最新鋰電池安全運送指導綱要介紹

劉亮 譯

每年有超過十億件鋰離子電池及鋰金屬電池因應市場需求而且運輸量逐年成長中，由於數量大量成長，也提升了因錯誤的包裝而引發火災的機率。

一份由國際航空運輸協會(International Air Transport Association以下簡稱IATA)提出的網路線上指導文件、目的在透過國際空運危險品安全要求達到鋰電池安全運送方式。

“鋰電池只要按照全球性安全運輸標準來設計、測試、製造及包裝，就可以安全地運送了。”IATA飛航安全資深副總Kevin Hiatt如此表示。

在IATA發布的“航空公司降低鋰電池危害指導”(Lithium Batteries Risk Mitigation Guidance for Operators, First edition, effective Jan. 1, 2015-Dec. 31, 2015, Montreal. 2014)中指出，如果不按照安全標準操作時，結果將會帶來極大災難，正如自2006年以來就有3架全貨機因此墜燬。

“這是非常明確這3架飛機都承運了鋰電池貨物。”該文件指出；“然而鋰電池在這3件重大意外事件扮演什麼角色一例如：火災是否由鋰電池造成或加劇一依然無法證實。”

聯合國民航組織(International Civil Aviation Organization以下簡稱ICAO)已經宣布鋰電池是危險品，並且訂立一些加強客機及全貨機特別的安全規範。

IATA指出在過去幾年間，已經增加限制每一件包裝件內鋰電池的最大裝載淨重、並且需要通知機長每班機上所載運的鋰電池相關規定。

雖然有這麼多的管制，問題依然持續不斷發生。顯然有一些人故意不理會這些規範，甚至完全漠視鋰電池在空運貨物及郵袋運送時的規定。很多旅客同樣的對於鋰電池潛在危害莫不關心，導致鋰電池在行李中、貨物及郵袋內造成安全問題。

安全分析

IATA的指導文件以建議航空公司依據ICAO安全管理手冊(ICAO Safety Management Manual)明列的所有運送鋰電池運送危險因素、執行危害安全評估。航空公司高階貨運、安管及飛行主管部門建議將所有潛在危害因素從1列到5，並將發生的可能性從A列到E。所得到的危害指標---從“不重要”到“非常危險”的等級將會決定該貨物是否可以接運。

IATA用下面例子介紹航空公司的客機、可能遭遇到旅客攜帶手提電子器材(portable electronic devices---PEDs)在客艙內發生的情形；

▲危害程度---

假設一件PED在客艙內發生火災，受過訓練的空服員可以立刻拿到滅火器滅火。同時、可以降低鋰電池發生火災的水就在手邊。因此，依據飛行途中航機意外發生時、空服組員滅火作業規範，這項危害程度將可列為3級(moderate)。

▲可能性---

因為旅客經常會帶PEDs登機，這類意外空服組員滅火很有可能會發生。因此，可以歸類到C級(possible/remote)。

危害指數：將第3級危害程度與C級可能性配對後，得到結論：危害程度為3C或是中度(moderate)。

航空公司下一步將是採取預防性控管(preventive controls)防止鋰電池失火發展為不安全的飛機失火案件。擴大因素(escalation factor)將會減弱預防性控管成效，然而、控制擴大點(escalation controls)則可限制擴大因素發生。

例如：預防性控管就是限制將鋰電池放在托運行李內交運。擴大因素就可能是旅客不理會這項規定。控制擴大

點就是航空公司在旅客報到櫃台、確實要求旅客了解並遵守這項規定。

該項指導文件強調：雖然預防性控管在做，這類鋰電池失火不安全事件仍然會發生。因此，就必須採取救援手段(recovery measures)，然而，擴大因素必須嚴格控管以免減弱救援手段效果。

例如：救援手段就是空服組員可以隨手取得海龍滅火器及足夠滅火的水。擴大因素就是滅火器過期了、或是手邊水不夠多。控制擴大點就將是製作標準作業程序、確保每架飛機上滅火器是在有效期內，而且有足夠的水可用。

注意事項

該項指導文件強調鋰電池安全運送的注意事項，通常是透過鋰電池製造商、貨運承攬業者及郵局作業人員，在機場旅客報到櫃台、電視影片、大眾媒體、及其他公關媒介加以宣傳。

IATA及ICAO要求鋰電池與其他危險品一樣、在運送時必須運用檢查表，確認文件及標籤都符合運送規範，同時要求航空公司防止鋰電池在運送途中受損。

在這些規範中特別要求鋰電池在運送途中不會移動、也不會被其他貨物因移動而受損。IATA文件建議航空公司將鋰電池放在有煙霧偵測裝備、並且可以通知機長的Class C 級貨艙機艙內。同時，該型機艙必須具備合格的可由駕駛艙內控制的滅火系統，而且可以預防失火造成的煙霧、火焰及滅火藥劑影響到航機組員及旅客，而且機艙內通風設備確保滅火藥劑可以控制火源。

ICAO並沒有要求鋰電池要與其他危險品保持區隔，但是IATA建議航空公司考慮將列為危險品的鋰電池、要與其他危險品保持相當距離以策安全。

該指導文件同時建議航空公司、透過貨運接收程序及訓練、採取額外行動來查核未申報的鋰電池。詳細查核空運文件、特別是會含有鋰電池的電子/電器器材。

PEDs與鋰電池

由於PEDs的大量製造與使用，大型飛機可能載運數百件鋰電池產品。IATA建議鋰電池產品盡量手提登機，如果無法全數手提上機，托運行李內鋰電池必須防止短路及其他無意情況下啟動。

備份鋰電池禁止以托運行李方式交運、而且必須放在原始包裝盒內、或用絕源膠帶將正負兩極貼妥。

該項文件內也建議航空公司向旅客說明、要將手機及其他手提電子產品保管好，避免掉到座椅下，造成因座椅活動時將手機壓碎。

加強訓練

適當的空服員訓練將最有力減緩鋰電池意外發生機率。特別是下列兩項訓練：

1.預防性訓練：集中在如何發現鋰電池已經受損或不符合標準規格。

2.反應式訓練：著重對於鋰電池產生的煙霧、火警或毒氣如何處理。

在任何一種貨物發生火災時，最大可能就是未申告的鋰電池引起的。空勤組員應該接受緊急反應訓練，以應付鋰電池發生火災或產生煙霧，最重要的是盡快緊急降落同時該文件建議加強組員在煙霧進入客艙或駕駛艙時，應該如何緊急反映處理。

未來趨勢

目前已經開始研發貨艙裝設最新式滅火系統、也就是內含防火材質的空運貨櫃。

其他設備也進行測試中，例如在貨櫃中加裝自行偵測煙霧或火災發生的滅火系統、當溫度過高時、會自行刺穿貨櫃頂部引入滅火藥劑，以及快速提供氧氣面罩、並且利用煙霧替換系統(smoke-displacement system)、提供組員可以清楚看見飛航儀表及窗外景象的清潔空氣。

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Packing UP

New industry guidance describes the safest ways of transporting lithium batteries.

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Billions of lithium-ion and lithium-metal batteries are shipped by air every year, with that number likely to increase in coming years with worldwide demand.

The increase in numbers may well be accompanied by an increase in fire risks associated with mishandling of the batteries as they are packed for shipment.

An online guidance document, published by the International Air Transport Association (IATA), is aimed at reducing those risks by explaining international requirements for the safe transport by air of dangerous goods and describing methods of complying with the requirements as they relate specifically to lithium batteries.

"Lithium batteries are safe to transport, provided that they are designed, tested, manufactured and packaged in accordance with the global transport safety standards," said Kevin Hiatt, IATA senior vice president for safety and flight operations.

When those safety standards are ignored, however, IATA said in its document, Lithium Batteries Risk Mitigation Guidance for Operators, the results can be catastrophic. The document cited three cargo aircraft that were destroyed by fire since 2006.

"It is known that all three aircraft were carrying lithium batteries as cargo," the document said. "However, the degree to which the lithium batteries were involved in these incidents (i.e., whether they were the cause or aggravated the fire) could not be determined."

The United Nations has declared lithium batteries to be "dangerous goods," and the International Civil Aviation Organization (ICAO — an agency of the U.N.) has set forth specific requirements for their safe transport

in both cargo and passenger airplanes.

In the last few years, requirements have been strengthened to limit the number of lithium batteries per package and to require more notices of lithium battery shipments to pilots-in-command, IATA said.

Despite these controls, problems persist, the association said. Although some people intentionally ignore the requirements, the "ubiquitous nature" of the batteries "means that people who are completely unaware of the dangerous goods regulations and the requirements for lithium batteries are shipping them as cargo and in mail," the IATA document added. "Many passengers are similarly oblivious to the potential hazards of lithium batteries. The result is that there are safety risks from lithium batteries in baggage, cargo and mail."

Risk Assessment

IATA's guidance begins with the recommendation that operators conduct a risk assessment, as described

in the ICAO Safety Management Manual, to identify all risks associated with transporting lithium batteries. Senior-level representatives of cargo, safety and flight operations departments should identify all potential hazards and then rate their severity, on a scale of 1 to 5, as well as the likelihood that they will occur, on a scale of A to E. The resulting risk index — ranging from "negligible" to "extreme" — should then be examined to determine shipment tolerability.

As an example, IATA describes how the operator of a passenger airplane might assess the risk of carrying portable electronic devices (PEDs) in the cabin, using this reasoning:

▲Severity level — If a PED catches fire in the cabin, fire extinguishers will be readily available to cabin crew, who will have been trained in their use. Additionally, water, which is necessary to cool lithium batteries involved in an accident, will be at hand. Therefore, on the basis that an abnormal flight operations incident procedure would be applied (firefighting by cabin crew), with few other consequences, it may be appropriate to assign a severity level of 3 'moderate.'

▲Likelihood — Given the propensity for… PEDs to be carried by passengers, it would be reasonable to assume that such an incident might occur at some time, and so the likelihood would be Level C [possible/remote].

The risk index would be calculated by pairing the severity (3) and the likelihood (C) to conclude that the risk would be 3C, or "moderate."

The operator's next step would be to examine preventive controls that would prevent a hazard such as a lithium battery fire from developing into an unsafe event such as an aircraft fire, escalation factors that could weaken the effectiveness of the preventive controls and escalation controls that could block the escalation factors.

In the example, a preventive control might be a prohibition against carrying spare lithium batteries in checked baggage, an escalation factor might be a passenger's ignorance of the requirement, and an escalation control might be that the operator "has a robust process to ensure that all passengers are made aware of the requirement (e.g., by questioning at check-in)."

The guidance material added, "Despite preventive controls being in place, there is always the possibility that an unsafe event (in this case a lithium battery fire) can occur. Consequently, 'recovery measures' must be considered. … As with preventive controls, recovery measures can also be weakened by escalation factors that need to be controlled."

In the example, a recovery measure might be having halon fire extinguishers and water available to the cabin crew, an escalation factor might be that the fire extinguishers are out of date or that insufficient water is available, and an escalation control might be implementing a process to ensure that aircraft always have current fire extinguishers and adequate water.

Awareness

The guidance material emphasizes the importance of increasing awareness of lithium battery safety, often through the involvement of battery manufacturers, freight forwarders and postal operators; with warning notices at airport check-in desks; and in videos, social media and other publicity material.

Both IATA and ICAO require lithium batteries and other dangerous goods to undergo an "acceptance check" to ensure that they have met shipping requirements — and document and labeling requirements associated with such shipments — and stipulate that operators must take steps to ensure that the goods are not damaged during transport.

Among the requirements are provisions specifying that packages must be secured to prevent movement and must be protected against damage that could result from the shifting of other cargo. IATA's guidance suggests that operators consider loading lithium batteries in a Class C cargo compartment with a smoke detector or fire detector to warn the flight crew of problems. There also should be an approved built-in extinguishing system that can be controlled from the flight deck; methods of keeping hazardous smoke, flames and extinguishing agent away from crew and passengers; and methods of controlling compartment ventilation to ensure that the extinguishing agent can control the fire, the guidance says.

ICAO does not require separation of lithium

batteries from other dangerous goods, but the IATA guidance suggested that operators "consider segregating packages of fully regulated lithium batteries from packages of other dangerous goods" with some exceptions.

The guidance material also suggested that operators take extra steps to detect the presence of undeclared lithium batteries through "enhanced cargo acceptance processes and training to better detect noncompliant shipments." Increased scrutiny of the paperwork accompanying cargo shipments is recommended, the guidance says, suggesting that items described as "electrical/electronic equipment" might include lithium batteries.

PEDs and Lithium Batteries

Because of the proliferation of PEDs, large airplanes could be carrying hundreds of lithium batteries, IATA says, noting recommendations that the devices be in carry-on baggage whenever possible. When this is not possible, steps must be taken to prevent short circuits or other unintentional activation.

Spare lithium batteries are prohibited in checked baggage, and must be protected against — that is, they should remain in their original protective packaging or exposed terminals should be covered with nonconductive tape.

The guidance material also suggests that operators incorporate into the preflight briefing a request that passengers stow cell phones and other PEDs safely when they are not in use to prevent them from falling into a seat mechanism. The material cites a number of incidents in which cell phones that had fallen into seats were crushed when the seat was moved.

Training

Appropriate crew training is the greatest mitigating factor in preventing incidents involving lithium batteries, the guidance says, specifying that there are two types of training:

- Preventive training, which concentrates on detecting damaged packages and situations in which lithium batteries are not in compliance with requirements; and,

- Reactive training on how to respond to an incident involving smoke, fire or fumes.

In any cargo fire, "there is always the possibility of undeclared lithium batteries," the guidance material says. "Flight crew should be trained to respond to an emergency suspected of involving lithium batteries carried as cargo by following the standard operating procedure for smoke or fire events, the most important aspect of which is land as soon as possible.

In addition, the material recommends emergency training on the problems of retaining aircraft control if smoke enters the flight deck.

In the Future

Research has turned up new methods of containing and suppressing fires in cargo compartments, the guidance material says, citing as an example cargo containers built of fire-resistant material.

Tests are in progress on other devices, including cargo containers equipped with selfcontained fire-suppression systems that activate automatically if smoke or fire is detected, penetrators that automatically pierce the roof of a cargo container to inject fire extinguishant if excess heat is detected, and quick-donning oxygen masks that can be used along with smoke-displacement systems to provide a space of clear air through which pilots can see both their flight instruments and the view outside the windscreen.

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