Lithium Battery Safety Program

Purpose

The purpose of the Lithium Battery Safety Program is to provide guidelines concerning the safe handling and use of lithium batteries at Wentworth Institute of Technology (Wentworth), which are regulated by International Air Transport Association (IATA), U.S. Department of Transportation (DOT), U.S. Environmental Protection Agency (EPA) and generally under the U.S. Occupational Safety and Health Administration (OSHA) Hazard Communication Standard.

Lithium batteries present both physical and potential chemical health hazards. It is important that lithium batteries be handled properly during all procedures, locations, and activities at Wentworth. This Program provides Wentworth employees and students with guidelines for the safe storage and disposal of lithium-based batteries and proper emergency response procedures. This document has been created to help protect Wentworth employees and students and ensure that batteries are handled and disposed of in a safe manner.

Responsibilities

This program has been developed in accordance with the requirements of OSHA Title 29 Code of Federal Regulations (CFR) Section 1910.1200, EPA 40 CFR 273, and DOT 49 CFR 173.185 and covers each of the basic elements in the regulations. All Wentworth employees and students have the authority to stop any unsafe act or condition if it is being performed in a hazardous manner. If an employee or a student believes that they are being asked to perform a task in an unsafe environment, that employee or student is authorized to decline the request. Employees or students are encouraged to communicate all health and safety concerns to their Department Head/Supervisor. Additionally, Department Heads/Supervisors have authority to halt operations whenever activities are non-compliant with the provisions of this plan. It is the responsibility of Department Heads/Supervisors to inspect project areas to ensure compliance with this plan.

Department Heads and Supervisors

Department Heads and Supervisors who oversee laboratories containing or handling lithium batteries are responsible for:

- Implementation of applicable guidelines of this program.
- Reviewing and maintaining the battery in accordance with the manufacturer's technical specifications and safety information (including the safety data sheet, if applicable) for each battery.
- Educating all users of lithium batteries within their department on the proper usage, potential hazards, and emergency response procedures as described in this program.
- If beyond the scope of this program, developing a task-specific standard operating procedure that detail safe work practices related to specific lithium battery tasks or applications.
- Ensuring lithium batteries, chargers, and associated equipment are tested in accordance with an appropriate test standard (e.g., UL 2054) and, where applicable, certified by a National Recognized Testing Laboratory (NRTL) and are rated for their intended uses.

NOTE: Recognizes private sector organizations to perform certification for certain products to ensure that they meet the requirements of both the construction and general industry OSHA electrical standards. Each NRTL has a scope of test standards that they are recognized for, and each NRTL uses its own unique registered certification mark(s) to designate product conformance to the applicable product safety test standards.

Wentworth Employees and Students

Wentworth employees and students that handle and work with lithium batteries are responsible for the following, which are further discussed in the other sections of this Program:

- Handling lithium batteries in accordance with this program, the Department-specific standard operating procedures, and manufacturer instructions for use.
- Obtaining the appropriate training, if applicable.
- Only handling lithium batteries after receiving Department Head/Supervisor's approval.
- Knowing the emergency response procedures if a battery were to ignite.
- Ensuring lithium batteries are stored in accordance with this program.

Background

General

Lithium batteries are typically safe; however, if damaged or used without proper care they can overheat, ignite, and become very difficult to extinguish. Even though

there is a low probability, lithium batteries should be handled as if they can ignite at any moment.

There are two categories of these batteries that pose different hazards:

- Primary (non-rechargeable) lithium batteries are comprised of single-use cells containing metallic lithium anodes. These types of batteries are used up to capacity and then are typically discarded.
- Secondary (rechargeable) lithium batteries are comprised of rechargeable cells containing an intercalated lithium compound for the anode and cathode. Rechargeable lithium batteries are commonly referred to as “lithium-ion” batteries.

Lithium vs. Lithium-Polymer Batteries

The difference between lithium-ion and lithium-polymer batteries is the type of electrolyte used. Lithium-polymer batteries contain a micro porous gel electrolyte instead of a porous separator as found in lithium-ion. Standard lithium batteries require a rigid case to press the electrodes together whereas lithium-polymer batteries use laminated sheets that do not need compression. Lithium-ion batteries are commonly used at Wentworth while lithium-polymer batteries are not.

OSHA Nationally Recognized Testing Laboratory Program

Testing batteries, chargers, and associated equipment in accordance with an appropriate test standard (e.g., UL 2054), NRTL certification (where applicable), and product recalls help identify defects in design, manufacturing, and material quality.

If a UL2054 or NRTL tested battery or battery pack is at any time disassembled, attached to another battery, opened, or modified in any way, it is no longer considered safe.

UN Certified versus Non-Certified Batteries

The United Nations (UN) 38.3 certification process includes a combination of significant environmental, mechanical, and electrical stress tests designed to assess lithium batteries' ability to withstand the anticipated rigors incurred during transport. A battery that does not have this certification, also referred to as a prototype battery, can present an elevated risk, specifically of combustion. For these reasons, there should be significant differences in the handling, transportation, and storage of these prototype batteries and they should be used with additional caution. Wentworth does not perform this certification. If you are

going to ship a battery prototype, please contact the Wentworth Police Department for additional information.

Distinguishing Certified Vs. Non-Certified Batteries

Typically, UN38.3 Certified batteries will often note the certification on the pack. The certification is provided by the manufacturer of the battery and the manufacturer will provide Wentworth with a copy of the certification. Many prototype batteries will have the label information handwritten. Please note, handwritten certifications can be verified by contacting the manufacturer. If a UN38.3 approved battery or battery pack is at any time disassembled, attached to another battery, opened, or modified in any way, it is no longer considered approved.

Hazards

The section was provided by OSHA's Safety and Health Bulletin SHIB 06-20-2019 entitled “Preventing Fire and/or Explosion Injury from Small and Wearable Lithium Battery Powered Devices”.

Lithium batteries are generally safe and unlikely to malfunction (i.e., fail), but only so long as there are no defects, and the batteries are not damaged. When lithium batteries fail to operate safely or are damaged, they may present a fire and/or explosion hazard. Damage from improper use, storage, or charging may also cause lithium batteries to fail.

Damage to lithium batteries can occur immediately or over a period of time, from physical impact, exposure to certain temperatures, and/or improper charging.

- Physical impacts that can damage lithium batteries include dropping, crushing, and puncturing.
- Damage to all types of lithium batteries can occur when temperatures are too high (e.g., above 130 degrees Fahrenheit [°F]). External heat sources (e.g., open flames, heaters, etc.) can also accelerate failure in cells with defects or damage from other causes.
- Damage to lithium-ion batteries can occur when the batteries themselves or the environment around the batteries is below freezing (32 °F) during charging. Charging in temperatures below freezing can lead to permanent damage, increasing the risk for failure.
- Charging a device or battery without following manufacturer’s instructions may cause damage to rechargeable lithium-ion batteries. For example, some manufacturer-authorized chargers will cycle the power to the battery on and off

before it is fully charged to avoid overcharging. Since ultra-fast chargers may not cycle power, do not use them unless the manufacturer's instructions include them as an option.
- Heat released during cell failure can damage nearby cells, releasing more heat in a chain reaction known as a thermal runaway. The high energy density in lithium batteries makes them more susceptible to these reactions.

Depending on the battery chemistry, size, design, component types, and amount of energy stored in the lithium cell, lithium cell failures can result in chemical and/or combustion reactions, which can also result in heat releases and/or over-pressurization.

- In chemical reactions, by-products from the electrolyte solution and electrodes can increase the pressure in the cell to the point where the cell walls expand, and by-products leak out. Chemical by-products usually include carbon monoxide, carbon dioxide (CO2), hydrogen, and hydrocarbons. In many cases, the by-products are also combustible and could ignite.
- In combustion reactions, a thermal runaway releases byproducts that may ignite to cause smoke, heat, fire, and/or explosion. The by-products from a lithium battery combustion reaction are usually CO2 and water vapor. In some lithium batteries, combustion can separate fluorine from lithium salts in the battery. If mixed with water vapors, fluorine may produce hydrofluoric acid, which is particularly hazardous because workers may not feel its effects until hours after skin exposure."

Lithium Battery Safe Handling Practices

This section outlines the requirements when using lithium batteries to prevent exposure to the potential hazards, which were identified in Section 3.6. Wentworth employees and students are only permitted to use lithium batteries that meet the requirements of this Battery Safety Program.

Below are the safe handling practices for lithium batteries:

- Store lithium batteries and devices in dry, cool locations.
- Avoid excessively hot and humid conditions. Do not place batteries in direct sunlight, on hot surfaces or in hot locations.
- Do not place or store batteries with materials that may conduct electricity, e.g., other metals, liquids.
- Keep batteries away from water, oxidizing agents and corrosive materials.

- Ensure lithium batteries, chargers, and associated equipment are UL listed, or tested, and where applicable, certified by a NRTL, and are rated for their intended uses.
- Follow manufacturer's instructions for storage, use, charging, and maintenance.
- When replacing batteries and chargers for an electronic device, ensure they are specifically designed and appropriate for use with the intended device.
- Remove lithium-powered devices and batteries from the charger once they are fully charged.
- Avoid damaging lithium batteries and devices.
- Avoid damaging lithium batteries and inspect them for signs of damage before each use, (e.g., bulging/cracking, hissing, leaking, rising temperature, and smoking) especially if they are wearable.
- For damaged batteries, remove from service, place in a metal drum/container filled with dry sand, or extinguishing media (emergency isolation container).

Emergency / Fire Response Procedures

- **For all emergencies and fires, call Wentworth Police Department at 617-989-4444.**
- **Refer to the posted Emergency Response Guide.**
- **No one is permitted to respond to a fire involving a lithium battery.**

Most causes of lithium battery fires are due to overcharging or discharging, unbalanced cells, excessive current discharge, short circuits, physical damage, excessively hot storage and, for multiple cells in a pack, poor electrical connections.

Emergency Isolation Containers (Safe Container)

In areas where lithium batteries are used, an emergency isolation container should be nearby to safely hold depleted or damaged batteries that pose a potential fire risk until they are transferred to a central accumulation area for universal waste or off-site for disposal. Battery fires can be extremely difficult to extinguish, the purpose of the container is to prevent a battery fire and prevent spread to the building or contents. It is good practice for the emergency isolation container to have non-conductive sand to use as a smothering agent. The container must be placed away from combustible materials.

Thermal Runaway

- If you notice a battery rapidly heating, remove plug from the outlet (if possible and can be done safely).
- Place into an emergency isolation container. Smother with sand if safe to do so.

Medical Emergencies / Exposures

In case of exposure to byproducts or gases from combustion of batteries adhere to the following procedures. For all medical emergencies/exposures, always seek hospital medical attention.

- Eye exposure—Immediately flush eyes with a direct stream of water for at least 15 minutes with eyelids held open, to ensure complete irrigation of all eye and lid tissue.
- Skin exposure—Flush with cool water or get under a shower, remove contaminated garments. Continue to flush for at least 15 minutes.
- Inhalation—Move to fresh air.

Training

Training shall include the instruction of proper storage, handling, shipping, and charging techniques outlined in this program.

Lithium Battery Awareness Training

Awareness training is required for all Wentworth employees and students who may regularly handle, transport, charge, or store lithium batteries in academic settings (e.g., Technical Services spaces used for lithium battery storage, laboratories, studio, maker spaces). Any Wentworth employee or student who engages in modification of batteries, shall receive a higher level of training. Please contact the Wentworth Police Department to obtain information about this additional training.

For lithium batteries being used for consumer use (e.g., offices, dormitories), should follow manufacturer's instructions.

Additionally, as part of the Hazard Communication Program, all employees should be aware of the general hazards of lithium batteries as well as the emergency response procedures.

DOT/IATA Shipping and Receiving Training

Only Wentworth employees, who are trained in applicable DOT Hazardous Material Training and IATA Dangerous Goods Regulations, are permitted to receive or ship lithium batteries.

Disposal

Waste lithium and lithium-ion batteries are stored at universal waste accumulation areas throughout Wentworth. Never dispose of a lithium battery in the regular trash. Below is the proper procedure for disposing of lithium batteries.

1. Tape exposed terminals with non-conductive duct tape.
2. Dispose of a battery into a
    1. Lithium battery bag:
        1. Place each battery into a bag
        2. Peel away backing from adhesive and seal the bag
    2. Plastic bag:
        1. Place battery into plastic bag
        2. Pour non-conductive packing material around the battery within the plastic bag
        3. Seal the bag with tape
3. Place bags into a designated/labeled universal waste container within the designated universal waste accumulation area.
4. When the universal waste container becomes full, email the waste contact(s) to pick-up this waste container.