AVIONICS ROB COPPINGER / LONDON

Lead-free future poses problems

Worldwide legislative changes expected to spark industry rethink on avionics production processes

Avionics manufacturers face having to develop new production processes to cope with a global industry shift to lead-free components and solder.

Lead-free solder requires higher process temperatures to work, which has implications for component and circuit-board choices. The move to lead-free electronics is being driven by worldwide legislation. Electronics that use lead are being outlawed because it is feared the toxic metal will leak into the environment from waste dumps.

To cope with the legislation, industry standards bodies are discussing the practicalities of the change, which must begin by July 2006. This is when EU law comes into effect and is being treated by the industry as a global deadline.

"Before then, the industry is trying to answer questions like, what solder alloys do they use after 2006?" says Roger Goldberg, executive secretary of the Avionics Maintenance Conference standards body.

The maintenance challenge the change represents to industry is the need to track every avionics box's components. With leaded electronic avionics still in service but being repaired beyond 2006 with lead-free components and solder, airlines will have to track which type of components each aircraft's avionics boxes contain.

However, lead-free avionics boxes are available. Matsushita is already shipping lead-free products because Japan is ahead of the EU with its lead free legislation. According to Goldberg, the Airbus A380 and Boeing 7E7 are likely to use lead-free and leaded avionics because lead-free alternative products may not be available in time.

TESTING GRAHAM WARWICK / WASHINGTON DC

Hummingbird takes to the air again

Boeing has restarted flight testing the A160 Hummingbird long-endurance unmanned helicopter as it prepares to offer the aircraft for the US Army's Extended-Range Multi-Purpose unmanned air vehicle requirement. Boeing acquired the A160's developer, Frontier Systems, in May.

The 80min flight on 17 September at Victorville, California, "took a big bite out of the riskiest part of the programme – the optimal-speed rotor", says programme manager Steve Glusman. The A160 is designed to fly efficiently at between 50% and 100% main-rotor RPM, whereas conventional helicopters can only operate over a narrow rotor speed range. The high-stiffness, low-weight rigid rotor can be slowed in forward flight to extend range and endurance.

BOEING

A160 is set to fly more efficiently

Results from the flight were "very close to the analysis", says Glusman. The A160 is one of three built by Frontier under contract to the US Defense Advanced Research Projects Agency (DARPA), and the only one still flyable. The other two suffered "mechanical anomalies". The 2,000kg (4,500lb)-class A160 has an 11m (36ft)-diameter four-blade rotor and is designed for an endurance exceeding 24h and payload of more than 135kg.

Five new A160s with larger engines and improved airframes and systems will be built for further flight testing under Spiral 2 of the DARPA contract, with the first to fly next year. One will be powered by a 650shp (485kW) turboshaft in place of the modified automobile gasoline engine. "The real goal is a heavy fuel [diesel] piston engine. That gets us 24h-plus endurance," says Glusman.

STRUCTURES ROB COPPINGER / LONDON

Stiffness is the key to responsive composites

Composite aerospace structures that use a combination of shape memory alloys (SMA) and optical fibres to respond to and monitor in-flight stresses are being developed by Swiss researchers.

To resist vibration and structural loading, composites need to be as stiff as possible when needed and have adaptive damping properties, while remaining lightweight.

The problem with today's composites is they have conflicting stiffness and vibration damping characteristics. Researchers believe that the use of SMA could resolve this problem.

These fibres change their stiffness, but not their shape, with the application of heat or electricity. This changes the tension in this new composite system, which could provide both damping and stiffness capabilities.

Such an SMA composite structure could be 60% carbonfibre, 36% matrix material and epoxy resin, with the remaining 3-4% consisting of fibres of a shape memory alloy such as nickel titanium.

The SMA material is then combined with optical fibres because they can act as strain sensors, through the observation of light reflections along the length of the optical fibres (*Flight International*, 20-26 July).

The interface between these optical fibres and the epoxy and the nickel titanium fibres is the focus of current research.

The combination of SMAs and optical fibres has led the industry to classify it under smart composite technology.

MAINTENANCE

Ultrasonic health check

A continuous structural health monitoring system that uses ultrasonic signals with sensors placed throughout an aircraft is being developed under the EU's sixth-framework programme.

Information on the state of the fuselage and wings and even helicopter rotors would be presented on a cockpit display and could be transmitted to a maintenance centre. Micro-cracks, composite structure delamination, the weakening of adhesive bonds and thermal and chemical damage could be detected and imaged. The technology, to be developed over the next five to 10 years, uses non-linear elastic wave spectroscopy. This involves active and passive sensors transmitting and detecting ultrasonic signals that pass throughout the aircraft.

"The sensitivity of this method is superior to existing methods," says Professor Josef Maes, aerospace division head for project participant Asco, the Belgian aircraft component supplier. "It will use novel actuators and sensors with tunable properties that can be integrated into the aircraft. Research will focus on sensor integration into structures."

Sensors with tunable properties will be developed because different types of damage are detected and imaged using different ultrasonic frequencies.