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## **Module 13: Materials Handling, Use and Disposal**

### **Module Description**

This module introduces the hazards that are involved in the handling and storage of materials. Different methods of handling and storage are discussed, the hazards they pose to workers, and the methods by which these hazards can be reduced or eliminated from the workplace.

### **Module Learning Objectives**

At the conclusion of this module, you should be able to:

- State the major causes of injury suffered from handling and storing materials.
- Identify the various methods that can be used to prevent injuries.
- Discuss the safety measures involved when operating mechanical handling devices.
- Discuss the various safety and health principles that can be adopted in the workplace.

# **Lesson 1: The Hazards and Methods of Prevention**

## **(Manual Handling)**

### **Lesson Focus**

This lesson focuses on the following topics:

- Introduction
- Body Movement
- Methods of Prevention

### **Introduction**

Every industry needs a continuous inflow and outflow of resources and materials. Therefore, there is an ever-present need to handle and store materials that are so vital to industry. However, improper handling and storage of materials can be hazardous if precautions are not taken.

### **Bulkiness and Weight of Materials**

Two of the major hazards involved in handling and storing materials include:

- Bulkiness
- Weight of Materials

Often, handling heavy and bulky objects results in back and spinal injuries. Workers that lift these objects may suffer from acute and chronic back pains.

### **Body Movement**

This is a common factor related to back injuries. Bending, twisting, and turning are some of the common body movements that lead to back and spinal injuries.

Another common factor that can potentially cause severe injuries is falling objects. Materials that have been improperly stacked can present a great danger.

When workers move materials they must be aware of the following:

- Improper lifting may cause strains and sprains.
- Falling materials may cause bruises, fractures, or even death.

It is very important that efforts be made by both the employer and worker to ensure that dangers from improper material handling are minimized, if not eliminated, from the workplace. Inspections of the workplace must be carried out on a periodical basis to ensure that they are free from any related hazards.

## **Methods of Prevention**

If the worker has to manually handle an object, he or she must ask for assistance when a load is:

- Bulky to the extent that it cannot be grasped or lifted properly.
- Bulky to the extent that it cannot be seen around or over.
- One that cannot be handled safely.

## **Blocks**

When placing blocks under raised loads, workers must make sure that the raised loads are kept in a raised position until their hands have been removed from beneath them. The blocks must be large and sturdy enough to be able to support the load. Block materials with cracks, splintered pieces, and rot must not be used.

## **Handles, Holders, and Protective Equipment**

All loads ideally should be moved via mechanical means when possible. When loads are to be moved manually, with the use of handles and holders may minimize chances of injuries to the fingers and hands. In the case of loads with sharp and rough edges, workers must wear gloves. It also may be advisable for a worker to be fitted with steel-toed shoes when carrying heavy or bulky loads, so as to minimize the risk of foot injuries in the case of accidentally dropping the load.

## **Load Weight and Mechanical Moving Equipment**

Workers must never overload mechanical moving equipment. All types of material handling equipment have maximum weight specifications which must be adhered to. As such, the type of equipment used to move a load from one point to another must be dictated by the specifications of the load itself.

## **Stored Materials**

Workers must ensure that stored materials do not create hazards. For example, workers must ensure that storage spaces are not left to accumulate flammable materials, cause explosions or tripping hazards, or easily harbor rats and other pests. Additionally, storage

containers must have adequate capacity to handle the height and weight of stored items, as well as being accessible and in good condition.

### **Bound Material**

All materials stored in tiers shall be stacked, racked, blocked, interlocked, or otherwise secured to prevent sliding, falling, or collapse.

Furthermore, maximum safe load limits that have been specified by building inspectors must not be exceeded or otherwise violated, and signs displaying load limits must be posted in all storage areas except for slab on grade.

### **Height Limitations**

Always adhere to height limitations when stacking materials.

Lumber that is manually handled must not be stacked at a height of more than 16 feet; 20 feet if a forklift is being used. Painting stripes on poles and walls is a good way to indicate the maximum height allowed.

### **Stacking Lumber, Bricks, and Masonry Blocks**

If used lumber is being stacked, workers must ensure that all nails have been removed before stacking lumber. Furthermore, workers must ensure that the lumber stacks are on level and solidly supported bracing. Lumber must be stacked such that it is stable and self-supporting.

Loose bricks must not be stacked to heights of more than seven feet. When a stack of loose bricks exceeds four feet, they must be tapered back two inches for every foot of height over and above the four-foot level.

When masonry blocks are stacked to a height of six feet or higher, the stacks must be tapered back one-half block for each tier over the six-foot level.

### **Bags and Bundles**

It is advisable that when bags and bundles are stacked, interlocking rows are used. Bagged materials must be stacked by stepping back the layers and cross-keying the bags at least every ten bags high. When workers remove bags from the stack, they must start with the topmost layer working their way down.



Non-compatible materials shall be segregated in storage. Baled paper and rags must be kept at a minimum of 18 inches from walls, sprinklers, and partitions. Finally, it is advised that boxed materials be banded, or at least held in place using cross-ties or shrink plastic fiber.

### **Drums, Barrels, and Kegs**

- Drums, barrels, and kegs must be stored symmetrically.
- However, if they are stored on their sides, the bottom tiers must be blocked accordingly to prevent them from rolling.
- When barrels are stacked on end, planks must be placed between each tier to make a firm, flat stacking surface.
- If the stack reaches two or more tiers, the lowest tier must be secured on either side to prevent the barrels from shifting.

### **Availability for the Material**

When employees stack materials, they must consider the need for availability of the material. Some materials cannot be stacked due to shape, size, or fragility constraints. In most cases these can be safely stored on shelves or in bins.

Poles, structural steel, and other cylindrical materials can be stored in racks. If they are stacked, they must be blocked to prevent them from spreading and/or tilting. Pipes and bars must not be stored in racks that face the main aisle, as this could be hazardous to passers-by, especially while moving materials.

## **Lesson Summary**

Some materials cannot be stacked due to shape, size, or fragility constraints. In most cases, these can be safely stored on shelves or in bins. All materials stored in tiers must be stacked, racked, blocked, interlocked, or otherwise secured to prevent sliding, falling, or collapse. Storage containers must also have adequate capacity to handle the height and weight of stored items, as well as be accessible and in good condition. Fitting loads with handles and holders may minimize the chances of injuries to the fingers and hands.

Bending, twisting, and turning are some of the common body movements that can lead to back and spinal injuries. Frequent handling of heavy and bulky objects often results in such injuries. Workers that lift these types of objects may suffer from acute and chronic back pains.

## **Lesson 2: Materials Handling Equipment**

### **Lesson Focus**

This lesson focuses on the following topics:

- Conveyors
- Cranes
- Slings
- Powered Industrial Trucks

### **Conveyors**

#### **Risks**

The following risks are associated with using conveyors:

- Workers' hands can get caught at points where the conveyor runs over support members.
- If the conveyor passes over a work area, workers can be struck by falling materials.
- A worker can become caught and drawn into the conveyor.

#### **Safety Measures**

There are a number of methods an employer can use to reduce the frequency and severity of conveyor-related injuries.

- Emergency buttons or pull cords designed to stop the conveyor must be installed, preferably near worker stations.
- Conveyor belts that are continuously accessible (such as those used in assembly lines) must have emergency stop cables that run along the entire length of the belt.
- Emergency stop systems must be designed in such a manner that they have to be reset before the conveyor can start again. This ensures that the conveyor can run only after an employee has been removed from danger.
- Employees are strictly prohibited from riding on the conveyor.
- When a conveyor passes over a work area, guards must be fitted along the sides of the belt to ensure that materials do not fall on employees.
- In cases where the crossover is low, a warning sign must be displayed or the area must be painted in a bright color that is easily noticeable.

## Cranes

### Operators

It is very important to note that only qualified, competent persons must be allowed to operate cranes. Operators must know the specifications of all loads they lift, such as what is actually being lifted and its weight. Each crane has a rated capacity that is determined by the length of its boom and the boom radius.

**Note:** Cranes that have telescopic booms may be capable of lifting a heavier load when the boom length and radius are small. If the boom is extended, the weight of the object can overload the crane.

### Movable Cranes

When using movable cranes, the operator must ensure that a boom angle indicator has been fitted. In cases where the crane has a telescopic boom, a means of determining the boom's length also must be present. Load rating charts that are specific to the crane must be placed in the operator's cabin.

### Outriggers

Mobile that requires the use of outriggers must be placed on firm, level ground. The outrigger must be placed on timbers or cribbed so as to spread the weight of the crane and the load over a large enough area. This helps to ensure that the crane remains stable and does not tip while in operation.

### Loads

Operators must ensure that hoisting chains and ropes are properly attached in reference to the load. This can be achieved by ensuring that loads are connected to the load hooks by slings or fixtures. All sharp edges of loads must be padded to prevent them from cutting into slings.

## Safety Inspections

Cranes must be inspected as directed by the manufacturer and OSHA standards by competent persons who are familiar with them. Critical parts such as the operating mechanisms, hooks, and load-carrying components must be checked on at least a daily basis to ensure that no deterioration, damage, or maladjustments have occurred.



## Slings

Employers must ensure that slings are visually inspected before and during all operations. A damaged or defective sling must be removed from service immediately.

- Slings must not be shortened with knots, bolts, or by any other means unless they are specifically designed by the manufacturer to do so. The rated capacity of a sling must be noted and strictly adhered to.
- Slings must not be loaded beyond their rated capacity.
- Shock loading is strictly prohibited.
- Jerking the load, rather than slowly picking it up causes the force to be multiplied and can exceed the rated capacity of the sling or chain even though the load weight is a fraction of the capacity.
- Hands or fingers should not be placed between the sling and its load while the sling is being tightened around the load.
- A sling should not be pulled from under a load when the load is resting on the sling.

## Powered Industrial Trucks

New powered industrial trucks (e.g. tow motors, forklifts, fork trucks, cherry-pickers, etc.) must meet the design and construction requirements of the American National Standard for Powered Industrial Trucks, Part II, ANSI b56.1-1969. Powered industrial trucks (P.I.T.s) manufactured since 1969 must have identifying marks indicating that they have been inspected and accepted by a nationally accepted testing laboratory.

P.I.T. owners and operators must not make any modifications or additions to the truck without the approval of the manufacturer. If any modifications are made, capacity, operation, and maintenance instruction tags, and signs must be changed to reflect the new requirements.

There are 11 different types of industrial trucks or tractors, each having varying safety levels, constraints, and load capabilities. They all operate under different conditions and environments. In some cases, certain trucks cannot be used, and in other cases they can be used only if approved by a nationally accepted testing laboratory.

Under normal circumstances, P.I.T.s must not be used in atmospheres containing high concentrations of metal dust, carbon black, coal, or coke dust.

In cases of existing high concentrations of magnesium, aluminum, or aluminum bronze dust, the circuit breakers, fuses, switches, and motor controllers of P.I.T.s must be protected or enclosed.

**More Information:**

- **Metal Dust:** Trucks must not be used in atmospheres containing **Metal Dust**.
- **Carbon Black:** Trucks must not be used in atmospheres containing **Carbon Black**.
- **Coal or Coke Dust:** Trucks must not be used in atmospheres containing **Coal or Coke Dust**.

Some powered industrial trucks have been constructed specifically for use in areas that contain flammable vapors or dusts. Additions, such as safeguards to the exhaust, fuel, and electrical systems, have to be made to the trucks in such cases. Due to the flammability and volatility of the atmosphere, such trucks will have to be equipped with non-electrical ignitions, temperature limitation features, and electrical engines, and many other safety devices.

There are some safety precautions that must be followed when operating and maintaining a powered industrial truck. These include:

- High lift trucks must be fitted with overhead guards.
- Forklifts must be equipped with vertical load backrest extensions that comply with the manufacturer's specifications.
- Battery charging installations must be placed only in areas that have been specified for that purpose.
- A conveyor, overhead hoist or equivalent handling equipment must be used when handling batteries.
- Trucks that have a general lighting of less than two lumens per square foot must be provided with auxiliary directional lighting.
- Arms and legs must not be placed between uprights of the mast or outside the running lines of the truck.
- Overhead installations such as lights, pipes, and sprinkler systems must be adequately protected.
- Personnel working on a properly designed loading platform must have means to shut off power to the truck if needed.
- All trucks that are to undergo repairs to their electrical systems must have their batteries disconnected prior to the repairs.
- Any replacement part for the trucks must have the equivalent safety levels as the original parts.
- Only stable and safely arranged loads are to be handled. Caution must be exercised at all times when handling loads.
- When using trucks to load or unload materials onto train boxcars, trucks, trailers, or railroad cars, the trucks must be secured using brakes and wheel blocks to prevent their movement.

## Lesson Summary

Employers must ensure that slings are visually inspected before and during all operations. A damaged or defective sling must be removed from service immediately.

There are a number of methods an employer can use to reduce the severity of crane-, industrial truck-, and conveyor-related injuries. For example, determining the rated capacity of a crane by the length of its boom and the boom radius will aid in preventing potential injuries.



## **Lesson 3: Ergonomics, Training and Education**

### **Lesson Focus**

This lesson focuses on the following topics:

- Ergonomic Safety and Health Principles
- Fire Safety Precautions
- Aisles and Passageways
- Training and Education
- Safety and Health Program Management Guidelines

### **Ergonomics Safety and Health Principles**

Ergonomics is a principle that states that jobs should be adapted to fit the person, rather than the person being forced to fit the job. As such, the study of ergonomics attempts to provide the most conducive environment possible to fit the employee's needs and lead to the greatest possible productivity.

Ergonomics includes changing workplace conditions to make the job as least physically demanding as possible and to reduce the stressors that can lead to trauma or injuries from repetitive actions. In the case of material storage and handling, this may include reducing the size or weight of objects lifted, making use of mechanical lifting aids, or changing the height of pallets and shelves to make them more accessible.

There are numerous methods by which lifting injuries can be prevented, including the implementation of ergonomically designed systems and the proper training and supervision of employees.

In addition to the use of ergonomic principles, there are a number of basic safety precautions that can be employed to reduce the incidence and severity of lifting injuries. These include the use of general fire safety precaution techniques and keeping aisles and passages clear.

### **Fire Safety Precautions**

Employees must always keep in mind that flammable and combustible materials must be stored in accordance to their fire characteristics. For example, when storing flammable liquids, employees must ensure that they are separated from other materials by using fire walls or other appropriate storage facilities and equipment.



Combustibles must be stored in areas where smoking, open flames, and sparks are prohibited. Some materials are only dangerous when they come together. Employees must be aware of the reactive qualities of different materials and keep potentially reactive materials properly separated from each other.

## Aisles and Passageways

Sufficient clearance must be allowed in passageways and aisles for the movement of materials mechanically, particularly at loading docks, through doorways, and wherever turns must be made. Providing sufficient clearance will minimize the possibility that workers will get pinned down. Also, sufficient clearance will reduce the risk that a load will strike an obstruction and fall on an employee. As such, all passageways and aisles must be kept clear of obstructions and tripping hazards. Materials should never be stored in aisles.

## Training and Education

OSHA requires that all employees participate in training programs related to handling and storage hazards. These programs must contain material that will be helpful to employees in reducing material handling and storage hazards. The training program must include the following:

- Informing employees about the dangers of handling heavy and bulky materials without proper training.
- Illustrating how to avoid unnecessary physical stress and strain.
- Teaching employees to determine what they are able to comfortably handle without having to undergo physical strain.
- Instructing employees about the proper use of equipment.
- Teaching employees how to recognize potential hazards and how to prevent or correct them.

Due to the high incidence of back and spinal injuries that results from manual lifting, safe lifting techniques must be demonstrated to all employees. As such, a training program that is designed to instruct on proper lifting techniques must include:

- The health risks of improper lifting.
- Knowledge of the basic anatomy of the spine, muscles, and joints.
- Awareness of individual body weaknesses and strengths.
- Recognizing the physical factors that may lead to an accident.
- Use of safe lifting postures and timings and how to minimize load—moment effects.
- Use of handling aids such as steps, platforms, handles, etc.

- The warning signals the body may send if you lift something you should not.

## **Safety and Health Program Management Guidelines**

It is imperative that your company's management play an active role in the effective implementation of a safety and health program designed for handling and storage. When management is closely involved with such a program, line supervisors and (by extension) employees can be persuaded of its importance and motivated to take it seriously.

### **Material Storage**

Material stored inside buildings under construction shall neither be placed within 6 feet of any hoist way or inside floor openings, nor within 10 feet of an exterior wall which does not extend above the top of the material stored.

Each employee required to work on stored material in silos, hoppers, tanks, and similar storage areas shall be equipped with personal fall arrest equipment meeting the requirements of Subpart M of this part.

Non-compatible materials shall be segregated in storage.

### **Materials Stored on Tiers**

All materials stored in tiers shall be stacked, racked, blocked, interlocked, or otherwise secured to prevent sliding, falling, or collapse.

Maximum safe load limits of floors within buildings and structures, in pounds per square foot, shall be conspicuously posted in all storage areas, except for floor or slab on grade. Maximum safe loads shall not be exceeded.

Aisles and passageways shall be kept clear to provide for the free and safe movement of material handling equipment or employees. Such areas shall be kept in good repair.

When a difference in road or working levels exists, means such as ramps, blocking, or grading shall be used to ensure the safe movement of vehicles between the two levels.

OSHA's recommended *Safety and Health Program Management Guidelines*, issued in 1989, can provide a blueprint for employers who are seeking guidance about how to effectively manage and protect worker safety and health. The four main elements of an effective occupational safety and health program are:

- Management commitment and employee involvement

- Worksite analysis
- Hazard prevention and control
- Safety and health training

**More Information:** These elements encompass steps such as:

- Establishing and communicating clear safety and health management program goals.
- Conducting worksite audits to identify existing hazards and eliminate them. Effectively designing the job site or job to prevent hazards.
- Providing essential training to address the safety and health responsibilities of both management and employees.

### **Dock boards (Bridge Plates)**

- Portable and powered dock boards shall be strong enough to carry the load imposed on them.
- Portable dock boards shall be secured in position, either by being anchored or equipped with devices that will prevent their slipping.
- Handholds, or other effective means, shall be provided on portable dock boards to permit safe handling.
- Positive protection shall be provided to prevent railroad cars from being moved while dock boards or bridge plates are in position.

### **Lesson Summary**

It is imperative that your company's management play an active role in the effective implementation of a safety and health program designed for handling materials and their storage. When management is closely involved with such programs, it can persuade supervisors and employees alike of its importance, and motivate them to take the program seriously.

Employees must also be aware of the reactive qualities of different materials and keep them properly segregated. All passage ways must be maintained clear of obstructions. By implementing ergonomically designed systems and training employees, employers can greatly reduce the number of personnel injuries.