Tech focus

This month's focus is on facilities and equipment used to test advanced systems and components.

Indoor testing at USAF climatic lab

Goodyear Tire and Rubber has employed the **U.S. Air Force**'s (USAF) McKinley Climatic Laboratory, at Eglin AFB, in Ft. Walton Beach, FL, to help fine-tune the final characteristics of a new passenger-car tire it will introduce this year. The company used the opportunity while the facility was rented to demonstrate the capability of its new Assurance TripleTred all-season tires on icy, snow-covered surfaces to the media and to its dealers.

The idea of testing snow tires indoors, in Florida, may sound absurd on the face of it, but the Eglin facility gives its users the ability to carefully control conditions, so that testing may be repeated reliably with the same conditions. All branches of the U.S. military employ the lab, as do commercial aviation companies, carmakers, and tire manufacturers.

While tropical temperatures prevail outside the McKinley Climatic Lab, the billboard-sized thermometer shows that cold-weather testing is under way inside. Goodyear set temperatures at 15°F.

Construction of the lab was launched in 1943 and completed in 1947, after Lt. Col. Ashley McKinley developed the idea of using a refrigerated hangar to test aircraft under conditions of extreme cold. The test lab quickly met McKinley's forecast of a 10 times cost savings compared to outdoor testing in uncontrollable weather, according to the USAF.

In addition to purely cold temperatures, the lab can produce snow in any quantity and of whatever character required for the test, from dense, wet, heavy snow to light, powdery snow, according to Kirk Velasco, Director of the McKinley Climatic Lab. It can also produce freezing rain and icing clouds to test deicing systems.

Since launching as a cold-weather lab, the McKinley facility has added all kinds of weather to its capabilities, with torrential rain, baking heat, hurricane-force wind, and driving dust and sandstorms among its repertoire. The lab's main chamber can produce a range of temperatures between -65 and +165°F, while ancillary chambers can simulate rainfall at a rate of 25 in/h and produce withering bright light to simulate days that the tested equipment might sit in the desert.

The McKinley lab not only tests the effects of cold and snowfall on vehicles sitting on the ground; it is also able to test aircraft as if they are in flight. Jacks prop up aircraft so they can retract and extend their landing gear, and an exhaust extractor expels the hot jet exhaust from one running engine. An "air make-up system" provides a continuous supply of chilled incoming air to replace the air consumed by the running engine. The system has enough capacity to accommodate the 40,000 ft^3/min airflow of an F-16 running on afterburner, said Velasco.

Sand-filled steel bullet catchers even let aircraft fire their weapons inside the hangar, so all systems may be tested. "Whatever climate extreme weapons systems may encounter anywhere in the world, it is our job to re-create that extreme and operate that weapon system under that extreme in this facility," Velasco said.

"We are the only place in the world that can make snow indoors," added Velasco. "It requires a great amount of refrigeration. The type of snow varies depending on what the customer wants. We can make light, powdery snow or the hard, icy stuff that Goodyear wants for tire testing." Creating the icy snow field on the hangar's floor, especially during days with 85°F ambient temperatures, requires "two long days."

Dan Carney

Magtrol test bench for aircraft maintenance

Magtrol SA of Fribourg, Switzerland, has developed a customized motor test bench for **British Airways** Avionic Engineering. The complete turn-key system is designed to test a wide range of electrical motors used on passenger aircraft in accordance with the OEM's Component Maintenance Manual. Components to be tested include flap motors, starter motors, rotary actuators, and fans.

With three dynamometer benches and one fan testing rig, the system enables the user to test motors from 18 mN·m/7 W to 600 N·m/24 kW, with speeds up to 30,000 rpm. All three Magtrol dynamometer technologies—hysteresis, eddy-current, and magnetic powder—are employed and used depending on the torque-vs.-speed range of the motor(s) to be tested. The fan testing rig allows speed, electrical power consumption, and vibration measurement of aircraft fan motors.

Fixtures are used to secure the motors in place during a test, but they also allow motors to be moved from one dynamometer to another for assorted tests. Accessible connector panels, located on each dynamometer test bench, allow for quick connection of motors when setting up a test.

All supporting electronics—dynamometer controllers, power analyzers, and power supplies—are built into a heavy-duty, industrial cabinet. The cabinet also houses a PC (with IEEE and ethernet connection), computer monitor, and keyboard.

Dedicated software developed under **National Instruments**' LabVIEW environment provides the system with full PC-based data-acquisition capabilities, including closed-loop regulation. Test sequences are easily configured, allowing several motor performance characteristics (torque, speed, power, temperature, current, voltage, efficiency, *etc.*) to be tested and calculated. The data generated can be stored, displayed, and printed in tabular or graphic formats, and can be imported into a spreadsheet. Each test configuration can be programmed and saved, allowing the procedure to be recalled every time a motor returns for maintenance testing.

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The customer's existing power supply (60 kW) is integrated into the system along with two Magtrol-provided power supplies (12 and 45 kW). Cabling and connection is in accordance with a 2000-A current requirement.

To comply with health and safety regulations, every dynamometer test rig is protected by a safety guard, and each dynamometer test bench, as well as the electronics cabinet, is fitted with one or more emergency stop buttons. On-site installation, commissioning, and training also have been provided by Magtrol engineers.

Ryan Gehm

NIAR deploys MTS crash simulator

In January, **MTS Systems** delivered a horizontal acceleration crash simulator to the **National Institute for Aviation Research** (NIAR), located on the campus of **Wichita State University** in Kansas. NIAR is deploying the simulator in its Crash Dynamics Laboratory to enhance its ability to host proprietary research, testing, and certification of aircraft components under dynamic impact conditions.

"Acquiring the MTS crash simulator is integral to our efforts to maintain our status as the premier dynamic testing facility for the nation's aircraft and aircraft component manufacturers," said John Tomblin, Executive Director of NIAR. He added that the capabilities gained from the system should help NIAR achieve its goal of having all U.S. aircraft seat manufacturers use the Crash Dynamics Laboratory.

The crash simulator employs a servohydraulic drive to achieve speeds of 81 km/h with a 1500-kg payload. Impact pulse peak profiles can be adjusted to reach accelerations of 65 *g* with the same payload, or 75 *g* with a 1000-kg payload. The system is said to feature state-of-the-art data-acquisition capabilities, and it employs a high-resolution digital video system to capture high-velocity simulations at 1000 frames/s.

"High-performance MTS crash simulation solutions are designed to help aircraft and ground vehicle manufacturers adapt quickly to increasingly stringent occupant safety regulations and reduce the time required to gain valid, meaningful test data," said Joseph Mitchell, NIAR's Director of Crash Dynamics. "They deliver a [wide] operating range of acceleration, frequency response, and payload capabilities…, giving test engineers the flexibility to replicate both high- and low-acceleration events."

The new crash simulator is the latest MTS equipment procured by NIAR. MTS digital controllers, actuators, and servohydraulic and electromechanical load frames are deployed throughout

MTS's horizontal acceleration crash simulator will enhance NIAR's ability to test and certify aircraft components under dynamic impact conditions.

the institute's 17 research laboratories to gain insight into the static and dynamic load-carrying capabilities of aircraft materials and structures. MTS also recently delivered an I-STIR friction-stir welding system to NIAR's newly established Advanced Joining Laboratory, which assists the institute's Aircraft Design & Manufacturing Research Center in studying practical problems associated with aircraft manufacturing.

Ryan Gehm

Astro-Med workstation for flight testing

A new rackmount data-acquisition workstation from **Astro-Med**'s Test and Measurement Product Group offers an open architecture design, 18.1-in color display for real-time viewing, intuitive touch-screen interface, integrated computer, and 32 analog or digital input channels.

Designated EV2, the unit is designed and engineered for aerospace applications, including flight testing, missile testing, flight simulation, and satellite telemetry. With its six PCI slots for third-party PCI cards and software, and multiple expansion bays for removable media, the EV2 extends beyond the capabilities of Astro-Med's flagship Everest telemetry recorder-workstation and enables telemetry facilities to consolidate large amounts of equipment into one system.

In addition to a hard-copy paper option, the new workstation includes four drive bays for installation of internal CD-RW and DVD-RW drives, Kingston removable drive shuttles, and

The EV2 data-acquisition workstation from Astro-Med is suitable for aerospace applications such as flight testing, missile testing, flight simulation, and satellite telemetry.

other memory options. The CD and DVD drives are suitable for upgrading software, saving test setups and archiving captured data.

The unit's VDiS operating software allows data to be monitored in real time and simultaneously displayed in strip chart, numeric data-logging, and x/y plot formats. "Moving pen tips" driven by the signal data mark the real-time data points. Alarm limits can be set to allow waveforms to change color when predefined limits are exceeded. IRIG (Inter-Range Instrumentation Group) time code is displayed, and grids can be synchronized with time, allowing data to be interpreted in military time. The unit accepts IRIG A, B, H, and NASA 36 time codes.

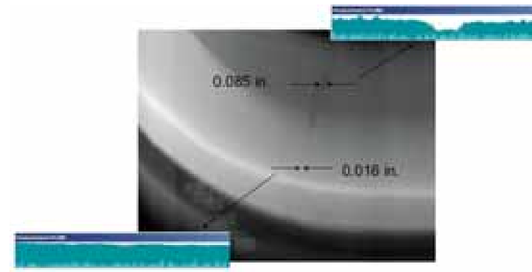
Virtual Chart (VC) allows users to save an entire test to the internal hard drive without the need for printing. VC data can be reviewed on the display, printed on the chart, or transferred to a PC for offline analysis. Up to 32 waveforms and 32 events can be displayed on the screen and recorded at any one time. The user can design personal grids with custom formats of channel widths, number of divisions, *etc.*

Ryan Gehm

Digitome 'sees' defects for NASA

In its continuing efforts to ensure the safety of shuttle flights, **NASA** is using a new device that looks through shuttle wings and jet-engine turbine blades to "see" subtle yet serious defects invisible to current nondestructive testing and imaging systems, according to **Digitome**. The imaging technology company has developed a patented method of analyzing and measuring the presence, volume, and internal features of objects using nondestructive penetrating radiation, typically X-rays.

Shown is the Digitome VXI-500 digital x-ray system, a non-mobile version of the device used by NASA to test for defects in a shuttle wing.



X-ray images obtained by conventional means are the basis for Digitome volumetric imaging. A vertical view provides measurement of crack width.

Called the Digitome Volumetric X-Ray Imaging System, the new inspection unit found minute cracks in the internal structure of a wing leading edge carbon-composite panel removed from the Orbiter and subjected to similar conditions to the Columbia on liftoff.

NASA has purchased and installed the system at the Marshall Space Flight Center for evaluation. The technology is being evaluated for potential use in testing wing leading edge panels and other components developed for future spacecraft, particularly for defects that may occur during manufacture or as the result of impacts or stresses during take-off, re-entry, and landing.

During testing, the Digitome VXI-1200C system not only detected the presence of cracks, but also was able to measure accurately the width of the defects along the entire length of each crack. The system combines conventional x-ray imaging hardware and proprietary software. It reconstructs the full volume of an object and then "dials through" contiguous levels along a selected axis, producing images on a computer screen that can be manipulated for closer inspection.

"The Digitome system has demonstrated it can find otherwise-undetectable potential-failure regions in a wide range of voluminous or even solid metal objects," said Bill Dryden, Vice President Operations, Digitome. "For instance, it has been used to inspect jet-engine turbine blades, [finding] defects that could knock out the engine of a passenger jet if a blade failed in flight."

The device can be used with any penetrating radiation—X-ray, neutron beams, or a radioactive source. "We can use the Digitome to look through almost any material. For instance, we can use it to inspect any object a terrorist might have chosen to hide a weapon in, such as hand luggage or boxes packed to go on an airline or cargo ship," Dryden said.

During field-testing at the Marshall Center, the company will work to develop techniques for inspecting wing leading edge panels after installation on the structure and after the shuttle is used for orbital missions.

Digitome is also working on concepts for a portable unit that astronauts could use inside and outside the shuttle in space to analyze potential problems encountered in flight such as debris hitting the vehicle on liftoff or flight that might endanger the vehicle's stability or structure.

Ryan Gehm