

# UK invents welding innovation

IAN SHEPPARD/CAMBRIDGE

THE UK WELDING Institute (TWI) has developed a means by which previously "unweldable" aluminium alloys, such as the 2000 and 7000 series, can be joined.

It had previously been impossible to weld harder aluminium alloys because heating would cause the heat-treated metal to revert to its previous, softer, characteristics, or to become brittle.

"Friction-stir" welding is a solid-phase process, involving the generation of sufficient heat to fuse two pieces of metal together through friction between the parts and a rotating tool, the details of which remain a closely guarded secret.

Sue Dunkerton, head of advanced materials and processes at TWI, says that the advance was identified through the UK's Technology Foresight initiative, which aims to increase productivity in manufacturing, and pinpointed the need to supplant the widespread use of rivets.

According to Chris Dawes, principal research engineer at the Cambridge-based centre for work

into advanced joining technologies, the process "plasticises" the metal instead of melting it, crushing the surface oxide and enabling molecular bonding to occur. A rotating metal "consumable" leaves a deposit fused between the two surfaces. The tool is "remarkably simple", says Dawes, who adds that there are "no fumes, shielding gases or arc-lights and no unwanted deposits".

The institute's sister organisation in the USA, the Edison Welding Institute in Columbus, Ohio, and industrial partners – including British Aerospace, Boeing and Lockheed Martin – participated in development. In four years, the process has gone "from laboratory curiosity to an industrially viable technique".

In initial tests in what is the first aerospace application to reach the prototype stage, TWI fabricated three 2000-series aluminium spacecraft fuel-tanks for Boeing, using the friction-stir process, and tested them to destruction by pressurising them until they "barrelled", says Dawes. The result "...almost matched the metal in its annealed condition, which sur-

prised us", he adds. Tests also showed that failure was not at the weld, but at the "slightly heat-affected zone".

"Excellent" fatigue tolerance has also been demonstrated, says Dawes, even with the unfinished weld which already has a surface finish good enough to "...dramatically cut finishing costs...pre- and post-weld preparation is far reduced". TWI has proven the technique on materials with thicknesses varying between 1.5mm and 18mm. Dawes believes that the theoretical maximum thickness of 37.5mm is feasible.

There is great interest in the process for 7000-series aluminium, says Dawes, particularly for wing spars, and he predicts weight savings of around 20% for load-bearing floors, with the first commercial application in about five years.

Dunkerton says that, with interest growing in the metal scandium, the only mine for which is in Uzbekistan (*Flight International*, 27 August-2 September), even higher-strength alloys will be available and friction-stir welding will be the only conceivable way to avoid even greater use of riveting. □

## NEWS IN BRIEF

### ■ VIRTUAL PROTOTYPES

Boeing will back Virtual Prototypes of Montreal, Canada, in developing its automatic C-code software generator, CCG/Lite, which allows interactive environments to be developed for real-time, embedded systems.

### ■ CELLS SEE LIGHT

New dual-junction gallium-arsenide solar cells developed by Spectrolab of the USA have been used for the first time on the recently launched PamAmSat PAS-5 satellite, which has 15,000 cells generating 10kW of power, doubling the efficiency of silicon-based cells traditionally used for spacecraft solar panels.

### ■ GUIDED ROBOTS

Leica of Switzerland has introduced a rugged global-positioning-system unit for industrial robots. The MCS1000 is a 12-channel receiver using real-time kinematic processing to size millimetre-accuracy in three dimensions, claims Leica.

### ■ DAEWOO FRAMES 747

Daewoo Heavy Industries has signed an agreement worth \$100 million with Northrop Grumman to continue supplying fuselage frames for the upper deck of the Boeing 747-400 until 2006. The South Korean company has already delivered 500 shipsets, each containing 48 frames.

### ■ APACHE DISPLAYS

A Boeing AH-64 Apache Longbow was flown for the first time on 12 September fitted with four-colour flat-panel multi-purpose displays (MPDs) developed by Allied-Signal Guidance and Control Systems of New Jersey. The test flight, at Mesa, Arizona, marked the start of an upgrade which will result in all Apache Longbows being retrofitted with the MPDs.



## NASA tests probe

AN AIR-DATA probe developed by Rosemount Aerospace has had initial flight tests on NASA Dryden Flight Research Center's Boeing F/A-18 Systems Research Aircraft. The advanced L-probe air-data-integration trial proved that two probes can be operated at an angle of attack of up to about 70° and provide sideslip from the pressure difference, as well as altitude and airspeed information.

## New system screens all luggage

ANDRZEJ JEZIORSKI/FRANKFURT

US AIRPORT-security-equipment manufacturers InVision and EG&G Astrophysics have joined forces to develop a high-throughput, automated-screening system for hold baggage.

According to InVision, the TSS 2000 is the only security system which screens "...all hold baggage, including oversized bags". The system combines InVision's US CTX technology for explosives detection with EG&G's Z-scan.

Bags first enter one of several parallel Z-scan devices, which X-ray luggage from above and from the side, automatically identifying suspected threats.

In high-flow periods, bags identified as safe can bypass the next level of detection to increase throughput, but InVision says that the system aims to put as many bags

as possible through the second level of detection – InVision's new CTX 5500 DS.

The CTX system combines computed tomography with X-ray imaging, thoroughly comparing bag contents with a database of explosive parameters. Bags which remain suspicious are passed on to a second CTX device, monitored by one operator, with over-sized luggage passing through a separate Z-scan device, controlled by another operator. No further personnel are required to keep the system running.

■ EG&G has recently won a \$1 million contract from the UK's Manchester Airport for the installation of three Z-scan 7 systems and one Linescan 237 X-ray screening system, starting in November. Manchester operates ten Z-scans, and each of the new devices can process up to 1,200 bags/h. □