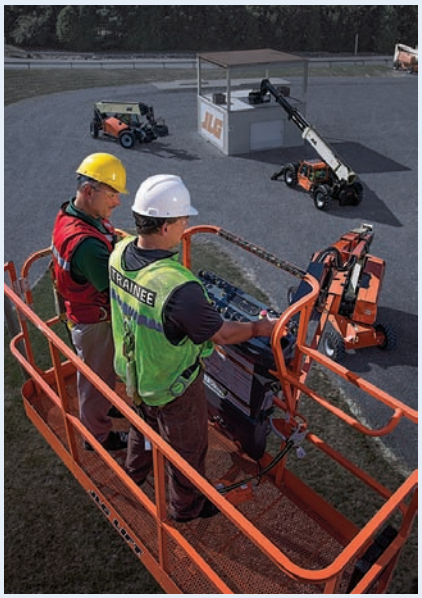
Teaching moments are important. Some teaching moments are like one of Sister Cyanide's chalk erasers to the head, leaving behind a day long reminder. Hopefully, other teaching moments are a little more permanent … and effective. ***AMT***

STEPHEN CARBONE is an avid writer of aviation fiction; his first novel *Jet Blast* has appealed to mechanics, pilots, air traffic controllers, etc. by giving accurate depictions of the accident investigation process. A former airline mechanic, he has been involved in many aspects of commercial aviation and went on to investigate major aviation accidents for the NTSB. A member of ISASI, Stephen holds a Master's degree in systems safety from ERAU. His weekly blog can be found at: http://jetblast.tateauthor.com

$436M

The amount Frost & Sullivan expects Western European fall protection market to reach in 2021.

Aircraft Technical Publishers (ATP) and MD Helicopters Inc. launch of the next evolution of the helicopter manufacturer's online portal, ATP Aviation Hub cloud solution, to keep aircraft safe and airworthy, as well as increase productivity and speed of repair times.



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— Research and Markets

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NONDESTRUCTIVE TESTING

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TOOLS

Aerospace Maintenance Competition

Snap-on Industrial

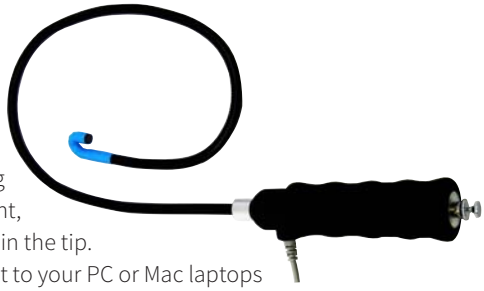
Aviation's top technicians from around the world are gearing up to compete against each other in the industry's premier annual event, the Aerospace Maintenance Competition at the MRO Americas 2017 Convention, April 25-27, in Orlando. It provides certified AMTs from major airlines, MROs and OEMs, as well as military personnel and students in FAA Part 147 schools, the chance to test their skills against their peers. The teams will compete in more than 20 events that challenge their knowledge, skill and team work.

For more information about Snap-on, call (877) 740-1900, or visit www.snapon.com; for more on the Maintenance Skills Competition, visit www.aerospacecompetition.com.

BORESCOPES & VIDEOSCOPES

Articulating USB Borescope

Oasis Scientific Inc.



The Vividia VA-980, Semi-rigid Ablescope, Digital USB Inspection Camera features a 180-degree articulating camera head and bright, dimmable LED lighting in the tip. This device will connect to your PC or Mac laptops and desktop computers directly, and comes with a micro-usb adapter to work directly with OTG compatible Android smartphones. A wifi box adapter can be purchased to connect to Apple devices. It is a hybrid of both rigid and flexible borescopes as it can be bent and formed to access hard-to-reach places while keeping its rigidity. Mechanics will find this feature useful for looking up into engines and wings without having to provide extra support to keep the probe stabilized.

For more information call (864) 469-0919 or visit www.Vividia-Tech.com.

AMT AIRCRAFT MAINTENANCE TECHNOLOGY SUPPORTS CAREER DEVELOPMENT

At *AMT* we understand how important education and training is in our industry. If you are one of our subscribers you already know that we regularly provide feature articles on education, training, workforce and career-related topics, as well as provide education news in our daily newsletter.

AMT is actively involved in aircraft maintenance workforce and training issues. Our chief editor proudly serves on the board of directors of the Aviation Technician Education Council. He with other ATEC members engage in a number of initiatives aimed to support the Part 147 maintenance schools in this country.

In the 2016 *AMT* Magazine Readership Survey, you, our readers told us your top two critical issues were in this order; Training on the complexity of aircraft today, and recruitment and retention of employees.

AMT decided to step-up our own coverage of these important issues and have taken additional steps to keep you informed on training, education, workforce, and career development.

Last year we added the Education and Training channel to our website www.aviationpros.com. Now we have a dedicated page for current news and articles relating to these topics. Just click on the Education and Training button on the home page navigation bar and start reading.

This month, *Aircraft Maintenance Technology – AMT Magazine* launched our new *AMT* Career Development Newsletter. This new newsletter is designed to bring you current news and relevant articles on education, training, professional development, new technologies, best practices, tips for job seekers, and the occasion job opportunity directly to you. We plan to begin with sending these two times each month.

It's important to note these new offerings are not only meant for students. Although important to students and the next generation of aviation professionals, education, training, professionalism, and career development is applicable to nearly any age person working at any level in our great industry.

IN THE NEXT ISSUE

In the April issue of AMT we'll be focusing on MROs as the issue will be distributed at MRO Americas in Orlando. Articles will include:features on:

- AAR Rockford,
- Passenger to freighter conversions by PEMCO,
- Delta Air Lines and AeroMexico's joint maintenance facility in Queretaro, Mexico,
- Along with SWISS entry into service of new aircraft types,
- Financial considerations for business aviation upgrades: new vs. used parts,
- And more.

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LOOKING BACK AT 2016 AND **AHEAD TO NEW INNOVATIONS**

While the overall 2016 GA shipment results were down, the good news is there are a number of new products expected to be certified later this year and in the next few years

AT GAMA'S ANNUAL INDUSTRY Review press conference in Washington, D.C., last month, we revealed the 2016 year-end shipment and billing numbers and, in short, they were not what we'd hoped for. Global airplane shipments were down 3.9 percent, while rotorcraft shipments worldwide dropped nearly 17 percent. Airplane billings fell 14 percent, and rotorcraft billings were down 23 percent.

The slowdown in business jet sales — particularly among long-range, large-cabin jets — is responsible for much of the drop in airplane billings. Business jet shipments fell to their lowest level since 2004, declining 7.9 percent to 661 units. Piston airplane shipments also dropped 4.9 percent. The bright spot in the market came from turboprop airplane shipments, which experienced a 4.5 percent jump.

In each of these segments, the North American market remained strong in 2016, accounting for almost 70 percent of piston airplane shipments, 62 percent of business jet shipments, and nearly 58 percent of turboprop shipments. The North American demand was the largest on record for business jets and the largest share for piston airplanes in at least a decade. Elsewhere in the world, Europe notably showed an increase in turboprop airplane shipments after an unusually slow two years. The Asia-Pacific region showed strength in the turboprop market, taking the second spot after the U.S., but overall, the Latin American and Middle East regions showed softness.

Separately, the global rotorcraft sector continued to have a difficult time, with preliminary turbine shipments showing a 15.9 percent drop, and piston rotorcraft shipments declining 19.7 percent from 2015. Low oil and gas prices — resulting in less exploration — are in part behind these lower numbers. More information on the performance of all aircraft sectors is available in our annual Databook, which can be found at www.GAMA.aero.

THE GOOD NEWS

While the overall 2016 results were disappointing, the good news is that we have a number of exciting new products that we expect to be certified later this year and in the next few years. They include Gulfstream Aerospace Corp.'s G500 and G600, Textron Aviation's Cessna Denali and Citation Longitude, the Pilatus PC-24, Bombardier Business Aircraft's Global 7000, the Dassault 5X, the Mooney M10, and Bell Helicopter's 505 Jet Ranger X and 525 Relentless. The innovative designs and technologies featured in these aircraft should bring more customers off the sidelines and into showrooms. The recent introduction, and strong response to, Cirrus Aircraft's Vision Jet, Piper Aircraft's M600 turboprop, the TBM 930, the Diamond DA-62, and the HondaJet show that customers are ready to embrace new products.

In addition, GAMA continues to press for certification reform with members of the U.S. Congress and the new Trump administration. It was a key topic of a U.S. House Aviation Subcommittee hearing last month that focused on the state of American manufacturing. As Subcommittee Chairman Frank LoBiondo (R-NJ) noted about the certification process in his opening remarks, "As manufacturers design and build to meet these standards, they can experience needless and harmful bureaucratic delays, both internationally and domestically. These delays can be very detrimental to U.S. manufacturers trying to compete globally where every day of delay can mean real losses in both profits and jobs."

Subcommittee Ranking Member Rick Larsen (D-WA) agreed, adding, "Bipartisan compromise and significant industry input produced an entire certification reform title that would have brought long-overdue changes to the FAA certification process" in last year's FAA reauthorization legislative attempt. He noted that certification and other critical reforms should be included in the next FAA reauthorization bill. We agree, and hope Congress will act soon on this issue to bring relief to our industry — in 2017 and beyond. **AMT**

PETE BUNCE is president and CEO of the General Aviation Manufacturers Association (GAMA), which represents more than 85 of the world's leading manufacturers of general aviation airplanes and rotorcraft, engines, avionics, components, and related services. GAMA's members also operate repair stations, FBOs, pilot and maintenance training facilities and manage fleets of aircraft. For more info: www.gama.aero.

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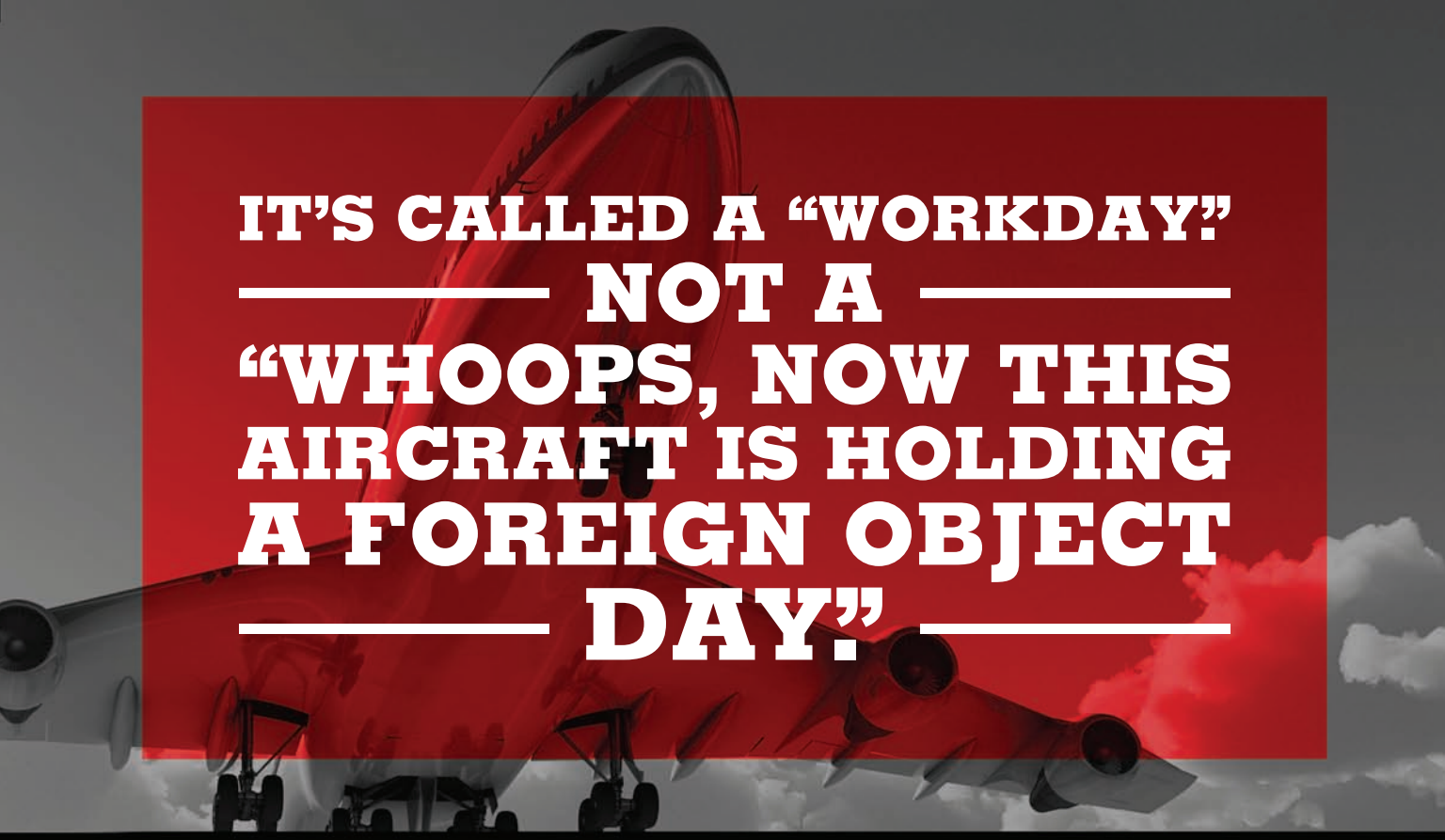

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