

# Technology update

## A380 reaches for the sky

The first twin-deck **Airbus A380**, the world's largest commercial airliner, completed its successful maiden flight on April 27. Airborne for 3 hours 54 minutes, it was powered by **Rolls-Royce Trent 900** engines. A single Trent 900 had previously flown on Airbus' A340-300 flying testbed for 60 hours, so the A380 flight crew had experience with its operation.

"We had no surprises," said Airbus Flight Test Engineer Jacky Joye. The A380 made a full power takeoff. Measured by emissions per lb of thrust, the Trent 900 is claimed by Rolls-Royce to be the world's cleanest high-thrust engine.

Seven companies are participating as risk- and revenue-sharing partners on the Trent 900 program, including **Industria de Turbo Propulsores, Hamilton Sundstrand, Avio, Marubeni, Volvo Aero, Goodrich, and Honeywell. Samsung Techwin, Kawasaki Heavy Industries, and Ishikawajima-Harima Heavy Industries** are program associates.

The A380's first flight marks the start of a comprehensive test program that will require Rolls-Royce to supply engines for four aircraft. First customer deliveries will be made in the second half of next year, starting with **Singapore Airlines**. Typical seating capacity is expected to be 555.

Claude Lelaie, Senior Vice President, Airbus Flight Division, commented on the ease of handling of the aircraft both in the air and on the ground. "We could also appreciate the new features in the cockpit, including interactivity, vertical display—new interfaces that make the work of the crew very easy and efficient." Customer airline pilots made significant contributions to the cockpit design.

The aircraft took off at a water-balanced weight of 421 t, which Airbus said was the "highest ever of any civil airliner to date." During the first flight, the aircraft's handling was tested using



**Up and away: 421 t of Airbus A380 gets airborne for its first flight, which occurred in late April.**



**The Airbus A380 completes its first flight, which lasted 3 hours 54 minutes.**

both direct and normal flight control laws with the landing gear raised and lowered and with all flap and slat settings. Comfort levels were evaluated in both main and upper deck cabins. Two test instrumentation sets and working stations were carried, one on each deck.

Ground tests of the A380 had started last summer. Airbus said all primary flight test objectives were met. The 2500 hour flight test program will include five A380s.

One of these will be used for the certification of the **Engine Alliance GP7200** engine. Composites and advanced materials (including GLARE) comprise some 25% of the A380's structure. The aircraft uses a 5000-psi hydraulic system. Airbus believes some 60 airports around the world will be capable of handling the A380 by 2010. At the time of its first flight, Airbus had received firm orders and commitments for 154 A380s—27 of them the freighter version.

An innovative new tailbumper has been developed for the A380 for low-speed takeoff tests scheduled to start shortly. Because of its size, a regular tailbumper comprising steel beams was not suitable. Fourteen suppliers worked together to develop the special bumper based on a system similar to a hydraulic shock absorber.

Three weeks after the A380's first flight, wing manufacture for the A380F



**Four Rolls-Royce Trent 900 engines took the first Airbus A380 into the air.**

freighter started at Airbus UK's facility. It will be the world's largest commercial freighter and is due in service in 2008, with a capacity of 150 t of cargo. Non-stop range capability will be 10,400 km.

In the early 1990s, Airbus was in talks with **Boeing** to design what was then termed a VLCT (Very Large Commercial Transport) but this collaboration did not reach fruition. In 1996, Airbus decided to go it alone with the A3XX, as the A380 was originally designated. First metal components for the aircraft were manufactured in early 2002, signaling the start of production.

Stuart Birch

## Envisioning structural repairs

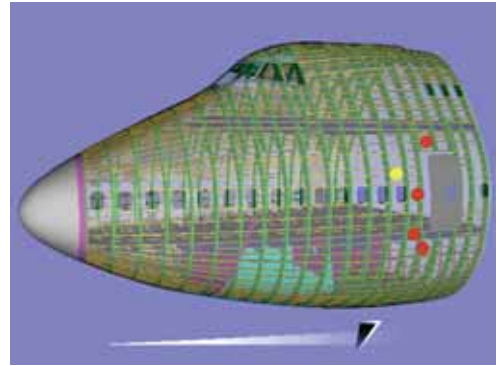
At-a-glance representations of data have value in all technical disciplines. Typically, though, the mechanic on the hangar floor is rarely in the position to use information in such a way. Boeing's just-introduced Maintenance Performance Toolbox addresses that desire with a 3-D user interface that provides a visual presentation of the locations of structural repairs (which are represented by dots on a computer screen). The software can be used to research repairs for a single airplane or conduct a multi-airplane search to identify all repair locations in a particular operator's fleet.

Such integration of text, data, and graphics, as well as multimedia capabilities, is designed to boost productivity of line mechanics, in particular. Active

links within 2-D and 3-D system diagrams and structural models, as well as what Boeing says is "intuitive navigation that helps users construct a mental image of the solution," direct mechanics directly to the applicable information. Built-in workflow tracking creates a complete audit trail for approvals.

The Maintenance Performance Toolbox software was also written for engineers to help them track day-to-day tasks, as well as for technical publications departments so they can create customized airline documents, modify original equipment manufacturer manuals, and create task cards. Boeing also envisions the Toolbox being employed as a training aide for students.

Barry Rosenberg



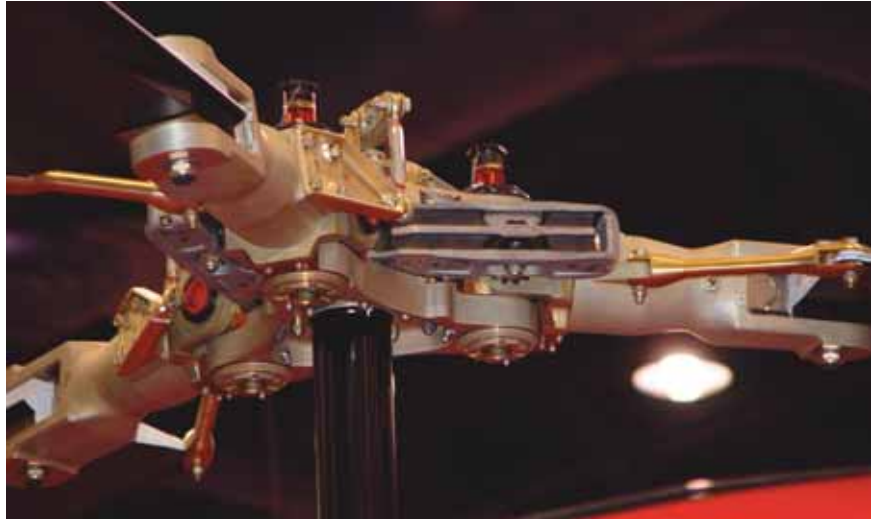
**Boeing's Maintenance Performance Toolbox creates 3-D images of previously completed structural repairs on an aircraft (shown as dots on the screen), giving line mechanics, in particular, a potentially valuable visualization tool.**

## Elastomeric dampers make the grade

Enstrom Helicopter recently received certification for new elastomeric dampers for its 480B helicopters, either as retrofit or for new production aircraft. Designed by Lord, the dampers replace the current hydraulic dampers and already have improved ground operation, ride, and handling qualities while decreasing maintenance costs, according to the company.

Todd Haughee, Lord Market Manager, said Enstrom contacted Lord in 2000 seeking a main rotor damper with improved damping performance characteristics, reduced scheduled maintenance, and increased service life. Lord began the improved damper development by reviewing damper load and motion data generated from an instrumented aircraft.

An elastomeric damper was designed based on the flight test data and Lord's analysis of the 480B aircraft dynamics. The elastomeric damper entered bench and flight test certification

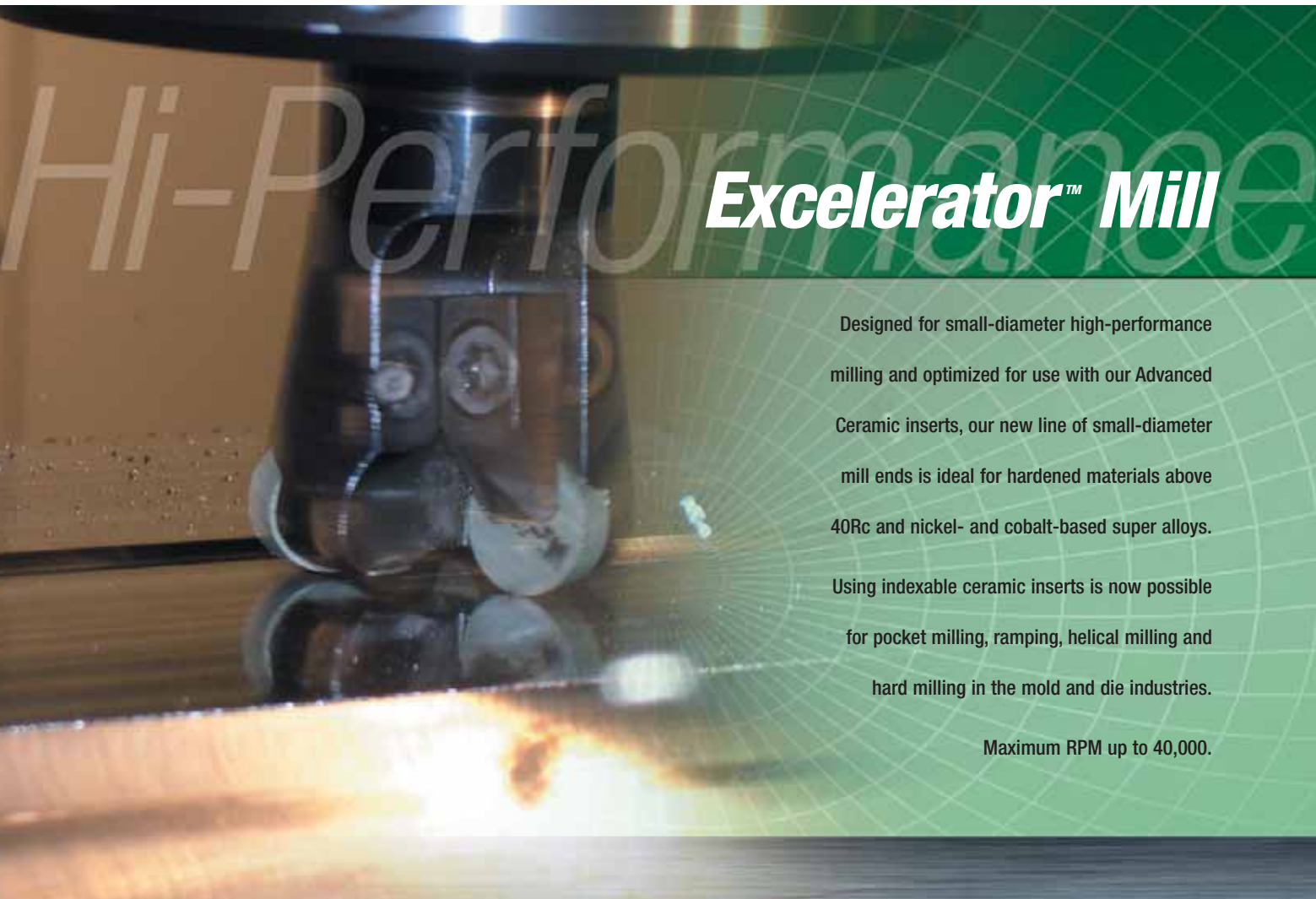


*With the newly designed elastomeric damper, Enstrom's 480B is said to no longer have a feedback issue between the airframe and the ground.*

in 2002 and achieved FAA certification for use this past January.

Lord's design uses a highly damped

elastomer specifically formulated for the demanding requirements for helicopter main rotor damping applications. The



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Enstrom claims the 480 is one of the first FAA-certified (December 1994) helicopters developed via CAD. With more than 80 aircraft in use, the light turbine commercial helicopter seats five.

dampers' improved performance—confirmed through bench testing at Lord, flight testing at Enstrom, and field installations—offers improved performance with a significant reduction in ground feedback and vibration issues.

Lord also supplies a Surface Effect (SE) damper for the cyclic control system of the Model 480B. SE dampers generate damping through relative linear motion between a specially designed plunger installed with interference fit into an elastomeric sleeve. Proprietary lubricants, surface finishes, and coatings are used to achieve very long life on the lightweight damper. Installed in any orientation, Haughee said the dampers have proven to control the response of the spring in the trim actuator. Further, because SE dampers use viscous grease lubricants, they typically do not require seals and do not leak.

Jean L. Broge

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	Competitor	Greenleaf
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Time Difference – 1 hour 13 minutes  
 Cost Savings (@ \$72.85/hr) – \$88.64

Circle 9

## Noncontact torque sensing at 22,000 rpm

One of the more interesting challenges in sensing torque on spinning helicopter shafts is finding a way to take measurements without attaching a strain gauge to the shaft. The need is particularly important in large helicopter transmissions that have an unusually high-speed input/output configuration and require full load dynamic testing prior to being approved for flight use.

**BEI Technologies' Duncan Electronics** Division will work with **Hydradyne Hydraulics' Aerospace Systems Group** to develop an advanced torque-sensing solution called iTorq. The torque sensor will be used in Hydradyne's helicopter transmission test stands that test the main gearbox, tail rotor gearbox, and intermediate gearbox to a dynamic load of up to 5000 hp. A proprietary sensing technology, iTorq was licensed by BEI approximately six months ago.

The upcoming test stand application of iTorq is designed to take advantage of key noncontacting attributes to deliver a high-resolution, dynamic torque reading from an existing input shaft that is typically operating above 20,000 rpm. BEI will conduct application engineering of iTorq with Hydradyne, and expects to begin shipping production units by the early fall of 2005.

The iTorq sensor is based on the magnetostrictive properties of certain steels. One of the test-rig drive shafts has been magnetically encoded by a special process for the Hydradyne application. When there is no stress or driving torque on the shaft, the steel does not behave as a magnet and has no apparent magnetic field. When a twisting force is applied to the shaft, a magnetic field appears around it. The higher the twisting force the stronger the magnetic field.

By using a magnetic field-strength measuring system, located close to but not touching the shaft, the sensor can accurately measure the torque being transmitted. The torque measurement is accurate both when the shaft is stationary, *i.e.* not rotating, or while spinning at any speed.

The most common methods for measuring torque is by using strain gauges, which must be bonded to the rotating shaft and then connected to the measuring electronics by slip rings (contacting), or RF transmitters and receivers, which also need additional electronic components to be attached to the rotating shaft. Strain gauges will not survive when rotating at high speeds or when immersed in water or oil.

For the Hydradyne application, the shaft will be rotating at 22,000 rpm. At these speeds, strain gauges and electronic components will fly off under the influence of centrifugal force.

In addition to their applications in aerospace, iTorq sensors are currently being used in Formula One racecars to measure and control the power and torque transmitted to the wheels. The sensors will work at very high temperatures and can be built into engines and gearboxes, where they convert existing engine or transmission components into torque sensors.

The very high frequency response of iTorq sensors makes it possible to measure the torque curves developed by each individual cylinder of an internal-combustion engine running at high speed, which can be used for engine knock detection and onboard, real-time diagnostics.

Because there are no components, coatings, or special machining tolerances, iTorq sensors can be used in completely submerged applications in oil, water, or any other fluid without destroying the shaft.

Barry Rosenberg

## Improved P-3C delivered to Navy

**Lockheed Martin** has delivered the 65th P-3C aircraft modified under the **U.S. Navy's** Anti-Surface Warfare Improvement Program (AIP). This aircraft represents the second of five P-3C aircraft Lockheed Martin will update in 2005.

The AIP upgrades are designed to improve the venerable aircraft's surveillance capabilities with commercial-off-the-shelf (COTS) and non-developmental technology. New workstations, satellite communication capabilities, and enhanced radar, optical, and infrared sensors now significantly increase the P-3C's surveillance role.

Since 1994, Lockheed Martin has been the prime contractor and systems integrator for the aircraft's avionics,



**With its AIP improvements, the P-3C aircraft has been used extensively in all major U.S. combined forces operations, including those in Iraq, Afghanistan, Kosovo, Bosnia, and others associated with the global war on terrorism.**

including non-acoustic sensors, communications, survivability, and displays and controls. Lockheed Martin Tactical

Systems, the Navy's AIP prime contractor, performs engineering and major contract work in Eagan, MN. Lockheed Martin Aircraft and Logistics Center completes the aircraft installation.

The P-3 is the primary maritime surveillance aircraft operated by the Navy and 15 international allies. Its roles include anti-submarine warfare; anti-surface warfare; command, control, communications, computers and intelligence, surveillance, and reconnaissance (C4ISR); search and rescue; drug interdiction; and exclusive economic zone protection.

Barry Rosenberg

## Getting more out of the factory floor

In the commercial aviation industry, intense competition is driving more manufacturing collaboration and greater reliance on the supply chain. Companies are also implementing lean initiatives to maintain or gain a competitive advantage.

In the defense sector, there is a different set of priorities shaped by a different set of dynamics. In short, defense companies are focused on adapting to new **Department of Defense** programs, technologies, and initiatives such as RFID (radio frequency identification).

That's how Matt Hobson-Rohrer assesses the Aerospace and Defense (A&D) industry for his company, **Brooks Software**. "Our technology helps companies get more information out of their manufacturing operations to make better real-time decisions, meeting the needs of both sectors," said Hobson-Rohrer, Director of Aerospace & Defense for Brooks.

A shop floor is producing more than just products, as he sees it; the shop floor is also a gold mine of information. Brooks aims to help companies take advantage of that information by feeding it, real time, to other systems within a company to maximize operations and synchronize it with the enterprise-level systems. After all, he said, how well a company uses its shop floor equipment



**When large airframe manufacturers look to optimize manufacturing, such as Boeing's Everett plant in Washington where the 737-700 series aircraft are manufactured, they use Brooks' real-time manufacturing applications to validate process, layout, and material-handling plans.**



**The supply chain for commercial aircraft manufacturing has become more complex and global. Brooks' software facilitates visibility between suppliers, integrators, and customers for improved real-time decision making.**



**Defense manufacturers use Brooks' applications to achieve lean manufacturing goals and improve return on assets. Manufacturing Execution Systems such as Brooks' FACTORYWorks eliminates waste through reduced work-in-process and improved yields.**

directly impacts return on assets.

Brooks offers a suite of manufacturing applications, one of which centers on lean manufacturing. One of the things that solution does is monitor overall cycle times to identify bottlenecks. The company's supply chain software includes a real-time dispatching capability that takes demand fluctuations and real-time status of factory-floor com-

ponents and streamlines the flow of work-in-progress across the supply chain. Brooks also has a radio frequency identification solution for tracking.

The company's big push at the moment, however, is a reporting solution that, Hobson-Rohrer said, captures a wide variety of manufacturing information over time "and allows managers to play that information back...and

anticipate trends." For example, he said, it gives managers advance warning when a piece of equipment is expected to go down so the manager can act accordingly.

"Much of what's driving our initiatives comes from a concept our general manager, Joe Bellini, calls the real-time enterprise, which means having real-time data enable better decisions and

better equipment to automate those decisions so managers can concentrate on more complex decisions," said Hobson-Rohrer.

Brooks' approach provides for a manufacturing environment that is fully aware of what is happening with respect to incoming materials and with respect to materials being delivered to the customer. This real-time connectivity

allows for faster, more informed decisions at the plant based on what is happening outside of it as well as within it.

The solutions from Brooks, which are being used by companies such as **Honeywell**, **Northrop Grumman**, and **BAE Systems**, are designed to work with existing software solutions a customer might have.

Patrick Ponticel

## First 757-200 with winglets enters service

The first revenue-service **Boeing 757-200** aircraft equipped with Aviation Partners Boeing Blended Winglets has entered revenue service with **Continental Airlines**. The addition of the 8-ft, 2-in-tall winglets, which replace the standard wingtip, enables increased fuel efficiency and range. Continental is the first commercial airline to add winglets to the 757-200.

By reducing the amount of drag on the aircraft, the winglets are expected to achieve up to a five percent fuel savings, as much as 300,000 gal per aircraft per year, and give the airplanes approximately 200 nmi of additional range. Eleven of Continental's 41 757-200 aircraft are scheduled to be equipped with winglets this year.

"Modification of our Boeing 757-200 fleet is one of the most important steps we can take to offset the incredible expense of fuel in today's record price environment and ensure we are



**Continental Airlines is the first carrier to fly a Boeing 757-200 aircraft with blended winglets, which are said to increase fuel efficiency and range.**

flying the most efficient aircraft in the industry," said Mark Moran, Continental's Executive Vice President of Operations and former Head of Maintenance. "In addition, with the

extended range of these aircraft, we are now able to offer service to a number of cities that we couldn't reach with these planes before."

Barry Rosenberg

## Benz flex tester offers slow-motion observation

### Benz Materials Testing Instruments'

DFT2100 DeMattia flex tester is suitable for testing fatigue, breakage, or crack growth in rubber, plastics, leather, fiber optics, and exotic composites. The tester is used for products such as tires, belts and hoses, laminates, and fiber-optic tubing.

With 20 stations, the DFT2100 simultaneously flexes as many as 20 product samples for up to 10 million cycles, and offers variable speed testing from 30 to 300 cycles/min. The accelerated testing can save days in determining a product's ability to withstand repeated flexing, according to

the company.

Its temperature chamber allows testing from -100 to +150°C. The Benz-designed temperature controller precisely controls the temperature while also controlling the test speed.

The front panel controls consist of a circuit breaker on/off switch, on/off switches for the lights and motor, and a push-button knob for test setup. Temperature and speed are adjusted from this knob, making it a very simple setup and a short learning curve for new technicians, according to the company.

Several different products can be



**The Benz DFT2100 DeMattia can be pre-set to as many as 10,000,000 cycles and then digitally display either the number of cycles remaining in the test or the number that have been completed.**

simultaneously tested. Fixed distances range from 0.25 to 4 in.

The DFT2100 can be used in testing materials to ASTM, ISO, DIN, BS, JIS, and other U.S. and international standards.

With a heavy-duty steel base plate, stainless-steel chamber, hard-coat anodized aluminum, stainless-steel components, and safety glass in the door, the Benz DFT2100 is rugged, functional, and safe. Switches are vibration-resis-

tant. The 0.5-hp direct-drive dc motor is mounted securely to the pedestal and drives the camshaft without belts.

The DFT 2100 requires only 2 ft<sup>2</sup> of counter space and stands 2 ft tall.

Jean L. Broge

## Goodrich IMD-HUMS goes into production for Super Stallion

Due to successful operational evaluation completed in October 2004, the **U.S. Marines Corps** has approved Goodrich's Integrated Mechanical Diagnostics Health and Usage Management System (IMD-HUMS) for full-rate production on board CH-53E Super Stallion helicopters. Goodrich has received contracts to deliver and support the installation of 28 IMD-HUMS kits in 2005 and 2006. Currently the Marines have a total fleet of 147 CH-53E Super Stallion helicopters.

This system is the first fully integrated, multifunctional health-management system to be fielded on Marine helicopters. Goodrich's IMD-HUMS applies full-time diagnostic monitoring to the entire CH-53E mechanical drive train, from the engines to the rotor system, with the goal being a reduction in vibration-related maintenance. The system is designed for long-range predictive maintenance, as opposed to reactive maintenance.

The CH-53E's seven-blade main rotor system used to require special instrumentation and flight checks to verify rotor adjustments. With Goodrich's IMD-HUMS, data is automatically col-



**U.S. Marines from Combat Logistics Battalion 2 make final preparations to a Humvee so that it can be airlifted by the incoming CH-53E Super Stallion helicopter from the flight line of Al Asad, Iraq, to forward-deployed Marines on the ground.**

lected on each flight, allowing adjustments to be made to minimize rotor vibration. A single set of adjustments provides a markedly smoother ride for the aircrew and passengers, according to the company.

In addition, the system automatically performs diagnostics on the complex set of gearboxes, driveshafts, and bearings

that deliver engine power to the rotors and aircraft systems by reading, storing, and analyzing data collected from more than 40 vibration sensors throughout the aircraft. The system can recognize significant vibration changes that could indicate excessive wear or potential failure of critical components.

Barry Rosenberg

## Ameco Beijing opens China's first calibration center

**Ameco Beijing** has opened a calibration and testing center (CTC) consisting of more than 350 sets of calibration and testing equipment. The project originated in 2003 when the **Civil Aviation Authority of China** (CAAC) selected Ameco Beijing to establish a CTC for the Chinese aviation industry. The center has two functions: guaranteeing the reliability and traceability of measuring

instruments; and providing performance testing and conformity verification for various products, materials, and devices.

"With its strong material base, high technical level, market-oriented operating mechanism, and experience in calibration work, a large operation like Ameco Beijing has advantages in building such a calibration center on behalf

of CAAC," said Zhou Kaixuan, Deputy Director General of Airworthiness Department of CAAC.

CTC is the only Chinese calibration organization that has been approved by CAAC, and employs 50 technicians.

Barry Rosenberg