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# FORKLIFT BASICS & SAFETY

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<b>Sub Category:</b>	-
<b>Course #:</b>	CIV-116
<b>Course Content:</b>	23 pgs
<b>PDH/CE Hours:</b>	2

## OFFICIAL COURSE/EXAM

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# CIV-116 EXAM PREVIEW

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## Exam Preview:

1. According to the reference material, standard warehouse forklifts have lifting capacities from 2,000 to 15,000 pounds and lifting heights from 100 to 210 inches.
  - a. True
  - b. False
2. The 4K rough-terrain (RT) forklift is a diesel engine-driven, rubber-tired, self-contained, rider type of mechanized materials-handling vehicle. They are designed to lift loads of 4,000-pound capacity with a \_\_\_-inch load center to a maximum height of 100 inches.
  - a. 12
  - b. 18
  - c. 24
  - d. 36
3. According to the reference material, the 4K (RT) forklift can be used both indoors and outdoors and is capable of fording streams or pools of water up to \_\_\_ inches deep.
  - a. 10
  - b. 15
  - c. 20
  - d. 30
4. The center of balance is a critical factor for capacity. On most forklifts, the center of balance (C/B) is located in the rear of the forklift.
  - a. True
  - b. False

5. According to the reference material, you should lift and lower with the mast vertical or tilted slightly back. Tilt elevated loads forward only when they are directly over the unloading place.
  - a. True
  - b. False
6. The NCF has two types of lift-king forklifts (fig. 8-8) rated at 12K and 16K. These two models provide a lifting capacity of 12,000 to 16,000 pounds at a 48-inch load center to a height of \_\_\_\_ inches.
  - a. 80
  - b. 100
  - c. 120
  - d. 140
7. The height the forks can raise before the inner slides move upward from the mast and increase the overall height is called free lift.
  - a. True
  - b. False
8. Using Figure 8-13.—Drum-handling attachments, and the surrounding reference material, what is the maximum number of 55 gallon drums than can be carried by the attachment in view A?
  - a. 1
  - b. 3
  - c. 2
  - d. 4
9. The mast of the lift-king forklift is equipped with a lift interrupt device that prevents lifting the fork assembly above \_\_\_\_ inches from the ground. This is a safety device to prevent raising the mast while inside an aircraft and causing extensive damage.
  - a. 43
  - b. 46
  - c. 48
  - d. 49
10. Lifting speed is controlled by the speed of the engine and the extent the control lever is pulled. Engine speed has the same effect on lowering speed.
  - a. True
  - b. False

# FORKLIFT BASICS AND SAFETY

The forklift is a primary piece of equipment that is essential to the mission of the NCF. Forklifts are used to support construction operations whenever there is a need to lift, load, or unload materials or supplies. Because of the variety of makes and models of forklifts used in the Navy and the NCF, this chapter covers only the characteristics and basic principles of operations of forklifts. By reading the operator's manuals, you can obtain detailed information about each make and model.

## MATERIALS-HANDLING EQUIPMENT

Forklifts are classified as materials-handling equipment. The term materials handling describes an ongoing activity for every construction project or operation that requires the picking up and moving of raw materials, processed parts, finished products, tools, equipment, supplies, or maintenance items. Every operation that requires raising, lowering, or moving an item is classified as materials handling.

Since materials handling involves lifting, lowering, and moving in some form, forklifts excel over other methods of handling. Forklifts are specifically designed to ensure efficient handling of materials under varied conditions. Design specifications and performance characteristics of forklifts define their capabilities and limitations under adverse conditions. To operate a forklift efficiently, you must know its capabilities and limitations.

This chapter covers the capabilities, limitations, attachments, and principles of operation of warehouse and rough terrain forklifts.

## WAREHOUSE FORKLIFTS

The most common types of warehouse forklifts used are either electric-, gasoline-, or propane-powered and have solid, semisolid, or pneumatic rubber tires. These forklifts are used in warehouses or on hard-surfaced outdoor storage areas. The warehouse forklift (fig. 8-1) is a unit designed to pickup, carry, and

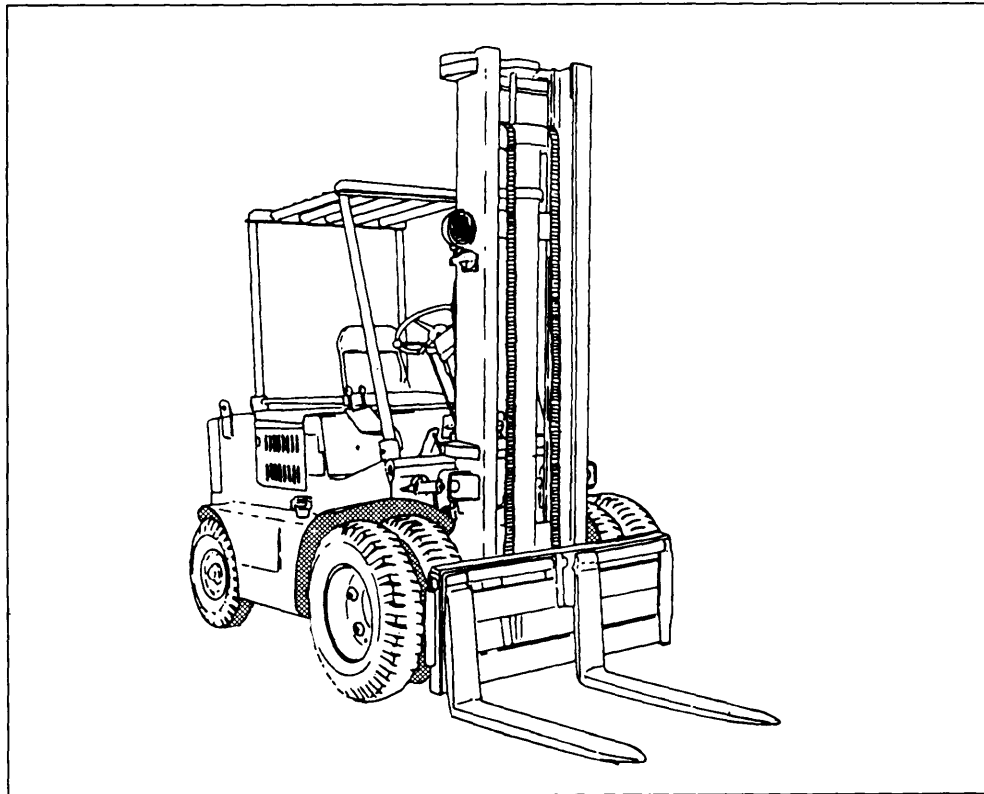


Figure 8-1.—Warehouse forklift

stack unit loads of supplies and equipment. Standard warehouse forklifts have lifting capacities from 2,000 to 15,000 pounds and lifting heights from 100 to 210 inches. Warehouse forklifts are equipped with a telescopic mast that permits loads to be lifted beyond the height of the collapsed mast. The height the forks can raise before the inner slides move upward from the mast and increase the overall height is called **free lift**.

#### 4K ROUGH-TERRAIN (RT) FORKLIFT

The 4K rough-terrain (RT) forklift (fig. 8-2) is a diesel engine-driven, rubber-tired, self-contained, rider type of mechanized materials-handling vehicle. They are designed to lift loads of 4,000-pound capacity with a 24-inch load center to a maximum height of 100 inches. The lifting forks are mounted on the front of the vehicle and the engine faces the rear. Controls for operating the lifting forks (lifting, tilting, rotating, and side shifting) are located to the right when the operator is sitting in the operator's seat.

The 4K (RT) forklift is designed for the loading and unloading of flatcars, flatbed trailers, cargo aircraft, and landing craft. Additionally, the 4K (RT) is used for stocking, unstacking, and transporting heavy-crated boxes, containers, and palletized loads of heavy equipment and supplies over unprepared and unstable surfaces. This forklift is the primary forklift used in rough terrain, such as a beach, in deep sand, or where the terrain is covered with ice, snow, or mud, or where hard standing is not available. The 4K (RT) forklift can be used both indoors and outdoors and is capable of fording streams or pools of water up to 30 inches deep. This forklift can be transported by tractor-trailer or by military aircraft.

The 4K forklift may be driven to project sites under its own power without any special preparation; however, when performing the prestart operational check, you should ensure the safety pin (fig. 8-3) is disengaged before operating. The safety pin prevents the forklift

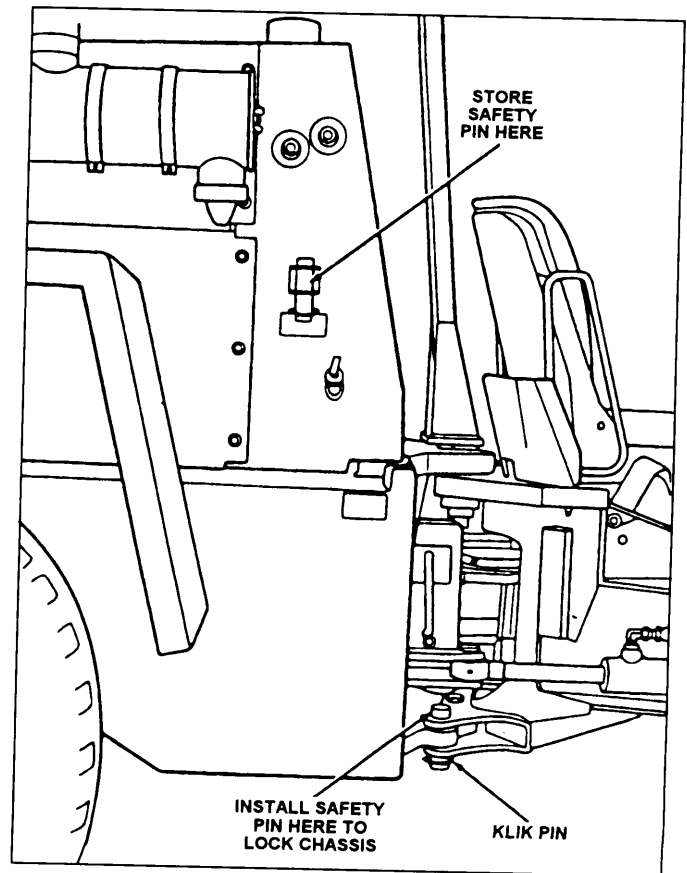


Figure 8-3.—Safety pin location.

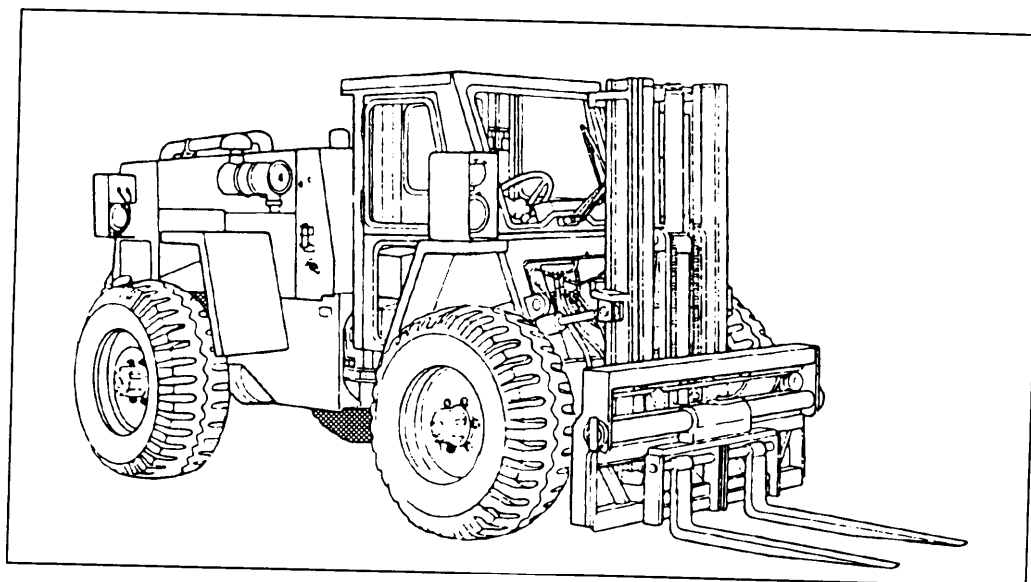


Figure 8-2.—4K rough-terrain (RT) forklift.

from articulating; therefore, the forklift cannot be steered. Failure to disengage the pin may cause serious injury or death.

The 4k forklift can be towed rearward using the tow bar (fig. 8-4) located on the rear of the vehicle.

The towing procedure for the 4K (RT) forklift is as follows:

1. Remove the pin securing the tow bar in the vertical position and lower the tow bar into the towing position and attach it to the pintle hook on the towing vehicle.
2. Disconnect the hook end of the two safety chains from the forklift and attach them to the towing vehicle.
3. Push the **axle disconnect lever** (fig. 8-5) to the right toward the front chassis to disconnect the axles for towing.

The axle disconnect lever controls the engagement of the transmission output shaft to the front and rear axles. To engage the axles for operation, you push the lever to the left towards the rear of the vehicle.

4. Open the steering **bypass valve** (fig. 8-6) by turning it counterclockwise fully.

The steering bypass valve allows the front chassis to pivot freely on the rear chassis when towing the forklift. For normal steering control, close the valve by turning the knob clockwise fully.

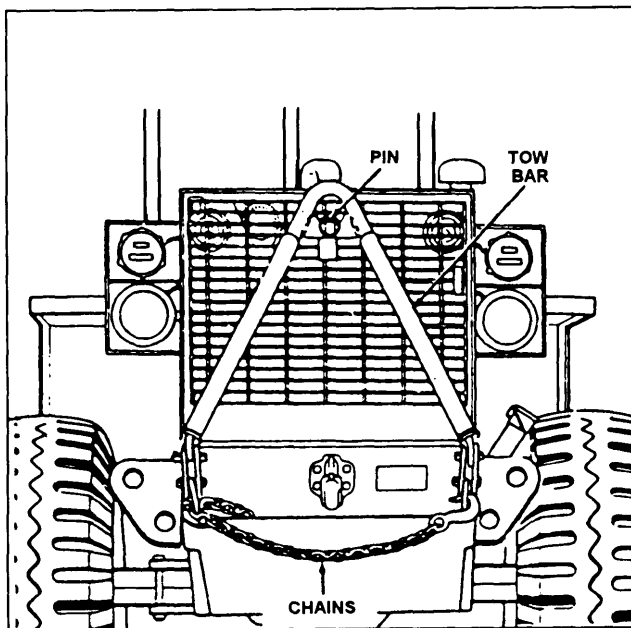


Figure 8-4.—Tow bar and chains.

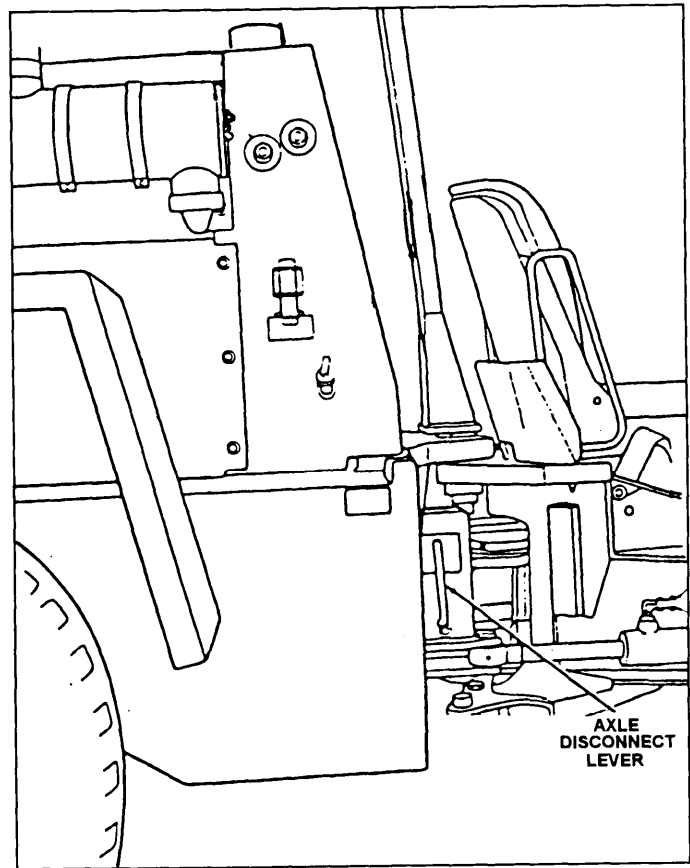


Figure 8-5.—Axle disconnect lever.

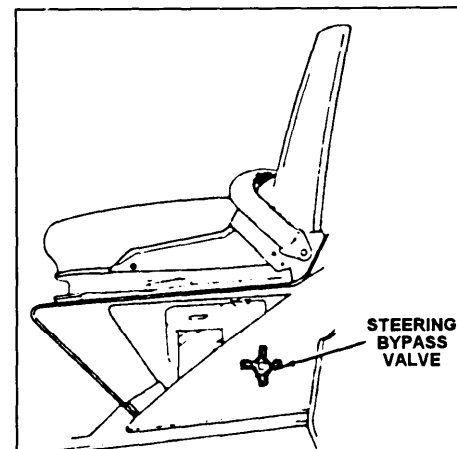


Figure 8-6.—Steering bypass valve.

### CAUTION

Verify that the steering bypass valve is closed before operating the 4K forklift.

5. Remove the safety pin (fig. 8-3), if installed. **The safety pin must not be installed when the forklift is being towed.**

## CAUTION

Before pushing the forklift, install the safety pin to prevent the forklift from articulating and damaging the tow bar.

**NOTE:** Do not tow the forklift faster than 35 mph.

### 6K ROUGH-TERRAIN (RT) FORKLIFTS

The 6K rough-terrain (RT) forklifts (fig. 8-7) are all-wheel drive, all-wheel steer materials-handling equipment capable of lifting 6,000-pound loads to a height of 200 inches.

The 6K (RT) forklift is designed to handle loads over rough terrain consisting of unprepared or

unstabilized surfaces, such as beaches, deep sand, snow, ice, or mud. The 6K (RT) is used primarily for loading and unloading flatbed trailers, landing craft, and other types of cargo vessels.

A hydraulic-operated forklift mechanism, mounted on the extreme front of the 6K (RT) forklift, provides for lifting, reaching, tilting, and sliding loads during material-handling operations.

A unique design feature of the rough-terrain forklift is an oscillating hydraulic cylinder that allows the rotation of the forklift frame about its longitudinal axis when being operated over rough terrain. The operator controls the rotation by manipulating the control that activates the oscillating hydraulic cylinder. The 6K (RT) forklift is also equipped with a power shift

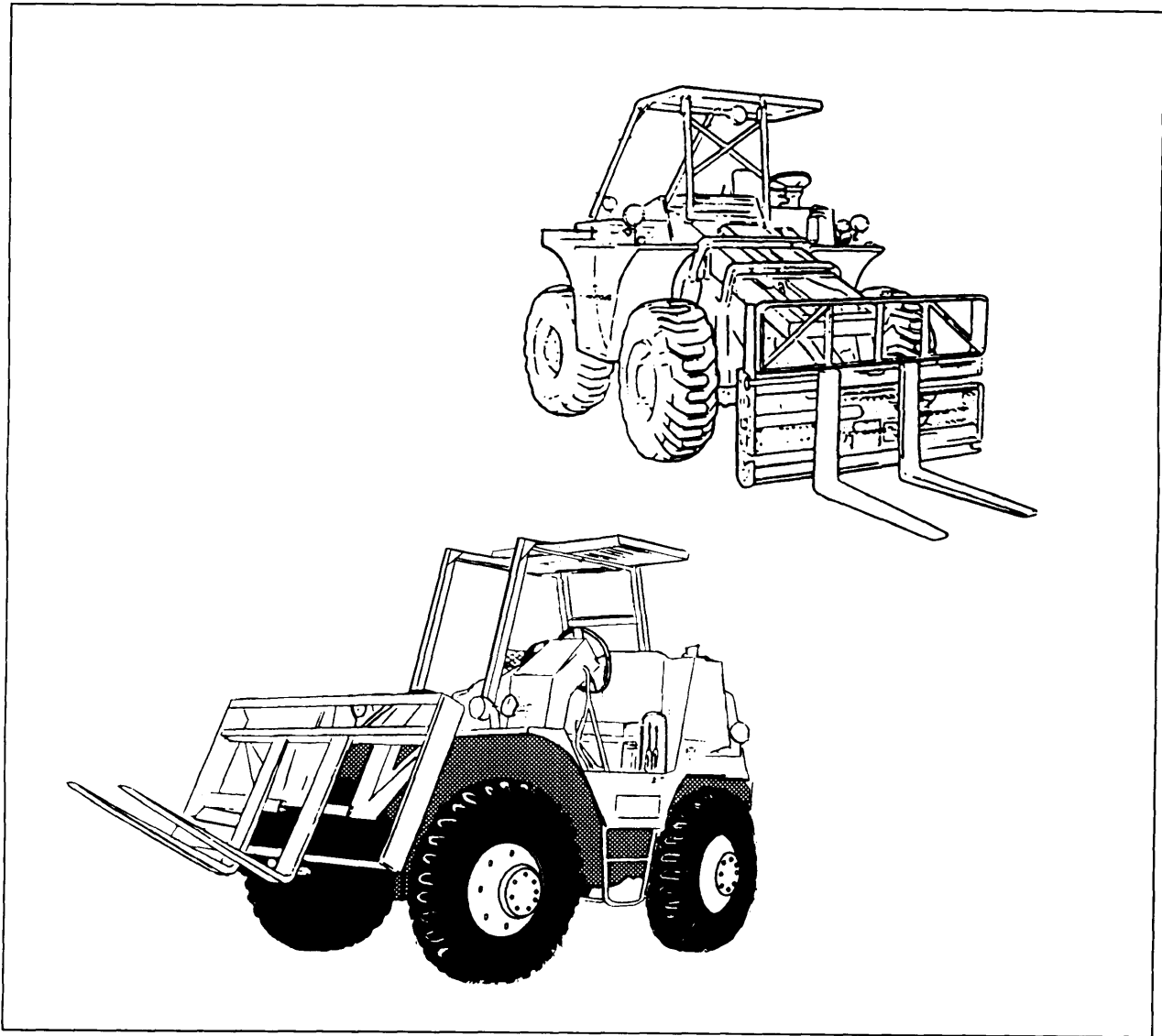


Figure 8-7.—6K rough-terrain (RT) forklifts.

transmission for smooth acceleration, deceleration, and easy handling.

## LIFT-KING FORKLIFT

The NCF has two types of lift-king forklifts (fig. 8-8) rated at 12K and 16K. These two models provide a lifting capacity of 12,000 to 16,000 pounds at a 48-inch load center to a height of 120 inches. The lift-king forklift is equipped with forklift oscillation, load side shift, lift interrupt, fork positioning, four-wheel and two-wheel-crab steering selection, and counterweight lowering.

The lift-king forklift is equipped with an inching control that is controlled by the inching pedal located to the left of the brake pedal. Depressing the inching pedal slightly varies the amount of oil pressure in the transmission, allowing the forklift to be “inched” along slowly while the engine is operated at high speed for fast lifts. When the inching pedal is depressed fully, the transmission is disengaged.

**NOTE:** Do not use the inching pedal as a clutch and under high-torque requirements.

The mast of the lift-king forklift is equipped with a lift interrupt device that prevents lifting the fork assembly above 43 inches from the ground. This is a safety device to prevent raising the mast while inside an aircraft and causing extensive damage. To lift loads higher than 43 inches, you must press the red-colored manual lift interrupt override button. This button allows the forks to attain their maximum lift height when required.

The lift-king forklift is air transportable; however, where the load per axle weight cannot be exceeded, the front carriage assembly and rear counterweight must be removed. The procedure of carriage removal is as follows:

1. Lower the forks to the ground and tilt the mast slightly forward to produce slack in the lifting chains.
2. Remove the lower chain anchor pins.
3. Raise the mast above the carriage rollers and back the forklift out, leaving the forks and carriage on the ground.

**NOTE:** For reinstallation, the procedures are simply reversed.

The procedure for counterweight removal is as follows:

1. Remove the two bolts (one on each side of the forklift) that secures the counterweight (fig. 8-9).

2. Lower the counterweight lifting arm to rest the counterweight on the ground (hydraulic control lever is located in the back of the operator's cab to the right of the seat).

3. Remove the pin from the shackle to disconnect the arm from the counterweight. **Remember:** Store the bolts and the pin in the toolbox.

4. Drive the forklift away from the counterweight.

**NOTE:** When the lift-king forklift is transported on a tractor-trailer, seal the exhaust pipe to prevent autorotation of the turbocharger turbine due to wind velocity. Failure to do so can result in damage to the turbine bearing due to lack of lubrication.

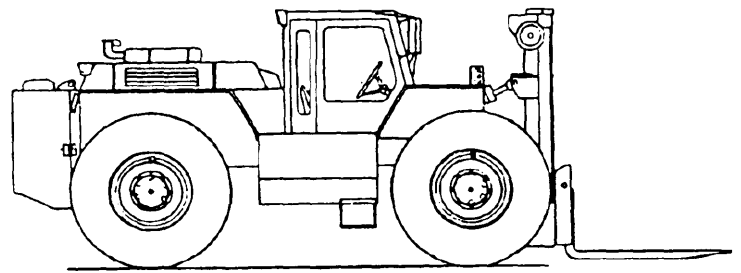


Figure 8-8.—Lift-king forklift.

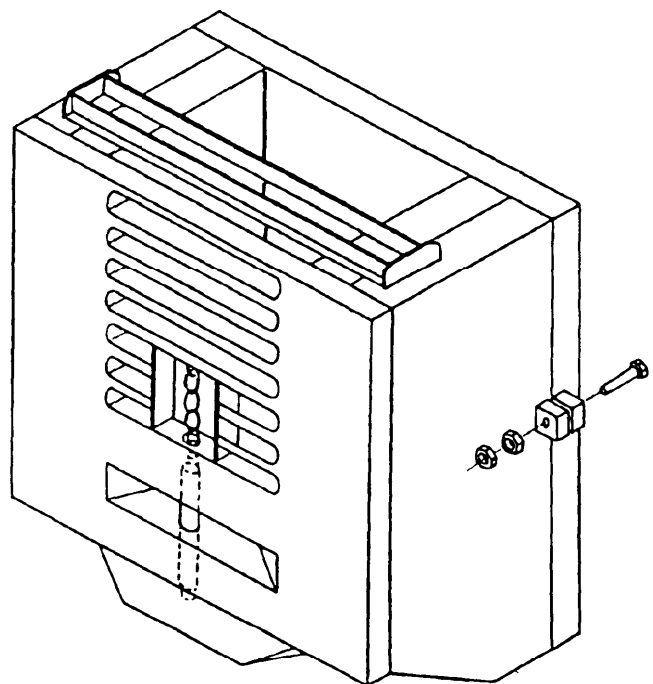


Figure 8-9.—Counterweight.



## ATTACHMENTS

Attachments give forklifts versatility that allow them to do more work efficiently; however, you must remember that the attachment may reduce the capacity of the forklift by changing the center of gravity of the load.

### Fork Extensions

Forklift extensions that are known by the term **tine (fork) extender** are designed in two configurations: bare tine extender (fig. 8-10) and rollerized tine extenders (fig. 8-11).

An extender provides additional length to the forklift tines that permits an easier way to load tractor-trailers and Air Force 463-L pallets. The extender moves the center of gravity of the load, and this restricts the weight that can be lifted. You must remember these restrictions when using the extensions to handle large or bulky loads. The lift-king forklift has

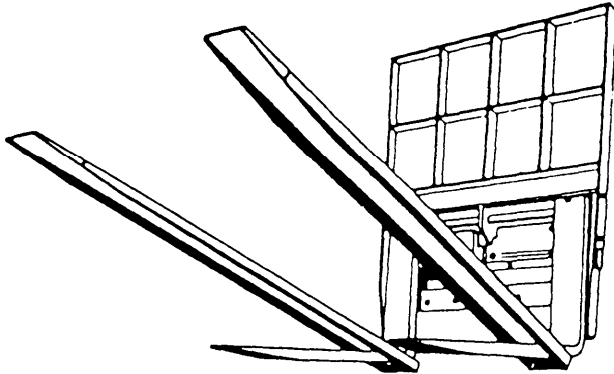


Figure 8-10.—Bare tine extender.

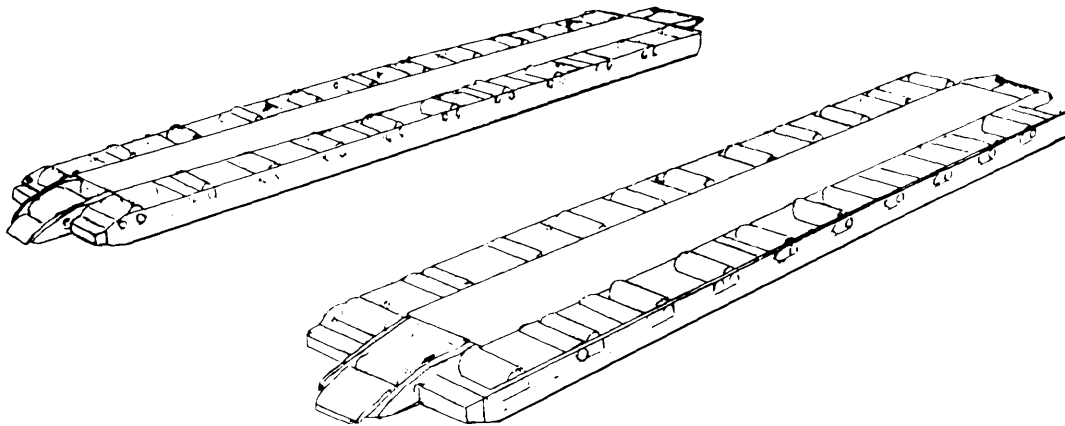


Figure 8-11.—Rollerized tine extenders.

a set of roller tine extensions assigned as an attachment. The roller tines are used when handling 463-L pallets.

### Crane Boom Attachment

The crane boom attachment converts the forklift to a mobile crane jib capable of handling bulky, irregularly shaped objects and is a valuable aid in maintenance work (fig. 8-12). The crane boom is raised or lowered with the standard lift mechanism.

### Drum-Handling Attachment

A drum-handling attachment can handle filled 55-gallon drums by means of a forklift truck. Three types of drum-handling attachments are shown in figure 8-13.

The first consists of a series of specially shaped and spaced forks that cradle the drums to be handled (fig. 8-13, view A). This attachment handles three filled drums at one time.

The second type is mounted on the forks of the forklift and consists of side rails from which specially designed hooks are suspended at the front and rear (fig. 8-13, view B). The attachment is lowered over the drums until the hooks drop into position over the drum rims. This attachment can handle two filled drums at one time.

The third type is vertically operated and handles one filled drum at one time (fig. 8-13, view C).

## PRINCIPLES OF OPERATION

Forklifts operate on the simple principle of a fulcrum or like a playground teeter-totter. A unit load

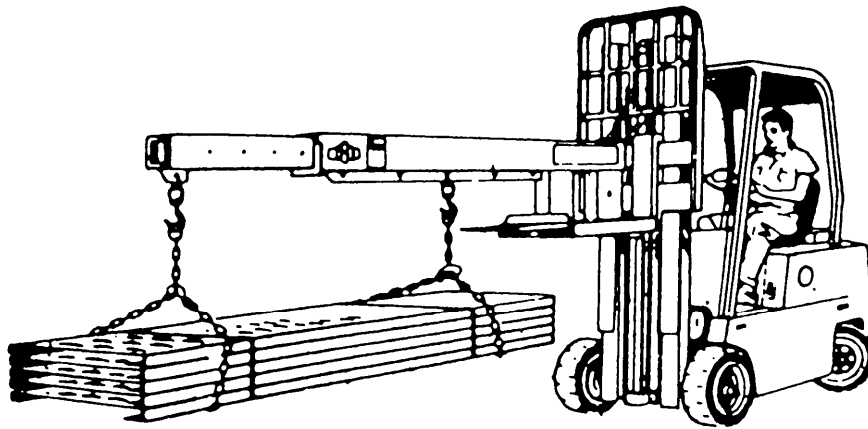


Figure 8-12.—Crane boom attached to the forklift.

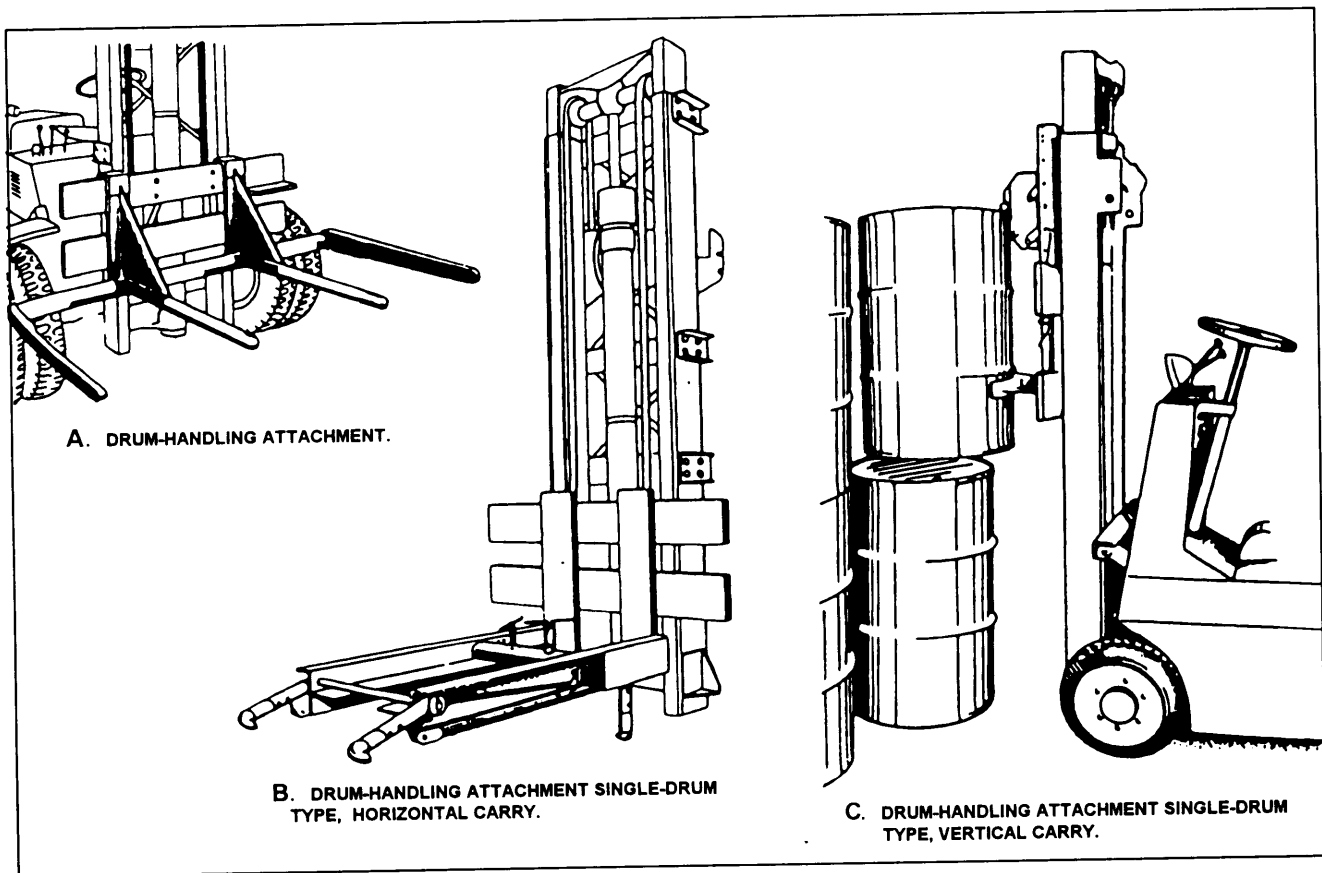


Figure 8-13.—Drum-handling attachments.

on the forks must be counterbalanced by the counterweight and weight of the forklift. The fulcrum, or pivot, is the drive axle.

A forklift must be physically small and compact to work in confined areas, such as boxcars, container vans,

and narrow aisles. Additionally, the forklift must offer enough working space for both the operator and maintenance personnel. It must handle maximum loads and stack them safely and still have an upright, minimum load, and collapsed height to maneuver in

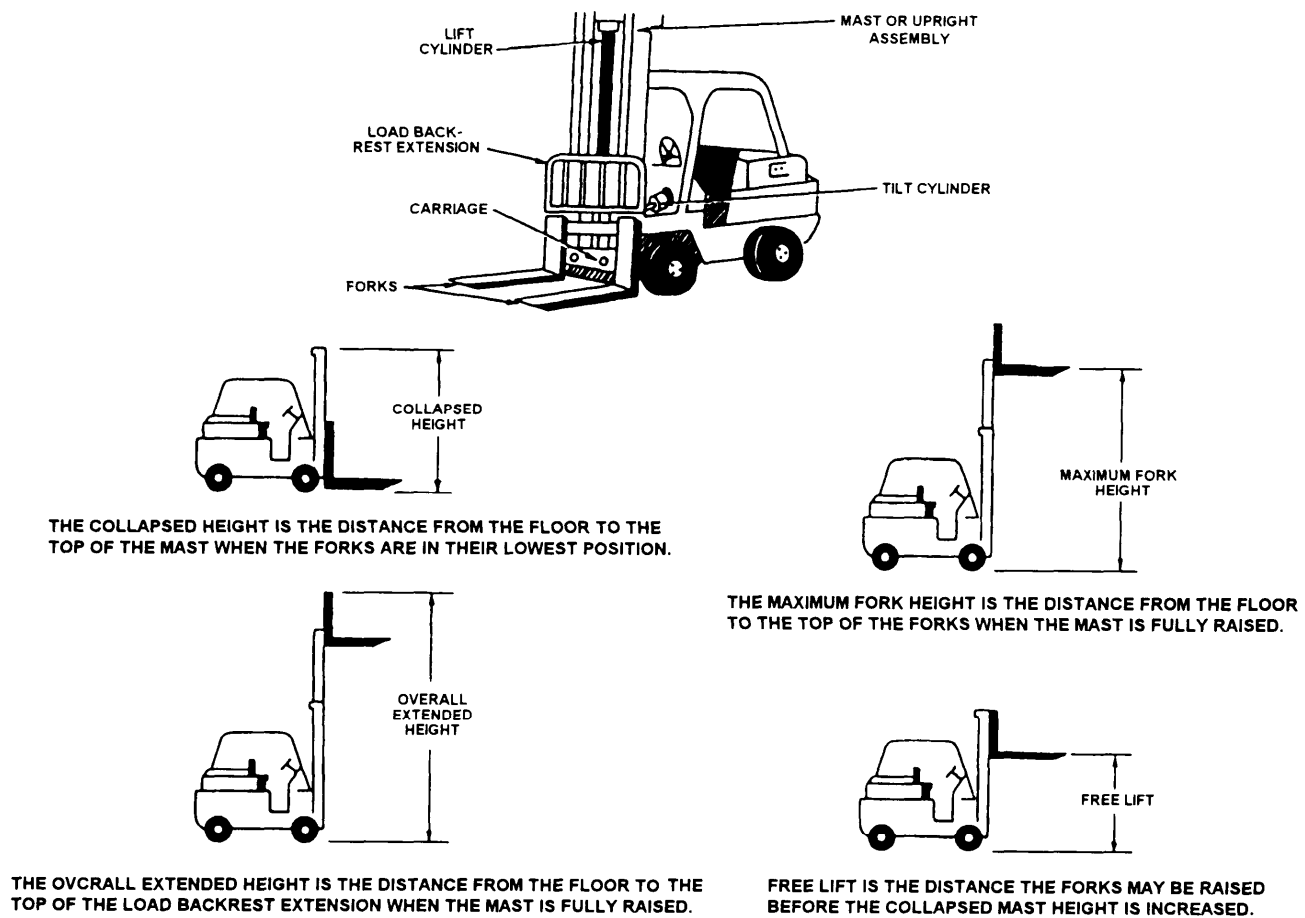


Figure 8-14.—Technical terms used in forklift operations.

areas with low-overhead clearance. It must be able to negotiate inclines, either empty or loaded. Technical terms associated with forklift operations are explained in figure 8-14.

## CAPABILITIES AND LIMITS

The safe and efficient use of a forklift requires skill and alertness from the operator. For the majority of materials-handling operations, the forklift excels, because it is self-propelled and requires only the operator to control the lifting, transporting, stacking, and unstacking. To develop the skill required for safe and efficient forklift operations, you must have an understanding of the makeup, capabilities, and limitations of the forklift, and see that it is maintained in good mechanical condition.

In the selection of a forklift, consider the performance, lift height, power, and capacity; also consider the available space and area the forklift must operate in.

**NOTE:** For complete information on the capabilities of your forklift, refer to the operator's manual provided by the manufacturer.

### Lift Height

Forklifts are available in standard models that have lift heights of up to 210 inches. The lift height of a forklift selected for an operation depends on how high the material is stored and the overall height of the forklift, with the mast lowered, that must clear door casings, overhead obstructions, and other building limitations. Also, there are restrictions and limitations on lift height during unloading and loading of cargo vessels, trucks, tractor-trailers, and so forth.

### Capacity

The capacity of the forklift must be equal to the task. For this reason, the weight of each load must be known before a lift is made.

The center of balance is a critical factor for capacity. On most forklifts, the **center of balance (C/B)** is under the operator's seat, as shown in figure 8-15. When a load is lifted a combined center of balance (C C/B) is created, as shown in figure 8-16. When the load is raised, the C C/B changes, as shown in figure 8-17.

A forklift is designed to lift its maximum capacity with the load centered on the forks, not with the tip of the forks.

### CAUTION

Never lift a load with the load balanced on the tips of the forks.

You should know where the center of balance (C/B) is before trying to lift any load. The C/B of the load should be as far back on the forks as possible. If the C/B

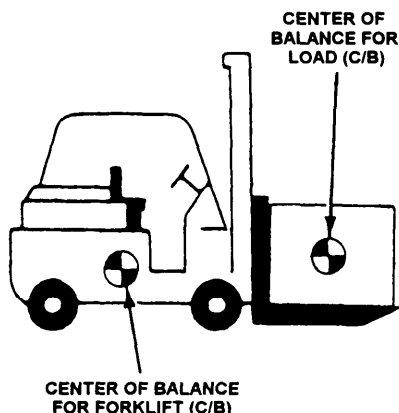


Figure 8-15.—Center of balance (C/B) for the forklift and load.

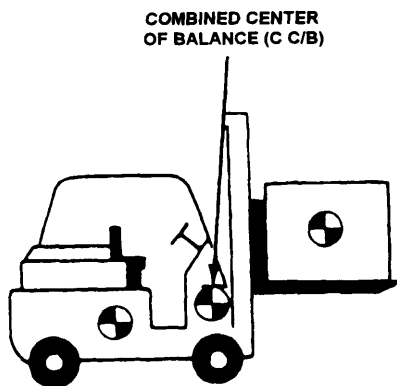


Figure 8-16.—Combined center of balance (C C/B).

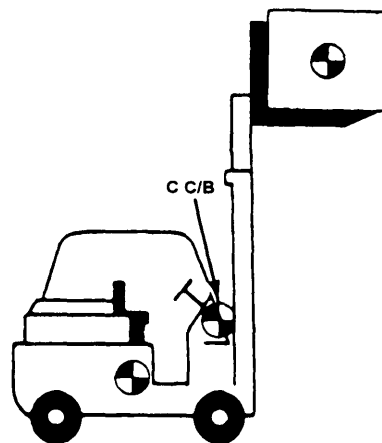


Figure 8-17.—Movement of the combined center of balance as the load is raised.

is on one side, as shown in figure 8-18, the load may flip off the forks and land on its side once you lift it. The C/B of the load should be placed directly in front of the C/B of the forklift, as shown in figure 8-19. Additionally, the C/B should be centered and placed as far back on the forks as possible.

### OPERATING TECHNIQUES

Before operating a forklift, you must have proper authorization and possess a thorough understanding of the operator's manual and safety precautions. If you have very little experience in operating forklifts, make sure a qualified operator guides you through at least several operating and load-handling operations before

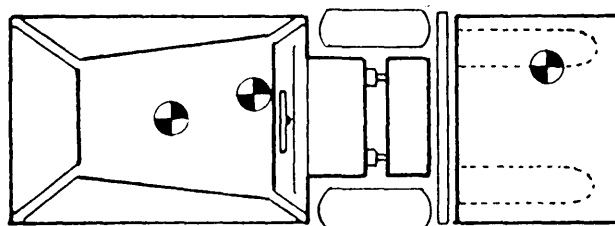


Figure 8-18.—Top view of how the combined center of balance moves with the C/B of the load.

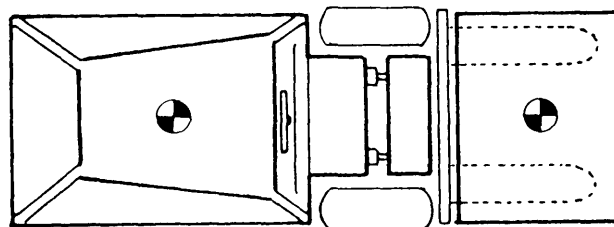


Figure 8-19.—How the C/B of the load should be centered

attempting to operate the forklift on your own. Basic education in safe operation and load-handling techniques is absolutely necessary to prepare you for proper operation and enables you to anticipate the unexpected.

**NOTE:** A forklift is only as safe as its operator. Only authorized, properly trained licensed personnel are permitted to operate it.

### Pallets and Boxes

Most of the loads that you will handle are on pallets or in boxes. A standard pallet is 40 inches by 48 inches, as shown in figure 8-20. Mount-out boxes are in all different sizes; however, they have stringers like pallets.

**LIFTING.**— The technique for lifting a pallet is as follows:

1. Position the forklift squarely in front of the load and raise the forks to the proper level, halfway between the top and bottom boards of the pallet.

2. Slowly insert the forks into the pallet until the load rests against the fork faces. If the mast is not in a vertical position, the forks may hang up in the pallet when they are inserted.

**NOTE:** If the pallet or load is against a wall or obstruction and the forks are longer than the pallet, you will have to pick up the pallet and back up the forklift until there is enough room to reposition the forks entirely under the pallet.

3. Lift the load just enough to clear the floor (or stack beneath the load being removed). Then tilt the mast or forks back enough to cradle the load. The load should always be carried as low as possible for maximum stability and vision.

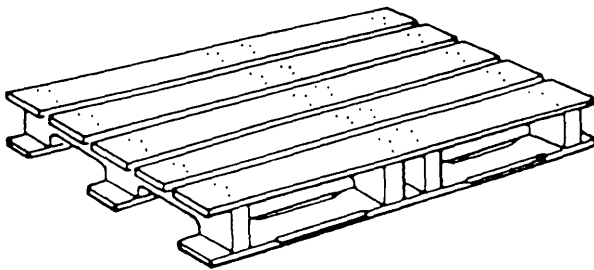


Figure 8-20.—40- by 48-inch pallet.

### WARNING

Overloading a forklift is strictly prohibited. The forklift can safely lift and carry no more than its rated capacity. Among the dangers of overloading are injury to the operator, damage to the cargo, and damage to the pump and lift mechanism. Additionally, overloading causes wear on the tires, engine, or electric motor. Also, a forklift will tip forward if the load on the forks exceeds the lift capacity of the forklift. The manufacturer has established the forklift rating (expressed in pounds of load on the fork) and the allowable distance in inches from the heel of the forks to the center of gravity of the load. This distance is known as the **load center**.

**CARRYING.**— Carrying material with a forklift to move it from one location to another requires skill and concentration. The techniques for carrying loads with a forklift are as follows:

1. Tilt the mast as far back as the load will permit when carrying a load, and raise the load only high enough to clear obstructions. Always change speed gradually, as sudden starts and stops will cause the load to shift. Gradual starts and stops also prevent rapid wear of equipment components.

2. Always know the ground clearance of your forklift truck and the surface you are traveling on.

**NOTE:** If the load is so bulky that your vision is obstructed, drive in reverse. Extra care must be taken when driving in reverse, because the operator does not have a constant view of the load; therefore, a backing guide is usually needed.

3. You should ascend and descend a grade with the load pointing upgrade when operating a loaded forklift on an incline (fig. 8-21). Normally, direction of travel should be determined by what direction the operator can see best. This is why forklifts are built with reverse as well as forward travel. But, on grades of 10 percent or more, both forklift and load stability demand that the load be kept upgrade.

4. Handle each load within the rated capacity of the forklift. The **rated capacity** is the weight the forklift can handle safely. The forklift data plate rating indicates the maximum safe load that can be lifted. This maximum rating should never be exceeded; however, there are conditions requiring a load less than the rated capacity. The data plate rating does apply for weak

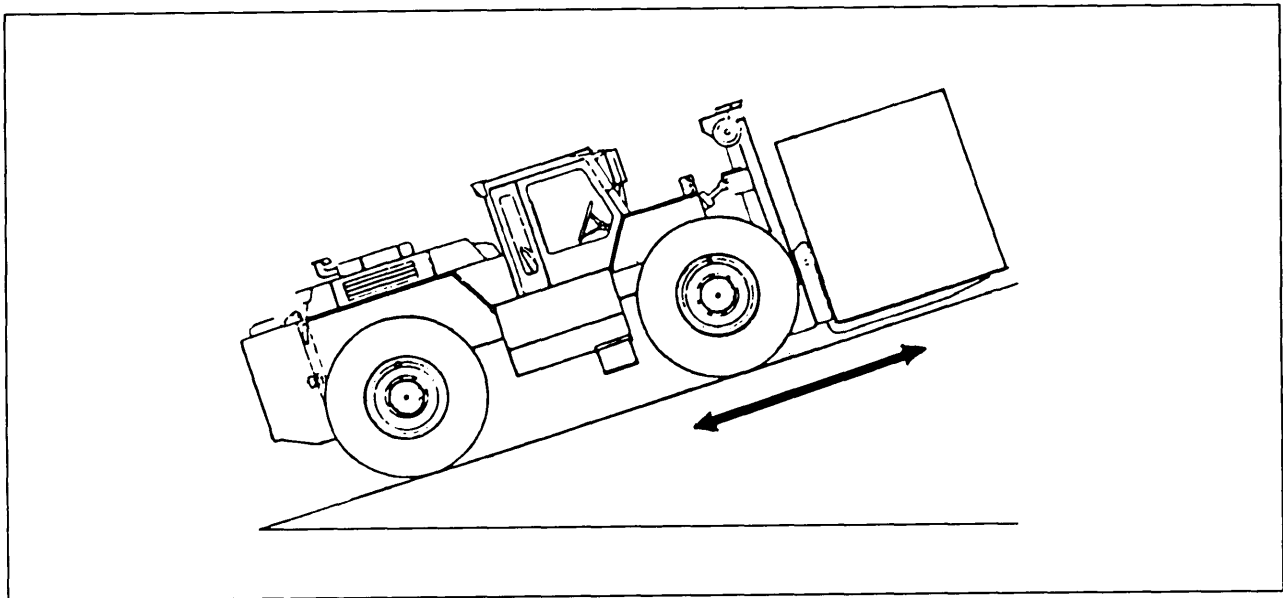


Figure 8-21.—Direction of travel on a grade.

floors, uneven terrain, special load-handling attachments, or loads with a high center of gravity. Under these conditions, the safe working load is well below the rated capacity. Under special conditions, you must reduce your load so your forklift will remain stable.

5. Handle only stable loads. Many loads are made up of unstable items that can be easily dislodged. This rule is critical to your safety when the forklift is not equipped with an overhead guard or roll over protection structure (ROPS).

6. Center the weight of wide loads between the forks; otherwise, the load may topple off the forks when you turn a corner or hit a bump.

7. Watch “swing” when handling long loads. Failure to watch clearance at the ends of your load can cause you to strike persons or objects.

8. Keep the load against the carriage by maintaining a slight backward tilt.

9. Do not travel with the load raised higher than 6 inches from the floor until you are ready to deposit the load. When loads are carried in an elevated position, the stability of the forklift is reduced. The load or part of it can fall on someone or something.

10. Drive carefully, observe traffic rules, and be in full control of the forklift at all times.

**POSITIONING.**— When loading and stacking material, move the forklift truck forward until the load arms are entirely under the load to be lifted. Ensure the

load is centered on the arms and that it is well-seated against the face of the lifting carriage. When picking up round objects, first tilt the uprights so the forks slide along the floor or ground under the object to be lifted, as shown in figure 8-22. Then decelerate, tilt backwark, and accelerate until there is enough backward tilt of the mast to allow safe handling of the load.

**NOTE:** Lifting speed is controlled by the speed of the engine and the extent the control lever is pulled. Engine speed has no effect on lowering speed.

Never race the engine while hoisting a load. Too much engine speed will not increase the speed of the hoisting mechanism but may result in fast wear and possible damage to the engine. From practice and experience, you will be able to determine the best hoisting speed by sound, sight, and feel. When a load has been raised to the desired height, ease the hoist lever to the neutral position and move the forklift to the base of the stack the load is to be placed.

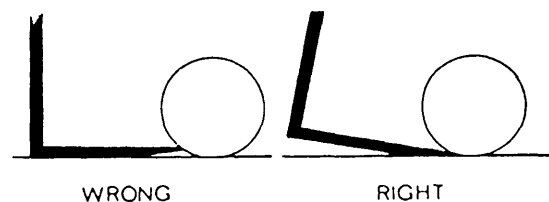


Figure 8-22.—Tilt position for picking up round objects.

Although a load maybe placed on or removed from a stack by using the hoist lever, you will learn from practice that a load can be placed or removed entirely with the tilting mechanism. The tilting mechanism is designed to raise the load arms slightly, as the mast is tilted backwards.

Practice raising the load while the forklift draws near the stack to reduce strain on the engine and the brakes. Study the problem of load handling, and keep in mind that carefully planned operations produce the most work with the least fatigue to yourself.

Lift and lower with the mast vertical or tilted slightly back. Tilt elevated loads forward only when they are directly over the unloading place. If the load or lifting mechanism is raised to pick up or deposit a load, reduce the tilt in either direction. Remember the side stability of the load and do not tilt back any farther than is necessary.

### CAUTION

Under no condition should additional counterweights be added to any materials-handling equipment to increase its stability or lifting capacity.

### Long Objects

As a forklift operator, you may be tasked to move lumber, steel, piling, or pipe. You must know where the center of balance (C/B) is to move long loads. Moving long objects takes special forklift operator skills.

**CARRYING.**— The load on the forklift shown in figure 8-23 is too wide for the door of the warehouse. In this case, the techniques of operation shown in figure 8-24 should be followed so the forklift and long load can be maneuvered through the door. With practice, this technique can be used to maneuver around most obstacles.

**POSITIONING.**— The positioning of long objects for loading can be a problem, and it is best to place dunnage under the object if it is not on a pallet. The thickness of the dunnage should allow the forks to slide out freely from the load. To load a piece of pipe, piling, or anything round, you must place blocking or dunnage to prevent the round object from rolling. Then tilt the forks forward until they are flat on the floor and slide them from underneath the object.

### FORKLIFT SAFETY

Safety is a vital part of forklift operations. Many forklift safety practices are as simple and clear as those for driving the family automobile. For instance, before you start your car, you check to see if the transmission is in NEUTRAL or PARK. When stopping your car, you do so gradually, not abruptly. Because a forklift is a special machine designed for a different purpose, you must exercise more caution and receive more training to operate a forklift properly.

The techniques for safe forklift operations are as follows:

1. Avoid lifting or hitting anything that is likely to fall on you or other personnel in the area. Remember that a forklift equipped with an overhead guard or ROPS

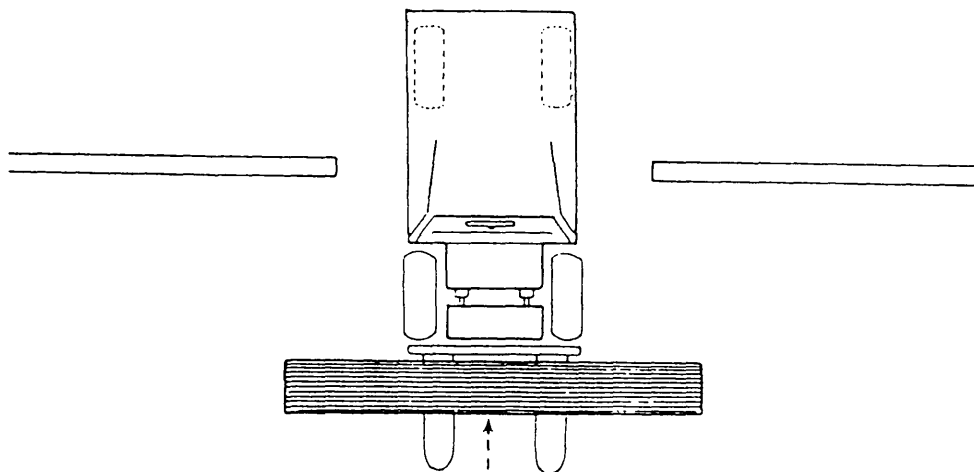
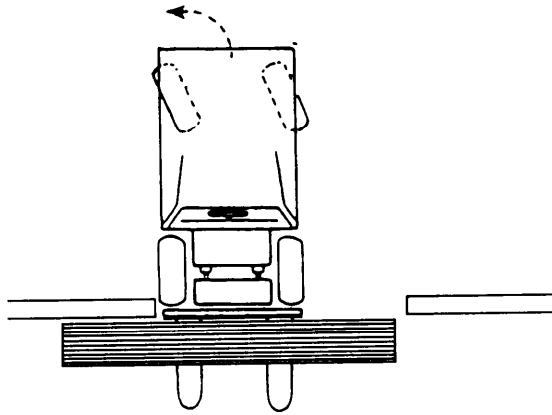
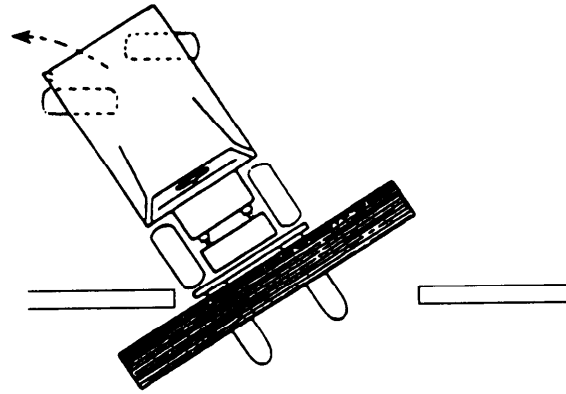


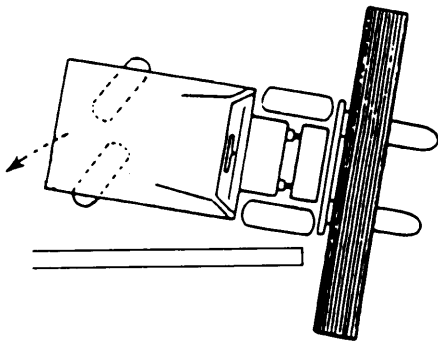
Figure 8-23.—Load too wide to maneuver through a warehouse door.



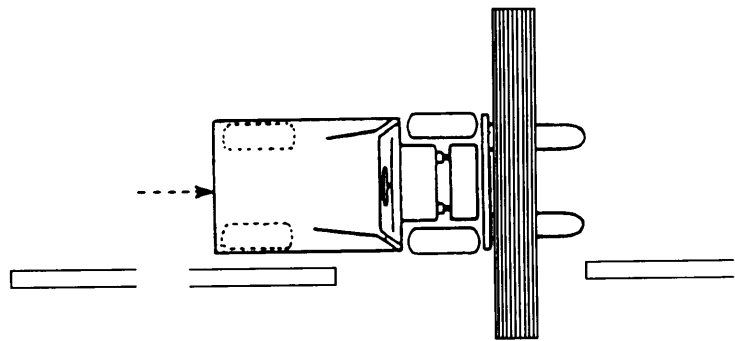
1. MOVE FORKLIFT AND LOAD CLOSE TO SIDE OF DOOR.



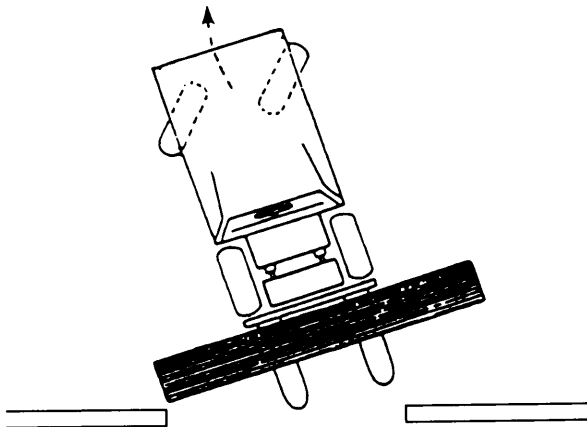
2. MAKE TURN SHARP TO SWING LOAD.



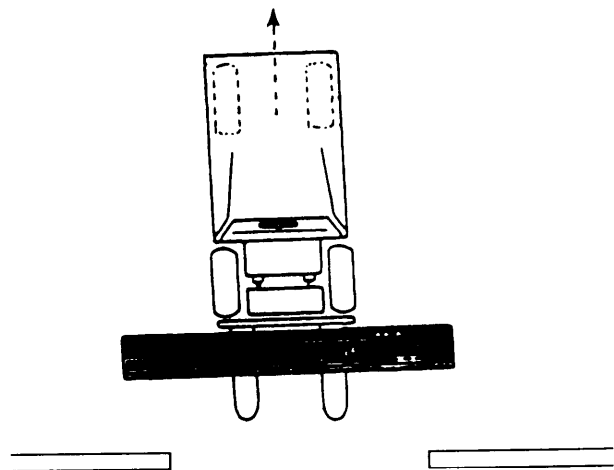
3. COMPLETING THE TURN.



4. MOVE LOAD TO OTHER SIDE OF THE DOOR.



5. SWING REMAINING PORTION INTO DOOR.



6. LOAD THROUGH DOOR AND INTO BUILDING.

Figure 8-24.—Technique of maneuvering a wide load through a warehouse door.



and load backrest extension provides reasonable protection against a falling object but cannot protect you against every impact. A forklift without an overhead guard provides no protection. For this reason, you should never attempt to pickup any loose, unstable, or stacked load if it appears that any part of the elevated load might topple through or over the top of the upright or fall on anybody standing nearby. You should also avoid hitting certain objects, such as stacked material, that could become dislodged and fall. Do not move your forklift around with the load carriage elevated. These rules apply whether or not your forklift is equipped with an overhead guard and are important if you are not protected by an overhead guard. Enforcing these rules may mean a smaller load, but you are protecting yourself and others working in your area.

2. Use a secured safety platform when lifting personnel. A forklift is built for only one rider—the operator. Because of the hazardous conditions that can result, it is unauthorized for anyone to ride the forks of a forklift or hitch a ride in any manner. If a forklift is used to elevate workers, a safety platform must be secured to the forks. The platform should be specially built and secured to keep it from slipping from the forks, and it should have a solid floor and handrail (fig. 8-25).

3. Keep arms and legs inside the operator's compartment. Holding them outside the machine can be dangerous in narrow aisles.

4. Keep yourself and all others clear of the hoisting mechanisms. **NEVER PUT HANDS, ARMS, HEAD, OR LEGS THROUGH THE HOISTING MECHANISM.** This rule applies to both you and the rigger. A rigger should not be near the load or hoisting mechanism while you are attempting to pick up, hoist, or deposit a load.

5. Never allow anyone under the load.

6. Report damaged or faulty equipment immediately—do not operate a forklift that is unsafe. You can complete a job with a forklift safely only when it is working correctly; therefore, a forklift should never be operated when it is not running properly.

7. Avoid bumps, holes, slick spots, and loose materials that may cause your forklift to swerve or tip over. Different models of forklifts are designed to operate under different conditions. Although large forklifts can adapt to more uneven ground, do not expect them to maintain their balance under abusive ground conditions. Try to pick the smoothest areas when moving material from one place to another.

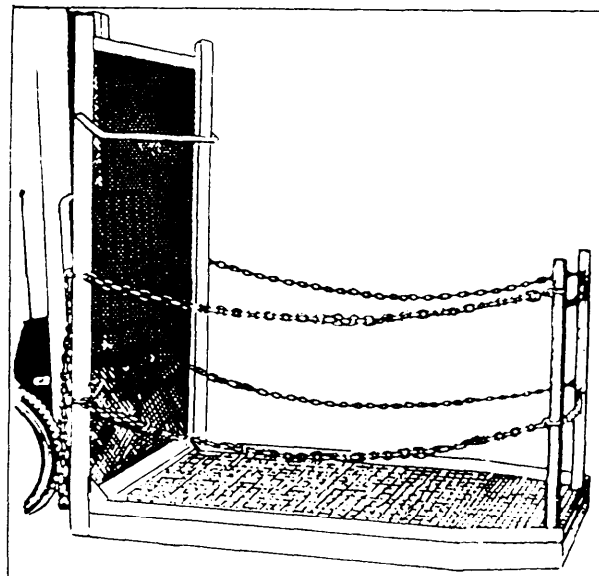


Figure 8-25.—Safety platform.

8. Travel slowly in narrow aisles and around corners, especially blind corners. To help avoid collisions, you should sound your horn in advance.

9. Lower the carriage completely, and set the parking brake before leaving your forklift. Block the wheels when parking on an incline or working on the forklift. These rules apply under all conditions, even if you are only going to leave your forklift for a moment. A driverless forklift does not have to move far in close quarters to cause serious injury.

10. Do not turn on an incline. For stability, a forklift should not be driven along the side of an incline that leans the forklift sideways. Always keep either the rear end or front end of the forklift pointed up or down the slope.

11. Do not fill the fuel tank while the engine is running.

12. Sudden starts and stops cause premature wear on parts of the forklift, such as axles and gears, and cause tires to wear faster. Personnel nearby may become injured and materials may be damaged by a forklift suddenly going into motion or going out of control.

13. Because a forklift is designed to perform so many functions within a small space, you must anticipate certain clearance situations. As an operator, you must be aware the forks will sometimes protrude beyond the front of the load. Because of this, you may

strike objects or lift or nudge other loads on pallets. Many serious mishaps have been caused by uprights and overhead guards striking pipes and beams connected to the ceiling in a warehouse. Some forklift models steer from the rear axle. On these machines, the tail swings and can hurt personnel or damage property.

## **CAUTION**

FAILURE TO KEEP A CAREFUL  
WATCH IN THE DIRECTION OF TRAVEL  
CAN RESULT IN DAMAGE TO  
SOMETHING OR INJURY TO SOMEONE.

## APPENDIX I

# GLOSSARY

**AGGREGATE**— Crushed rock or gravel, screened to sizes for use in road surfaces, concrete, or bituminous mixes.

**ANGLING DOZER** (Angledozer)—A bulldozer with a blade that can be pivoted on a vertical center pin so as to cast its load to either side.

**APRON**— The front gate of a scraper body.

**ASPHALT**— A dark brown to black cementitious material in which the predominating constituents are bitumens that occur in nature or are obtained in petroleum processing. Asphalt is a constituent in varying proportions of most crude petroleum.

**ASPHALT CEMENT**— A fluxed or unfluxed asphalt specially prepared as to quality and consistency for direct use in the manufacture of asphalt pavements.

**ASPHALT CONCRETE**— High-quality thoroughly controlled hot mixture of asphalt cement and well-graded, high-quality aggregate, thoroughly compacted into a uniform, dense mass.

**ASPHALT LEVELING COURSE**— A course (asphalt aggregate mixture) of variable thickness used to eliminate irregularities in the contour of an existing surface before a superimposed treatment or construction.

**ASPHALT, MEDIUM-CURING (MC)**— Cutback asphalt, composed of asphalt cement and a kerosene type of diluent of medium volatility.

**ASPHALT, RAPID-CURING (RC)**— Cutback asphalt, composed of asphalt cement and naphtha or gasoline type of diluent of high volatility.

**ASPHALT, SLOW-CURING (SC)**— Cutback asphalt, composed of asphalt cement and oils of low volatility.

**AUGER**— A rotating drill having a screw thread that carries cuttings away from the face.

**AUXILIARY**— A helper or standby engine or unit.

**AXIS OF ROTATION**— The vertical line around which the upper structure rotates.

**AXLE, LIVE**— A revolving horizontal shaft.

**BACKFILL**— (1) The material used in refilling a ditch or other excavation. (2) The process of such refilling.

**BAIL BLOCK**— Block attached to a dragline bucket, through which rope line is reeved. Also referred to as "PADLOCK."

**BAIL (BUCKET)**— A yoke or spreader, hinged to the sides of a dragline bucket, to which is attached a connecting sheave or chain for hoisting and dragging operations.

**BALL JOINT**— A connection, consisting of a ball and socket, that will allow a limited hinge movement in any direction.

**BANK**— Specifically, a mass of soil rising above a digging or trucking level. Generally, any soil that is to be dug from its natural position.

**BANK GRAVEL**— Gravel found in natural deposits, usually more or less intermixed with fine material, such as sand or clay, and combinations thereof; gravelly clay, gravelly sand, clayey gravel, and sandy gravel indicate the varying proportions of the materials in the mixture.

**BASE COURSE**— The layer of material immediately beneath the surface or intermediate course. It may be composed of crushed stone, crushed slag, crushed or uncrushed gravel and sand, or combinations of these materials. It also may be bound with asphalt.

**BANK YARDS**— Yards of soil or rock measured in its original position (before digging).

**BEDROCK**— Solid rock, as distinguished from boulders.

**BENCH**— A working level or step in a cut that is made in several layers.

**BINDER**— (1) Fines which hold gravel together when it is dry. (2) A deposit check that makes a contract valid.

**BITUMEN**— A class of black or dark-colored (solid, semisolid, or viscous) cementitious substance, natural or manufactured, composed principally of

high molecular weight hydrocarbons, or which asphalts, tars, pitches, and asphaltites are typical.

**BLASTING MAT**— A heavy, flexible fabric of woven wire rope or chain, used to confine blasts.

**BLEEDING OR FLUSHING**— Is the upward movement of asphalt in an asphalt pavement, resulting in the formation of a film of asphalt on the surface. The most common cause is too much asphalt in one or more of the pavement courses, resulting from too rich a plant mix, an improperly constructed seal coat, too heavy a prime or tack coat, or solvent-carrying asphalt to the surface. Bleeding or flushing usually occurs in hot weather.

**BLUE TOPS**— Grade stakes with blue tops to indicate finish grade level, usually a 2-inch by 2-inch by 6-inch hub stake.

**BM**— Bench mark.

**BODY**— The load carrying part of a truck or scraper.

**BOGIE AXLE**— Two or more axles, mounted to a frame so as to distribute the load between the axles and permit vertical oscillation of the axles.

**BOOM CHORD**— A main corner member of a lattice type of boom.

**BOOM, CRANE**— A long, light boom, usually of lattice construction.

**BOOM HOIST**— Mechanism to control the elevation of the boom and to support it.

**BOOM LACING**— Structural truss members at angles to and supporting the boom chords of a lattice type of boom.

**BOOM, LATTICE**— A long, light boom fabricated of crisscrossed steel or aluminum angles or tubing.

**BOOM LENGTH**— Boom length is a straight line through the center line of the boom pivot into the center line of the boom point load hoist sheave pin, measured along the longitudinal axis of the boom.

**BOWL**— (1) The bucket or body of a carrying scraper. (2) Sometimes the moldboard or blade of a dozer.

**BUCKET**— A part of an excavator that digs, lifts, and carries dirt.

**BULLDOZER**— (1) A tractor equipped with a front pusher blade. (2) In a machine shop, a horizontal press.

**CAPILLARY ATTRACTION**— The tendency of water to move into fine spaces, as between soil particles, regardless of gravity.

**CASING**— A pipe lining for a drilled hole.

**CAT**— (1) A trademark designation for any machine made by the Caterpillar Tractor Company. (2) Widely used to indicate a crawler tractor of any make.

**CAT HEAD**— A capstan winch.

**CATWALK**— A pathway, usually of wood or metal, that gives access to parts of large machines.

**CENTRIFUGAL FORCE**— Outward force exerted by a body moving in a curved line. It is the force that tends to tip a car over in going around a curve.

**C-FRAME**— An angling dozer lift and push frame.

**CHECK VALVE**— Any device that will allow fluid or air to pass through it in only one direction.

**CHOKER**— A chain or cable so fastened that it tightens on its load as it is pulled.

**CIRCLE REVERSE**— The mechanism that changes the angle of a grader blade.

**CLAM**— A clamshell bucket.

**CLAMSHELL**— (1) A shovel bucket with two jaws that clamp together by their own weight when it is lifted by the closing line. (2) A crane equipped with a clamshell bucket.

**CLAMSHELL BUCKET**— Usually consists of two or more similar scoops hinged together and a head assembly connected to the outer corners by struts. When the head and hinge are pulled toward each other, the scoops are forced together to dig and hold material. Control is by a holding line reeved over a boom point sheave and attached to the head assembly to support the bucket in open position and usually by a closing line also reeved over a boom point sheave, ending in a force amplifying tackle or other means between the head assembly and scoop hinge to close the bucket.

**CLAMSHELL BUCKET, HYDRAULIC**— Usually consists of two or more scoops hinged to a head assembly housing the hydraulic cylinder or cylinders and the force amplifying linkage to open and close the scoops and to supply the digging force for the scoops. The bucket assembly is suspended from the boom by a rope. Because digging ability is largely dependent upon bucket weight, buckets are supplied in various weight classes which range from

light, for easily dug stockpiled materials, to heavy, for excavating hardpan material and the like.

**CLAMSHELL EQUIPMENT**— Machines with clamshell attachments are used to load material from stockpiles, gondola cars, barges, and the like, or from virgin soil generally out of small-area holes, deep trenches, or from below water. Orange peel buckets, grapples, and similar rope suspended attachments are included in this classification.

**CLOSING LINE**— The rope reeved from the hoist drum to control closing of a rope-operated clamshell bucket.

**COFFERDAM**— A set of temporary walls, designed to keep soil and/or water from entering an excavation.

**COLLAR**— A sliding ring, mounted on a shaft so that it does not revolve with it, used in clutches and transmissions.

**COMPACTION**— The act of compressing a given volume. Insufficient compaction of the asphalt pavement courses may result in channeling on the pavement surface. Compaction is usually accomplished by rolling.

**CONVEYOR BELT**— An endless belt of rubber-covered fabric that transports material on its upper surface.

**CORRUGATIONS (WASHBOARDING) AND SHOVING**— Are types of pavement distortion. Corrugation is a form of plastic movement typified by ripples across the asphalt pavement surface. Shoving is a form of plastic movement, resulting in localized bulging of the pavement surface. These distortions usually occur at points where traffic starts and stops, on hills where vehicles brake on the downgrade, on sharp curves, or where vehicles hit a bump and bounce up and down. They occur in asphalt layers that lack stability. Lack of stability may be caused by a mixture that is too rich in asphalt, has too high a proportion of fine aggregate, has coarse or fine aggregate that is too round or too smooth, or has asphalt cement that is too soft. It may also be due to excessive moisture, contamination due to oil spillage, or lack of aeration when placing mixes using liquid asphalt.

**CRACKS**— Breaks in the surface of an asphalt pavement.

**CRACKS, ALLIGATOR**— Interconnected cracks forming a series of small blocks resembling an alligator's skin or chicken wire, caused by excessive

deflection of the surface over unstable subgrade or lower courses of the pavement.

**CRACKS, EDGE JOINT**— Are the separation of the joints between the pavement and the shoulder, commonly caused by the alternate wetting and drying beneath the shoulder surface. Other causes are shoulder settlement, mix shrinkage, and trucks straddling the joint.

**CRACKS, LANE JOINT**— Longitudinal separation along the seam between two paving lanes caused by a weak seam between adjoining spreads in the courses of the pavement.

**CRACKS, REFLECTION**— Cracks in asphalt overlays that reflect the crack pattern in the pavement structure underneath. They are caused by vertical or horizontal movements in the pavement beneath the overlay, brought on by expansion and contraction with temperature or moisture changes.

**CRACKS, SHRINKAGE**— Are interconnected cracks forming a series of large blocks, usually with sharp corners or angles. Frequently they are caused by volume change in either the asphalt mix or in the base or subgrade.

**CRACKS, SLIPPAGE**— Are crescent-shaped cracks that are open in the direction of the thrust of wheels on the pavement surface. They result when there is a lack of good bond between the surface layer and the course beneath.

**CRANE**— A mobile machine, used for lifting and moving loads without the use of a bucket.

**CRANE MATS**— A device, used for supporting machines on soft ground, usually of timber construction.

**CREEP**— (1) Very slow travel of a machine or a part. (2) Unwanted turning of a shaft due to drag in a fluid coupling or other disconnect device.

**CRUMBER**— A blade that follows the wheel or ladder of a ditching machine to clean and shape the bottom.

**CULVERT**— A pipe or small bridge for drainage under a road or structure.

**CURVE, VERTICAL**— A change in gradient of the center line of a road or pipe.

**CUTBACK ASPHALTS**— Mixture of asphalt cement and a cutting agent. There are three main types.

**DATUM**— Any level surface taken as a plane of reference from which to measure elevations.

**DEADHEADING**— Traveling without a load, except when traveling from the dumping area to the loading point.

**DENSITY**— The ratio of the weight of a substance to its volume.

**DIESELING**— In a compressor, explosions of mixtures of air and lubricating oil in the compression chambers and/or other parts of the air system.

**DOLLY**— A unit consisting of a draw tongue, an axle with wheels, and a turntable platform to support a gooseneck trailer.

**DOUBLE-CLUTCHING**— Disengaging and engaging the clutch twice during a single-gear shift (change of gears) to synchronize gear speeds.

**DOWNSTREAM FACE**— The dry side of a dam.

**DOZER**— Abbreviation of bulldozer.

**DRAFT**— Resistance to movement of a towed load.

**DRAGLINE**— A crane with a dragline attachment, used to excavate material from below the grade on which the crane is sitting.

**DRAWBAR**— A fixed or hinged bar, extending to the rear of a tractor and used as a fastening for lines and towed machines or loads.

**DRAWBAR HORSEPOWER**— A tractor's flywheel horsepower minus friction and slippage losses in the drive mechanism and the tracks or tires.

**DRAWBAR PULL**— The pull that a tractor can exert on a load attached to the drawbar. Depends on power, weight, and traction.

**DRILL COLLAR**— Thick-walled drill pipe, used immediately above a rotary bit to provide extra weight.

**DRILL, PERCUSSION**— A drill that hammers and rotates a steel and bit. Sometimes limited to large blast hole drills of the percussion type.

**DRILL PIPE**— The sections of a rotary drilling string, connecting the kelly with the bit or collars.

**DRIVE SPROCKET**— A drive roller with teeth that engage matching recesses or pins (bushings) in the track assembly.

**DROP HAMMER**— A pile-driving hammer that is lifted by a cable and that obtains striking power by falling freely.

**DRUM, SPUDDING**— In a churn drill, the winch that controls the drilling line.

**EJECTOR**— A clean-out device, usually a sliding plate.

**EMBANKMENT**— A fill whose top is higher than the adjoining surface.

**EROSION**— Wear caused by moving water or wind.

**FACE**— (1) The more or less vertical surface of rock exposed by blasting or excavating or the cutting end of a drill hole. (2) An edge of rock used as a starting point in figuring drilling and blasting. (3) The width of a roll crusher.

**FACTOR OF SAFETY**— The ratio of the ultimate strength of the material to the allowable or working stress.

**FAIRLEAD**— A device which lines up cable so that it will wind smoothly onto a drum.

**FEATHER**— To blend the edge of new material into the old surface smoothly.

**FIFTH WHEEL**— The weight-bearing swivel connection between highway type of tractors and semitrailers.

**FILL**— An earth or broken rock structure or embankment. Soil or loose rock used to raise a grade. Soil that has no value except bulk.

**FLOAT**— In reference to a dozer blade, to rest by its own weight or to be held from digging by upward pressure of a load of dirt against its moldboard.

**FOOT**— In tamping rollers, one of a number of projections from a cylindrical drum.

**FOOT-POUND**— Unit of work equal to the force in pounds multiplied by the distance in feet through which it acts. When a 1-pound force is exerted through a 1-foot distance, 1 foot-pound of work is done.

**FOUR BY FOUR (4 x 4)**— A vehicle with four wheels or sets of wheels, all engine-driven.

**FREE FALL**— Lowering of the hook (with or without a load) without it being coupled to the power train with the lowering speed being controlled by a retarding device, such as a brake.

**FRONT-END LOADER**— A tractor loader with a bucket that operates entirely at the front end of the tractor.

**FROST**— Frozen soil.

**FROST LINE**— The greatest depth to which ground may be expected to freeze.

**GANTRY**— (1) An overhead structure that supports machines or operating parts. (2) An upward extension of the revolving frame of a crane that holds the boom line sheaves.

**GEAR**— A toothed wheel, cone, or bar.

**GOOSENECK**— An arched connection, usually between a tractor and a trailer.

**GRADE**— (1) Usually the elevation of a real or planned surface. (2) Also means surface slope.

**GRADER**— A machine with a centrally located blade that can be angled to cast to either side with an independent hoist control on each side.

**GRADE STAKE**— A stake indicating the amount of cut or fill required to bring the ground to a specified level.

**GRAVEL**— (1) Rock fragments from 2mm to 64 mm (.08 to 2.5 inches) in diameter. (2) A mixture of such gravel with sand, cobbles, boulders, and not over 15 percent fines.

**GRIEF STEM**— See “KELLY.”

**GRIZZLY**— (1) A coarse screen used to remove oversize pieces from earth or blasted rock. (Maybe spelled “grizzlie.”) (2) A gate or closure on a chute.

**GROUND PRESSURE**— The weight of a machine, divided by the area in square inches of the ground directly supporting it.

**GROUSER**— Projecting lug(s) attached to or integral with the machine track shoes to provide additional traction.

**GRUBBING**— Digging out roots.

**HAND LEVEL**— A sighting level that does not have a tripod, base, or telescope.

**HARDPAN**— (1) Hard, tight soil. (2) A hard layer that may form just below plow depth on cultivated land.

**HAUL DISTANCE**— (1) Is the distance measured along the center line or most direct practical route between the center of the mass of excavation and the center of mass of the fill as finally placed. (2) It is the distance the material is moved.

**HOLDING LINE**— The cable reeved from a hoist drum for holding a clamshell bucket or grapple suspended during dumping and lowering operations.

**HOOK, PINTLE**— A towing bracket, having a fixed lower part and a hinged upper one, which, when locked together, makes a round opening.

**HOPPER**— A storage bin or a funnel that is loaded from the top and discharges through a door or chute in the bottom.

**HORSEPOWER**— (1) A measurement of power that includes the factors of force and speed. (2) The force required to lift 33,000 pounds 1 foot in 1 minute.

**HORSEPOWER, DRAWBAR**— Horsepower available to move a tractor and its load after deducting losses in the power train.

**HOLDING LINE**— The hoist cable for a clamshell bucket.

**IDLER**— Large end roller of a track assembly at the opposite end from the drive sprocket; the roller is not power-driven.

**INJECTOR**— In a diesel engine, the unit that sprays fuel into the combustion chamber.

**JACK**— (1) A mechanical or hydraulic lifting device. (2) A hydraulic ram or cylinder.

**JACKKNIFE**— A tractor and trailer in such an angle that the tractor cannot move forward.

**JAW**— (1) In a clutch, one of a pair of toothed rings, the teeth of which face each other. (2) In a crusher, one of a pair of nearly flat faces separated by a wedge-shaped opening.

**JIB BOOM**— An extension piece, hinged to the upper end of a crane boom.

**KELLY**— A square or fluted pipe which is turned by a drill rotary table, while it is free to move up and down in the table. Also called a “GRIEF STEM.”

**LAGGINGS**— Removable and interchangeable drum spool shells for changing the hoist drum diameter to provide variation in rope speeds and line pulls.

**LAY**— The direction of twist in wires and strands in wire rope.

**LAY, REGULAR**— A wire rope construction in which the direction of twist of the wires in the strands is opposite to that of the strands in the rope.

**LEVEL**— To make level or to cause to conform to a specified grade.

**LIFT**— A layer or course of paving material, applied to a base or a previous layer.

**LIP**— The cutting edge of a bucket. Applied chiefly to edges including tooth sockets.

**LOAD BINDER**— A lever that pulls two grab hooks together and holds them by locking over the center.

**LOADER, FRONT-END**— A tractor loader that both digs and dumps in front.

**LOAM**— A soft easily worked soil, containing sand, silt, and clay.

**LOOSE YARDS**— Measurement of soil or rock after it has been loosened by digging or blasting.

**LOW BED**— A machinery trailer with a low deck.

**LUFFING**— Operation of changing the boom angle in the vertical plane. See “BOOM HOIST.”

**LUG DOWN**— To slow down an engine by increasing its load beyond its capacity.

**MASS DIAGRAM**— A plotting of cumulative cuts and fills, used for engineering computation of construction jobs.

**MINERAL DUST**— The portion of the fine aggregate passing the 0.075-mm (No. 200) sieve.

**MINERAL FILLER**— A finely divided mineral product, at least 70 percent or which will pass a 0.075-mm (No. 200) sieve. Pulverized limestone is the most commonly manufactured filler, although other stone dust, hydrated lime, portland cement, and certain natural deposits of finely divided mineral matter are also used.

**MISFIRE**— Failure of all or part of an explosive charge to go off.

**MOLDBOARD**— A curved surface of a plow, dozer blade, grader blade, or other dirt-moving implement that gives dirt moving over it a rotary, spiral, or twisting movement.

**MUCK**— Mud rich in humus.

**OIL**— Any fluid lubricant, but not water.

**OPEN-GRADED ASPHALT FRICTION COURSE**— A pavement surface course that consists of high-void, asphalt plant mix that permits rapid drainage of rainwater through the course and out the shoulder. The mixture is characterized by a large percentage of one-sized coarse aggregate. This course prevents tire hydroplaning and provides a skid-resistant pavement surface.

**OPTIMUM**— Best.

**OSCILLATION**— Independent movement through a limited range, usually on a hinge.

**OUTRIGGER**— An outward extension of a frame that is supported by a jack or block, used to increase stability.

**OVERBURDEN**— Soil or rock lying on top of a pay formation.

**PAN**— A carrying scraper.

**PAWL**— A tooth or set of teeth, designed to lock against a ratchet.

**PENETRATION**— The consistency of a bituminous material expressed as a distance in tenths of a millimeter (0.1mm) that a standard needle penetrates vertically a sample of the material under specified conditions of loading, time, and temperature.

**PERCENT OF GRADE**— Measurement of slope, expressed as the ratio of the change in vertical distance (rise) to the change in horizontal distance (run) multiplied by 100.

**PETCOCK**— A small drain valve.

**PILE CAP**— An adapter between the pile-driving unit and the upper end of the pile, used to center the pile under the pile-driving unit and to reduce damage to the upper end of the pile.

**PIONEERING**— The first working over of rough or overgrown areas.

**PIONEER ROAD**— A primitive, temporary road built along the route of a job to provide means for moving equipment and men.

**POND**— A small lake.

**PORT**— Left side of a ship or boat.

**POTHOLE**— A small steel-sided hole caused by traffic wear.

**POWER EXTRACTOR**— A unit hanging from the hoist line or block and attached to the upper end of the pile and containing within itself a member (ram) which is caused to reciprocate either by means of externally supplied air, steam, or hydraulic fluid under pressure, or by internal combustion within the unit. Upward pull from the hoisting machinery supplements the extraction forces.

**POWER PLANT**— The power plant (or plants) includes the prime power source (which may be an internal combustion engine or electric motor) and the power takeoff.

**POWER TAKEOFF**— A place in a transmission or engine to which a shaft can be so attached as to drive an outside mechanism. A power takeoff may be direct drive, friction clutch, fluid coupling,



hydrodynamic torque converter, hydrostatic, or an electric generator type.

**POWER TRAIN**— All moving parts connecting an engine with the point or points where work is accomplished.

**PRIME MOVER**— A tractor or other vehicle used to pull other machines.

**PROPELLER SHAFT**— Usually a main drive shaft fitted with universal joints.

**PSI or psi**— Pressure in pounds per square inch.

**PUMP, DIAPHRAGM**— A pump that moves water by the reciprocating motion of a diaphragm in a chamber having inlet and outlet check valves.

**PUSHER**— A tractor that pushes a scraper to help it pick up a load.

**RAKE BLADE**— A dozer blade or attachment made of spaced tines.

**RAKE, ROCK**— A heavy-duty rake blade.

**RANGE POLE**— A pole marked in alternate red and white bonds, 1 foot high.

**RED TOPS**— Grade stakes with red tops to indicate finish subgrade level, usually a 2-inch by 2-inch by 6-inch hub stake.

**REFUSAL**— The depth beyond which a pile cannot be driven.

**RIPRAP**— Heavy stones placed at the edge of the water to protect the soil from waves or current.

**RIPPER**— A towed machine, equipped with teeth, used primarily for loosening hard soil and soft rock.

**ROAD OIL**— A heavy petroleum oil, usually one of the slow-curing (sc) grades.

**ROCK**— The hard, firm, and stable parts of earth's crust.

**ROTARY TILLER**— A machine that loosens and mixes soil and vegetation by means of a high-speed rotor equipped with tines.

**RPM or rpm**— Revolutions per minute.

**RUBBLE DRAINS**— French drains.

**RULE OF THUMB**— A statement or formula that is not exactly correct but is accurate enough for use in rough figuring.

**SAND**— A loose soil, composed of particles between 1/16 mm and 2 mm in diameter.

**SCRAPER (Carrying scraper) (Pan)**— A digging, hauling, and grading machine, having a cutting edge, a carrying bowl, a movable front wall (apron), and a dumping or ejecting mechanism.

**SCREEN**— (1) A mesh or bar surface, used for separating pieces or particles of different sizes. (2) A filter.

**SEIZE**— To bind wire rope with soft wire to prevent it from raveling when it is cut.

**SEMITRAILER**— A towed vehicle whose front rests on the towing unit.

**SHEEPSFOOT**— A tamping roller with feet expanded at their outer tips.

**SHOE**— (1) A ground plate, forming a link of a track or bolted to a track link. (2) A support for a bulldozer blade or other digging edge to prevent cutting down. (3) A clean-up device following the buckets of a ditching machine.

**SIDECASTING**— Piling spoil alongside the excavation from which it is taken.

**SNATCH BLOCK**— A pulley in a case that can be easily fastened to lines or objects by means of a hook, ring, or shackle.

**SPILLWAY**— An overflow channel for a pond or a terrace channel.

**SPROCKET**— A gear that meshes with a chain or a crawler track.

**STOCKPILE**— Material dug and piled for future use.

**STONE**— Rock.

**SUPERCHARGER**— A blower that increases the intake pressure of an engine.

**SURGE BIN**— A compartment for temporary storage.

**SWELL (Growth)**— Increase of bulk in soil or rock when it is dug or blasted.

**SWING LOCK**— A swing lock is a mechanical engagement device, not dependent on friction, to hold the upper structure in one or more fixed positions with respect to the undercarriage. When provided, it must be constructed to prevent unintentional engagement or disengagement.

**SWING BRAKE (Dynamic)**— A dynamic swing brake is a device to stop, hold, or retard the rotating motion of the upper structure with respect to the undercarriage.

**SWITCHBACK**— A hair-pin curve.

**TAG LINE**— A line from a crane boom to a clamshell bucket that holds the bucket from spinning out of position.

**TAMP**— Pound or press soil to compact it.

**TERRACE**— A ridge, a ridge and hollow, or a flat bench built along a ground contour.

**TERRAIN**— Ground surface.

**TOE**— The projection of the bottom of a face beyond the top.

**TOOTH ADAPTER**— Main part of bucket or dipper to which a removable tooth is fastened.

**TOPOGRAPHIC MAP**— A map, indicating surface elevation and slope.

**TOPSOIL**— The topmost layer of soil, usually refers to soil containing humus that is capable of supporting good plant growth.

**TORQUE**— The twisting force exerted by or on a shaft (without reference to the speed of the shaft).

**TRACK**— A crawler track.

**TRACK CARRIER ROLLERS**— Rolling elements in/on a track frame that support and guide the upper track shoes or chain.

**TRACK SHOES**— The members of the track assembly that distribute the load to the supporting surface.

**TRACTION**— The total amount of driving push of a vehicle on a given surface.

**TRENCH**— A ditch.

**TRUNNION (Walking beam or bar)**— (1) An oscillating bar that allows changes in angle between a unit fastened to its center and another attached to both ends. (2) A heavy horizontal hinge.

**UNDERCARRIAGE**— The undercarriage is an assembly that supports the upper structure of the crane. It consists of an undercarriage frame, a swing bearing, or hook and load rollers, travel mechanism, and steering mechanism. The undercarriage may be either a crawler or wheeled type.

**VISCOSITY**— The resistance of a fluid to flow. A liquid with a high viscosity rating will resist flow more readily than will a liquid with a low viscosity. The Society of Automotive Engineers (S.A.E.) has developed a series of viscosity numbers for indicating viscosities of lubricating oils.

**VOIDS**— Empty spaces in a compacted mix, surrounded by asphalt-coated particles.

**VOLTS**— The electromotive force that will cause a current of 1 ampere to flow through a resistance of 1 ohm.

**WATERLOGGED**— Saturated with water. If conditions are too wet, you will be unable to work construction equipment.

**WATERSHED**— Area that drains into or past a point.

**WATER TABLE**— The surface of underground, gravity-controlled water.

**WHEEL AND AXLE ARRANGEMENT**— The wheeled undercarriages.

**WINCH**— A drum that can be rotated so as to exert a strong pull while winding in a line.

**WINDROW**— A ridge of loose dirt.

**WING WALL**— A wall that guides a stream into a bridge opening or culvert barrel.

**WORKING CYCLE**— A complete set of operations. In an excavator, it usually includes loading, moving, dumping, and returning to the loading point.