



FIRE TACTICS AND PROCEDURES HAZARDOUS MATERIALS 20 April 19, 2022

LITHIUM-ION BATTERY MOBILITY DEVICE FIRES

1. PURPOSE

- 1.1 This bulletin describes the hazards associated with Lithium-Ion Batteries in Mobility Devices and addresses 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.

2. BACKGROUND

- 2.1 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.
- 2.2 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.
- 2.3 Lithium-Ion batteries are commonly used in mobility devices which include:
- 2.3.1 Electric Bikes (Figure 1)
 - 2.3.2 Scooters (Figure 2A and 2B)
 - 2.3.3 Hoverboards
 - 2.3.4 Wheelchairs



Figure 1



Figure 2A



Figure 2B

3. CONSTRUCTION

- 3.1 **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

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

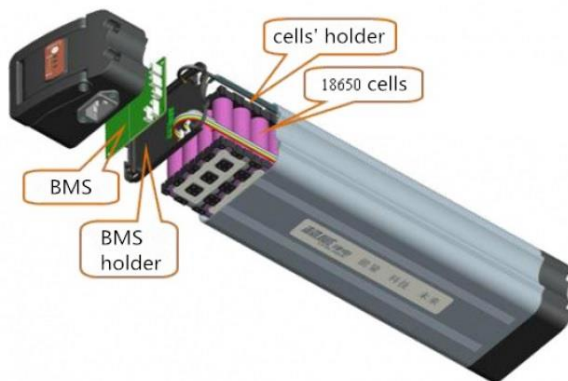


Figure 4A



Figure 4B

- 3.3 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.

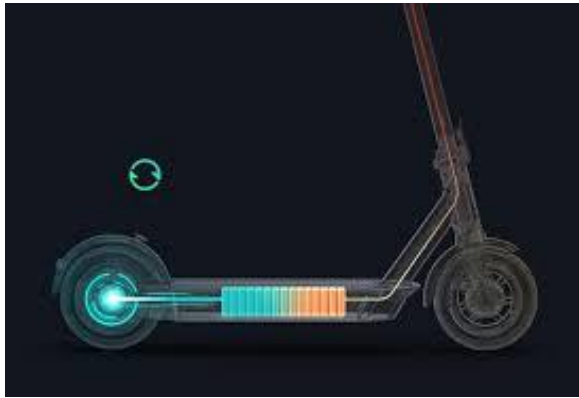


Figure 5A



Figure 5B



Figure 6

4. HAZARDS

- 4.1 Batteries may rupture and vent toxic flammable gases and/or explode violently when the gases ignite, when subject to the following:
 - 4.1.1 Thermal – Hot or Cold temperatures.
 - 4.1.2 Physical – Impacted, crushed, or pierced.
 - 4.1.3 Electrical – Over-charging or forced discharge, including internal manufacturing defects or internal short circuiting.
 - 4.1.4 Drying after being wet.
- 4.2 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.
- 4.3 *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.
 - 4.3.1 Usually there is a “pop” or rupture sound heard proceeding Thermal Runaway with pressurized white smoke (flammable / toxic gases) venting moments prior to ignition.
 - 4.3.2 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.
 - 4.3.3 Dry Chemical is ineffective for any type of lithium-ion related extinguishment.
- 4.4 *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.
- 4.4 *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 has happened at fires here in New York City.

- 4.5 *Explosive force.* On more than one occasion in NYC, lithium-ion batteries ruptured and ignited with such force that walls were blown down resulting in structural damage and extensive fire spread.

5. OPERATIONS

Whenever the following procedures take place, a charged handline must be in position.

- 5.1 Lithium-ion batteries or mobility devices involved in fire:
- 5.1.1 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.
- 5.2 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 members will be operating. This should be accomplished before overhaul operations begin.
- 5.3 When a Lithium-Ion Battery or mobility device fire involves a 10-45 (any code) all members operating should be aware of the need for scene preservation prior to the arrival of the Fire Marshals.
- 5.4 When possible, prior to overhaul in the area of the lithium-ion battery or mobility device, members 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.
- 5.4.1 Firefighters must not place the lithium-ion battery pack or cells in the pocket of their bunker coat or pants.
 - 5.4.2 When possible, members should move the lithium-ion batteries by use of a non-conductive tool, a shovel with a wooden handle or other method that doesn't require members to carry in their hands.
- 5.5 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 Haz Mat Company 1 or a Haz Mat Tech Unit:
- 5.5.1 Bathroom tub in fire apartment, with all cells fully submerged in water.
 - 5.5.2 Sink large enough that all cells can be fully submerged in water.
 - 5.5.3 Garbage pail or bucket large enough that all cells are capable of being fully submerged in water.

- 5.6 When the above options are not practical, the Incident Commander may remove the batteries or mobility device via a fire apartment window.
- 5.7 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 building, the Incident Commander may move the batteries or mobility device to a different location on the fire floor and ensure the batteries are protected by a charged hoseline. The charged hoseline will remain in place until overpacking/mitigation procedures have been completed by a Haz Tech Unit.
- 5.8 A lithium-ion battery or mobility device shall NOT be moved in an elevator or via stairs unless overpacked (mitigated) by Haz Mat Technicians and approved by the IC.

6. SAFETY

- 6.1 Full PPE with a donned facepiece must be worn at all times with lithium-ion batteries or mobility devices that have been involved in fire or subjected to elevated temperatures. Due to the rapid re-ignition danger when involved in fire or subjected to elevated temperatures, full PPE with a donned facepiece must also be worn at all times during the following:
 - 6.1.1 Whenever members are operating in the immediate area / same room.
 - 6.1.2 When handling or removing from an area to the bathtub, sink or bucket.
 - 6.1.3 When securing a mobility device with a rope for removal via window.
 - 6.1.4 Physical damage (impacted, crushed or pierced) to the Mobility Device or Battery.

7. INCIDENT COMMAND CONSIDERATIONS

- 7.1 Haz Mat Company 1 and a Haz Mat Tech Unit (HMTU) shall be special called to any fire or incident involving a lithium-ion battery or mobility device suspected of being powered by a lithium-ion battery.
- 7.2 A charged handline shall remain ready until Haz Mat units have completed over packing and mitigation procedures.
- 7.3 The determination by the IC to establish a watch line for the over-packed batteries, while awaiting removal, should be determined at the IC's discretion and the guidance of Haz Mat Units. Consider the occupancy, access by pedestrians, given ETA of DSNY and whether it's a high-profile location vs. the impact on unit availability.

- 7.4 Haz Mat units will be responsible to notify Department of Sanitation (DSNY) for final removal from the scene. DSNY-EPU (Environmental Police Unit) will pick up the battery in the overpacked drums the next business day (except holidays). When the IC and HAZMAT Battalion determine the overpacked drum (s) should not be left unattended (e.g. High-profile area, school), FDNY can request an emergency pickup by DSNY-EPU. When an emergency pickup is requested, the IC must have an Engine Company remain at the scene awaiting arrival of DSNY-EPU. The HAZMAT Battalion / IC should request an ETA from DSNY.

BY ORDER OF THE FIRE COMMISSIONER AND CHIEF OF DEPARTMENT