

## Manufacturing Novator drilling system finds favor at Airbus

Because orbital drilling allows for drilling and finishing in a single operation, a fully implemented process can reduce drilling time by 50% over conventional methods, according to **Novator**. The need to disassemble the parts to remove burrs is eliminated.

To exploit the advantages of orbital drilling, **Airbus** started a project with Novator a few years ago in order to develop a portable orbital drilling unit for final assembly lines in Toulouse, France, and Hamburg, Germany. Called Twinspin PX3, the CNC-controlled unit allows for a continuous radial offset adjustment of the cutting tool. It can produce not only cylindrical, but also conical and other complex-shaped holes.

In addition, an ID chip reader for position control and automatic diameter and parameter settings is included in the unit. The ID chip reader can also be used to identify a specific predetermined hole drilling recipe to perform adaptive stack drilling (parameters can be changed when moving from layer to layer in a material stack).

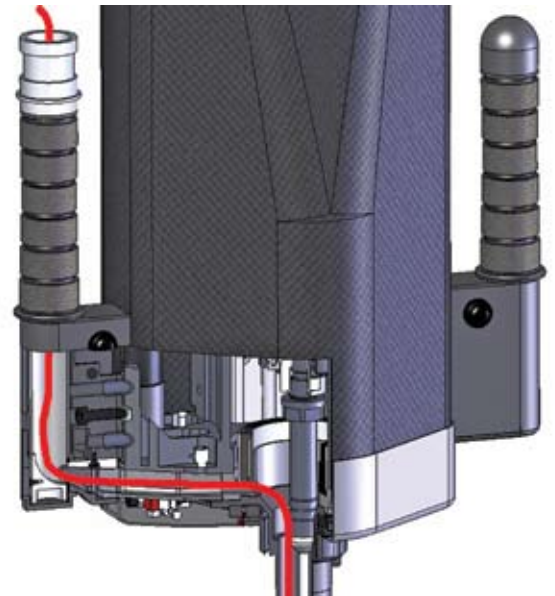
By working in close cooperation with Novator, Airbus has been able to thoroughly specify all requirements of the system to qualify and use it in a production environment. Intensive tests have been performed at Airbus to validate the industrial capability of the system for the A320 family final assembly lines, and the aircraft maker has decided to fully deploy it on all wing-to-body stations. With the switch to the Novator unit, the need for five currently used machines is eliminated.

Orbital drilling is based on machining material both axially and radially by rotating the cutting tool about its own axis as well as eccentrically about a principal axis while feeding the tool through the material at low thrust force. The small chips that are produced can be removed easily by vacuum. Efficient chip removal prevents

heat buildup and eliminates the risk for matrix melting in composite materials and heat-affected zones in metals. In addition, it eliminates the risk for chip-induced damage and makes cleaning of structures obsolete.

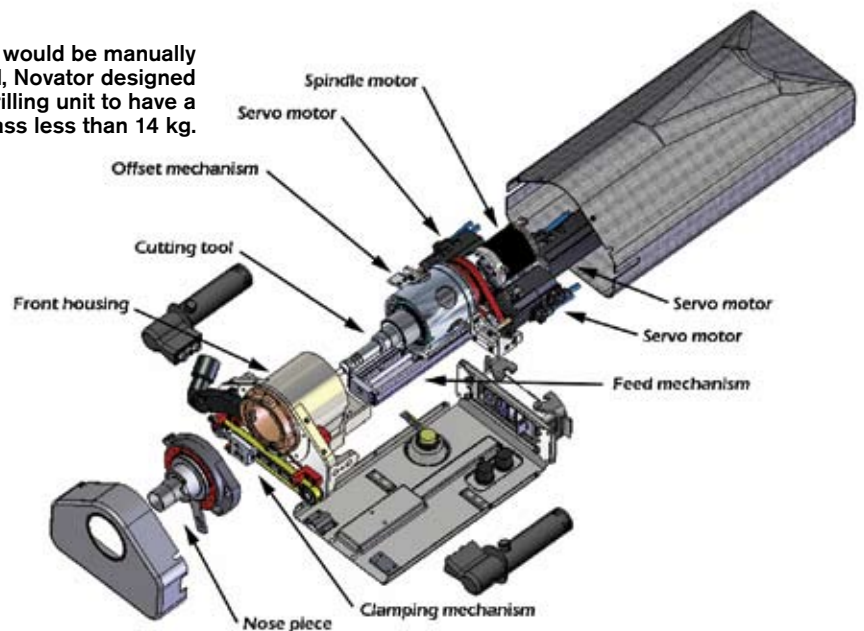
The tool only intermittently contacts the material, which allows for efficient cooling and makes dry drilling possible. It also increases the tool life in dry drilling. Dry drilling is highly desirable as it reduces cost and has little environmental impact (vs. the use of coolant). In some applications, however, minimal-quantity lubrication is required to reduce friction between the cutting tool and the workpiece to reduce cutter wear.

Low thrust force allows for burr-less



By producing chips of small size, orbital drilling allows for the efficient removal of them by vacuum.

Because it would be manually operated, Novator designed the drilling unit to have a mass less than 14 kg.



drilling in metals and delamination-free drilling in laminated composite material. It also minimizes the risk for part deflection when drilling in thin structures and it facilitates use of automation such as indus-

trial robots, which are force-sensitive.

Patrick Ponticel edited this article based on information supplied by **Benoît Marguet**, **Frédéric Wiegert**, and **Olivier Lebahar** of Airbus France; **Bertrand Bretagnol** of Assystem; **Fahri Okcu** of Airbus Germany; and **Eriksson Ingvar** of Novator.

## Manufacturing Preventing quality defects before they happen

Reducing cycle time and time to market while improving quality and efficiency are the benefits customers of Intercim's Pertinence Suite can expect, according to the company. The Suite manages the entire production process, from design through final inspection.

ment," he said. "Take the cost of poor quality, for example. Intercim's patented predictive analysis capability offers manufacturers a totally new way of understanding and preventing quality defects before they happen, improving yield while decreasing the cost of rework and scrap."

A new value-based pricing model, unique to the industry, eliminates the large initial investment typical in purchasing enterprise software licenses, the company says, adding that the new pay-per-use model allows customers to take advantage of the suite's production management capabilities sooner.

Native web technology allows the Pertinence Suite to do what Intercim claims no manufacturing execution system can: "manage production within the four walls of the factory, across a company's enterprise, and throughout the supply chain." Process plans, data collection, risk patterns, emergent processes, electronic approvals, and key performance indicator reports may be entered locally and accessed globally.

Comprehensive interoperability also allows customers to optimize and leverage their existing product lifecycle management and enterprise resource planning investment.

User acceptance is also made easy via an intuitive user interface, according to Todd.

Another innovation is the ability to extend 3-D modeling

to the shop floor. "Since everything conforms to the 3-D design, translating it to 2-D as it leaves, engineering is non-value-add and possibly error-prone," said Todd. "Using 3-D as a common model throughout the process ensures consistency and is more intuitive for the shop-floor technician." The product also ensures that work is performed only by authorized or certified employees.

The Pertinence Suite comprises Process Planning, Process Rules Discovery, Process Execution, Operations Advisor, Emergent Process Management, and Performance Tracker. It is powered by the company's Velocity Core, an innovative transactional layer that facilitates data exchange between modules. Using Service Oriented Architecture and built on the Microsoft .Net platform, the system is the only completely web-based, commercial-off-the-shelf operations management solution available, according to the company.

Intercim says the launch is the latest accomplishment resulting from its July 2007 merger with Pertinence. Intercim describes itself as a leader in the development and application of web-based manufacturing operations software.

Among the company's customers are Boeing, which uses Intercim's products to manage final-assembly process at its Everett plant in Washington, and the quality

process worldwide. The company says its software provides Boeing immediate knowledge of supplier product anomalies that could affect production. For example, if a supplier anywhere in the world has an interruption in its facility, Boeing can make immediate decisions to avoid production disruptions downstream at Everett.

In final assembly at Everett, Intercim software manages or integrates with every aspect of the production process. The software ensures procedural control in every task. Every piece of data pertaining to installation of the aircraft is archived in a complete as-built record, including the date, time, and person who performed the work. The system also manages the process for each aircraft's airworthiness certification.

Other aerospace customers include **Bell Helicopter**, for which Intercim software is used to manage final assembly of the V-22 Osprey and H-1 military helicopters; **Ball Aerospace**, for an anomaly and corrective tracking system; **United Launch Alliance**, for process execution in rocket assembly and launch procedures related to the Delta Program; and **EADS/Airbus** for operational risk analysis.

Patrick Ponticel



Boeing is using Intercim software for work on the interior of the 787 Dreamliner.

The Suite offers customers in aerospace and other sectors the power and technology to manage the most complex processes through simplicity, according to Intercim President and CEO John Todd. "What makes the suite unique is the way it delivers additional return on invest-



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## Manufacturing

### Renishaw system leads CMM scanning out of 'time warp'

Renishaw says early adopters of its ultra-high-speed scanning system for coordinate measuring machines are achieving good productivity gains. At the heart of the Renscan5 system is the infinite-positioning REVO head. The system is being applied to complex parts that take long to manufacture.

One example is a jet engine blisk. The manufacturer had experienced a 922% throughput improvement, according to Renishaw. The inspection sequence comprises nine section scans of the airfoil profile, eight longitudinal scans of the blade, two scans of the root

profile, and one scan of the annulus profile.

With conventional 3-axis scanning at 10 mm/s, it takes 46 min per blade, or 22 h, 14 min for all 29 blades. With the EVO head, scanning takes place at the rate of 500 mm/s for a per-blade time of 4 min, 30 s—2 hr, 10 min, 30 s for all 29 blades.

"Besides major reductions in cycle times, Renscan5 and REVO make it possible to obtain far greater data point coverage," said Denis Zayia, Renishaw CMM Product Manager.

"Faster inspection is especially vital on large, complex,

high-value parts with many critical features," he continued. "CMM [coordinate measuring machine] inspection can be a major bottleneck to efforts to speed throughput and gain lean efficiencies. Form measurement of complex parts and critical geometries for functional fits can demand many thousands of data points. Needing to produce and document parts to ever-higher precision, ever-tighter tolerances, manufacturers are looking to CMM speed for a solution."

Conventional three-axis CMMs scan at rates of 5 to 15 mm/s to hold accuracy, according to Zayia. The aim is to avoid high acceleration and deceleration rates and rapid axis changes that can induce inertia errors, causing deterioration in measurement accuracy. "CMM inspection has been stuck in that time warp for over two decades," he said.

The Renishaw was created in the company's longest and largest development program. Renscan5 enabling technol-

ogy encompasses a range of breakthrough five-axis scanning products that measure at up to 500 mm and 4000 data points per second while virtually eliminating the measurement errors normally associated with existing three-axis scanning systems.

A 3-D measuring device in its own right, the REVO head features two rotary axes—one in the vertical plane, one in the horizontal—to give infinite rotation and positioning capability. The measuring head performs synchronized Y- and Z-axis motion to quickly follow changes in part geometry during inspection routines, eliminating dynamic errors caused when moving the larger mass of a CMM structure. Where X axis motion is required for the probing routine, Renscan5 moves the CMM at a constant velocity along a constant vector as measurements are being taken, removing the acceleration/deceleration inertia errors incurred in conventional scanning.

Patrick Ponticel

It takes one early adopter of Renishaw's Renscan5 system a little more than 2 h to scan all 29 blades of a jet engine blisk, compared with more than 22 h using conventional three-axis scanning.



## Manufacturing

### Eclipse looks to improve production processes

Eclipse Aviation will use an integrated software suite from Right Hemisphere to generate consistent and transferable manufacturing and maintenance procedures for its production facilities in Albuquerque, NM, and for its various service centers in the U.S.

Illustrated production and maintenance instructions will be derived from the origi-

nal 3-D CAD files that were used in the engineering development of the airplane maker's Eclipse 500, a very light jet.

"Eclipse Aviation strives to use the most advanced technology available, and the design of the Eclipse 500 was guided by this principle," said Vern Raburn, Eclipse Aviation President and CEO, who noted that use of the Right Hemisphere

product complements the company's emphasis on continuous improvement.

Use of the integrated software suite, which already is used by several commercial and general-aviation manufacturers, will reduce the time required to create written production and maintenance directions. It also will reduce the time required for the interpretation needed to



**Eclipse Aviation claims to have reached the 100-unit production milestone faster than any other general-aviation jet aircraft manufacturer.**

change engineering models into production applications. Production line technicians can visualize work as it is performed and make improvements at any step in the process.

The product is expected to improve processes at the plant, which already are efficient. Eclipse has produced and certified 104 500s since December 31, 2006. That makes it "the fastest general-aviation jet aircraft manufacturer in history to produce its first 100 airplanes," according to the company.

"Our goal this year remains ramping production, and that means anything we can do to become more efficient is what we're working on," said company spokeswoman Alana McCarraher. The company does not release figures for projected production numbers, she said, but the company plans to produce "significantly more in 2008" than it did in 2007.

McCarraher noted that Eclipse is producing one aircraft per day. "We believe we can eventually produce four aircraft per day," she said. "But to get to our ultimate goal, that could take years."

On January 14, Eclipse announced that under an expanded partnership with Luxembourg-based **ETIRC Aviation**, a European assembly plant is being considered. The leading candidate site at the

moment is the city of Ulyanovsk in Russia. With its equity investment of more than \$100 million under the expanded partner-

ship, ETIRC will become the largest single investor in Eclipse Aviation.

Patrick Ponticel



## From 3D CAD to production-quality metal parts in hours

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## Testing

### Weathering changes in aerodynamic innovations

Most people are familiar with the expression, "Trying to build a better mousetrap," and yet no one has really been able to do it. A design so simple that it accomplishes its intended purpose seems to leave no room for improvement. However, not many innovations can lay claim to perfection on the first go-around.

The probe, developed in the mid-1990s, recently underwent a technological refresh and modernization by the Institute of Aerospace Systems (ILR) of the **University of Braunschweig**, Germany. The Helipod's main purpose is to measure basic meteorological quantities, not only on a wide scale but including extremely

hardware and software. For temperature measurement, the unit includes a **Rosemount** 102 platinum resistance wire thermometer as well as an **Aerodata** AD-STS with a **Dantec** "open-wire" element. The Helipod's humidity sensor system consists of a dew point mirror, a **Humicap** capacitive sensor, and a **Lyman-Alpha** hygrometer. Only a few meters in length, the Helipod probe is controlled via a complex measuring computer system based on CompactPCI boards and M-Modules from **MEN Micro** for harsh environmental conditions that collects and analyzes the measurement data.

The Helipod is the most modern airborne system worldwide for measuring atmospheric turbulences. In addition to its operation in many applications in Germany, such as LITFASS (Lindenberg Inhomogeneous Terrain - Fluxes between Atmosphere and Surface), the Helipod has been used in the Arctic on the Polarstern, a 17,300-ton polar icebreaker operated by Germany's **Alfred Wegener Institute**, for the PHELIX (Profiler-HELIPOD Intercomparison Experiment) project at California's Vandenberg Air Force Base on the Pacific Coast near Santa Maria, and in other applications with many notable international scientific organizations. Aside from uniquely precise measuring results, these missions yielded some unexpected scientific findings

in the lower atmosphere. Often, a number of measuring types (such as micro-meteorological ground stations and remote sensing systems) are carried out over the same area, with the highly accurate and geographically precise Helipod probe data being taken as a reference.

The Helipod drag probe has a length of 5 m, a diameter of 60 cm, and a mass of about 250 kg. The probe is populated with measuring equipment that is controlled by an industrial computer from MEN Micro. During the measurements, the probe is attached to a helicopter using a 15-m-long rope. At a forward speed of 40 m/s, the air turbulence caused by the helicopter rotor is driven to the rear so strongly that the probe is not affected by it. With this relatively small forward speed, the probe can log measurements using the latest instruments and the powerful onboard computer at a precision unattainable by other measuring systems (40 cm after anti-aliasing filter). Since the probe does not have wings, propellers, or an engine, the undisturbed state of the air is measured in unaltered form at the current parameters.

The probe records turbulent transport, wind vector, humidity, air and surface temperatures, as well as CO<sub>2</sub> at very high precision in defined altitudes up to 2000 m above land or water surface. Most flights follow a grid pattern



Its rugged construction makes the Helipod ideal for data capture in extreme temperatures and environments, such as on this icebreaker in the Arctic.

What we tend to see, more often than not, is that an invention's design principles serve as the basis to take that invention into new realms of possibilities and technological advancements. Such is the case with the Helipod, an autonomous measuring probe attached to a helicopter in such a way that it is out of the downwash area of the carrying helicopter.

small variations—i.e. small-scale turbulence. Among others, the gathered measuring data helps to understand the energy exchange between the atmosphere and the Earth's surface in order to improve numerical models. This also has an influence on the quality of our daily weather forecast.

The system meets extreme environmental conditions using standardized, inexpensive



The compact Helipod, seen here with a recent LITFASS field crew, can be easily disassembled and transported.

and accurately acquire the dynamic state of the atmosphere. The integration of further measuring instruments as well as optical and infrared cameras is optional.

All measurements are done using two different devices. One device measures fast, but drifts in time. The other device measures slowly but very precisely. The two data sets are merged for analysis using complementary filters. This makes for the precision previously unattainable, as noted earlier (40 cm).

An unexpected result lay in the measurements taken at high altitudes due to the air's high heterogeneity. Up to now, scientists believed that air was mixed at heights of 100 to 500 m. However, Helipod measurements have shown that air keeps its structure at even greater heights depending on the surface underneath (forest, farmland, lake, sea, ice). Air mixes completely with neighboring air over these types of surfaces only in much higher regions, influencing weather-

forecasting models.

The Helipod is a self-sufficient system with its own power supply using batteries, navigation systems, data processing, and mass storage. The basis of the onboard computer system is a robust industrial computer from MEN Micro in a standardized CompactPCI format. The probe's most important feature is the ability to operate over a wide temperature range—from  $-40^{\circ}\text{C}$  in the Arctic to up to  $+85^{\circ}\text{C}$  in the desert. This conforms to the E2 industrial standard temperature range and the T2 telecom temperature standard range. A 300-MHz MPC8245 PowerPC processor with a 603e core sufficiently controls the system. The 6U computer board's total power dissipation is approximately 8 W. Low power consumption with high logical performance is critical for applications with demanding temperature ranges due to the limited capacity of the onboard batteries.

For the Helipod project, the

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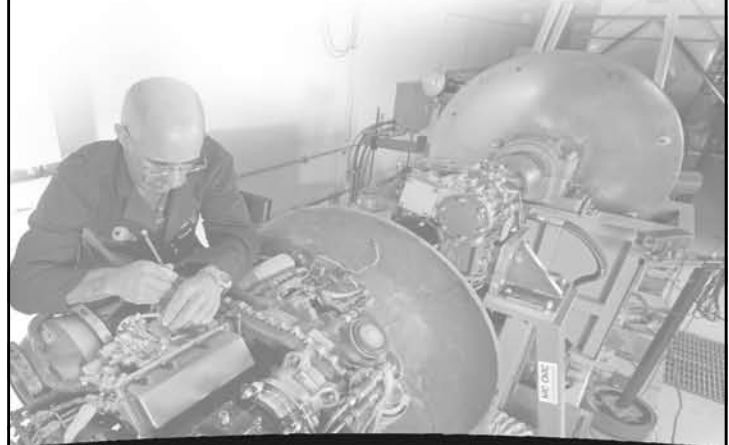
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single-board computer is populated with SDRAM, flash memory, and a CompactFlash card. Four serial interfaces, one USB, and two ethernet ports are also included. In addition, the SBC can carry up to three M-Modules (mezzanine modules) according to the ANSI/VITA-12 standard. Up to four additional M-Modules can be accommodated on a passive carrier board. For this project, an I/O

module with 32 individually usable digital inputs/outputs, four 16-bit A/D modules with 32 differential inputs, and a 12-bit A/D module with 16 single-ended inputs are used, for a total of six M-Modules. Another M-Module provides the ARINC interface that transfers the position data to the CompactPCI system. Thus, only two CompactPCI boards, in an exceptionally small housing, are needed for

data processing and for the connection of multiple measuring inputs and control outputs. To precisely determine its position, Helipod has several onboard GPS receivers. All data is intermediately stored in a very large flash memory for even more precise filtering and analysis later on in the laboratory.

The computer system runs the ELinOS embedded Linux system from Sysgo and uses

the integrated RTAI for real-time requirements. Because of the special requirements, ILR has made a number of adaptations in the Linux core. Owing to its open source, this is no problem with Linux. Drivers and board support packages for all plug-on boards are easily available.

**Stephen Cunha**, Vice President, MEN Micro, wrote this article for Aerospace Engineering & Manufacturing.

## Materials

### GKN Aerospace develops advanced materials for Black Hawk, Boeing 787

GKN Aerospace teamed up with Sikorsky Aircraft, a subsidiary of United Technologies, and the U.S. Army's ManTech Program Office to complete the design, development, and manufacture of the UH-60 Common Composite Tailcone (CTC) test units for Black Hawk helicopters.

As a result of the development program, long-term production potential of up to 1000 tailcones over the next 20 years is possible, according to GKN.

The new all-composite tailcone report-

edly met critical goals in reduced weight, parts count, tooling costs, and manufacturing costs. An improved manufacturing approach, referred to as a Reduced Tooling Concept, has reduced the number of tools by more than 70% compared to traditional methods. Costs have also been reduced, claims GKN, through the use of automated fiber placement in the manufacture of the tailcone skins, providing high-quality, repeatable laminates.

The CTC uses the lightweight material X-Cor throughout the assembly. X-Cor is

an engineered tailored material that replaces traditional honeycomb in sandwich structures. The design features a paintless finish with the color integrated into the skin laminate at the lay-up stage—a new technique that results in reduced labor costs and a durable finish, according to the composite-structures supplier.

"This pioneering program for the Black Hawk helicopter has employed a range of new techniques and materials, creating a valuable database of knowledge and understanding for all involved in the team," said Jim Gibson, Vice President, Sales and Marketing at GKN Aerospace, in a statement. "We believe this will support Sikorsky and the U.S. government as they bring the considerable benefits these technologies offer to other areas of the aircraft—and to other aircraft."

The GKN Aerospace facility in Tallahassee, AL, led the manufacture of the six test units and was responsible for design producibility, production inputs, tool design and manufacture, process development, and hardware fabrication. Support came from GKN Aerospace, St. Louis, where the CTC skin halves were fiber-placed.

In a separate announcement, GKN Aerospace was awarded a contract by Boeing to develop and supply titanium



GKN Aerospace helped to develop an advanced all-composite tailcone (CTC) for Black Hawk helicopters that uses X-Cor, an engineered material that replaces traditional honeycomb in sandwich structures, throughout the assembly. (UH-60L model shown does not feature the CTC.)

metal matrix composite (TMMC) thrust links for the 787—the first use of TMMC in a commercial application, claims GKN.

TMMC is an advanced engineered material consisting of silicon carbide fiber and titanium powder that has been diffusion-bonded, a process that creates a hybrid material said to be stiffer and stronger than conventional titanium alloys. According to the supplier, TMMC offers weight savings of 25-40% compared to traditional steel or Inconel thrust links and increased temperature tolerance compared to monolithic titanium.

A new TMMC manufacturing process has been developed by GKN Aerospace's partner, **FMW Composite Systems**. FMW developed this method of TMMC manufacture by producing its own fiber material, and using powdered titanium in the diffusion process to keep material costs low. GKN Aerospace and FMW will partner on this contract and seek other opportunities for TMMC in

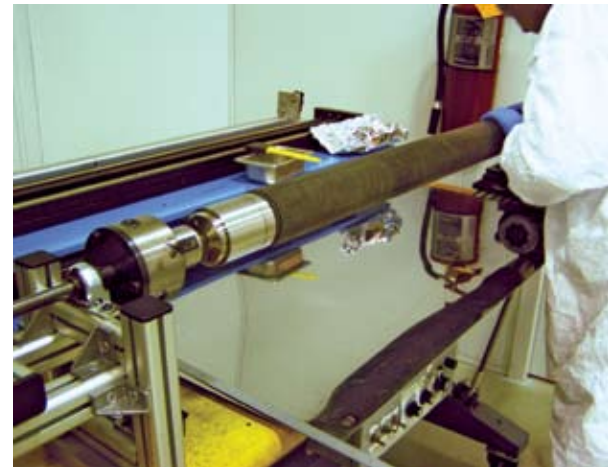


**GKN Aerospace will supply titanium metal matrix composite (TMMC) thrust links for the Boeing 787—reportedly the first use of TMMC in a commercial application.**

the aerospace sector.

“FMW’s innovative TMMC manufacturing skills and our expertise in program management—and in the complex welding of highly loaded titanium structures using our low-cost machining center in Mexico—means the Boeing 787 will be the first of many civil aircraft to benefit from this promising development,” said Frank Bamford, Senior Vice President of Business Development and Strategy for GKN Aerospace.

The Boeing 787 thrust link will com-



**Several plies of FMW’s silicon-carbide-fiber tapecast mat are rolled onto a mandrel, awaiting inspection and further processing.**

prise an FMW-manufactured TMMC center tube, which GKN Aerospace will plasma-weld to two machined titanium end lugs, final machine, and assemble. GKN Aerospace will also manage the contract, supplying two versions of the thrust link to enable integration with either the **Rolls-Royce** Trent 1000 or the **GE**nx engine.

Ryan Gehm

## Materials

### Sentinel against corrosion

Monitoring aircraft structures to detect and, if necessary, control corrosion is an essential part of aerospace engineering. Aircraft metals may be produced with chemical protection and receive high-class paint finishes, but erosion by weather or solvents, and in-use physical damage can lead to corrosion. **BAE Systems’** Sentinel uses custom electrical sensors and provides a system to alert operators if corrosion is occurring or likely to occur.

“Sentinel is essentially a paint sensor,” said Mike Hebbron, Corrosion Specialist at BAE Systems’ Aerospace Technology Center. The sensor is de-

signed to simulate the part of the structure being monitored, the structure and protective coating mimicked by using thin layers of alloy. “The sensor then has all the ingredients of the structure being monitored and will ‘see’ all the same conditions,” he said.

The principle is similar to the “witness” crack gauges used on buildings to check subsistence effects. With Sentinel, the sensors are either periodically hooked up to a small, handheld instrument to check status, or they form part of a continuous, online monitoring system. “Even if readings are missed, the history of how the corrosion protection is degrading is stored



**BAE Systems’ Sentinel has been selected for the System Development and Demonstration phase of the Lockheed Martin F-35 Lightning II Joint Strike Fighter program.**

in the materials of the sensor itself, simply by being there,” added Hebbron.

Sentinel has been selected for the System Development and Demonstration phase of the **Lockheed Martin F-35**

Lightning II Joint Strike Fighter program. If successful, it could be a candidate for the production aircraft, due to enter service in 2012.

Stuart Birch

## Materials

### Chomerics puts up EMI shield

A lightweight, electrically conductive plastic from **Chomerics**, Premier PEI-140, was developed for EMI shielding of high-temperature avion-

ics. The material is said to maintain high-temperature tolerance, chemical resistance, and UL 94V-0 flammability rating for electronics shielding up to 85 dB over a wide range of frequencies. PEI-140 complies with avionics smoke density requirements.

The materials supplier chose polyetherimide (PEI) for the base resin of avionics grade Premier for its elevated thermal resistance, high-strength mechanical properties, flame resistance, and low

smoke generation. PEI-140 is an amorphous thermoplastic reinforced with a matrix of proprietary conductive fillers to provide EMI shielding. It is engineered to optimize stable electrical, mechanical, and physical performance for EMI shielding in continuous use at temperatures up to 340°F.

Chomerics claims that Premier PEI-140 provides the only commercially available thermoplastic system with a homogenous dispersion of the fiber throughout the molded part, regardless of part geometry. This filler morphology, combined with a proprietary dispersion agent, provides conductivity and consistent shielding throughout the part.

The material's eco-friendli-

ness is another characteristic the company touts. PEI-140 complies with RoHs, WEEE, EPA, EU, and TCO specifications for ecological compatibility, contains no halogenated compounds, and is recyclable.

"By using PEI-140, avionics systems suppliers can offer their customers weight reductions...and closer tolerance mechanical parts to facilitate tighter fit, improved sealing, and excellent EMI shielding performance," said John Perkins, Chomerics Global Product Line Manager.

The company is also targeting high-performance applications in other industries, including defense and transportation.

Ryan Gehm



Chomerics' Premier PEI-140 was developed for EMI shielding of high-temperature avionics.

## Materials

### Andrews Space provides thermal protection for re-entry

**Andrews Space** has developed and tested new materials to enable advanced thermal protection systems (TPS) for non-rigid aero surfaces. The tests were conducted at the **NASA Ames Research Center (ARC)** arc-jet facility as part of a

NASA Phase II Small Business Innovation Research program to create lightweight ballute designs.

Developing a lightweight, flexible material that can withstand re-entry heating is a particular challenge of the ballute de-

sign, according to Andrews.

Compared to traditional ballute designs, which use several layers of Nextel fabric with insulating layers of Kapton and Kevlar structural backing, Andrews' uses thinner materials and transpiration cooling (the effect of using a gas to cool the surface and 'transport' heat).

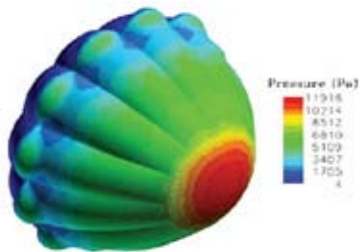
"The goal of our transpiration-cooled design is to reduce the mass of the ballute TPS by 20% over traditional, purely insulative solutions," said Dana Andrews, Andrews' Chief Technology Officer.

Andrews Space is experimenting with materials that change properties when heated. The leading material designs combine a fabric matrix with pre-ceramic polymers, according to the company.

At room temperature, the material is



Andrews Space has developed and tested new materials to enable advanced thermal protection systems (TPS) for non-rigid aero surfaces. Shown is the result of a coupon sample test of the TPS materials.



Developing a lightweight, flexible material that can withstand re-entry heating is a particular challenge of ballute design. Shown at top is the Mars entry of an inflatable aerobrake; below is a ballute CFD surface pressure analysis.

flexible and easily packaged in a small volume; when heated, the fabric becomes rigid, and in certain conditions porous, allowing gas to escape to provide transpiration cooling. When the ballute is past peak heating and the temperatures drop, the coating becomes impermeable again, Andrews explained.

The company worked with the **University of Washington** to develop more than 20 different material samples, each of which was tested in NASA ARC's arc-jet facility at re-entry heating conditions (temperatures above 700°C for 300 s). The goal of the tests was to identify candidate materials that were nonporous at on-orbit conditions, but then changed during re-entry heating to enable transpiration cooling.

Following the first round of arc-jet testing, researchers discovered that several material design approaches are capable of surviving the high temperatures of re-entry. During tests, these materials reacted and pyrolyzed as expected.

According to Andrews Space, the materials support the ballute design requirements as well as the program objective of enabling a new class of space structures and re-entry systems for Earth return ve-

hicles and planetary probes.

Andrews is also investigating other applications of the new material, including

for inflatable structures like deployable wings, as well as advanced acreage TPS.

Ryan Gehm

## How LASERDYNE Makes Satisfied Customers Into More Successful Customers

For over 26 years LASERDYNE has worked side-by-side with OEM, MRO, and contract manufacturers around the world. The innovative features of the LASERDYNE 450 and 790 systems are the result.

The LASERDYNE 450 is an ideal system for processing blades, vanes, shrouds and other "small" components common in turbine engines. It is also a cost effective replacement for older, less efficient Nd:YAG laser drilling systems.

The LASERDYNE 790 is the industry standard for the production of larger, more complex parts or where multiple setups may be an advantage. The 790 is available with X axis travel of 1 m and 2 m and with automated part load /unload.

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## Propulsion NASA begins rocket testing

Data from the tests of core components of a rocket engine from the Apollo era that carried the first Americans to the moon will help NASA build the next-generation engine

that will power the new Ares launch vehicles, it says. Beginning this past December, NASA began testing the engine's powerpack, a gas generator, and turbopumps that



Core components of the J-2X engine for NASA's Constellation program being installed on the A-1 Test Stand at NASA's John C. Stennis Space Center. Tests simulated inlet and outlet conditions that would be present on the turbomachinery during a full-up engine hot-fire test.



A J-2 engine awaits testing on the A-1 Test Stand at SSC. NASA is testing the engine's powerpack—a gas generator and turbopumps that perform the rocket engine's major pumping and combustion work. The engine is being studied anew by NASA rocket scientists building the engines that will power the next generation of launch vehicles, the Ares I and Ares V, and carry humans to the moon.

perform the rocket engine's major pumping and combustion work. These components originally delivered propellants to the J-2 engine that fueled the second stage of the Saturn V rockets.

Those heritage components are being used to develop the J-2X, which will be tasked to power the upper stages of both the Ares I crew launch vehicle and the Ares V cargo launch vehicle. Results from the tests will help engineers modify the turbomachinery to meet the higher performance requirements of the two next-generation vehicles.

"The J-2X engine will incorporate significant upgrades to meet higher thrust and efficiency requirements for Ares," said Mike Kynard, Manager of the upper-stage engine in the Ares Projects Office at

NASA's Marshall Space Flight Center (MSFC). "That's why we're taking a new look at these components—to gather performance data, test their limits, and reduce risks down the road when we're building and testing the engine."

The powerpack tests were conducted at NASA's Stennis Space Center, where the components were installed in late September.

During the initial trials, engineers ran liquid oxygen and liquid hydrogen through the powerpack, monitoring its ducts, valves, and lines while simulating conditions as if it were attached to a rocket upper stage and main combustion chamber. Engineers were able to preview conditions that might be present during an engine test fire.

The first test in the series



An original J-2 engine for the Saturn V undergoes processing at NASA's Marshall Space Flight Center in 1965. The Saturn V, like key hardware and components of the Ares launch vehicles, was designed, developed, and tested by Marshall Center engineers.

was a chill test, during which engineers verified the tightness of seals in the fuel lines and pumps at propellant temperatures as low as -425°F. Engineers also verified the accuracy of the chill procedure and determined the amount of time required to chill the pumps. NASA says that initial indications show that all test

objectives were met and no anomalies were noted.

Later tests in the series will include test fires at a variety of power levels and durations ranging from 12 s to 550 s. At press time, testing was scheduled to continue through the end of this month.

The Ares I is an inline, two-stage rocket that will transport

the Orion crew vehicle to low Earth orbit. Orion will accommodate as many as six astronauts on missions to the International Space Station or as many as four crew members on lunar missions. The Ares V, a heavy-lift launch vehicle, will enable NASA to launch a variety of science and exploration payloads and key

components needed to go to the moon.

Under a contract awarded in July 2007, **Pratt & Whitney Rocketdyne** will design, develop, test, and evaluate the engine. MSFC in Huntsville manages the J-2X upper stage engine for NASA's Constellation Program

Jean L. Broge

## Propulsion Airbus and the environment

Very large aircraft do not necessarily have to impose high noise levels on the environment, a fact that has been demonstrated by the **Airbus A380's** appearance at international air shows and during its world tours. Now, Airbus is claiming its A380 as the quietest long-range aircraft in service. The aircraft, with **Engine Alliance GP7200** powerplants, has received external noise levels validation from the European Aviation Safety Agency (**EASA**) and the U.S. **FAA**. External noise certification was part of the process for the joint EASA and FAA type certification for the GP7200.

The noise levels certified on the GP7200-powered A380 are equivalent to those already approved on the **Rolls-Royce Trent 900**-powered A380, according to the company. The levels are 17 EPNdB (effective perceived noise in decibels) cumulative margin to the **ICAO** Chapter 4 noise standard, which is more stringent and voluntarily used by Airbus instead of the mandatory Chapter 3 standard. The company stated that the A380 was now "easily compliant" with today's most stringent noise standards and "well prepared" for the future. Mario Heinen, Airbus Executive Vice President, A380 Program, said the aircraft "is consistently meeting and often exceeding its design targets."

The Engine Alliance A380 generated at least 50% less noise than "its nearest



Noise levels certified on the GP7200-engined A380 are equivalent to those already approved for the Rolls-Royce Trent-powered version of the aircraft (now in service with Singapore Airlines), reducing the airliner's environmental effect. Airbus is now helping to research and evaluate the potential environmental friendliness of aviation GTL synthetic fuels.

competitor" at takeoff and on landing, claims Airbus. Both engine variants of the A380 meet the most stringent noise rules at any international airport, including London Heathrow's QC2 for departures and QC0.5 for arrivals. Airbus regards that ability as being of major benefit both to A380 operators who have more flexibility to operate night-time flights, and to airports, because passenger capacity would be increased while limiting the impact of noise on the surrounding communities.

The certification program for the GP7200-powered A380, including noise testing, has been carried out with A380 flight test aircraft MSN009. In May of last year, that aircraft confirmed its low noise emissions during a series of certification tests that were performed at the Spanish

Air Force base at Morón de la Frontera in southern Spain and jointly witnessed by European and U.S. noise authority specialists. Airbus has stated that compared to "the former largest commercial aircraft," the A380 seated over 40% more passengers in a typical three-class, 525-seat configuration, with seat-mile costs 20% lower and range capability over 1000 nmi longer.

The A380's fuel burn is also low. The company's figures show that it consumes less than 3 L/100 km per passenger. The GP7200 validation statement came shortly after the announcement at the Dubai Air Show that Airbus was one of several major companies and organizations to sign an agreement to research the potential benefits of synthetic jet fuel in aerospace engines. The others are

## **Qatar Airways, Qatar Petroleum, Qatar Fuel, Qatar Science and Technology Park, Rolls-Royce, and Shell.**

Objective of the research work is to examine the feasibility and potential benefits of using GTL (gas-to-liquid) synthetic jet fuels, which takes natural gas and converts it to liquid kerosene. "The properties of GTL kerosene are largely similar to conventional jet fuel, making it a 'drop-in' replacement for today's kerosene, capable of being used in today's aircraft and airports without modification," said the signatories in a joint statement. Focus of the research will be evaluating potential improvements in local air quality, fuel economy, and overall reduction in CO<sub>2</sub> and other emissions. Specific studies are

also to examine potential operational benefits for airlines, including enhanced payload-range, reduced fuel burn, and increased engine durability.

Initially, the synthetic fuels would be mixed with standard kerosene to enable the group to model aircraft and engine performance, with a view to exploring the potential of fully synthetic fuels.

Airbus, Rolls-Royce, and Shell are members of the industry-wide Commercial Alternative Aviation Fuels Initiative (CAAFI). GTL fuels are being developed to meet international standards required for aviation use under the auspices of CAAFI.

"No one industry has all the answers," said Christian Scherer, Executive Vice

President, Strategy and Future Programs, Airbus. "Cooperation remains key to finding technology-driven solutions that address global and local environmental challenges facing us."

Shell and Qatar Petroleum are building what is described as the "world-scale" integrated Pearl GTL complex. Due to start up at the end of the decade and located in Ras Laffan Industrial City, Qatar, Pearl GTL will produce 120,000 barrels of oil equivalent per day of condensate, liquified petroleum gas and ethane, and 140,000 barrels per day of cleaner, high quality GTL fuels and products. This will include 12,000 barrels a day (equivalent to some 500,000 t per annum) of GTL kerosene.

Stuart Birch

## **Electronics**

### **A step toward self-inspecting aircraft**

Smart sensors have a very significant role in aerospace, particularly when they can quickly detect potentially serious damage to a structure. Their increasing sophistication and reliability is expected to contribute to huge savings in maintenance, servicing, and support costs, all of which are

central to the successful operation of aircraft that may have service lives that span decades.

**BAE Systems** leads research and development work on the Advanced Structural Health Monitoring System (AHMOS), part of a European R&D-funded initiative, which

has now seen smart sensors flight tested on a BAE Hawk aircraft. The trial demonstrated, for what some say is the first time, the operation of a fully integrated automated damage-detection system within a flight environment. BAE regards it as an important step toward the eventual goal of self-inspecting aircraft.

Structural inspection is a significant factor in the cost of supporting fleets of both military and commercial aircraft. In-service lives of 40 years or more are now expected. However, as aircraft age, the servicing needed to maintain stringent airworthiness standards invariably becomes more costly.

"The new system aims to avoid lengthy and expensive structural inspections that require the repeated dismantling of large sections of an aircraft," said Jim McFeat, AHMOS

Technical Manager, BAE. "Very often, such inspections are precautionary and no faults that need repairing are found."

The flight test Hawk carried an acoustic emissions detection kit that was able to record the existence of cracks in specifically designed dummy structures and download a diagnosis when the aircraft landed.

"Using a combination of strain gauge sensors and fiber-optic cables connected to a computer, and contained within an aerodynamic pod under the fuselage of the Hawk, we demonstrated that the technology works," said McFeat. "We have been able to compare all of the aircraft's maneuvers in flight with the pilot's notes and our own computer." He added the first two flights by the AHMOS-equipped Hawk had "good results."

Further flights were to be



The modified BAE Systems Hawk used for research and development work on the Advanced Structural Health Monitoring System being developed toward the ideal of a totally self-inspecting aircraft.

made with a formal report expected shortly. "Ultimately, we are trying to automate the non-destructive testing process in the same way that car manufacturers have done for engine management systems," said McFeat. "The customer will plug a computer into a data-box on the aircraft and download in-flight information gathered from gauges and sensors at strategic points."

If sensors fitted deep inside the aircraft structure can reliably detect the onset of damage, the need to dismantle sections of the airframe would be greatly reduced

and new detection process could be performed remotely; at the press of a button or automatically online.

"Engineers are just beginning to realize the potential value of this type of structural monitoring," added McFeat. "Aircraft are expensive assets, and their owners are pushing to get the maximum possible use from them. Any technology that can help deliver more cost-effective operations or increased availability is bound to be welcome."

Stuart Birch

## Electronics

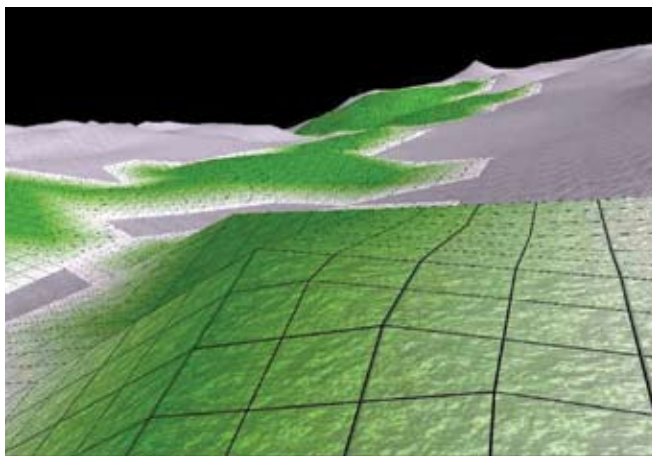
### Synthetically seeing in zero visibility

**BAE Systems** will be using **Mercury Computer Systems'** VistaNav Synthetic Vision technology for a rotorcraft brown-out landing system.

Brownout landings are a critical safety issue facing rotorcraft. They can occur when a rotorcraft attempts to land on dusty terrain and the rotors pick up the

measurements that are captured and updated in real time via a standard interface and displayed with Synthetic Vision.

Mercury's system will be integrated with a radar sensor from BAE Systems. When terrain and obstacles are detected, Mercury's Synthetic Vision will generate a computerized 3-D terrain map drawn from



**Mercury Computer Systems' VistaNav Synthetic Vision technology allows pilots in zero-visibility conditions to visualize sensor outputs in an intuitive format.**

dust on the ground. As a result, pilots cannot see nearby objects that provide the outside visual references necessary to control the aircraft near the ground during landing and takeoff operations. The patent-pending Synthetic Vision with Real-Time Terrain Morphing Engine from Mercury incorporates terrain sensor mea-

sures and sensor readings, allowing pilots to see the surrounding terrain and obstacles whether or not they have visibility outside their window.

Flight tests for the rotorcraft brownout landing system are expected to start this year.

Jean L. Broge

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## Simulation A Mach 0.8, 40,000-ft challenge

**MPC Products**, headquartered in Skokie, IL, is completing the final testing phase on a **NASA** project to develop an actuator control system that will mechanically operate a cavity door drive system (CDDS) for what is considered to be the largest telescope to ever to be placed in an aircraft.

The reflecting telescope will allow scientists to study distant astronomical objects such as stars, comets, asteroids, forming solar systems, and black holes. It is being permanently installed inside of an airborne astronomical observatory—a modified **Boeing 747SP** referred to by NASA as **SOFIA** (Stratospheric Observatory for Infrared Astronomy).

With its 2.5-m aperture, the **SOFIA** telescope will be capable of making observations that are impossible for even the largest and highest of

ground-based telescopes. The telescope, provided to NASA by the **DLR** (German Aerospace Center), is designed to detect the IR light or energy that is emitted from many different kinds of astronomical objects.

Most forms of IR light/energy are blocked by water vapor in the Earth's atmosphere, making it almost impossible to view from ground-based telescopes. But flying at about 40,000 ft above ground, the **SOFIA** telescope will have the capability to detect IR light 100 to 1000 times greater than ground-based telescopes.

One of the key engineering aspects necessary to achieve this observation capability is through the design of the **CDDS**. The challenge, according to **MPC** Program Manager **Chris Wall**, was to design an actuator control system capable of opening



NASA's Boeing 747SP SOFIA airborne observatory is shown during its second checkout flight in May 2007.

and closing the large telescope cavity door on an airplane flying at Mach 0.8—about 500 mph—at 40,000-ft altitude. In addition to speed and altitude, **MPC** had to take other load factors into consideration, including ice formation, inertial loads, and gravitational forces.

"This has certainly been the most comprehensive software project we've undertaken," **Wall** said. "Within the next six months, we will be delivering (to NASA) the hardware that will be going on the aircraft to open and close the door system."

**MPC** Systems Lead Engineer **Matt Polley** explained that the telescope is run by a computerized control system, which drives electromagnetic motors to move the telescope into position. The doors are required to follow close to the telescope as it moves, relative to the aircraft maintaining position on the observed object.

"The control system we designed for the doors consists of two redundantly driven actuators commanded by an electronic control unit," **Polley** said. "Accurate position and speed control are a critical part of the door design. If the door doesn't move correctly—if it moves too fast or if it goes beyond the set limits—it could damage the aircraft and cause a catastrophe."

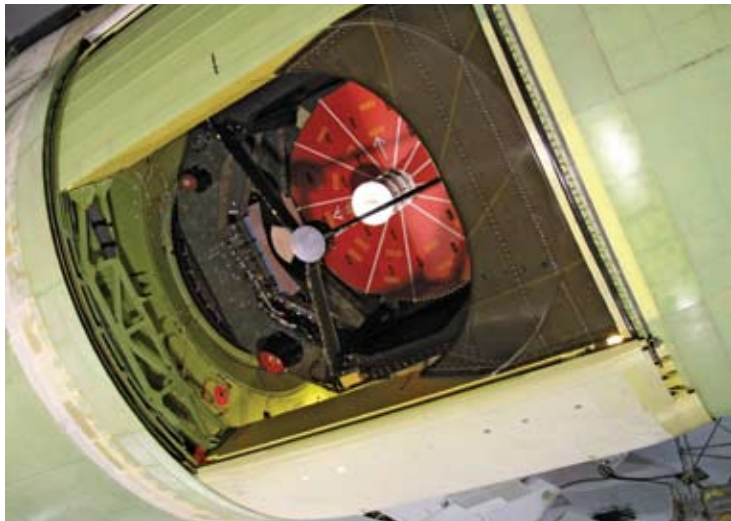
To develop the actuator

control system, **MPC's** team designed a test setup to simulate the system's operational environment using **dSPACE** tools. A modular system was established using the company's: **DS1005** processor board to achieve real-time and high sampling rates; resolver card; encoder card; and **DS2201** analog-to-digital multi-I/O board designed for applications requiring a lot of varying I/O types.

**Polley** said the **dSPACE** tools were used to fine-tune the control design and generate a control methodology for simulating the aerodynamic and gravitational loads that the **CDDS** will encounter during actual operation. More than 400 system-level requirements had to be taken into consideration as part of the design process.

"A crucial element of this project was to simulate the roll and gravitational loads that the actuators will experience during aircraft operation," **Polley** said. "Because this behavior could not be defined as a linear function, we had to custom-build a computer system to do closed-loop controls. The system is quite large in terms of the loading, and is more complex than our normal dynamometers, which have lower torque output."

"It was a major challenge to wrap our hands around the software development aspect,"



The 100-in telescope at the heart of NASA's Stratospheric Observatory for Infrared Astronomy (SOFIA) is nestled inside the SOFIA 747's rear fuselage.

NASA, Universities Space Research Association, and L-3 Communications Integrated Systems

Polley continued. "We used dSPACE tools to aid in our development process. The tools are very adaptable and are being used on multiple projects here at MPC."

MPC is wrapping up the final production phase of its first development units. The company is preparing to start

a "testing only" phase to prove that its actuator control design works by simulating all conceivable conditions that may be encountered while the telescope and CDDS are in operation and airborne. NASA will obtain the equipment and start testing the CDDS independently in August 2008.

"We have an excellent team in place," Wall said. "We've been working directly with NASA to streamline the software to their expectations. There has been a lot of collaborative effort."

MPC will be on site to support NASA with the integration of the CDDS and actuator

control system onboard the SOFIA aircraft. MPC will also assist NASA as it prepares to engage open-door flight testing, which will result in the first IR pictures of constellations.

**Alicia Alvin**, Marketing Manager, dSPACE, wrote this article for Aerospace Engineering & Manufacturing.

## Regulations & standards

### SAE seeks to improve communications capabilities for weapons

Two recently published **SAE International** standards (AS5725 and AS5653) address communications between aircraft and weapons systems.

AS5725 concerns the interface for miniature mission stores. The standard came out of the AS-1 Aircraft Systems & Systems Integration Committee. According to AS5725 standard sponsor Joseph Cammarota of **EDO MTEch**, the **U.S. Air Force** approached the committee several years ago to develop a new weapon interface standard that "would provide many, if not all, of the services provided by MIL-STD-1760, but for a smaller class of weapons: 250 lb and below."

This new open interface needed to provide three things, Cammarota said: a reduced release force solution to minimize the impact of connector separation on vehicle dynamics; a much smaller form factor than the existing 1760 connector; and all needed services using cost-effective components.

A subcommittee headed by

Jerry Provenza of the **Air Force Research Laboratory**, Munitions Directorate, Eglin Air Force Base, was formed to explore options. Initially the group had almost no boundaries in the design concepts it evaluated, including contactless and single-pin interfaces. Pressures from the Small Diameter Bomb (SDB) program, however, forced the group to converge on a more conventional, connector oriented solution, Cammarota said. Fred Benedick of **Wintek** was tasked with creating and maintaining the detailed requirements and initial draft of the standard.

A separate working group was formed to tackle the requirement for a higher-speed and more cost-effective (than MIL-STD-1553) solution for the digital communications requirements of the new weapon interface. The findings of this Communications Protocol Working Group were handed over to AS-1A and led directly to the development of AS5652, the Enhanced Bit Rate (EBR) 1553, 10 Mbps protocol.

The first version of the new Miniature Mission Store Interface (MMSI) was completed in 2002 and submitted

to the U.S. government for tri-service coordination. The competitive nature of the SDB program prevented the imme-



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Several SAE standards address weapons communication systems.

diated adoption of the SAE document, and a similar interface, the Joint Miniature Munitions Interface (JMMI), was developed by the winner of the SDB competition. There were some attempts to reconcile the differences between the MMSI and JMMI interfaces, but they proved unsuccessful and the SAE document languished.

Then, in 2006, the **U.S. Navy** (PMA-263) recognized the need for a truly open standard to support the integration of miniature weapons on unmanned combat air vehicles. AS-1B was once again approached, this time by the Navy, to complete the work it

had started in 1996. Cammarota said that in less than a year following the Navy's request, AS-1B had resurrected the last known draft of the SAE document, compared that to the last draft of a proposed **Department of Defense MMSI** document, defined the allowable design trade space, and proceeded to formalize AS5725.

This new standard supports the original intent of providing 1760-like services to miniature weapons using a small connector and cost-effective, open components, but also incorporated some new requirements that were not defined as such in 1996, said

Cammarota. "These new services added increased power and safety features into AS5725 over those in the 2002 draft, and did so using a smaller connector. Although not required by the Navy, AS-1B worked to make AS5725 compatible with JMMI and, in fact, JMMI can be mapped to a subset of the AS5725 signal set. That mapping is defined in Appendix B of the SAE standard."

The AS5653 standard, according to standard sponsor Thomas Lystrup of the Naval Air Warfare Center, Weapons Division, China Lake, CA, "defines a high-speed fiber channel network to improve the capability of MIL-STD-1760 to transfer digital data between aircraft/platforms, carriage systems, and mission stores." This activity, he said, was initiated at the request of the U.S. Navy in 2001 due to excessive length of time downloading GPS data to weapon systems through the 1760 Mass Data Transfer

process on current platforms.

AS5653 (High Speed 1760) provides a digital data command and control interface similar to MIL-STD-1555 based on fiber channel protocol but operating at a 1-gigabaud data rate. This interface has been incorporated in MIL-STD-1760E, which was recently published. High Speed 1760 has replaced the previous coax interface identified as HB 2 and HB4.

This change is considered a Class 2 interface change, since High Speed 1760 is designed to replace the 1553 interface in the future.

"Implementing AS5653 will dramatically reduce the time it takes to download weapon GPS target programming data and will facilitate rapid re-targeting of preplanned weapon-delivery missions such as the Joint Direct Attack Munition, the Joint Standoff Weapon, and SDB," Lystrup said.

Patrick Ponticel

## Design

### Airlines can find better colors, quicker

Commercial aircraft livery is an important part of marketing as well as providing protection for the structure of an aircraft. **Akzo Nobel Aerospace Coatings** (ANAC) has established a new facility to provide guided color expertise to livery and help operators create airline liveries more quickly.

The dedicated color design studio within the ANAC Color Center at the company's Sassenheim facility in the Netherlands is equipped with a range of representations to help designers select colors and finishes to provide an effective

solution to meet the requirements of an airline and ANAC as an OEM applicator. The color representations can then be converted into paint samples ("spray outs") using ANAC digital color "fingerprinting" techniques.

The fingerprinting techniques involve the use of a spectrophotometer to measure the characteristics of a color. Results are interpreted as spectral data, the most precise description of a color. An object's color appearance results from light being changed by an object and reflected to a viewer. Spectral data is a description of

how the reflected light was changed. This data can be saved digitally and is the color's fingerprint.

The effects of the spray outs are viewed under various light sources that can simulate full daylight, dusk, and hangar lighting conditions. The light sources were created to allow designers to make better decisions for overall livery designs—particularly useful for judging different combinations of solid and special effect paints.

At the center, "Designers are made aware of the huge range of finishes, col-

ors, and effects available to them through new coating technologies,” said Hans Peter van Wilsem, Plant Manager of the ANAC Color Center. “It gives them the time and opportunity to experiment and to access the technical resources and product knowledge of the global ANAC color team—and to expand their knowledge of aircraft coatings and how they will perform in service.”

Working together with designers is also valuable for ANAC, said van Wilsem, who explained that in face-to-face discussions and when using the right techniques, it was easier and quicker to select the correct color, thus reducing the number of colors that have to be sprayed out and ultimately shortening the process time, which could take weeks.

“Once designers are satisfied with the coatings and colors they have chosen, and confident that their concept is achievable, they leave the site with a complete set of ‘spray outs’ and actual



Designers working on airline liveries can now visit ANAC's dedicated color design studio within the company's Color Center.

paint references to present to their airline clients,” he said.

ANAC claims to be the only aerospace coatings business to offer a dedicated color design studio accessible by customers. Idea of creating the facility came from suggestions made by livery design-

ers. ANAC describes itself as the “global leader” in the manufacture, development and supply of coatings for the commercial, general aviation, and military aerospace markets.

Stuart Birch

## Vehicles

### Alenia demonstrates UAV technologies for future product

Alenia Aeronautica, a Finmeccanica company, last year participated in the first flights of its Sky-Y, an operational demonstrator for a new-generation UAV. It is Alenia's first in the MALE (medium-altitude, long-endurance) category to be conceived, designed, and built in less than a year.

First flights were from the Vidsel air base in Sweden. It reached an altitude of 3000 ft and a speed of 110 knot. It has been designed to carry out missions of more than 12 h and to reach an altitude of 26,000 ft. It has a mass of about 1 t and uses an adapted automotive diesel engine.

A particularly important as-



The Sky-Y is the system testbed for the Alenia Aeronautica Molynx, now in early development.

pect of its development program concerns verification of the use of the engine and of its carbon-fiber structure. At last year's Paris Air Show, Alenia Aeronautica signed a

cooperation agreement with **Dassault** and **SAAB** for the development of new-generation systems.

Both military and civil surveillance applications are envi-

sioned for the final UAV product, the Molynx, for which the Sky-Y is serving as testbed.

Stuart Birch