EASA
European Union Aviation Safety Agency

PEDs / lithium batteries fire risk in the passenger cabin/flight deck

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PEDs / lithium batteries fire risk in the passenger cabin/flight deck

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EASA Safety Promotion

Safety Promotion

Safety Promotion is a set of means, processes and procedures that are used to develop, sustain and improve aviation safety through **awareness raising and changing behaviours.**

Since 2020 **Safety Promotion material** is published in the EASA Community and under *Together4Safety* before that date.

Safety Promotion is one key enabler to reach the ultimate objectives of the EU Safety Management Strategy and contributes to continuous improvement of our aviation safety system in Europe and worldwide, together with regulations and oversight.

Safety promotion includes the development of products and actions such as reports and technical publications, bulletins, leaflets and posters, audio-visual material, toolkits, manuals and guides, social media and e-applications, and also conferences, safety events, roadshows and campaigns. Safety Promotion is also about sharing best practices from the authorities and the industry. Safety Promotion can also contribute to the dissemination of regulatory developments.

Safety promotion activity features a strong dimension of communication and social marketing.

Together4Safety
Safety Promotion material

Safety Promotion Networks & Initiatives

Flight Data Monitoring

Conferences & Workshops

EASA Safety Promotion

EASA Safety Promotion

Portable electronic devices (PEDs) – frequently asked questions

What is a portable electronic device (PED)?

PEDs are any kind of electronic device, typically but not limited to consumer electronics, brought on board the aircraft by crew members, passengers, or as part of the cargo. PEDs include the following two categories:

(1) Non-intentional transmitters can non-intentionally radiate transmissions. This category includes, but is not limited to, calculators, cameras, radio receivers, audio and video players, electronic games and toys; when these devices are not equipped with a transmitting function.

(2) Intentional transmitters (T-PEDs) radiate transmissions on specific frequencies as part of their intended function. T-PEDs include two-way radios, mobile phones of any type, satellite phones, computers with mobile phone data connection, wireless local area network (WLAN) or Bluetooth capability. After deactivation of the transmitting capability, e.g. by activating the so-called 'flight mode' or 'flight safety mode', the T-PED remains a PED having non-intentional emissions.

PED/ Lithium batteries in the flight deck

- **Continuing Airworthiness (CAW) activities:**
  - In May 2018 EASA issued a Continuing Airworthiness Review Item (ref. CARI 25-09) to request TCHs to assess the hazard associated to a lithium battery fire on the flight deck
  - The CARI identifies a minimum set of measures necessary to address the hazard
- **Initial Airworthiness (IAW) activities:**
  - In December 2021 EASA published proposed special conditions to address the safety concern highlighted in the CARI for new design certification project
  - On 26 April 2022 EASA published the final Special Condition SC-G25.1585-01 Issue 2 and the related CRD
- **SIB addressed to operators:**
  - On 12 October 2022 EASA published SIB 2022-08 including recommendations based on the special conditions
  - The SIB was shared with other Aviation Authorities before pubblication

CARI 25-09

Potential Risks due to devices containing Lithium batteries located on the flight deck

- Personal electronic devices (PED) carried by passengers and crew contain as well lithium batteries. Additionally, passengers and crew may carry spare lithium batteries and powerbanks. Lithium batteries and PEDs commonly found in the flight deck are electronic flight bags (EFB) and those carried by the flight crew for personal convenience.

- The increasing number of lithium batteries contained in equipment carried by the flight crew on commercial transport aircraft results in a higher risk of in-flight lithium battery fires.

- Typical location may be in the storage boxes available or on mounting brackets when provided. On certain aircraft design, the flight deck storage boxes may be located in close proximity to built-in oxygen lines routed in the flight deck, the oxygen mask storage box or other critical system components.

CARI 25-09

Potential Risks due to devices containing Lithium batteries located on the flight deck

- In case of a battery/cell thermal runaway, the flight deck would become potentially affected by generation of heat, smoke and flames, as well as by explosions. Additionally, a battery fire affecting critical aircraft systems (e.g. flight controls and oxygen lines) may be catastrophic.

- The use of PED's in the flight deck is regulated by operational requirements. However, the Agency believes that the safety risks associated to PED fires relate for some aspects to the design.

- The purpose of CARI 25-09 is to investigate if potential unsafe conditions associated to lithium battery fires in the flight deck may exist on any specific transport aircraft type that would require corrective actions as a second step.

CARI 25-09

Potential Risks due to devices containing Lithium batteries located on the flight deck

The Type Certificate Holder (TCH) is requested to:

- 1) Perform a hazard assessment of a representative lithium battery fire in the flight deck.
- 2) If in case of lithium battery thermal runaway the storage boxes or mounting brackets cannot keep their physical integrity, or the thermal runaway effects may may be critical f or the surrounding systems, the TCH is requested to define how to handle such event.
- 3) Define the procedure associated to a PED fire in the flight deck.
- 4) Define the safety equipment (e.g. fire gloves) necessary to relocate an overheated PED to the location specified for fire fighting and subsequent storage.
- 5) Define the necessary safety makings.

Special Condition SC-G25.1585-01

Special Condition

Mitigation of flight deck fires originating from lithium batteries

that are not part of the aircraft design

1) The emergency procedures to be followed in case of lithium battery fire on the flight deck must be specified considering the different threats (i.e. heat, smoke, fire and explosion) associated to a potential lithium battery thermal runaway event.

2) Adequate training must be specified for the flight- and cabin crew addressing such emergency procedures.

3) The emergency equipment required to effectively follow the procedures established to meet above SC 1) must be suitable for lithium battery fires and must be located either in the flight deck or in its close proximity so that it can be timely retrieved by the flight crew or the cabin crew, as applicable.

4) The design of each stowage compartment and each mounting bracket on the flight deck, must be evaluated by means of a fire hazard assessment supported by test evidence to determine its suitability to place or stow PEDs, power banks and spare batteries.

5) Placards must be installed to allow the identification of stowage locations and mounting brackets inside the flight deck that are determined to be suitable for PED stowage according to above SC 4).

Special Condition SC-G25.1585-01

Means of Compliance

The associated Means of Compliance is published for awareness only and is not subject to public consultation.

MOC to SC 1

The emergency procedures required to meet special condition 1) should be included in the AFM and should be developed considering the following guidance:

a. Personal Electronic Devices (PEDs) powered by lithium batteries are commonly transported on the flight deck of Large Aeroplanes, e.g. electronic flight bags (EFB) or devices carried by the flight crew for personal convenience (mobile phones, tablets, laptop computers, e-cigarettes,etc.). In addition to PEDs, also power banks or spare batteries may be transported on the flight deck by flight crew members.
b. A possible means of compliance with special condition 1) consists in prohibiting the carriage on the flight deck of lithium batteries that are not part of the aircraft type design and that have a capacity exceeding 2 Wh.
c. The lithium battery may be in a PED on a mounting bracket or may be in the personal belongings of the flight crew - both cases need to be addressed.
d. A lithium battery fire on the flight deck could be potentially catastrophic and therefore the emergency procedures should involve either the removal of the PED, power bank or spare battery from the flight deck or placing it in a safe stowage that is readily on the flight deck.
e. The need to use liquids to cool the battery as part of the fire-fighting procedure.
f. The likelihood that cabin crew members can actively participate to the fire-fighting procedure should be evaluated.
g. The procedure should make clear whether it is required for the aircraft to land as soon as possible.

Special Condition SC-G25.1585-01

MOC to SC 4

The hazard assessment required by SC 4) should cover all the consequences of a thermal runaway event, such as for example:

a. Smoke and toxic gases released from the battery, taking into account the effects of the implementation of the applicable flight deck smoke evacuation procedure.
b. The need to remove the battery from the flight deck, if applicable.
c. The consequences of the use of liquids to cool the battery as part of the fire-fighting procedure.
d. The impact of the battery fire on the physical integrity of stowage boxes or mounting brackets.
e. The potential for corrosive leakage from the battery.

The hazard assessment should be performed considering a representative lithium battery fire in terms of heat, smoke and toxic gases generation. In absence of any other justification, it should be assumed that in a thermal runaway of a representative PED battery temperatures as high as 760° C could be reached and that the event could have a duration of at least 2 minutes. The setup and procedure of any test conducted to support the demonstration of compliance with SC 4 should be agreed with EASA.The proximity of critical systems (e.g. oxygen systems, wire bundles, other batteries, etc.) that could be affected by direct flame impingement or heat transfer should be taken into account. Mounting brackets should be shown to withstand the PED overheat/ fire until the PED can be safely removed from the mounting bracket.

A possible means of compliance with special condition 4) consists in prohibiting the carriage on the flight deck of lithium batteries that are not part of the aircraft type design and that have a capacity exceeding 2 Wh.

Special Condition: applicability

→ From the Comment Response Document:

EASA has launched an investigation to identify the need for continuing airworthiness action on Large Aeroplanes from EU TC Holders and foreign TC Holders for which our bilateral partners are the State of Design Authority. The outcome of such investigations confirmed that:

- *a potential hazard exists on the majority of aircraft types*
- *and in such case mandatory action would be required from the TCHs to define the necessary emergency procedures, training, equipment and improvements of the flight deck design as defined in Special Condition ref. SC-G25.1585-01.*

Therefore, it is expected that the SC will become part of the type certification basis for most if not all of the EU and Non-EU large aeroplanes aircraft types and introduced in the associated TCDSs accordingly.

Special Condition: applicability

→ From the Comment Response Document:

The special conditions will be applicable to STC projects affecting the configuration of a flight deck design originally compliant with the special conditions. EASA does not intend to apply the special conditions to STC projects, unless:

- *the special conditions are referenced on the TCDS of the aircraft to which the STC is applicable or*
- *the subject change would extensively affect the flight deck design with respect to the potential hazard of lithium battery fire on the flight deck.*

EASA SIB 2022-08

EASA published the referenced Special Condition SC-G25.1585-01 to ensure that the design of newly certified large aeroplanes can withstand the threat of a flight deck fire originating from a lithium battery that is not part of the aircraft design.

EASA has also started the process of reviewing the design of already certified large aeroplanes to determine, if any unsafe condition exists due to a PED fire.

At this time, the safety concern described in this SIB is not considered to be an unsafe condition that would warrant either an Airworthiness Directive (AD) action under Regulation (EU) 748/2012, Part 21.A.3B, or a Safety Directive (SD) action under Commission Regulation (EU) 965/2012, Annex II, ARO.GEN.135(c).

EASA SIB 2022-08

Recommendation(s):

EASA recommends the large aeroplane operators to:

- Ensure that no PEDs, spare batteries or power banks are transported on the flight deck, unless, when not in use, they can be placed or stowed in flight deck stowage compartments that have been specifically designated to stow PEDs, power banks and spare batteries by the relevant design approval holder.
- Implement Service Bulletins published by TC holders to address the lithium battery fire events on the flight deck.
- For EFBs, ensure that the battery fire scenario is addressed in the risk assessment performed to authorize their use on the flight deck. In such risk assessment no credit should be given to existing EASA approvals of mounting brackets installations, as regards to withstanding the effects of a lithium battery thermal runaway, unless there is the evidence that EASA Special Condition SC-G25.1585-01 was part of the certification basis considered for the related projects.

Future steps

- **CAW issues:**
  - With some exceptions, Non-EU TCHs have not replied to the CARI yet
  - The review of the data received from TCHs has not been finalized
  - if an unsafe condition is identified, an AD has to be issued

- **IAW issues:**
  - Define more detailed conditions for the applicability of special conditions to design changes

LOKI-PED

Research project EASA.2021.HVP.24
based on the Horizon Europe Work Programme 2021-2022
on Cluster 5 Climate, Energy and Mobility

- Lithium batteries fire/smoke in the cabin
- Budget: 0.8 M€
- Project started in September 2022
- Project duration: 36 months

Fraunhofer

AIRBUS

DLR Deutsches Zentrum für Luft- und Raumfahrt
German Aerospace Center

LOKI-PED project objectives

1. Fully characterise the hazards related to the carriage of lithium batteries and PEDs by passengers in the aircraft cabin, including but not limited to the following:

   — identify, determine and assess through a series of fire tests the safety risks posed by PEDs transported in the cabin, clearly separating in the study the types of PEDs that could be representative of the items carried by passengers (e.g. laptops/cell phones, drones, electric tools); normal circumstances of flight and factors potentially affecting the results should be considered when designing the different scenarios, which shall reflect representative cabin situations.

   — identify common threats using incident data from available safety reports ;

   — as part of this assessment, study the risk of smoke penetration in the cockpit and the toxicity of the smoke in the cabin, clearly separating the data related to toxic fumes from materials and batteries;

   — study the observed evolution of battery thermal runaway events caused by batteries and PEDs, and consider similarities and coincidences that could serve as a basis to establish patterns;

   — study the consequences of modifying the limits in terms of size and battery power allowances, based on the assessment of the typical batteries and values used;

   — assess the additional risks of undeclared items[20] carried on board by passengers (including, e.g., counterfeit batteries, higher power than marked, etc.) and include them in the conclusions; and

   — include future developments in the conclusions, such as emerging technologies and potential passenger needs in terms of carriage of PEDs and batteries.

LOKI-PED project objectives

2. Determine the extent of the consequences of fire and smoke caused by an event on the safe conduct of the flight, using modelling and numerical simulation and involving operational safety experts. This includes, among others, defining tolerances both in the cabin and the cockpit, identifying failures in the aircraft systems, studying the smoke penetration in the cockpit, determining the most dangerous conditions for passengers and aircrews, and assessing solutions from the perspective of the design of both the cabin emergency equipment and the battery .
3. Assess the limits related to battery design (energy content and power output) and number of PEDs on board to maintain acceptable risk level(s). Determine the relationship between the risk and the increase/decrease of both battery energy and number through the experimental data available.
4. Compare the scenarios assessed with the limits established by the applicable regulations to identify potential gaps and needs for change and justify the conclusions.
5. Assess and evaluate current emergency procedures with the risk characterisation and data obtained, particularly benefiting from the data obtained as regards the patterns and obtain data from testing realistic scenarios. Identify potential improvements of the existing emergency procedures in the cabin, making a distinction between the different types of PED fires, and develop particular procedures to be used in the cockpit.

LOKI-PED project objectives

6. Establish whether additional mitigating measures in relation to the hazard would need to be applied, determining whether the use of certain solutions may minimise or increase the risks and consequences and justifying whether manufacturing or testing standards should be developed by the appropriate entities.
7. Identify gaps in the applicable provisions, as well as any need for improvement, in particular in relation to the following:
   - ICAO Doc 9284, *Technical Instructions for the Safe Transport of Dangerous Goods*, and where appropriate, its Supplement (ICAO Doc 9284SU);
   - UN Recommendations on the Transport of Dangerous Goods;
   - UN Manual of Tests and Criteria; and
   - ICAO Doc 9481, *Emergency Response Guidance for Aircraft Incidents Involving Dangerous Goods*.
8. Identify whether there is a need for guidance for operators for performing their risk assessment and/or safety promotion for passengers.

LOKI-PED project tasks

- Task 1 - Characterisation of the main hazards posed by lithium batteries and PEDs carried by passengers and aircrew in the cabin
- Task 2 - Evaluation of the consequences of fire and smoke
- Task 3 - Assessment of the limits related to the number of batteries and the battery power / energy capacity
- Task 4 - Comparison of the risk scenarios with the limits established by the applicable regulations
- Task 5 - Assessment of the cabin emergency procedures using the output of Tasks 1, 2 and 3
- Task 6 - Assess additional mitigation measures
- Task 7 - Identification of gaps in the regulatory provisions

LOKI-PED project expected outcome

- Provide experimental test evidence for the establishment of limits (power output and quantity) for the transport of PEDs, and study the effects of an increase/decrease in the risks involved.
- Develop new and improve existing emergency procedures to cope with lithium batteries and PEDs transported in the cabin, thus rendering it a safer environment for both passengers and aircrew.
- Reduce the occurrences of safety events caused by lithium batteries and PEDs carried by passengers and aircrew by better understanding the causes, consequences and patterns of lithium-battery thermal runaways in flight.
- Reduce the consequences of fire and smoke events by determining cabin and cockpit tolerances, identifying the consequences of failures in the aircraft systems, and identifying solutions both at aircraft and lithium-battery level.
- Support operators in assessing the risks associated with the transport of lithium batteries and PEDs in the cabin and identify the need for safety promotion for passengers.

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Any questions?

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