CHAPTER 5

WIRE ROPE

Wire rope is stronger, lasts longer, and is much more resistant to abrasion than fiber line. Because of these factors, wire rope is used for hoisting tasks that are too heavy for fiber line to handle. Also, many of the movable components on hoisting devices and attachments are moved by wire rope.

Wire rope is an intricate device made up of a number of precise moving parts. The moving parts of wire rope are designed and manufactured to maintain a definite relationship with one another. This relationship ensures that the wire rope has the flexibility and strength crucial to professional and safe hoisting operations.

WIRE ROPE

This chapter discusses the construction, the characteristics and specifications, and the criteria used for the selection of wire rope. The related attachments and the proper handling procedures for wire rope are also discussed.

NOTE: In the Navy, you may hear wire rope referred to as wire or rope but never as line.

WIRE ROPE CONSTRUCTION

Wire rope is composed of three parts: wires, strands, and core (fig. 5-1). A predetermined number of wires of the same or different size are fabricated in a uniform arrangement of definite lay to form a strand. The required number of strands is then laid together symmetrically around the core to form the wire rope.

Wires

The basic component of the wire rope is the wire. The wire may be made of steel, iron, or other metal in various sizes. The number of wires to a strand varies,

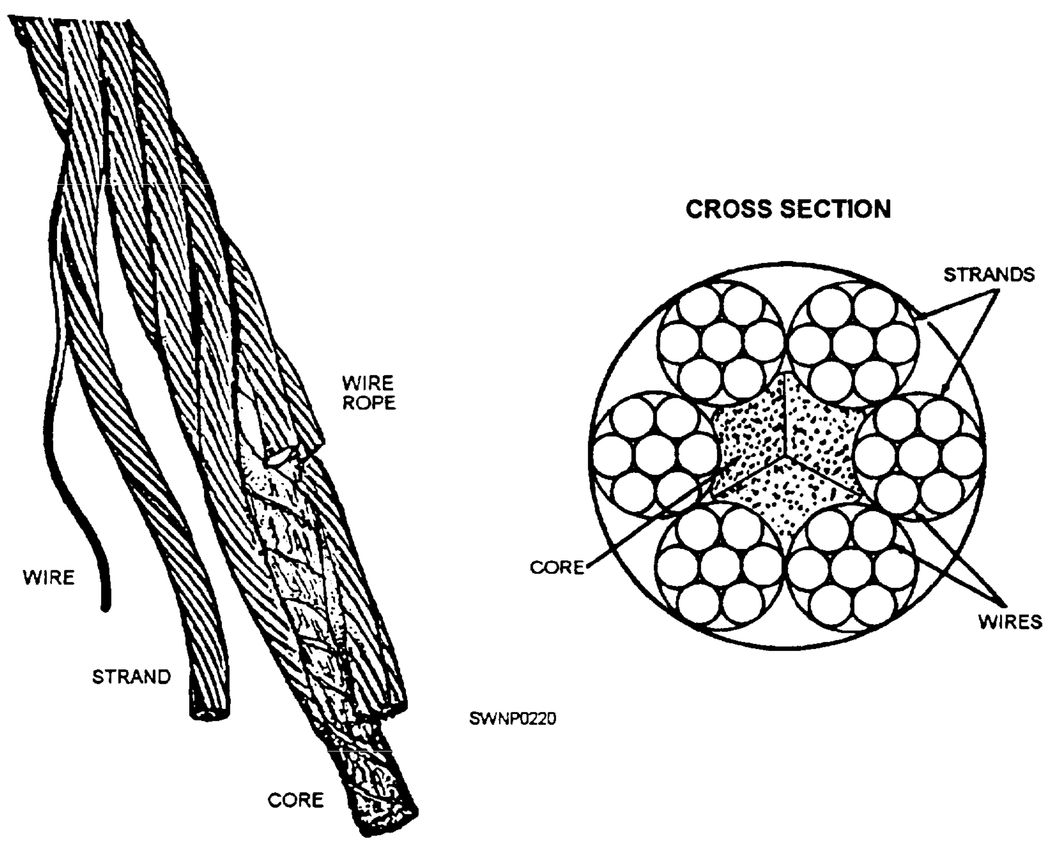

Figure 5-1.—Fabrication of wire rope

depending on what purpose the wire rope is intended. Wire rope is designated by the number of strands per rope and the number of wires per strand. Thus a 1/2-inch 6 by 19 wire rope has six strands with 19 wires per strand. It has the same outside diameter as a 1/2-inch 6 by 37 wire rope that has six strands with 37 wires (of smaller size) per strand.

Strands

The design arrangement of a strand is called the construction. The wires in the strand may be all the same size or a mixture of sizes. The most common strand constructions are Ordinary, Scale, Warrington, and Filler (fig. 5-2).

- Ordinary construction wires are all the same size.
- Scale is where larger diameter wires are used on the outside of the strand to resist abrasion and smaller wires are inside to provide flexibility.
- Warrington is where alternate wires are large and small to combine great flexibility with resistance to abrasion.
- Filler is where small wires fill in the valleys between the outer and inner rows of wires to provide good abrasion and fatigue resistance.

Core

The wire rope core supports the strands laid around it. The three types of wire rope cores are fiber, wire strand, and independent wire rope (fig. 5-3).

- A fiber core maybe a hard fiber, such as manila, hemp, plastic, paper, or sisal. The fiber core offers the advantage of increased flexibility. It also serves as a cushion to reduce the effects of sudden strain and act as an oil reservoir to lubricate the wire and strands (to reduce friction). Wire rope with a fiber core is used when flexibility of the rope is important.

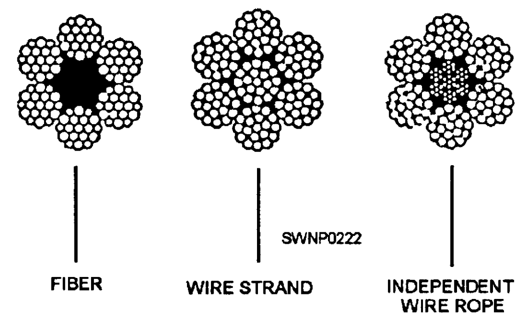

Figure 5-3.—Core construction.

- A wire strand core resists more heat than a fiber core and also adds about 15 percent to the strength of the rope; however, the wire strand core makes the wire rope less flexible than a fiber core.
- An independent wire rope core is a separate wire rope over which the main strands of the rope are laid. This core strengthens the rope, provides support against crushing, and supplies maximum resistance to heat.

When an inspection discloses any unsatisfactory conditions in a line, ensure the line is destroyed or cut into small pieces as soon as possible. This precaution prevents the defective line from being used for hoisting.

Wire rope may be manufactured by either of two methods. When the strands or wires are shaped to conform to the curvature of the finished rope before laying up, the rope is termed *preformed wire rope.*

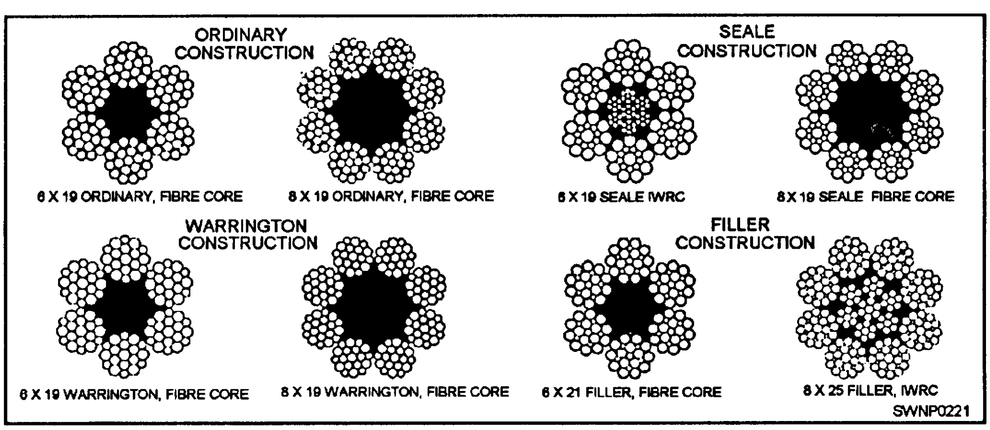

Figure 5-2.—Common strand construction.

When they are not shaped before fabrication, the wire rope is termed *nonpreformed wire rope.*

The most common type of manufactured wire rope is preformed. When wire rope is cut, it tends not to unlay and is more flexible than nonpreformed wire rope. With nonpreformed wire rope, twisting produces a stress in the wires; therefore, when it is cut or broken, the stress causes the strands to unlay.

WARNING

When wire rope is cut or broken, the almost instantaneous unlaying of the wires and strands of nonpreformed wire rope can cause serious injury to someone that is careless or not familiar with this characteristic of the rope.

GRADES OF WIRE ROPE

The three primary grades of wire rope are mild plow steel, plow steel, and improved plow steel.

Mild Plow Steel Wire Rope

Mild plow steel wire rope is tough and pliable. It can stand repeated strain and stress and has a tensile strength (resistance to lengthwise stress) of from 200,000 to 220,000 pounds per square inch (psi). These characteristics make it desirable for cable tool drilling and other purposes where abrasion is encountered.

Plow Steel Wire Rope

Plow steel wire rope is unusually tough and strong. This steel has a tensile strength of 220,000 to 240,000 psi. Plow steel wire rope is suitable for hauling, hoisting, and logging.

Improved Plow Steel Wire Rope

Improved plow steel wire rope is one of the best grades of rope available and is the most common rope used in the Naval Construction Force (NCF). Improved plow steel is stronger, tougher, and more resistant to wear than either mild plow steel or plow steel. Each square inch of improved plow steel can stand a strain of 240,000 to 260,000 pounds; therefore, this wire rope is especially useful for heavy-duty service, such as cranes with excavating and weight-handling attachments.

LAYS OF WIRE ROPE

The term lay refers to the direction of the twist of the wires in a strand and the direction that the strands are laid in the rope. In some instances, both the wires in the strand and the strands in the rope are laid in the same direction; and in other instances, the wires are laid in one direction and the strands are laid in the opposite direction, depending on the intended use of the rope. Most manufacturers specify the types and lays of wire rope to be used on their piece of equipment. Be sure and consult the operator's manual for proper application.

The five types of lays used in wire rope are as follows:

- Right Regular Lay: In right regular lay rope, the wires in the strands are laid to the left, while the strands are laid to the right to form the wire rope.
- Left Regular Lay: In left regular lay rope, the wires in the strands are laid to the right, while the strands are laid to the left to form the wire rope. In this lay, each step of fabrication is exactly opposite from the right regular lay.
- Right Lang Lay: In right lang lay rope, the wires in the strands and the strands in the rope are laid in the same direction; in this instance, the lay is to the right.
- Left Lang Lay: In left lang lay rope, the wires in the strands and the strands in the rope are also laid in the same direction; in this instance, the lay is to the left (rather than to the right as in the right lang lay).
- Reverse Lay: In reverse lay rope, the wires in one strand are laid to the right, the wires in the nearby strand are laid to the left, the wires in the next strand are laid to the right, and so forth, with alternate directions from one strand to the other. Then all strands are laid to the right.

The five different lays of wire rope are shown in figure 5-4.

LAY LENGTH OF WIRE ROPE

The length of a wire rope lay is the distance measured parallel to the center line of a wire rope in that a strand makes one complete spiral or turn around the rope. The length of a strand lay is the distance measured parallel to the centerline of the strand in that one wire makes one complete spiral or turnaround the

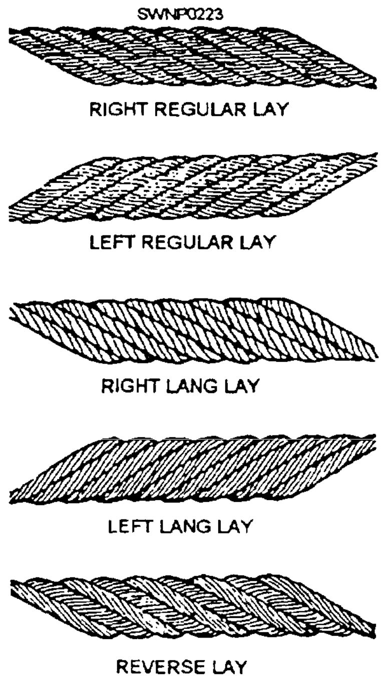

Figure 5-4.—Lays of wire rope.

strand. Lay length measurement is shown in figure 5-5.

CLASSIFICATION OF WIRE ROPE

The primary types of wire rope used by the NCF consist of 6, 7, 12, 19, 24, or 37 wires in each strand. Usually, the wire rope has six strands laid around the core .

The two most common types of wire rope, 6 by 19 and 6 by 37, are shown in figure 5-6. The 6 by 19 type (having six strands with 19 wires in each strand) is the stiffest and strongest construction of the type of wire rope suitable for general hoisting operations. The 6 b y 37 wire rope (having six strands with 37 wires in each strand) is flexible, making it suitable for cranes and similar equipment where sheaves are smaller than

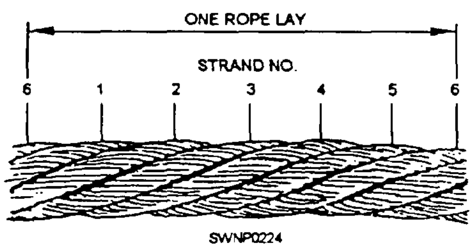

Figure 5-5.—Lay length of wire rope.

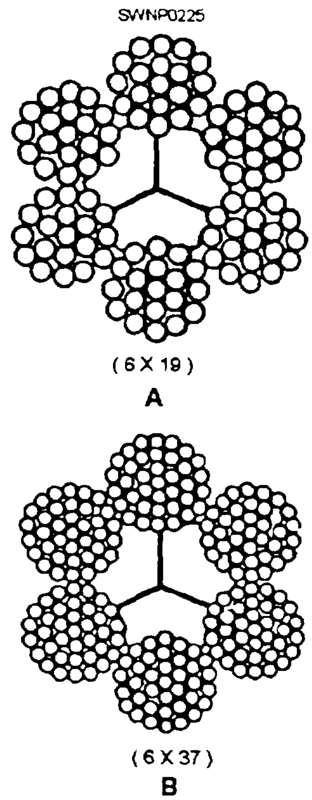

Figure 5-6.—A. 6 by 19 wire rope; B. 6 by 37 wire rope.

usual. The wires in the 6 by 37 are smaller than the wires in the 6 by 19 wire rope and, consequently, will not stand as much abrasive wear.

WIRE ROPE SELECTION

Several factors must be considered when you select a wire rope for use in a particular type of operation. Manufacture of a wire rope that can withstand all of the different types of wear and stress, it is subjected to, is impossible. Because of this factor, selecting a rope is often a matter of compromise. You must sacrifice one quality to have some other more urgently needed characteristic.

Tensile Strength

Tensile strength is the strength necessary to withstand a certain maximum load applied to the rope. It includes a reserve of strength measured in a so-called factor of safety.

Crushing Strength

Crushing strength is the strength necessary to resist the compressive and squeezing forces that distort the cross section of a wire rope, as it runs over sheaves, rollers, and hoist drums when under a heavy load. Regular lay rope distorts less in these situations than lang lay.

Fatigue Resistance

Fatigue resistance is the ability to withstand the constant bending and flexing of wire rope that runs continuously on sheaves and hoist drums. Fatigue resistance is important when the wire rope must be run at high speeds. Such constant and rapid bending of the rope can break individual wires in the strands. Lang lay ropes are best for service requiring high fatigue resistance. Ropes with smaller wires around the outside of their strands also have greater fatigue resistance, since these strands are more flexible.

Abrasion Resistance

Abrasion resistance is the ability to withstand the gradual wearing away of the outer metal, as the rope runs across sheaves and hoist drums. The rate of abrasion depends mainly on the load carried by the rope and the running speed. Generally, abrasion resistance in a rope depends on the type of metal that the rope is made of and the size of the individual outer wires. Wire rope made of the harder steels, such as improved plow steel, has considerable resistance to abrasion. Ropes that have larger wires forming the outside of their strands are more resistant to wear than ropes having smaller wires that wear away more quickly.

Corrosion Resistance

Corrosion resistance is the ability to withstand the dissolution of the wire metal that results from chemical attack by moisture in the atmosphere or elsewhere in the working environment. Ropes that are put to static work, such as guy wires, maybe protected from corrosive elements by paint or other special dressings. Wire rope may also be galvanized for corrosion protection. Most wire ropes used in crane operations must rely on their lubricating dressing to double as a corrosion preventive.

MEASURING WIRE ROPE

Wire rope is designated by its diameter, in inches. The correct method of measuring the wire rope is to measure from the top of one strand to the top of the strand directly opposite it. The wrong way is to measure across two strands side by side.

To ensure an accurate measurement of the diameter of a wire rope, always measure the rope at three places, at least 5 feet apart (fig. 5-7). Use the average of the three measurements as the diameter of the rope.

NOTE: A crescent wrench can be used as an expedient means to measure wire rope.

WIRE ROPE SAFE WORKING LOAD

The term *safe working load* (SWL) of wire rope is used to define the load which can be applied that allows the rope to provide efficient service and also prolong the life of the rope.

The formula for computing the SWL of a wire rope is the diameter of the rope squared, multiplied by 8.

D x D x 8 = SWL (in tons)

Example: The wire rope is 1/2 inch in diameter. Compute the SWL for the rope.

The first step is to convert the 1/2 into decimal numbers by dividing the bottom number of the fraction into the top number of the fraction: (1 divided by 2 = .5.) Next, compute the SWL formula: (.5 x .5 x 8 = 2 tons.) The SWL of the 1/2-inch wire rope is 2 tons.

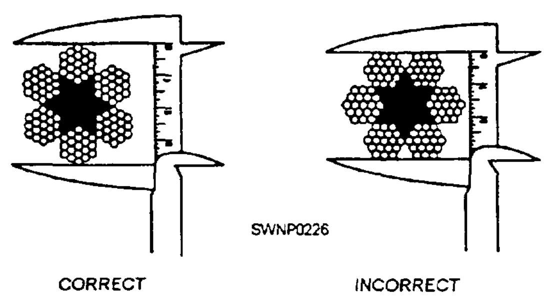

Figure 5-7.—Correct and incorrect methods of measuring wire rope.

CAUTION

Do NOT downgrade the SWL of wire rope because it is old, worn, or in poor condition. Wire rope in these conditions should be cut up and discarded.

WIRE ROPE FAILURE

Some of the common causes of wire rope failure are the following:

- Using incorrect size, construction or grade
- Dragging over obstacles
- Improper lubrication
- Operating over sheaves and drums of inadequate size
- Overriding or cross winding on drums
- Operating over sheaves and drums with improperly fitted grooves or broken flanges
- Jumping off sheaves
- Exposure to acid fumes
- Use of an improperly attached fitting
- Grit being allowed to penetrate between the strands, causing internal wear
- Being subjeted to severe or continuing overload

WIRE ROPE ATTACHMENTS

Attachments can be put on a wire rope to allow it to be attached to other ropes; for example, pad eyes, chains, or equipment.

END FITTINGS

Some end fittings that are easily and quickly changed are wire rope clips, clamps, thimbles, wedge sockets, and basket sockets. Generally these attachments permit the wire rope to be used with greater flexibility than a more permanent splice would allow. These attachments allow the same wire rope to be made in numerous different arrangements.

Wire Rope Clips

Wire rope clips are used to make eyes in wire rope, as shown in figure 5-8. The U-shaped part of the clip with the threaded ends is called the U-bolt; the other

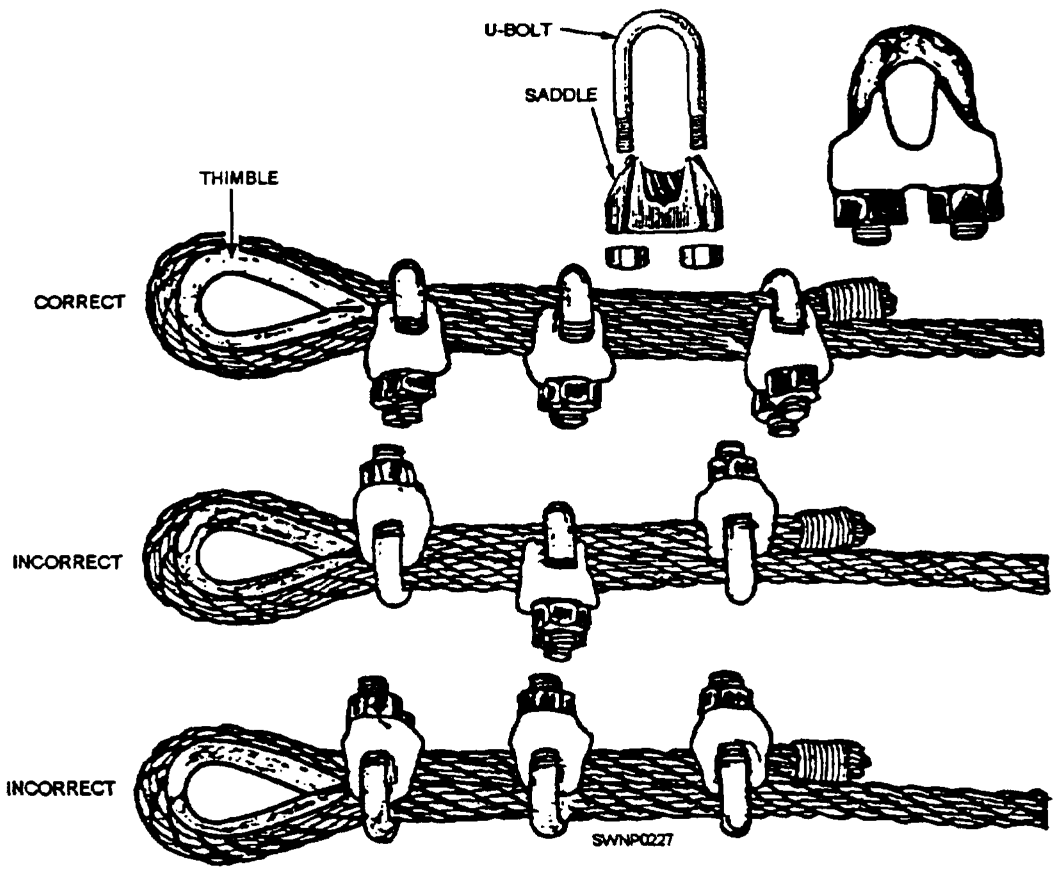

Figure 5-8.—Wire rope clips

part is called the saddle. The saddle is stamped with the diameter of the wire rope that the clip will fit. Always place a clip with the U-bolt on the bitter (dead) end, not on the standing part of the wire rope. When clips are attached incorrectly, the standing part (live end) of the wire rope will be distorted or have smashed spots. A rule of thumb to remember when attaching a wire rope clip is to "NEVER saddle a dead horse."

Two simple formulas for figuring the number of wire rope clips needed are as follows:

3 x wire rope diameter+ 1 = Number of clips

6 x wire rope diameter= Spacing between clips

Another type of wire rope clip is the twin-base clip, often referred to as the universal or two clamp (fig. 5-9). Both parts of this clip are shaped to fit the wire rope; therefore, the clip cannot be attached incorrectly. The twin-base clip allows a clear 360-degree swing with the wrench when the nuts are being tightened.

Wire Rope Clamps

Wire rope clamps (fig. 5-10) are used to make an eye in the rope with or without a thimble; however, a clamp is normally used without a thimble. The eye will have approximately 90 percent of the strength of the rope. The two end collars should be tightened with wrenches to force the wire rope clamp to a good, snug fit. This squeezes the rope securely against each other.

Thimble

When an eye is made in a wire rope, a metal fitting, called a thimble, is usually placed in the eye (fig. 5-8). The thimble protects the eye against wear. Wire rope eyes with thimbles and wire rope clips can hold approximately 80 percent of the wire rope strength.

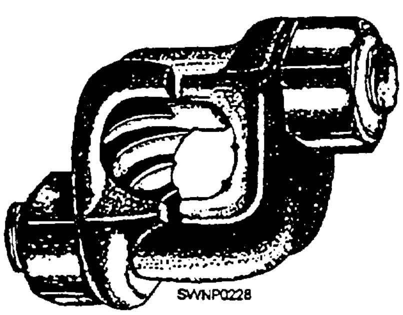

Figure 5-9.—Twin-base wire rope clip.

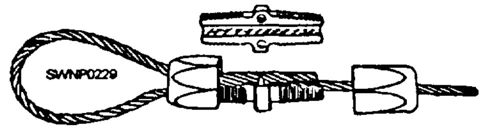

Figure 5-10.—Wire rope.

After the eye made with clips has been strained, the nuts on the clips must be retightened. Checks should be made now and then for tightness or damage to the rope cause by the clips.

Wedge Socket

A wedge socket end fitting (fig. 5-11) is used in situations that require the fitting to be changed frequently. For example, the attachment used most often to attach dead ends of wire ropes to pad eyes, or like fittings, on cranes and earthmoving equipment is the wedge socket. The socket is applied to the bitter end of the wire rope. Fabricated in two parts, the wedge socket has a tapered opening for the wire rope and a small wedge to fit into the tapered socket. The loop of wire rope must be installed in the wedge socket, so the standing part of the wire rope will form a nearly direct line to the clevis pin of the fitting. When a wedge socket is assembled correctly, it tightens as a load is placed on the wire rope.

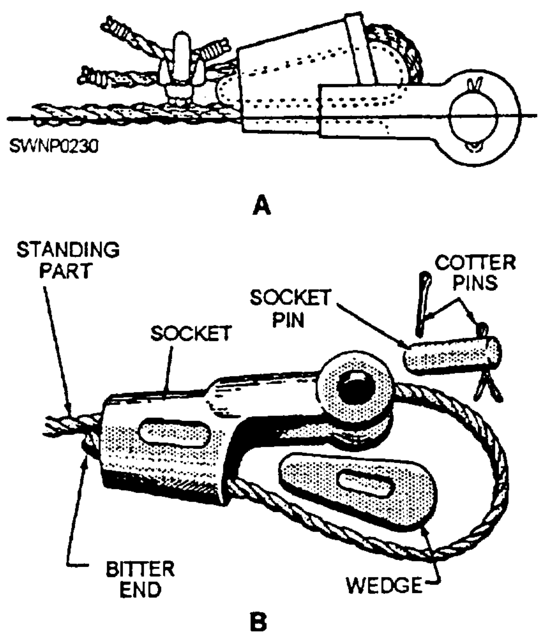

Figure 5-11.—A. Wedge socket B. Parts of a wedge socket.

NOTE: The wedge socket efficiency is approximately two thirds of the breaking strength of the wire rope due to the crushing action of the wedge.

Basket Socket

A basket socket is normally attached to the end of the rope with either molten zinc or babbitt metal; therefore, it is a permanent end fitting. In all circumstances, dry or poured, the wire rope should lead from the socket in line with the axis of the socket.

DRY METHOD.— The basket socket can also& fabricated by the dry method (fig. 5- 12) when facilities are not available to make a poured fitting; however, its strength will be reduced to approximately one sixth of that of a poured zinc connection.

POURED METHOD.—– The poured basket socket (fig. 5-13) is the preferred method of basket socket assembly. Properly fabricated, it is as strong as the rope itself, and when tested to destruction, a wire rope will break before it will pull out of the socket. When molten lead is used vice zinc, the strength of the connection must be approximate] y three fourths of the strength of a zinc connection

Permanent eyes in wire rope slings can also be made in 3/8- to 5/8-inch (9.5 to 15.9-mm) wire rope by using the nicopress portable hydraulic splicing tool and oval sleeves. The nicopress portable splicing tool (fig. 5-14) consists of a hand-operated hydraulic pump connected to a ram head assembly. Included as a part of the tool kit are interchangeable compression dies for wire sizes 3/8, 7/16, 1/2, 9/16, and 5/8 inch (9.5, 11.1, 12.7, 14.3, and 15.9 mm). The dies are in machined halves with a groove size to match the oval sleeve and the wire rope being spliced. The oval sleeves (fig. 5-15) are available in plain copper or zinc-plated copper.

To make an eye splice, pick an oval sleeve equal to the size of the wire rope being spliced. Slide the sleeve over the bitter end of the length of rope, then form an eye and pass the bitter end through the end again (fig. 5-16). Next, place the lower half of the compression die in the ram head assembly. Place the oval sleeve in this lower half and drop in the upper half of the die. Fully insert the thrust pin that is used to hold the dies in place when making the swage. Start pumping the handle and continue to do so until the dies meet. At this time the overload valve will pop off, and a 100-percent efficient splice is formed (fig. 5-17). Retract the plunger and remove the swaged splice.

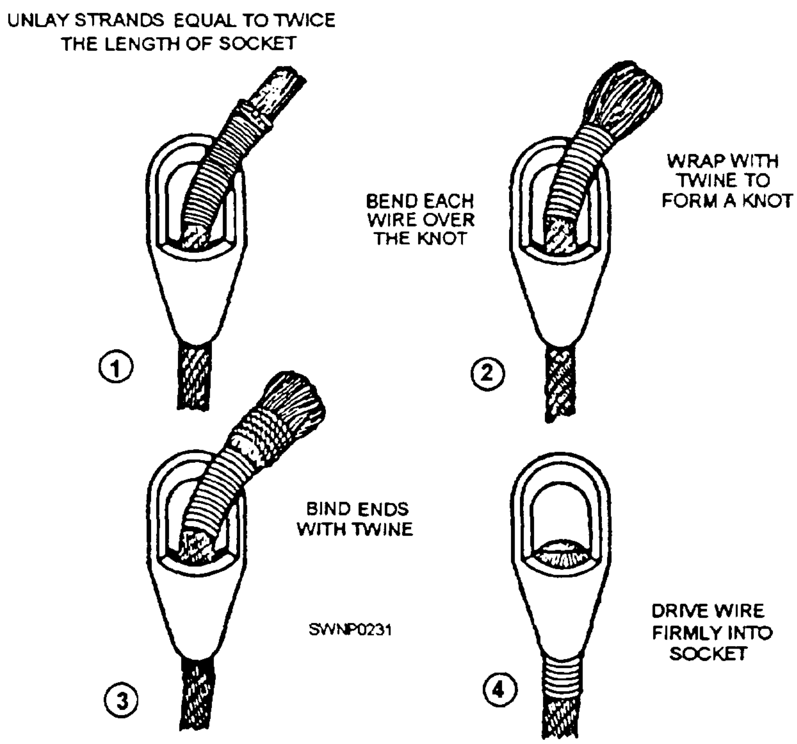

Figure 5-12.—Attaching a basket socket by the dry method.

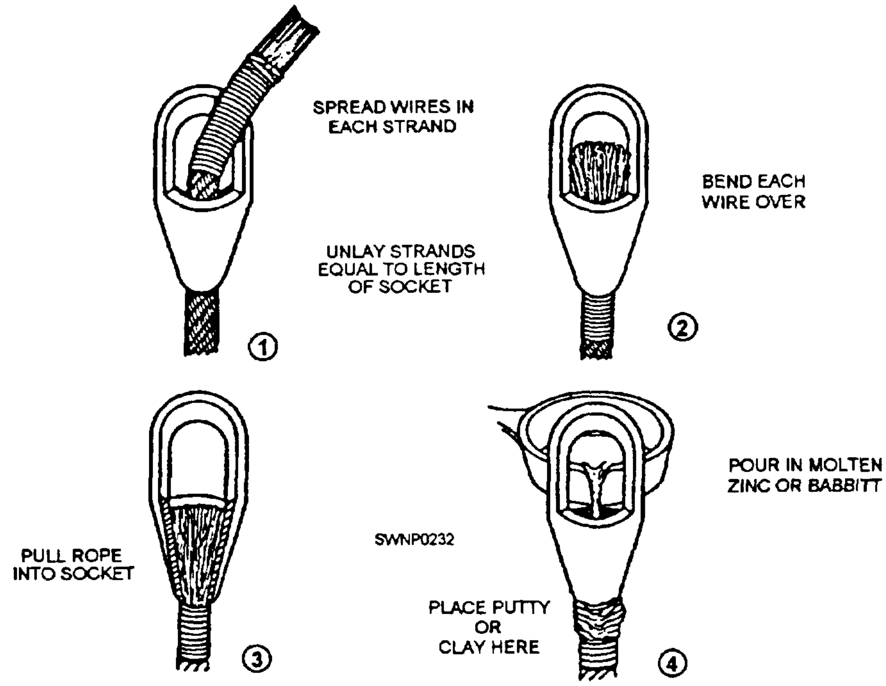

Figure 5-13.—Attaching a basket socket by the pouring method.

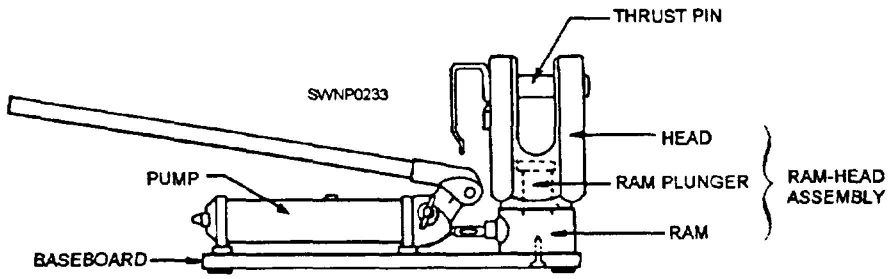

Figure 5-14.—Nicopress portable splicing tool.

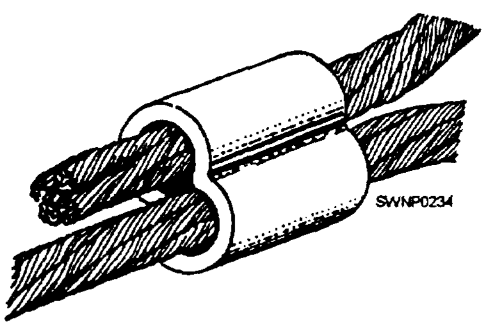

Figure 5-15.—Oval sleeve.

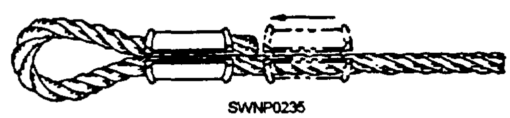

Figure 5-16.-Starting an eye splice using an oval sleeve.

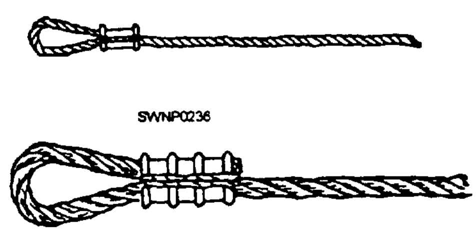

Figure 5-17.—Completed eye splice using an oval sleeve.

Check the swage with the gauge supplied in each die set (fig. 5-18). This process represents a savings in time over the eye formed by using wire rope clips.

Additionally, lap splices can be made with nicopress oval sleeves (fig. 5-19). Usually, two sleeves are needed to create a full-strength splice. A short

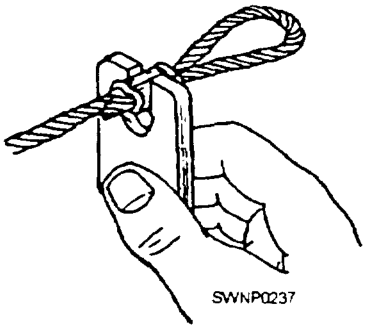

Figure 5-18.—Swage gauge.

Figure 5-19.—Lap splice using a nicopress oval sleeve.

space should be maintained between the two sleeves, as shown. The lap splice should be tested before being used.

HANDLING AND CARE OF WIRE ROPE

To render safe, dependable service over a maximum period of time, you should take good care and upkeep of the wire rope that is necessary to keep it in good condition. Various ways of caring for and handling wire rope are listed below.

Coiling and Uncoiling

Once anew reel has been opened, it may be coiled or faked down, like line. The proper direction of coiling is counterclockwise for left lay wire rope and clockwise for right lay wire rope. Because of the general toughness and resilience of wire, it often tends to resist being coiled down. When this occurs, it is useless to fight the wire by forcing down the turn because the wire will only spring up again. But if it is thrown in a back turn, as shown in figure 5-20, it will lie down proper] y. A wire rope, when faked down, will run right off like line; but when wound in a coil, it must always be unwound.

Wire rope tends to kink during uncoiling or unreeling, especially if it has been in service for a long time. A kink can cause a weak spot in the rope that wears out quicker than the rest of the rope.

A good method for unreeling wire rope is to run a pipe, or rod, through the center and mount the reel on drum jacks or other supports, so the reel is off the ground (fig. 5-21, view A). In this way, the reel will turn as the rope is unwound, and the rotation of the

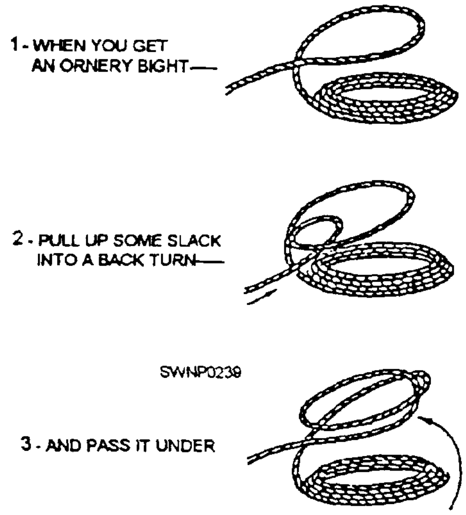

Figure 5-20.—Throwing a back turn.

reel helps keep the rope straight. During unreeling, pull the rope straight forward and avoid hurrying the operation. As a safeguard against kinking, NEVER unreel wire rope from a reel that is stationary.

To uncoil a small coil of wire rope, simply stand the coil on edge and roll it along the ground like a wheel, or hoop (fig. 5-21, view B). NEVER lay the coil flat on the floor or ground and uncoil it by pulling on the end because such practice can kink or twist the rope.

Kinks

One of the most common types of damage resulting from the improper handling of wire rope is the development of a kink. A kink starts with the formation of a loop (fig. 5-22).

A loop that has not been pulled tight enough to set the wires, or strands, of the rope into a kink can be removed by turning the rope at either end in the proper direction to restore the lay, as shown in figure 5-23. If this is not done and the loop is pulled tight enough to cause a kink (fig. 5-24), the kink will result in irreparable damage to the rope (fig. 5-25).

Kinking can be prevented by proper uncoiling and unreeling methods and by the correct handling of the rope throughout its installation.

Reverse Bends

Whenever possible, drums, sheaves, and blocks used with wire rope should be placed to avoid reverse or S-shaped bends. Reverse bends cause the individual wires or strands to shift too much and increase wear and fatigue. For a reverse bend, the drums and blocks affecting

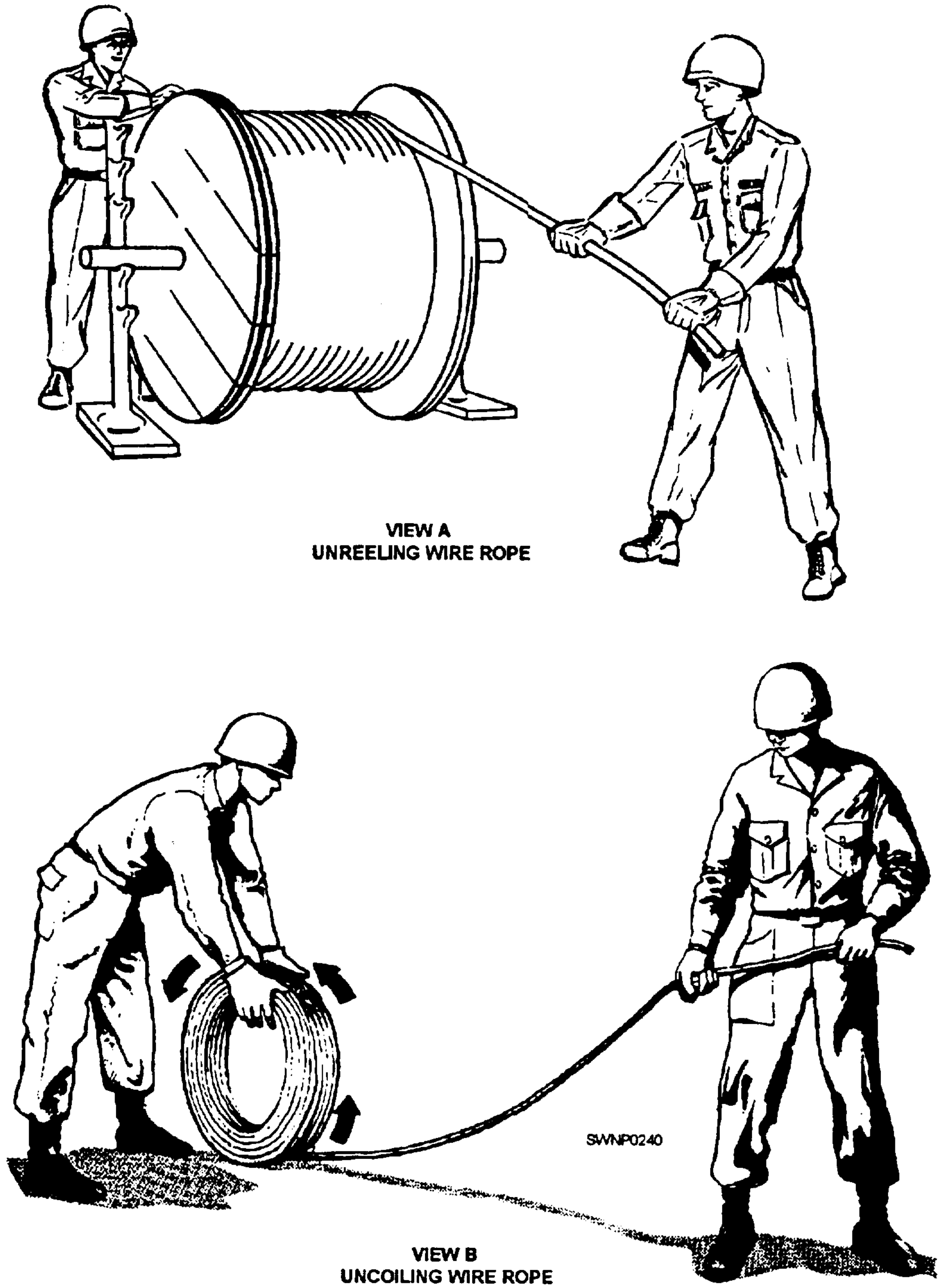

Figure 5-21.—A. Unreeling wire rope; B. Uncoiling wire rope.

Figure 5-22.—A wire rope loop.

the reversal should be of a larger diameter than ordinarily used and should be spaced as far apart as possible.

Sizes of Sheaves

The diameter of a sheave should never be less than 20 times the diameter of the wire rope. An exception is 6 by 37 wire for a smaller sheave that can be used because this wire rope is more flexible.

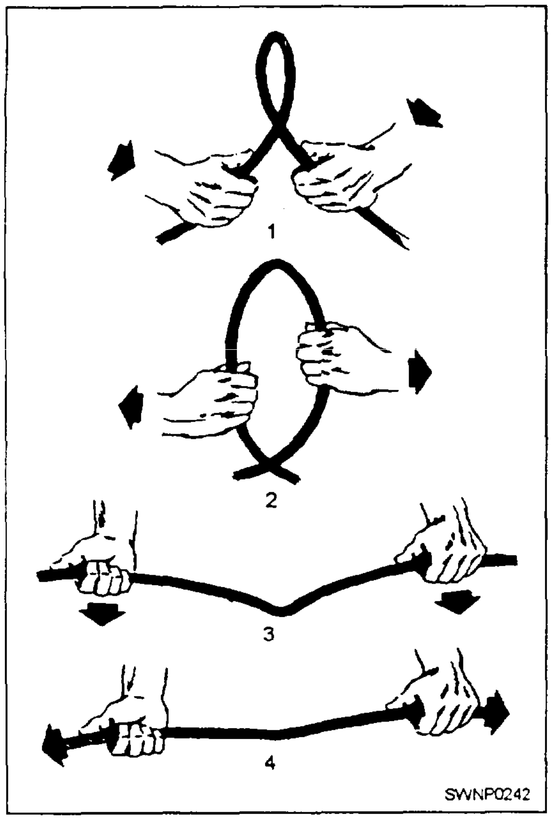

Figure 5-23.—The correct way to remove a loop in a wire rope

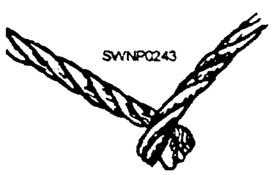

Figure 5-24.—A wire rope kink.

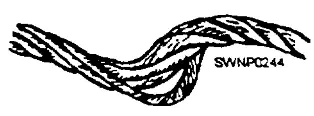

Figure 5-25.—Kink damage.

The chart shown in table 5-1 can be used to determine the minimum sheave diameter for wire rope of various diameters and construction.

Seizing and Cutting

The makers of wire rope are careful to lay each wire in the strand and each strand in the rope under uniform tension. When the ends of the rope are not

Table 5-1.—Suggested Mininum Tread Diameter of sheaves and Drums

Rope diameter in inches	Minimum tread diameter in inches for given rope construction*			
	6 × 7	6 × 19	6 × 37	8 × 19
1/4	10 1/2	8 1/2	- - -	6 1/2
3/8	15 3/4	12 3/4	6 3/4	9 3/4
1/2	21	17	9	13
5/8	26 1/4	21 1/4	11 1/4	16 1/4
3/4	31 1/2	25 1/2	13 1/2	19 1/2
7/8	36 3/4	29 3/4	15 3/4	22 3/4
1	42	34	18	26
1 1/8	47 1/4	38 1/4	20 1/2	29 1/4
1 1/4	52 1/2	42 1/2	22 1/2	32 1/2
1 1/2	63	51	27	39

*Rope construction is in strands times wires per strand.

secured properly, the original balance of tension is disturbed and maximum service cannot be obtained because some strands can carry a greater portion of the load than others. Before cutting steel wire rope, place seizing on each side of the point where the rope is to be cut, as shown in figure 5-26.

A rule of thumb for determining the size, number, and distance between seizing is as follows:

1. The number of seizing to be applied equals approximately three times the diameter of the rope.

Example: 3- x 3/4-inch-diameter rope = 2 1/4 inches. Round up to the next higher whole number and use three seizings.

2. The width of each seizing should be 1 to 1 1/2 times as long as the diameter of the rope.

Example: 1- x 3/4-inch-diameter rope= 3/4 inch. Use a 1-inch width of seizing.

3. The seizing should be spaced a distance equal to twice the diameter of the wire rope.

Example: 2- x 3/4-inch-diameter rope = 1 1/2 inches. Space the seizing 2 inches apart.

A common method used to make a temporary wire rope seizing is as follows:

Wind on the seizing wire uniformly, using tension on the wire. After taking the required number of turns, as shown in step 1, twist the ends of the wires

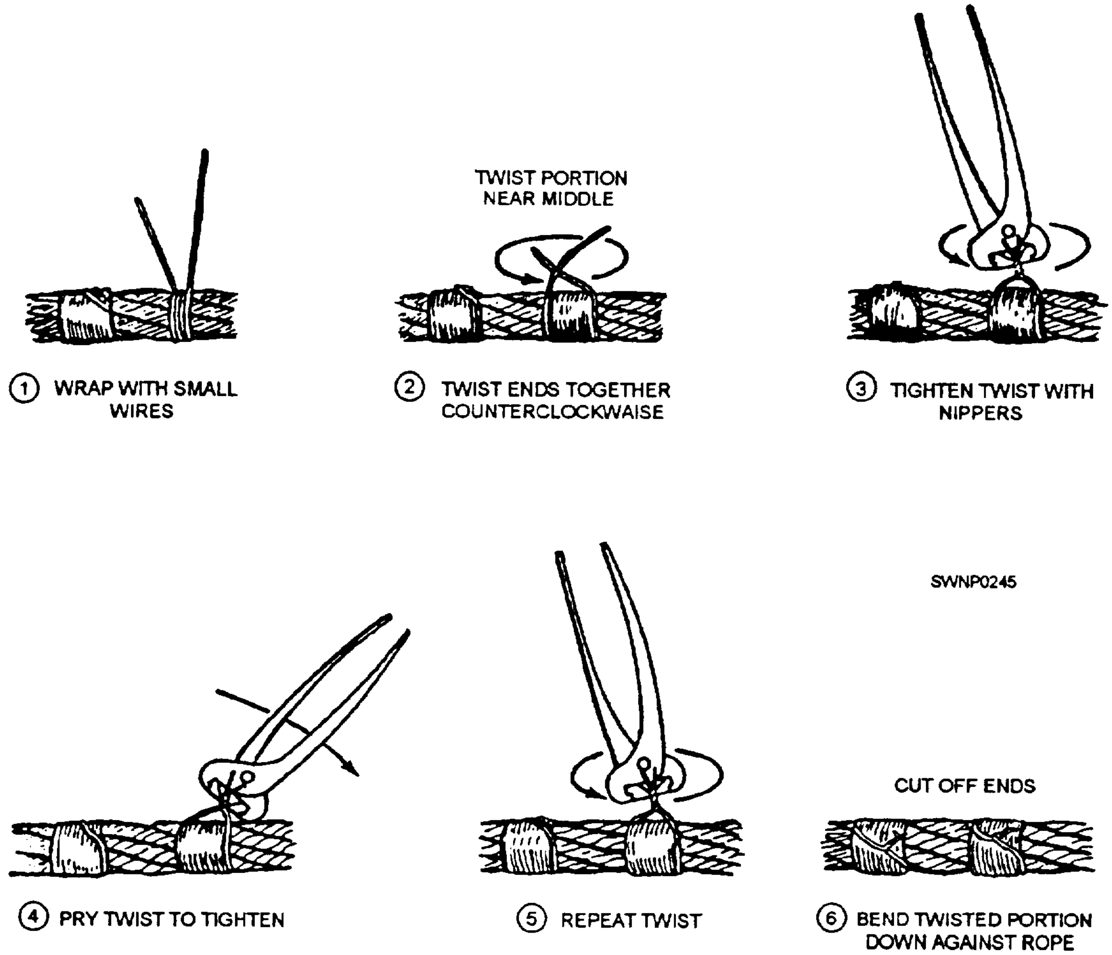

Figure 5-26.—Seizing wire rope.

counterclockwise by hand, so the twisted portion of the wires is near the middle of the seizing, as shown in step 2. Grasp the ends with end-cutting nippers and twist up the slack, as shown in step 3. Do not try to tighten the seizing by twisting. Draw up on the seizing, as shown in step 4. Again twist up the slack, using nippers, as shown in step 5. Repeat steps 4 and 5 if necessary. Cut the ends and pound them down on the rope, as shown in step 6. When the seizing is to be permanent or when the rope is 1 5/8 inches or more in diameter, use a serving bar, or iron, to increase tension on the seizing wire when putting on the turns.

Wire rope can be cut successfully by a number of methods. One effective and simple method is to use a hydraulic type of wire rope cutter, as shown in figure 5-27. Remember that all wire should be seized before it is cut. For best results in using this method, place the rope in the cutter, so the blade comes between the two central seizings. With the release valve closed, jack the blade against the rope at the location of the cut and continue to operate the cutter until the wire rope is cut.

INSPECTION

Wire rope should be inspected at regular internals, the same as fiber line. The frequency of inspection is determined by the use of the rope and the conditions under which it is used.

Throughout an inspection, the rope should be examined carefully for fishhooks, kinks, and worn and corroded spots. Usual] y breaks in individual wires will be concentrated in areas where the wire runs continually over the sheaves or bend onto the drum. Abrasion or reverse and sharp bends cause individual wires to break and bend back These breaks are known as fishhooks. When wires are slightly worn but have broken off squarely and stick out all over the rope, that condition is usually caused by overloading or rough handling. If the breaks are confined to one or two

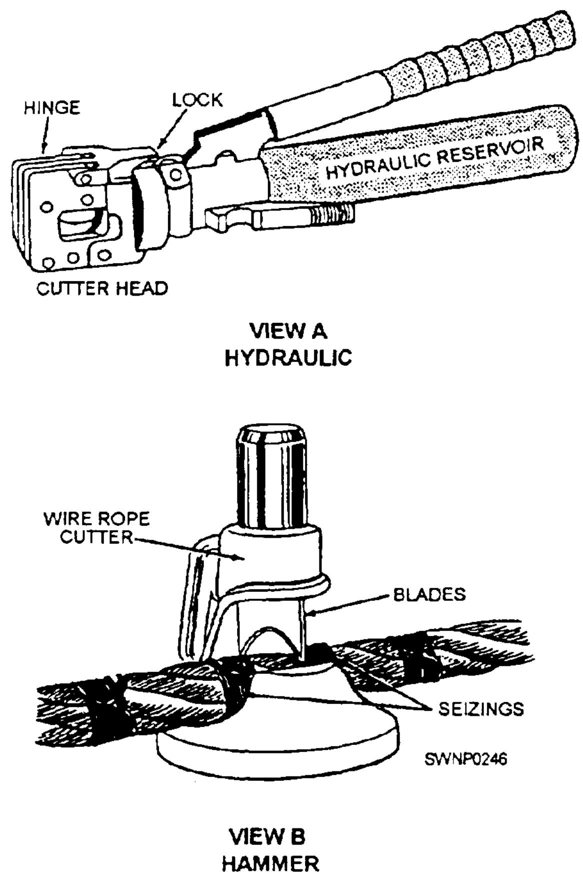

Figure 5-27.—Types of wire rope cutters: A. Hydraulic; B. Hammer.

strands, then the strength of the rope maybe seriously reduced. When 4 percent of the total number of wires in the rope are found to have breaks within the length of one lay of the rope, the rope is considered unsafe. Consider the rope unsafe when three broken wires are found in one strand of 6 by 7 rope, six broken wires in one strand of 6 b y 19 rope, or nine broken wires in one strand of 6 by 37 rope.

Overloading a rope will reduce the diameter. Additionally, failure to lubricate wire rope will reduce the diameter. This occurs because the hemp core will eventually dry out and collapse or shrink. The surrounding strands are therefore deprived of support, and the strength and dependability of the rope are equally reduced. Rope that is 75 percent of its original diameter should be removed from service.

When wide-spread pitting and corrosion of the wires are visible through inspection, the rope should be removed from service. Special care should be taken to examine the valleys and small spaces between the strands for rust and corrosion. Since corrosion is normally caused by improper, infrequent, or no lubrication, the internal wires of the rope are often subject to extreme friction and wear. This type of internal and often invisible destruction of the wires is one of the most frequent causes of unexpected and sudden wire rope failure. To safeguard against this occurring, you should always keep the rope well lubricated and handle and store it properly.

CLEANING AND LUBRICATING WIRE ROPE

Wire rope should always be cleaned carefully before lubrication. Scraping or steaming removes most of the dirt and grit that has accumulated on used wire rope. Rust should be removed at regular intervals by wire brushing. The objective of cleaning is to remove all foreign material and old lubricant from the valleys between the strands as well as the spaces between the outer wires. This allows the new lubricant to flow into the rope.

Wire rope bending around hoist drums and sheaves will wear like any other metal article, so lubrication is just as important to an operating wire rope as it is to any other piece of working machinery. For a wire rope to work right, the wires and strands must be free to move. Friction from corrosion or lack of lubrication shortens the service life of wire rope.

Deterioration from corrosion is more dangerous than that from wear because corrosion ruins the inside wires—a process hard to detect by inspection. Deterioration caused by wear can be detected by examining the outside wires of the wire rope because these wires become flattened and reduced in diameter as the wire rope wears.

Both internal and external lubrication protects a wire rope against wear and corrosion. Internal lubrication can be properly applied only when the wire rope is being manufactured, and manufacturers customarily coat every wire with a rust-inhibiting lubricant, as it is laid into the strand. The core is also lubricated in manufacturing,

Lubrication that is applied in the field is designed not only to maintain surface lubrication but also to prevent the loss of the internal lubrication provided by the manufacturer. The Navy issues an asphaltic petroleum oil that must be heated before using. This lubricant is known as Lubricating Oil for Chain, Wire Rope, and Exposed Gear and comes in two types:

• Type I, Regular: Does not prevent rust and is used where rust prevention is not needed; for example, elevator wires used inside are not exposed to the weather but need lubrication.

• Type II, Protective: A lubricant and an anticorrosive that comes in three grades: grade A, for cold weather (60°F and below); grade B, for warm weather (between 60°F and 80°F); and grade C, for hot weather (80°F and above).

The oil, issued in 25-pound and 35-pound buckets and in 100-pound drums, can be applied with a stiff brush, or the wire rope can be drawn through a trough of hot lubricant, as shown in figure 5-28. The frequency of application depends upon service conditions; as soon as the last coating has appreciably deteriorated, it should be renewed.

A good lubricant to use when working in the field, as recommended by COMSECOND/COMTHIRD NCBINST 11200.11, is a mixture of new motor oil and diesel fuel at a ratio of 70-percent oil and 30-percent diesel fuel. The NAVFAC P-404 contains added information on additional lubricants that can be used.

Never lubricate wire rope that works a dragline or other attachments that normally bring the wire rope in contact with soils. The reason is that the lubricant will pick up fine particles of material, and the resulting abrasive action will be detrimental to both the wire rope and sheave.

As a safety precaution, always wipe off any excess when lubricating wire rope, especially with hoisting equipment. Too much lubricant can get into brakes or clutches and cause them to fail. While in use, the motion of machinery may sling excess oil around over crane cabs and onto catwalks, making them unsafe.

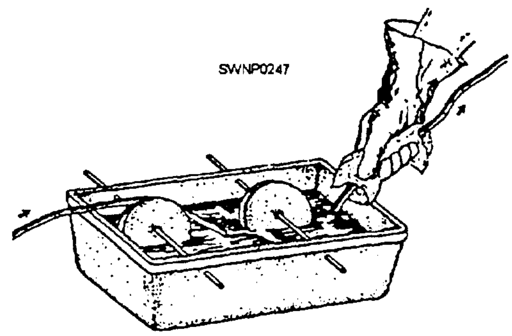

Figure 5-28.—Trough method of lubricating wire rope

STORAGE

Wire rope should never be stored in an area where acid is or has been kept. This must be stressed to all hands. The slightest trace of acid or acid fumes coming in contact with wire rope will damage it at the contact spot. Wire that has given way has been found many times to be acid damaged.

It is paramount that wire rope be cleaned and lubricated properly before placing it in storage. Fortunately, corrosion of wire rope can be virtually eliminated if lubricant is applied properly and sufficient protection from the weather is provided, Remember that rust, corrosion of wires, and deterioration of the fiber core will significantly reduce the strength of wire rope. Although it is not possible to say exactly the loss due to these effects, it is certainly enough to take precautions against.