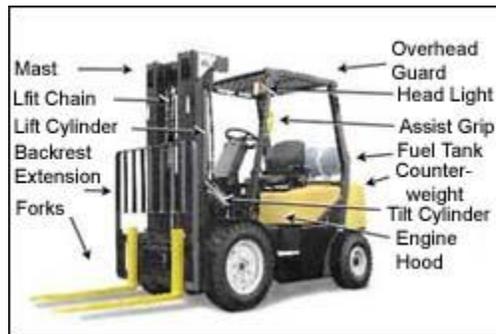


## Parts



The following are the major parts of a forklift. This discussion focuses on the most common types of forklifts. Be sure to read the operator's manual for your forklift and follow the manufacturer's recommendations.

## Mast and Carriage

The mast is the vertical assembly that does the work of raising, lowering, and tilting the load. The mast supports the carriage that allows its vertical movement with the hydraulic lift. The carriage is made of flat metal plates that move along the mast by chains or are directly attached to the hydraulic cylinder. The hydraulic lift cylinder supplies the power to lift the load.

### Mast Types

There are a number of mast types:

#### **SIMPLEX:**

The features of a simplex mast are:

- Single stage mast.
- Limited Free Lift (4-6") Free lift is the distance the forks go up before the mast is extended.
- **Recommended Use:** In loading and unloading trucks and in areas where overhead clearance is a problem.



**Figure 1. Reach truck with mast extended.**

**DUPLEX:**

The features of a duplex mast are:

- Two stage mast.
- Has greater Free Lift (50-60") than the simplex mast.
- Can load and unload higher-tiered stacks than simplex.



**Figure 2. Triplex mast in narrow aisle rider reach truck. Note that the forklift is removing stock from a rack. Foot and truck traffic in the opposite aisle way should be controlled to prevent injury from falling materials.**

**TRIPLEX:**

The features of a triplex mast are:

- Three stage mast.
- Has same Free Lift (50-60") as duplex mast but extends further.
- Can load and unload higher-tiered stacks than simplex or duplex.

**QUAD:**

The features of a quad mast are:

- Four stage mast.
- Has same Free Lift (50-60") as duplex or triplex mast but extends further.
- Can load and unload higher-tiered stocks than the duplex or triplex, but requires precautions at its highest lifting heights.

Note: The lifting capacity of the forklift decreases as its load is raised. For more information, see [Load Handling](#) and [Narrow Aisles](#).

**Visibility**

Mast configuration can affect the operator's visibility. Newer mast designs, such as those that use two side cylinders, can provide substantially improved visibility compared with some older mast designs that have a single central cylinder. (Figures 3 and 4)

The operator should travel with the load trailing and/or use a spotter whenever necessary to achieve adequate visibility.



**Figure 3. Mast with central cylinder obscuring visibility.**



**Figure 4. High visibility mast with hydraulic cylinders on the sides.**

## Forks

The forks (also known as tines or blades) carry the load. They have a heel where they curve upward and an upright shank where they are attached to the carriage.

### Forks

#### Potential Hazards:

A fork that shows any of the following defects shall be withdrawn from service and discarded or properly repaired:

- Surface cracks.
- Blade or shank are not straight.
- Fork angle from blade to shank is not straight.
- Difference in height of fork tips.



**Figure 1. Forks.**



**Figure 2. Damaged fork.**

- Positioning lock not in working order.
- Fork blade or shank wear.
- Fork hooks wear.
- Fork marking not legible.

### Requirements and Recommended Practices:

- Do not operate the forklift if the forks show any of the defects listed above.
- Always inspect forks during the pre-operation inspection. Repair or replace the forks if they are not in good working order. Replacement parts shall be equivalent as to safety with those used in the original design. [[29 CFR 1910.178\(q\)\(5\)](#)]
- Do not operate a forklift from which the positioning lock has been removed or is inoperable. As the forklift travels, the positioning lock holds the forks in position and prevents sliding of the forks and loss of the load.

### Additional Information:

- [Fork inspection requirements for powered industrial trucks](#). OSHA Standard Interpretation, (1999, October 22).

## Attachments

Powered industrial trucks often use various attachments in place of traditional forks. These attachments increase the versatility of the truck, but can present important safety considerations, including stability, capacity, and visibility.

Some common attachments are:

- Slipsheet attachments which avoid the use of pallets. (Figure 2)
- Sideshifters shift the forks right and left. (Figure 3)



**Figure 1. Carton clamp carrying cotton bales.**



**Figure 2. Slipsheet attachment eliminates need for pallets.**

- Container handlers designed to lift shipping containers.
- Carton clamps equipped with a pressure valve to squeeze the load.
- Cotton or pulp bale clamps that grab and hold bales.
- Paper roll handlers.
- Barrel clamps. (Figure 4)
- Rotators that grab and rotate the load.
- Extending or telescoping forks such as in reach and turret trucks. (Figure 5)
- Personnel platforms specially designed for lifting personnel.



**Figure 3. Side-shifter controls enable the forks to be moved right and left.**

Operators must be trained in the proper use of attachments because they alter the performance of the forklift. Attachments affect the truck's performance by changing its center of gravity, visibility, and capacity.

### Potential Hazards:

- Overloading. The weight of the attachment reduces the lifting capacity of the truck.
- Tipover and falling loads. The attachment increases the load center by moving the load further away from the balance or fulcrum point.

### Requirements:

- Train operators in the fork and attachment adaptation, operation, and use limitations. [[29 CFR 1910.178\(l\)\(3\)\(i\)\(G\)](#)]
- Retrain an operator if a new attachment is added to the forklift. Consult the operator's manual for instructions on how to use the new equipment.
- Do not exceed the rated capacity of the forklift/attachment combination.



**Figure 4. Forklift equipped with a barrel clamp attachment.**

- Know the mechanical limitations of your forklift.
- Change capacity, operation, and maintenance instruction plates, tags, or decals when a forklift truck is equipped with an attachment.
- Treat an unloaded forklift with an attachment as partially loaded. [[29 CFR 1910.178\(o\)\(4\)](#)]
- Include attachments in a scheduled maintenance and inspection program. Tailor inspection steps to the attachment.
  - Examine load-bearing components for deformation.
  - Examine load-bearing welds for cracks.
  - Inspect mechanical and hydraulic components and maintain in accordance with the manufacturer's instructions.



**Figure 5. Reach stacker used in marine terminals and longshoring.**

- If the truck is equipped with front-end attachments other than factory installed attachments, request the truck be marked to identify the attachments and show the approximate weight of the truck and attachment combination at maximum elevation with load laterally centered. [[29 CFR 1910.178\(a\)\(5\)](#)]

WARNING		IMPROPER OPERATION OR MAINTENANCE COULD RESULT IN INJURY OR DEATH.	
MODEL	TYPE	SERIAL No.	TRUCK WT.
	LPS	37M 000000	8,680 lbs
CAPACITY OF STANDARD TRUCK WITH SIMPLE MAST			
AND FORK:	5,000	lbs at 24 in. load center with	
MAXIMUM HEIGHT OF 120 in.		RATED CAPACITY WITH	
OPTIONAL MAST AND/OR ATTACHMENT LISTED BELOW			
MAST: VERTICAL	A	B	FORKS ONLY
	in.	in.	lbs.
24 in.	136	24	4,500
A			
B			
ATTACH: Sideshifter			
LATCH/MODEL MEETS DESIGN SPECS ANSI B56.1			

**Figure 6. Data plate for an attachment (sideshifter).**

- Modifications or additions that affect capacity or safe operation shall not be performed without prior written approval from the forklift truck manufacturer. Capacity, operation, and maintenance instruction plates, tags, or decals shall be changed accordingly. [[29 CFR 1910.178\(a\)\(4\)](#)]
  - If no response or a negative response is received from the manufacturer, written approval of the modification/addition from a qualified registered professional engineer is acceptable. A qualified registered professional engineer must perform a safety analysis and address any safety or structural issues contained in the manufacturer's negative response before granting approval. The forklift nameplates must be changed accordingly.
  - See [Forklifts: Free Rigging Requires Manufacturer's Approval](#), OSHA Standard Interpretation, (1999, October 22). Free rigging is the direct

attachment to or placement of rigging equipment (slings, shackles, rings, etc.) onto the forks of a powered industrial truck for a below-the-forks lift. This type of lift does not use an approved lifting attachment. Although free rigging is a common practice, it could affect the capacity and safe operation of a powered industrial truck.

## Nameplate

Each operator is required to be aware of the truck specifications on the nameplate and what they mean. If there is a special attachment, it must be listed on the nameplate.

## Nameplate

The nameplate (also called the data plate) provides important information for the forklift operator, including the fuel type, forklift weight, and capacity. Operators should read the nameplate to know the forklift's capabilities and limitations.



**Figure 1. This data label indicates that this forklift has a 156" upright mast height in column A and a 24" load center in column B. Its stated capacity is 5,000 lbs with just its forks. With the sideshifter attachment, its stated capacity is 4,500 pounds. The truck weighs 8,600 pounds.**

## Requirements and Recommended Practices:

OSHA requirements state:

"Approved trucks shall bear a label or some other identifying mark indicating approval by the testing laboratory. See paragraph (a)(7) of this section and paragraph 405 of "American National Standard for Powered Industrial Trucks, Part II, ANSI B56.1-1969", which is incorporated by reference in paragraph (a)(2) of this section and which provides that if the powered industrial truck is accepted by a nationally recognized testing laboratory, it should be so marked." [[29 CFR 1910.178\(a\)\(3\)](#)]

- Train employees to properly read and understand the nameplate and to know what the information means.
- Ensure every truck has its durable, corrosion-resistant nameplate legibly inscribed with the following information:
  - Truck model and serial number
  - Truck weight

- Designation of compliance with the mandatory requirements of ASME B56.1, "Safety Standard for Low and High Lift Trucks," applicable to the manufacturer
- Type designation to show conformance with the requirements, such as those prescribed by Underwriters Laboratories, Inc., and Factory Mutual Research Corporation
  - Capacity
- Do not operate a truck with an illegible or missing nameplate.

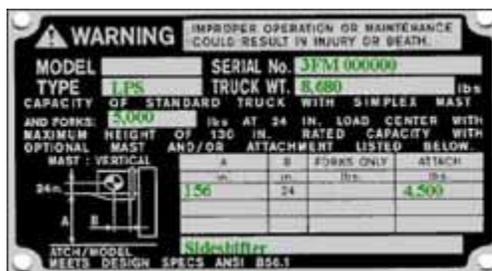
### Additional Information:

ANSI/ITSDF B56.1 calls for additional information on nameplates on high-lift trucks, electric trucks, and trucks intended for use in hazardous locations. [See ANSI/ITSDF B56.1, "Safety Standard for Low and High Lift Trucks," Section 7.5, "Nameplates and Markings"]

### Capacity

The capacity is the manufacturer's guideline for how much weight a forklift can safely lift. Exceeding the capacity of a forklift presents serious hazards, including tipover.

The nameplate in Figure 2 indicates that the forklift is an [LPS](#) type, which is a liquid petroleum gas powered unit provided with additional safeguards to operate in certain hazardous locations. The truck weight is 8,680 pounds and its capacity is 5,000 pounds at a 24 inch load center to a maximum height of 130 inches. The nameplate indicates that the capacity of the forklift with the sideshifter attachment is 4,500 pounds to a maximum height of 156 inches.



**Figure 2. The nameplate indicates that the capacity of the truck is 4,500 pounds with the sideshifter attachment.**

If the load has a different load center or it is irregular, such as a series of boxes of varying weights, then the capacity must be recalculated. [See [Load Composition](#)].

### Requirements and Recommended Practices:

- Train employees to properly read the nameplate and to understand what the information means.
- Check the nameplate for maximum capacity and maximum height.

- Do not exceed the capacity of the truck.
- Understand that the addition of an attachment generally lowers the capacity of a forklift.
- Understand that the size, position and weight distribution of the load also affects the capacity. Capacity assumes the center of gravity of the load is at the load center shown on the label. If this is not the case, the load may exceed the forklift's capacity.

## Danger, Warning and Caution Labels

In addition to the nameplate, forklifts may have other warning labels or decals that provide safety information to operators. Safety labels should be clearly visible to the operator and must be replaced if missing, damaged, or illegible.

Under one classification system, there are three types of warning labels or decals:

- **DANGER** means if the danger is not avoided, it will cause death or serious injury.
- **WARNING** means if the warning is not heeded, it can cause death or serious injury.
- **CAUTION** means if the precaution is not taken, it may cause minor or moderate injury.

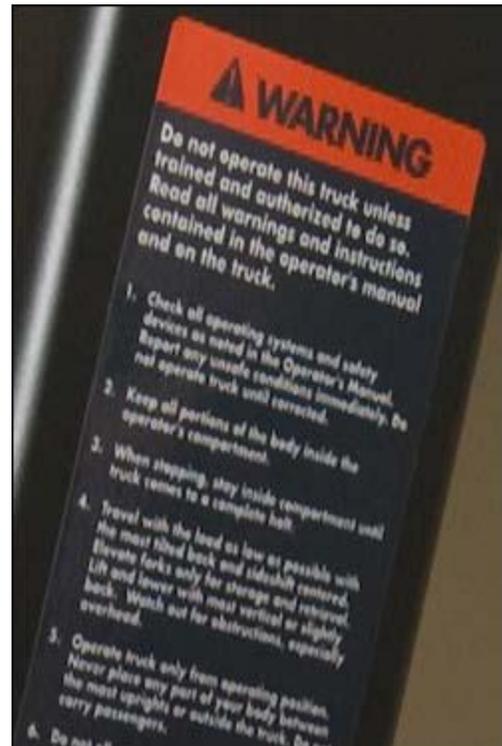
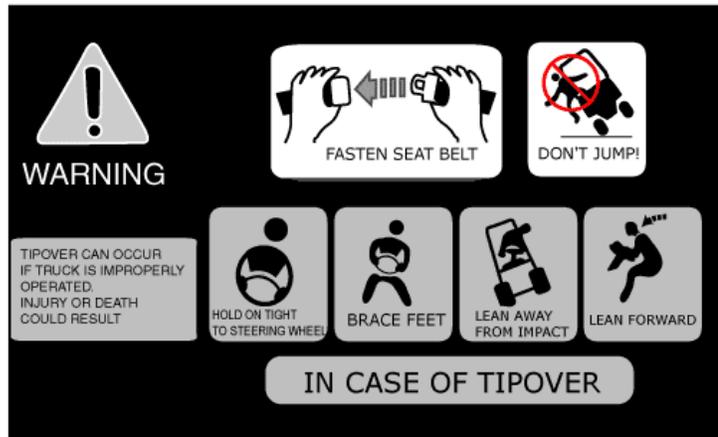


Figure 1. Safety decal on forklift.

Figures 1 and 2 show examples of warning labels.

**Figure 2. The steps to take in a tipover of a sit-down counterbalanced forklift: Fasten seat belt, don't jump, hold on tight to steering wheel, brace feet, lean away from impact and lean forward. Note that the seat belt should already be fastened.**



## Controls

Before operating a forklift, read and study the operator's manual discussion on controls. Locate each control and understand how to use each one.

- Forward/Reverse Directional Controls**  
 The directional control allows the operator to move the forklift forwards or backwards. Directional controls can be column mounted (mounted on the steering column) or foot operated (controlled by shifting the accelerator pedal side to side).



**Figure 1. Operator depressing inching pedal.**

- Hydraulic Lift Controls**  
 Forklifts have hydraulic lift controls to raise and lower the forks and to tilt the forks. Visually inspect the hydraulic controls before each use and test that they are working properly. See [Load Handling](#) for more information on lifting loads.
- Pedals**  
 Forklifts have accelerator and brake pedals that operate similarly to these pedals in other vehicles. Some forklifts also have a clutch, which allows shifting into higher forward gears.

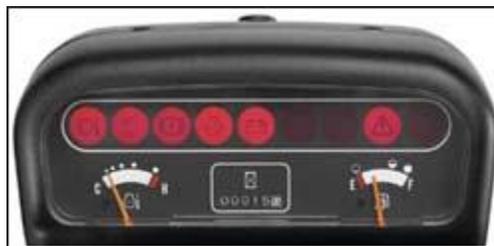
The inching pedal gives the operator more control of the forklift in tight places. See [Steering, Turning and Changing Direction](#) for more information on using inch pedals.

- Parking Brake**  
 Forklifts are equipped with a parking brake. Be sure to set the parking brake

when leaving a forklift and block the wheels if the forklift is parked on an incline. See [Parking](#) for more information on parking a forklift.

## Instruments

Forklifts have a variety of instruments on the dashboard. Read your operator's manual and become familiar with each of the warning lights and gauges on the dashboard. Never operate a forklift if a warning light or gauge signals an unsafe condition.



**Figure 1. Dashboard showing gauges on a forklift.**

## Instrument Panel

Read your operator's manual and become familiar with each of the warning lights and gauges on the dashboard. Know what each one indicates.

### Potential Hazards:

- Mechanical breakdown
- Forklift malfunction



**Figure 2. These common forklift gauges show normal operating condition.**

### Requirements and Recommended Practices:

- Turn on the forklift and check all the warning indicators on your dashboard.
- Never operate a forklift with a warning light or gauge signaling an unsafe condition.
- Do not attempt a repair unless authorized to do so.
- Report any abnormality to your supervisor.



**Figure 3. Typical warning gauges.**

## Oil Pressure Gauge

The **oil pressure gauge** indicates the oil pressure inside the engine. An oil pressure warning light may also be present.

### Requirements and Recommended Practices:

- Do not operate the forklift if the light comes on or the gauge indicates oil pressure problems.
- Check for leaks. Clean up any spills or mark the hazard area until it can be cleaned.
- Notify your supervisor or maintenance personnel.
- Only trained and authorized personnel may service a forklift.

## Temperature Gauge/Light

The **engine temperature gauge** is similar to the engine temperature gauge found on a car or truck.

- Engine temperature may be indicated by "C" for cold or green indicating safe operating temperature, while a hot, overheating engine may be indicated by an "H" for hot or red.
- Refer to your owner's manual for the appearance and significance of your engine temperature gauge.

### Requirements and Recommended Practices:

- Do not operate a forklift if the light comes on or the gauge indicates an overheated engine.
- Check for leaks. Clean up any spills or mark the hazard area until it can be cleaned.
- Notify your supervisor or maintenance personnel.
- Allow an overheated forklift to cool down before removing the radiator cap. When removing the cap, wear leather gloves and eye protection and open the

**Figure 4. Electronic engine oil gauge, warning indicators.**



**Figure 5. Engine temperature gauge in the normal zone.**

cap slightly to check for stored pressure before completely removing the cap. Only trained and authorized personnel may service a forklift.

## Transmission Temperature Gauge

The transmission temperature warning light or gauge indicates when the transmission temperature is too high.

### Requirements and Recommended Practices:

- Do not operate a forklift if the light comes on or the gauge indicates an overheated transmission.
- Check for leaks. Clean up any spills or mark the hazard area until it can be cleaned.
- Notify your supervisor or maintenance personnel.
- Transmission fluid may need to be added. Only trained and authorized personnel may service a forklift.



**Figure 6. Transmission temperature in normal range.**

## Fuel Gauge

The **fuel gauge** shows the amount of fuel remaining.

### Requirements and Recommended Practices:

- Do not operate while extremely low on fuel.
- Check the fuel level during your daily inspections.
- Refuel only in designated areas. Clean up any spills or mark the hazard area until it can be cleaned.



**Figure 7. Fuel gauge.**

## Hour Meter

The **hour meter** records the number of hours that a truck has been used. It should be recorded in your Daily Inspection Log. Maintenance is often scheduled by hours of truck use, so it is an important indicator.

### Requirements and Recommended Practices:

- Log the hours of use daily.
- Do not exceed manufacturer's recommended hours in service.
- Properly maintain vehicles according to manufacturer's recommended maintenance schedule. Only trained and authorized personnel may service a forklift.



**Figure 8. Hour meter indicating the total time the forklift has been in service.**

## Battery Discharge Meter

Electric forklifts have a battery discharge indicator that shows when a battery charge is low. Some ways that battery gauges on the instrument panel indicate the battery is discharged are:

- the warning light indicator is on.
- the gauge needle is in the warning zone.
- a percentage indicator shows the battery charge level.



Battery

**Figure 9. Battery low.**

### Requirements and Recommended Practices:

- Return to the battery recharging area if the battery gauge is low.
- Recharge the battery only if you are trained and authorized to do so.

For the procedures, see [Battery Charging and Changing Procedures](#).

## Battery

This section reviews the parts of batteries used in electric forklifts. For information on battery use, maintenance, recharging, and changing, see [Power Sources: Electrical](#).

### Parts of an Industrial Battery

Electric forklift service personnel need to know the parts of an industrial battery in order to properly and safely handle it at the end of every shift. The parts of a industrial battery include:

- **Cell:** The interior of the battery is divided into **cells**, with each cell containing a set of alternately spaced positive and negative plates. A negative plate is contained at each end of the cell to maintain proper electrical balance. The battery's voltage is determined by the number of cells.
- **Separator:** Separators are located between the plates for insulation.
- **Battery tray:** The cells are in a steel container called the battery tray.
- **Electrolyte:** The cell elements are fully submerged in a sulfuric acid solution called the **electrolyte**.
- **Element:** A **positive and negative terminal** is visible at the top of each cell. This assembly is known as the **element**. It is placed in the **jar**, the acid-proof, high-impact resistant container. A high-impact cover seals to the jar.
  - **Positive terminal.** All the positive plates are connected to the positive terminal.
  - **Negative terminal.** All the negative plates are connected to the negative terminal.

### Potential Hazards:

- Electrical shock.



**Figure 1. Recharging battery.**



**Figure 2. This is a cutaway of an industrial battery showing the rugged plates, extra heavy grids and impact-resistant case.**

- Explosion.

### **Requirements and Recommended Practices:**

- Never accidentally create an electrical current by connecting the positive to the negative terminal through any part of your body or through any other conductor.
- Never wear metal jewelry which will conduct electricity when working around batteries.
- Never put metal articles or tools on top of the batteries or place conductive articles across the battery posts.
- Always shut the charger off when connecting or disconnecting the battery. An arc or spark could cause an explosion.
- Use only non-sparking, non-conductive tools.
- Keep the vent plugs in place at all times except when adding water to the cells or taking hydrometer readings.
- Check the battery cables and cable connectors regularly. If the insulation is worn or connector contacts are pitted, the truck should be removed from service and repairs made immediately.
- Follow proper lockout/tagout procedures [[29 CFR 1910.147](#)] when working on a battery in a forklift.

For more information, see [Battery Charging and Changing Procedures](#).

### **Additional Information:**

- [Electrical](#). OSHA Safety and Health Topics Page.
- [Control of Hazardous Energy \(Lockout/Tagout\)](#). OSHA Safety and Health Topics Page.



## Overhead Guard

An overhead guard is designed to protect the operator from falling objects.

## Overhead Guard

### Requirements and Recommended Practices:



Figure 1. Overhead guard.

- Use an overhead guard as protection against falling objects such as small packages, boxes, bagged material, etc., but not to withstand the impact of a falling capacity load. [[29 CFR 1910.178\(m\)\(9\)](#)]
- Wear a hard hat when appropriate for additional protection.
- Keep hands and feet within the forklift to avoid danger of falling loads.
- Use a load backrest extension behind the forks whenever necessary to minimize the possibility of the load or part of it from falling rearward. [[29 CFR 1910.178\(m\)\(10\)](#)]
- Equip all high-lift rider trucks, order-picker trucks and rough-terrain forklift trucks with an overhead guard manufactured in accordance with ANSI B56.1-1969, "Safety Standard for Low and High Lift Trucks," unless operating conditions do not permit. [[29 CFR 1910.178\(e\)\(1\)](#)]
- As part of the daily inspection of the forklift, check the overhead guard for broken welds, missing bolts, or other damage.

## Tires

There are several different types of forklift tires, depending on how the forklift is used. Common types of forklift tires include pneumatic, solid, and polyurethane. As part of the daily inspection of the forklift, check tire condition, including cuts and gouges, and check pressure for air-filled tires.



**Figure 1. Forklift tire.**

## Other Safety and Warning Devices

Forklifts can incorporate many warning and safety devices to help protect operators, pedestrians, other forklift operators and others.

### Warning and Safety Devices

Powered industrial trucks may be equipped by the manufacturer with the following safety devices:

- Seat belts and similar restraints
- Horns
- Backup alarms that sound when forklift reverses
- Fire extinguisher
- Warning lights that flash
- Directional signals and brake lights
- Mirrors



**Figure 1. Forklift operator using a seat belt.**



**Figure 2. Fire extinguisher.**

## Requirements and Recommended Practices:

- Equip every power-propelled truck with an operator-controlled horn, whistle, gong, or other sound-producing device. ANSI B56.1-1969 Incorporated by reference [[29 CFR 1910.178\(a\)\(2\)](#)]
- Equip every truck with an operator-controlled horn, whistle, gong, or other sound-producing device. ANSI/ITSDF B56.1-2005.
- Where appropriate to the worksite, equip trucks with additional sound-producing or visual (such as lights or blinkers) devices. ANSI/ITSDF B56.1-2005.



**Figure 3. Safety mirror with pedestrian in view.**



**Figure 4. Warning strobe light flashes as operator backs up.**

#### **Additional Information:**

- [OSHA Instruction CPL 02-01-028 \(CPL 2-1.28A\)](#) - Compliance Assistance for the Powered Industrial Truck Operator Training Standards (Nov. 30, 2000). Section 1910.178 does not currently contain requirements for the use of operator restraint systems. However, Section 5(a)(1) of the OSH Act requires employers to protect employees from serious and recognized hazards.
- [OSHA's Seat Belt Policy](#): OSHA's enforcement policy on the use of seat belts on powered industrial trucks in general industry is that employers are obligated to require operators of powered industrial trucks that are equipped with operator restraint devices, including seat belts, to use the devices.
- ANSI/ITSDF B56.1-2005 - Safety Standard for Low Lift and High Lift Trucks.