

endurance, environmental, fatigue and strength qualification testing are still to be conducted by the manufacturers. Flight test gears will be delivered in the first quarter of next year.

Wheels and brakes on all the gears are being provided by Dunlop Aerospace and Honeywell, which is designing and manufacturing the metal matrix composite (MMC) MLG wheels and brake piston housings. Dunlop is responsible for the MMC nose wheels, torque tubes and the 20 high-density carbon brake packs on the MLGs.

Barry Ecclestone, vice-president of Honeywell Aerospace Europe, claims a 25% weight reduction against today's "base technology" by using the MMC wheels, and says the high-density carbon brake packs allow a 15% volume reduction for the same heat-pack mass and energy absorption capability.

"Total [wheel and brake] system weight is around 4,000kg [8,800lb]," says Ecclestone, "and we reckon we've saved between 600kg and 700kg over one built using conventional technology." However, the Dunlop-Honeywell team is also pursuing a backup design using older technologies as a contingency, he adds.

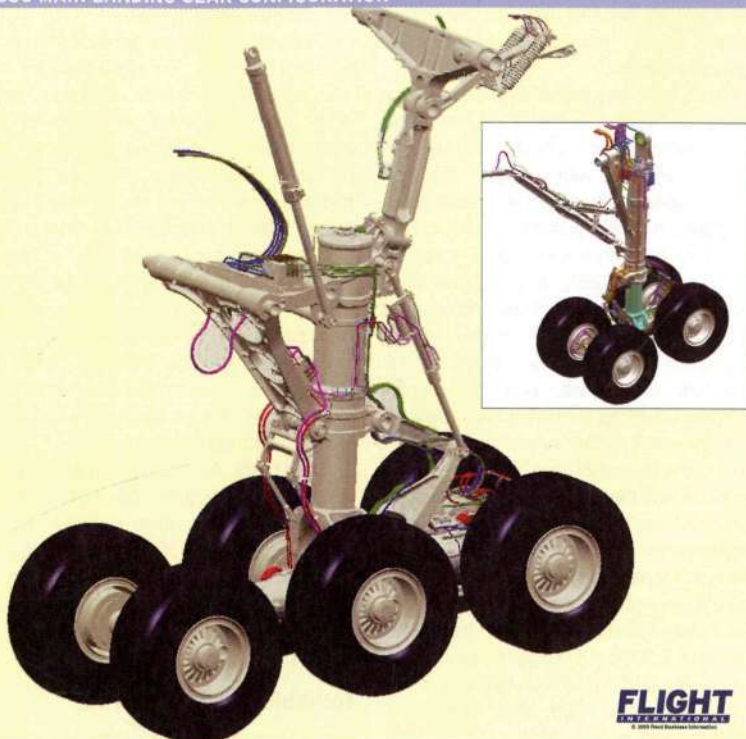
Carl Trustee, director of engineering and quality assurance at Dunlop Aerospace, says some major hurdles were overcome in developing the MMC wheels, adding: "The breakthrough was in being able to forge MMC." He says the material contains silicon carbide (SiC) particles, with properties that do not vary with direction as they would with SiC strand reinforcement.

Trustee says Airbus has increased the severity of its rejected take-off (RTO) braking requirements, with the test now to be conducted with 100%-worn brakes rather than the previous 90% limit. Airbus has also added a flapless landing case.

Goodrich is the largest single subcontractor on the A380 programme and, as well as the MLGs, is supplying the primary and standby air data systems, the primary and secondary FCS, the cargo mechanical system, the engine pylon aft fairing and rear secondary structure, exterior lighting and emergency evacuation system.

The primary and secondary air data systems provide information for the flight controls, cockpit displays and standby instruments. The system uses SmartProbe multifunction sensing probes and processing, and Airbus will receive the first prototype units for laboratory testing in September. The following month, Goodrich will deliver a prototype of its automatic ice-detection system, which uses a small probe vibrated at ultrasonic frequencies to detect ice buildup as small as 0.13mm. The cargo mechanical system follows from Goodrich's systems on the A340, and initial examples are due to be delivered next year. The A380 has 23 exte-

#### A380 MAIN LANDING GEAR CONFIGURATION



Computer generated diagram of the body-mounted main landing gear, (wing-mounted gear in inset). The landing gear will stop the 560t A380 from 174kt in 32s

rior lights, either high-intensity discharge xenon or light-emitting diodes, including landing, taxi, take-off and anti-collision lights.

Goodrich is also involved in the Aerolec joint venture with Thales Avionics Electrical Systems to develop the A380's variable-frequency (VF) electrical power generation system (EPGS), one of the most vaunted systems innovations.

#### Vaunted innovation

It will be the first time VF electrical power has been available on a large commercial aircraft, and follows Goodrich's experience of using a VF system on the Bombardier Global Express. Aerolec is supplying four VF generators for the main engines, two constant frequency 400Hz generators for the APU and six generator and ground power control units (GGPCUs).

The first VF generator – each of which will provide 150kVA in the 370Hz to 770Hz frequency range – was delivered to Rolls-Royce in March for testing on the Trent 900 engine. Alain Marthes, Thales Avionics' vice-president A380 programme, says generator endurance tests have already been completed for the generators. "Total power output will be 600kVA, compared to 360kVA at a

fixed 400Hz on the A340," he adds.

Peter Crouchley, vice-president engineering and quality at Goodrich Power Systems, says the major advantage of the VF system is the "elimination of the complex hydro-mechanical constant-speed drive (CSD) required by conventional systems".

Crouchley says the generator main rotors are made smaller and lighter by using a hollow shaft with the windings inside. "The arrangement was developed for the two-pole APU generators, which run at a constant 24,000RPM, and was carried across to the four-pole VF generators," he says. First deliveries of system components are required for Airbus "iron bird" testing by November, with first-flight production versions following next year.

Hamilton Sundstrand's ram air turbine (RAT) also reflects the scale of the A380's power requirements, delivering 90kVA at between 480Hz and 640Hz. "The 62.5in [1.6m] diameter RAT is 58% bigger than anything we've done before and 25% more efficient by weight than that on the A340-500/600," says David Hess, president of Hamilton Sundstrand's Aerospace Power Systems. It is the first all-electric RAT for Airbus. The first generator is currently in test and the first full RAT test is scheduled for the first quarter of 2004.

Honeywell is developing the secondary electrical power distribution system (SEPDS), fed by the primary system, which will be the first to incorporate solid-state power control in place of traditional electro-

**Many innovations have been driven by Airbus's need to stem weight growth**