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Rope-handling Techniques

I. Introduction

Rope is used in a wide range of ways in firefighting efforts—for entry, extraction, rescue of the wounded, ill, and incapacitated, to raise and lower various kinds of materials and equipment, to haul away obstructive objects, etc. Rope is used with very high frequency in comparison to other types of rescue tools As disaster situations change in the future, research and development will likely lead to changes in the construction of ropes, materials used, and other details. The basic need for ropes in firefighting, however, will remain as crucial as ever.

For this reason it is important to acquire basic knowledge in rope handling that is used in human rescue and other duties of firefighters. It is also vital to master the correct methods for handling ropes and the appropriate methods of use for the situation being faced.

II. Basic Knowledge in Rope Handling

1. Types of Rope

Classification by material, construction

Ropes can be classified by material and type of construction.

There are three material classifications: natural fibers (manila, sisal, cotton, and other plant fibers); synthetic fibers (nylon, kremona, vinylon, polyethylene, polypropylene, etc.); and steel (wire rope).

Natural and synthetic fiber rope generally have the same uses, while wire rope has special uses.

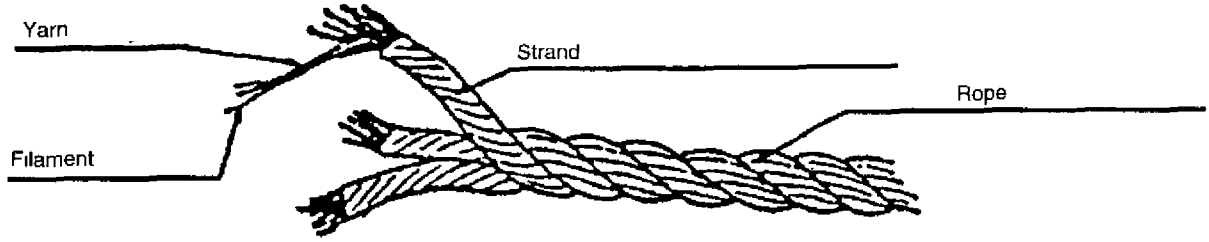
Classification by type of construction

By type of construction, ropes are classified in myriad ways according to how it is braided and laid. Ordinarily one speaks of a "three-strand rope," an "eight-strand rope," etc.

2. Rope Construction

Each part name of the rope excluding the special ropes is as shown in Fig. 3-1. Terms for lay and thickness of the rope except for the idiomatic expression is as shown in the chart 3-1.

Fiber rope



Steel rope

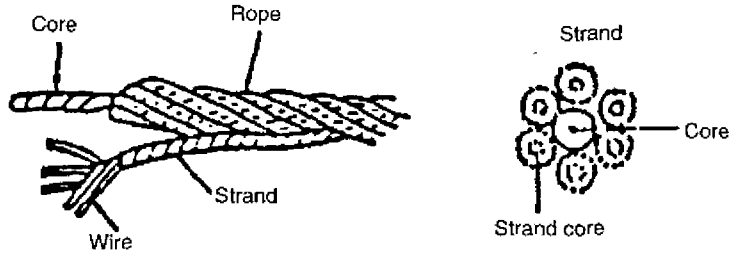
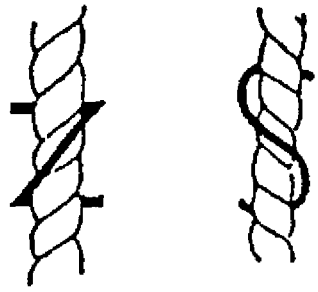
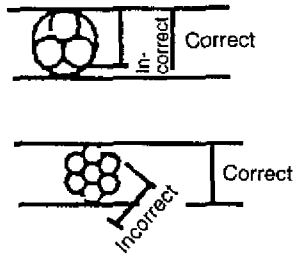


Fig. 3-1

Chart 3-1 Terms for lay and thickness of rope

Class	Term	Explanation
Lay	Z-type S-type	
Thickness	Thickness	Diameter of the circumscribed circle is measured in millimeters. 

3. General Cautions in Rope Use

Choose a rope whose strength matches the load it will bear; choose the most efficient way to handle the rope; and heed the following cautions.

(1) Do not use rope that shows clear signs of deterioration or distortion, or rope that has soaked up moisture.
(2) Do not step on rope or drag it along the ground.
(3) Do not give rope any sudden access of load, or abrasion.
(4) Do not drop rope from a high place while still coiled or drop any heavy object on top of a rope.
(5) When hanging the rope over an edge or other protrusion, place a blanket, cloth, or other material underneath to absorb the shock. (Fig. 3-2-1)
(6) Do not use rope while in a twisted, unnatural state; this might cause extreme crimping or kinking (See Note 1). Nor should you keep a load hanging for a long period of time. (Fig. 3-2-2)
(7) When using several ropes, differentiate as necessary by color.
(8) When setting up a rope to carry people or materials, use a rope having proper length for the job so that no knots need to be made except for the ends and hitched areas.

Note 1: When uncoiling a rope, if improperly uncoiled, the rope can twist excessively or untwist. If this twisting (plus) or untwisting (minus) becomes concentrated at a single point in the rope, that portion of the rope can become deformed.
This is called a kink; its presence vastly lowers the strength of a rope.

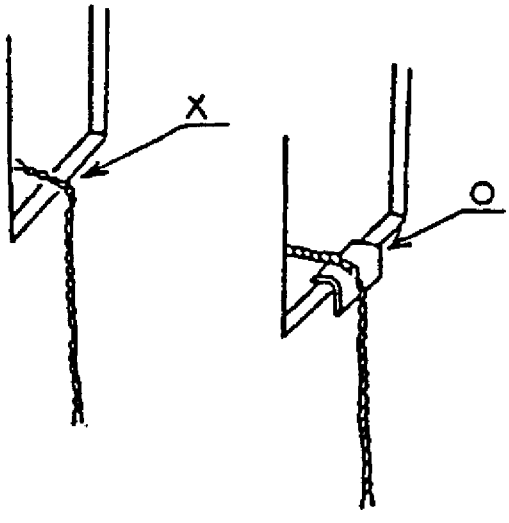


Fig. 3-2-1

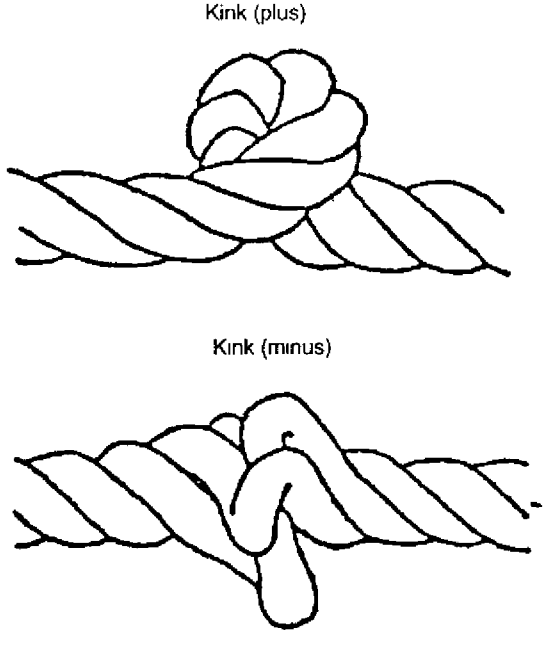


Fig. 3-2-2

III. Knot Tying

1. Introduction

Knot tying is performed to ensure safety in carrying out a job. Knot tying must make use of the properties of the rope, these techniques form the basis for all rope-handling techniques.

An improperly tied knot may directly endanger human life. It is therefore essential to: master the correct methods for tying knots, know how to use the right knot for the situation being faced, and be able to tie any knot with confidence.

2. Types of Knots

The method used for tying is determined by the type of rope, the object that is being tied, and the situation. In general there are four classifications.

(1) Knot
Creating a knot in a rope

(2) Hitch
Tying one end of a rope to an object.

(3) Bend
Joining both ends of a rope or joining two ropes.

(4) Slings and Other Knots
Methods of tying for various applications, shortening of a length of rope, or knots for decoration.

3. Cautions When Tying Knots

In addition to standard cautions in the use of rope, the following points must also be heeded.

(1) Do not stress the rope; make full use of the rope's properties.

(2) When tying, minimize the number of crosses and overlaps.

(3) On a tied rope, adjust the knot to give it the right slackness for the use (braking procedure using a prusik knot, e.g.) or remove slackness.

(4) The length of the end of a tied rope should be at least 15 times the diameter of the rope as a rule. The exception is when the end needs to be used for a specific purpose or when it is treated.

4. Introduction to Knot Tying

(1) Basic Knots

A. Joining Ropes

(a) Square Knot (Reef Knot)

The square knot is the most basic knot for joining two ropes and is suitable for uniting ropes of equal thickness. If used when the thicknesses or material of the ropes differ, it can slip and spill. (Fig. 3-9)

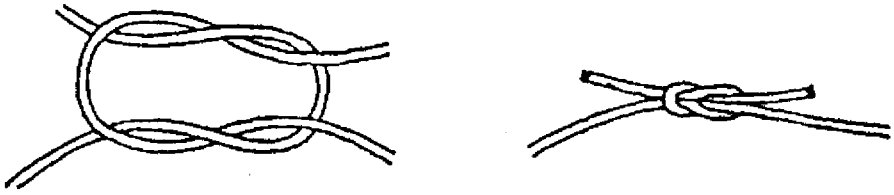


Fig. 3-9

<Caution>
If tied improperly, it becomes a granny knot, which is an impractical and dangerous knot. (Fig. 3-10)

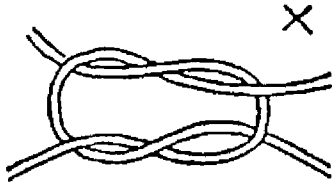


Fig. 3-10

(b) Single Sheet Bend

The single sheet bend will hold even when ropes of differing thickness or wet ropes are used.

a. Bend one end of the rope back on itself and hold it in your left hand. (Fig. 3-11-1)

b. With your right hand, thread the end of the other rope through the loop upwards from beneath. (Fig. 3-11-2)

c. Wrap this working end around your left forefinger, behind the doubled-back rope and around your left thumb, and then under itself. (Fig. 3-11-3)

d. Once it is passed through, tighten. (Fig. 3-11-4)

Fig. 3-11-1

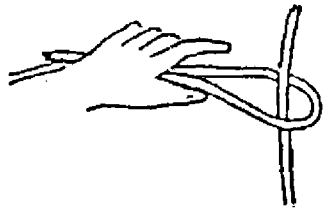


Fig. 3-11-2

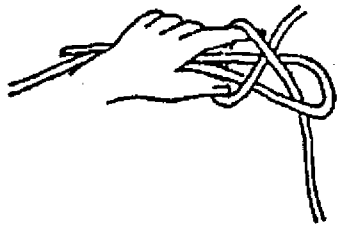


Fig. 3-11-3

Fig. 3-11-4

Note: This knot is also known as a weaver's knot, used for its ability to quickly tie together broken strands of raw silk.

(c) Double Sheet Bend

This knot serves the same purpose as the single sheet bend. After completing steps 'a' and 'b', wrap the working end one more time around the rope held in the left hand before threading it under itself. (Fig. 3-12)

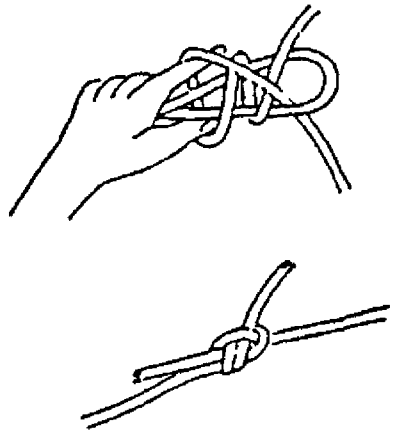


Fig. 3-12.

B. Knotting a Rope

(a) Overhand knot (3-13)

a. Prevents a rope from slipping off a pulley or out of a hole.
b. Temporarily stops the end of a cut rope from unraveling.
c. Used when one has to make a knob on a rope.

Fig. 3-13

Caution: The single use of the overhand knot is not secure.

(b) Stopper Knot (Fig 3-14, Fig 3-15)

This knot serves the same purpose as the overhand knot. With the additional twist, it is stronger than the overhand knot and easier to undo.

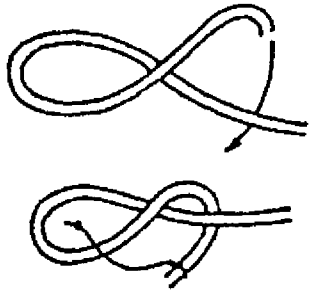


Fig. 3-14

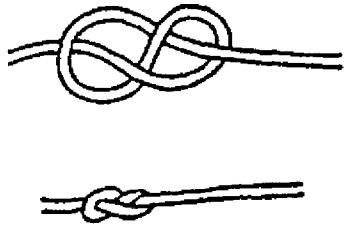


Fig. 3-15

(c) Harness Loop (Figure Eight)

The harness loop is used for hanging rope on a tree or hook, or for tightening a rope.

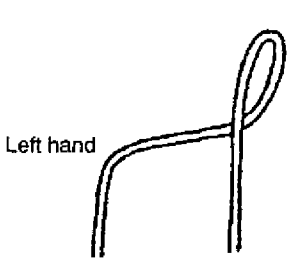


Fig. 3-16-1

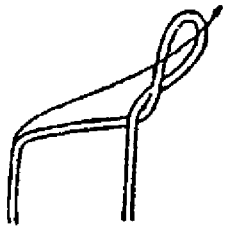


Fig. 3-16-2

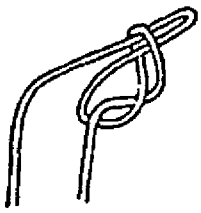


Fig. 3-16-3

Fig. 3-16-4

a. Hold the rope with both hands (shoulder distance apart) Using your right hand, twist the hanging portion once inward (into the body) to form a loop. (Fig. 3-16-1)

b. Twist once more. (Fig. 3-16-2)

c. Pass the rope in your left hand through the loop. (Fig. 3-16-3)

d. Grasp with your right hand the portion of rope that has been passed through and pull the hanging portion with the left hand to tighten. (Fig. 3-16-4)

(d) Fire-escape Knot
A series of single overhand knots is created on a single rope in succession for use in climbing or descending the rope.

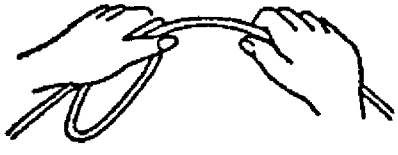


Fig. 3-17-1

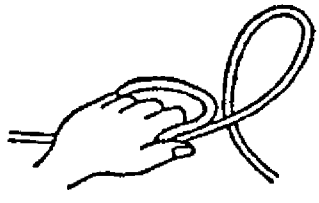


Fig. 3-17-2

Fig. 3-17-3

Fig. 3-17-4

Fig. 3-17-5

a. Hold one end of the rope in your left hand and in front of you. Use your right hand to form a single loop and then hold it in your left hand. (Fig. 3-17-1)

b. With your right hand, form a loop that turns inward, set it upon the back of your left hand, and then grasp it together with the first loop you made. (Fig. 3-17-2)

c. Form only the needed number of these loops. (Fig. 3-17-3)

d. Grasp the working end of the rope in your right hand, and pass it through all of the loops starting from the back of the hand. (Fig. 3-17-4)

e. Pull through this working end to form the overhand knots one by one. (Fig. 3-17-5)

Fig. 3-18

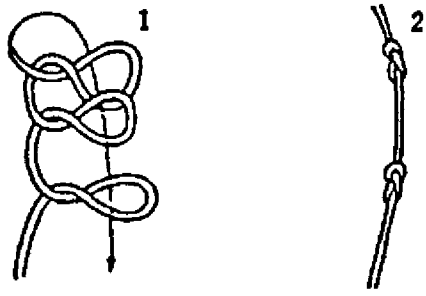


Fig. 3-19

(e) Loop Knot (Overhand Loop)

The loop knot is used when a loop is needed in the bight of the rope. The knot is the same as the overhand knot except that it is made using rope folded back upon itself. (Fig. 3-20)

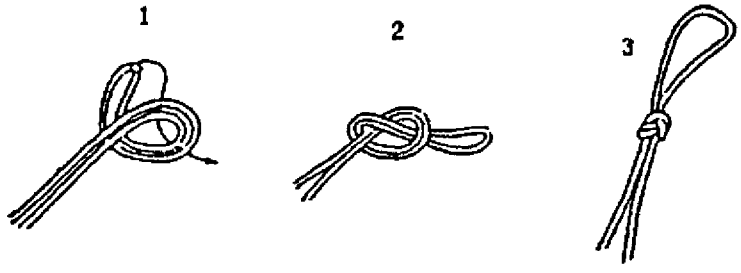


Fig. 3-20

(f) Englishman's Loop

The Englishman's loop is used when a loop is needed in the bight of the rope. It is an essential knot for a taut rope.

Fig. 3-21-1

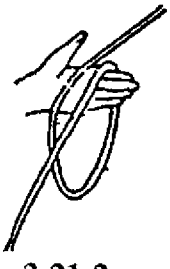


Fig. 3-21-2

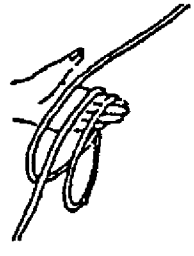


Fig. 3-21-3

Fig. 3-21-4

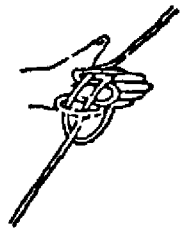


Fig. 3-21-5

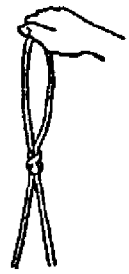


Fig. 3-21-6

a. Lay the rope in the palm of your left hand. (Fig. 3-21-1)

b. Grasp with your right hand the portion of rope hanging down in front, make a loop, and lay it next to the rope in your left hand. (Fig 3-21-2)

c. Make another loop in the same way and lay it between the two portion of rope already in your left hand. (Fig. 3-21-3)

d. Grasp with your right hand the portion of rope closest to the fingertips (Fig. 3-21-4)

e. Wrap this over and around the two sections of rope closest to the wrist. (Fig. 3-21-5)

f. Grasp the loop formed with your right hand, the hanging ends with your left hand, and pull. (Fig. 3-21-6)

(g) Bowline on a Bight

The bowline on a bight is used to make a loop in the bight of the rope, and is used in rescuing the wounded or ill.

This is also called a seat knot, and if used for a seat, adjust the loop according to the object being carried, so that it will not fall out.

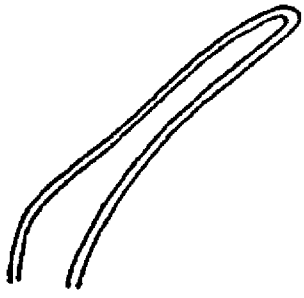


Fig. 3-22-1

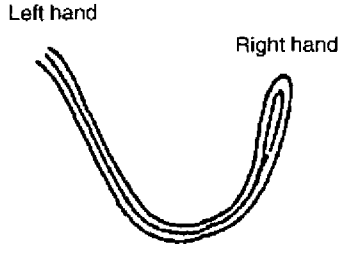


Fig. 3-22-2

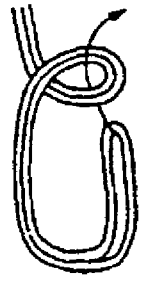


Fig. 3-22-3

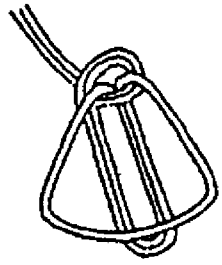


Fig. 3-22-4

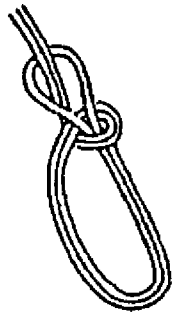


Fig. 3-22-5

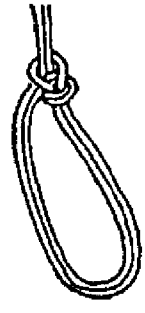


Fig. 3-22-6

a. At the point in the rope where the bowline is needed, fold the rope in two. (Fig. 3-22-1)

b. Hold the folded end in your right hand and the standing part of the rope in your left (Fig. 3-22-2)

c. Make a small loop such that the long part of the rope in your left hand extends downward. (Fig. 3-22-3)

d. Pass the portion of rope in your right hand up through the loop and widen it out (Fig. 3-22-4)

e. Pass the widened single loop behind the double loop and pull the double loop through. (Fig. 3-22-5)

f. Tighten while adjusting the loop to the desired size at your left hand. (Fig. 3-22-6)

(h) Double Bowline on a Bight (Forked Loop)
The forked loop is used like the bowline on a bight to form loops in the bight of the rope. It is also one way to tie a rope to secure a person who needs rescuing at the scene of a fire, for example, and is used for a rescue. When used on a person being rescued, adjust the loops to the size of the person's body.

a. Follow steps 'a' through 'c' for a bowline on a bight, pass the portion of rope in your right hand up through the loop, and pass it behind the rope in the direction shown by the arrow. (Fig. 3-23-1)

b Again pass through the small loop, this time from above, and extend the loop downwards, adjusting the size of the formed loops at the position of the left hand as you tighten. (Fig. 3-23-2)

Fig. 3-23-1

Fig. 3-23-2

(i) Single Hitch
The single hitch is a knot used to secure knots that join or attach ropes. (Fig. 3-24)
Caution: It cannot be used alone.

Fig. 3-24

C. Fastening

(a) Clove Hitch
The clove hitch is used to moor a rope to an object using the bight or end of the rope. As shown in Fig. 3-25, it is all right to first form the hitch in the rope and then fasten it to an object. Or as shown in Fig. 3-26, wrap the rope around the object from the start to form the hitch.

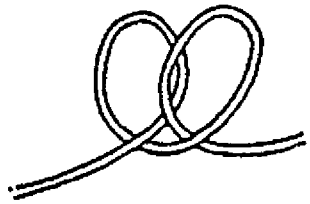


Fig. 3-25

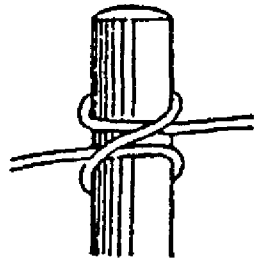


Fig. 3-26

(b) Bowlinehe

The bowline is a knot that is easy to tie and easy to undo no matter how thick the rope, and is a reliable way to tie a rope to a person, tree, or other object.

a. Hold the end of the rope in your right hand and the standing part of the rope in your left. Lay the end over the standing part. (Fig. 3-27-1)

b. Holding the rope in position with the right hand. (With the left hand, form a small loop in the standing part of the rope; pass the end through it.) (Fig. 3-27-2)

c. Pass the end around the back of the standing part from right to left, back down through the small loop, and tighten. (Fig. 3-27-3)

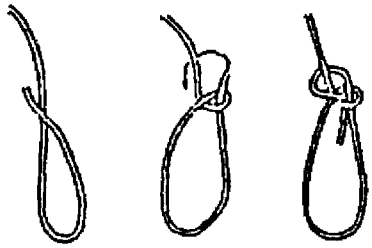


Fig. 3-27-1 **Fig. 3-27-2** **Fig. 3-27-3**

(c) Coiled Bowline

This knot is used for rescue of the wounded and ill, to secure oneself for entry or extraction, or during high-impact training such as training in falling to minimize the pain caused to the body.

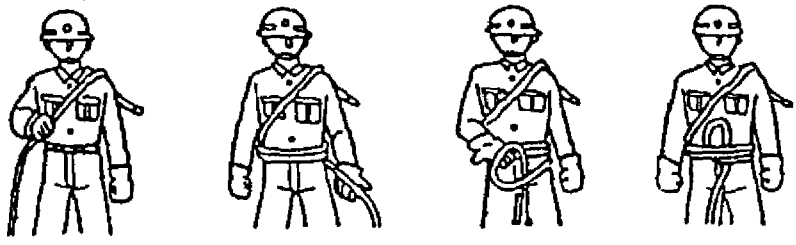


Fig. 3-28-1 **Fig. 3-28-2** **Fig. 3-28-3** **Fig. 3-28-4**

a. Lay one end of the rope over your left shoulder. (Fig. 3-28-1)

b. Wrap the rope around your waist in a clockwise direction. (Make sure the rope does not double up over itself.) (Fig. 3-28-2)

c. After wrapping only the needed number of times, hold the standing part of the rope in your right hand and twist the rope to form a loop to the inside. (Fig. 3-28-3)

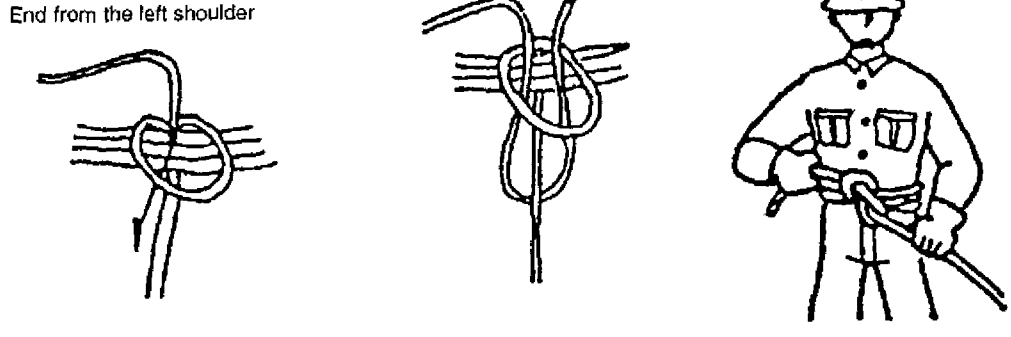


Fig. 3-28-5 **Fig. 3-28-6** **Fig. 3-28-7**

d. Pass this loop upward from below, underneath all of the loops around your waist. (Fig. 3-28-4)

e. Take the end of the rope from your left shoulder and pass it downward through the loop. (Fig. 3-28-5)

f. Pass it behind the hanging portion of the rope from right to left, and then through the loop going upward. (Fig. 3-28-6)

g. Hold the rising end with your right hand, the hanging portion with your left hand, and tighten. (Fig. 3-28-7)

Cautions: ① The single hitch to secure the knot can be tied around all of the loops around your waist or done in the same fashion as the bowline.
② The rope wrapped around your waist should be about the tightness of an ordinary belt.

(d) Round Turn and Two Half Hitches

This knot is used to moor a rope to an object using the bight or end of the rope. It is a secure knot for fastening to a taut rope or suspended rope.

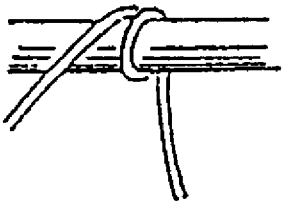


Fig. 3-30-1

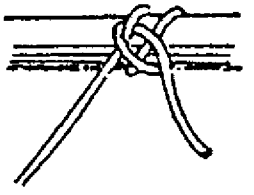


Fig. 3-30-2

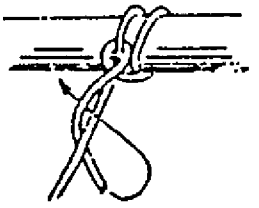


Fig. 3-30-3

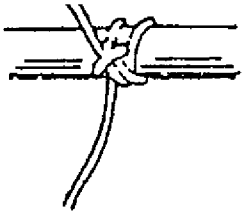


Fig. 3-30-4

a. Hold the standing part of the rope in your left hand and the end in your right. Wrap the end twice around the spar. (Fig. 3-30-1)

b. Pass the end over and under the standing part of the rope for the first tie. (Fig. 3-30-2)

c. Pass this end again over the standing part of the rope to hang down to the left. (Fig. 3-30-3)

d. With your right hand, pass the end under, around, and through as shown in the diagram, then tighten. With any excess rope, tie single hitches. (Fig. 3-30-4)

Cautions: The round turn and two half hitches means that tying around the object to be moored twice and making a round turn on the longer rope at the end of the shorter rope. Single hitches can be hung as many as possible on the extra length.

(e) Prusik Knot

The prusik knot is generally used to fasten a sling rope onto a thick rope. When the sling rope is loosened, the knot will slide When the sling rope is pulled tight, the knot stays fast.

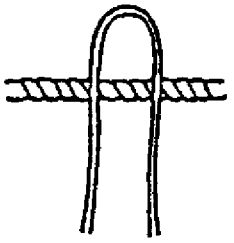


Fig. 3-31-1

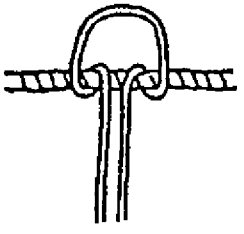


Fig. 3-31-2

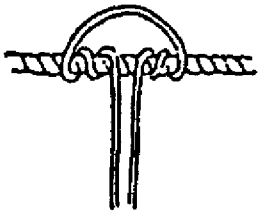


Fig. 3-31-3

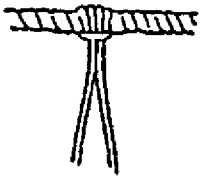


Fig. 3-31-4

a. Fold the sling rope back on itself to form an open loop and lay this against the thick rope. (Fig. 3-31-1)

b. Pull both ends of the rope through the loop at the same time from behind the thick rope. (Fig. 3-31-2)

c. Pass the ends through the loop again in the same fashion. (Fig. 3-31-3)

d. Adjust the knot while tightening. (Fig. 3-31-4)

Note: If tightened at the 'b' stage (Fig. 3-31-2), this type of nondoubled fastening is also known as a cow hitch or lark's hitch.

(f) Timber Hitch

Used to bind timber, etc. This knot is easy to tie and easy to undo, but it is safe when tied tightly as friction keeps it from coming loose by itself.

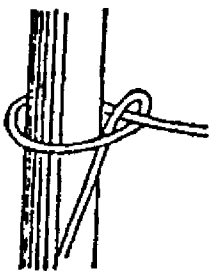


Fig. 3-32-1

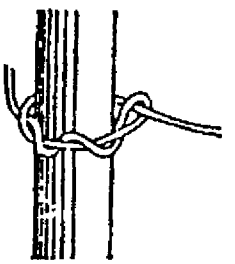


Fig. 3-32-2

a. Wrap one end of the rope around the spar and tie a loose overhand knot. (Fig. 3-32-1)

b. Wrap the end several times under and over the loop formed. (Fig. 3-32-2)

(g) Towing Knot (Timber and Half Hitch)

This knot is used to haul a relatively long cylindrical object.

a. With the end of the rope, tie a timber hitch

b Close to the end of the spar, tie a single hitch. (Fig. 3-33)

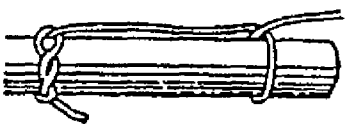


Fig. 3-33

(h) Transport Knot

Used to fasten a taut rope to a holdfast, to tie a load down to a truck wagon, etc.

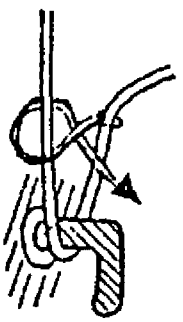


Fig. 3-34-1

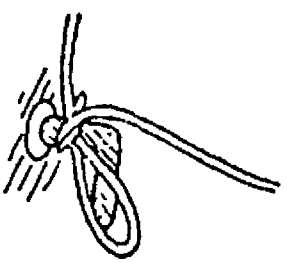


Fig. 3-34-2

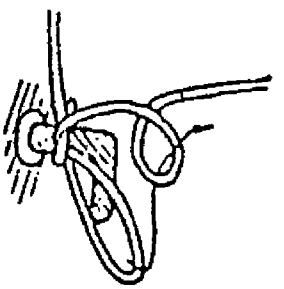


Fig. 3-34-3

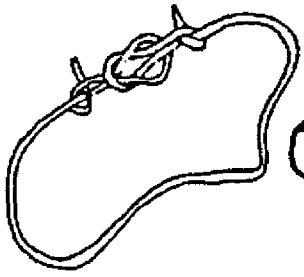
a. Hang the rope on the hook or other holdfast. (Fig. 3-34-1)

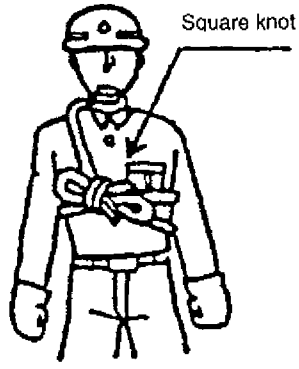
b. Fasten into a loop to serve as a stopper knot. (Fig. 3-34-2)

c. Use the excess rope to form a small loop, pass the original loop through it and tighten into a single hitch. (Fig. 3-34-3)

(i) Selbst Seil

The Selbst Seil is used to secure one's own body safely when working high above the ground. Used when carrying a lot of rescue equipment (ropes, karabiners, pulleys, etc.).





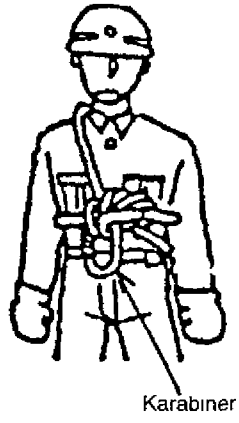


Fig. 3-42-1 **Fig. 3-42-2** **Fig. 3-42-3** **Fig. 3-42-4**

a. Join the two ends of a short rope using a square knot and secure with single hitches. (Fig. 3-42-1)

b. Hold the loop over one shoulder and extend the remaining part out below the waist. (Fig. 3-42-2)

c. Tie a square knot at waist level. (Fig. 3-42-3)

d Hang karabiners from the extra length of the square knot (Fig 3-42-4)

(j) Transport Line

A transport line is used to suspend a person or equipment for transporting.

a. Join the ends of a sling rope using a square knot and secure with single hitches. (Fig 3-43-1)

b. Keep in mind that this knot will come to one side or the other when folding the rope back on itself. (Fig. 3-43-2)

c. Make a loop knot at each end. (Fig. 3-43-3)

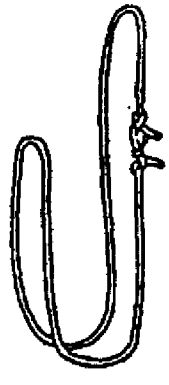


Fig. 3-43-1 **Fig. 3-43-2** **Fig. 3-43-3**

(2) Equipment Slings

The following types of tying are used to sling various kinds of tools.

a. Pipe End (Fig. 3-44)
b. Hose (Fig. 3-45)
c. Fire Hook (Fig. 3-46)

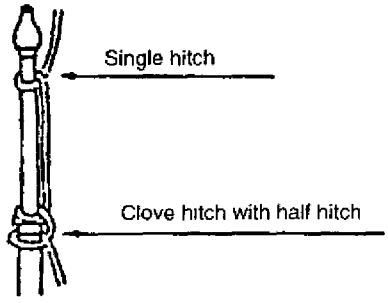


Fig. 3-44

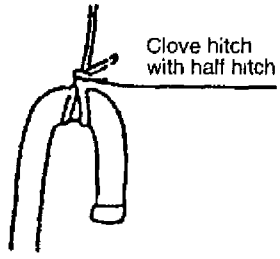


Fig. 3-45

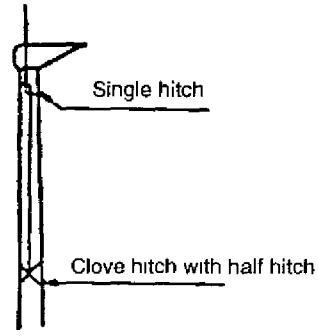


Fig. 3-46

d. Ladder (Fig. 3-47)
e. Hatchet (Fig 3-48)

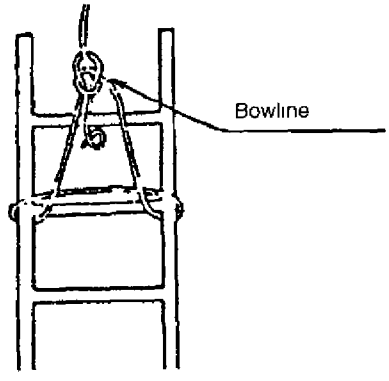


Fig. 3-47

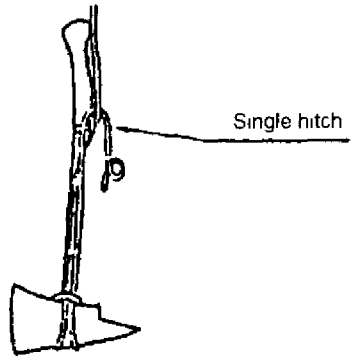


Fig. 3-48

f. Cylindrical Can (Fig. 3-49-1, 2, 3)

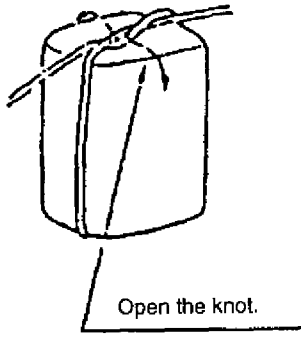


Fig. 3-49-1

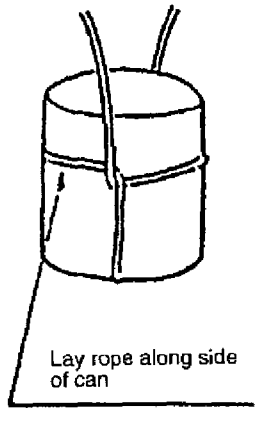


Fig. 3-49-2

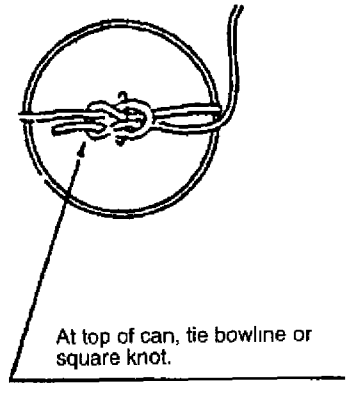


Fig. 3-49-3

g. Respirator (Fig. 3-50)
h. Oxygen Tank (Fig. 3-51)

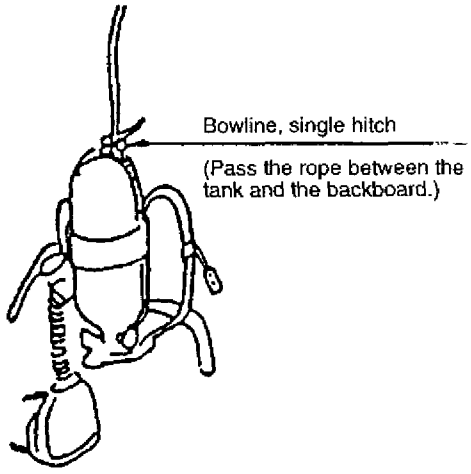


Fig. 3-50

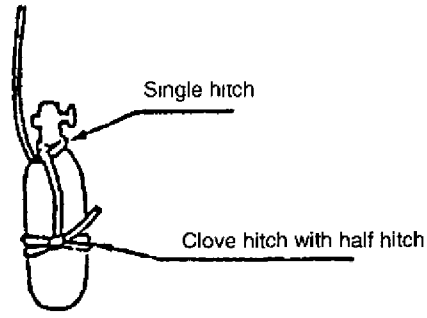


Fig. 3-51

(3) Body Slings

A body sling is used to extract a person needing rescue, when the proper tools and methods are unavailable at the scene. It can also be used as a safety rope for the firefighter.

A. Bowline Body Sling

This is the right tying technique to use for extracting a person from a manhole, building foundation recess, well or other vertical shaft. It becomes the safety rope for the person being rescued, and can also be used as a safety rope to lower in the firefighter. It is tied as described below

(a) Fold one end of a rope. (Fig. 3-52-1)

(b) Make a bowline. Place both of your legs into the loops so that the loops come up high on the thigh and the knot sits just below belt level, and adjust the size of the loops. When tying for a person being rescued, adjust the loops to the size of the person's body. (Fig. 3-52-2)

(c) Place both legs into the loops of the bowline. (Fig. 3-52-3)

(d) Wrap the standing part of the rope once around your torso, fold the rope at the height of your chest, and pass this open loop under the rope wrapped around your torso. (Fig. 3-52-4)

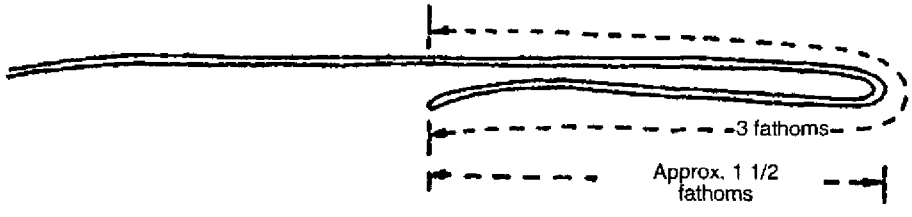


Fig. 3-52-1

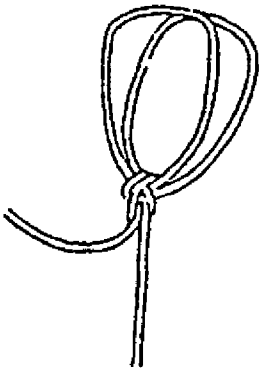


Fig. 3-52-2

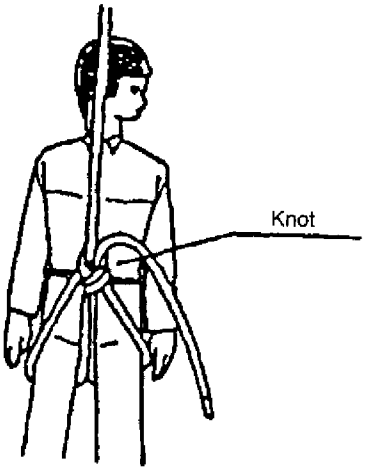


Fig. 3-52-3

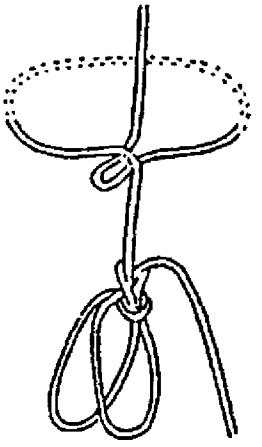


Fig. 3-52-4

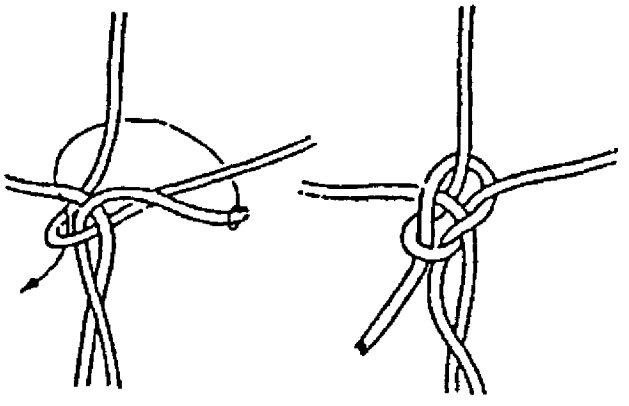


Fig. 3-52-5

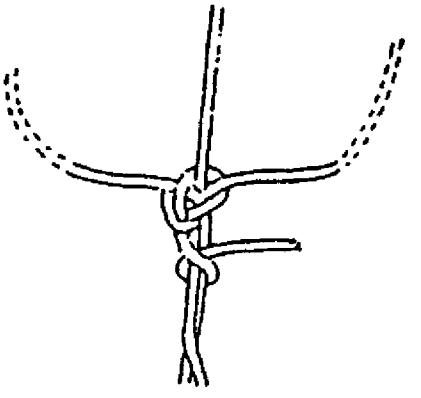


Fig. 3-52-6

(e) Using the loop at your chest, tie a square knot by passing the end of the rope through it as shown in the diagram. (Fig. 3-52-5)

(f) Add a single hitch. (Fig. 3-52-6, 7)

B. Double Bowline Sling

This is a good tying technique for lifting or lowering a person who needs rescuing in a working area that is relatively wide, or for extracting people one after another from a roof at the scene of a fire. It is tied as described below.

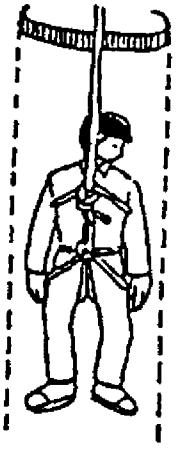


Fig. 3-52-7

(a) Fold one end of a rope. (Fig. 3-53-1)

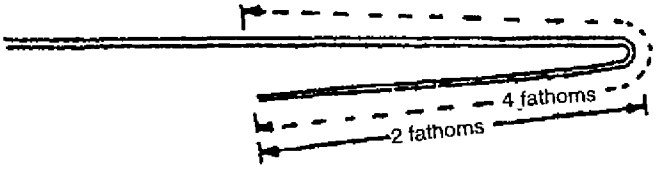


Fig. 3-53-1

(b) Take the folded rope end, and leaving about 20 centimeters, form a double bowline on a bight. In this case, make the last loop (torso sling) slightly larger than the other two loops. (Fig. 3-53-2)

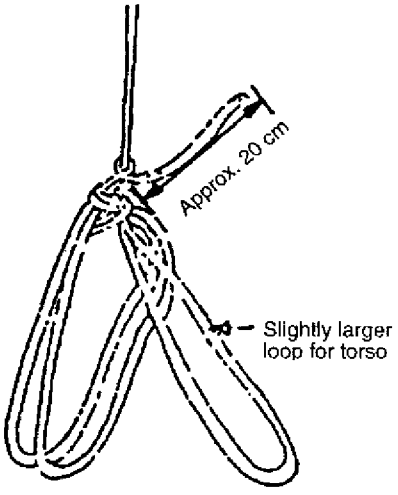


Fig. 3-53-2

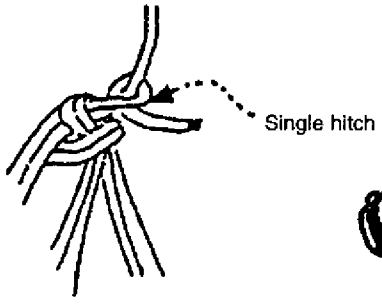


Fig. 3-53-3

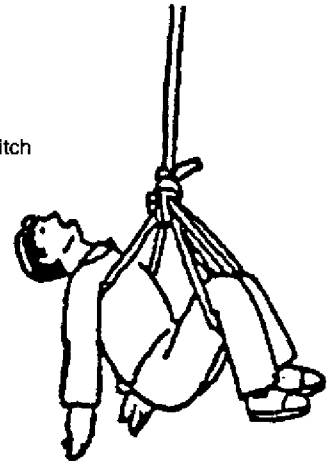


Fig. 3-53-4

(c) Add a single hitch. (Fig. 3-53-3)

(d) With the three loops formed, put the legs of the person being rescued into the loops first, then the torso sling under the arms, lastly sliding the leg loops behind the knees. (Fig. 3-53-4)

Fig. 3-54-1

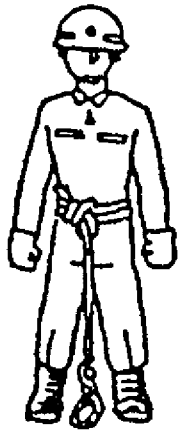


Fig. 3-54-2

C. Clove Hitch Sling

This is the right tying technique to use for extracting a person from a sewage pipe or other narrow space that must be entered from a horizontal shaft. It becomes the safety rope for the firefighter. It is tied as described below.

(a) Tie each end to an ankle using a clove hitch secured with a single hitch, and move the knot to the back.

(b) With one end of a long rope, make a small bowline with single hitch. Hang a karabiner on this loop, and attach the karabiner to the sling rope tied to your legs. (Fig. 3-55)

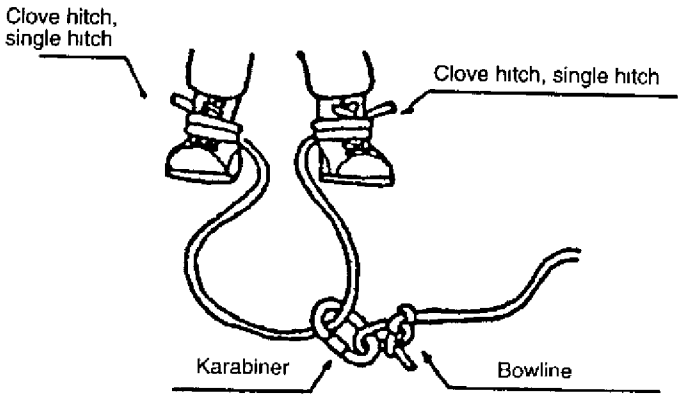


Fig. 3-55

IV. How to Coil a Rope

Rope Coiling

Methods to coil a rope are shown below.

(1) One-fathom Coil (long rope)

a. Hold the end of the rope with your left hand, and with your right hand extend the rope one fathom, and coil while straightening the lay. (Fig. 3-56-1)

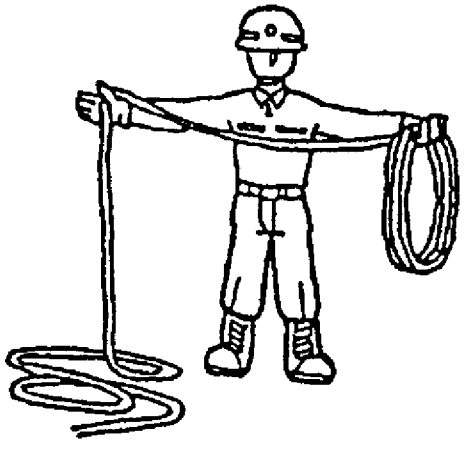


Fig. 3-56-1

Fig. 3-56-2

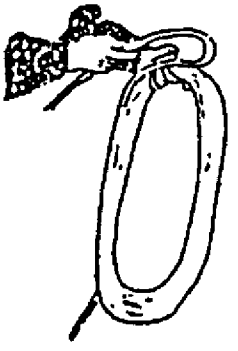


Fig. 3-56-3

b. Put your knee into the loop of coiled rope, and using your hands and leg, stretch the rope 2-3 times to even out the coil. (Fig. 356-2)

c. Fold back the end that you started coiling with. (Fig. 3-56-3)

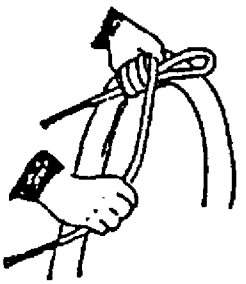


Fig. 3-56-4

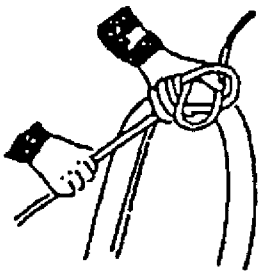


Fig. 3-56-5

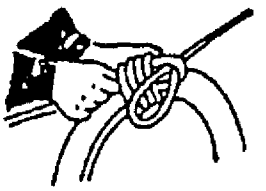


Fig. 3-56-6

d. Over the folded rope, wrap the other end of rope several times tightly according to the length of the coiled rope. (Fig. 3-56-4)

e. Fold the working end into an open loop and insert it through the loop formed by the starting end of the coil. (Fig. 3-56-5)

f. Pull the starting end to tighten. (Fig. 3-56-6)

Caution: A rope whose entire length cannot be coiled at once should be coiled in stages, as shown in Fig. 3-57

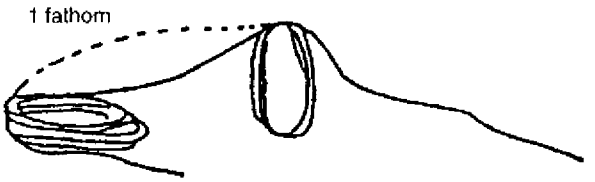


Fig. 3-57

(2) Coiling a Sling Rope

A sling rope can be coiled in the following two ways, for storage or carrying.

Method 1

Fold the sling rope back on itself, and tie it using a sheet bend, double sheet bend (if the loop of the sling rope is too big), or bowline on a bight. (Fig. 3-60)

Method 2

Coil the sling rope twice, and tie the ends with a square knot and single hitch. In this case, also tie together the part of the rope other than the ends.

Fig. 3-60

V. Rope Maintenance

1. General Storage Methods

When storing a rope, heed the following general points.

(1) Store in a place that does not get hit by UV rays or direct sunlight.
(2) Store in a well-ventilated area, not too closely together.
(3) Avoid moisture; keep in a relatively dry place.
(4) Keep away from acids and salts.
(5) Prevent damage from mildew or bacteria
(6) Store so that no deformation or deterioration occurs.
When a rope must be hung on a wall, avoid using nails or other materials that can damage the rope.
(7) Do not store directly on the floor or ground, keep on a shelf. Do not stack one on top of another or place anything heavy on top.
(8) When using the next time, store using a one-fathom coil or other proper method.

2. Inspection

Check for the following things when inspecting a rope. If any abnormality is found, take necessary measures, such as discarding or setting aside for another purpose.

(1) Any point of breakage
(2) Loss of form
(3) Elongation in the rope lead (Fig. 3-66)
(4) Fluff, abrasion
(5) Wetness/dryness
(6) Adhesion of foreign matter
(7) Treatment of ends

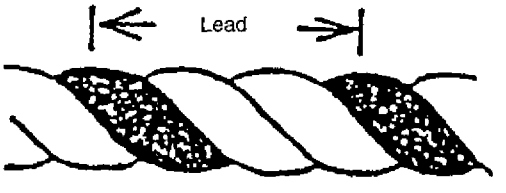


Fig. 3-66

3. Maintenance

After using a rope, take the following steps to keep it in good condition for the next use.

(1) Clean; remove all dirt and foreign matter.
(2) Always dry rope if it has gotten wet. Dry in the shade; never dry in direct sunlight or by a fire.
(3) If a portion of the rope has been fouled by oil, mud, or chemicals, cut off that portion and temporarily apply adhesive to the end or burn the end to stop it from unraveling.
(4) Keep the rope completely untwisted.
(5) If a point in the rope is exceptionally damaged, cut out that part and repair by splicing, or discard the entire rope.

VI. Auxiliary Devices

1. Karabiners

A karabiner is attached at one end of a safety rope to secure one's own safety, or used in a wide range of other ways including as an aid when a rope is drawn taut and extended, in place of a pulley, and as a support point for the rope.

(1) Types (Fig. 3-67, 68, 69, 70)

a. O karabiner
b. Locking O karabiner
c. Offset D karabiner
d. Locking offset D karabiner
e. Other

(2) Shapes, Materials

a. Mild steel, 10-12 cm in diameter, cylindrical ring with 5-6 cm minor axis that opens and closes on one axis by a spring.
b. The shapes are shown below.

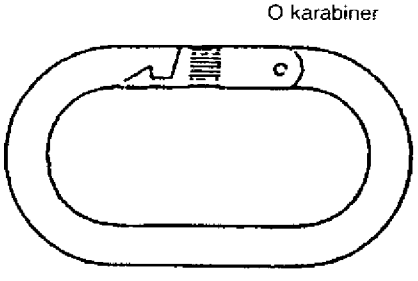


Fig. 3-67

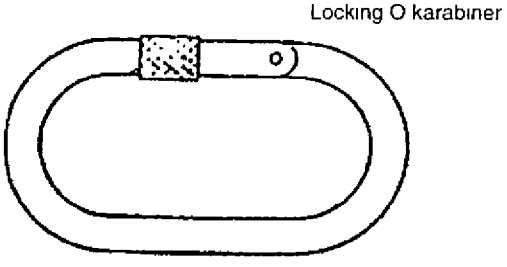


Fig. 3-68

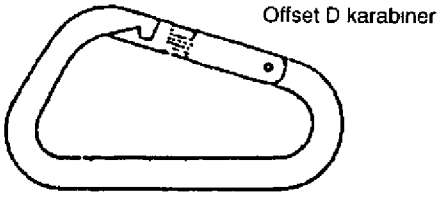


Fig. 3-69

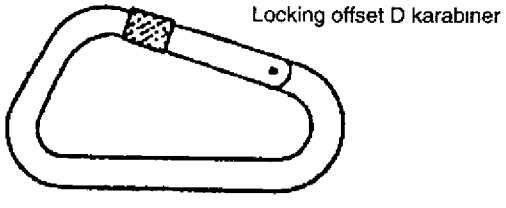


Fig. 3-70

Caution: The locking mechanism can be a screw-on ring or slide-on type.

(3) **Names of Parts (Fig. 3-71)**

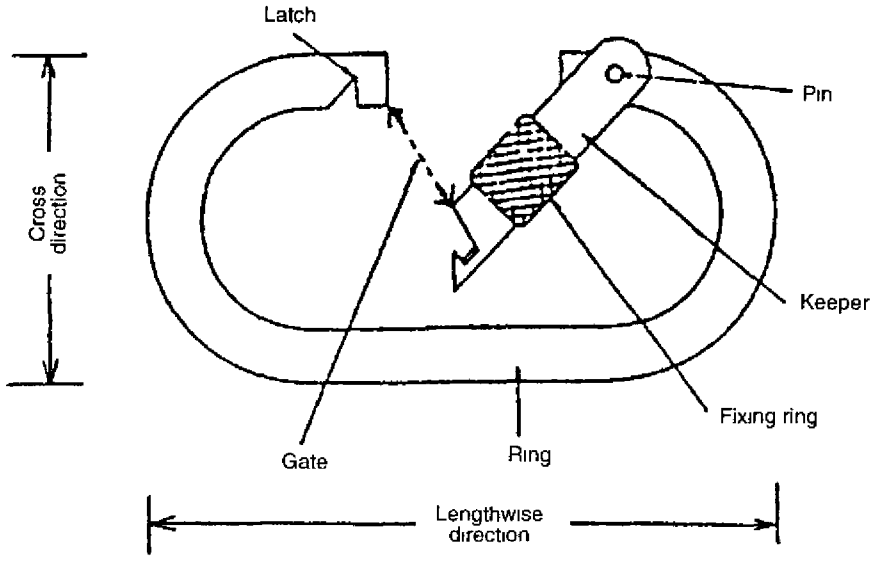


Fig. 3-71

(4) The lengthwise strength of the locking O karabiner, used frequently in firefighting, must be 1,300 kg or more, in accordance with sporting goods standards.

(5) Cautions in use

a. Never carry a load in the cross direction; the cross direction is very weak in the structure of the karabiner.
b. Do not drop from a high place or cause similar impact.
c. Do not hold or play with the gate unnecessarily.
d. A karabiner that has once borne a heavy load should be considered as having lost a degree of strength, and should be used accordingly.
e. Close the locking mechanism properly when using.
f. When using two karabiners together, face Fixing rings in opposite directions.

2. Pulleys

Pulleys are essential devices for transporting people (the wounded and ill, e.g.) and equipment smoothly and easily.

Pulleys used for rescue are small and lightweight, are used in concert with karabiners, and have a load strength of approximately 500 kilograms; the precise strength, however, is not clearly known.

If the direction of the pull of the rope and the score of the pulley become misaligned while the pulley is in use, the pulley's weakness to torsion can damage the pulley, leading to the danger rope breakage

Therefore, when using a pulley to transport a person, always use in combination with karabiners for reinforcement. (Fig. 3-72, 73, 74)

Parts of the Pulley

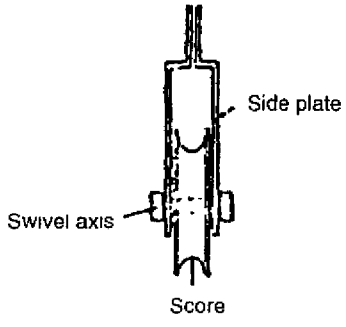


Fig. 3-72

Combined use of pulley and karabiners

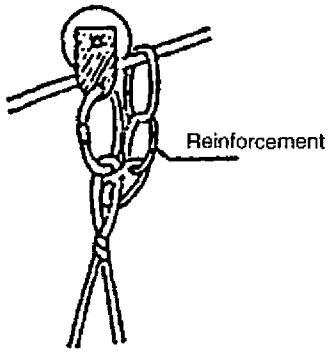


Fig. 3-73

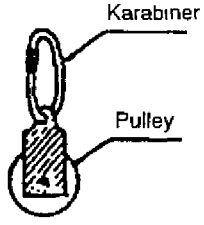


Fig. 3-74

Check the following things when inspecting a pulley. Pulleys that are used frequently are particularly prone to breakage of the swivel axis, so check thoroughly.

(1) Smooth rotation of the wheel
(2) No looseness.
(3) No distortion of parts, cracks, or damage.

3. Leather Gloves

Use leather gloves to prevent injury to the hands when performing jobs such as descent by rope and holding. The gloves must meet conditions such as being easy to put on and take off quickly, and must be matching five-fingered pairs. (Fig. 3-75)

(Thick gloves)

Fig. 3-7