Safety Hazards

Battery Charging - Industrial Lead-Acid Batteries

On this page

Why is it important to follow safety procedures when charging batteries?

The use, handling and charging of batteries in the workplace can be hazardous. It is important to identify and assess the hazards and risks, and to have the appropriate control measures in place to protect workers. The hazards and risks associated with a battery will depend on the type of battery, how it is used, how it needs to be charged and maintained, the area where it is being charged and used, among other factors.

Workplaces should always make sure that procedures and practices are developed based on the battery's manufacturer's instructions and recommendations. Requirements from occupational health and safety legislation, building codes, electrical codes, and fire codes must also be followed.

Always make sure the charging stations and devices have a Canadian certification mark (such as from the Canadian Standards Association (CSA) or Intertek (cETL)), indicating it meets Canadian electrical safety standards (jurisdictions may specify which certification marks are acceptable).

In all cases, workers should be trained on safe work procedures, spill response, first-aid, and other related duties. Refer to the manufacturer's instructions and safety data sheets (SDS).

NOTE: This OSH Answers document provides general guidance for industrial lead-acid batteries used to operate forklifts and is not meant to replace the requirements from the manufacturer or legislation.

What are the risks of charging an industrial lead-acid battery?

The charging of lead-acid batteries (e.g., forklift or industrial truck batteries) can be hazardous. The two primary risks are from hydrogen gas formed when the battery is being charged and the sulfuric acid in the battery fluid, also known as the electrolyte. Hydrogen gas can lead to fires and explosions, and worker exposure to sulfuric acid can lead to chemical burns and other adverse health effects. Improper handling of batteries can also lead to shocks and electrocution, and battery charging can also result in the release of other harmful contaminants.

For general safety precautions when working with batteries, please see the OSH Answers Garages - Batteries which covers automotive vehicle sized batteries and the OSH Answers on Forklift Trucks - Lead-Acid Batteries for forklift batteries.

For specific guidelines regarding large industrial batteries, check with the manufacturer for recommended safe work procedures.

Why is there a risk of an explosion?

When leac-acid batteries are being recharged, they generate hydrogen gas that is explosive in certain concentrations in air (explosive limits are 4.1 to 72 percent hydrogen in air). The ventilation system needs to be able to exchange an adequate amount of fresh air for the number of batteries being charged. This is essential to prevent an explosion. Batteries should also not be charged or handled near sources of heat, flames or sparks, such as welding activities, burning cigarettes, or other source of ignition.

Charging stations for battery-powered industrial trucks, per the National Fire Code of Canada, must be located at least 1.5m from combustible materials, in well-ventilated areas, and in areas where there are no hazardous concentrations of flammable gases or vapours, combustible dusts or combustible fibres.

What are the ventilation requirements for charging areas?

The occupational health and safety legislation does not always indicate specific ventilation requirements. In general, the areas where batteries are charged need to be adequately ventilated to make sure there is no risk of an explosion or fire, and that workers are not exposed to hazardous concentrations of any contaminants (e.g., above exposure limits).

Many standards and codes recommend a ventilation system that prevents the accumulation of hydrogen to above 25% of its lower explosive limit (LEL), or above 1% by volume. Guidelines for ventilation in battery charging areas, based on the National Fire Protection Agency Standards (NFPA 855), are provided below:

Natural exhaust ventilation: designed to limit the concentration of flammable gas to 25% of the lower explosive limit (LEL) during the worst-case scenario of charging all batteries at the same time.

Mechanical Ventilation: an exhaust ventilation rate that is effective at limiting the maximum concentration of hydrogen to 1% of the total volume of the room or area during a worst-case scenario when all batteries are being charged at the same time. Alternatively, having a ventilation rate based on the area of not less than 1ft3 / min / ft2 of the floor area of the room.

Why can you get a burn from acid when handling the batteries?

You can get a skin burn when handling lead-acid batteries. Sulfuric acid is the acid used in lead-acid batteries (electrolyte) and it is corrosive. Note: workers should never pour sulfuric acid into flooded lead acid batteries (included in new watering a battery section). If a worker comes in contact with sulfuric acid when watering a battery or when handling a leaky battery, it can burn and destroy the skin. It is corrosive to all other body tissues. For example, the eyes, respiratory tract, or digestive system can be harmed severely if a worker gets a splash in the eyes, inhales sulfuric acid mist or unintentionally ingests sulfuric acid. As with any corrosive chemical, appropriate handling procedures must be followed to prevent contact with the liquid. These procedures include the wearing of face and eye protection, and protective chemical-resistant clothing such as aprons and gloves that are suitable for protecting you from contact with sulfuric acid.

As well, adequate first aid facilities, eye wash stations, and emergency showers are necessary to reduce the severity of incidental contacts. Spill response equipment, including neutralizing solution and personal protective equipment, should be available near battery charging areas. Develop procedures on how to deal with spills and worker exposures, and train workers. Procedures should be based on the instructions from the manufacturer and the safety data sheet (SDS).

An example of a first aid procedure is:

- If contact with acid occurs, flush the area (eyes, skin) immediately for at least 30 minutes with clean, lukewarm, gently flowing water using an emergency eye wash station or shower.
- If irritation persists, repeat flushing.
- DO NOT INTERRUPT FLUSHING. If necessary, keep the emergency vehicle waiting if advised by medical professionals.

- Take care not to rinse contaminated water into the unaffected eye, or onto the face or skin.
- First aiders should avoid direct contact. Wear chemical protective gloves, eye and face protection and other PPE, as necessary.
- Quickly transport the victim to an emergency care facility or call 911. If safe to do so, continue flushing during transport.
- Safely dispose of contaminated clothing, equipment, and materials.

What should I know about watering a lead-acid battery?

Flooded lead-acid batteries (e.g., used in some electric forklifts) contain an electrolyte solution of sulfuric acid and distilled water. During normal operation, the water evaporates and needs to be refilled (watered) to keep the battery operating effectively and safely. Use distilled water. Do not add sulfuric acid to the electrolyte. Batteries should be watered after it has been fully charged and has cooled down. Do not water a battery before or during charging, as the water may boil over and cause acid to leak from the battery.

Develop procedures on how to safely water a battery, based on the manufacturer's instructions, and train workers. Appropriate personal protective equipment (PPE) should be worn, including eye and face protection (e.g., chemical safety goggles and face shield); chemical-resistant gloves, aprons, and boots; or other protective clothing as needed. Make sure to water the batteries in the designated charging area where there is access to spill response equipment, PPE, and emergency eyewash stations or showers.

There are also sealed batteries, such as absorbed glass mat batteries, which have the electrolyte fluid sealed into the battery, and do not require distilled water to be added. Always use the type of battery that is compatible with the equipment and recommended by the manufacturer.

Are there any other hazards involved?

It is important to always follow appropriate procedures when handling batteries to prevent electrical shocks and electrocution, even when disconnected. Prevent metal objects from touching the battery, and make sure a worker or an item never makes contact with both the positive and negative terminals at the same time.

Depending on the metal alloy composition in lead-acid batteries, a battery being charged can generate two highly toxic by-products. One is arsine (arsenic hydride, AsH_3) and the other is stibine (antimony hydride, SbH_3). Generally, the air levels of these metal hydrides tend to remain well below the current occupational exposure limits during battery charging operations. Overcharging a lead acid battery can also lead to the generation of hydrogen sulfide, which can cause harm to workers if exposed. Although these risks may be minimal when batteries a properly charged, their possible presence re-enforces the need for adequate ventilation systems. In addition, always follow the manufacturer's recommend charging time and only use manufacturer-approved charging devices appropriate for the voltage and amp-hours (ah) of the battery.

How should industrial size batteries be handled?

Industrial batteries (e.g., forklifts or battery powered industrial trucks) may weigh up to 900 kg (2,000 lbs) or more.

Workers must be trained in how to safely move batteries using appropriate equipment (e.g., specially equipped forklift, battery cart, conveyor, overhead hoist, etc.)

- Batteries must be securely placed and restrained.
- Use only the appropriate tools and follow safe work procedures.

Fact sheet last revised: 2023-01-26

Disclaimer