

# Forklift Evaluator Training

## Module 1

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# Powered Industrial Trucks (Forklift)

- Powered industrial trucks, commonly called forklifts or lift trucks, are used in many industries, primarily to move materials. They can be used to move, raise, lower, or remove large objects or a number of smaller objects on pallets or in boxes, crates, or other containers.
- The hazards commonly associated with powered industrial trucks vary depending on the vehicle type and the workplace where the truck is used. Each type of truck presents different operating hazards. For example, a sit-down, counterbalanced high lift rider truck is more likely than a motorized hand truck to be involved in a falling load accident, because the sit-down rider truck can lift a load much higher than a hand truck.



# Powered Industrial Trucks (Forklift)

- Workplace conditions also present different hazards. For example, retail establishments often face greater challenges than other worksites in maintaining pedestrian safety.

The best way to protect employees from injury also depends on the type of truck operated and worksite where it is being used.



# Types and Fundamentals

- This module reviews the classes of commonly-used powered industrial trucks. It also summarizes the major types of power sources used in powered industrial trucks and reviews safe practices for refueling and battery charging/changing operations. Finally, this module reviews the major parts of a powered industrial truck, including some of the potential hazards and possible solutions associated with each part.



# Types: Class 1

Types The following are classes of commonly-used powered industrial trucks. This classification does not include all powered industrial trucks covered by the OSHA standard [29 CFR 1910.178(a), 29 CFR 1910.178(b) and 29 CFR 1910.178(c)].



Class I  
Electric Motor Rider Trucks

Lift Code 1: Counterbalanced Rider Type, Stand Up.

Lift Code 4: Three Wheel Electric Trucks, Sit Down.

Lift Code 5: Counterbalanced Rider, Cushion Tires, Sit Down.

Lift Code 6: Counterbalanced Rider, Pneumatic or Either Type Tire, Sit Down.



# Types: Class 2



Class II

Electric Motor Narrow Aisle Trucks

Lift Code 1: High Lift Straddle.

Lift Code 2: Order Picker.

Lift Code 3: Reach Type Outrigger.

Lift Code 4: Side Loaders: Platforms.

Lift Code 4: Side Loaders: High Lift Pallet.

Lift Code 4: Turret Trucks.

Lift Code 6: Low Lift Platform.

Lift Code 6: Low Lift Pallet.



# Types: Class 3



Class III  
Electric Motor Narrow Aisle Trucks

Lift Code 1: Low Lift Platform.

Lift Code 2: Low Lift Walkie Pallet.

Lift Code 3: Tractors

Lift Code 4: Low Lift Walkie/Center Control.

Lift Code 5: Reach Type Outrigger.

Lift Code 6: High Lift Straddle.

Lift Code 6: Single Face Pallet.

Lift Code 6: High Lift Platform.

Lift Code 7: High Lift Counterbalanced.

Lift Code 8: Low Lift Walkie/Rider Pallet and End Control.



# Types: Class 4



Class IV  
Internal Combustion Engine  
Trucks (Solid/Cushion Tires)

Lift Code 3: Fork, Counterbalanced (Cushion Tire).





# Types: Class 5



Class V  
Internal Combustion Engine  
Trucks (Pneumatic Tires)

Lift Code 4: Fork, Counterbalanced (Pneumatic Tire).



# Types: Class 6



Lift Code 1: Sit-Down Rider (Draw Bar Pull Over 999 lbs.).

Class VI  
Electric and Internal Combustion  
Engine Tractors

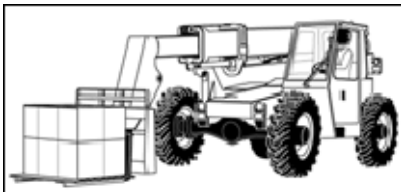


# Types: Class 7

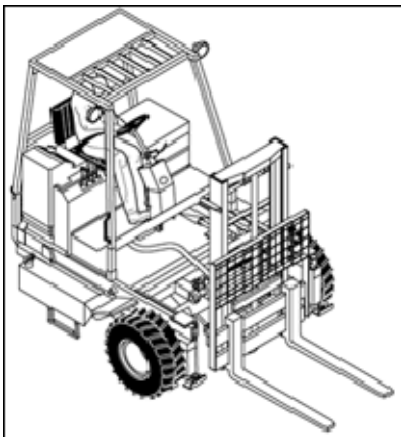
Class VII – Rough terrain forklift is a generic term used to describe forklifts typically intended for use on unimproved natural terrain and disturbed terrain construction sites. However, the term “rough terrain” does not imply that the forklift can be safely operated on every conceivable type of terrain.



This is an example of a ruggedly constructed forklift and is designed to be used primarily outdoors.



This is an example of a vehicle equipped with a telescoping boom, which enables it to pick and place loads at various distances and lift heights in front of the machine. The ability to reach out in front of the forklift allows the operator flexibility in the placement of a load.



This is an example of a portable self-propelled rough terrain forklift that is typically transported to the job site. It is mounted on a carrier to the back of a truck/trailer and is used to unload heavy items from the truck/trailer at the job site. Note that not all truck/trailer mounted forklifts are rough terrain forklifts.



# Power Sources

- The two main power sources for powered industrial trucks are internal combustion, which uses a traditional engine that runs on liquid petroleum gas (LPG), compressed natural gas (CNG), gasoline, diesel, or other fuel, and electric, which uses an on-board battery. This section provides information on these power sources, including some of the potential hazards and possible solutions associated with their use and with refueling and battery charging/changing operations.
- Other power sources that may become more widespread in the future include fuel cells and hybrid systems. Hydrogen fuel cells will have zero emissions and quiet operation plus the ability to be refueled as quickly as gasoline engines. Hybrid systems will use a combination of fuel cells and batteries.



Internal Combustion (IC)



Electric



# Internal Combustion

- Forklifts powered by internal combustion engines run on a variety of fuels, including gasoline, diesel fuel, liquid petroleum gas (LPG), and compressed natural gas. Forklifts with internal combustion engines can be quickly refueled but require regular maintenance checks for leaks of fuel or oil and worn parts to keep systems working properly. Forklifts powered by internal combustion engines are also used indoors, although this may increase exposure to exhaust and noise.



# Internal Combustion

- The most widely used forklifts have an internal combustion engine powered by fuels that include gas, liquid petroleum, diesel fuel, and compressed natural gas. Forklifts with internal combustion engines can be quickly refueled but require regular maintenance checks for leaks of fuel or oil, worn parts requiring replacement, and to keep systems working properly. Newer forklifts with internal combustion engines have on-board sensors that monitor and adjust emissions and have catalytic converters that help reduce emissions.
- Potential Hazards
  - Exposure to engine exhaust containing carbon monoxide. If the engine is not properly combusting fuel, the exhaust may contain high levels of carbon monoxide.
  - Exposure to spills and leaks of fuel and oil.



# Internal Combustion

**Requirements and Recommended Practices: Do not operate in a poorly ventilated area where fumes can concentrate.**

- Carefully wash away or completely evaporate spillage of oil or fuel.
- As part of the pre-operation inspection, check all fluid levels, including oil, water, and hydraulic.
- Check for leaks from the hydraulic cylinder, the battery, and the fuel system.
- Check the exhaust color for incomplete combustion. For example, black smoke may be an indication of incomplete combustion.
- Check and report unusual noises or excessive vibration.





# Refueling: Gasoline and Diesel

Forklifts that use gasoline are easy to refuel. However, gasoline is very flammable.

## Potential Hazards:

- Exposure to explosive fumes.

## Requirements and Recommended Practices:

- Refuel only at designated safe locations.
  - A designated safe location outdoors is preferable to a refueling area indoors. Do not refuel trucks in hazardous areas or around heat sources.
- Stop the engine during refueling.
- Do not smoke while refueling.
- Do not allow the forklift to become low on fuel or run out of fuel. Sediment or other impurities in the tank could be drawn into the fuel system causing difficulties in starting and actual damage to the internal components.
- Fill the fuel tank at the end of each day.
- Do not fill the tank to the top; it may overflow because fuel expands as it is heated.



Operator refueling diesel-powered forklift.



# Refueling: Gasoline and Diesel

Follow correct refueling procedures:

1. Park the forklift in the designated refueling area.
2. Place the transmission in Neutral.
3. Lower the forks to the ground.
4. Engage the parking brake.
5. Shut off the engine.
6. Open the filler cap.
7. Fill the tank slowly (if spillage occurs, wipe off fuel and wash down the area with water).
8. Close the filler cap.



# Refueling: Liquid Petroleum Gas

Liquid petroleum gas (LPG) is a commonly used fuel for forklifts. It is a safe fuel when handled properly. When handled improperly, it can cause serious injury or death.

- LPG vapor is heavier than air and will seek the lowest lying area. If not adequately dissipated, it will collect in pockets and possibly ignite when exposed to a heat source.
- LPG is extremely flammable.
- LPG is extremely cold when exposed to the atmosphere. If your skin is exposed to LPG, you can get frostbite.



# Refueling: Liquid Petroleum Gas

## Requirements and Recommended Practices:

- Do not refuel LPG-powered trucks in confined areas where LPG vapors could collect if a leak occurs.
- Do not leave LPG-powered trucks near heat sources, stairways, exits, or other egress areas.
- When parking LPG-powered trucks for a long period of time, turn the service valve off.
- Only trained and authorized personnel should replace LPG containers.
- Follow proper procedures for storing and handling liquid petroleum gas. [29 CFR 1910.110]



# Electric-powered forklifts

Electric-powered forklifts are most commonly used indoors in warehouses. Unlike internal combustion forklifts, electric forklifts are quiet and generally non-polluting but present other serious hazards that must be addressed.

- Electric forklifts produce zero emissions, virtually eliminate the hazard of carbon monoxide poisoning, and run more quietly than internal combustion forklifts. However, electric forklifts present other serious hazards that must be addressed.

## Potential Hazards

- Electric forklifts are powered by large lead-acid batteries, which must be routinely charged. The hazards and recommended practices for charging and changing batteries are reviewed below.



# Electric-powered forklifts

## Requirements and Recommended Practices:

- Designate an area for the purpose of battery charging.
- Make sure that the forklift is charged before using.
- Recognize that heavy loads drain the battery more quickly.



# Battery Charging Area

- A properly equipped battery charging area will have:
- No smoking.
- Warning signs posted.
- Adequate fire protection.
- Ample and readily available water supply for flushing and neutralizing spilled electrolyte.
- An eyewash able to provide a 15 minute flow. Note: For large installations, there should be a plumbed drench shower and an eyewash.
- A phone or other means of communication in the event of an emergency.
- Adequate ventilation to avoid the build up of hydrogen gas during battery charging.
- Soda ash or other neutralization materials in the immediate area.
- A dry chemical, CO<sub>2</sub> or foam fire extinguisher.
- Means to protect charging apparatus from damage from trucks.



# Battery Charging and Changing Procedures

An electric forklift is designed to operate for one shift and then be charged on the next shift or overnight. Some employers routinely change batteries instead of charging them in the vehicle. The discharged battery is removed from the forklift and a charged battery is installed in its place.

Only trained personnel should charge and change batteries in electric forklifts. In addition to training in battery changing and charging procedures, these employees should be trained on emergency procedures in the event of an acid splash, including how to use eyewash and shower facilities.

## **Potential Hazards:**

- Batteries are very heavy.
- Batteries contain sulfuric acid that is highly corrosive and could be splashed on personnel servicing or changing batteries.
- Toward the end of the battery charging process, batteries can give off highly explosive hydrogen fumes.
- Contact with battery cells can cause electrical short circuits, which can burn unprotected skin.



# Battery Charging and Changing Procedures

Always follow your facility's specific safety procedures. Follow the recharger manufacturer's recommendations for attaching and removing cables and for proper operation of your equipment.

- Properly position trucks and apply brakes before attempting to change or charge batteries. (Figure 4) [29 CFR 1910.178(g)(8)]
- Use a lifting beam or equivalent material handling equipment when lifting the battery. (Figure 5) Do not use a chain with two hooks. This may cause distortion and internal damage. [29 CFR 1910.178(g)(4)]
- Charge batteries in the designated battery charging area. (Figure 6) [29 CFR 1910.178(g)(1)]



Fig. 4



Fig. 5



Fig. 6



# Battery Charging and Changing Procedures

Facilities shall be provided for flushing and neutralizing spilled electrolyte, for fire protection, for protecting charging apparatus from damage by trucks, and for adequate ventilation for dispersal of fumes from gassing batteries. [29 CFR 1910.178(g)(2)]

- NOTE: OSHA Directive, STD 1-11.4 - 29 CFR 1910.178(g)(2); Battery Charging Stations for Fork Lifts and Other Industrial Trucks, 10/30/1978 states:  
"**Battery charging**" areas where power industrial truck batteries are charged only--no maintenance is performed, batteries are not removed from the trucks and no electrolyte is present in the area--are not subject to the requirement of [29 CFR 1910.178(g)(2)]. The charging areas shall be in compliance with [29 CFR 1910.178(g)(1), (8), (9), (10), (11) and (12)]. Personal protective equipment shall be used when and where required.



# Battery Charging and Changing Procedures

- When charging batteries, pour acid into water. Never pour water into acid. [29 CFR 1910.178(g)(7)]
- Care shall be taken to assure that vent caps are functioning. The battery (or compartment) cover(s) shall be open to dissipate heat. [29 CFR 1910.178(g)(9)]
- Prohibit smoking in the charging area. [29 CFR 1910.178(g)(10)]
- Take precautions to prevent open flames, sparks, or electric arcs in battery charging areas. [29 CFR 1910.178(g)(11)]
- Remove all metallic jewelry before recharging. Tools and other metallic objects shall be kept away from the top of uncovered batteries. [29 CFR 1910.178(g)(12)]
- Wear personal protective equipment (face shield, safety goggles, neoprene or rubber gloves and apron). [29 CFR 1910.132]
- Where the eyes or body of any person may be exposed to injurious corrosive materials, suitable facilities for quick drenching or flushing of the eyes and body must be provided within the work area for immediate emergency use. (Figure 7) [29 CFR 1910.151(c)]



Fig. 7



# Battery Charging and Changing Procedures

- Check the electrolyte level before recharging. Record the specific gravity with the hydrometer in the service log. Check the pilot cell.
- Check the water level. Do not add water prior to recharging. Record in service log.
- Check the voltage. If the battery has sealed vents, do not recharge with a current greater than 25 amperes.
- Unplug and turn off the charger before connecting or disconnecting the clamp connections.
- Attach the positive clamp (+, usually colored red) to the positive terminal first and then the negative clamp (-, usually colored black) to the negative terminal, keeping the proper polarity.
- Turn off the charger if the battery becomes hot or the electrolyte fluid comes out of the vents. Restart charging at a lower charging rate.
- Check water level after charging. Add distilled water or de-ionized water if water level is below level indicator. Record in service log.
- Return battery to forklift with lifting beam and secure in place after charging. [29 CFR 1910.178(g)(4) and (g)(5)]
- Check the indicator on the hour meter to see that battery is fully charged.



# Battery Maintenance

- Under normal operating conditions, power industrial truck forklift batteries can be expected to remain in service for 2,000 work shifts or charge/discharge cycles. Implementing a proper battery maintenance program can increase the life of the batteries and help protect employees. Battery failure could lead to mechanical breakdowns and possible accidents involving forklift operators and/or other personnel.
- Do not continue a battery in service merely because it continues to deliver power.
- Do not exceed the service hours in the manufacturer's recommendations.
- Do not over charge or under charge batteries.
- Avoid discharging batteries beyond the manufacturer's discharge level. This can result in permanent battery damage and shorten battery life considerably.
- Warning signs of a low battery include slow starting, dim headlights, and the ammeter indicating discharge at high RPM.
- Recycle or properly dispose of batteries. Spent batteries are a hazardous waste unless they are properly reclaimed at a lead smelter or battery recycler.



# Sulfuric Acid Splash

- Battery acid is dilute sulfuric acid. Sulfuric acid is a clear, colorless liquid with an acrid smell. It is corrosive and can cause severe burns.

**Potential Hazards:** Acid splash, especially to the eyes.

- Acid spill.
- Corrosive burns.
- Requirements and Recommended Practice: Wear personal protective equipment:
  - Wear chemical splash goggles or full face shield with safety glasses equipped with side shields.
  - Wear acid-proof gloves made of rubber or neoprene.
  - Wear acid-resistant clothing or rubber or neoprene apron.
  - Wear acid-resistant safety shoes or boots.
- Employees who wear contact lenses should wear chemical splash goggles during battery charging. In the event of an acid splash to the eyes, the contact lens could hold the acid to the eye, making it more difficult to flush the acid away and causing more serious damage to the eye.



# Emergency Procedure in the Event of an Acid Splash

## Emergency Procedure in the Event of an Acid Splash

These are sample procedures. Your facility may have its own safety procedure, requiring employees to contact their supervisors or medical personnel either on-site or off-site. Consult the Material Safety Data Sheet for additional information.

### **If the acid splash is to the eyes:**

1. Remove safety glasses and flush eyes with clean water in eyewash for 15 minutes.
2. Seek medical attention immediately.
3. Report the incident to your supervisor.

### **If the acid splash is to the skin:**

1. Remove acid soaked clothing immediately.
2. Flush acid contacted skin with clean water for 15 minutes.
3. Seek medical attention immediately if redness or burns occur.
4. Report the incident to your supervisor.



# Emergency Procedure in the Event of an Acid Splash

## **If the acid is swallowed and the victim is conscious:**

1. Remove victim from battery area and provide fresh air.
2. Wash out mouth with large amounts of water.
3. Give victim milk to drink.
4. Do not try to induce vomiting.
5. Monitor victim's breathing and condition. Start CPR if victim stops breathing.
6. Use NIOSH approved acid mist respirator, if OSHA PEL ( 1.0 mg/m<sup>3</sup>) is exceeded or if respiratory irritation occurs.
7. Seek immediate medical attention.
8. Report the incident to your supervisor.

## **If the acid is swallowed and the victim is unconscious:**

1. Remove victim immediately from battery area and provide fresh air.
2. Start CPR if victim stops breathing.
3. Provide oxygen, if properly trained personnel are available.
4. Seek immediate medical attention.
5. Report the incident to your supervisor.



# Sulfuric Acid Spill (In the event of battery breakage)

1. Neutralize the spill with soda ash or baking soda. Use 1 pound of baking soda to 1 gallon of water.
2. The acid reaction is complete when it stops fizzing. Make certain that the acid is neutralized by checking the pH is neutral between 6 and 8.
3. Absorb neutralized material onto clay or other absorbent material, if necessary. If the spill is very large, contain the spill with earth or clay dikes.
4. Brush under the battery connectors and remove all grime. Rinse the residue from the battery with clean water with a hose.
5. Report the incident to your supervisor.
6. Determine proper disposal by contacting local environmental authorities.





# Hydrogen Gas

Flammable hydrogen gas is always present during battery recharging. Hydrogen gas is potentially explosive if allowed to accumulate in a closed area.

## **Potential Hazards:**

- Ignition/explosion of accumulated hydrogen gas.

## **Requirements and Recommended Practice:**

- Post no smoking signs.
- Use non-sparking tools.
- Prevent open flames, sparks, or electrical arcs in the battery charging area to minimize the danger of explosion.
- Provide adequate ventilation.
- Open the battery cover when charging, so that the hydrogen gas can vent better. This is especially important in confined areas where the danger of accumulation is greatest.



This Is The End of Module 1

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