New fire bucket on show

by John King

Aircraft, their development and operation, are the mainstay of aviation, but items of equipment on the periphery of the industry can also show the sort of innovation associated with the usual airborne hardware.

IMS NZ Ltd is a Havelock North general engineering company formed a few years ago. It has recently started to supply the aviation industry, more particularly helicopter operators, with a range of buckets intended to make some things grow and stop other things growing, and it also won the award for best stand at the NZAAA conference in Tauranga in July.

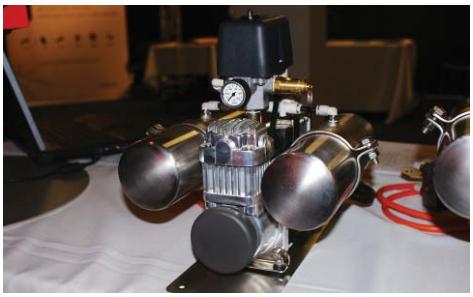
IMS managing director Richard Lane says he developed his Cloudburst collapsible fire bucket two years ago and has just sold 30 examples of the 1,400litre model, suitable for operation under a Huey, to China.

The Cloudburst comes in a range of sizes to suit different helicopters, from the 130litre baby for the R22 through the 420 (MD500 and JetRanger), 500 (LongRanger), 640 (Squirrel) up to the 1,400, the biggest made — although the largest design is a 5,000lt whopper. Each packs into a carry bag which will fit comfortably into that particular helicopter and the 500lt model, for example, weighs 47kg.

Unlike most such fire buckets which rely on electrical actuation of valves for dumping water, the Cloudburst uses pneumatics. Richard Lane gives several reasons for that decision, including instant reaction, non-pollution of the load with hydraulic oil and no need to seal electrics away from liquids.

And a built-in pouch can contain fire retardant foam, mixed into the water in measured amounts and kept agitated by pneumatic air exhaust. Turbine helicopters can use engine bleed air for the pneumatic source, but piston powered machines have a self-contained compressor (pictured top right), skid mounted and approved for the R44, taking typically 70 seconds to build up to 150psi operating pressure from scratch. The air reservoir is built into the valve mechanism in the bottom of the bucket.

Photographs: John King



The bucket material is urethane with a UV rating or 15 years, and all metal components are stainless steel. The spread pattern is conical, some 6–8m, but a control skirt can be attached for a straight column of water.

Filling is by simply dunking the bucket in water, and a weight encourages the bucket to tip over and fill immediately. The wineglass shape, narrowing at the top, gives less wind resistance for carrying empty and can be flown at 100kts in that state, with no speed restriction when full.

The first example appeared in May 2006, and Paihiatua-based Paul Green did the testing. On his first real fire, in the Wanganui area, he dumped 289 bucket loads.

Design work on the next IMS project started in 2005, a metal fertiliser bucket in a range of sizes from 200litres, weighing 40kg, to the 148kg 1500lt model. Its flattened conical shape is aerodynamically significant and it is equipped with an engine for rotating the spreader.

Once again, pneumatic control and built-in air reservoir give progressive release of the load and instant response when it's needed. Some 20 examples are in use throughout New Zealand and a number have been exported.

Underslung buckets have tended to be sourced overseas, but this Havelock North company aims to change that, as well as offering a new slant on some design features.

Lycoming back from the brink

by John King

Announced at Oshkosh in July and expected to be certified this month is Textron Lycoming's answer for the burgeoning LSA field. Its IO-235 is significantly lighter than the venerable (first seen in 1940) O-235 from which it derives, and with an output of 100hp it is aimed squarely at the Rotax which has captured much of the worldwide advanced microlight/LSA market. With fuel injection and roller tappets, the new IO-235 has a TBO of 2,400 hours.

Also recently certified are the 210hp IO-390, basically a big-bore O-360, and 315hp IO-580 which is an IO-540 with enlarged bore. Launched for the experimental market is the TIO-360, a 180hp version of the familiar O-360 but turbo normalised to 20,000ft.

Lycoming's latest initiative, planned to be finalised about now, is mogas certification on standard compression ratio O-320, O-360, IO-360 and O-540 engines, to ASTM D4814, 97 octane RON. The use of ethanol blends and their effects is still being explored, says Adrian McHardy, Rotorua-based regional manager whose territory covers Asia-Pacific, Africa and the Middle East, "but the emphasis is on availability, and we're trying to identify 'safe' use".

The roller tappet, he says, has been highly successful with no recorded failures during some 3.5 million hours' flight time clocked up by around 7,000 engines. Certified by Lycoming in December 2004, the roller tappet is offered as a free upgrade on factory overhauled engines.

Long criticised for their reliance on old-technology magnetos, engine manufacturers are exploring modern electronic solutions. Lycoming has its IE2 (integrated electronics engine) which Adrian describes as being "beyond FADEC. The electronics have been integrated into the engine and eliminated the need for manual backup. No more magnetos — it's all solid state.

"This is for new applications and there are no plans for retrofit. The new systems integrate with glass cockpits. It's simply plug and play."

A few years ago, not long after producing its 300,000th horizontally opposed aircraft engine, the company was struggling. Part of its problems stemmed from massive warranty claims, and in 2004 came sorely needed new leadership, vision and direction. Six Sigma, the manufacturing process and philosophy system developed by Toyota (the name derives from the six defects per million limit) has been adopted, and Adrian McHardy (below, with Alan Campbell on the Lycoming stand at the AIA conference) says Lycoming is in better shape than ever.

Why we need to be concerned about pilot fatigue

by Fiona Johnston

It has been evident that pilot fatigue is a significant safety issue in aviation. Rather than simply being a mental state that can be willed away or overcome through motivation or discipline, fatigue is rooted in physiological mechanisms related to sleep, sleep loss, and circadian rhythms.

Fatigue is a threat to aviation safety because of the impairments in alertness and performance it creates.

Fatigue and sleepiness are often considered to be the same. While there is some debate about the nature of fatigue, for the purposes of this article we are using the term fatigue as an umbrella description of the state of tiredness due to prolonged work and/or insufficient sleep. Its effects are underestimated because it can't easily be measured, and sleepy pilots are often reluctant to admit that they are tired.

Performance effects of pilot fatigue include:

- slowed reactions
- reduced concentration
- increased risk taking
- increased mistakes
- impaired accuracy of use of controls
- decreased vigilance
- impaired situation awareness
- missed or erroneous performance of routine procedures
- impaired peripheral vision

Fatigue is a normal response to many conditions common to flight operations because of sleep loss, sleeping disorders and long duty cycles. It has significant physiological and performance consequences because it is essential that all flight crewmembers remain alert and contribute to flight safety by their actions, observations and communications. The only effective treatment for fatigue is adequate sleep.

Sleep and sleep loss

Sleep is a vital physiological function. Like food and water, sleep is necessary for survival. Sleepiness results when sleep loss occurs. Sleep is as important as breathing.

How much sleep do we need?

Most people need about eight hours' sleep, but we are all different. To work out your sleep requirement, next time you are on holiday don't use an alarm clock and, over a period of seven days, record the amount you sleep. Begin your recording once you have had time to recover from any pre-existing sleep debt. At the end of the week add your sleep hours together and divide by 7 to determine your average sleep requirement.

If you fall asleep in less than 10 minutes the chances are you are in sleep debt and you will be feeling very tired during waking hours. Increase your sleep time by 30 minutes each day and evaluate how alert you feel each day.

The negative effects of one night of sleep loss are compounded by subsequent sleep loss. Sleep loss can degrade most aspects of human performance. In the laboratory it has been demonstrated that losing as little as two hours of sleep can negatively affect alertness and performance.

Fatigue countermeasures

Research has shown that several countermeasures for fatigue are effective in improving alertness and performance. Long naps, 3–4 hours, can significantly restore alertness for 12–15 hours. Short or "power" naps of 10–30 minutes can help restore alertness for 3–4 hours. Make sure that 15–20 minutes is allowed after awakening to become fully alert.

Other countermeasures include:

- eat high protein meals to keep yourself alert
- minimise high fat and high carbohydrate foods
- drink plenty of fluids, especially water
- caffeine used strategically can help counteract noticeable fatigue symptoms
- keep the flight deck temperature cool
- move/stretch in the seat, and periodically get up to walk around the aircraft if possible.

Shiftwork Services is developing a fatigue risk management programme with Graeme Martin from Super Air. The project involves assessing pilot fatigue in relation to hours of work, aptitude for early morning starts and assessing the fatigue related risk associated with agricultural aviation.

[Fiona Johnston (above) is a Director of Shiftwork Services, a consultancy and training organisation specialising in providing fatigue, risk management, rostering solutions and wellness programmes for the 24/7 workplace. Visit her at www.shiftwork.co.nz or contact Fiona@shiftwork.co.nz]

Graeme Martin (standing) watches an interactive session on pilot fatigue during the NZAAA conference in July.