Module 13: Materials Handling, Use and Disposal

Pages 318 - 332

Lesson Summary

- Ignition hazards often include electrical wiring and equipment, individuals smoking, pipes or tanks that carry flammable material, and combustible dust.
- Temporary buildings should not be constructed in any location where the means of exit could be adversely affected. If a temporary structure is constructed within a building, it should be made of non-combustible material.
- Combustible materials should be stored in a stable condition and should not be stacked or piled higher than 20 feet.
- Proper planning includes regularly scheduled safety inspections, and methods of informing fire and rescue personnel if and when fires are discovered.
- A temporary or permanent water supply must be available and be able to provide a sufficient volume, duration, and pressure for the proper operation of firefighting equipment.
- Automatic sprinkler protection should be installed, if possible, and should be placed in service as soon as possible. During demolition or alterations, existing automatic sprinkler installations should be retained in service as long as is reasonable.

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, as well as 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, students will 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 during materials handling
- Discuss the safety measures necessary 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

At the end of this lesson, students will be able to:

- Explain how proper body movement can prevent injuries while handling materials
- Identify tools workers can use to handle materials more safely

Introduction

Every industry needs a continuous inflow and outflow of resources and materials. 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 their bulkiness and weight. Handling heavy and bulky objects often results in back and spinal injuries. Workers that lift these objects may suffer from acute and chronic back pains.

Body Movement

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, such as materials that have been improperly stacked.

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 periodic basis to ensure that they are free from any related hazards.

Methods of Prevention

When a worker has to manually handle an object, he or she must ask for assistance if 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

Safe Lifting

Before performing a lifting task, here are some questions to ask:

- Does the object really need to be lifted? If so, can a lift assist be used?
- Can a cart, dolly, or hand truck be used to help with the move?
- Is the entire load really needed?
- Does the entire load need to be lifted?
- Can the load be broken into smaller quantities?

The proper technique for lifting an object depends largely on its weight, size, and shape. Here are some guidelines for proper lifting:

- Plan ahead before lifting. Know what you're doing and where you're going to help prevent you from making awkward movements or turning awkwardly while holding heavy objects. Try to gauge the object's weight and balance and determine the best way to position, grasp and support the load. Clear a path, and if lifting something with another person make sure both of you agree on the plan.
- Stand close to the load with your feet spread about shoulder-width apart. Place one foot slightly in front of the other for balance. Avoid "reaching out" in an attempt to pick up objects. If you are picking up a number of small objects, reposition your feet as necessary to avoid reaching and twisting.
- Bend your knees, not your back. Squat down and maintain the curve in the spine. Tuck your chin while keeping your back as vertical as possible.
- Control the load. Get a firm grasp of the object before beginning the lift. Grasp the load by handles or good handholds whenever possible.
- Lift with your legs. Begin slowly lifting with your LEGS (not your back) by straightening them. Never twist your body during this step.
- Keep the load close to your body. Once the lift is complete, keep the object as close to your body as possible. As the load's center of gravity moves away from the body, there is a dramatic increase in stress to the lumbar region of the back. Do not twist your body while you are carrying an object. Move and reposition your feet rather than twisting your torso. To put the load down when you reach your destination, reverse the procedure. Bend your knees... not your back, as you set the load down.

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 should be moved via mechanical means when possible. When loads are to be moved manually, the use of handles and holders may minimize chances of injuries to the fingers and hands. In the case of loads with sharp or 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 and be accessible and in good condition.

Bound Material

All materials stored in tiers should 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, or 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

When bags and bundles are stacked, interlocking rows should be 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 should 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 crossties or shrink-plastic fiber.

Drums, Barrels, and Kegs

Drums, barrels, and kegs must be stored symmetrically. 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 of 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

At the end of this lesson, students will be able to:

- Explain how conveyors, cranes, slings, and powered industrial trucks are used to move materials
- Identify the risks associated with using conveyors, cranes, slings, and powered industrial trucks are used to move materials
- Explain how to mitigate those risks to workers

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 systems should be equipped with an audible warning signal to be sounded immediately before starting up the conveyor.

- 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.

Case Study 1

An older belt conveyor was being operated without a totally enclosed tail pulley guard as required by current ANSI standards (ANSI B20). A worker cleaning in the area was accidentally caught in the tail pulley and lost an arm. This unit was originally sold as an individual conveyor to a third party, then purchased by a used equipment company. In turn, that firm sold the conveyor to its present owner, who had installed the unit once, then re-installed the unit in its current location.

Case Study 2

Transfer points between older conveyors used as part of a single system were not viewable from the operator's station. The unit did not have proper guarding, an emergency shutoff switch and/or a start-up warning device, which are required under current ANSI standards (ANSI B20). A worker inspecting the system was caught and injured in a conveyor transfer. In this case, an outside engineering firm had designed the manufacturing operation using existing equipment—including conveyors—that had been moved from an abandoned facility.

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.

The employer must ensure that each operator is trained, certified/ licensed, and evaluated before operating any equipment. Each operator must be provided with

sufficient training, through a combination of formal and practical instruction, to ensure the operator-in-training develops the skills, knowledge, and ability to recognize and avert risk necessary to operate the equipment safely for assigned work.

Movable/Mobile 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 cranes that require the use of outriggers must be placed on firm, level ground. The outriggers 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 improper adjustments 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. Some other guidelines for slings include the following:

- 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 (PITs) manufactured since 1969 must have identifying marks indicating that they have been inspected and accepted by a nationally approved testing laboratory.

PIT 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 its own 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, PITs 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 PITs must be protected or enclosed.

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.

Training

Employers must ensure each powered industrial truck operator is competent to operate the truck safely. Prior to permitting an employee to operate a powered industrial truck (except for training purposes), the employer should ensure that each operator has successfully completed training.
Training must consist of a combination of formal instruction (e.g., lecture, discussion, interactive computer learning, video tape, written material), practical training (demonstrations performed by the trainer and practical exercises performed by the trainee), and evaluation of the operator's performance in the workplace.

All operator training and evaluation should be conducted by persons who have the knowledge, training, and experience to train powered industrial truck operators and evaluate their competence.

Lesson Summary

- Conveyors present a variety of safety hazards, such as workers catching their hands in the mechanism or falling in it, or objects falling off of it and striking workers below.
- Conveyor systems should be equipped with an audible warning system as well as emergency stop buttons or pull-cords.
- Employers must ensure anyone operating a crane is properly trained to do so.
- When using movable cranes, the operator must ensure that a boom angle indicator has been fitted. Mobile cranes that require the use of outriggers must be placed on firm, level ground.

- 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 improper adjustments have occurred.
- Employers must ensure that slings are visually inspected before and during all operations. A damaged or defective sling must be removed from service immediately.
- Forklifts must be equipped with vertical load backrest extensions that comply with the manufacturer's specifications.
- Personnel working on a properly designed loading platform must have means to shut off power to the truck if needed.
- 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 3: Ergonomics, Training, and Education

Lesson Focus

At the end of this lesson, students will be able to:

- Explain ergonomic safety and health principles
- Identify the correct fire safety precautions
- 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 best possible environment for the employee's needs, leading to the greatest possible productivity.

Ergonomics includes changing workplace conditions to minimize the physical demands of a job as much 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 with 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:

- 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 should be placed neither 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 should be equipped with personal fall arrest equipment meeting the requirements of Subpart M.

Non-compatible materials should be segregated in storage.

Materials Stored on Tiers

All materials stored in tiers should 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, should be conspicuously posted in all storage areas, except for floor or slab on grade. Maximum safe loads should not be exceeded.

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

When a difference in road or working levels exists, means such as ramps, blocking, or grading should 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

These elements require such steps as:

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

Lesson Summary

- Ergonomics holds that jobs should be adjusted to fit the person, rather than the person to fit the job. It includes changing workplace conditions to minimize the physical demands of a job as much as possible.
- Employees must always keep in mind that flammable and combustible materials must be stored in accordance with their fire characteristics. Combustibles must be stored in areas where smoking, open flames, and sparks are prohibited. Some materials are only dangerous when they come together.

- 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.
- Due to the high incidence of back and spinal injuries that results from manual lifting, safe lifting techniques must be demonstrated to all employees.
- 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.

Module 14: Motor Vehicles, Mechanized Equipment and Marine Operations; Rollover Protective Structures and Overhead Protection; and Signs, Signals and Barricades

Module Description

This module is intended for workers who need to know about motor vehicles, mechanized equipment, rollover protective structures, overhead protection, signs, signals, and barricades.

We will be discussing motor vehicles, mechanized equipment, marine operations, rollover protective structures, overhead protection, signs, signals, and barricades in detail. This course will also cover the topics included in OSHA 29 CFR 1926 Subparts O-Motor Vehicles; W-Rollover Protection; and G-Signs, Signals, and Barricades.

Module Learning Objectives

At the conclusion of this module, students will be able to:

- Identify OSHA standards for Motor Vehicle Safety
- Demonstrate machine and equipment handling according to OSHA standards
- Describe how industrial tractors are regulated by OSHA
- Discuss the purpose of signs and barricades

Lesson 1: Motor Vehicles (Subpart O)

Lesson Focus

At the end of this lesson, students will be able to:

- Describe the general requirements for the use of motor vehicles in construction

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