

Handling Lithium Battery as Passenger or Crew Baggage

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Abstract

The purpose of this paper to maintain flight safety and zero accident rates related to the level of safety of the use of electronic devices and lithium / non lithium batteries when passengers onboard on a plane. This research study reviews and analyzes the handling of bringing separately the electronic equipment containing lithium ion and/or metal batteries by referring the rules set by IATA (International Air Transport Association). In the Dangerous goods regulation book 59th Edition of 2018, and which have not been regulated but there have been events related to Passengers carry lithium batteries and electronic devices into the aircraft cabin. Also associated with the latest Circular from the Ministry of Transportation No. 015 of 2018 concerning Provisions to Carry Portable Battery Chargers (Power Banks) and Spare of the Lithium Batteries on Airplanes that had the chance to viral through social media lately. This research uses descriptive - explorative method. And obtain the secondary data from the Technical Instruction of The International Civil Aviation Organization (ICAO), IATA DGR, last Seminar or workshop related to Lithium Battery Handling, and finally with the Focus Group Discussion. The results of this study to encourage interested parties, especially ground handling and airlines, as well as passengers to be able to apply appropriate handling methods and procedures when carrying the electronic equipment and batteries, then need actions when emergency conditions on the plane in the future.

Keywords : Lithium Battery; Flight Safety; Implementation

Introduction

This study aims to find out several things, namely how the acceptance process and guarantee the level of security of the use of electronic equipment and lithium batteries when received by the passenger receiving officer (check in) and also when going to the plane in the waiting room (boarding), until handling aircraft cabin by the cockpit crew and the cabin on duty. In connection with the potential risk of explosion / fire hazard on Power Bank or backup Lithium Batteries where the last incident occurred on the aircraft , then in order to ensure the safety of government aviation in this case the Ministry of Transportation of the Directorate General of Civil Aviation has issued circular no. 15 of 2018 regarding Provisions

for Carrying Portable Battery Chargers (Power Banks) and Lithium Backup Batteries on Aircraft (Kementerian Perhubungan, 2018) .

Furthermore, the Directorate General of Air Transportation instructed the three agencies directly related to the handling of electronic equipment, namely the first Air Transport Business and Foreign Air Transport Company was instructed, second to the Airport Management Unit, Airport Business Entity, Special Airport Operator Unit, and third at the Office of the Airport Authority. In accordance with these instructions it is hoped that the relevant parties can carry out these provisions as well as possible. The international regulations have been arranged technically in table 2.3.A in the Book of IATA dangerous goods regulations , wherein the table contain that Passenger can carry approximately 17 out of 33 items carried containing Lithium electronic equipment and batteries that have the potential misused, and people use it with inappropriate procedures and resulting in unexpected incidents.

The purpose of this paper is to maintain flight safety and zero accident against mishandling of Lithium battery as passenger baggage. The carriage of Lithium Batteries as passenger baggage is increasing exponentially and we must act now to prevent further loss of life. “from market trends, anticipation that safety may still act as a restraint in the search for acceptable compromise with overall performance and cost of lithium-ion based and post lithium-ion rechargeable batteries of the future”(Abada et al., 2016). “Lithium batteries character is high specific energy, high efficiency and long life. These unique properties made lithium batteries as the power sources of choice for the consumer electronics market with a production of the order of billions of units per year” (Scrosati & Garche, 2010). Total outgoing is 155.7 ton and incoming is 174.9 ton , so overall total Is 330,6 ton of electronic (computer, hand phone and camera), while only 50% according to staff handling has potential involve Lithium battery. Consequently, the incidents involving lithium batteries create the fire on board aircraft . It is not always possible to determine the cause of such incidents, but where to determine the cause , they are invariably due to non-compliance with the

requirements. Field incidents that result in fire of battery cells and packs of lithium ion chemistry are still a matter of discussion and cast doubts on the readiness of the technology for applications that require more energy (longer life) or more power (higher current) (Cabrera-Castillo, Niedermeier, & Jossen, 2016).

However, the degree to which the involve of lithium batteries in these incidents (i.e., still could not determine whether they were the cause or aggravated the fire). Numerous Li-ion battery fire and explosion incidents attracted more and more attention to the issue of battery safety (Kong, Li, Jiang, & Pecht, 2018). FAA record As of August 2, 2018, 225 air or airport incidents involving the carrying of lithium batteries as cargo or baggage since March 20, 1991 (FAA (federal Aviation Administration), 2016). To certify the Lithium ion batteries , these batteries must pass a series of safety tests for use in a particular application such as portable electronics or automotive. “In International, national and regional standard describe Safety tests, typically developed based upon pre-normative research and experience from industry, academia and regulatory bodies” (Ruiz et al., 2017). From the matter above, IPA recommend for both passenger and cargo operator, to perform a risk assessment of the carriage of Lithium Batteries within Their current operation.

The authority or the operator need to analyze the specific issue against the public policy and the Ministerial decree socialized are the sub regulation of the Indonesian laws as the legal standing in handling the safe transport of Lithium battery. Transportation Minister has standardized The Regulation based on the reference, either transportation, environment and Health to find the solution to Lithium battery handling. The scope review is check in counter and airside or aircraft of Indonesia as well as main gateway. Two major types of lithium batteries power are 1) lithium ion batteries, including lithium ion polymer and 2) lithium metal batteries. For Lithium ion batteries are typically rechargeable, and power devices such as laptop computers, mobile phones and portable music players, while for non-rechargeable lithium metal batteries, for power devices

including cameras, flashlights and Automatic External Defibrillators. A single cell compose for lithium metal battery , while maybe between 6 and 12 cells compose for lithium ion laptop battery. In recent years, the use of electronic cigarettes or e-cigarettes has increased world widely. The re-chargeable lithium ion batteries powered the majority of these devices , can represent a fire hazard if damage, over-heat, over-charge or store inappropriately. Currently no reports in the medical literature of lithium ion battery burns related to EC use and no guidance on the appropriate management of lithium ion battery associated injuries (Nicoll, Rose, Khan, Quaba, & Lowrie, 2016) “The security of e-cigarettes is a significant problem, due to several incidents of fire in Li-ion batteries and explosions that result in bodily injury and damage to several properties (Saxena, Kong, & Pecht, 2018). There is also a lack of guidance specifically on the management of lithium ion battery burns”. Widely utilization of Lithium ion batteries in various types of electronic components, such as laptops, cameras and mobile phones, due to their efficient gravimetric and volumetric energy density, high power density, long service life and pollution-free use. (Scrosati, 2000; Omara 30 et al, 2014). Clearly, for not declared Lithium battery to operator , the above measures are not possible. Therefore, must make efforts to detect such batteries. These could include implementing: enhanced baggage acceptance processes and training to better detect non-compliant baggage. This could include greater scrutiny of the descriptions of goods or items on accompanying paperwork. additional training for passenger terminal personnel to increase awareness of the need to better detect baggage contain Lithium battery, remove damaged lithium battery from the baggage, etc.

Other studies, analyzing the impact on batteries to remove 99.1% of the total stored energy (Barai et al., 2017). The requirement to Asses for testing, for safe and reliable lithium cell / battery batteries; and to help develop national and internal policies (Huo et al., 2017). In research on lithium-ion batteries, as a portable electric energy storage medium because it has high energy density and a

long life cycle. Commonly utilization of The material as a cathode on lithium-ion batteries is lithium cobalt oxide (LiCoO_2), but the element cobalt is a heavy metal that is harmful to the environment, has a price that is expensive and reactive so that it is easy to explode at high temperatures (Satriady, Alamsyah, Saad, & Hidayat, 2016).

When sending out (export) or importing lithium batteries internationally with aircraft, Part 12 of the TDG Regulations requires compliance with the International Civil Aviation (ICAO) Technical Directive and some additional requirements from the TDG Regulations. The utilization of Lithium batteries in many electronic devices such as cameras, cell phones, laptop computers, medical devices, and electrical equipment (Kaur, 2016). Airlines including America, Delta and Alaska announced restrictions on smart luggage because Lithium-ion batteries found on several bags can pose a risk of fire (Wamsley, 2017). Using Lithium ion batteries in product devices, such as cellphones, laptops, and electric cars. About 5.4 billion lithium ion cells are produced worldwide in 2014. A battery consists of two or more cells. Airlines to and from the United States that receive shipments of lithium batteries carry 26 million passengers per year according to the Civil Aviation Agency (FAA) estimates. Aviation authorities have long known that the battery can ignite on its own and can create fires that are hotter than 593 degrees Celsius (Permana, 2016).



Figure 1. Step of receiving Power Bank based on SE 015 of 2018 and Flow chart for Receiving Power bank (Kementerian Perhubungan, 2018)

Method

Participant

The FGD held during workshop for Dangerous Goods for Regulator on 15 August 2018. There are 20 safety inspector of airport authority who attend the FGD.

Apparatus

This paper based on study of literature review and collection of secondary data from Airport Operator and from the experts' sharing of the waste management from each side point of view at the socialization continue with focus group discussion (FGD).

Procedures

Through the extensive literature review , Based on IATA DGR Subsection 2.3.0.1 to 2.3.0.2. Goods in Table 2.3.A. where dangerous goods including excepted

packages of radioactive material, forbidden for passengers or crew members to carry, as or in 1) checked baggage; as or in 2) carry on baggage; 3) on the person; except as stated in, the following dangerous goods, as listed in 2.3.2.1 to 2.3.2.6, are permitted in aircraft as registered baggage only and with operator agreement (s), to dangerous goods, as listed in 2.3.5.1 to 2.3. 5.11, is permitted on the aircraft as baggage without the operator's approval (s). Without prejudice to additional restrictions that may be exercised by the State for the purposes of aviation security, except for incident reporting requirements 9.6.1 and 9.6.2, the provisions of this Regulation do not apply to 2.3.2 to 2.3.5 when passengers or crew members carry or in baggage transported by operators that have been separated from their owners during transit (eg lost baggage or baggage not directed properly) or in excess baggage carried as cargo as permitted by 1.2.7.1 (g). Note: 1. See subsection 2.2 for a list of Hidden Hazardous Goods that may not be clear to passengers and crew and which may be accidentally in the trunk. 2. The following provisions are tabulated in Table 2.3.A.

Discussion and Results

Discussion

The analysis process is carried out through the following stages:

1. Analysis Process

- a. Initial stage preparation : Review the location of warehousing at Halim Perdana Kusuma, including analysis of passenger receipts at check-in counters, and boarding.
- b. Calculate the number of electronic equipment and lithium batteries that passengers carry on one flight as one sample . Calculate the number of possible uses of electronic equipment.

- c. Review regulations on the acceptance of electronic equipment and lithium batteries that are restricted to being carried on board by both passengers and flight crew.

And there are at least 17 types of goods that have been categorized as items of an excepted quantity, and can be carried as carry-on baggage into the cabin, put into cargo compartments. as registered baggage, and are prohibited from being carried either as a luggage, and registered. The following types of goods are in table 1(IATA, 2018) as per IATA DGR table 2.3.A)

Table 1. Types of electronic items and types of lithium / non lithium batteries that has limitation when passengers and crew carry it.

A. Ground handling or Airline Staff must inform Pilot in charge the item location					Permissible Quantity
B. Permit as <i>hand carry</i>					
C. Permit as <i>checked baggage</i>					
D. Need approval from Operator					
1. Batterai, spare loose, including Lithium metal or Lithium ion ion cell or Batteries	NO	NO	YES	NO	
2. Chemical Agent Monitoring Equipment	YES	YES	YES	NO	
3. E-Cigarettes	NO	NO	YES	NO	
4. Electro Shock Weapons	Forbidden				
5. Fuel Cells , give power to Camera, handphone. Laptop	NO	NO	YES	NO	
6. Fuel Cell Cartridges, spares (see IATA DGR 2.3.5.10)	NO	YES	YES	NO	
7. Heat Producing Articles	YES	YES	YES	NO	
8. Lithium Batteries, Security Type Equipment Containing lithium batteries (seeIATA DGR 2.3.2.6)	YES	YES	NO	NO	
9. Lithium Batteries, <i>Portable electronic devices Containing Lithium metai or lithium ion cell or batteries for Camera. Hand phone, see IATA DGR 2.3.5.9</i>	NO	YES	YES	NO	100-160 Wh ≤2g

10. Lithium batteries, spare loose (lithium metal)	YES	NO	YES	NO	100-160 Wh/2-8g For PMED 2 sparebatt
11. <i>Lithium battery-power electronic devices</i>	YES	YES	YES	NO	100-160 Wh 2-8g 2 sparebatt
12. Mobility Aids with non spillable wet battery or with battery comply with Special provision A123 dan A199 (see IATA DGR 2.3.2.2)	YES	YES	NO	NO	
13. Mobility Aids with spillable battery or with lithium Batteries (see IATA DGR 2.3.2,3 and 2.3.2.4)	YES	YES	NO	YES	
14. Mobility Aids with lithium ion batteries (collapsible) (lihat IATA DGR 2.3.2.4d)	YES	NO	YES	YES	
15. Permeation Devices (refer to A41), see IATA DGR 2.3.5.16	NO	YES	NO	NO	
16. PED containing non spillable Batteries (must refer A67), see IATA DGR 2.3.5. 12 V atau 100 Wh	NO	YES	YES	NO	2 Spare batte
17. Security Attache Cases, cash boxes, cash bag	Forbidden				

2. Testing the results of the analysis,

- a. Visual Observations : Observation of electronic equipment, and lithium batteries received or carried by passengers, and posters for handling electronic items in the passenger reception area, waiting rooms before boarding aircraft, and domestic or international aircraft pamphlets;
- b. Lay Out Cabin observation and safety support equipment in the aircraft cabin: Observation of the baggage compartment, and calculation of the number of safety devices and safety device models. The following flow handling when an emergency occurs. In order to obtain the right size and handling capacity;
- c. Observation of Standard Procedures : Obtain the Analysis from National and international regulations and countries and flights

related to the handling of receipt of electronic equipment and lithium batteries.

3. FGD (Focus Group Discussion)

in the end of discussion using the FGD by inviting the experts in the field of dangerous goods, especially in the passenger terminal, regarding the results of the survey or observation.

Discussion and Results

After carry out the FGD , conclusions and suggestions to apply in handling the level of safety in the use of electronic equipment and lithium batteries in passenger terminals in Indonesia.

The firefighting Procedures against incident Lithium Batteries in passenger aircraft is important. Some passenger may carry the lithium batteries as hand carry on passenger cabin and possibility of loading the checked in baggage contain the lithium batteries in cargo compartment with the greatest fire suppression capability. Therefore based on a risk assessment load lithium batteries in cargo compartment with most appropriate mitigation capability Class C compartment or alternative with fire suppression capability. This protection equipment such as fire containment covers (FCC) and Fire-resistant containers (FRC), while Class E compartments use FCC to provide additional protection for cargo in. The standards available currently to provide battery safety testing under abusive conditions, including electrical/mechanical/thermal abuse, but do not provide guidance for battery fire protection or extinguishing Li-ion battery fires. When extinguishing battery fires, cooling the battery is as important as suppressing the flame (Kong et al., 2018). in tests where other personal items containing permitted dangerous goods (such as aerosol cans) are placed in the same checked baggage as a PED, an explosion may occur, not related to the gases from the battery; there is a likelihood that the halon system in a Class C compartment might not be

sufficiently discharged and reach a suppression concentration of 3 per cent before such an explosion would occur. For an equivalent example tested in a Class D compartment, there is a poor likelihood that the resulting fire could be controlled or contained and no protection is provided to prevent the event of an explosion.(ICAO, 2017)

Learning from other state authority like FAA(Federal Aviation Administration)’s policy of Unites States. This authority determine that airlines can safely expand passenger use of Portable Electronic Devices (PED) during all phases of flight, and immediately provide airlines with guidance. The Airlines has variation on the process in handling the PED safely, but agencies expect airlines to allow passengers to use their devices safely in airplane mode, the gateway to the gate, at the end of 2013. For reducing number of battery fire incidents need to apply some safety steps as follows : separator shutdown, flame retardants, and cell venting. Although the most widely used polymer separator has a shutdown function, once the separator shrinks and loses its integrity, the shutdown function is useless (Kong et al., 2018). In general the utilization of Lithium metal batteries for power devices inside watches, calculators, cameras, temperature data loggers, car key fobs and defibrillators. The abbreviation of Lithium-ion batteries is Li-ion batteries are secondary or rechargeable batteries where lithium is only present in ionic form in electrolytes. Also included in the category of lithium-ion lithium polymer batteries. While generally utilization of Lithium-ion batteries for electrical devices such as cellular phones, laptop computers, tablets, electric tools and e-bikes. There is no verification/little control to determine that the device has been turned off or not damaged, therefore increasing the risk that a cell goes into thermal runaway, which would result in a fire initiated within the concerned checked bag (ICAO, 2017).

Most of the incidents because of noncompliance have invariably, but “undeclared”. Therefore the screening of PEDs should separately when using conventional X-ray equipment, and Security screening equipment is currently undergoing a technological evolution and the full extent of the capabilities of new equipment is

not yet known. However, any additional factors to be added to the screening process cause additional challenges on both detection and false alarm rates. Optimization of these would need carefully study before taking any decisions.(ICAO, 2017). From FGD , eventhough there is no limit quantity for Passenger who carry Lithium ion Battery as cabin baggage for less than 100 watthour per unit, but IATA may set up the limitation next year that limit for Portable Electronic Devices (PED) will be 15 and for Spare batteries will be 20 units per passenger. There is a recommendation to buy good quality Lithium Battery with better price to avoid counterfeit batteries or low quality battery that may have flammable due to unstable composition of unit. Further if any irregularities during acceptance, need all party concerned to raise Incident report to DGCA (Directorate General Civil Aviation), the purpose to apply the regulation properly and make correction for the matter.

Safety start from the ground, but more safety in preventing unstable dangerous goods substance such as Lithium batteries-large size enter the first gate in x-ray gate, then check in counter and more screening before loading and transporting into aircraft. From various type of Lithium Battery, we know how they look like and type and handling upon loading and inside aircraft cabin or passenger compartment and cargo compartment, also know how to act during emergency. Proper system or alert system can prevent incompatibility on passenger and cargo compartment, support with proper equipment install on the aircraft, can handle fire during incident. We wish party involve on this dangerous goods handling can implement the recommendation or best practice and create standard operation procedure based on update of latest edition or revision of regulation.

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