

Lithium Batteries – The Good, The Bad and The Ugly

Air transport operators need to be aware of the danger presented by lithium batteries, because often their passengers are not.

The Ugly

To date and globally, there have been more than 150 occurrences in the air involving lithium batteries, including fatal accidents. Consequently, both lithium ion and lithium metal batteries are considered Dangerous Goods when transported by air.

From cellphones to self-propelling baby strollers, lithium batteries are increasingly powering goods transported by aircraft.

There is a growing number of reports of such goods spontaneously combusting as the lithium battery contained in them explodes.

A current study of such incidents suggests that when an aircraft takes off, the noise of its engines and associated sonic vibrations may upset the internal structure of the batteries. That's thought to cause a battery to short circuit, heat up, and eventually burst into flame.

The likelihood of such an occurrence is still rare, but the consequences are, of course, potentially catastrophic.

Traditional extinguishers are impotent against a lithium battery fire, because if one cell of the battery catches fire, it'll generate heat in the others. Halon extinguishers may suppress the fire for a moment, but it will erupt again in the same, or another, cell. The only way to effectively put out a lithium ion battery fire is to submerge it in water.

One of the more common lithium powered products to explode is the electronic cigarette. E-cigarettes are forbidden in checked-in luggage, because if it's in the cabin and 'detonates', at least any smoke will be obvious to passengers and crew who can take action. But many people don't appreciate the danger, and such products are often not discovered unless a bag is screened and searched for a separate reason. They are usually an incidental find.

The Bad

There are many lithium batteries produced with no regard to manufacturing standards, including counterfeit batteries.

"They're the ones with realistic labels on them indicating they've been manufactured by a known and approved maker,

but can be fake," says Clayton Hughes, the CAA's avionics specialist.

"But even properly manufactured batteries can be subject to failure, as mainstream device manufacturers have discovered."

Clayton says rough handling is another danger. "It can damage the lithium battery inside the product even though the outside looks fine."

The Good

Lithium batteries are increasingly popular because they're low-weight, high-density, and very high performance. For that reason some aircraft equipment is actually fitted with them, and approved lithium main aircraft batteries are now also available.

"But those batteries need to be TSO-certified, which includes safety testing. They come under airworthiness requirements and often have service life airworthiness limitations," says Clayton.

"They're also sited inside, or with, components which normally contain associated battery protection circuitry, reducing the risk of fire and explosion.

"Regulation of the manufacture and use of those batteries means they provide the least risk, as long as they're maintained according to the manufacturer's instructions."

The 'Regs'

CAA's dangerous goods specialist, Kate Madden, says it's sometimes hard for people to comprehend that the lithium batteries in their cameras, power tools and cellphones are considered Dangerous Goods when carried on aircraft.

"For obvious safety reasons, ICAO has regulations covering how lithium batteries are carried by air," she says, "including restrictions on the maximum power – or 'Watt hours' – of the battery, and where in the aircraft they may be carried.

"Lithium batteries fully contained in the equipment for which they were designed, and under a certain power limit, are allowed in the cabin or in checked-in luggage. But if in the cargo hold, the product they're powering must be fully switched off, not in 'hibernation' or sleep mode.

“Batteries must be taken on board the aircraft if they are packed externally to the equipment they are powering. The equipment, however, has to be stowed in checked-in luggage.

“Similarly, if the battery is on its own, and that includes power banks, it must be taken as carry-on, and individually protected by insulating the terminals to prevent short circuits.

“That can be done by placing the product in the original retail packaging, taping over the exposed terminals, or placing each battery in a separate plastic bag or protective pouch.”

Kate says there are some batteries or products powered by batteries that cannot be carried anywhere on an aircraft.

“The capacity of lithium batteries is measured in Watt hours (Wh). If you have a 100 Wh battery, and your product uses one Watt an hour, it will last 100 hours. If it draws 100 Watts an hour, it will last an hour.

“The higher the capacity of the battery, the more lithium contained in it, the more dangerous it is.

“Batteries must have capacity of no more than 100 Wh to be carried anywhere on the aircraft. If the battery’s capacity is more than 100 Wh, the operator should check ICAO’s *Technical Instructions for the Safe Transport of Dangerous Goods by Air* and IATA’s *Dangerous Goods Regulations*. Passengers with such batteries also need to seek operator approval to have them on the aircraft.

Some battery labels describe capacity in ampere hours (Ah) or milliampere hours (mAh) instead of Wh. You can calculate the Wh by multiplying the Ah by the voltage. If in mAh, multiply by voltage and divide by 1000.

If an air transport operation has a self-check in system, passengers need to be made very aware of what they can, or cannot take on board, and why. And why not.

Clayton Hughes recounts a story of a videographer who removed the battery from his camera and packed it in his checked-in luggage.

“The plane was delayed for ages, while they searched for his bag and removed the battery. They took it very seriously,” he says.

The Advice

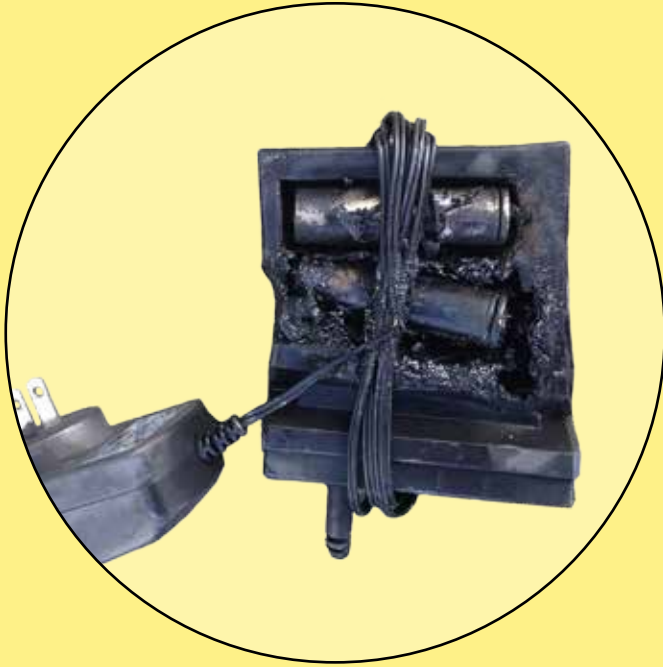
“In some ways,” says Clayton Hughes, “the risk of lithium battery fires is, overall, decreasing because the major airlines are so aware of the issue.

“However, it’s the small passenger operations that need to be very aware of the dangers, and to make sure their passengers are too.

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A potential catastrophe was averted when an alert ramp worker noticed a checked-in bag was smoking during loading of an aircraft in the US. They pulled the bag from the luggage trailer and called fire response.

“That might mean some really close questioning of passengers at the time of embarkation. Or noticing a comment from a passenger about their cellphone not charging very well, which can indicate a damaged battery. Or by having posters in prominent positions in the check-in area, or information posted to a web site or other publication.”

It’s important for operators to keep current with the increasing array of products powered by lithium batteries. They include motorised suitcases, or electronic bikes that can pass for ordinary ones.

“The Aviation Security Service (Avsec) web site, www.avsec.govt.nz, is a good place to start,” says Kate Madden. “This is a fast-moving issue because of changing technology, and Avsec will have the most up-to-date information.”

Clayton says pilots and operators should be proactive and alert.

“A pilot or operator of a small airline carrying the occasional piece of cargo should be very sure they know what is actually in that cargo.

“And if a pilot knows that a product has been recalled because of the risk of a lithium battery fire, don’t wait for the regulators to make a comment, just don’t carry it!”

For more information, read Part 92 *Carriage of Dangerous Goods* at www.caa.govt.nz. ■

Cliff Jenks

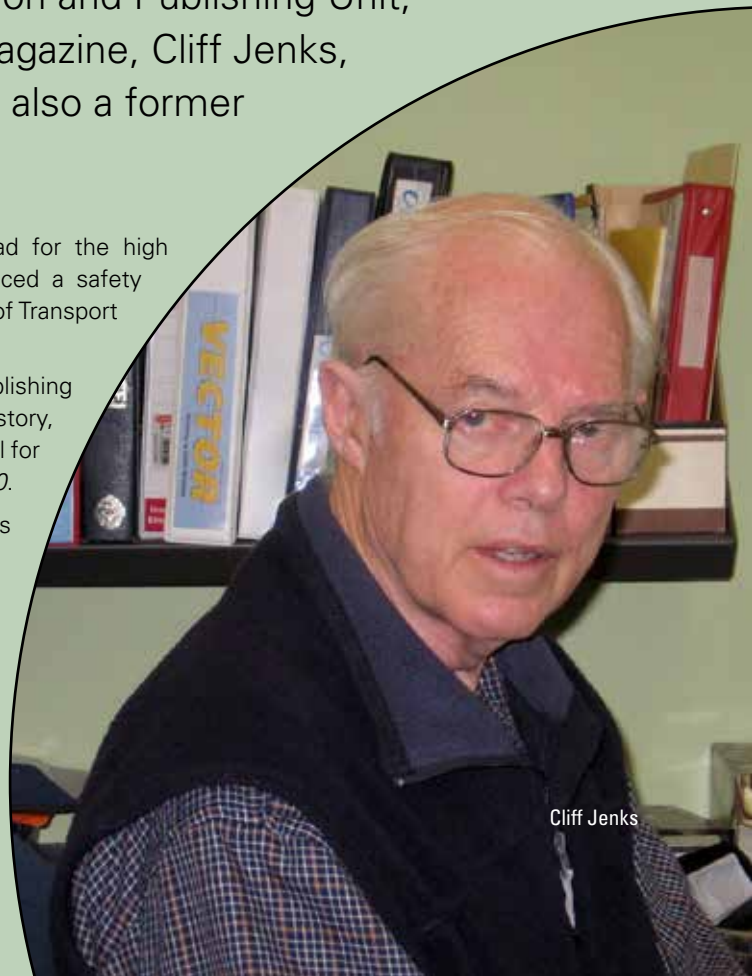
Former manager of CAA’s Safety Education and Publishing Unit, and original managing editor of *Vector* magazine, Cliff Jenks, died on Sunday 6 August 2017. Cliff was also a former RNZAF Wing Commander.

Cliff was universally respected in New Zealand and abroad for the high standards he established for CAA publications. He produced a safety magazine, *Insight*, for the RNZAF before joining the Ministry of Transport Civil Aviation Division in 1985.

Flight Safety was the original CAA safety magazine, with Cliff establishing the new name of *Vector* in 1996. Cliff had a passion for aviation history, and also edited the Aviation Historical Society of New Zealand journal for many years. He co-authored *New Zealand Tiger Moths 1938 to 2000*.

He retired from the CAA in 2003, but even then continued to help us as a part-time adviser for a few years.

On his retirement, Cliff had this advice for instructors, “You never stop learning. It’s a trite observation, but if you’re an inexperienced instructor, then never make the mistake of thinking you know enough to get by. You should aspire to the highest, and when you get there I’m sure the people already there will say that you’re never too old to learn.” ■



Cliff Jenks