

Materials Handling Safety

This course covers the potential hazards and safe practices for moving, handling, and storing materials involving diverse operations such as hoisting, carrying, and stacking.

This page intentionally blank

OSHAcademy Course 619 Study Guide

Materials Handling Safety

Copyright © 2018 Geigle Safety Group, Inc.

No portion of this text may be reprinted for other than personal use. Any commercial use of this document is strictly forbidden.

Contact OSHAcademy to arrange for use as a training document.

This study guide is designed to be reviewed off-line as a tool for preparation to successfully complete OSHAcademy Course 619.

Read each module, answer the quiz questions, and submit the quiz questions online through the course webpage. You can print the post-quiz response screen which will contain the correct answers to the questions.

The final exam will consist of questions developed from the course content and module quizzes.

We hope you enjoy the course and if you have any questions, feel free to email or call:

OSHAcademy

15220 NW Greenbrier Parkway, Suite 230

Beaverton, Oregon 97006

www.oshatrain.org

instructor@oshatrain.org

+1 (888) 668-9079

Disclaimer

This document does not constitute legal advice. Consult with your own company counsel for advice on compliance with all applicable state and federal regulations. Neither Geigle Safety Group, Inc., nor any of its employees, subcontractors, consultants, committees, or other assignees make any warranty or representation, either express or implied, with respect to the accuracy, completeness, or usefulness of the information contained herein, or assume any liability or responsibility for any use, or the results of such use, of any information or process disclosed in this publication. GEIGLE SAFETY GROUP, INC., DISCLAIMS ALL OTHER WARRANTIES EXPRESS OR IMPLIED INCLUDING, WITHOUT LIMITATION, ANY WARRANTIES OF MERCHANTABILITY OR FITNESS FOR A PARTICULAR PURPOSE. Taking actions suggested in this document does not guarantee that an employer, employee, operator or contractor will be in compliance with applicable regulations. Ultimately every company is responsible for determining the applicability of the information in this document to its own operations. Each employer's safety management system will be different. Mapping safety and environmental management policies, procedures, or operations using this document does not guarantee compliance regulatory requirements.

This page intentionally blank

Contents

Course Introduction	1
Module 1: Manual Handling	2
Lifting and Moving Material.....	3
Factors Associated with Back Injuries.....	4
Manual Handling Precautions.....	5
Moving Objects	6
Lifting Objects	7
Stacking Materials.....	8
Personal Protective Equipment	9
Hand and Foot Protection.....	9
Hard Hats	10
Loading, Transporting, and Unloading.....	10
Moving Trailing Cables.....	11
Module 2: Mechanical Handling.....	13
Forklift Operations	14
Designations.....	19
Selecting the Right Forklift for the Environment	20
Traveling.....	22
Driving on Ramps and Grades.....	24
Driving onto Trucks, Trailers, and Railroad Cars.....	24
Loading and Unloading the Forklift	26
Leaving a Forklift Unattended.....	29
Lifting and Lowering People.....	29

Traffic Patterns.....	30
Workplace Conditions.....	31
Module 3: Cranes and Slings.....	32
Crane Rated Capacity.....	32
Safety Measures for Crane Operation.....	32
Keeping Clear of the Load.....	34
Safe Hoisting Routes.....	34
Stationary Suspended Load.....	34
Hooking, Unhooking, or Guiding the Load.....	34
Receiving a Load.....	35
Operator Attention.....	35
Operator Responsibility While the Load is Suspended.....	35
Brake Test.....	36
Protection Against Rope Detachment.....	36
Traveling with a Load.....	36
Authority to Stop Operation.....	36
Signals.....	37
Work Area Control.....	37
Sling Safety.....	38
Safe Lifting Practices.....	39
Size, Weight, and Center of Gravity of the Load.....	40
Number of Legs and Angle with the Horizontal.....	40
Rated Capacity of the Sling.....	40
History of Care and Usage.....	40

Care and Use of Slings	41
Module 4: Conveyors, Housekeeping, and Storage.....	43
Working Around Conveyors.....	43
Housekeeping	44
Staging.....	45
General Storage Considerations	46
Storing Materials in an Open Yard.....	47
Storing Materials Indoors	47
Bagged Materials	48
Bulk Materials	48
Lumber	49
Bricks and Masonry Blocks.....	49
Cement and Lime	49
Reinforcing, Sheet, and Structural Steel	49
Pipe, Conduit, and Cylindrical Material	49
Sand, Gravel, and Crushed Stone	50
Handling and Storing Drums and Containers	50
Flammable or Combustible Liquids	52
Resources	54

This page intentionally blank

Course Introduction

The ability to handle materials-to move them from one location to another, whether during transit or at the worksite-is vital to all segments of industry. Materials must be moved, for example, for industry to manufacture, sell, and utilize products. In short, without materials-handling capability, industry would cease to exist.

Mishandling materials is the single largest cause of accidents and injuries in the workplace. Most of these accidents and injuries can be readily avoided. Whenever possible, mechanical means should be used to move materials to avoid employee injuries such as muscle pulls, strains, and sprains. Many loads are too heavy and/or bulky to be safely moved manually. Various types of equipment, therefore, have been designed specifically to aid in the movement of materials: cranes, derricks, hoists, powered industrial trucks, and conveyors.

The hazards associated with materials handling include:

-) the improper use of equipment,
-) the accumulation of materials and clutter,
-) unsafe conditions of materials and containers,
-) toxic and flammable materials,
-) the weight of materials being handled,
-) binding ties or other devices to secure bundles or bound materials,
-) exposure to struck-by or caught-in/between hazards,
-) lifting, lowering, pushing and pulling heavy or unwieldy objects, and
-) improperly stacked materials.

This course describes basic concepts and principles of manual and mechanical materials handling, including moving, transferring, handling, lifting, and storing materials.

Module 1: Manual Handling

Being struck by materials or being caught in pinch points causes fractures, bruises, and crushing injuries. In addition, persons responsible for material handling are subject to several types of injuries and hazards:

-) Back injuries can result from lifting incorrectly.
-) Many injuries occur when using maximum force or jerking to free stuck or frozen objects and parts. It's important to recognize this hazard and use less forceful means to free the items (penetrating oil with tapping, heaters for ice, long handled tools properly secured, etc.).
-) Moving heavy, and sometimes awkward, loads can result in dropped material, injuring other body parts.
-) Suspended loads are sometimes cut loose, released, or dropped on workers.
-) Uneven, cluttered, and slippery walking and working surfaces can contribute to slips, trips, and falls.

Material Handling - Safety Memos

-) Many injuries occur when manually handling materials while loading or unloading pick-up and delivery trucks.
-) The size and design of surface mining machines often restrict operators' vision and makes it impossible to see vehicles and persons close to them.
-) Delivery persons and vehicles are also subject to falls of rock or ore from high walls or banks.

For these reasons, the persons responsible for the handling and delivery of supplies should be trained in all procedures for traffic control, signaling of machine operators, and general hazard awareness.

Quiz Instructions

Read the material in each section to discover the correct answer to questions. Circle the correct answer. When you're finished go online to take the final exam. This exam is open book, so you can use this study guide.

1. During manual handling of materials, many injuries occur when _____ to free stuck or frozen objects and parts.

- a. trying to pry an object with the fingers
- b. using steady pressure on an object
- c. using maximum force or jerking
- d. static resistance suddenly releases

Lifting and Moving Material

The weight and bulkiness of objects lifted are major contributing factors to injuries. Workers also frequently cite body movement as contributing to their injuries. Bending, twisting, and turning are the more commonly cited movements that cause back injuries. Below are some statistics based on the U.S. Bureau of Labor Statistics:

-) Strains and sprains result from lifting improperly or from carrying loads that are either too large or too heavy. Sprains and strains account for more than 40% of injuries and illnesses resulting in days away from work.
-) Back injuries occur when workers lift heavy or bulky objects, lift improperly, carry excessive loads, or push/pull awkwardly. Back injuries account for more than 20% nonfatal occupational injuries involving days away from work.
-) Hands, arms, and feet are also vulnerable to injury during manual handling of materials.
-) Overexertion cases with lost workdays account for more than 25% of all lost-workday cases. Most of those cases were due to lifting. Pushing/pulling and carrying also result in large numbers of overexertion injuries.

2. Which of the following are two major factors contributing to injuries when lifting objects?

- a. weight and bulkiness
- b. posture and attitude
- c. number of lifts and
- d. slipperiness and vibration

Factors Associated with Back Injuries

Reaching while lifting is common when loading/unloading pickup trucks. Trucks can be equipped with small mechanical lifts or powered gates. Sometimes conveyors are used to transport supplies or other items, and reaching and twisting while lifting is often involved. Mechanical lifts can also be positioned over conveyors that are used for this purpose.

Back disorders result from exceeding the capability of the muscles, tendons, or discs, or the cumulative effect of several contributors, including:

-) reaching while lifting
-) poor posture - how one sits or stands
-) stressful living and working activities
-) staying in one position too long
-) bad body mechanics - how one lifts, pushes, pulls, or carries objects
-) poor physical condition - losing the strength and endurance to perform physical tasks without strain
-) poor design of job or workstation
-) repetitive lifting of awkward items or equipment

If you are overweight, and especially if you have developed a pot belly, the chances for chronic back pain are greater. The extra weight throws your body out of alignment and increases the burden on your back. Infrequent exercise is a major factor, too. A sudden strain on generally unused back muscles often leads to trouble. Watching your weight by having a proper diet and exercise are both sensible ways to help avoid back problems.

3. Each of the following is a contributing factor causing back disorders, except ____.

- a. reaching while lifting
- b. poor posture
- c. using mechanical lifts
- d. poor physical condition

Manual Handling Precautions

When moving materials manually, workers should attach handles or holders to loads. In addition, workers should always wear appropriate personal protective equipment and use proper lifting techniques. To prevent injury from oversize loads, workers should seek help in the following:

- J When a load is so bulky that employees cannot properly grasp or lift it,
- J When employees cannot see around or over a load, or
- J When employees cannot safely handle a load.

Using the following personal protective equipment prevents needless injuries when manually moving materials:

- J hand and forearm protection, such as gloves, for loads with sharp or rough edges
- J eye protection
- J steel-toed safety shoes or boots
- J metal, fiber, or plastic metatarsal guards to protect the instep area from impact or compression

See [OSHA Publication 3151, Personal Protective Equipment](#), for additional information.

Employees should use blocking materials to manage loads safely. Workers should also be cautious when placing blocks under a raised load to ensure that the load is not released before removing their hands from under the load. Blocking materials and timbers should be large and strong enough to support the load safely. In addition to materials with cracks, workers should not use materials with rounded corners, splintered pieces, or dry rot for blocking.

4. When should employees seek help when manually moving materials?

- a. When employees cannot see under the load
- b. When the load is too bulky to grasp the load properly
- c. When employees are lifting bagged objects
- d. When more than one object must be carried

Moving Objects

Many of the items that must be moved at worksites are heavy, bulky, and/or awkward to handle. The items being handled when back injuries occur include heavy boxes, bags, drums, screens, buckets, guards/covers/doors, bags/boxes of explosives, gas cylinders, belt rollers, and rock. Getting necessary help and coordinating movements with your helper(s) is very important in many of these cases. Use of mechanical lifting/moving aids and safe lifting techniques are likewise important.

Safe site-specific standard operating procedures should be established for common jobs like changing screens and belt rollers, handling drums and gas cylinders, etc.

-) Material handling tasks should be designed to minimize the weight, range of motion, carrying distance, and frequency of the activity.
-) Work methods and stations should be designed to minimize the distance between the person and the object being handled.
-) Repetitive or sustained twisting, stretching, or leaning to one side are undesirable.
-) Corrections could include repositioning bins and moving employees closer to parts and conveyors.
-) Store heavy objects at waist level.
-) Provide lift-assist devices and lift tables.

Other factors may include constraints on posture, work rates imposed by the process, and insufficient rest or recovery time. Sometimes the work can be varied, allowing one set of muscles to rest while another is used.

When placing blocks under a load:

-) Keep hands in the clear.
-) Blocking materials should be large and strong enough to support the load safely.
-) Don't use materials with cracks, rounded corners, splintered pieces, or dry rot for blocking.

5. Where should heavy objects be stored?

- a. Floor level
- b. Knee level
- c. Waist level
- d. Shoulder level

Lifting Objects

It's always best to first consider engineering solutions to eliminate or minimize manual handling of materials. Many injuries result from not using handling aids. People should be educated and informed about what devices are available, their safe use, and what should be used in various situations to "take the work out of work" and make it safer.

Split the load into smaller parts, when you can, to achieve manageable lifting weight. Sometimes loads can also be made easier to grasp. Suppliers may be able to help with load size and packaging.

When possible, it's best to avoid lifts from below the knees or above the shoulders. Sometimes mechanical handling aids can be used to avoid this. And sometimes you can position yourself so that the object to move is within a more acceptable lifting range (between the shoulders and knees).

When lifting, consider the following:

-) Can engineering solutions be used to eliminate the lift or reduce the hazard?
-) Break loads into parts.
-) Get help with heavy or bulky items.
-) Lift with legs, keep back straight, do not twist.
-) Avoid lifting above shoulder level.
-) Using handling aids such as steps, trestles, shoulder pads, handles, wheels, lift gates, wheelbarrows, come-alongs, chain falls, overhead hoists, hydraulic jacks, and similar devices.

6. When possible, it's best to avoid lifts from _____.

- a. floor level or above the waste
- b. floor level or above the knees
- c. below the waist or above the head
- d. below the knees or above the shoulders

Stacking Materials

Stacking materials can be dangerous if workers do not follow safety guidelines. Falling materials and collapsing loads can crush or pin workers, causing injuries or death. To help prevent injuries when stacking materials, workers must do the following:

-) Stack lumber no more than 16 feet high if it is handled manually, and no more than 20 feet if using a forklift;
-) Remove all nails from used lumber before stacking;
-) Stack and level lumber on solidly supported bracing;
-) Ensure stacks are stable and self-supporting;
-) Do not store pipes and bars in racks that face main aisles to avoid creating a hazard to passersby when removing supplies;
-) Stack bags and bundles in interlocking rows to keep them secure; and
-) Stack bagged material by stepping back the layers and cross-keying the bags at least every ten layers (to remove bags from the stack, start from the top row first).

During materials stacking activities, workers must also do the following:

-) Store baled paper and rags inside a building no closer than 18 inches to the walls, partitions, or sprinkler heads;
-) Band boxed materials or secure them with cross-ties or shrink plastic fiber;
-) Stack drums, barrels, and kegs symmetrically;
-) Block the bottom tiers of drums, barrels, and kegs to keep them from rolling if stored on their sides;

-)] Place planks, sheets of plywood dunnage, or pallets between each tier of drums, barrels, and kegs to make a firm, flat, stacking surface when stacking on end;
-)] Chock the bottom tier of drums, barrels, and kegs on each side to prevent shifting in either direction when stacking two or more tiers high; and
-)] Stack and block poles as well as structural steel, bar stock, and other cylindrical materials to prevent spreading or tilting unless they are in racks.

In addition, workers should do the following:

-)] Paint walls or posts with stripes to indicate maximum stacking heights for quick reference;
-)] Observe height limitations when stacking materials;
-)] Consider the need for availability of the material; and
-)] Stack loose bricks no more than 7 feet in height. (When these stacks reach a height of 4 feet, taper them back 2 inches for every foot of height above the 4-foot level. When masonry blocks are stacked higher than 6 feet, taper the stacks back one-half block for each tier above the 6-foot level.)

7. What is the maximum height for stacking lumber when manually handled?

- a. 6 feet
- b. 10 feet
- c. 16 feet
- d. 20 feet

Personal Protective Equipment

Prevention of material handling injuries continues to be a difficult task because of the variety of conditions under which supplies and materials are lifted, moved, and carried. Proper attention to the way lifting is done and the use of personal protective equipment can reduce the number of accidents.

Hand and Foot Protection

-)] For loads with sharp or rough edges, wear gloves or other hand and forearm protection.
-)] When loads are heavy or bulky, wear steel-toed safety shoes to prevent foot injuries if the load is dropped.

- J Metatarsal (bones in feet) protection adds an extra measure of safety.
- J Besides providing the necessary foot protection, shoes should be comfortable, low-heeled, and have nonslip soles.

Hard Hats

- J Hard hats need to be worn where falling objects may create a hazard.
- J This includes hazards from material stored or handled overhead.

8. Why does the prevention of material handling injuries continue to be a difficult task?

- a. Little effort to find solutions
- b. Political considerations affecting policy
- c. Varied conditions under which materials are handled
- d. Defunding of OSHA consultation

Loading, Transporting, and Unloading

Be sure to take the following precautions when loading, transporting, and moving materials.

- J **Stage:** Think about the loading process and arrange parts and supplies to assure that loading is efficiently conducted.
- J **Height:** Do not stack material too high, to avoid falling material hazards and muscle strains.
- J **Get Help:** Obtain help when loads are heavy, and use proper lifting techniques.
- J **Mechanical help:** Use mechanical loading/unloading facilities when available.
- J **Pinch points:** Watch out for pinched hands or fingers. Keep fingers from underneath when setting material down.
- J **PPE:** Wear personal protective equipment, and be careful not to drop heavy objects on feet. Avoid using slippery gloves or lifting slippery objects.
- J **Good housekeeping:** Slippery floors, crowded work conditions, and tools or other material on the floor can create hazards that can result in a variety of injuries, including back injuries. Be careful of your footing.
- J **Arrangement:** Arrange parts and supplies/stack neatly. Don't overload vehicles. Secure material to prevent unexpected movement.

Note: Although not specifically "manual handling" problems, consider other precautions for loading, transporting, and unloading, such as:

-) Deliver parts and supplies to side of machine away from stockpiles, or banks and maintain a safe distance from them.
-) Stay away from trailing cables.
-) Be sure vehicle is secured. Place vehicle in proper gear for parking, set brakes, and turn off motor. When parking on a grade, turn wheels into a bank or berm or block them.
-) Use mechanical loading/unloading facilities when available, but be sure you're trained in and cautious of machinery hazards involved. Follow safe operating procedures for equipment being used.
-) When transporting, maintain safe distance from all heavy equipment. Call or signal machine operators and wait for acknowledgement before approaching. Be aware of operators' blind spots and park in areas where vehicle is easily seen.

9. Each of the following is a good manual material handling practice, except ____.

- a. wearing personal protective equipment
- b. getting help when loads are heavy
- c. never placing fingers under the load when setting it down
- d. using mechanical methods only if absolutely necessary

Moving Trailing Cables

Trailing cables are used for carrying electricity from a permanent line or trolley wire to a movable machine, such as used in mining or quarrying. They are heavily insulated and protected with either galvanized steel wire armoring, extra stout braiding hosepipe, or other material.

When moving trailing cables, slips, trips, and falls can occur, and the cables may be damaged, or they may cause damage to other objects. If improper handling is used to move cables, back injuries may result. Be sure to use the following precautions when handling trailing cables:

-) Wear protective rubber gloves when handling energized trailing cables.
-) Use non-conductive hooks designed for cable handling, or other protective devices, to reduce bending and lifting and to prevent cables from contacting the body or clothing.
-) Examine cables for damage before handling.

- J Ask for help when necessary. Use mechanical help, such as slings attached to a powered industrial trucks or bulldozers, as appropriate.
- J Make sure work area is free of tripping hazards. Be especially careful in mud, snow, and icy areas.
- J Maintain safe distance from loose and unconsolidated material.

10. What should you do if the trailing cables are too heavy to manually move them?

- a. Pull the cable using levers
- b. Use a sling attached to a bulldozer
- c. Place the cables on a dolly
- d. Call a professional cable mover

Check your Work

You can check your questions by going online and clicking on the "Check Quiz Answers" button in Section 10 to grade your quiz and see your score. You will receive a message if you forgot to answer one of the questions. After clicking the button, the questions you missed will be listed below. You can correct any missed questions and check your answers again.

Module 2: Mechanical Handling

Mechanical devices and machines are necessary for many material handling operations. Mechanical alternatives to manual handling of materials should also be used whenever possible to minimize lifting and bending requirements. These techniques include use of:

-) dollies,
-) forklifts,
-) hoists,
-) cranes, and
-) other mechanical devices.

Employees must be trained in the proper use and limitations of the equipment they operate. This includes knowing how to effectively use equipment such as forklifts, hoists, and slings.

Mechanical equipment should always be used according to the manufacturers' manual which are valuable safety references for a variety of material handling equipment. Every effort should be made to keep the manuals available and to comply with the manufacturer's instructions, specifications, and limitations.

Employees should avoid overloading equipment when moving materials mechanically by letting the weight, size, and shape of the material being moved dictate the type of equipment used. Rated capacity should be displayed on each piece of equipment.

To avoid the necessity for manual handling of materials, automation (particularly for new processes) and mechanization (such as use of a forklift) should be considered. But beware of new hazards from automation or mechanization, and remember that an automated plant still needs cleaning, maintenance, etc.

1. Mechanical equipment should always be ____.

- a. used according to the manufacturer's manual
- b. sized greater than the anticipated use
- c. inspected and checked at least quarterly
- d. OSHA approved and certified as compliant

Forklift Operations

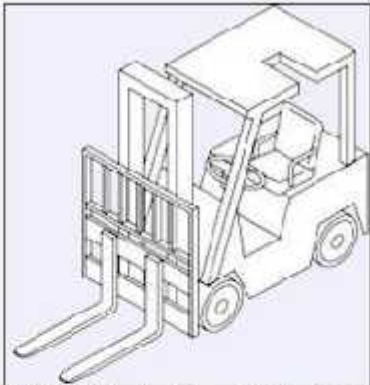
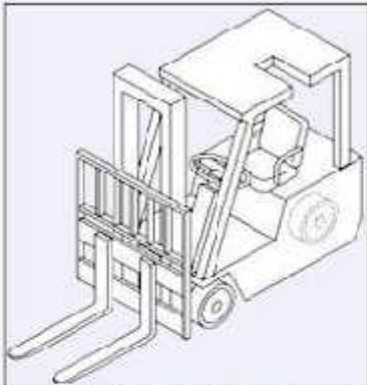
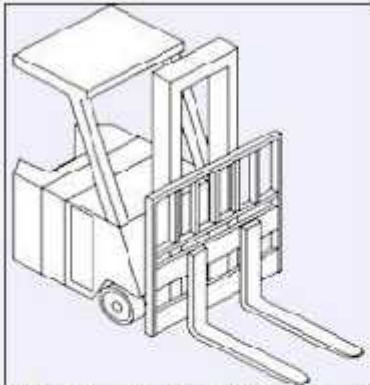
Forklifts need to be suited to the work and have properly trained operators.

Commonly used types include:

High lift trucks, counterbalanced trucks, cantilever trucks, rider trucks, forklift trucks, high lift trucks, high lift platform trucks, low lift trucks, motorized hand trucks, pallet trucks, straddle trucks, reach rider trucks, high lift order picker trucks, motorized hand/rider trucks, and counterbalanced front/side loader lift trucks.

Class I: Electric Motor Rider Trucks


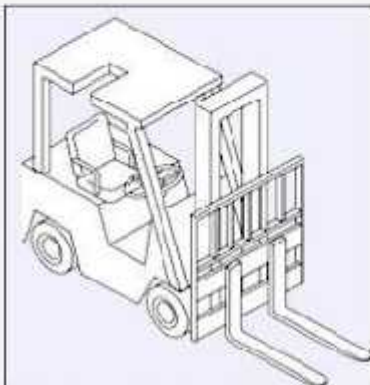
The following are examples of Class I powered industrial trucks.



Lift Code 1: Counterbalanced Rider Type, Stand Up.

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

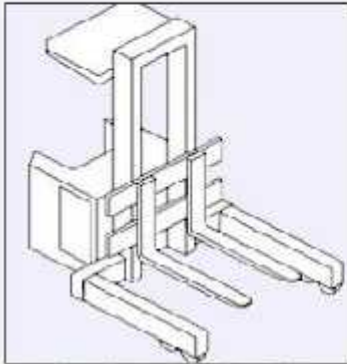
Lift Code 5: Counterbalanced Rider, Cushion Tires, Sit Down.



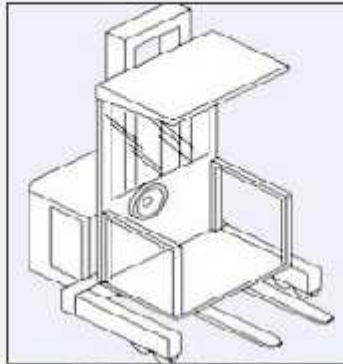
Lift Code 6: Counterbalanced Rider, Pneumatic or Either Type Tire, Sit Down.

Class II: Electric Motor Narrow Aisle Trucks

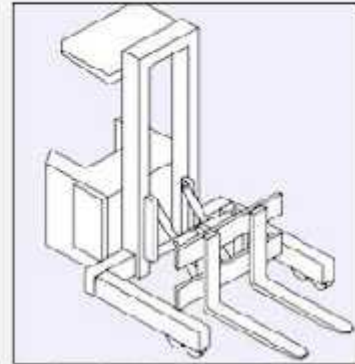
The following are examples of Class II powered industrial trucks:



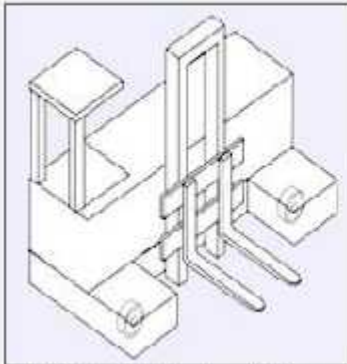
Lift Code 1: High Lift Straddle.



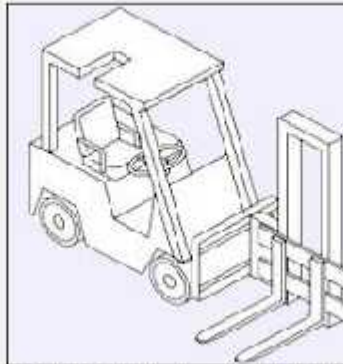
Lift Code 2: Order Picker.



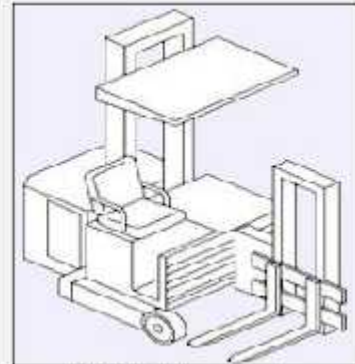
Lift Code 3: Reach Type Outrigger.



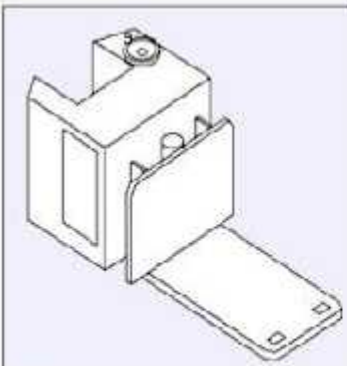
Lift Code 4: Side Loaders: Platforms.



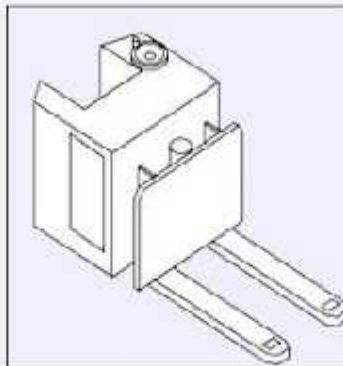
Lift Code 4: Side Loaders: High Lift Pallet.



Lift Code 4: Turret Trucks.



Lift Code 6: Low Lift Platform.

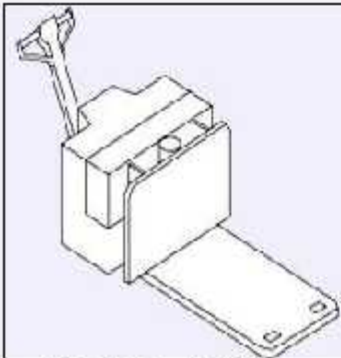


Lift Code 6: Low Lift Pallet.

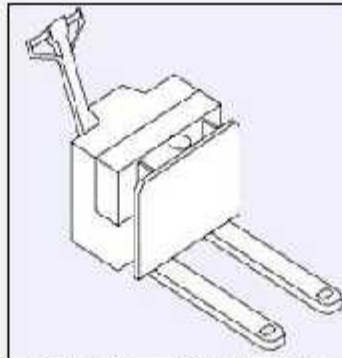


Class III: Electric Motor Hand Trucks or Hand/Rider Trucks

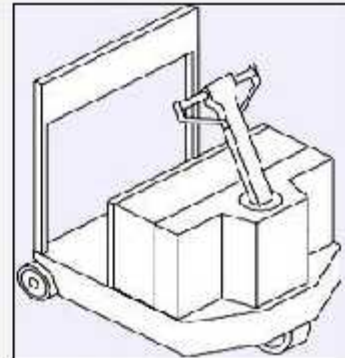
The following are examples of Class III powered industrial trucks.



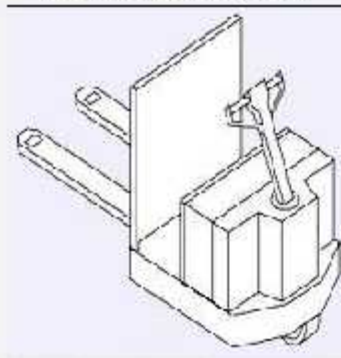
Lift Code 1: Low Lift Platform.



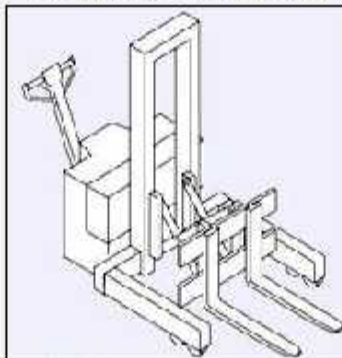
Lift Code 2: Low Lift Walkie Pallet.



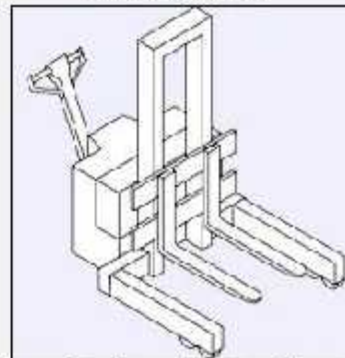
Lift Code 3: Tractors



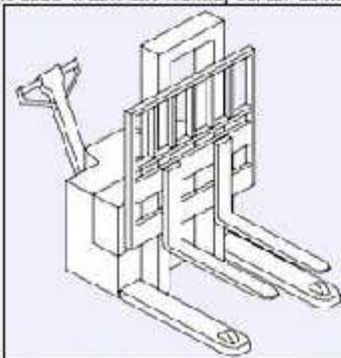
Lift Code 4: Low Lift Walkie/Center Control.



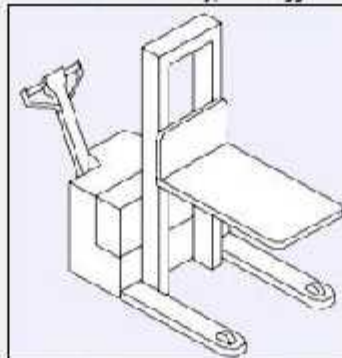
Lift Code 5: Reach Type Outrigger.



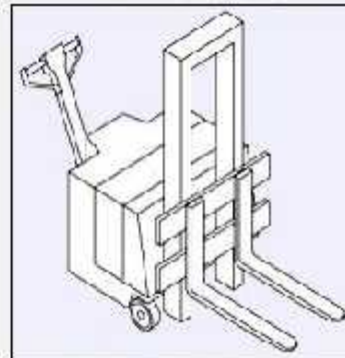
Lift Code 6: High Lift Straddle.



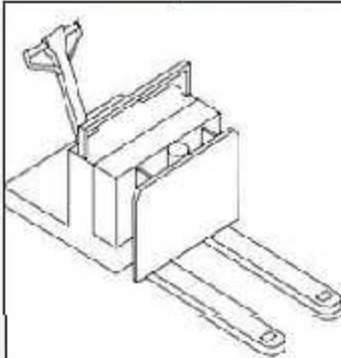
Lift Code 6: Single Face Pallet.



Lift Code 6: High Lift Platform.



Lift Code 7: High Lift Counterbalanced.

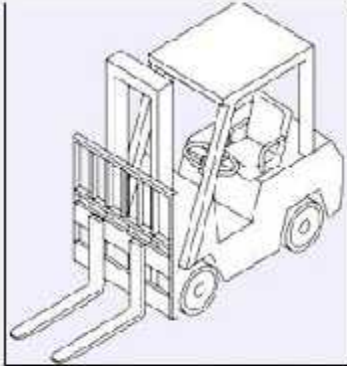


Lift Code 8: Low Lift Walkie/Rider Pallet and End Control.



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

The following are examples of Class IV powered industrial trucks.

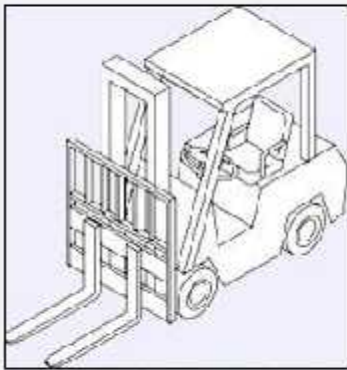


Lift Code 3: Fork, Counterbalanced (Cushion Tire).



Class V: Internal Combustion Engine Trucks (Pneumatic Tires)

The following are examples of Class V powered industrial trucks.

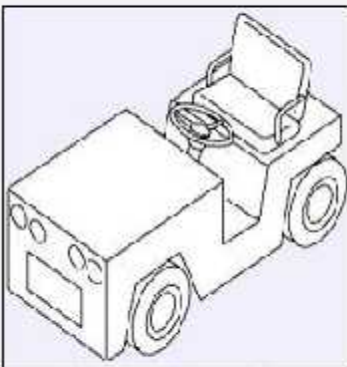


Lift Code 4: Fork, Counterbalanced (Pneumatic Tire).



Class VI: Electric and Internal Combustion Engine Tractors

The following are examples of Class VI powered industrial trucks.



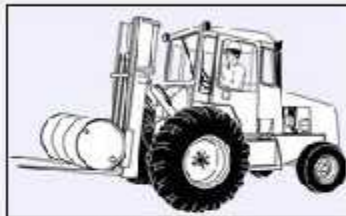
Lift Code 1: Sit-Down Rider (Draw Bar Pull Over 999 lbs.).



Class VII: Rough Terrain Forklift Trucks

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

There are three basic types of rough terrain forklift:



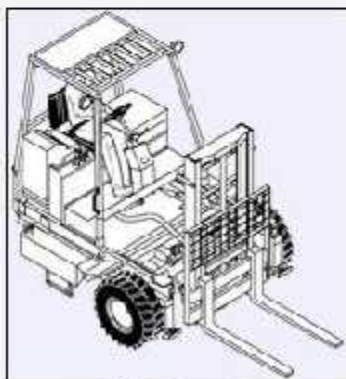
Vertical mast type.

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



Variable reach type.

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



Truck/trailer mounted.



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

2. What two criteria should be met prior to using forklifts?

- a. Inspected forklift and operator 16 years or older
- b. A suitable forklift and trained operator
- c. Approved operation during normal work hours
- d. Correct forklift and approved task

Designations

The hazards commonly associated with powered industrial trucks vary for different vehicle types, makes and models. All forklifts have a hazard designation assigned to them that tells whether they are suitable for use in certain kinds of hazardous atmospheres. You can find the designation on the forklift's load capacity plate. The table below explains the designations.

Type	Built-in Safeguards Against Fire Hazards
D (Diesel forklift)	Minimum acceptable safeguards
DS	D + additional safeguards for fuel, exhaust, and electrical systems
DY	DS + all electrical equipment enclosed plus temperature-limiting features
E (Electrical forklift)	Minimum acceptable safeguards
ES	E + safeguards to prevent sparks and limit surface temperatures
EE	ES + all electric motors and equipment are completely enclosed
EX	E, ES, or EE + can be used in flammable vapor or dust atmospheres
G (Gasoline forklift)	Minimum acceptable safeguards
GS	G + additional safeguards for fuel, exhaust and electrical systems
LP (Liquid Petroleum)	G + minimum safeguards for liquid petroleum gas
LPS	LP + additional safeguards for fuel, exhaust and electrical systems

3. Which of the following forklifts will operate using diesel fuel and have additional safeguards for fuel, exhaust, and electrical systems?

- a. LP
- b. GS
- c. ES
- d. DS

Selecting the Right Forklift for the Environment

The hazards commonly associated with powered industrial trucks vary for different vehicle types, makes and models. All forklifts have a hazard designation assigned to them that tells whether they are suitable for use in certain kinds of hazardous atmospheres. You can find the designation on the forklift's load capacity plate. The table below explains the designations.

Operating a forklift in an environment where chemicals or other substances are present can be hazardous. Use only forklifts that are designed for operations under those conditions.

To select the appropriate forklift, you must know the type of location (Class) in which the forklift will be operated, the name of the chemical or substance and how likely it is that the hazardous condition would be present (Division).

Below are the various classes of locations in which a forklift may be used:

-) A **Class I** location contains flammable gases or vapors.
-) A **Class II** location contains combustible dust.
-) A **Class III** location contains easily ignited fibers.
-) An **Unclassified** location is a general storage, commercial or industrial location without the hazard conditions described above.

Below are the two divisions used to define how likely a hazard is present:

-) A **Division I** location has a high potential for the hazard to be present.
-) A **Division II** location has a lower potential for the hazard to develop.

4. Where can you find the hazard designation on a forklift?

- a. On the manufacturer's sticker
- b. On the inspection form
- c. On the load capacity plate
- d. On the front steering column

To select the right forklift for each class and division, use the table below. Look in the first column of the table for the hazard class of the material. Find the row that has the chemical or substance handled. Choose the second or third column based on the division that represents the exposure condition.

Hazard Classification	Acceptable Forklift Designations	
Class 1: Flammable gases or vapors are or may be present in quantities sufficient for explosion or ignition.	Division 1: Condition exists continuously, intermittently, or periodically under normal operating conditions.	Division II: Condition may occur accidentally (e.g., puncture of a storage drum)
Examples: Acetylene, Acetaldehyde, Butadiene, Cyclopropane, Diethyl ether, Ethylene, Ethylene oxide, Isoprene, Propylene oxide, Hydrogen (or gases or vapors equivalent in hazard to hydrogen, such as manufactured gas), Unsymmetrical dimethyl hydrazine (UDMH)	Forklift use prohibited	DY, EE, EX (also DS, ES, GS, LPS) if the only exposure is sealed containers or liquefied or compressed gases in containers
Examples: Acetone, Acrylonitrile, Alcohol, Ammonia, Benzine, Bensol, Butane, Ethylene dichloride, Gasoline, Hexane, Lacquer Solvent, Natural gas, Naphtha, Propane, Propylene, Styrene, Xylenes, Vinyl acetate, Vinyl chloride	EX	DY, EE, EX (also DS, ES, GS, LPS) if the only exposure is sealed containers or liquefied or compressed gases in containers
Class II: Combustible dust is present	Division I: Explosive or conductive mixture may be present under normal conditions or where equipment failure can lead to both this condition and arching or sparking.	Division II: Explosive mixture not normally present but where deposits of dust may cause heat rise in electrical equipment.

<ul style="list-style-type: none">) Aluminum, magnesium, and their commercial alloys) Other metals of similarly hazardous characteristics 	Forklift use prohibited	Forklift with electrical enclosures manufacturer approved where magnesium, aluminum or aluminum bronze may be present
<ul style="list-style-type: none">) Carbon black) Coal or coke dust 	EX	Forklift manufacturer approved for this location.
Other combustible dusts	EX	DY, EE, EX
Class III: Easily ignitable fibers or flyings are present but not likely to be in suspension in quantities sufficient to ignite.	Division I: Locations in which these materials are handled, manufactured or used	Division II: Locations in which these materials are stored or handled (other than manufacture)
Examples: Baled waste, Cocoa fiber, Cotton, Excelsior, Hemp, Istle, Jute, Kapok, Oakum, Sisal, Spanish moss, Synthetic fibers, Tow	DY, EE, EX	DS, DY, ES, EE, GS, LPS (Type E may continue to be used if used previously at this location.)
Unclassified Locations: Piers and wharves inside and outside general storage, general industrial or commercial properties	D, E, G, LP (more protective designations may also be used)	

5. Class I/Division I forklift operation is prohibited where continuous or periodic exposure to _____ is possible.

- a. acetylene
- b. vinyl chloride
- c. ignitable fibers
- d. aluminum dust

Traveling

Precautions and best practices while traveling in a forklift include:

-) The most basic rule for traveling is you maintain control of your forklift at all times.
-) Operate a forklift only while in the seat or operator’s station.

- J Never start it or operate the controls while standing beside the forklift.
- J Never allow passengers unless the forklift was designed for a passenger.
- J Do not put any part of your body between the uprights of the mast or when traveling, outside of the forklift frame.
- J Never drive with wet or greasy hands. If necessary, keep a towel or rag handy at all times.
- J Whether loaded or empty, carry forks and platforms on lift trucks as low as possible. This lowers the center of gravity and reduces the possibility of overturning the truck or dumping the load.
- J Always look in the direction of travel and keep a clear view of the travel path. Travel in reverse if the load blocks your view.
- J Always observe posted speed limits (usually 5 mph) at your workplace. A forklift should not be driven faster than a quick walking pace.
- J Keep a distance of at least three forklift lengths between you and any forklift traveling in front of you.
- J Do not pass a forklift traveling in the same direction if it is at a blind spot, intersection or other dangerous location.
- J Never drive a forklift up to anyone in front of a bench or other fixed object.
- J Never allow anyone to walk or stand under the elevated forks—even if the forks are not carrying a load.
- J Check that there is adequate clearance under beams, lights, sprinklers, and pipes for the forklift and load to pass.
- J Never engage in stunt driving or horseplay.

For more information on forklift safety, see OSHAcademy course [725 Forklift Safety](#).

6. What is the usual posted speed limit for forklifts?

- a. No limit
- b. 5 mph
- c. 10 mph
- d. 15 mph

Driving on Ramps and Grades

Forklift operators should follow certain general rules of the road when traveling on ramps and other inclines. Traveling up and down ramps and grades can be quite dangerous because the forklift can more easily tip over. Be sure to follow these safety practices when operating the forklift on ramps and grades:

-) Always look in the direction of travel.
-) Never turn on a ramp or incline. Turn prior to the ramp or incline to place forks in proper direction.
-) Keep a safe distance from the edge of a ramp.
-) Do not travel on ramps with slopes or other conditions that exceed the manufacturer's recommendation.
-) When traveling with a load, the load should point up the incline, regardless of direction of travel.
-) When traveling without a load, the forks should point downgrade, regardless of direction of travel.

Driving onto Trucks, Trailers, and Railroad Cars

Forklifts are often driven onto trucks, trailers, or railroad cars over a dock board (also known as a bridge plate) at loading docks. If the truck, trailer or car is not secured to the dock or otherwise chocked, it may move forward. The dock board can then fall between the trailer and the dock as the forklift crosses it.

You can secure wheel chocks with chains at each loading dock bay and tell truck drivers that they must place them in front of the rear wheels. Another way of securing the trailer is to use a vehicle restraint system mounted to the dock that clamps onto a bar below the trailer as it backs into place. This system will signal when the restraint is engaged or if there is a problem.

The pavement at some loading docks slopes downhill toward the loading dock. This is not a substitute for chocking wheels.

7. Which of the following is TRUE when driving a forklift on a ramp?

- a. Travel backward down the ramp when loaded
- b. Travel forward down the ramp when loaded
- c. Travel forward up the ramp when empty
- d. Travel backward down the ramp when empty

Sometimes a trailer is left at a loading dock without the tractor attached. Use trailer jacks to prevent the trailer from up-ending when a forklift drives to the front of the trailer to load or unload. Here are some additional loading and unloading procedures:

- J Inspect the floor of the trailer to be sure that it will support the forklift and load.
- J Ensure the height of the entry door is adequate to clear the height of your vehicle, taking into consideration the height of the loading platform.
- J Drive straight across the bridge plates when entering or exiting the truck trailer or railroad car.
- J Use dock lights and headlights when working in a dark trailer.
- J Sound the horn when entering or exiting the trailer.
- J In determining the capacity of the trailer floor to support a forklift, consider various factors, including floor thickness and cross-member spacing or unsupported floor area. In general, the larger the unsupported area, the lower the forklift capacity the trailer will have for the same floor thickness.
- J Never use the forklift to open railroad car doors unless:
 - o It has a device designed for that purpose.
 - o The operator is trained in the use of the device.
 - o All other employees stand clear.
- J Keep a safe distance from the edge of a loading dock or a ramp. The edge must be painted yellow or with alternating yellow and black diagonal stripes to warn of both the fall hazard and the potential to be crushed by a trailer backing into the dock.

- J A portable dock board must be secured in place to prevent it from moving. Some boards have pins that are inserted into the sides and project below the board. This prevents the board from moving toward the dock or toward the trailer. To prevent crushed fingers and make for safe handling, a portable dock board must also have handholds or lugs that allow the forklift to pick it up.
- J Some loading docks have a bull rail that prevents a wheel from slipping off the sides of ramps or edges of the dock where a forklift would not have to cross to enter a trailer.
- J Any part of the dock edge that is four feet or more above the adjacent surface must have a standard guardrail. Removable rails (such as chain rails) and posts can be used at the place where trucks or trailers will be loaded.
- J Use rail mounted chocks to secure a railroad car. Also, prevent anyone from moving the rail car while the forklift is working. A blue sign with the word "STOP" attached to the track is one way of signaling that the car must not be moved. A special attachment must be used if a forklift is used to open a rail car door.

8. What do some loading docks have installed to prevent a wheel from slipping off the sides of ramps or edges of the dock where a forklift would not have to cross to enter a trailer?

- a. laser position sensors
- b. a safety watch
- c. painted yellow and black striped lines
- d. a bull rail

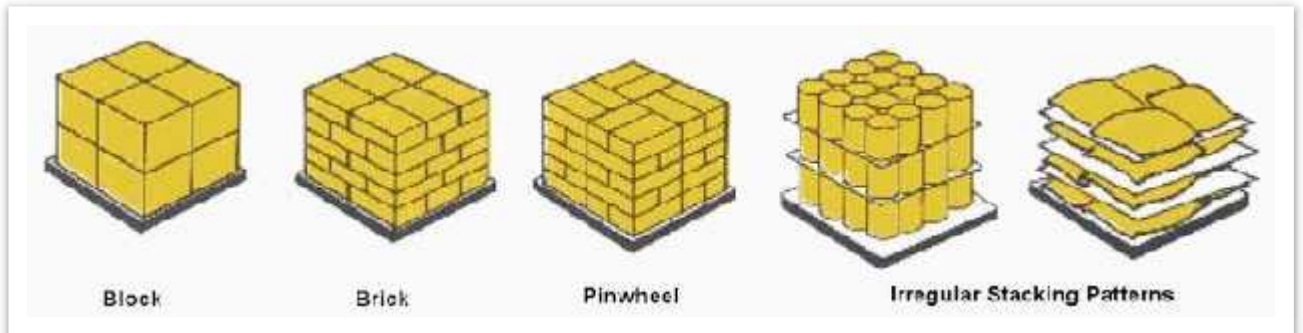
Loading and Unloading the Forklift

Because of the wide variety of equipment used and the different kinds of stock and materials handled, each company must form additional rules for loading and unloading to fit the needs of its facilities. Know the maximum load that each truck can carry safely; do not overload it. An overloaded truck will not operate in a safe manner.

When handling materials, be sure to ask and get answers to the following questions and check the load before you pick it up.

- J Is it stable or will parts slide or fall during transit? Secure it as necessary. The illustrations below show some common pallet stacking patterns.

- Do the dimensions and weight of the load fall within the capacity rating of the forklift at the highest elevation and maximum extension you will handle the load? If not, can you break the load into smaller parts?



When you pick up the load:

- Move squarely into position in front of the load.
- Make sure your view is not obstructed.
- Do not permit anyone to stand under or too close to a load that is being hoisted or lowered.
- Position the forks wide apart to keep the load balanced.
- Drive the forks fully under the load.
- Tilt the mast backward slightly to stabilize the load and lift.
- Check the destination before you place the load.

9. What should the forklift operator do to stabilize the load and lift?

- a. Tip the mast back up to 30 degrees
- b. Tip the mast backward slightly
- c. Tip the mast forward slightly
- d. Tip the mast forward up to 30 degrees

Check out the destination:

- J Is the destination flat and stable—or, will the load rock, tilt or lean?
- J Never place heavy loads on top of light loads.
- J Observe maximum stacking quantities and orientation if printed on cartons.
- J Do you know the load bearing capacity of your rack or storage loft destination?
- J Are rack legs or support members bent or disconnected? The load bearing capacity of a damaged rack is unknown. Wait until the damaged component has been replaced before loading.
- J Are racks arranged back to back with a stock behind where you will place the load? Someone may need to be in the next aisle to control access while you place the load.
- J Are wooden stringers or decking laid between front and rear rack beams in good condition? They may support the load if the pallet is not properly placed on both front and rear rails.
- J If you are stacking, are other pallets in the stack in good condition and capable of supporting the load in addition to what they are already supporting?
- J Move squarely into position in front of the rack or stack where the load will be placed.
- J When ready to place the load, tilt the mast to level. Only tilt forward when the load is over the spot where it will be placed.
- J Lower the forks and back away.
- J Visually verify that the load is stable.

10. Each of the following is an important consideration when checking the destination of a forklift load, except _____.

- a. check that heavy loads are always placed on light loads
- b. verifying the load bearing capacity of racks or storage loft
- c. check that the destination is flat and stable
- d. make sure rack legs or support members are not bent or disconnected

Leaving a Forklift Unattended

A forklift is unattended when it is not in view of the operator or if it is in view, the operator is 25 feet or more away.

If you leave a forklift unattended:

1. Lower the forks to the ground.
2. Set the controls to neutral.
3. Turn off the power.
4. Set the brakes.
5. If the forklift is on an incline, block the wheels.
6. If you dismount a forklift and stay within 25 feet, you must at least lower the forks to the ground, set the controls to neutral, and set the brakes.

Lifting and Lowering People

Lifting or lowering a person on forks or a pallet can result in a fall injury or fingers caught in moving parts of the mast.

No worker should be allowed to be lifted while standing on the forks or on a pallet lifted by the forks.

If you want to use a forklift to raise an employee to an elevated position, use a platform or structure specifically built for this purpose that meets the conditions described below.

-) The platform must have standard guardrails which include a top rail 36" to 42" above the platform (39" to 45" on a construction site), midrail and toeboard. It must also prevent contact with chains and shear points on the mast.
-) The platform must be securely attached to the forks such as by a clamp or chain.
-) Check with the forklift manufacturer to verify that the hydraulic system will not allow the lift mechanism to drop faster than 135 feet per minute in the event of a system failure. Identify the forklift as approved for use with the platform.
-) Lock or secure the tilt control to prevent the boom from tilting.
-) A forklift operator must be at the normal operating position when lifting and lowering the platform. The operator must be near the forklift while a worker is elevated.

- J Except to inch forward/backward or maneuver at low speeds, do not move the forklift between two points when a worker is on the platform.

Order picker forklifts are designed to allow the operator to be lifted along with the controls to an elevated location. However, if the operator station does not have standard guardrails on all open sides, then the operator must wear a full body harness with lanyard attached to a manufacturer approved anchor.

11. Which of the following is NOT TRUE about lifting people with a forklift?

- a. The boom tilt control must be locked
- b. Lift platforms must have proper guardrails
- c. Only one person may ride on each fork
- d. The platform must be securely attached to forks

Traffic Patterns

The first step to prevent powered industrial truck accidents in a facility is to establish a traffic pattern. This is management's responsibility.

Management must ensure:

- J Aisles are well-lighted and free from obstructions.
- J Floors are sound and in good shape. Wet, oily or icy surfaces should be avoided. Clean them up as soon as possible.
- J Aisles are marked clearly. When they are wide enough for two trucks to pass each other, the center of the aisle and the two extreme edges should be marked with painted lines. In some plants, the aisles are wide enough for two truck lanes and a pedestrian lane.
- J Do not allow for two trucks to run side by side in the same direction.
- J A truck must never pass another truck at an intersection, blind spot or other dangerous location. In areas where there is high concentration of truck traffic, it may be best to have one-way aisles.
- J Speed limits are set and strictly enforced. A few speed limit signs at strategic points serve as constant reminders to truck operations.
- J Prominently display stop signs at all crossings. These may be regular stop signs or signs painted or set into the floor. You can also use stripes and discs as indicators.

-) Each plant must set up its own rules regarding traffic control, but a required four-way stop at every intersection is a wise way to avoid collisions. Plants that have adopted the four-way stop requirements have found that no significant time is lost by this extra precautionary measure.

Workplace Conditions

Workplace surface and overhead conditions are an important part of safe lift truck operation. Operating surfaces must be strong enough to support the forklift, its load and its operator. They must also be free of holes, grease, oil or obstructions that could cause the lift truck to skid, bounce, and/or possibly tip over.

Workplace surface and overhead conditions and factors to consider when traveling include:

-) **Slippery Conditions:** There is a danger of skidding when traveling on oil, grease, water or other spills. A forklift could tip over when traveling on ice, snow, mud, gravel and uneven areas.
-) **Obstructions and Uneven Surfaces:** There is a danger of tip over when traveling over obstructions, holes and bumps.
-) **Floor Loading Limits:** There is a danger of the floor collapsing if it's unable to support the weight of the forklift, load, and operator.
-) **Overhead Clearance:** There is a chance of damage to lights, stacks, doors, sprinklers and pipes. Damage to the load may also occur, and the forklift may tip over when traveling and hitting an overhead obstruction.

12. Which of the following traffic pattern practices should be followed?

- a. Forklifts should pass on the right
- b. Forklifts should not run side by side
- c. Speed limits should be based on common sense
- d. Forklift operation rules should be identical in all workplaces

Module 3: Cranes and Slings

Crane Rated Capacity

One of the most serious hazards that cranes present is collapse of the equipment caused by exceeding the crane's rated capacity. The term "rated capacity" is defined as:

"The maximum working load permitted by the manufacturer under specified working conditions. Such working conditions typically include a specific combination of factors such as equipment configuration, radii, boom length, and other parameters of use."

The combination of factors that determine rated capacity is set forth in a load chart that must be on the equipment. In general, the load chart states the weight of the load that the crane can lift at different boom radii. The longer the radius at which the lift occurs, the smaller amount of weight the crane can lift.

Employees must not operate a crane in excess of its rated capacity. Because of variable worksite conditions on worksites, such as swinging of the load caused by wind or other factors, the capacity of the crane may be less than that which exists under ideal conditions.

To comply with the rated capacity, the weight of the load must be known. Before beginning a lift, the operator must determine the load weight by using a reliable means.

1. To comply with crane's rated capacity, _____ must be known.

- a. the model of the crane
- b. height of the lift
- c. the weight of the load
- d. the duration of the lift

Safety Measures for Crane Operation

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

For example, the rated capacity of mobile cranes varies with the length of the boom and the boom radius. When a crane has a telescoping boom, a load may be safe to lift at a short boom length or a short boom radius, but may overload the crane when the boom is extended and the radius increases.

To reduce the severity of an injury, employers must take the following precautions:

-) Equip all cranes that have adjustable booms with boom angle indicators.

- J Provide cranes with telescoping booms with some means to determine boom lengths unless the load rating is independent of the boom length.
- J Post load rating charts in the cab of cab-operated cranes. (All cranes do not have uniform capacities for the same boom length and radius in all directions around the chassis of the vehicle.)
- J Require workers to always check the crane's load chart to ensure that the crane will not be overloaded by operating conditions.
- J Instruct workers to plan lifts before starting them to ensure that they are safe.
- J Tell workers to take additional precautions and exercise extra care when operating around power lines.
- J Teach workers that outriggers on mobile cranes must rest on firm ground, on timbers, or be sufficiently cribbed to spread the weight of the crane and the load over a large enough area. (Some mobile cranes cannot operate with outriggers in the traveling position.)
- J Direct workers to always keep hoisting chains and ropes free of kinks or twists and never wrapped around a load.
- J Train workers to attach loads to the load hook by slings, fixtures, and other devices that have the capacity to support the load on the hook.
- J Instruct workers to pad sharp edges of loads to prevent cutting slings.
- J Teach workers to maintain proper sling angles so that slings are not loaded in excess of their capacity.
- J Ensure all cranes are inspected frequently by persons thoroughly familiar with the crane, the methods of inspecting the crane, and what can make the crane unserviceable. Crane activity, the severity of use, and environmental conditions should determine inspection schedules.
- J Ensure the critical parts of a crane—such as crane operating mechanisms, hooks, air, or hydraulic system components and other load-carrying components are inspected daily for any maladjustment, deterioration, leakage, deformation, or other damage.

2. What must crane operators do to make sure the crane will not be overloaded by operating conditions?

- a. Check capacity rating of slings
- b. Always check the crane's load chart
- c. Ask the safety officer if conditions have been met
- d. Have a safety observer watch for overload indications

Keeping Clear of the Load

OSHA regulation [1926.1425](#) seeks to protect employees against being struck by a moving or falling load.

Safe Hoisting Routes

Where available, hoisting routes that minimize the exposure of employees to hoisted loads must be used, to the extent consistent with public safety.

Stationary Suspended Load

While the operator is not moving a suspended load, no employee may be within the fall zone, except for employees:

-) engaged in hooking, unhooking, or guiding the load;
-) engaged in the initial attachment of the load to a component or structure; or
-) operating a concrete hopper or concrete bucket.

Hooking, Unhooking, or Guiding the Load

When employees in the fall zone are engaged in hooking, unhooking, or guiding the load, or are connecting a load to a component or structure, all the following criteria must be met:

-) The materials being hoisted must be rigged to prevent unintentional displacement.
-) Hooks with self-closing latches or their equivalent must be used. Exception: "J" hooks may be used for setting wooden trusses so that a worker need not go onto the truss to open the hook.
-) The materials must be rigged by a qualified rigger.

Receiving a Load

Only employees needed to receive a load are permitted to be within the fall zone when a load is being landed.

3. Who may be within the fall zone of a suspended stationary load?

- a. An employee conducting load inspection
- b. No employee may be within the fall zone
- c. Any employee involved with the lift and positioning
- d. Employees who are hooking, unhooking, or guiding the load

Operator Attention

The operator must not engage in any practice or activity that diverts their attention while engaged in operating the equipment, such as the use of a cell phone (except when used for signal communications).

Operator Responsibility While the Load is Suspended

The operator must not leave the controls while the load is suspended except where ALL the following criteria are met:

1. The operator remains adjacent to the equipment and is not engaged in any activities that take attention away from his or her duties.
2. The load is to be held suspended for a period of time exceeding normal lifting operations.
3. The competent person determines that it is safe to do so and implements measures necessary to restrain the boom hoist and telescoping, load, swing, and outrigger or stabilizer functions.
4. Barricades or caution lines and notices are erected to prevent all employees from entering the fall zone. No employees are permitted in the fall zone.

The four criteria immediately above do not apply to working gear (such as slings, spreader bars, ladders, and welding machines) where:

-) the weight of the working gear is negligible relative to the lifting capacity of the equipment as positioned, and
-) the working gear is suspended over an area other than an entrance or exit.

4. Which of the following is NOT one of the four criteria that must be met before a crane operator may leave the controls while a load is suspended?

- a. A competent person must determine it is safe and implements safety measures
- b. The operator may leave to operate a second crane on the worksite
- c. Barricades, caution lines and notices are erected to prevent entrance to fall zone
- d. The operator remains adjacent to equipment and on duty

Brake Test

The operator must test the brakes each time a load is 90% or more of the maximum line pull. The test is handled by lifting the load a few inches and applying the brakes. In duty cycle and repetitive lifts where each lift is 90% or more of the maximum line pull, this requirement applies to the first lift but not to successive lifts.

Protection Against Rope Detachment

To prevent rope from becoming detached from a drum, neither the load nor the boom must be lowered below the point where less than two full wraps of rope remain on their respective drums.

Traveling with a Load

Traveling with a load is prohibited if the practice is prohibited by the manufacturer. Where it is not prohibited, you must take precautions to prevent hazardous movement of the load and avoid excessive movement of the load that could overload the crane.

Authority to Stop Operation

OSHA regulation [1926.1418](#) provides that, whenever there is a concern about safety, the operator must have the authority to stop and refuse to handle loads until a qualified person has determined safety has been assured.

5. The operator must perform a brake test _____.

- a. each time the load is 90% of maximum line pull
- b. if the load is 100% of anticipated line pull
- c. anytime it is believed the load exceeds capacity
- d. when the load exceeds 50% of crane capacity

Signals

A crane operator often needs a second set of eyes - a signal person - to be able to operate safely. A signal person that uses hand, voice, or audible (bells, whistles, horn, etc.) signals must be provided:

-) when the point of operation, meaning the path the load travels or the area where the load is placed, is not in full view of the operator;
-) when the equipment is traveling and the operator's view in the direction of travel is obstructed; or
-) when, due to site-specific safety concerns, either the operator or the person handling the load determines that it is necessary.

During operations requiring signals, the ability to transmit signals between the operator and signal person must be maintained. If that ability is interrupted at any time, the operator must safely stop operations until signal transmission is reestablished and a proper signal is given and understood.

Only one person may give signals to a crane/derrick at a time, though any person may give an emergency stop signal.

6. What must the crane operator do if the ability to transmit signals between the operator and signal person is interrupted?

- a. Continue operations
- b. Stop operations
- c. Rely on common sense
- d. Use two signal persons

Work Area Control

OSHA regulation [1926.1424](#) is designed to protect employees who work near a crane from being struck or crushed by the crane's rotating superstructure. To prevent employees from entering an area where they could be struck/crushed, you must:

-) Train each employee assigned to work on or near the equipment in how to recognize struck-by and pinch/crush hazard areas posed by the rotating superstructure.
-) Erect and maintain control lines, warning lines, railings, or similar barriers to mark the boundaries of the hazard areas.

- J **Exception:** When you can demonstrate it is neither feasible to erect such barriers on the ground nor on the equipment, the hazard areas must be clearly marked by a combination of warning signs (such as "Danger – Swing/Crush Zone") and high visibility markings on the equipment that identify the hazard areas. In addition, you must train each employee to understand what these markings signify.

Before an employee goes to a location in the hazard area that is out of view of the operator, the employee (or someone instructed by the employee) must ensure that the operator is informed that he/she is going to that location.

Where the operator knows that an employee went to such a location, the operator must not rotate the superstructure until the operator is informed in accord with a pre-arranged system of communication that the employee is in a safe position.

7. What must be done if it can be demonstrated that it is neither feasible to erect barriers to mark crane hazard boundaries?

- a. Conduct operations without rotating the superstructure
- b. Stop operations until employees are trained
- c. The hazard areas must be clearly marked
- d. Post safety observers in hazard areas

Sling Safety

The dominant characteristics of a sling are determined by the components of that sling. For example, the strengths and weaknesses of a wire rope sling are essentially the same as the strengths and weaknesses of the wire rope of which it is made.

Slings are generally one of the following types:

- J **Chains:** Chains are commonly used because of their strength and ability to adapt to the shape of the load. Care should be taken, however, when using alloy chain slings because sudden shocks will damage them. Misuse of chain slings could damage the sling, resulting in sling failure and possible injury to an employee.
- J **Wire Rope:** A second type of sling is made of wire rope. Wire rope is composed of individual wires that have been twisted to form strands. Strands are then twisted to form a wire rope. When wire rope has a fiber core, it is usually more flexible but is less resistant to environmental damage. Conversely, a core that is made of a wire rope strand tends to have greater strength and is more resistant to heat damage.

- J) **Metal Mesh:** Metal mesh slings are widely used in metalworking and in other industries where loads are abrasive, hot, or will tend to cut web slings. Unlike nylon and wire rope slings, metal mesh slings resist abrasion and cutting. Metal mesh slings grip the load firmly without extensive stretching, easily maintaining balanced loads.
- J) **Fiber Rope and Synthetic Web:** Fiber rope and synthetic web slings are used primarily for temporary work, such as construction and painting jobs, and in marine operations. They also are the best choice for use on expensive loads, highly finished parts, fragile parts, and delicate equipment.
 - o **Fiber Rope Slings:** Fiber rope deteriorates on contact with acids and caustics. Fiber ropes slings, therefore, must not be used around these substances unless the manufacturer recommends them for that use.
 - o **Synthetic Rope and Web Slings:** The most commonly used synthetic web slings are made of nylon, polypropylene, and polyester. Because each synthetic material has unique properties, it should be used according to the manufacturer's instructions, especially when dealing with chemically active environments.

8. Which of the following sling types is used because of its strength and ability to adapt to the shape of the load?

- a. Fiber rope
- b. Metal mesh
- c. Wire rope
- d. Chains

Safe Lifting Practices

Slings should be selected based upon the characteristics of the load and the environmental conditions surrounding the lift. Be sure to inspect slings prior to each use and make sure you know how to use it safely. There are four primary factors to consider when safely lifting a load. They are:

1. the size, weight, and center of gravity of the load;
2. the number of legs and the angle the sling makes with the horizontal line;
3. the rated capacity of the sling; and
4. the history of the care and usage of the sling.

Size, Weight, and Center of Gravity of the Load

The center of gravity of an object is that point at which the entire weight may be considered as concentrated. To make a level lift, the crane hook must be directly above this point. While slight variations are usually permissible, if the crane hook is too far to one side of the center of gravity, dangerous tilting will result causing unequal stresses in the different sling legs. This imbalance must be compensated for at once.

Number of Legs and Angle with the Horizontal

As the angle formed by the sling leg and the horizontal line decreases, the rated capacity of the sling also decreases. In other words, the smaller the angle between the sling leg and the horizontal, the greater the stress on the sling leg and the smaller (lighter) the load the sling can safely support. Larger (heavier) loads can be safely moved if the weight of the load is distributed among more sling legs.

Rated Capacity of the Sling

The rated capacity of a sling varies depending upon the type of sling, the size of the sling, and the type of hitch. Operators must know the capacity of the sling. Charts or tables that contain this information generally are available from sling manufacturers. The values given are for new slings. Older slings must be used with additional caution. Under no circumstances shall a sling's rated capacity be exceeded.

History of Care and Usage

Mishandling and misusing slings are the leading cause of sling-related accidents. Most injuries and accidents, however, can be avoided by becoming familiar with the essentials of proper sling care and use. Be sure to check this history of the sling to be used and that it has passed inspections.

9. When calculating sling rated capacity, as the angle formed by the sling leg and the horizontal line _____, the rated capacity of the sling _____.

- a. decreases, remains the same
- b. decreases, decreases
- c. increases, decreases
- d. increases, remains the same

Care and Use of Slings

Proper care and use are essential for maximum service and safety. Slings must be protected with cover saddles, burlap padding, or wood blocking as well as from unsafe lifting procedures such as overloading to prevent sharp bends and cutting edges. Follow these safe practices when working with slings:

-) Before making a lift, check to be certain that the sling is properly secured around the load and that the weight and balance of the load have been accurately determined.
-) If the load is on the ground, do not allow the load to drag along the ground. This could damage the sling. If the load is already resting on the sling, ensure that there is no sling damage prior to making the lift.
-) Next, position the hook directly over the load's center of gravity and seat the sling squarely within the hook bowl. This gives the operator maximum lifting efficiency without bending the hook or overstressing the sling.
-) Wire rope slings also are subject to damage resulting from contact with sharp edges of the loads being lifted. These edges can be blocked or padded to minimize damage to the sling.

After the sling is properly attached to the load, there are many good lifting techniques common to all slings.

1. Make sure the load is not lagged, clamped, or bolted to the floor.
2. Guard against shock loading by taking up the slack in the sling slowly. Apply power cautiously to prevent jerking at the beginning of the lift, and slowly accelerate or decelerate.
3. Check the tension on the sling. Raise the load a few inches, stop, and check for proper balance and that all items are clear of the path of travel. Never allow anyone to ride on the hood or load.
4. Keep all personnel clear while the load is being raised, moved, or lowered. Crane or hoist operators should watch the load always when it is in motion.
5. Obey the following "Nevers."
 - Never allow more than one person to control a lift or give signals to a crane or hoist operator except to warn of a hazardous situation.

- Never raise the load more than necessary.
- Never leave the load suspended in the air. And never work under a suspended load or allow anyone else to.

Once the lift has been completed, clean the sling, check it for damage, and store it in a clean, dry airy place. It is best to hang it on a rack or wall.

Remember, damaged slings cannot lift as much weight as new or older well-cared for slings. Proper and safe use and storage of slings will increase their service life.

10. When lifting a load, where should the hook be positioned over the load to give maximum lifting efficiency?

- a. As determined by the load chart on the capacity plate
- b. Anywhere depending on the shape of the load
- c. Directly over the center of gravity of the load
- d. Within one foot of the physical center of the load

Module 4: Conveyors, Housekeeping, and Storage

In this module, we will discuss material handling considerations for handling materials using conveyors, general housekeeping measures to make handling materials less hazardous, and general best practices for storing materials.

Working Around Conveyors

When using conveyors, workers may get their hands caught in nip points where the conveyor medium runs near the frame or over support members or rollers. Workers also may be struck by material falling off the conveyor, or they may get caught in the conveyor and drawn into the conveyor path as a result. To prevent or reduce the severity of an injury, employers can use engineering and administrative controls to protect workers.

Engineering controls include:

-) Install an emergency button or pull cord designed to stop the conveyor at the employee's work station.
-) Install emergency stop cables that extend the entire length of continuously accessible conveyor belts so that the cables can be accessed from any location along the conveyor.
-) Design the emergency stop switch so that it must be reset before the conveyor can be restarted.
-) Provide guards where conveyors pass over work areas or aisles to keep employees from being struck by falling material. (If the crossover is low enough for workers to run into it, mark the guard with a warning sign or paint it a bright color to protect employees.)
-) Cover screw conveyors completely except at loading and discharging points. (At those points, guards must protect employees against contacting the moving screw. The guards are movable, and they must be interlocked to prevent conveyor movement when the guards are not in place.)

Administrative controls include:

-) Ensure appropriate personnel inspect the conveyor and clear the stoppage before restarting a conveyor that has stopped due to an overload.
-) Prohibit employees from riding on a materials-handling conveyor.

1. Which of the following is an example of effective engineering controls to prevent injuries while working around conveyors?

- a. Ensuring proper inspection of conveyors
- b. Prohibiting employees from riding conveyors
- c. Installing machine guards, switches, cables and covers
- d. Developing safety rules for working around conveyors

Housekeeping

Poor housekeeping creates a disorderly workspace, which increases the risk of ergonomic and other injuries while handling, moving, and storing materials. Employees can spend less time moving materials and more time performing skilled tasks. Ultimately, poor housekeeping decreases productivity.

Uncluttered working conditions are essential to the safety of all workers and should be maintained always in both work and office areas. Proper housekeeping management provides for an orderly arrangement of operations, tools, equipment, storage facilities, supplies, and waste material.

Maintaining the below conditions contributes significantly to lower injury and illness rates:

- floors free from grease and oil spillage;
- properly identified hallways, isles, and passageways;
- unobstructed accesses and exits;
- neat and orderly machinery and equipment;
- well-nested hoses and cords;
- properly stored materials;
- removal of excess waste material or debris from the working area;
- walkways free from ice and snow;
- surfaces, including elevated locations, free from accumulated dust; and
- adequate lighting.

A little caveat: It's also important to understand OSHA sees poor housekeeping during most of their inspections, especially on construction sites. When OSHA inspectors see poor housekeeping, they may assume, "a messy workplace is not a safe workplace, if they're not paying attention to good housekeeping practices, they're probably not paying attention to safe work practices." The inspectors are more likely to look closely for violations in the workplace or worksite. So, it's not only smart safety, but smart business to keep the workplace clean and orderly.

See more on the benefits of good housekeeping at [OSHA's Process: Housekeeping Safety Page](#).

2. What is an OSHA inspector likely to think when they see good housekeeping in the workplace?

- a. It's nice and clean in here
- b. A clean workplace is a safe workplace
- c. I'll have to look hard to find violations
- d. They're just trying to impress me

Staging

Poorly-planned staging may result in employees lifting materials from awkward locations or carrying materials longer than necessary.

Possible Solutions:

-) Ensure materials are off the floor and are placed on stands, racks, or other devices that allow the materials to be in the power zone, minimizing the need to bend or reach to access materials.
-) Ensure that materials are staged within 25 to 50 feet of the point of use. This reduces walking distances, an element that affects risk factors, efficiency, and productivity.
-) Plan staging so that materials and equipment can be placed in a central location so employees have good access to materials.
-) Preplan, in the bidding stage, the space and type of racking needed to store conduit and spools of wire at a central location, allowing easy access and locating materials in the power zone.

3. When staging materials, place them _____.

- a. at floor level within 50 feet of the work
- b. according to OSHA requirements
- c. within 25-50 feet from the point of use
- d. in a decentralized area away from workstations

General Storage Considerations

Stored materials must not create a hazard for employees. Employers should make workers aware of such factors as the materials' height and weight, how accessible the stored materials are to the user, and the condition of the containers where the materials are being stored when stacking and piling materials. To prevent creating hazards when storing materials, employers must do the following:

-) Keep storage areas free from accumulated materials that cause tripping, fires, or explosions, or that may contribute to the harboring of rats and other pests;
-) Place stored materials inside buildings that are under construction and at least 6 feet from hoist ways, or inside floor openings and at least 10 feet away from exterior walls;
-) Separate noncompatible material; and
-) Equip employees who work on stored grain in silos, hoppers, or tanks, with lifelines and safety belts.
-) Workers should consider placing bound material on racks, and secure it by stacking, blocking, or interlocking to prevent it from sliding, falling, or collapsing.

4. In buildings under construction place stored materials _____ from hoist ways, or inside floor openings.

- a. between 4 and 6 feet
- b. 2 feet
- c. 10 feet
- d. at least 6 feet

Storing Materials in an Open Yard

Storing materials in an open yard requires attention to combustible materials, access, powerlines, and fire protection.

- J **Combustible Materials:** Stack combustible materials securely. Stacks or piles must be no more than 16 feet high. Store combustible material at least 10 feet away from a building or structure.
- J **Access:** Driveways between and around combustible storage piles must be at least 15 feet wide. Keep them free from accumulations of material or rubbish. Use a map grid system of 50 by 150 feet when planning driveways in open-yard combustible material storage areas.
- J **Powerlines:** Do not store materials under power lines or where materials may block egress or emergency equipment.
- J **Fire Protection:** Provide portable fire extinguishing equipment rated 2-A:40-B:C at accessible marked locations in the yard so that the nearest extinguisher is no more than 50 feet away for a Class B hazard or 75 feet away for a Class A hazard.

5. Stacks or piles stored outside must be no more than _____ high.

- a. 5 feet
- b. 10 feet
- c. 16 feet
- d. 20 feet

Storing Materials Indoors

Storing materials indoors requires attention to access, fire prevention and protection, floor loading, and overhead hazards. Buildings under construction require special precautions.

- J **Access:** Place or store materials so they do not interfere with access ways, doorways, electrical panels, fire extinguishers, or hoistways. Do not obstruct access ways or exits with accumulations of scrap or materials. Aisles must be wide enough to accommodate forklifts or firefighting equipment.
- J **Fire Prevention:** When storing, handling, and piling materials, consider the fire characteristics. Store noncompatible materials that may create a fire hazard at least 25 feet apart or separate them with a barrier having at least a 1-hour fire rating. Pile

material to minimize internal fire spread and to provide convenient access for firefighting.

- J **Fire Doors:** Maintain a 24-inch clearance around the travel path of fire doors.
- J **Sprinklers:** Maintain at least an 18-inch clearance between stored materials and sprinkler heads.
- J **Heating Appliances:** Maintain at least a 3-foot clearance between stored materials and unit heaters, radiant space heaters, duct furnaces, and flues or the clearances shown on the approval agency label.
- J **Fire Protection:** Emergency fire equipment must be readily accessible and in good working order.
- J **Floor Loading:** Conspicuously post load limits in all storage areas, except for floors or slabs on grade.
- J **Buildings Under Construction:** Store materials inside buildings under construction at least 6 feet away from any hoistway or inside floor openings, and 10 feet away from an exterior wall that does not extend above the top of the material stored.

6. Stored materials must be kept at least _____ from overhead sprinkler heads.

- a. 6 inches
- b. 12 inches
- c. 18 inches
- d. 24 inches

Bagged Materials

Bags and bundles should be stacked in interlocking rows to remain secure. Bagged material should be stacked by stepping back the layers and cross-keying the bags at least every ten layers. To remove bags from the stack, start from the top row first.

Bulk Materials

Ensure entry to bulk storage locations, such as silos, hoppers, tanks, or bins (which are also classified as confined spaces) complies with OSHA requirements and local operating procedures.

Lumber

Stack lumber on level and solidly supported sills so that the stacks are stable. Do not pile lumber more than 16 feet high.

Bricks and Masonry Blocks

Stack bricks and masonry blocks on level and solid surfaces.

-) **Bricks:** Stack bricks no more than 7 feet high. Step back a loose brick stack at least 2 inches for every foot of height above 4 feet. Stack packaged brick no more than three units high.
-) **Masonry Blocks:** Step back masonry blocks one-half block per tier above the 6-foot level.

Cement and Lime

Handling or storing cement or lime requires a job hazard analysis (JHA). Lime requires careful storage and handling procedures. Store unslaked lime in a dry area and, because it presents a fire hazard, separate it from other materials.

7. What is the requirement for stacking bagged material so that they remain secure?

- a. They must be cross-linked
- b. They must not be cross-linked
- c. Do not stack over 16 feet high
- d. Step back rows 2 inches every foot

Reinforcing, Sheet, and Structural Steel

-) Stack steel to prevent sliding, rolling, spreading, or falling.
-) Use lagging (sleeve) when steel is handled by a crane or forklift to aid safe rigging.

Pipe, Conduit, and Cylindrical Material

Make sure cylindrical materials are stable when storing or handling.

-) **Stacking:** Place pipe, conduit bar stock, and other cylindrical materials in racks or stack and block them on a firm, level surface to prevent spreading, rolling, or falling. Use either a pyramided or battened stack. Step back battened stacks at least one unit per tier and securely chock them on both sides of the stack.

- J **Removal:** Remove round stock (e.g., wood poles, pipe, and conduit) from a stack from the ends of the stock.
- J **Unloading:** Unload carriers so that employees are not exposed to the unsecured load.
- J **Taglines:** Use taglines when working with round stock.

Sand, Gravel, and Crushed Stone

- J Locate stockpiles to provide safe access for withdrawing material. Material on vertical faces must not overhang.
- J Store material against walls or partitions only in an amount that will not endanger the stability of the wall or partition.

8. How should pipe and conduit bar stock be stored?

- a. Use only approved pallets
- b. Stacked vertically and blocked
- c. In racks or stacked on level surface and blocked
- d. Store against walls at 45-degree angle

Handling and Storing Drums and Containers

Handling: Improper handling of drums and barrels can result in severe injuries. These include painful back sprains, smashed toes and fingers, or exposure to hazardous chemicals if the contents are leaking. Proper work practices can minimize your risk of injury, so consider the following best practices:

- J Prior to handling the drum, read the label on the drum and look for symbols, words or other marks which indicate if its contents are hazardous, corrosive, toxic or flammable. If the drum isn't labeled, consider the contents hazardous until they are positively identified.
- J Look around the drum to see if it is leaking. Find and review the appropriate SDS to see what the drum contains.
- J Before moving the drum or barrel, replace missing bungs and/or lids and secure as necessary.
- J Depending upon the contents of the drum, estimate its weight. Determine whether you can move it yourself or if you need assistance. A 55-gallon drum can weigh 400-800 pounds.

-) If you decide to move it yourself, use a forklift if one is available, a hand truck or a drum cart that is designed specifically for drum handling.
-) If the drum is on its side, upend a barrel or drum using a drum lifter bar. If one is not available, crouch in front of the drum, knees apart and firmly grasp the chime on each side. Keep your back straight and use your leg muscles to lift. Balance the drum on the lower chime, shift your hands to the far edge, and ease the drum into the upended position.
-) Use PPE to protect your hands, feet, back and face during this work.
-) Most importantly, use material handling equipment whenever possible, and get help when you need it!

Storage: Fifty-five-gallon drums or other similar containers should be stored in rows that are no more than two (2) 55-gallon drums high and two 55-gallon drums wide. This recommendation takes into consideration the following:

-) Inspections not only detect spills but also detect container deterioration.
-) It is difficult to inspect drums or containers when ladders are required when drums are more than two high.
-) Rows should be no more than two drums wide. Drums inside the rows are not visible. This would require containers to be moved to perform adequate inspection.
-) Variability in container strength and condition make it unwise to stack containers more than two high. This puts unnecessary strain on the supporting containers.
-) Variability in container dimensions can make stacking more than two high risky because of the uncertain support given by the different container sizes.
-) Variability in the number of drums on each pallet may also lead to instability. It is not uncommon to find only three drums on a pallet.

9. Fifty-five-gallon drums should be stored in rows that are no more than ____.

- a. 3 drums high and 1 drum wide
- b. 2 drums high and 2 drums wide
- c. 3 drums high and 2 drums wide
- d. 2 drums high and 4 drums wide

Flammable or Combustible Liquids

Indoor Storage: Do not store flammable and combustible liquids indoors, except as follows:

-) Store no more than 25 gallons in a room or single fire area.
-) Store no more than 60 gallons of Class I or II liquids, or more than 120 gallons of Class III liquids, in an approved cabinet. Locate no more than three such cabinets in a single fire area.
-) You may store larger quantities in separated indoor storage areas when such storage meets the requirements of NFPA 30, Section 4-4, "Design, Construction, and Operation of Inside Storage Areas."
-) Place at least one 2-A:40-B:C fire extinguisher 10 feet to 30 feet away from the stored material or cabinet.
-) Place at least one 2-A:40-B:C fire extinguisher outside of, but not more than 10 feet from, the door opening into an inside liquid storage area.

Outdoor Storage: Do not store flammable and combustible liquids outdoors, except as follows:

-) Above ground in approved containers with no more than 60-gallon capacity, subject to the following restrictions:
 - o The total capacity of any one group of containers stored together must not exceed 1,100 gallons. Each group of containers must be at least 5 feet apart, and each group must be at least 20 feet away from any building or other combustibles.
 - o Each group of containers must be adjacent to an access way at least 12 feet wide to facilitate the use of firefighting equipment.

- J Above ground in approved portable tanks with no more than 660-gallon capacity, providing that you:
 - o Keep a 5-foot clear area around groups of two or more tanks with a combined capacity of more than 2,200 gallons.
 - o Keep portable tanks at least 20 feet away from any building or other combustibles.
 - o Equip portable storage tanks with emergency venting and other devices, as required in NFPA 30.
 - o Locate each tank adjacent to an access way at least 12 feet wide to facilitate use of firefighting equipment.
- J Above ground in approved tanks installed in accordance with NFPA 30, Section 2-3, "Installation of Outside Above Ground Tanks."
- J Dike storage areas at least 12 inches high or grade and slope them, and seal them with a 50-mil plastic compatible sheeting or equivalent liner to contain leaks and spills equal to the capacity of all tanks or containers in each area. Keep the area free from vegetation or combustible material within 10 feet of the storage area perimeter.
- J Place at least one portable fire extinguisher unit rated not less than 2-A:40-B:C 25 feet to 75 feet away from each portable tank or group of tanks or containers.

10. What is the maximum amount of flammable and combustible liquids in a room or single fire area?

- a. 10 gallons
- b. 15 gallons
- c. 25 gallons
- d. 60 gallons

Resources

1. [1910.176 Handling materials - General](#) - OSHA
2. [1926.958 Materials Handling and Storage - Electrical Power Transmission and Distribution](#) - OSHA
3. [1926.250 Materials Handling, Storage, Use and Disposal - General](#) - OSHA
4. [Materials Handling and Storage](#) - OSHA Pub 2236
5. [Materials Handling Industry \(MHI\) Association](#)
6. [Guidance on Safe Sling Use](#) - OSHA
7. [Hoisting and Rigging Fundamentals](#) - OSHA
8. [Hoisting and Rigging Fundamentals](#) - OSHA