

## Materials Handling and Storage

There are hundred of thousands of materials handling accidents every year, ranging from small splinters, cuts or scrapes, to crushed fingers, hands and feet - even deaths.



### Potential Hazards

- Handling and storing materials involves diverse operations:
- Hoisting tons of steel with a crane
- Driving a truck loaded with concrete blocks
- Manually carrying bags or materials
- Stacking drums, barrels, kegs, lumber or loose bricks

The efficient handling and storing of materials is vital to Industry:  
Provide continuous flow of raw materials, parts, and assemblies through workplace  
Ensure materials are available



## **Improper handling and storing of materials can cause costly injuries**

- **Each year there are approximately 400,000 workplace accidents resulting in back injuries**
- **Back injuries make up more than 20% of all occupational illnesses**
- **On average there are approximately 600,000 over-exertion cases with lost workdays**
  - lifting heavy objects
  - pushing/pulling
  - Carrying heavy objects without mechanical device
- Workers can be injured by:
  - Falling objects
  - Improperly stacked materials
  - Various types of equipment
- When manually moving materials, be aware of potential injuries such as:
  - Strains and sprains
  - Fractures and bruises
  - Cuts and bruises
- It is important to be aware of accidents that may occur from unsafe or improperly handled equipment and improper work practices
- Recognize the methods for eliminating or at least minimizing the occurrence of those accidents'
- Examine your workplace to detect any unsafe or unhealthy conditions, practices or equipment
- Take the necessary steps to correct them

### **Methods of prevention**

- General Safety Principals
- Work Practices
- Ergonomic Principals
- Training and Education



## Moving, Handling and Storing Materials

### Manually Moving Materials

- You should seek help when
- A load cannot be properly grasped or lifted
- You cannot see around or over it
- You cannot safely handle the load
- Ensure that no part of the body is under a raised load
- Blocking: materials should be large and strong to support load
  - When loads are heavy and/or bulky
  - Use to reduce finger pinching or smashing



- **Use personal Protective Equipment (PPE)**
  - For loads with sharp/rough edges:
  - Use gloves/hand and forearm protection
  - Eye protection
  - Steel-toe safety shoes or boots



**Mechanically moving materials:**

- Avoid overloading equipment
- Equipment-rated capacity on each piece of equipment

**Powered Industrial Trucks:**

- The load must be centered on the forks
- The load must be as close to the mast as possible
- Never overload a lift truck
- The load must be at the lowest position for traveling
- All stacked loads must be correctly piled



**Lumber:**

- Stack and level on solidly supported bracing
- Self-supporting



**Bricks:**

- Stacks should be no more than 7 feet high
- Taper back 2 inches for every foot of height above 4 feet



**Masonry blocks:**

- Taper back half block for each tier above the 6-foot level
- 





**Bags and bundles:**

- Stack in interlocking rows to remain secure

**Bagged materials:**

- Stack by stepping back the layers and cross-keying the bags at least every ten layers



**Baled paper and rags stored inside a building:**

- Must not be closer than 18 inches to the walls, partitions, or sprinkler heads
- Boxed materials:
- Must be banded or held in place using cross-ties or shrink plastic fiber



**Drums, barrels, and kegs must be stacked symmetrically**

- If stored on their sides, the bottom tiers must be blocked up to keep them from rolling
- When stacked on end, put planks, sheets of plywood dunnage, or pallets between each tier to make a firm, flat stretching surface.
- When stacking materials two or more tiers high, the bottom tier must be chocked on each side to prevent shifting in either direction.



When stacking, consider the need for availability of material.

Material that cannot be stacked due to size, shape, or fragility can be safely stored on shelves or in bins.

Structural steel, bar stock, poles, and other cylindrical materials, unless in racks, must be stacked and blocked to prevent spreading or tilting.

Pipes and bars should not be stacked in racks that face main aisles (This could create a hazard to passers-by when removing supplies).



### **Using Materials Handling Equipment**

**To reduce potential accidents associated with workplace equipment, employees need to be trained in the proper use and limitations of the equipment they operate.**

**This includes:**

- Conveyers
- Cranes
- Slings



## Conveyors



### When using conveyors:

- Workers' hands may be caught in nip points where the conveyor medium runs near the frame or over support members or rollers
- Workers may be struck by material falling off the conveyor
- Workers may become caught on or in the conveyor, being drawn into the conveyor path as a result.

### To reduce the severity of an injury:

- The emergency button or pull cord designed to stop the conveyor must be installed at the employee's workstation
- Continuously accessible conveyor belts should have an emergency stop cable
- Emergency stop switch must be designed to reset before the conveyor can be restarted.
- Clear the stoppage before restarting
- Never ride on a materials handling conveyor

### Where a conveyor passes over work areas or aisles:

- Guards must be provided to keep employees from being struck by falling material
- if the crossover is low enough for workers to run into it:
- The guard must be either marked with a warning sign or painted a bright color to protect employees

### Screw Conveyors:

- Must be completely covered except at loading and discharging points
- Guards must protect employees against contacting the moving screw:
- The guards are movable, and must be interlocked to prevent conveyor movement when not in place

## Cranes:



Employers must permit only thoroughly trained and competent persons to operate cranes  
Operators should know what they are lifting and what it weighs

- For example, rated capacity of mobile cranes varies with the length of the boom and the boom radius
- When a crane has telescoping boom, a load may be safe to lift at a short boom length and/or a short boom radius, but may overload the crane when the boom is extended and the radius increases
- Moveable cranes must have boom angle indicators
- cranes with telescoping booms must have means to determine boom lengths
- Load rating charts must be posted in the cab-operated cranes
- All mobile cranes do not have uniform capacities for the same boom length and radius
- Always check the crane's load chart
- Plan lifts before starting
- Take additional precautions and exercise extra care when operating around power lines
- Some mobile cranes cannot operate with outriggers in the traveling position
- Outriggers must rest on firm ground, on timbers, or be sufficiently cribbed to spread the weight of the crane and the load over large enough area
- 

**Following the bulleted items above will help the crane from tipping**

- Hoisting chains and ropes must always be free of kinks or twists and never wrapped around a load
- Loads should be attached to the load hook by slings, fixtures and other devices that have the capacity to support the load on the hook
- Sharp edges of loads should be padded top prevent cutting slings

- proper sling angles must be maintained so that the slings are not loaded in excess of their capacity

**All cranes must be inspected frequently by persons familiar with:**

- The crane
- The methods of inspecting the crane
- What can make the crane unserviceable
- Crane activity, the severity of use, and environmental conditions should determine inspection schedules
- Critical parts, such as crane operating mechanisms, hooks, air or hydraulic system components and other load-carrying components should be inspected daily for any maladjustment, deterioration, leakage, deformation or other damage

**Slings**



When working with slings, employers must ensure that they are visually inspected before use and during operation, especially if used under heavy stress

**Riggers**



- Riggers or other knowledgeable employees should conduct or assist in the inspection because they are aware of how the sling is used and what makes it unserviceable.
- A damaged or defective sling must be removed from service.
- Slings must not be shortened with knots or bolts or other makeshift devices.
- Sling legs that have been kinked are prohibited.
- Slings must not be loaded beyond their rated capacity
- Suspended loads must be kept clear of all obstructions
- Crane operators should avoid sudden starts and stops when moving suspended loads
- Employees must remain clear of loads about to be lifted and suspended.
- All shock loading is prohibited

### Powered Industrial Trucks



Workers who must handle and store materials often use:

- Fork Trucks
- Platform lift trucks
- Motorized hand trucks
- Other specialized industrial trucks powered by electrical motors or internal combustion engines

Affected Workers should be aware of:

- The safety requirements pertaining to fire protection
- The design
- Maintenance
- Use of powered industrial trucks
  
- All new powered industrial trucks must meet the requirements for powered industrial trucks established in the American National Standard for Powered Industrial Trucks, part II, ANSI B56.1-1969
- Approved trucks also must bear a label or some other identifying mark indicating acceptance by a nationally recognized testing laboratory
- An owner or user must not make modifications and additions affecting capacity and safe operation of the trucks without the manufacturer's prior written approval
- Plates and tags or decals must be changed to reflect new information such as:
  - - Capacity
    - Operation
    - Maintenance instructions
  
- If the truck is equipped with front-end attachments that are not factory installed
  
- The user should request that the truck be marked to identify these attachments
  - Show the truck's approximate weight, including the installed attachment
  - When it is at maximum elevation with its load laterally centered

Modifications and additions that affect capacity and safe operation of the trucks shall not be performed by an owner or user without the manufacturer's prior written approval. In these cases, capacity, operation, and maintenance instruction plates and tags or decals must be changed to reflect the new information. If the truck is equipped with front-end attachments that are not factory installed, the user should request that the truck be marked to identify these attachments and show the truck's approximate weight, including the installed attachment, when it is at maximum elevation with its load laterally centered.

There are 11 different types of industrial trucks or tractors, some having greater safeguards than others. There are also designated conditions and locations under which the vast range of industrial-powered trucks can be used. In some instances, powered industrial trucks cannot be used, and in others, they can only be used if approved by a nationally recognized testing laboratory for fire safety. For example, powered industrial



trucks must not be used in atmospheres containing hazardous concentrations of the following substances:

Acetylene  
Butadiene  
Ethylene Oxide  
Hydrogen  
Propylene Oxide  
Acetaldehyde  
Cyclopropane  
Diamethyl Ether  
Ethylene  
Isoprene  
Unsymmetrical Diamethyl Hydrazine

- In atmospheres containing hazardous concentrations of metal dust, including aluminum, magnesium, and other metals of similarly hazardous characteristics
- In atmospheres containing carbon black, coal or coke dust

Where dust of magnesium, aluminum, or aluminum bronze dusts may be present, the fuses, switches, motor controllers, and circuit breakers of trucks must be enclosed with enclosures approved for these substances.

## **Using Materials Handling Equipment**

### **Powered Industrial Trucks**

- There are powered industrial trucks that are designed, constructed and assembled for use in atmospheres containing flammable vapors or dusts.
- These include industrial-powered trucks equipped with:
  - Additional safeguards to their exhaust, fuel, and electrical systems
  - No electrical equipment, including the ignition, electric motors and all other electric components
- These specifically designed powered industrial trucks may be used in locations where volatile flammable liquids or flammable gases are handled, processes, or used.
- Liquid, vapors or gases should, among other things, be confined within closed containers or closed systems from which they cannot escape.

### **Temperature limitation features – Atmosphere vapors or dust:**

Some other conditions and/or locations in which specifically designed powered industrial trucks may be used include the following:

Only powered industrial trucks that do not have any electrical equipment, including the ignition, and have their electrical motors or other electrical equipment completely enclosed should be used in atmospheres containing flammable vapors or dust.

**Piers and wharves that handle general cargo:**

Powered industrial trucks that are either powered electrically by liquefied petroleum gas or by a gasoline or diesel engine are used on piers and wharves that handle general cargo.

**Safety precautions the user can observe when operating or maintaining powered industrial trucks include:**

- That high lift rider trucks be fitted with an overhead guard, unless operating conditions do not permit.
- That fork trucks be equipped with a vertical load backrest extension according to manufacturers' specifications, if the load presents a hazard.
- That battery charging installations be located in areas designated for that purpose.
- That facilities be provided for flushing and neutralizing spilled electrolytes when changing or recharging a battery to prevent fires, to protect the charging apparatus from being damaged by the trucks, and to adequately ventilate fumes in the charging area from gassing batteries.
- That conveyor, overhead hoist, or equivalent materials handling equipment be provided for handling batteries.
- That auxiliary directional lighting be provided on the truck where general lighting is less than 2 lumens per square foot.
- That arms and legs not be placed between the uprights of the mast or outside the running lines of the truck.
- That brakes be set and wheel blocks or other adequate protection be in place to prevent movement of trucks, trailers, or railroad cars when using trucks to load or unload materials onto train boxcars.
- That sufficient headroom is provided under overhead installations, lights, pipes, and sprinkler systems.
- That personnel on the loading platform have the means to shut off power to the truck. That dockboards or bridgeplates be properly secured, so they won't move when equipment moves over them.
- That only stable or safely arranged loads be handled, and caution be exercised when handling loads.
- That trucks whose electrical systems are in need of repair have the battery disconnected prior to such repairs.
- That replacement parts of any industrial truck be equivalent in safety to the original ones.

## **ERGONOMIC SAFETY AND HEALTH PRINCIPLES**

Ergonomics is defined as the study of work and is based on the principle that the job should be adapted to fit the person, rather than forcing the person to fit the job.

Ergonomics focuses on the work environment and items such as design and function of workstations, controls, displays, safety devices, tools, and lighting to fit the employees' physical requirements and to ensure their health and well being.

Ergonomics includes restructuring or changing workplace conditions to make the job easier and reducing/stressors that cause cumulative trauma disorders and repetitive motion injuries. In the area of materials handling and storing, ergonomic principles may require controls such as reducing the size or weight of the objects lifted, installing a mechanical lifting aid, or changing the height of a pallet or shelf.

Although no approach has been found for totally eliminating back injuries resulting from lifting materials, a substantial number of lifting injuries can be prevented by implementing an effective ergonomics program and by training employees in appropriate lifting techniques.

In addition to using ergonomic controls, there are some basic safety principles that can be employed to reduce injuries resulting from handling and storing materials. These include taking general fire safety precautions and keeping aisles and passageways clear.

In adhering to fire safety precautions, employees should note that flammable and combustible materials must be stored according to their fire characteristics. Flammable liquids, for example, must be separated from other material by a fire wall. Also, other combustibles must be stored in an area where smoking and using an open flame or a spark-producing device is prohibited. Dissimilar materials that are dangerous when they come into contact with each other must be stored apart.

When using aisles and passageways to move materials mechanically, sufficient clearance must be allowed for aisles at loading docks, through doorways, wherever turns must be made, and in other parts of the workplace. Providing sufficient clearance for mechanically moved materials will prevent workers from being pinned between the equipment and fixtures in the workplace, such as walls, racks, posts, or other machines. Sufficient clearance also will prevent the load from striking an obstruction and falling on an employee.

All passageways used by employees should be kept clear of obstructions and tripping hazards. Materials in excess of supplies needed for immediate operations should not be stored in aisles or passageways, and permanent aisles and passageways must be marked appropriately.



## TRAINING AND EDUCATION

OSHA recommends using a formal training program to reduce materials handling hazards. Instructors should be well-versed in matters that pertain to safety engineering and materials handling and storing. The content of the training should emphasize those factors that will contribute to reducing workplace hazards including the following:



- Alerting the employee to the dangers of lifting without proper training.
- Showing the employee how to avoid unnecessary physical stress and strain.
- Teaching workers to become aware of what they can comfortably handle without undue strain.
- Instructing workers on the proper use of equipment.
- Teaching workers to recognize potential hazards and how to prevent or correct them.

**Because of the high incidence of back injuries, safe lifting techniques for manual lifting should be demonstrated and practiced at the work site by supervisors as well as by employees.**



- A training program to teach proper lifting techniques should cover the following topics:
- Awareness of the health risks to improper lifting — citing organizational case histories.
- Knowledge of the basic anatomy of the spine, the muscles, and the joints of the trunk, and the contributions of intra-abdominal pressure while lifting.
- Awareness of individual body strengths and weaknesses—determining one's own lifting capacity.
- Recognition of the physical factors that might contribute to an accident, and how to avoid the unexpected.
- Use of safe lifting postures and timing for smooth, easy lifting and the ability to minimize the load-moment effects.
- Use of handling aids such as stages, platforms, or steps, trestles, shoulder pads, handles, and wheels.
- Knowledge of body responses—warning signals—to be aware of when lifting.

A campaign using posters to draw attention to the need to do something about potential accidents, including lifting and back injuries, is one way to increase awareness of safe work practices and techniques. The plant medical staff and a team of instructors should conduct regular tours of the site to look for potential hazards and allow input from workers.

## **SAFETY AND HEALTH PROGRAM MANAGEMENT GUIDELINES**

To have an effective materials handling and storing safety and health program, managers must take an active role in its development. First-line supervisors must be convinced of the importance of controlling hazards associated with materials handling and storing and



must be held accountable for employee training. An on-going safety and health program should be used to motivate employees to continue to use necessary protective gear and to observe proper job procedures.

*OSHA's recommended "Safety and Health Program Management Guidelines" issued in 1989 can provide a blueprint for employers who are seeking guidance on how to effectively manage and protect worker safety and health. The four main elements of an effective occupational safety and health program are (a) management commitment and employee involvement, (b) worksite analysis, (c) hazard prevention and control, and (d) safety and health training. These elements encompass principles such as establishing and communicating clear goals of a safety and health management program; conducting worksite examinations to identify existing hazards and the conditions under which changes might occur; effectively designing the job site or job to prevent hazards; and providing essential training to address the safety and health responsibilities of both management and employees.*

Instituting these practices, along with providing the correct materials handling equipment, can add a large measure of worker safety and health in the area of materials handling and storing.



