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LITHIUM-ION BATTERY GUIDELINES

These guidelines provide requirements for lithium-ion (Li-ion) and lithium polymer (LiPo) cells and battery packs. These guidelines are established to ensure faculty, staff, and students know proper disposal requirements and protective measures necessary to prevent fires and explosions associated with these types of batteries.

Recreational vehicles (hover boards, skateboards, scooters, motor assisted pedal bicycles, remote controlled vehicles, etc.) are not permitted in university buildings, unless part of an approved University operation, as a requirement for an individual's mobility assistance, or as part of a faculty-directed academic or research activity.

1. APPLICATION AND HAZARD DESCRIPTION

- 1.1. Li-ion batteries are typically used for laptop computers, cell phones, and hand tools. LiPo batteries are used for recreational vehicles such as hover boards, skateboards, scooters, motor-assisted pedal bicycles, remote controlled vehicles, and delivery devices. These battery types require similar storage, use and charging procedures.
- 1.2. Li-ion and LiPo batteries represent risks due to their high energy density and the presence of a flammable electrolyte. There have been numerous incidents at universities and other establishments involving Li-ion and LiPo batteries. Most incidents were caused by extended charging times; unattended charging; incompatible chargers; and/or use of poorly manufactured batteries, improper connections, and use of damaged batteries.
- 1.3. Proper lithium-ion battery storage is very important for maintaining battery performance and reducing the risk of fire and/or explosion. Incidents regarding lithium-ion battery fires have been reported due to inadequate storage areas or conditions. Spontaneous fires involving these batteries are rare, but an internal short circuit can start a series of reactions that may lead to a fire. Other factors that pose a higher risk of fire in a storage area include the temperature, state-of-charge, and length of storage period.
- 1.4. Battery overheating may be caused by electrical shorting, rapid discharge, overcharging, manufacturer defects, poor design, or mechanical damage.
- 1.5. An exploded battery can result when overheated or mechanically damaged. In the event of an explosion involving a lithium-ion battery, the room can fill quickly with dense white smoke that can cause severe irritation of the respiratory tract, eyes, and skin.

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2. GENERAL GUIDELINES AND PRECAUTIONS

- 2.1. Operation, storage and recharging of recreational type vehicles with lithium-ion/LiPo batteries (hoover boards, skateboards, scooters), remote controlled vehicles or devices, are not permitted inside university buildings.
- 2.2. Exterior storage of these devices should not block or restrict egress paths and entrance/exit doors.
- 2.3. Li-ion and LiPo batteries must be UL-Certified and purchased from a reputable manufacturer
- 2.4. Follow all safety instructions provided by the manufacturer.
- 2.5. Never burn, overheat, disassemble, solder, puncture, crush or otherwise mutilate battery packs or cells.
- 2.6. Keep batteries away from water.
- 2.7. Do not touch terminals.
- 2.8. Do not mix different types of batteries during use and recharging.
- 2.9. Avoid hot and humid conditions (e.g., steam sources, ovens, furnaces and other heat producing equipment). Do not place batteries in direct sunlight, on hot surfaces or in hot locations.
- 2.10. Inspect batteries for any signs of damage before use.
- 2.11. Immediately disconnect the batteries if, during operation or charging, the batteries become overheated. emit an unusual smell/odor; or change shape/geometry.
- 2.12. Lithium-ion batteries with voltages over 50 V present risk of electrical shock and arcing. Follow applicable electrical protection standards including OSHA, NEC 70, NFPA 70E, and focus on terminal protection, shielding, and PPE to avoid exposure to electrical hazards
- 2.13. If batteries are being offered for transport, See EH&S Guideline 03-027 - Lithium Battery-Cell Shipping.

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3. BATTERY CHARGING

- 3.1. The Lithium-ion battery packs found in laptops and similar devices contain a Battery Management System (BMS) that controls the charging process. Use only the supplied charging cable and AC adapter from the manufacturer. Do not use if there are any signs of damage to the charger or power cord.
- 3.2. Follow all manufacturer recommendations for use of the charger.
- 3.3. Chargers should be plugged directly into wall receptacles without the use of extension cords.
- 3.4. Consider charging these devices when they can be observed or constantly attended. Monitor for any unusual conditions.
- 3.5. Keep the batteries and chargers away from heat and ignition sources.

4. STORAGE OF BATTERIES FOR APPROVED UNIVERSITY OPERATIONS

- 4.1. Lithium-ion batteries should be stored in a cool, dry, well-ventilated area in fire-resistant containers (e.g., metal cabinets, fire safe bags).
- 4.2. The storage area should be maintained clear of any flammable or combustible materials such as cardboard, paper products, wood, carpet and flammable liquids and gases.
- 4.3. The storage should be in room/area provided with smoke detection connected to the buildings fire alarm system.
- 4.4. It is recommended that the storage room/area is protected by an automatic sprinkler system
- 4.5. A Class ABC or CO2 fire extinguisher should be provided at the entrance to the storage room/area.
- 4.6. Remove the li-ion/ LiPo battery from a device when the device is not being used.
- 4.7. When using Lithium-ion/LiPo battery packs, they should be stored at 60-70% of the pack's rated capacity. Lithium-ion cells should never be stored fully charged with suggested voltage of approximately 3.8V. Most chargers have a "storage mode" that will either charge or discharge the cell to the proper storage voltage. Placing the cells in storage mode after every use can lengthen the life span.
- 4.8. Batteries should not be stored in direct contact with each other.
- 4.9. Protect the cell terminals with electrical insulating material.

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5. FACULTY DIRECTED RESEARCH

- 5.1. Prior to conducting research, review the battery manufacturer's Safety Data Sheet (SDS), Technical Specification sheet(s) and/or other safety documents.
- 5.2. Perform a hazard analysis to understand the various failure modes and hazards associated with the proposed configuration and type(s) and number of batteries used.
- 5.3. Ensure that written standard operating procedures (SOPs) for lithium-ion and LiPo powered research devices are developed and include methods to safely mitigate possible battery failures.
- 5.4. The following battery charging guidelines apply, in addition to those listed above:
 - 5.4.1. Batteries must only be charged with a charger or charging method designed to safely charge cells or battery packs at the specified parameters. Verify correct voltage and current charger settings for the battery pack being charged.
 - 5.4.2. The battery pack should be constantly attended during charging and periodically checked for any signs of battery or charger distress, output levels and balancing effectiveness.
 - 5.4.3. For series packs, always balance charge with a charger capable of monitoring the condition of individual cells to prevent individual cells being overcharged. The charger and battery should be put on a heat-resistant, noncombustible, and nonconductive surface. Fire-safe containers designed for Lithium-ion batteries should be used. Never place batteries or chargers on a carpet or similar surface.
 - 5.4.4. Keep all combustible and flammable materials away from operating area.
 - 5.4.5. Do not overcharge (greater than 4.2V for most batteries) or over-discharge (below 3V) batteries.
 - 5.4.6. Make sure that batteries do not exceed the manufacturers recommended operating temperatures during charging or discharging. Avoid charging a battery that is still warm from use or using a battery that is still warm from charging.
 - 5.4.7. Never parallel charge. Chargers cannot monitor the current of individual cells and voltage balancing which can result in high amperage, battery damage and heat generation that leads to a fire or explosion.
 - 5.4.8. Charge and store batteries in a fire-retardant container such as a high-quality Lithium battery safety bag.
 - 5.4.9. Do not leave batteries connected to chargers after charging is complete (see storage section).

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5.5. At the conclusion of testing the battery assemblies are disposed of properly or left in a safe condition for storage.

6. EMERGENCY PROCEDURES

6.1. DAMAGED BATTERIES

6.1.1. Disconnect damaged batteries if safe to do. Wear gloves, goggles/safety glasses and lab coat (if available). Place the damaged battery in a safe location free from combustible materials. Damaged batteries may be placed in a metal can with sand in the bottom to provide insulation.

6.1.2. Contact EH&S (412-624-9505).

6.1.3. Even though there may be no visible damage, the battery should be promptly discharged as a delayed fire can occur hours or days after impact/accident.

6.2. OVERHEATING, VENTING AND LEAKING CELLS

6.2.1. In the event of an overheated cell, disconnect the charger.

6.2.2. If a cell is venting or smoking, evacuate all personnel from the area.

6.2.3. Call 412- 624-2121.

6.2.4. Do not handle the cell until it reaches room temperature.

6.2.5. Once the cell reaches room temperature, contact EH&S (412-624-9505)

6.3. EXPLODED CELL

6.3.1. In the event of an exploded cell, evacuate all personnel from the area. The area should be secured to ensure that no unnecessary personnel enter.

6.3.2. Call 412- 624-2121.

6.3.3. Contact EH&S for assistance in removal of the damaged battery cell as hazardous waste.

6.4. LITHIUM-ION BATTERY FIRES

In the event of a lithium battery fire or explosion, evacuate the area and call 412-624-2121. Follow EH&S Guideline Number 02-001 - Fire and Emergency Evacuation Procedures.

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FIRST AID PROCEDURES FOR CONTACT WITH ELECTROLYTE

While the electrolyte composition will vary depending on the type of the battery cell, the general first aid procedures are the same for an exposure to the electrolyte.

EYES -- Immediately flush eyes with a direct stream of water for at least 15 minutes while forcibly holding eyelids apart to ensure complete irrigation of all eye and lid tissue. Have someone call 412-624-2121 to request medical attention.

SKIN -- Flush with cool water or get under a shower. Remove contaminated garments. Continue to flush for at least 15 minutes. Call 412-624-2121 to request medical attention.

INHALATION -- Move to fresh air. Monitor airway breathing. If breathing is difficult, GET EMERGENCY MEDICAL ATTENTION IMMEDIATELY.