



# Advisory Circular

**Subject: Potential for High Energy Fires Due to Lithium-Ion Batteries**

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## 1.0 Introduction

- (1) This Advisory Circular (AC) is provided for information and guidance purposes. It describes an example of an acceptable means, but not the only means, of demonstrating compliance with regulations and standards. This AC on its own does not change, create, amend, or permit deviations from regulatory requirements, nor does it establish minimum standards.

### 1.1 Purpose

- (1) The purpose of this document is to advise operators of the potential for high energy fires on board aircraft caused by the failure of lithium-ion batteries contained in portable electronic devices.

### 1.2 Applicability

- (1) This document applies to Transport Canada Civil Aviation (TCCA) personnel, delegates, and the aviation industry for information purposes.

### 1.3 Description of changes

- (1) Not applicable.

## 2.0 References and requirements

### 2.1 Reference documents

- (1) It is intended that the following reference materials be used in conjunction with this document:
  - (a) [Aeronautics Act](#) (R.S.C., 1985, c. A-2)
  - (b) Part VI, Subpart 2 of the *Canadian Aviation Regulations* (CARs) – Operating and Flight Rules
  - (c) Part VI, Subpart 4 of the CARs – Private Operators
  - (d) Part VII, Subpart 2 of the CARs – Aerial Work
  - (e) Part VII, Subpart 3 of the CARs – Air Taxi Operations
  - (f) Part VII, Subpart 4 of the CARs – Commuter Operations
  - (g) Part VII, Subpart 5 of the CARs – Airline Operations
  - (h) Standard 722 of the CARs – Aerial Work
  - (i) Standard 723 of the CARs – Air Taxi - Aeroplanes
  - (j) Standard 723 of the CARs – Air Taxi - Helicopters
  - (k) Standard 724 of the CARs – Commuter Operations - Aeroplanes
  - (l) Standard 724 of the CARs – Commuter Operations - Helicopters
  - (m) Standard 725 of the CARs – Airline Operations
  - (n) Chapter 551 of the *Airworthiness Manual* (AWM) — Aircraft Equipment and Installation
  - (o) Airworthiness Notice (AN) B067, Issue 01, 2003-06-03 — Inspection and Maintenance of Handheld Portable Fire Extinguishers and the Hydrostatic Testing of Pressure Vessels Used in Aircraft

- (p) Transport Canada Publication (TP) 12295, Edition Two, 2021-04-01 — *Flight Attendant Manual Standard*
- (q) TP 12296, Edition 2, 2008-04-01 – *Flight Attendant Training Standard*
- (r) Transport Canada Advisory Circular 700-042 – Crew Resource Management
- (s) Federal Aviation Administration (FAA) Advisory Circular – 120-80B Firefighting of General and High Energy In-Flight Fires, 2023-03-16
- (t) FAA Guidance Information – [https://www.faa.gov/hazmat/resources/lithium\\_batteries/](https://www.faa.gov/hazmat/resources/lithium_batteries/)
- (u) FAA Safety Alert for Operators (SAFO) 09013 – Fighting Fires Caused By Lithium Type Batteries in Portable Electronic Devices
- (v) FAA Fire Safety Training Videos – <https://www.fire.tc.faa.gov/Training/>
- (w) Air Accidents Investigation Branch – Investigation 20130712-0
- (x) FAA Information for Operators (InFO) 17021 – Risks Associated with the Use of Fire Containment Products

## 2.2 Cancelled documents

- (1) As of the effective date of this document, the following documents are cancelled:
  - (a) Commercial and Business Aviation Advisory Circular (CBAAC) 0260, Issue 01, 2007-03-20 — Potential for In-flight Fires Due to Lithium Battery Failure
  - (b) Service Difficulty Alert AL 2009-06, 2009-08-13 — Procedures for Fighting Fires Caused by Lithium Type Batteries in Portable Electronic Devices
- (2) By default, it is understood that the publication of a new issue of a document automatically renders any earlier issues of the same document null and void.

## 2.3 Definitions and abbreviations

- (1) The following definitions are used in this document:
  - (a) **Crew Member:** a person who is assigned to duty in an aircraft during flight time.
  - (b) **Flight Attendant:** a crew member, other than a flight crew member, who has been assigned duties to be performed in the interest of the passengers in a passenger-carrying aircraft.
  - (c) **Flight Crew Member:** a crew member assigned to act as a pilot or flight engineer of an aircraft during flight time.
  - (d) **High Energy Fire:** fires caused by the combustion of dangerous goods containing chemicals with a high energy density, such as is available in lithium batteries. High energy fires may occur when such batteries experience thermal runaway. A high energy fire can be explosive, exceedingly hot, and can result in large volumes of toxic or flammable gasses. After extinguishment, the device may require a period of time to cool prior to containment to minimize the possibility of re-ignition.
  - (e) **Operator:** for the purpose of this document, means an air operator or a private operator.
  - (f) **Thermal Runaway:** a situation where the chemical condition and the temperature within a battery cell are such that heat is generated faster than it can be dissipated, resulting in a chain reaction where the rising cell temperature accelerates the chemical reaction in the battery and destroys it. The thermal runaway event is often associated with the release of significant quantities of smoke, gases, and heat (in excess of 600 Degrees

Celsius), as well as the potential for resulting fire, explosion, and/or the release of flammable electrolyte material as well as miscellaneous shrapnel from the device.

- (2) The following **abbreviations** are used in this document:
- (a) **AC:** Advisory Circular
  - (b) **CBAAC:** Commercial and Business Aviation Advisory Circular
  - (c) **EFB:** Electronic flight bag
  - (d) **ELT:** Emergency locator transmitter
  - (e) **FAA:** Federal Aviation Administration
  - (f) **PED:** Portable electronic device
  - (g) **TCCA:** Transport Canada Civil Aviation
  - (h) **TP:** Transport Canada Publication

### 3.0 Background

- (1) There have been recent incidents of lithium-ion and lithium batteries overheating in portable electronic devices (PEDs) resulting in the propagation of smoke and flames from the units. In most of the fires reported, there were signs prior to the ignition of the PEDs. These signs included the sight and smell of smoke, the presence of heat, and sometimes a popping sound just prior to ignition.
- (2) Due to the potential for fires, manufactures have issued recalls and replacement programs for the batteries or devices that have been determined to be deficient and pose problems. As well, users of the devices in question have been advised by the manufactures to use the alternating current adapter and power cord approved to power the systems.
- (3) In other related incidents, lithium-ion batteries have resulted in injuries to passengers, crew members as well as damage to and destruction of the aircraft.
- (4) Cellphones and laptop computers were some of the first lithium-ion battery powered devices to receive wide acceptance by consumers. Concurrently, thermal runaways of batteries began to occur and recalls of batteries began shortly after. The problem of thermal runaways and recalls of batteries is still relevant today. Many new products still being released on the market have experienced at least one thermal runaway. In some cases these events have taken place on board passenger carrying aircraft.
- (5) The chemistry used to develop the products listed on the market is as varied as the products themselves. Some lithium-ion chemistries may be safer than others, but none are guaranteed not to go into thermal runaway under different circumstances. Continued evaluation is critical to keep pace as new technologies become available to power devices.
- (6) As additional energy sources are applied to PEDs for powering the device, there will be new challenges faced by crew members and operators in combating high energy fire situations. As such, guidance to deal with these situations will be updated as research is conducted among States to provide operators with recent safety information.
- (7) Since 2006 there have been 444 in-flight/airport reported incidents worldwide involving lithium batteries on board aircraft. In 2007, Transport Canada recognized the safety concerns generated by the potential of an in-flight fire due to a lithium battery failure. CBAAC 0260, *Potential for In-flight Fires Due to Lithium Battery Failures* was released to alert Canadian operators to the dangers of high energy fires caused by lithium battery failures. While there is significant risk related to both fires in the cargo compartment of an aircraft or smoke and fires in the flight deck,

many PEDs, and in turn lithium-ion batteries are carried by passengers within the passenger compartment. This AC provides guidance to the advances in safety equipment technology and the current research that is being conducted to combat high energy fires created by lithium-ion batteries.

- (8) Several manufactures have marketed fire containment devices. With this, operators may have amended, or are considering amending, their fire fighting procedures and training programs to include the procedures and equipment of these containment products.

## **4.0 Overview**

### **4.1 General information**

- (1) While the potential for a high energy fire caused by a failure of a lithium-ion battery is rare, operators may elect to advise all operational personnel of the associated hazards due to the possibility of a risk to passengers, crew members, and aircraft during both ground and flight operations.
- (2) Operators should be mindful of the number of PEDs that are being carried on board an aircraft as passenger numbers increase and have measures in place to mitigate risks associated with high energy fires.

### **4.2 Actions to minimize the effects of a high energy fire**

- (1) To minimize the risk of a battery failure, passengers should be discouraged from plugging in PEDs for the sole purposes of charging a battery. Additionally, passengers should be reminded that once their device is charged, the device should be unplugged.
- (2) Passengers should be reminded that to charge devices, they should only be connected to the aircraft electrical system, which can be controlled by crew members. Operators should develop procedures to reduce or eliminate the number of passengers using external battery charging devices to charge PEDs.
- (3) Should a high energy fire occur, the power to all outlets on the aircraft should be removed immediately and operator fire fighting procedures should be aggressively initiated to reduce the potential of propagation of the fire and hazards associated with smoke accumulation.
- (4) Operators are encouraged to conduct reviews on their fire fighting procedures to determine if they adequately address the potential hazards associated with high energy fires. Operators should include procedures for PEDs that may not be within a crew members view (e.g.: overhead bin compartments).
- (5) It is recommended that operators continually adapt and adjust their procedures to the best practices within their approved training programs to mitigate risks associated with high energy fires.

### **4.3 Recognition of thermal runaway**

- (1) In addition to the PED becoming hot to the touch, other signs of thermal runaway may be present. Signs that a thermal runaway is imminent or has commenced include, but are not limited to the following:
  - (a) Alert warning on the PED screen that the PED has overheated and must be cooled down;
  - (b) Excessive heat when touched;
  - (c) Discoloration or deformation of the display including a rainbow effect;

- (d) Smell of burning plastic;
- (e) Smoke emitting from the PED;
- (f) Sizzling or hissing sounds from the PED;
- (g) Sparks from the PED; and/or
- (h) Loud popping sounds or explosion similar to the sound of a fire cracker.

#### 4.4 Cooling of batteries experiencing thermal runaway

- (1) Cooling battery cells in a PED to limit thermal propagation to adjacent cells is critical to extinguishing a high energy fire, whether prior to thermal runaway or after flames have begun to emit from a device. Current best practices often recommend cooling the cells by dousing the device with water or other non-alcoholic liquids. Dousing with liquid is intended to ensure that the device is saturated internally, which cools the battery cells. However, as more water-resistant devices enter the consumer market, cooling the device with liquids may become more challenging.

**Note:** The use of water under, above, or behind a panel containing electrical wiring or electrical components is not recommended.

#### 4.5 Training environment

- (1) The location used to conduct training is an important component in the effectiveness of the instruction provided. It is recommended that operators tailor training to their operation utilizing the most realistic training environment possible. As an example, the use of a simulator or cabin trainer to conduct high energy fire training would be preferred versus conducting the training in a classroom or with the use of an external firepit. Additionally, training equipment that reflects the requirements of the *Flight Attendant Training Standard* should be used by flight attendants whenever possible.
- (2) When presenting instruction, it is recommended that operators attempt to create a realistic environment. This may include providing a cabin environment that replicates the confines of an aircraft and the location of emergency equipment installed and will allow for realistic communication between flight crew members, flight attendants, and simulated passengers. The introduction of simulated smoke and/or fire during practical training is encouraged as much as possible.
- (3) Static aircraft are also effective training devices. Operators may develop training programs using equipment as a part of practical training on static aircraft. When operators use static aircraft for training, there should be in place an operator procedure to document the use and any temporary removal of safety and/or emergency equipment and ensure that any equipment used is checked for serviceability and re-installed prior to the aircraft being dispatched. Training personnel should be familiar with this process and have a similar process in place to document the removal and return of training equipment.

#### 4.6 Training techniques and scenarios

- (1) Regardless of the environment used, hands-on training and simulated exercises offer a practical experience close to what can be expected in actual occurrences. Therefore, hands-on, and simulated exercises should be integrated into an operator's high energy fire training program. The training equipment criteria reflected in the *Flight Attendant Training Standard* should be similar to the equipment installed within the operators' fleet respective of narrow body and wide body aircraft. Additionally, operators should have equipment placed relative to the position within the aircraft, such as behind the last row of seats or in an overhead bin. This will allow crew members

to utilize the actions and forces necessary to retrieve and operate the equipment. If specific equipment on board the operator's fleet does not have a similar appropriate training device, an operator may need to include alternatives in their training programs outlining those differences to ensure crew members understand the training equipment and equipment installed on the aircraft.

- (2) It is recommended, that operators provide training on combatting high energy fires using simulated exercises representing full context scenarios. This allows crew members to practice the operator procedures and associated crew member communication and coordination skills for working through high energy fire situations.
- (3) Training scenarios will provide crew members with important skills and knowledge to help assess, fight, and mitigate different types and locations of high energy fires. Therefore, it is recommended that operators train crew members on a variety of different high energy fire events. The specific events or scenarios trained should be derived from recent incidents experienced in the aviation industry. If there have been no recent events applicable to an operator's type of operation, the operator should conduct a training scenario that would be applicable to their operations.
- (4) It is further recommended that operators develop training presenting crew members with a variety of scenarios requiring the use of extinguishers from different locations in the aircraft. Operators may also want to conduct training events located on a simulated or static flight deck.
- (5) For both flight deck and passenger compartment training scenarios, hands-on use of any applicable safety and/or emergency equipment should be included in the training event.

#### **4.7 Non-required fire fighting and protective equipment**

- (1) Should an air operator provide fire fighting and protective equipment that is in addition to the requirements of the CARs applicable to the air operator's operation, care should be taken when selecting a product designed to prevent or intended use during high energy fire events. The equipment should provide the crew member with protection from high energy fires and crew members should be provided with training on the use and after care of any additional high energy fire fighting and protective equipment on the aircraft.

#### **4.8 Fire containment bags**

- (1) Operators who have chosen to add fire containment bags and/or fire containment containers as a part of their on-board safety and emergency equipment should be fully aware of all the safety recommendations as well as the manufacturer procedures for use of the product. Operators should remain up to date with current research and guidance by the manufacturers of any unregulated safety and emergency equipment that is on board an aircraft.
- (2) Containment bags with the capability of receiving and holding liquids are preferred as it is critical crew members can reduce the internal temperature of a device.

**Note:** Dependent on the energy in the lithium-ion battery, a standard burn bag may not contain a lithium ion battery fire. Crew members should be aware of the risks associated with the use of a fire containment bag.

#### **4.9 Warnings**

- (1) Crew members should be aware that they are not to attempt to pick up or move a smoking or burning PED as bodily injury may result.
- (2) Crew members should be instructed to not use ice nor cover the device with a blanket or towel to reduce a PED's temperature. Ice or other materials may insulate the PED, which could increase the likelihood that additional battery cells reach the requirements for thermal runaway.



## 5.0 High energy fire fighting practices and procedures

### 5.1 Overview

- (1) The Air Carrier Training Aviation Rulemaking Committee recommends the following as best practices to enhance crew member fire fighting training, with continuous review and improvement through an operator's established processes or procedures. Operators are highly encouraged to collaborate with industry counterparts to compare these best practices to the best evidence-based training related to high energy fires. If sections of training are identified to be missing during these collaborations, it is recommended that an operator adopt and update their training programs in line with current guidance.

### 5.2 Assessing the situation

- (1) Failing or failed device location
  - (a) Passenger compartment:
    - (i) Aisle;
    - (ii) Under a passenger's seat;
    - (iii) If applicable, entrapped in a lay flat seat mechanism;
    - (iv) Overhead bins;
    - (v) Seatback pockets; and
    - (vi) Flight attendant assigned PEDs.
  - (b) Flight deck:
    - (i) Mounted electronic flight bag (EFB);
    - (ii) Stowed EFB; and
    - (iii) Flight crew member personal PED.
- (2) Type of device:
  - (a) Laptop computer;
  - (b) Tablet;
  - (c) Smartphone;
  - (d) Power bank;
  - (e) Electronic cigarette or vape;
  - (f) EFB.
- (3) Device status:
  - (a) Hot to the touch;
  - (b) Smoking;
  - (c) Burning;
  - (d) Visible flame.
- (4) Device orientation; and
- (5) How passengers and/or crew members are responding to the incident.

### **5.3 Fight the fire**

- (1) Clear occupants from the area around the device and reseal as necessary; recognize the potential for a prepared emergency landing and emergency evacuation.
- (2) Don personal protective equipment (PPE).
- (3) Obtain appropriate fire fighting equipment.
- (4) Approach the device with caution and only as close as necessary to effectively extinguish the flames and mitigate smoke generation.
- (5) After extinguishing the device, douse the device with water or other non-alcoholic liquid.
- (6) Ensure, as possible, that water used to cool the batteries is entering the interior of the device.
- (7) Once possible, submerge the device in water if deemed necessary to ensure re-ignition of the fire does not take place.

### **5.4 Precautions**

- (1) Maintain a safe distance from the device while monitoring cool down.
- (2) A safe distance is recommended to be the same safe distance as fighting other on-board fires.
- (3) Continue to use the PPE to minimize risk of injury from unexpected thermal runaway and/or explosion.

### **5.5 High energy fire in the passenger compartment**

- (1) Overhead bin:
  - (a) Exercise caution while conducting a tactile search of the closed bin area to determine the temperature and presence of fire, remembering that the possibility of a flashfire exists;
  - (b) If possible, remove the other baggage from the bin to identify and access the affected baggage and/or item(s);
  - (c) It is not recommended to open the affected baggage when there is any indication of smoke and/or flames;
  - (d) Fight the fire using the operator lithium battery or high energy fire procedures;
  - (e) Move the device as appropriate after a safe time has elapsed, and thermal runaway is no longer a concern;
  - (f) Isolate the device and surrounding area for the remainder of the flight.
- (2) Under a passenger seat or entrapped in an electronically adjustable seat:
  - (a) Assess for smoke and/or fire indications;
  - (b) Fight the fire using the operator lithium battery or high energy fire procedures;
  - (c) Move the device as appropriate after a safe time has elapsed;
  - (d) Isolate the device;
  - (e) Monitor the device and the surrounding area for the remainder of the flight.

### **5.6 High energy fire in the flight deck**

- (1) Assess smoke generation and its effect on visibility.

- (2) If the device is on fire, fight fire using flight deck fire fighting procedures.
- (3) If the device is not on fire or the fire has been extinguished, remove the device from the flight deck, using protective equipment and if applicable, operator procedures to alert flight attendant(s).
- (4) Flight attendant(s) to:
  - (a) fight the fire using lithium battery or high energy fire procedures;
  - (b) move the device if possible;
  - (c) isolate the device; and
  - (d) monitor the device and monitor the surrounding area for the remainder of the flight.
- (5) If the PED/EFB is mounted, there should be applicable operator procedures to mitigate applicable risks.
- (6) Operators should consider any relevant security procedures when opening a flight deck door.

### **5.7 Potential Passenger Reaction**

- (1) Crew members should be aware of potential negative reactions from passengers when surrendering their device.
- (2) Until such time the risk to passengers is apparent or real, a passenger may be apprehensive to surrender their device. Crew members should act quickly to inform the passenger of the reasons why surrendering the device is critical to the safety of the flight.
- (3) As a part of their procedures and training, air operators are encouraged to inform crew members of the best methods of retrieving a device from an apprehensive passenger.

### **5.8 Additional information**

- (1) Specific fire fighting procedures should be developed in conjunction with the aircraft manufacturer's suggestions and be applicable to the operator's operation.
- (2) Operator procedures should include crew member responsibility after landing including post incident procedures.
- (3) It is recommended that approved crew member training programs encompass all possible PED/EFB fire location scenarios.

### **6.0 Document history**

- (1) Not applicable.

## 7.0 Contact us

For more information, please contact:

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**Appendix A — Examples of standard operating procedures and their associated actions for high energy fire events**

(1) **Overview**

- (a) This appendix consists of examples of checklists with details of associated actions for high energy fire events in the passenger compartment during flight involving:
  - (i) PED fire and/or smoke;
  - (ii) overhead bin PED fire and/or smoke;
  - (iii) overheated battery and/or electrical smell involving a PED with no visible fire and/or smoke; and
  - (iv) PED inadvertently crushed or damaged in an electrically adjustable seat.
- (b) Please note that although this guidance provides sequences of tasks, some of these tasks occur simultaneously when carried out by crew members.
- (c) The checklists in this appendix are samples only, and each operator is requested to tailor any applicable checklists to their operator procedures and in accordance with manufacturer’s guidance.

(2) **PED fire and/or smoke checklist**

<b>Portable electronic device (PED) fire and/or smoke checklist</b>	
<b>Step</b>	<b>Crew member action</b>
<b>1</b>	<p><b>Identify the item</b></p> <p>It may not be possible to identify the source of the fire and/or smoke right away if the fire has started in a seat pocket or the device is not readily accessible. In this case, fire fighting procedures should be applied as the first step. If the item is contained in baggage, crew members action would be similar to the actions for a PED that is visible or readily accessible.</p> <p><b>Caution:</b></p> <p>To avoid injury from a flashfire, it is not recommended to open the affected baggage when there is any indication of smoke and/flames. However, in certain situations, crew members may assess and deem it necessary to slightly open the baggage to allow entry of the extinguishing agent and non-flammable liquid. This should be done with extreme caution and only after donning appropriate protective equipment available to crew members on the aircraft.</p>
<b>2</b>	<p><b>Apply operator fire fighting procedures</b></p> <p>Any occurrence concerning a fire in the passenger compartment should be communicated immediately to the pilot-in-command who should be kept informed of all actions taken and the effects of those actions. It is essential that crew members coordinate their actions and that each crew member is fully informed of the other actions and intentions. Appropriate fire fighting and emergency procedures must be used to deal with any in-flight fire. In a multi-flight attendant operation, the actions detailed in the operator’s fire fighting procedures should be conducted simultaneously. On aircraft with only one flight attendant, the aid of a passenger should be sought in dealing with high energy fire situations.</p> <p>Halon, halon replacement, or water extinguishers should be used to extinguish the fire and prevent its spread to additional flammable materials. It is important to wear any available protective equipment.</p>

	<p>If a fire develops, crew members should take prompt action to move passengers away from the area involved, if necessary, provide wet towels or cloths, and give instructions for passengers to breathe through them. Minimizing the spreading of smoke and fumes into the flight deck is critical for the continued safe operation of the aircraft, and therefore it is essential to keep the flight deck door closed at all times, unless otherwise directed by the pilot-in-command. Crew member communication and coordination are a top priority during the fire fighting procedures. The use of the interphone should be the primary means of communication unless the interphone system fails.</p>
<p><b>3</b></p>	<p><b>Remove power</b></p> <p>It is important to instruct the passenger to disconnect the device from the power supply if it is deemed safe to do so. By removing the power supply from the device, it will be assured that additional energy is not being supplied to the device promoting a fire.</p> <p>Turn off the in-seat power to the remaining electrical outlets, until it can be assured that a malfunctioning aircraft system does not contribute to additional failures of additional passenger PEDs connected to the aircraft in-seat power system.</p> <p>Visually check that power to the remaining in-seat electrical outlets remains off until the aircraft's system has been determined to be free of faults if the incident device was plugged into the aircraft's in-seat electrical power system before the incident.</p> <p><b>Caution:</b></p> <p>Do not attempt to remove the battery from the device.</p>
<p><b>4</b></p>	<p><b>Douse the device with water</b></p> <p>Water or other non-flammable liquids must be used to cool a battery that has ignited to prevent the spread of heat to other cells in the battery. If water is not available, any non-flammable liquid may be used to cool the device.</p> <p><b>Notes:</b></p> <p>Liquid may turn to steam when applied to a hot battery or PED.</p> <p>The use of water, under, above, or behind a panel containing electrical wiring or electrical components is not recommended.</p>
<p><b>5</b></p>	<p><b>Monitor for re-ignition</b></p> <p>A battery involved in a thermal runaway can re-ignite and emit flames multiple times as heat is transferred to other cells in the battery. Therefore, the device must be monitored regularly to identify if there is any indication that a fire risk may still exist. If there is any smoke or indication of fire, the device must be doused with more water.</p> <p><b>Caution:</b></p> <p>Do not attempt to pick up or move the device; batteries may explode or burst into flames without warning. The device must not be moved if displaying any of the following: flames, smoke, cracking sounds, debris and/ or shards of material separating from the device.</p> <p>Do not cover or enclose the device as it could cause the cells to overheat.</p> <p>Do not use ice or dry ice to cool the device. Ice or other materials insulate the device increasing the likelihood that additional battery cells will reach thermal runaway.</p>
<p><b>6</b></p>	<p><b>Secure the device</b></p>

	<p>The device may be moved with caution following a certain period of time, once it has cooled down, and if there is no evidence of smoke, heat or if there is a reduction in the crackling or hissing sound. Note: the waiting period may vary based on the device and its size.</p> <p>A suitable empty container, such as a pot, jug, or galley unit must be filled with enough water to completely submerge the device. It is important to wear protective equipment when moving any device following a high energy fire or thermal runaway incident.</p>
<b>7</b>	<p><b>Monitor device</b></p> <p>Monitor the device and surrounding area for the remainder of the flight to verify that the device does not pose a risk.</p>

(3) **Overhead bin PED fire and/or smoke checklist**

<b>Overhead bin portable electronic device fire and/or smoke checklist</b>	
<b>Step</b>	<b>Crew member action</b>
<b>1</b>	<p><b>Identify the item</b></p> <p>It may not be possible to identify the source of the fire and/or smoke right away if the fire has started in a seat pocket or the device is not readily accessible. In this case, fire fighting procedures should be applied as the first step. If the item is contained in baggage, crew members action would be similar to the actions for a PED that is visible or readily accessible.</p> <p><b>Caution:</b></p> <p>In order to avoid injury from a flashfire, it is not recommended to open the affected baggage when there is any indication of smoke and/flames. However, in certain situations, crew members may assess and deem it necessary to slightly open the baggage to allow entry of the extinguishing agent and non-flammable liquid. This should be done with extreme caution and only after donning appropriate protective equipment available to crew members on the aircraft.</p>
<b>2</b>	<p><b>Apply fire fighting procedures</b></p> <p>Any occurrence concerning a fire in the passenger compartment should be communicated immediately to the pilot-in-command who should be kept informed of all actions taken and the effects of those actions. It is essential that flight attendants and flight crew members coordinate their actions and that each crew member is fully informed of the other actions and intentions. Appropriate fire fighting and emergency procedures must be used to deal with any in-flight fire. In a multi-flight attendant operation, the actions detailed in the operator's fire fighting procedures should be conducted simultaneously. On aircraft with only one flight attendant, the aid of a passenger should be sought in dealing with high energy fire situations.</p> <p>Halon, halon replacement or water extinguishers should be used to extinguish the fire and prevent its spread to additional flammable materials. It is important to wear any available protective equipment.</p> <p>If a fire develops, crew members should take prompt action to move passengers away from the area involved, if necessary, provide wet towels or cloths, and give instructions for passengers to breathe through them. Minimizing the spreading of smoke and fumes into the flight deck is critical for the continued safe operation of the aircraft, and therefore it is essential to keep the flight deck door closed at all times, unless otherwise directed by the pilot-in-command. Crew</p>

	<p>member communication and coordination are a top priority during the fire fighting procedures. The use of the interphone should be the primary means of communication unless the interphone system fails.</p>
<b>3</b>	<p><b>Douse the device with water</b></p> <p>Water or other non-flammable liquids must be used to cool a battery that has ignited to prevent the spread of heat to other cells in the battery. If water is not available, any non-flammable liquid may be used to cool the device.</p> <p><b>Note:</b></p> <p>Liquid may turn to steam when applied to a hot battery or PED.</p>
<b>4</b>	<p><b>Secure the device</b></p> <p>The device should be moved from the overhead bin to prevent a hidden fire from developing. The device may be moved with caution following a certain period of time, once it has cooled down, and if there is no evidence of smoke, heat or if there is a reduction in the crackling or hissing sound. While this time frame is approximately 10-15 minutes the waiting period may vary based on the device and its size.</p> <p>A suitable empty container, such as a pot, jug, or galley unit must be filled with enough water to completely submerge the device. It is important to wear protective equipment when moving any device following a high energy fire or thermal runaway incident.</p>
<b>5</b>	<p><b>Monitor device</b></p> <p>Monitor the device and surrounding area for the remainder of the flight to verify that the device does not pose a risk.</p>

(4) **Overheated PED and/or electrical smell checklist**

<b>Overheated portable electronic device and/or electrical smell</b>	
<b>Step</b>	<b>Crew member action</b>
<b>1</b>	<p><b>Identify the item</b></p> <p>Identify the source of overheat or electrical smell. Ask the passenger concerned to identify the item.</p>
<b>2</b>	<p><b>Instruct passenger to turn off PED</b></p> <p>Instruct the passenger to turn off the device immediately.</p>
<b>3</b>	<p><b>Remove power</b></p> <p>It is important to instruct the passenger to disconnect the device from the power supply if it is deemed safe to do so. By removing the power supply from the device, it will be assured that additional energy is not being supplied to the device promoting a fire.</p>



	<p>Turn off the in-seat power to the remaining electrical outlets, until it can be assured that a malfunctioning aircraft system does not contribute to additional failures of additional passenger PEDs connected to the aircraft in-seat power system.</p> <p>Visually check that power to the remaining in-seat electrical outlets remains off until the aircraft's system has been determined to be free of faults if the incident device was plugged into the aircraft's in-seat electrical power system before the incident.</p> <p><b>Caution:</b></p> <p>Do not attempt to remove the battery from the device.</p>
<b>4</b>	<p><b>Monitor device</b></p> <p>The device must remain visible, and not stowed, and should be monitored closely. Unstable batteries may ignite due to thermal runaway even after the device is turned off.</p>
<b>5</b>	<p><b>Thermal runaway</b></p> <p>If smoke or flames appear apply PED fire and/or smoke checklist.</p>

(5) **PED inadvertently crushed or damaged in electrically adjustable seat**

<b>Portable electronic device inadvertently crushed or damaged in electrically adjustable seat checklist</b>	
<b>Step</b>	<b>Crew member action</b>
<b>1</b>	<p><b>Notify the pilot-in-command</b></p> <p>Any occurrence concerning a risk to flight safety in the passenger compartment should be communicated immediately to the pilot-in-command who should be kept well informed of all actions taken and the effects of those actions. It is essential that crew members coordinate their actions and that each crew member is fully informed of the other actions and intentions.</p>
<b>2</b>	<p><b>Obtain information from passenger</b></p> <p>Ask the passenger concerned to identify the item and where they suspect the PED may be within the seat, and if the seat has been moved since misplacing the item.</p>
<b>3</b>	<p><b>Retrieve device</b></p> <p>If possible, flight attendants should try to remove the device from the seat while wearing protective equipment.</p> <p>To prevent crushing of the PED and to reduce the potential fire risk to the PED and the surrounding area, flight attendants and/or passengers must not use the electrical or mechanical seat functions in an attempt to retrieve the item. Move passengers as required to facilitate the search. Do not move the seat. If a flight attendant is unable to retrieve the PED it may be necessary to move the passenger.</p>
<b>4</b>	<p><b>If smoke or flames appear</b></p> <p>If smoke or flames appear apply PED fire and/or smoke checklist.</p>

## Appendix B — High energy fire checklist examples

(1) **Overview**

- (a) The checklists in this appendix are samples only, and each operator is requested to tailor any applicable checklists to their operator procedures and in accordance with manufacturer’s guidance.

(2) **PED smoke checklist**

<b>Portable electronic device smoke checklist</b>	
Flight deck/flight attendant communication.....	Established
Crew member portable breathing equipment.....	Retrieve
Fire extinguisher.....	Retrieve
Remove power.....	Check
Douse with water.....	Check
Monitor device.....	Check
<p>■ If the PED begins to emit flames or visible signs of thermal runaway, begin <b>PED fire fighting checklist</b></p>	

(3) **PED fire checklist**

<b>Portable electronic device fire checklist</b>	
<p><b>Warning</b></p> <ul style="list-style-type: none"> <li>- Do not attempt to pick up and move a smoking or burning device.</li> <li>- Do not cover device or use ice to cool down the device. Ice or other materials insulate the device increasing the likelihood of thermal runaway</li> </ul>	
<p>■ Flames present</p>	
Flight deck/flight attendant communication.....	Established
Fire fighting equipment.....	Retrieve
Fire extinguisher.....	Discharge
<p>■ Flames suppressed</p>	
Douse with water.....	Check
PED stowage procedures.....	Apply

(4) **Overhead bin smoke and/or fire checklist**

<b>Overhead bin smoke and/or fire checklist</b>	
<p>■ Smoke and/or flames emitted from overhead bin</p> <p>Flight deck/flight attendant communication.....Established</p> <p>Fire fighting equipment.....Retrieve</p> <p>Fire extinguisher.....Retrieve</p> <p>Water.....Retrieve</p> <p>Passengers.....Relocate</p> <p>Overhead bin.....Tactile check</p> <p>Overhead bin.....Open Slightly</p> <p>Fire extinguisher.....Discharge</p> <p><b>Note:</b> the fire extinguisher must be discharged into the overhead bin, away from seats to prevent debris from contaminating the cabin.</p> <p>Overhead bin.....Close and latch</p> <p>Fire fighting procedures.....Repeat as required</p> <p>■ Smoke and/or flames suppressed</p> <p>Overhead bin.....Check source of fire</p> <p>Water.....Douse on device</p> <p>Overhead bin.....Remove remaining items</p> <p>PED stowage procedures.....Apply</p>	
<p><b>Caution</b></p> <ul style="list-style-type: none"> <li>- Opening the overhead bin more than necessary can cause contamination of the cabin with smoke and result in smoke inhalation.</li> <li>- Be mindful of the risk of a flashfire while opening an overhead bin.</li> </ul>	

(5) **PED stowage checklist**

<b>Portable electronic device stowage checklist</b>	
<p>■ Once the PED can be safely moved</p> <p>Fire fighting equipment.....Retrieve</p> <p>Stowage receptacle.....Retrieve</p> <p>Stowage receptacle.....Fill with water</p> <p>Lavatory.....Mark as inoperative</p> <p>Device.....Place in receptacle</p> <p>Flight deck/flight attendant communication.....Completed</p> <p>■ Once device is safely in the stowage receptacle, place receptacle in marked inoperative lavatory.</p>	
<p style="text-align: center;"><b>Caution</b></p> <ul style="list-style-type: none"><li>- The affected lavatory must be regularly monitored for the remainder of the flight to ensure that the device remains immersed.</li><li>- The affected lavatory must be regularly monitored for the remainder of the flight to ensure the device is free of re-ignition.</li></ul>	