
	POLK COUNTY FIRE RESCUE	STANDARD OPERATING GUIDELINES
	Operation Order Number: 646	Revised:
	Subject: Lithium-Ion Mobility Device Fires	Next Revision: Lexipol 2024
	Associated Directives:	Page: 1 of 6
Application:	Accreditation Standards:	Authorized By:  <small>Hezedeane Smith Jun 19, 2024 15:13 EDT</small> Dr. Hezedeane Smith, Fire Chief

PURPOSE

To describe the hazards associated with Lithium-Ion Batteries in Mobility Devices and address size-up, operational awareness and procedures. Most importantly, the bulletin is intended to help assess the degree of risk present with fires involving lithium-ion batteries.

646.1 BACKGROUND

- A. Lithium-Ion (Li-ion) batteries are becoming more prevalent in consumer products ranging in size from smaller products such as mobility devices up to and including use in large-scale power grid support. These smaller devices are being used in everyday applications by the public and are consequently being stored, charged, sold or repaired inside residential and commercial occupancies.
- B. Fires involving lithium-ion batteries have been increasing at an alarming rate and have resulted in fatalities. Even when the initial cause of a fire was not the lithium-ion device, the involvement of lithium-ion batteries in a fire can increase the intensity of the fire.
- C. Lithium-Ion batteries are commonly used in mobility devices which include:
 - (1) Electric Bikes (Figure 1)
 - (2) Scooters (Figure 2A and 2B)
 - (3) Hoverboards
 - (4) Wheelchairs




Figure 1



Figure 2A



Figure 2B

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646.2 CONSTRUCTION

- A. Battery cells - the most common is the 18650 cell which is cylindrical (left) and slightly larger than an AA battery (right). (Figure 3)



Figure 3


- B. Battery Pack (Module) - is a group of battery cells connected in a series or parallel configuration. (Figure 4A and 4B)



Figure 4A

Figure 4B

- C. Battery Packs may be permanently installed or removable from the mobility device. They are located externally on the frame, floorboard (Figure 5A and 5B) or rear rack of the mobility device but can be found internally on some devices. An internal mount is common when the mobility device is foldable (Figure 6). The mobility device in the closed (folded) position may give direct access to the lithium-ion battery pack.

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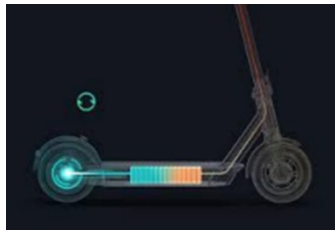


Figure 5A



Figure 6B



Figure 6


646.3 HAZARDS

- A. Batteries may rupture and vent toxic flammable gases and/or explode violently when the gases ignite, when subject to the following:
- (1) Thermal – Hot or Cold temperatures.
 - (2) Physical – Impacted, crushed, or pierced.
 - (3) Electrical – Overcharging or forced discharge, including internal manufacturing defects or internal short circuiting.
 - (4) Drying after being wet.

- B. It may be difficult to discern if a lithium-ion battery pack or cell is compromised; the resulting heat signatures may not be picked up by a Thermal Imaging Camera (TIC).

Note: A thermal imaging camera shall not be relied upon to determine if a Lithium-Ion battery pack or cell is compromised.

- C. Thermal Runaway. When the stable state of batteries/cells rapidly fails due to increased heat from charging or external conditions such as fire, the cell transitions from a stable state to an unstable state and then to catastrophic failure of the cell. Once thermal runaway begins it will propagate (spread, domino effect) to the adjacent battery cells. It may only take seconds for this dangerous event to take place.
- (1) Usually there is a “pop” or rupture sound heard preceding Thermal Runaway with pressurized white smoke (flammable / toxic gases) venting moments prior to ignition.

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(2) Water may not prevent a battery from entering thermal runaway. If able to penetrate the battery case, water may provide a cooling effect on the adjacent battery cells. This cooling may reduce propagation to other cells.

(3) Dry Chemical is ineffective for any type of lithium-ion related extinguishment.

D. Flammable and Toxic Gases. Lithium-Ion batteries in thermal runaway produce many different gases. These gases combine to form a flammable, explosive and toxic atmosphere. Toxicity and flammability levels vary depending on specific battery technology and manufacturer.

E. Unexpected Re-ignition. Lithium-Ion Batteries are known to unexpectedly re-ignite (with no warning) minutes, hours or even days after all visible fire has been extinguished. Reignition is a common occurrence and should be expected.

F. Explosive force. As noted in several incidents across the nation, lithium-ion batteries have ruptured and ignited with such force that walls were blown down resulting in structural damage and extensive fire spread.

646.4 OPERATIONS:


A. Use a handline to extinguish the fire; flames from a Lithium-Ion Battery should be knocked down with copious amounts of water. Water application should continue until conditions are dormant; that is when no more flame, gas or smoke is being released from the battery or mobility device.

B. Li-Ion Batteries or mobility devices which are involved in fire, found within a fire area, or subjected to elevated temperatures MUST be moved from the area in which personnel will be operating. This should be accomplished before overhaul operations begin.

C. When a Lithium-Ion Battery or mobility device fire involves a serious injury, fatality, or potential crime, all personnel operating should be aware of the need for scene preservation prior to the arrival of fire investigators and law enforcement.


D. When possible, prior to overhaul in the area of the lithium-ion battery or mobility device, personnel should conduct a diligent search for stray battery cells. These individual cells may have become dislodged from the battery pack during the fire or by the hose stream during extinguishment.

(1) When crews are removing damaged or potentially damaged batteries of any sort,

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the firefighter carrying the batteries should be in full PPE with SCBA and another firefighter should have a CO2 fire extinguisher at the ready due to the volatility and the quickness at which the batteries can change.

- (2) Firefighters must not place the lithium-ion battery pack or cells in the pocket of their bunker coat or pants.
 - (3) When possible, personnel should move the lithium-ion batteries by use of a non-conductive tool (i.e. a shovel with a wooden handle) or other method that doesn't require firefighters to carry in their hands.
- E. The batteries or mobility device should be moved to the following location in order of preference until it can be appropriately over packed/mitigated by Hazmat:
- (1) Outside the structure away from firefighting operations.
 - (a) Assessment of the safety of this operation, particularly when operating in an above ground floor, should be made by supervisors on site and in consult with Hazmat as needed.
 - (2) Bathroom tub or sink large enough that all cells can be fully submerged in water.
 - (3) Garbage pail or bucket large enough that all cells are capable of being fully submerged in water.
- F. When the above options are not practical, the Incident Commander may order the removal of the batteries or mobility device via a fire apartment window.
- G. When the battery or mobility device is in a location that makes removal via fire apartment window not practical, such as in an upper story apartment in a high-rise, the Incident Commander may order moving the batteries or mobility device to a different location on the fire floor and ensure the batteries are protected by a charged hose line. The charged hose line should remain in place until overpacking/mitigation procedures have been completed.
- H. A lithium-ion battery or mobility device shall NOT be moved in an elevator or via stairs unless approved by the IC.

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646.5 SAFETY

- A. Full PPE with a donned facepiece should be worn when handling lithium-ion batteries or mobility devices that have been involved in fire, or subjected to elevated temperatures, or have evidence of physical damage (impacted, crushed, or pierced). Due to the rapid re-ignition danger when involved in fire or subjected to elevated temperatures, full PPE with a donned facepiece should always also be worn during the following:
- (1) Whenever personnel are operating in the immediate area / same room.
 - (2) When handling or removing batteries from an area to the bathtub, sink, or bucket.
 - (3) When securing a mobility device with a rope for removal via window.

646.6 INCIDENT COMMAND CONSIDERATIONS

- A. Hazmat should be considered for any fire or incident involving a lithium-ion battery or mobility device suspected of being powered by a lithium-ion battery.
- B. A charged handline should remain ready until over packing and/or mitigation procedures have been completed.






SOG 646 Lithium-Ion Mobility Device Fires

Final Audit Report

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