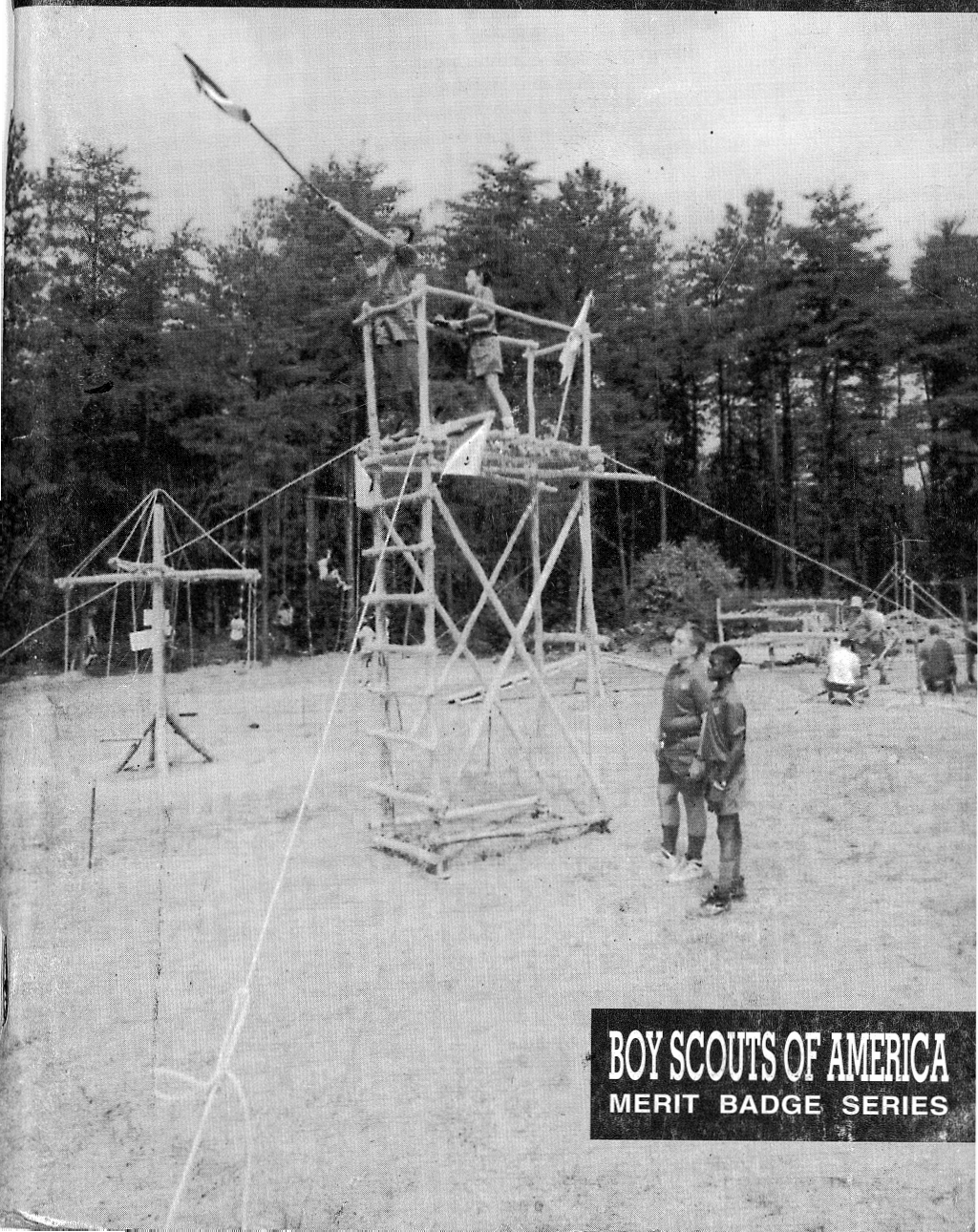
PIONEERING



BOY SCOUTS OF AMERICA
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The secret to successfully earning a merit badge is for you to use both the pamphlet and the suggestions of your counselor.

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Note to the Counselor

The material in this pamphlet is arranged in sections that pertain to the different skills needed to fulfill the requirements of this merit badge. Since this pamphlet will be used throughout the United States, counselors should understand that not every method of doing something can be fully described here. There might be more than one name used for a knot, method, or piece of equipment in different parts of the country. Counselors must take into consideration other methods that are described and illustrated in other Scouting literature.

Some pioneering skills or methods in the requirements will most likely require a period of practice and usage. Therefore, it might be advisable to have more than one session of review to earn the merit badge.

The review itself should be hands-on. The word demonstrate in the requirements means just that; the Scout should show that he has learned the skill and can use it.

Counselors should keep in mind that, for reasons of equipment availability, parts of some requirements might have to be done at summer camp, district or council events, or on a troop camp outing. In such cases, the person conducting the review and approving any partial completion must be approved to do so by the local council.

The appearance of a finished project or structure is not as important as the correctness of individual knots and lashings. In addition, the project should be judged for its structural soundness, to determine if it was built to safely withstand the use for which it was intended. Therefore, the use of only approved designs shown in this pamphlet or other Scouting literature is recommended.

In earning this merit badge, the Scout has a chance to learn skills that will be useful in a wide variety of Scouting activities as well as outside of Scouting. These skills should become an ongoing part of a Scout's advancement and his ever-broadening participation in new and challenging adventures. It could be a basis for the Scout to later teach younger boys coming into his troop, or add another dimension to his value as a member of a summer camp staff.

Planning ahead and making doubly sure as you go (disciplines inherent in pioneering) go hand in hand with the Scout motto, Be Prepared. Pioneering is a challenge and can be the foundation for forming long-term habits of doing it right the first time. Hopefully, earning this merit badge will be only the beginning.

Requirements

1. Demonstrate how to coil and throw a 40' length of ¼" rope.
2. Present five different rope samples, of any size or material. Explain the characteristics of each type of rope—its strength, mildew resistance, durability, and stretch. Explain where and how each type of rope can be used in pioneering work.
3. Demonstrate how to tie the following seven basic knots: square knot, timber hitch, clove hitch, bowline, sheepshank, sheet bend, and roundturn with two half hitches. Also select five more knots from the list of pioneering knots found in the *Pioneering* merit badge pamphlet. Tie each one for the examiner, and tell where it could be used in pioneering, camping, or other Scout activities.
4. Demonstrate how to make the back splice, eye splice, and short splice using ¼" three-strand rope.
5. Construct a device or machine to make rope. Then use the device with binder twine to make a 6' length of rope consisting of three strands, each having three yarns. Also demonstrate one method of whipping the end of the rope.
6. Build a 3-2-1 or log-and-stake anchor using pioneering stakes. Build the anchor at a size suitable to anchor one end of a monkey bridge.
7. Demonstrate the use of a rope tackle to lift a weight of 25 pounds. Pull a log at least 6" in diameter and 6' long with the tackle. Use the tackle to put a strain on a line.
8. By yourself, build an H-frame trestle with ropes and spars using square and diagonal lashings. Demonstrate how to tie two spars together using a West Country shear lashing.
9. With a group of Scouts, build a pioneering project. Before building, present a rough sketch of the project and a list of the ropes and spars needed to build it. (Note: This requirement may be done at summer camp, district or council events, or on a troop camp outing.)

Introduction

Pioneering is the knowledge and skill of using simple materials to build structures that are used in a wide range of Scouting activities. These skills are sometimes referred to as "backwoods engineering."

Down through the ages people have used ropes, spars, and simple hardware to build bridges, towers, and even their own shelters. In the early development of our country, pioneering methods were used in mining and transportation, to clear the wilderness, and to build roads and bridges. So it is understandable that the term "backwoods engineering" was applied.

The same skills can be used by Scouts to build pioneering projects ranging in complexity from a simple camp gadget to a signal tower.

Whatever the project, the same applied principles of physics, geometry, and math are used to build pioneering projects and structures. But, keep in mind that all the information in this pamphlet is eventually used for a practical, hands-on application; that is, to build something.

Pioneering is a good foundation for many Scouting activities. You must learn, and then use, such disciplines as planning ahead and teamwork. You can also put to use the basic skills learned in rank advancement, such as knot tying.

But most of all, pioneering provides a practical way to experience the joy of accomplishment when you've built something that is needed for yourself or others; it could be something that makes living at camp easier and more comfortable. Pioneering can be both fun and challenging when you use your skill and knowledge to choose the right materials (ropes and spars) and build a usable structure.

The basics of pioneering, such as tying knots, making lashings, using rope tackle, constructing anchors, and basic rope knowledge can be learned at home. The projects and structures shown in this pamphlet can usually be constructed with materials available at summer camp or at council camping events.

Contents

Safety

As you begin your pioneering activities, **safety** must be your first consideration. The following safety points are some that you and your group should keep in mind:

1. Check all equipment, rope, tools, and hardware to ensure that they are in good working condition.
2. Appoint a safety officer as soon as you arrive at the work site.
3. The safety officer, along with the rest of the group, should constantly check the work site to keep it clean of debris. Equipment should be kept in an organized fashion.
4. During the construction of a project, only one person should give instructions and signals.
5. Do not work during rainy or wet conditions. Rope and spars become slippery, as does your footing. Knots can slip when wet and become unsafe.
6. Wear clothing to fit the season and wear gloves when necessary to protect your hands.
7. Take regular breaks to discuss the work in progress and ensure that everyone understands what is required of them.
8. Double-check all anchors and holdfasts on the pioneering project as strain is applied during use.
9. Test the structure or bridge before allowing general use.
10. Ensure that you have good footing, use both hands to help make the work easier, and do not lift more than you can handle.
11. When the day's work is complete, untie all knots, coil all ropes, check all hardware, and store everything in its proper place.
12. When tying knots that will be out of reach, secure the running end with a piece of light cord.

13. When the bottom end of a spar, such as the leg of a tower, rests on hard ground, it should be "heeled in"; that is, set in a 4"- to 6"-deep hole to keep it from shifting.

14. When raising towers, have at least two hoisting lines and two lines on the opposite side to prevent overpulling the proper position.

15. If the design calls for a certain size and type of rope or spar, do not substitute something of lesser strength.

Coiling and Throwing Rope

You might never be called upon to throw a line to someone in distress; however, it's the Scouting way to **be prepared.** In addition, many pioneering activities call for coiling and throwing a line to get it across a creek or ditch, or up and over a high tree branch. How you make the coil is very important. To learn how to coil and throw a length of rope, select a 40' length of ¼" manila rope. Make sure both ends are whipped.

Coiling the Rope

To coil the rope, first secure one end of the line to your belt or loosely around your wrist. If you are right-handed, coil the line into your left hand. If you are left-handed, coil the rope in your right hand.

As you loop the rope over your hand, make each successive coil a little smaller than the one before (see figure 1). This is important to keep the coils from fouling as they pay out when thrown.

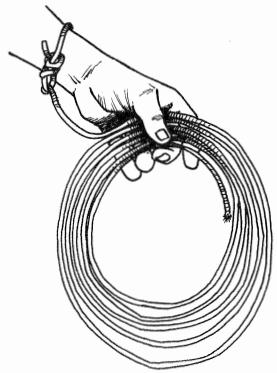


Figure 1. Coil the rope in your left hand, making each successive coil smaller than the one before so that when the coil is divided, and the line is thrown out, the coils will not become fouled. *Note:* Only a few coils are shown in this drawing for clarity.

Preparing to Throw the Rope

Now transfer approximately two-thirds of the coils from your nonthrowing hand to your throwing hand (see figure 2). Next, drop one of the loops from your nonthrowing hand to allow enough rope for a free swing between your hands. Hold your nonthrowing hand out so that those coils will peel off smoothly.

Figure 2. To throw the rope, transfer about two-thirds of the coils to your throwing hand. Drop one of the loops from your left hand. Then throw the rope as if you were pitching a softball.

Throwing the Rope

To throw the rope, swing the coils in your throwing hand in an arc, much like you pitch a softball. After making two or three "warm-up" swings, release the rope. A little practice will help you determine where your release point should be to get the most distance.

As the rope is released, the weight of the rope will pull the coils from your nonthrowing hand until the entire rope extends out in a straight line from where you're standing.

Challenges

A good way to become better at throwing a line is to participate in games and challenges with other Scouts. One challenge is to coil a line and make three throws, measure the distance of each throw, and add up the number of feet for your total score. The Scout with the highest score wins the challenge.

Another challenge is the rope-throw-log-lift game. This game requires the skill of throwing a rope, and also requires tying the timber hitch, sheep shank, and clove hitch. This game can be played by a single Scout or played in teams.

Rope games are illustrated in a number of Scout publications. Ask your counselor to assist you in finding those publications. Your troop might even want to create their own rope-throwing game. Remember that all of these games will help build your skills in throwing a rope.

Rope-Throw-Log-Lift Game

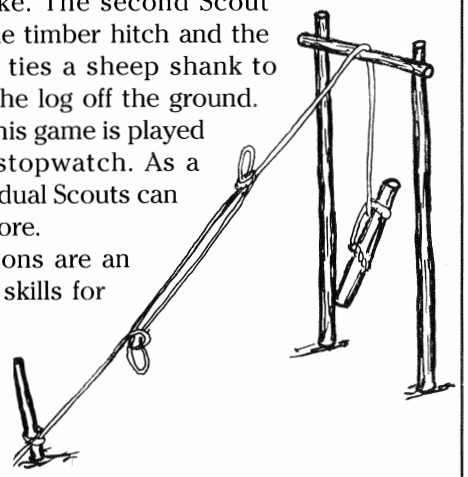
This game is intended to develop the knot-tying skills of an individual Scout or of a team of three Scouts. It is important to know that the knots used (clove hitch, timber hitch, sheep shank) are each tied in a typical application for each knot. Additionally, you will develop the skills of coiling and throwing a rope.

To prepare for this challenge, you should practice tying the individual knots and coiling and throwing a rope. The challenge starts for a single Scout with the rope coiled ready to throw. The rope is thrown over the cross spar. If the throw misses the mark, the Scout recoils the rope and throws again. If the throw is good, he uses the end of the rope he is holding to tie a clove hitch on the stake next to where he's standing.

Next, he moves to the end of the rope that was thrown over the cross spar and uses it to tie a timber hitch around a short length of log (about 4" diameter by 4' long). Then he ties a half hitch around one end of the log.

To complete the challenge, he moves to the part of the rope between the stake and the upright structure, and ties a sheep shank to shorten the rope enough to suspend the log above the ground.

When the challenge is played with a team of three Scouts, the first Scout throws the rope over the cross spar and ties the clove hitch on the stake. The second Scout moves to the log and ties the timber hitch and the half hitch. The third Scout ties a sheep shank to shorten the rope and hold the log off the ground. The challenge comes when this game is played while being timed with a stopwatch. As a patrol, the times of the individual Scouts can be added for a total patrol score.



Challenges and competitions are an excellent way to hone your skills for when they will be needed. Refer to knot games in other Scouting literature, or devise one suited to your troop.

Rope

Key Factors to Consider

There are several important factors to consider when selecting the kind and size of rope to use in pioneering and camping activities. Three of the most important factors to consider are the strength in both the working load and breaking point of the rope, the stretch factor of the rope, and how easily the rope handles.

Some other considerations are the rope's resistance to mildew, its ability to stand up to repeated wetting and drying, and whether or not it retains kinks from knots after having been under a hard strain, making it difficult to use a second time.

Cost is always an important factor to consider when equipping a pioneering kit. Factors that affect cost are quality, grade, packaged cut-length, and source of supply. Scout units can usually buy rope from wholesale suppliers if it's purchased in standard package lengths. Manila rope in ¼" diameter comes in a standard 1200' coil, while larger diameters come in 600' coils. Most other types of rope come in 600' spools as a standard package. Shorter lengths are available from retail suppliers.

Additional Factors

- Since all rope types and sizes come in different grades of quality, which can relate to the strength, it is best to refer to the manufacturer's specifications that appear on the package. It is a good idea to keep the package for future reference.
- Braided rope is about 10 percent stronger than twisted rope of the same diameter and type.
- Even the best knots can reduce rope strength 20 percent.
- Overhand knots reduce strength 50 percent.
- Polypropylene ropes lose strength when exposed to sunlight for extended periods of time.

- Nylon rope is 20 percent elastic and stretches to add 20 percent to its original length.
- The working load strength of most types of rope is up to 20 percent of its breaking strength. If available, go by the manufacturer's specifications to determine the safe working load.
- Good care and storage will prolong useful life.
- Frequent inspections and discarding questionable rope is essential to ensure safe working equipment.

Types of Rope

Manila. Pure manila rope is by far the best all-around rope. It is easy to handle, has good strength-to-size ratio, and does not have an objectionable stretch factor. It handles well in three important pioneering areas: knot tying, lashing, and in using a block and tackle.

Manila rope can be spliced easily and withstands repeated wetting and drying cycles, making it suitable for boat and marine use, as well as many camping and pioneering applications. Manila rope should provide the bulk of the rope needed for your troop's pioneering kit. (Its cost is mid-range.) Properly cared for it will give good service for quite a few years.

Polypropylene. Rope made of this man-made plastic fiber should be considered for pioneering activities because it is lightweight and its strength-to-size ratio is good. Size for size it is twice as strong as manila rope, but has a little higher stretch factor. Its strength makes it suitable for anchor strops (see the "Anchors" section, page 55) and for any application involving heavy strain.

Polypropylene does stretch under a hard pull, but should not pose a problem if taken into consideration beforehand. A hard pull will result in kinking with some knots. Polypropylene rope resists mildew and will float, making it a good rope to use for waterfront activities and in wet conditions.

It is easy to splice in a twisted three-strand form. Because it is somewhat slippery, four tucks should be made when splicing instead of the usual three tucks. Cut ends should be both melted back and whipped with a good flax cord.

A disadvantage of polypropylene is that long exposure to sunlight has a weakening effect on the fibers. But, all things considered it is worth including in your pioneering supplies.

Nylon. Nylon rope is commonly available in both braided and twisted forms. Both forms come in a loose braid or twist and in a hard solid braid or twist. The loose braid or twist is not as strong and its fibers can easily get caught on bark, which can be bothersome. The hard twist or braid costs more, but is well worth its price.

Nylon rope is strong for its size. It is two and a half times stronger than the same size manila rope but loses some of its strength when wet. The three-strand twisted form of nylon rope can be spliced, but, as with polypropylene rope, it's best to make four tucks instead of the usual three tucks and the cut ends should be both melted back and whipped to prevent raveling.

The most prevalent disadvantage of nylon rope is that it has a 20 percent stretch factor. But in cases where the stretch factor can be taken up with adjustment to the strain on the line, its strength can be an advantage. Nylon rope also has a tendency to slip when a hard pull is put on some knots. Because of these two factors, it is almost useless as a lashing rope.

All things considered, there is a place for both twisted and braided nylon rope in the solid, not loose, form.

Polyester. This man-made fiber rope is usually seen in the braided form. It handles well, is strong, and its stretch factor is less than nylon. It costs more than manila or nylon, but some sizes and lengths could be used in pioneering activities on a selected basis. A 6' length of ¼"-diameter braided polyester rope makes it an excellent rope for practicing knot tying and pioneering games.

Polyethylene. This is the cheapest of man-made fiber ropes. It is most often seen in braided form and has a distinctive shine. Don't let the low cost lure you into buying any quantity of polyethylene for pioneering or camp use. It is not suited to either knot tying or lashing because it holds kinks after being under a strain. (Since it floats it does have some very limited use at the waterfront for ski ropes or other waterfront activities).

Sisal. Sisal rope has much the same appearance as manila rope, but it is quite inferior in strength and does not handle well when used for lashing or knot tying. When sisal rope that is tied into a knot or lashing gets wet and then dries, it becomes useless because of the kinks that remain.

Even though it costs less, it is not cost effective because it breaks down quickly during use and when it is wet. It might offer limited use in cases where expendable, but overall the cost is high when compared to other types of rope that can be used again and again.

Cotton. Cotton rope in both twisted and braided forms is outclassed in strength by other types and today there is little use for it in pioneering and camping.

Binder twine. Binder twine is made from loosely twisted jute fibers that are treated with oil during manufacturing. Its principal use today is for tying up bales of hay as the baling machine compresses the hay.

Binder twine is readily available in varying quantities at hardware and farm supply stores. Its low cost makes it a throwaway item after use. But don't be too quick to toss it in the trash—a balled-up handful of discarded twine makes a very good fire starter in camp.

Here are some uses for binder twine:

- When pioneering projects or camp gadgets call for the use of saplings less than 2" diameter, binder twine can be used for lashing. (Do not use binder twine as a replacement for ¼" rope in general pioneering use or lashings.)
- See the "Making Rope" section, page 45, for how to make rope using binder twine.
- Use binder twine to make a simple strop lashing with six or eight wraps and a square knot.
- Use binder twine to hold the cross spars of a light bridge walkway in place.
- Two strands of binder twine quickly twisted together will equal a light cord.

- Use binder twine for the back stays of anchor stakes (see the "Anchors" section, page 55).
- Use binder twine to outline the ax yard for safety.
- Use binder twine for the construction of pioneering camp gadgets.

Knots

Rope and knots have been a part of basic trades and crafts throughout the ages: sailing, building, and sports, to name a few. In fact, almost all knots have been around for centuries. Only a handful of knots have been developed in recent years.

Names of Knots

In many cases, there is a connection between the name of a knot and the worker who used it. For example, the fisherman's knot, the surgeon's knot, the camel hitch, the lariat loop, and the anchor bend all give us a hint about who used them.

Some knots are known by two or more names. For example, a draw hitch and a thief's knot are exactly the same knot but have different names.

Other knots are very similar in the way they're tied but have different names only because of the way a small loop or tuck is made when tying them. For example the clove hitch and rolling hitch are very similar. The rolling hitch is a clove hitch with a roundturn added. A clove hitch and the constrictor are similar. The constrictor is a clove hitch with an overhand knot added. There are also many different bowline knots that are all much alike, but with slightly different names.

Many knots have names that include the terms *bend* and *hitch* in them, but these terms do not necessarily indicate the use of the knot. On the other hand, a number of different knots can be used for the same function. For example, you can tie two ropes together with a square knot, a carrick bend, a sheet bend, or a fisherman's knot.

All of this makes the lore of knots very interesting, but keep in mind that it is not necessary to learn all the different names and small variations of knots. There are many knots to choose from depending on your project or purpose. And certainly your knowledge of a few more knots will help make your work with rope easier and safer. The only way to know which knot is right for your situation is to study the knots and know their applications.

You will find that the knots you learned for rank advancement will serve you well in a wide variety of Scouting activities. How much more you learn about knot tying is only limited by how adventurous you are in Scouting and in pioneering.

Knot-Tying Terminology

Before you begin learning new knots, you need to know some of the basic terms used in knot tying. You should become familiar with these terms and use them as you learn how to tie the various knots.

Running end Standing part

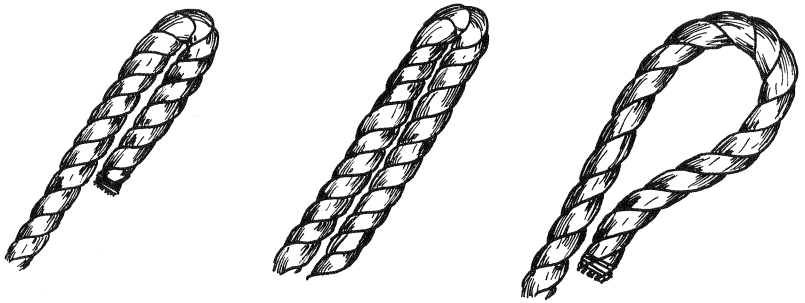
Running end and standing part. These are two of the most common terms used in knot tying. The *running end* is the end of the rope that is used to tie the knot. This end is sometimes referred to as the *working end.* The rest of the rope is the *standing part.*

Overhand loop. An *overhand loop* is formed when a loop is made so that the running end of the rope is on top of the standing part; it can be formed anywhere along the standing part of the rope in the same fashion.

Underhand loop. An *underhand loop* is formed when the running end of the rope is placed under the standing part of the rope.

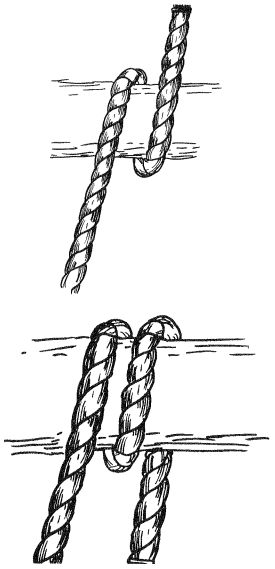
Overhand loop

Underhand loop



Bight. A *bight* is formed by doubling back a length of the rope against itself to form a U.

This can be done with the running end (as shown on the left), or anywhere along the standing part (as shown in the middle). Bights can vary from a few inches to a few feet in length. A bight doesn't have to have a sharp bend. It can be "open" (as shown on the right). In this case, the running end of the rope is alongside the standing part of the rope, but it is not crossed over (which would form an overhand or underhand loop).

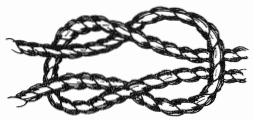


Take a turn. The term *take a turn* means to wrap the rope around a spar or stake so it continues off in the same direction. The friction this creates will give you a grip on the stake or spar that will help you hold the strain on the line. It also gives better control in taking up or letting out the line.

Roundturn. To make a *roundturn,* wrap the rope completely around a spar and bring the running end back along the standing part of the rope. A roundturn gives you even more grip in holding the strain on a line, and is the basis for tying several knots, as when making a roundturn with two half hitches.

Basic Knots

The seven knots listed here are important basic knots for use in pioneering and other Scouting activities. This list includes the knots you learned as part of your rank advancement or in camping activities. There are several Scouting publications and other books that explain how to tie these basic knots.

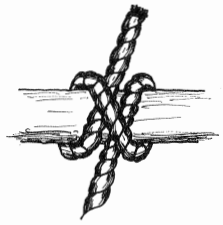


Square Knot

The square knot is used to tie together the ends of two ropes of the same diameter.

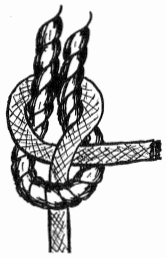
Bowline

The bowline makes a fixed loop that will not slip and it is easy to untie.



Clove Hitch

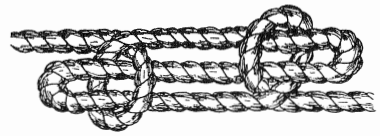
The clove hitch can be tied with the end of the rope or tied along the standing part of the rope to be slipped over a spar.



Sheet Bend

The sheet bend is used for tying the ends of different sized ropes together or when the rope is wet or slippery.

Sheep Shank

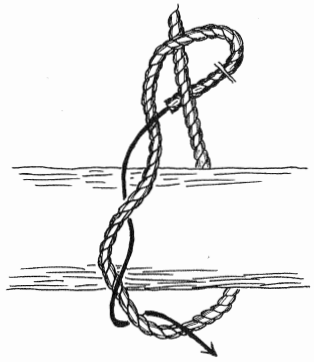


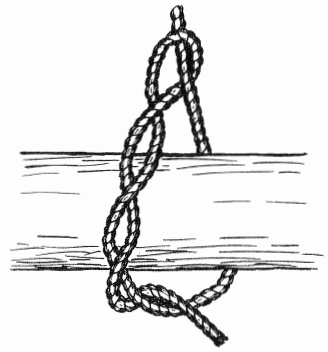
The sheep shank is used to temporarily shorten the length of a rope or to bypass a weak spot in the rope.

When tying the sheep shank, the standing part of the rope is doubled back on itself to shorten the rope. This forms two long bights next to each other.

To hold these bights in place, use the standing part of the rope ahead of the bight to form an overhand loop and slip it over the end of the bight. Then form another overhand loop at the other end and slip it over the bight at that end.

Timber Hitch





The timber hitch is a knot that can be tied quickly. As strain is put on the rope, the knot gets tighter, yet it remains easy to untie.

To tie a timber hitch, first wrap the running end around the timber log or spar. Then loop the running end around the standing part of the rope, continuing to wrap the running end around itself a few more times. This forms a hitch that will tighten on the timber as the rope is pulled. After the timber is dragged or hoisted into position, the timber hitch is easy to untie.

Roundturn with Two Half Hitches

This is one of the basic knots that is very reliable for a number of uses in pioneering work. It is easy to tie and untie and does not reduce the strength of the rope due to sharp turns when under a hard pull.

You start by making a roundturn. This provides extra surface around the spar when chafing or slipping might be a problem. Once you've made the roundturn, the rope has a grip on whatever it's around (see figure 3). The strain on the rope can then be adjusted before finishing off with two half hitches (see figures 4 and 5).

This knot is well suited for use at both ends of a guy line. When it is used in a place where you will not have easy access, as at the top of a tower, secure the running end (after the two half hitches are tied) with a piece of light cord.

It can be tied in the middle of a long rope by making a long bight with enough rope to make two half hitches after the roundturn.

Figures 3 through 5 illustrate the half hitches tied loosely. In actual use both half hitches are pulled up tight.

Pioneering Uses

- At both ends of large hand and foot ropes for a monkey bridge. Be sure to secure the running ends with a light cord.
- When wear is a factor when tied into an iron ring.
- For guy lines because it does not jam and is easy to tie and untie when adjustments are needed.

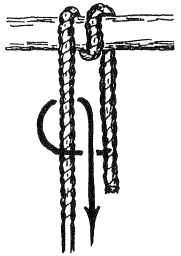


Figure 3. To make the knot, start by making a roundturn over a spar.

Figure 4. Next, make a half hitch around the standing part of the rope. Then make another half hitch.

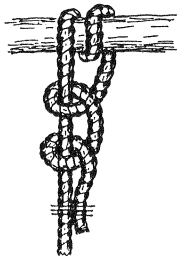


Figure 5. When both half hitches are made, pull them tight, and secure the ends with a small cord.

Pioneering Knots

The following fifteen knots are useful in many pioneering projects. Although you do not need to know how to tie all of them to meet the requirements for this merit badge, it is a good idea to become familiar with each of them in case they are needed during your pioneering and camping activities.

Double Sheet Bend

This knot is used to tie a small pliable rope to a large stiff rope or to a slippery rope.

First, form an "open" bight with the large rope. Then tie the small rope around the bight. To prevent the bight in the large rope from slipping, two or more turns are made around the bight in the large rope. To finish off the knot, tuck the running end of the small rope under the standing part.

When the larger rope is stiff, make extra turns with the smaller rope to hold the bight in place.

Pioneering Uses

- As a method to tie together the ends of two ropes of different diameters
- When you're tying wet or slippery ropes together

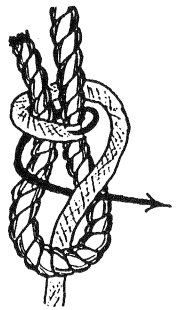


Figure 6. Form a bight in the larger rope. Then wrap the smaller rope around the bight at least twice. Use more wraps if needed to hold it tight.

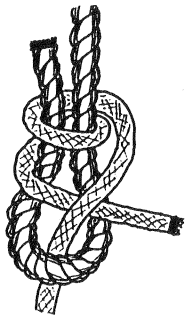


Figure 7. To finish off the knot, tuck the running end under the standing part of the small rope.

Rolling Hitch

As you become more involved in pioneering activities, you will find that there are many uses for the rolling hitch. After the roundturn is made, it supplies enough grip to allow you to complete the knot with ease, even when the line is under strain. Further adjustment can be made without completely untying the knot by loosening the knot slightly, pulling the rope tight, and tightening the knot again.

When a rolling hitch is tied to a spar, pull can be exerted either perpendicular to or along the length of the spar. After exerting heavy pressure, it will untie easily. When you need extra gripping power, just add extra turns. It works well with slippery or wet rope.

Pioneering Uses

- When you want to tie a rope to a stake or a spar, the rolling hitch can be loosened easily to take up slack, and then retightened.
- To attach a light tackle, double the rope over to form a bight, and tie a rolling hitch with a loop for the tackle (see figure 11).
- To form a hand or shoulder loop to pull a spar, tie two rolling hitches, one at each end of a short length of rope (see figure 12).

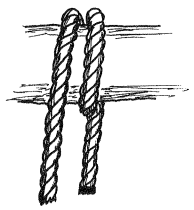


Figure 8. Start by making a roundturn around a spar.

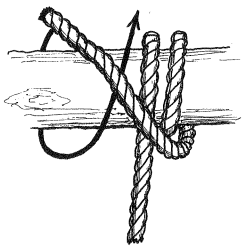


Figure 9. Cross the running end over and make a roundturn. Then tuck the end under.

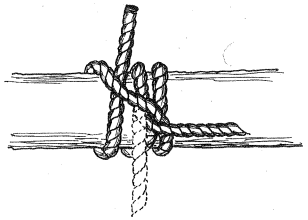


Figure 10. Strain can be applied parallel or perpendicular to the spar.

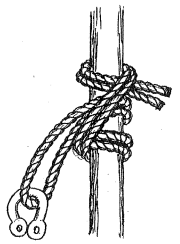


Figure 11. Double the rope and tie the knot to form a loop to attach light tackle.

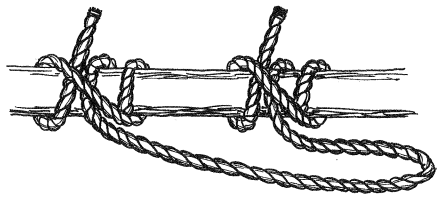


Figure 12. To form shoulder or hand loops for pulling a spar, use a short length of rope and tie two rolling hitches side by side.

Butterfly Knot

A butterfly knot is a fixed loop tied in the middle of a rope. There are a number of other knots that do the same thing, but the butterfly knot tends to work a little better because it doesn't jam when strained and it's easy to untie.

Since it's tied in a symmetrical fashion, strain can be put on it from any direction. Even though this knot is usually tied in the middle of the rope, you can also tie it at the end of the line if you need a fixed loop that is easily untied.

The butterfly knot is a favored knot of mountain/rock climbers, used for hand or foot loops or used to hook their carabiners into. It has many uses in pioneering work.

Pioneering Uses

- When using a rope to pull a heavy object (such as a log), tie a series of butterfly knots to form loops for each person's hand or shoulder.
- When climbing a rope, you can tie a series of butterfly knots to form loops for your hands and feet.
- To provide a fixed loop to use with a toggle.
- When making a rope tackle, the loop in the butterfly knot serves as the pulley. (See the "Rope Tackle" section, page 60.)

- To tie up horses or anchor canoes on shore, tie a series of these knots in a picket line for each horse or canoe.

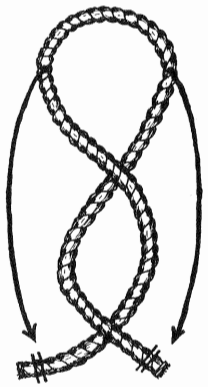


Figure 13. Start with an overhand loop. Then twist the rope to form a second overhand loop. Next, drop the upper loop down in back.

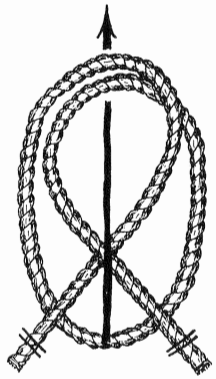


Figure 14. When the upper loop is dropped down, pull it under the two crossed standing parts of the rope. Then pull it up through the top loops to complete the knot.

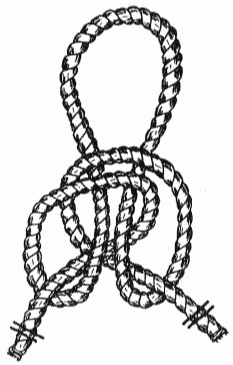


Figure 15. To pull the knot tight, pull the upper loop while holding the standing parts of the rope at the bottom.

Carrick Bend

When you have to tie the ends of two large ropes (½"-diameter or larger) together, there is no better knot to use than the carrick bend. While many other knots reduce the strength of the rope considerably, a carrick bend reduces its strength only slightly.

You'll find that once the carrick bend is put under a big strain, it's not all that hard to untie. The knot will tighten under the strain of the ropes, but won't slip and works well with wet or slippery ropes.

The carrick bend looks very symmetrical when it's first tied and is still loose, like two interlocking loops (see figure 15). But as soon as it is pulled tight, it looks quite different and is often hard to identify.

Pioneering Uses

- To tie large diameter (½"-diameter or larger) ropes together, especially if there will be a heavy strain on the rope
- To tie two ropes of any size together when the rope is wet or slippery and when you need a knot that will untie easily

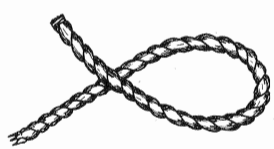


Figure 16. A carrick bend is used to tie the ends of two ropes together. Start by making an overhand loop at the end of one rope.

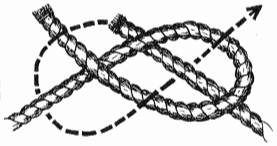


Figure 17. To complete the knot, bring the end of the other rope under the overhand loop. Then complete the knot as shown, weaving over and under as you go.

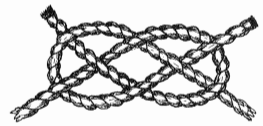


Figure 18. This drawing shows the knot laid out. But when it's pulled tight it looks very different.

Constrictor

Once you learn to tie and use the constrictor knot, you will wonder where it has been hiding in all those knot books and why it isn't in wider use today.

In the days when black powder was used for blasting in mining operations, this was the knot that was tied around the top of the bag containing the black powder to hold the fuse in securely; hence, its other common name, the bag knot.

The constrictor is based on the clove hitch, except that it has an extra half-knot that provides an extra hold when the knot is pulled tight. Like the clove hitch, the constrictor can be tied using the end of the rope (see figures 16 and 17) or by forming a twisted loop and slipping it over the end of a spar (see figures 21, 22, and 23).

Pioneering Uses

- To use interchangeably with the clove hitch, except once the constrictor is pulled up tight, it is quite hard to untie.
- To start a lashing. When it's tied to a vertical spar, the crossing spar can rest on it while the lashing is being made.
- To make a good temporary whipping at the cut end of a rope, or to start the West Country whipping. (Refer to the "Whipping" section, page 52.)
- To start a splice, use it to stop off the unlaid strands of the rope so they won't ravel further as you're working the splice.

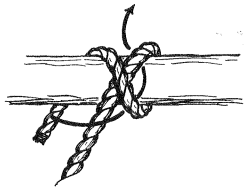


Figure 19. Make a turn around the spar with the running end. Then cross over the standing part of the rope.

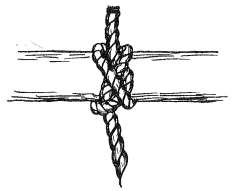


Figure 20. Following the arrow, you are tying an overhand knot around the standing part of the rope. Both ends are pulled to make the knot tight.

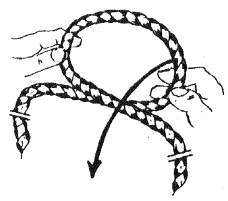


Figure 21. To tie a constrictor knot in the standing part of the rope, first make an overhand loop.

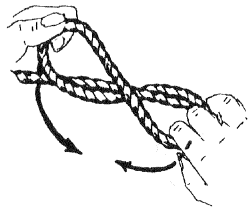


Figure 22. The left side of the loop is held while the right side is twisted down counterclockwise.

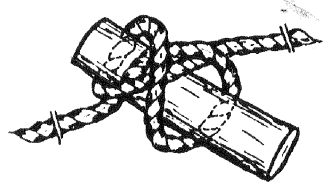


Figure 23. The two loops can be slipped over the spar to form the constrictor.

Water Knot

What could be simpler than tying two overhand knots to form a water knot? Its use goes back to commercial fishermen who needed to tie the ends of two wet fishing lines together.

In recent years, mountain climbers have found this knot very useful. They use a man-made fiber rope that is somewhat slick and is difficult to be spliced in the field. To tie two ropes together, climbers use the water knot because it's a simple knot with little bulk and above all, it's a knot that will not fail.

Mountain climbers also use the water knot to tie a rope seat and to tie the ends of short lengths of rope together to form a grommet (loop) that's used in many climbing applications. This knot also works well with nylon webbing used in mountain climbing.

Basically, the water knot is handy for tying together any types of ropes of the same diameter. In pioneering, whenever you're using ropes made of man-made fibers that are braided and slick and don't hold knots well, think of the water knot.

Pioneering Uses

- To tie together the ends of two wet or slippery ropes.
- To make a grommet (loop) using all types of rope (braided or twisted). Keep in mind that once strain is placed on the knot, it will be hard to untie.
- To tie together the ends of flag halyards.
- To tie the ends of flat nylon webbing to make a grommet (loop) or sling.

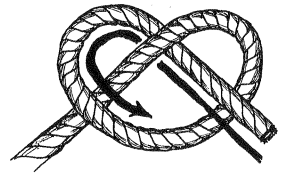


Figure 24. Begin the water knot by tying a loose overhand knot in the end of one rope.

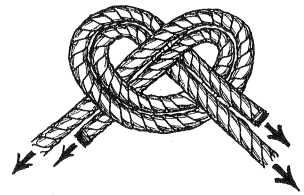


Figure 25. Then bring the end of the other rope over and under the first overhand knot, following the same path but in reverse.

Pipe Hitch

Using a rope to pull a pipe or spar can be difficult because you need all the gripping friction you can get to keep the knot from slipping off as you make the pull. One of the best knots for this type of task is a pipe hitch.

Most of the time the pipe hitch can be tied with four or six turns. If this doesn't hold, you can always lay on more turns to get the friction you need. Be sure to pull the turns snug as you make them so that you get the full effect of their friction.

Keep in mind that when you use this knot for a hard pull or for a heavy weight, it should be tied with larger-diameter rope.

Pioneering Uses

- When considerable grip is needed for a lateral pull on a pipe or spar, or to pull a stake or post out of the ground
- To hook a light tackle to use in lifting (see figure 27)

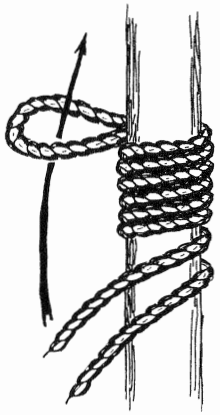


Figure 26. Form a bight in the rope and wrap it around the spar. Use at least four wraps, more for more gripping power. Finish the knot by pulling the standing end of the rope through the bight.

Figure 27. If a spliced grommet (fixed loop) is used, wrap it around the spar and finish it as shown. Then you can hook tackle in the bight of the grommet.

Cat's-Paw

The cat's-paw doesn't have any loops or tucks. It has a few twists in two bights of the rope that are slipped over a hook, stake, or spar. Although it is very simple to tie, it is still very effective.

If it is tied at the top of a sling and slipped over a hook, it will keep the load level. When it's put over a stake or spar, a strain can be put on either lead (end of the rope) and it will still hold. While we usually think of it as a knot to be tied somewhere in the middle of a rope, it can be as effective when tied near the end of the rope.

The best part of the cat's-paw knot is that once you slip it off, you can shake out the twists to untie it.

Pioneering Uses

- As a quick tie anywhere along the middle of a long line or to slip over a stake or spar
- To level a sling's load when tied at the top and slipped over a hook

Figure 28. Start by making two overhand loops next to each other.

Figure 29. Make at least two twists of each loop, turning the right loop clockwise, and the left loop counterclockwise.

Figure 30. Hook the loops over a hook or spar. A load can be put on both ends or just one end and the knot will hold.

Draw Hitch

It may seem that the draw hitch is out of place on a list of knots to be used in pioneering. It can be tied quickly, and more importantly, it can be untied with a sharp pull on the rope.

The draw hitch can be used to temporarily tie a rope to a spar during a rigging setup. It is not a knot that you would tie and leave unattended because an accidental pull on the right lead will cause it to quickly fall away.

On the other hand, the quick release has an advantage when this knot is tied through a ring or around a spar—it doesn't require the running end to be pulled through as it's untied. This means the line is free very quickly without getting fouled.

The manner in which the draw hitch is released makes it a suitable knot for a remote position (such as high up in a rigging). Then a sharp pull on the running end of your line will retrieve your rope. Make sure you remember which lead is holding the load and which will release it.

Pioneering Uses

- To make a temporary hitch while making adjustments in your setup (to be replaced with a more secure hitch).
- When used with a long line to lower equipment, release it, then retrieve your line for another load.

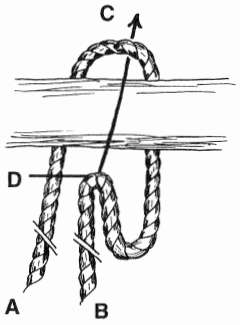


Figure 31. Form a bight (C) behind the spar. Then form a second bight (D) with the end of the rope (B) that will hold the load. Bring it in front of the spar and through (C).

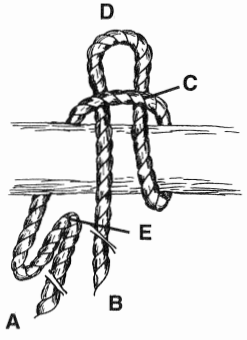


Figure 32. Form a third bight (E) with the release end of the rope (A). Bring it up through loop (D). The knot is tightened by holding bight (E) and pulling end (B).

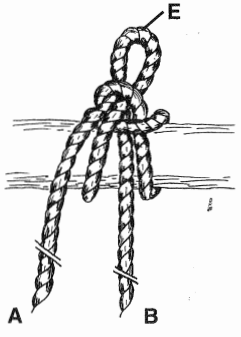


Figure 33. The knot can be easily released by a sharp pull on the running (release) end (A). The other end (B) carries the load.

Fisherman's Knot

The name alone indicates that the fisherman's knot can be used to tie two wet or slippery ropes together. It also has the advantage of less bulk than some other knots that are used to tie two ropes together. It is easy to tie because it consists of two overhand knots. But after a hard pull, you will find it rather hard to untie.

Pioneering Uses

- To tie the ends of a short length of rope to form a grommet (fixed loop). This is particularly useful with braided rope that cannot be spliced.
- When ropes are wet or when used on some types of man-made fiber ropes that tend to slip easily.

Figure 34. The fisherman's knot is used to join two ropes together by tying two overhand knots. Tie one overhand knot on the end of one rope.

Figure 35. Complete the knot by pulling the second rope through the first overhand knot. Then tie another overhand knot around the first rope.

Bowline on a Bight

Sometimes in ropework you might need more than one loop at the end or in the middle of your line. The bowline on a bight is a good knot to use.

Most illustrations show this knot tied with two loops of the same size, but this is not necessary. For example, when lifting a person, one of the loops can be made larger for the person to sit in and the other one smaller to fit around his back and under his arms.

Adjustments in the lengths of the loops can be made before the knot is snugged up tight. You will need to make the bight long enough so that the two loops formed are the sizes you need.

There are a number of double-loop bowlines that provide two loops, but they are a bit harder to tie. If you're faced with an emergency situation, such as in a rescue, stick with a knot that's easiest to remember how to tie.

Since this knot is usually tied with a bigger rope to form large loops, you might need a little more practice to get the hang of it.

Pioneering Uses

- To provide loops in the middle of your line to slip over a stake
- To provide hand and shoulder loops for heavy pulls
- To form loops for tying in other lines or for hooking in block and tackle

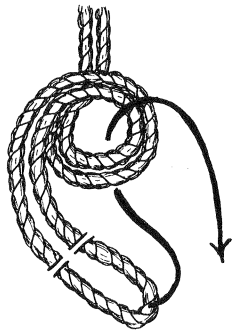


Figure 36. First form an overhand loop with a long bight in the rope. (Make the bight large enough for the two loops you need.)

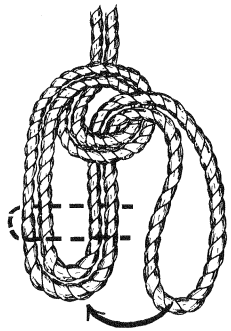


Figure 37. Bring the bight up through the overhand loop (as in making a single bowline).

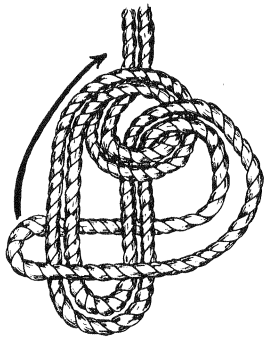


Figure 38. To complete the knot, slip the bight over the bowline loops and up to the standing part of the rope.

Figure 39. The completed knot has two loops that can be adjusted in size before pulling it up tight.

Honda

Cowboys need a strong rope (lariat) and a simple knot to form a loop to rope those dogies. Early lariats were made by braiding long strips of rawhide into a rope. Later, selected long fibers of the abaca plant were twisted into a four-strand premium manila rope that became, and still is, the standard for lariats.

The honda, which is the knot that forms the fixed loop at the end of the rope, is simple to tie. It's two overhand knots snugged up tight to form the 3"-diameter fixed loop. The running end of the rope is then passed through the honda loop to form a large running loop, known as the lariat loop.

Not only is the honda easy to tie, but it also presents less bulk than other fixed-loop knots and it has no dangling ends that could get fouled. Once under a hard pull it is almost impossible to untie and might have to be cut off.

Pioneering Uses

- As a fixed loop in the end of a rope to put over a stake or spar
- As a running loop when you want the knot to get tighter as you pull

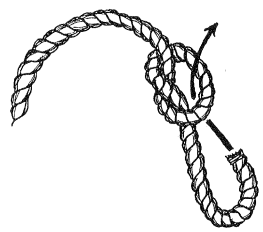


Figure 40. First tie an overhand knot approximately 12" from the running end of the rope.

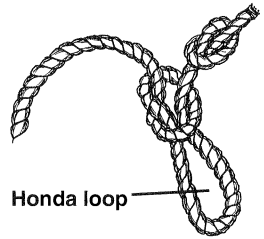


Figure 41. The running end is passed up through the overhand knot from the back. Then tie another overhand knot in the running end. Pull the two overhand knots tight to form the honda loop.

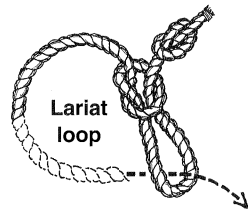


Figure 42. To form the running lariat loop, bring the standing part of the rope through the honda loop to form the lariat loop.

Masthead or Jury Knot

Pioneering often requires some type of temporary rigging at the top of a mast or spar. As its name implies, the jury knot is used to jury-rig a temporary setup of ropes and spars.

This is the knot to use when erecting a vertical spar that must be held in position with guy lines. This one knot provides four loops for the four guy lines. It should be tied with a separate rope that's larger in diameter than the guy lines.

Although this knot is shown with four loops, it also can be tied with only two or three loops. Remember that you start out by making a series of three loops. The fourth loop is formed by tying the two running ends together with a square knot. Be sure to secure the ends of the square knot with a piece of cord.

Note: While the masthead knot appears to be a constricting knot, it is not. It must be supported with cleats to keep it from sliding down the spar.

Pioneering Uses

- To attach the guy lines at the top of the pole
- To keep a spar in a vertical position for any purpose

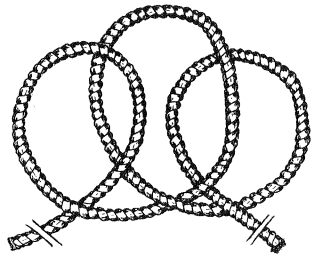


Figure 43. Start by making three overhand loops, laying the second under the first, and the third under the second.

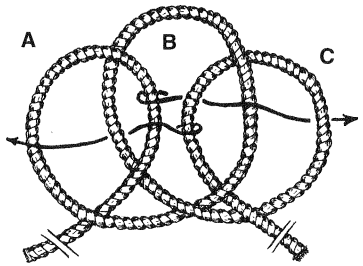


Figure 44. Hold the top of the loop (B) in place while pulling loops (A) and (C) over and under as the arrows show.

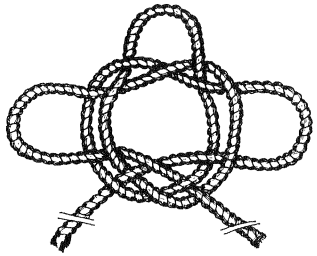


Figure 45. The fourth loop is made by tying the running ends with a square knot. Secure the ends with a short piece of cord.

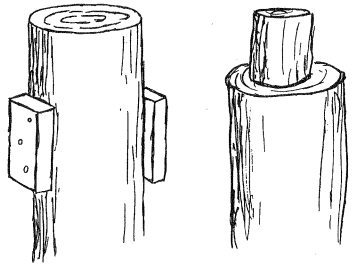


Figure 46. The masthead knot will slip unless supported. Use cleats to prevent the knot from slipping down.

Prusik

This knot has the reputation of having a firm, sure grip once it is put under pressure. The multiple opposing turns provide friction and put a bend in the standing part of the rope, which becomes more difficult to pass through the turns as a lateral pull is applied.

The Prusik is widely used by mountain climbers as they attach a loop (grommet) made from a smaller rope to a larger rope to form a hand- or foothold. It can also be used to form hand and shoulder loops for a lateral pull on another rope or to drag a log or spar.

Pioneering Uses

- To make hand and foot loops for climbing another rope or vertical spar.
- To make hand and shoulder loops as an aid to hauling a large log. It can easily be moved along as the positions require.
- To hook a light tackle on a vertical or horizontal spar.
- To provide the grip and a loop to tie into another line with a sheet bend.
- To provide a safety brake against back-slipping on a load-lifting line. (Do not use when lifting a person.)

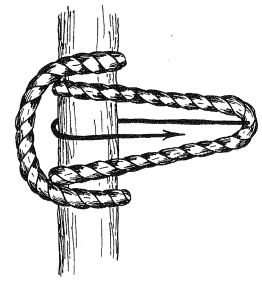


Figure 47. A Prusik is tied by first making a grommet (fixed loop).

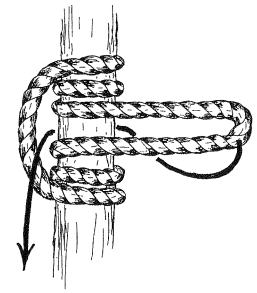


Figure 48. Wrap the grommet around the spar or large rope, making two complete wraps.

Figure 49. The Prusik can be used on a heavy rope to form a foot- or hand-hold.

Barrel Hitch

A barrel presents an awkward shape when you're trying to tie a rope to it to lift it. If the barrel is turned on its side (horizontally), a rope grommet can be made into a sling and slipped over a hook to hoist the barrel.

If the barrel has to be lifted while remaining upright, the barrel hitch is a special knot that does the job with ease. Most books show only one loop around the center of the barrel, but a second loop will help stabilize the barrel in the upright position.

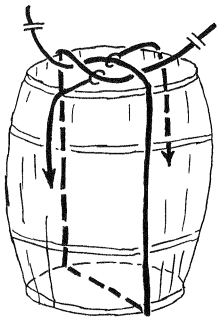


Figure 50. Stand the barrel centered on the rope and tie an overhand knot at the top of the barrel.

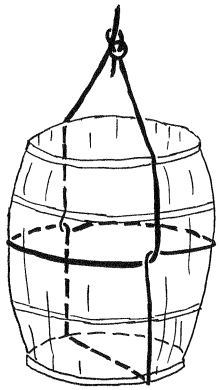


Figure 51. Spread the two sides of the knot down over the side of the barrel. If a single rope is used for tying and hoisting (as shown here), the running end of the rope is tied into the standing part using a bowline.

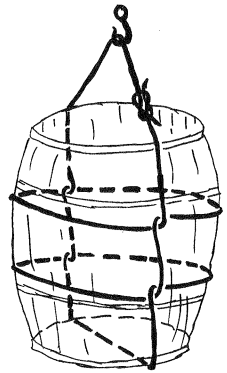


Figure 52. A second overhand knot may be used if needed, and slipped down over the barrel. If a separate rope is used to tie the barrel hitch (as shown here), tie the ends with a square knot, and slip it over a hook.

Splicing Rope

Making the proper splices in the proper places on your ropes is the benchmark of a skilled craftsman. Very often the ability to do a neat job of splicing is placed at the top of the skills list of ropework. Making splices is not really all that hard to do.

There are three basic types of splices that are typically made on three-strand twisted rope: an eye splice, a back splice, and a short splice. The basic process in all three splices is to unlay the strands at the end of the rope, then weave them over and under back into the rope to form the splice.

In some cases the right knot could do the same job as each of these three splices: a bowline might be used instead of the eye splice; a square knot or carrick bend instead of the short splice; and whipping could replace the back splice.

Knots are bulkier than splices. Splices are neater and smaller and not as likely to come untied in use. Splices in ropes make the rope secure and ready to go when needed.

There are a number of other rather complicated splices. The eye splice, back splice, and end splice are basic and well suited to the type of pioneering outlined in this pamphlet. The splices shown here can be made in any three-strand rope (manila, sisal, poly, or nylon).

Learning how to make the first tuck on each of the three strands is the key to splicing. The first tuck sets up the pattern for the following tucks and gives the splice a symmetrical appearance. Those first few tucks that you make might look a bit rough, but try to remember that neatness is one of the keys to a well-made splice. Try to prevent each strand from raveling while you're working with it. Also, you should try to pull each set of tucks tight and with even tension.

The rope should maintain approximately 80 percent of its strength if the splice is made with a series of three tucks on each of the three strands.

If after making the first three tucks on all three strands, you reduce each strand to one-half of its fibers and make a fourth tuck, the splice will have a nice tapered look.

To learn the technique of splicing, it's best to practice with short pieces of ¼" three-strand manila rope. Avoid sisal and plastic rope until you have mastered splicing with manila rope.

Even the best drawings of the steps for making a splice can look confusing. The best way to learn how to splice is to sit down one-on-one with someone who is familiar with the techniques and go over each step a few times until you get used to how the strands are woven together. Splicing is not one of those skills that you can do once and then never forget how to do it. It takes a lot of practice.

Back Splice

The back splice is made to prevent the end of the rope from raveling. It can also be used instead of making a whipping. Of the three splices shown here, the back splice is the least used because its bulk at the working end of a rope makes tying some knots more difficult.

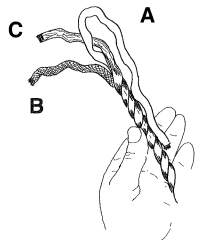


Figure 53. Unlay strands and fold strand (A) back on the standing part of the rope.

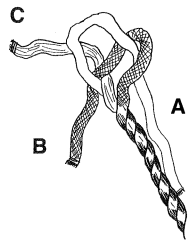


Figure 54. Wrap strand (B) around the loop formed by strand (A).

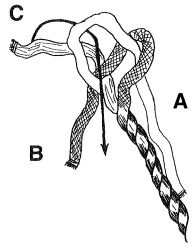


Figure 55. Bring strand (C) through the loop formed with strand (A).

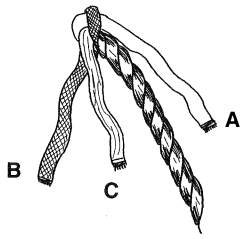


Figure 56. Tighten all the strands, pulling each one tight against each other.

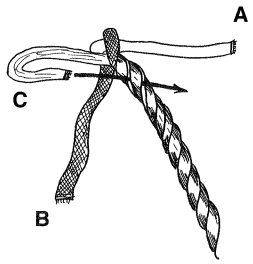


Figure 57. Tuck strand (A) over one strand and under the next.

Figure 58. Continue as in figure 57 to complete the back splice.

Eye Splice

The eye splice creates a fixed loop at the end of the rope. These are some of the uses for an eye splice:

- Splice a fixed loop into the end of a guy line.
- Splice a fixed loop with a thimble in a 10' rope to form a strop (refer to the "Anchors" section, page 55).
- Splice a rope into an eyebolt at the bow of a canoe.
- Splice a rope into a tent or fly grommet.
- Splice the throwing line into a ring buoy at the waterfront.
- Splice the line into the block of a block and tackle.
- Put eye splices at each end of a rope to be used as a sling.

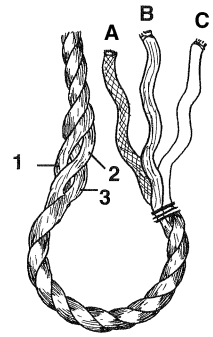


Figure 59. Unlay strands at the end of the rope and tie off with whipping.

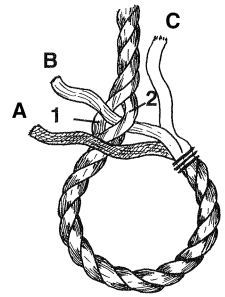


Figure 60. Tuck strand (B) through one strand on the standing part.

Figure 61. Now tuck strand (A) under the next strand on the standing part.

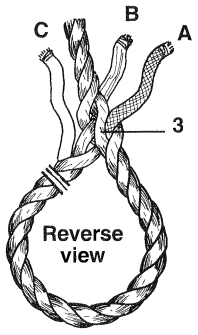


Figure 62. To complete the splice turn it around to the back side.

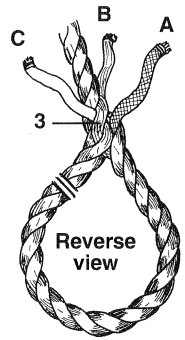


Figure 63. Tuck strand (C) under the next strand.

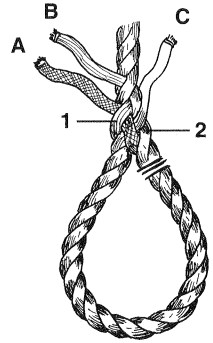


Figure 64. Turn rope back around. Continue, repeating steps 2 through 5.

Short Splice

A short splice can be used in place of a knot to join two ropes or the ends of the same rope together. If two ropes are being joined with a short splice, they should be the same type of rope and have the same diameter. Some of the applications of a short splice follow:

- Splice the ends of a long line that has been cut, or when a frayed or unsafe portion needs to be cut out.
- Splice the ends of a short length of rope to form a grommet (fixed loop).
- Use it on a 10' length of rope to form a strop (fixed loop). (Refer to the "Anchors" section, page 55.)

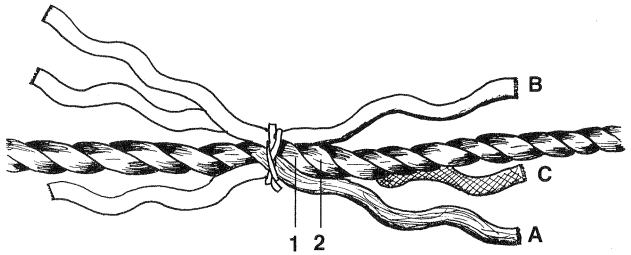


Figure 65. Unlay the ropes, intertwine the strands, and tie a temporary whipping to hold the ropes together. Tie each strand with a constrictor knot to prevent raveling.

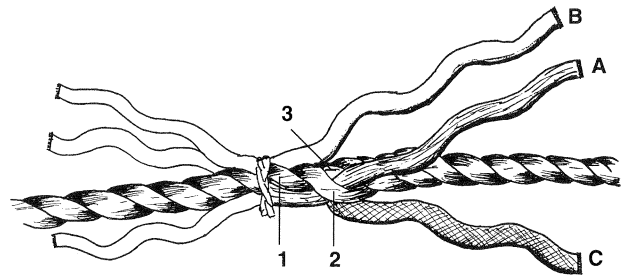


Figure 66. Starting with one strand (A) of the left rope, take it over one of the strands (1) on the right rope, and tuck it under the next strand (2) on the right.

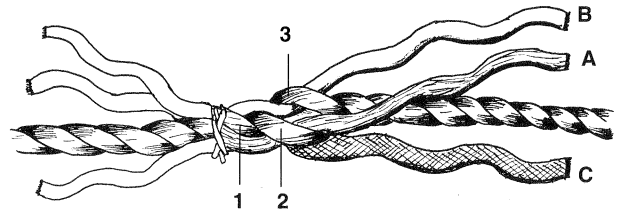


Figure 67. Roll the rope toward you and take the next strand (B) in turn. Take it over the strand (2) on the right rope, and tuck it under the next strand (3).

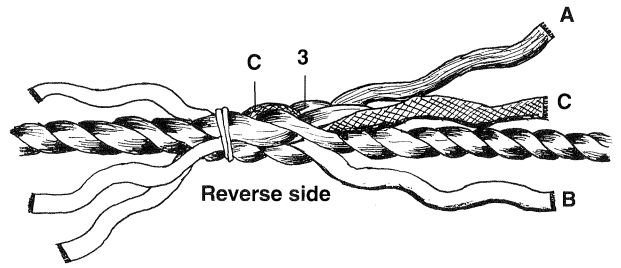


Figure 68. Roll the rope toward you again and tuck the third strand (C) over strand (3) and under the next strand on the right rope.

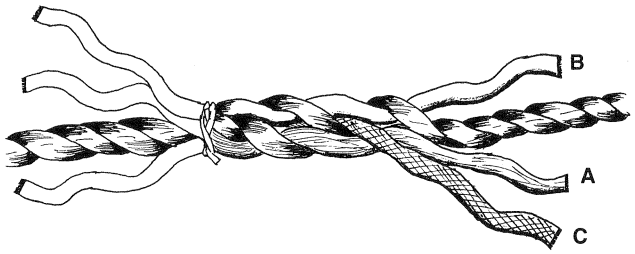


Figure 69. At this point three strands from the left rope should be tucked under three strands on the right rope. Continue by making another tuck with each strand.

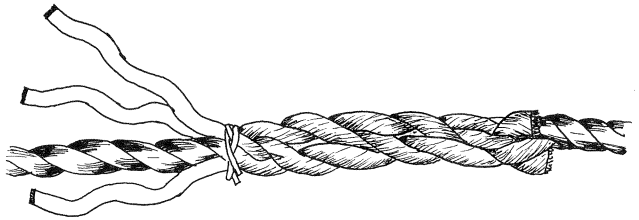


Figure 70. Continue the process until three tucks have been made with each strand. Remove the temporary whipping and splice the other left ends in the same way.

Making Rope

Making rope out of plant fibers is still done today in remote parts of the world. In many cases people make their own rope because money is in short supply and the native plants that have the needed fibers are in great abundance. As early as A.D. 1200 the Papago Indians of the American Southwest made rope from cactus fibers using a twirling stick. This technique can still be used today.

The old saying, "Necessity is the mother of invention," seems to apply to the fact that ropemaking became a common practice on many farms in this country around the turn of the century. This happened, in part, because of the invention of the McCormick reaper and the hay bailer. Both of these farm machines required the use of binder twine. Farmers soon realized that with the supply of binder twine they had for tying up bales of hay, they could easily make all the rope they needed at home by using a simple geared machine.

All they had to do was hook strands of binder twine to each of the three or four hooks on the machine to make almost any size and length of rope they wanted. These machines worked by turning a handle to twist the strands of binder twine into rope. The ropemaker also used a notched paddle to keep the strands from fouling and to regulate a uniform twist as the rope was forming.

At the turn of the century cast-iron ropemaking machines could be bought for a few dollars and were found on almost every farm. Today you have to search the antiques shops for one, and if you find one, it might cost over a hundred dollars.

Before the industrial revolution in the 1900s, rope used for big sailing ships was made by hand in 1200'-long *ropewalks* that required a great deal of manpower. Then fast-moving machines were invented to simplify the task. Even today fiber ropes are still made into coils of 1200'. Rope made from man-made fibers (plastics) comes in varying lengths on spools for ease in dispensing.

It might be a bit impractical for your troop to make all the rope needed for camping or for your pioneering projects, but learning how to make rope will help you understand how yarns and strands are twisted to form rope.

The basic process of making rope consists of twisting fibers to form yarns. Then several yarns are twisted together to form strands.

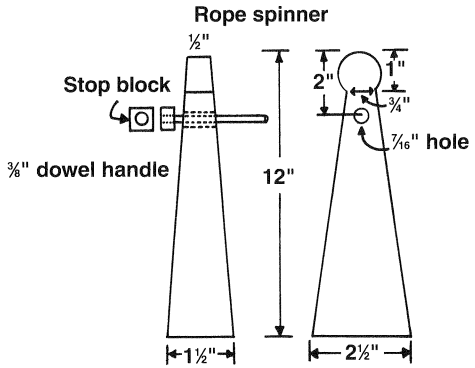
Finally, several strands are twisted to form the rope. For example, to make ¼"-diameter rope, we start with binder twine as the yarns. Three of these binder twine yarns are twisted to form a single strand. Then three strands are twisted to form rope approximately ¼" in diameter.

Indian Rope Spinner

The simple rope spinner shown in figure 71 is a replica of one used sometime around A.D. 1200 by American Indians who lived in what is now Arizona. With this spinner and fibers from cactus plants in that area, the Indians were able to make the rope they needed to construct shelters and for many other purposes. Museum samples show a two-strand rope slightly less than ¼".

Using this spinner, it is as easy to make rope today as it was a thousand years ago, except that today we can use binder twine instead of cactus fibers.

Figure 71



Making the spinner. To make the rope spinner, start with a piece of pine (or any softwood) about 1½" thick by 2" wide by 12" long. This can be cut from a two-by-four (2" by 4"), which is a type of construction lumber.

Draw the basic shape of the spinner on the wood, following the pattern shown in figure 71. Cut out the basic shape with a coping saw.

The sides are tapered to produce a shape with more weight at the bottom. This aids in spinning. The top knob is shaped to prevent the yarns from slipping off.

After the shape is cut out, drill a 7/16"-diameter hole 2" from the top for the handle.

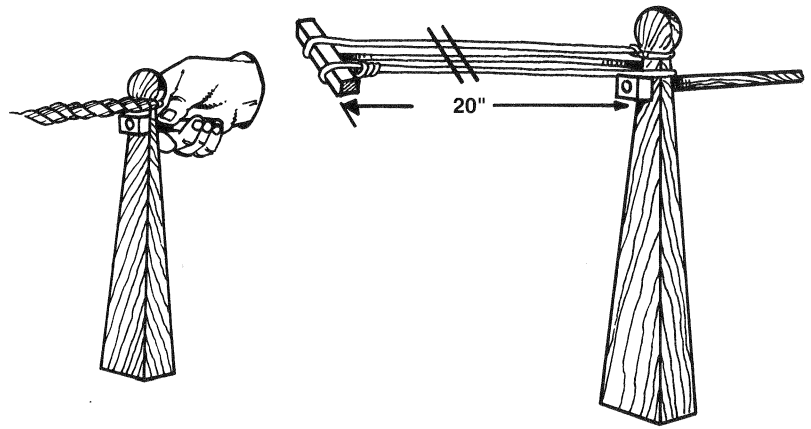
The handle for the rope spinner is made from a piece of ⅜"-diameter dowel about 10" long. To make the stop block needed at the end of the handle, cut a ¾" square block. Then drill a ⅜"-diameter hole through the center of this block. Glue the handle dowel into the hole. After the handle is made, slip it into the 7/16" hole in the spinner's main body.

Using the spinner. To use the Indian rope spinner to make a 6' length of rope, you will need to start with about 60' of binder twine.

Start by tying one end of the 60' length of binder twine to the neck of the spinner (see figure 72). Then run the binder twine out to another person holding a small stick or a hook about 20' away. Loop the binder twine over the stick and then run it back to the head of the spinner. Run it out to the other person one more time and tie it to the stick or hook so that you have three strands of binder twine running between the rope spinner and the hook.

Now hold the spinner in front of you and face the other person. Spin the head of the spinner in a clockwise rotation. This will cause the three yarns of binder twine to twist into a single piece that will

Figure 72



become one "strand." Twist the three yarns until the strand is tight. A little bit of practice will tell you how tight to spin the strand.

Spinning rope. After making one strand, it's easy to make a three-strand rope. Leave the strand on the spinner and the hook. Grab the strand and loop it over the spinner and also loop it over the hook. At the same time have the other person move closer to you so there are three strands running between the spinner and the hook, all the same length (about 7' long).

Now spin the spinner in a counterclockwise rotation, as was done with the three yarns of binder twine. (This is opposite of the way for making the strand.) As you spin, the three strands will twist to form a rope. Only practice will tell you how tight to twist the rope.

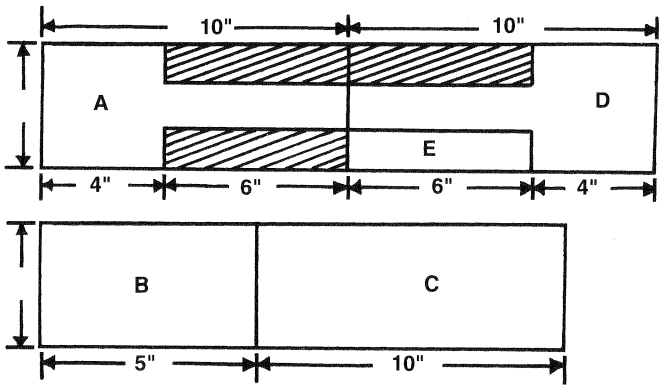
After making the rope, use a short piece of binder twine to temporarily tie both ends of the rope so it doesn't ravel. Then whip both ends of the rope and trim them.

Ropemaker

Another device that can be used to make rope is fashioned after the ropemaker used on farms during the early 1900s. With it you can twist the three yarns on each hook into a strand, and the three strands into the finished rope all at the same time.

Make the device. The pieces for the ropemaker are cut from two pieces of ¾"-thick plywood about 4" wide. One piece should be about 20" long, and the other about 15" long (see figure 73).

Figure 73

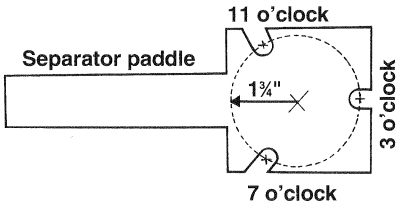


Cut out pieces. First, cut the handle (A) to shape, as shown in figure 74. (Do not drill the holes yet.)

Next, cut out pieces (B) and (C). Glue and screw them together to form the base unit (see figure 75).

Then cut the separator paddle (D) to the same shape as the handle (see figure 74). Later, notches will be cut in the paddle (see figure 76).

Figure 74

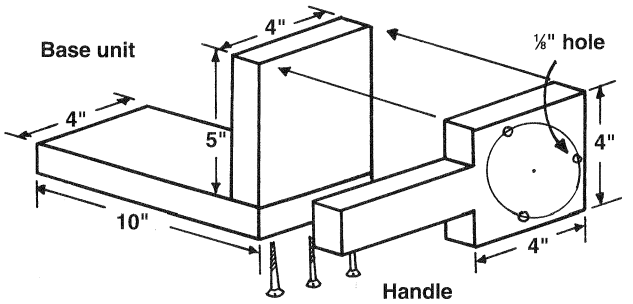


Mark holes in the handle. After these pieces are cut, you have to drill holes through the handle (A) and the upright part of the base unit (C) for the three turning hooks. To do this, first draw a 3½"-diameter (1¾" radius) circle on the paddle (see figure 74). The center of this circle should be 2" from the end of the paddle. The edge of the circle should be ¼" from each of the three edges of the handle (see figure 74).

Now mark the positions of the three holes for the turning hooks. You can use a protractor to mark these holes at 60° intervals, at the three, the seven, and the eleven o'clock positions.

Drill the holes. After marking the positions of the holes, hold the handle up to the upright piece on the base unit (C). (See figure 75.) Clamp the pieces together, then use a hand drill to drill three ⅛"-diameter holes through both pieces.

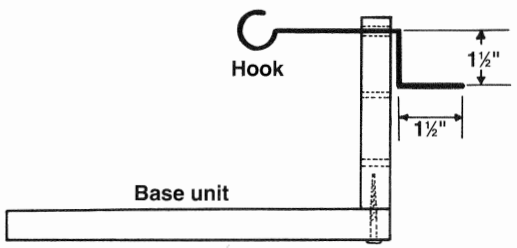
Figure 75



Make the hooks. These hooks are made from coat hangers. Cut three pieces of coat hanger wire about 8" long. Then make two bends in the end of each wire to form an L-shaped end to fit in the handle. Each bend should be about 1½" long (see figure 76).

Now, insert the three turning hooks in the holes in the upright piece (C) of the base unit. After they're in place, use pliers to bend a hook shape in the end of each wire (see figure 76).

Figure 76



Make the separator paddle. The separator paddle is used to keep the strands separated while they are twisted into rope. To make the separator paddle, place the handle (A) on top of the paddle (D) and mark the position of the three holes on the paddle. Then cut notches in the edges of the paddle at these locations. You can use a coping saw to cut out the notches (see figure 76).

Make the end hook. This is the final step (see figure 76). Use a piece of scrap left over from making the handle. Screw in a 3"-long screw hook in the center of the scrap piece.

Using the Ropemaker

To use the ropemaker, first clamp the base unit to a table or a bench. To make a 6' length of rope, cut a 60' length of binder twine. Tie one end of the binder twine to one of the three turning hooks on the base unit.

Then ask another Scout to hold the end hook about 6' away. Now thread the binder twine to the end hook and back to each of the three turning hooks. Continue to do this until you have three yarns of binder twine going from each turning hook to the end hook that's held by the other Scout.

As you begin, the Scout with the end hook should pull on his end to keep the slack out of the yarns. Then ask a third Scout to insert the three strands in the notches of the separator paddle. Start near the Scout holding the end hook. As the rope is turned, the Scout holding the separator paddle should move the separator paddle toward the base unit, making sure that the strands do not become fouled.

Start turning the handle so that the hooks turn in a clockwise rotation. As you turn the handle, the yarns (binder twine) will begin to form into twisted strands, and these strands will also twist to form into rope. The Scout operating the separator paddle should move it to prevent the strands from fouling. If the separator paddle is moved too fast toward the base unit, it will result in a loosely twisted rope.

You'll have to practice to determine the speed of turning the handle and the movement of the paddle to make a good piece of rope. Too few turns will produce rope that is loose. Too many turns will produce rope that is twisted too tight and might be hard to use.

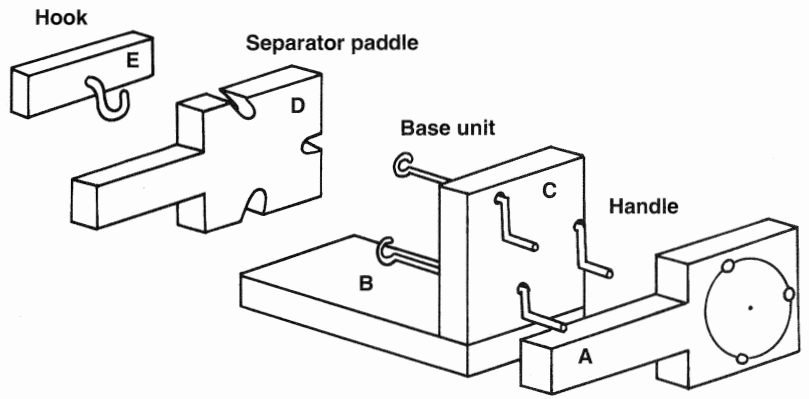


Figure 77

Whipping

Whipping the ends of all the ropes in your pioneering kit is an indication of a well-managed kit, and a practice that will give your ropes good service in the field. Trying to tie knots in ropes with frayed ends is not only a bother but a waste of time. This can all be avoided by having a small spool of whipping cord as part of your pioneering equipment.

The type of whipping cord that you use is most important. Flax cord that is waxed and made of six strands is the best for pioneering work. Cotton string is not strong enough and will not wear well. Nylon cord is very strong, but tends to be slippery, especially when it's waxed. A second drawback to nylon cord is that it stretches easily which makes it easy to slip off.

Waxed flax cord can be purchased at most leathercraft stores or shoe repair supply dealers.

The merit badge requirement for whipping can be fulfilled by using any whipping method shown in other Scouting publications. Because of the hard usage that ropes get during pioneering activities, it might be worth the time to learn how to do one or both of the following methods.

West Country Whipping

A group of counties west of Bristol, England, which has long been a seafaring area, is referred to as West Country. This area is also famous as a starting point for Pilgrims sailing to America. Why and how the West Country whipping was developed seems to be lost in history. Whoever invented it has left us with a simple and very effective method for whipping the end of a rope.

The West Country whipping works equally well on any type of rope, twisted or braided, or rope made from natural fibers or plastic filament. (All plastic ropes should have the end melted back first.) The success of this whipping depends on the tightness of the knots formed by the cord and the interlocking action of the overhand knots.

To make the West Country whipping on a ¼"-diameter rope, start with a 14" length of waxed flax cord. Wrap the cord around the end

Figure 78. Use waxed flax cord and tie an overhand knot about ¾" from the end of the rope.

Figure 79. Wrap the whipping cord around the back of the rope and tie another overhand knot.

Figure 80. Repeat tying overhand knots, front and back, until the whipping is ¼" to ⅜" long. Then tie a square knot to finish the whipping.

of the rope about ½" to ¾" from the end, and tie an overhand knot (see figure 78). If the rope is badly frayed, it can be pulled together with a clove hitch or constrictor knot to begin the whipping.

Continue by taking the two ends of the whipping cord around to the back of the rope (away from you), and tie another overhand knot (see figure 79). Keep repeating overhand knots, front and back until the whipping has been formed. A good rule of thumb to follow when using this type of whipping is to make the whipping as long as the diameter of the rope.

Always tie each overhand knot right over left or left over right so that the knots lay neatly together and snug against the previous knot to form a smooth finished whipping. The West Country whipping is finished with a square knot and the excess cord is trimmed.

Sailmaker's Whipping

Just the thought of sails and ropes flapping in a strong wind when a sailing ship is under way makes you realize that the ends of the ropes aboard a ship have to be whipped to keep from raveling under the strain. Sailmakers knew that a little extra effort spent whipping the ends of the ropes would make their work much easier in the long haul.

To make the sailmaker's whipping, first unlay the three strands at the end of the rope about 1" (see figure 81). With a length of whipping cord approximately 16" long, form an open bight about 3" long at one end of the cord. Slip the bight over one strand and then lay

the two running ends of the cord between the remaining two strands of the rope (see A and B in figure 81).

Relay the strands of the rope to form the original twist (see figure 82). Then wrap the long end of the whipping cord tightly around the rope. Wrap the cord clockwise, moving toward the end of the rope approximately six turns. Keep each wrap tight against the previous one and neatly together (see figure 82).

To complete the whipping, bring the original bight up over the same strand it was originally looped over (see figures 81 and 83). Then pull the short end of the whipping cord until the bight is pulled tight on top of the wrappings. Finally, bring both ends of the whipping cord, (A) and (B), up to the end of the rope and tie a square knot, pulling it down tight between the strands of the rope and snug on top of the wraps (see figure 83). Cut off any excess from the ends of the whipping cord. This sailmaker's whipping will stay put under hard use.

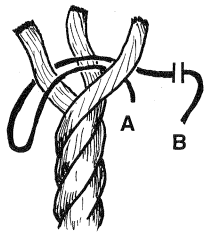


Figure 81. Form a bight about 3" from the end of the whipping cord. Then lay the running ends (A) and (B) between the opposite strands of the rope.

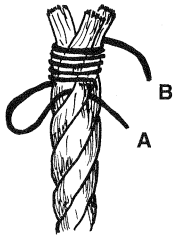


Figure 82. Make wraps, moving clockwise, around the rope. Keep the wraps tight against each other.

Figure 83. Loop the bight over its strand and tighten it by pulling on end (A). Then finish by tying a square knot, pulling it tight between the strands of the rope.

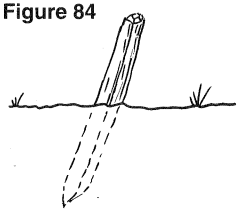
Anchors

Building pioneering projects often requires some type of strong point for attaching a guy line for a tower or derrick. An anchor point might also be needed to anchor one or both ends of a monkey bridge.

Sometimes nature will provide a tree or rock in just the right location or you might be able to shift the location of the project to take advantage of a natural anchor.

Stakes

Figure 84



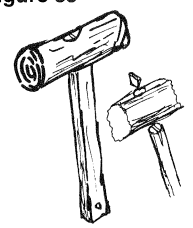
When nature does not provide a solution, anchors can be constructed using stout pioneering stakes.

Note: Under no conditions should tent pegs be used for pioneering stakes. They're not long enough or strong enough to make a safe anchor.

Pioneering stakes should be made of hardwood, such as oak or hickory. The most common size of stake for the projects shown in this pamphlet is 2½" in diameter and about 24" to 30" long (see figure 84). After cutting the stake to this size, cut a point on one end. Then bevel the top edge to prevent it from mushrooming or splitting when the stake is driven into the ground.

Mallet

Figure 85



When driving stakes into the ground, it's best to use a wooden mallet. Using a metal sledgehammer or an ax head will quickly damage the stake.

To make a wooden mallet, cut a 4"-diameter piece of hardwood, such as hickory, elm, or sycamore, about 11" (see figure 85). It should weigh about four pounds. Drill a 1⅛"-diameter hole to mount the handle. The handle can be

made from a 24" length of hardwood (similar to making a stake). Use a knife or ax to round the end of the handle to fit the hole in the mallet head. Secure the handle in place with a wedge placed crosswise to the length of the head.

Soil Conditions

When driving the stake into the ground, drive it at about a 20° angle. Soil conditions can vary and will dictate how large and long a stake you need. If there will be a heavy strain on the anchor, you might need additional stakes as in the 3-2-1 configuration shown in figure 88. After the stake is driven in the ground, keep your eye on it as strain is applied to see how it is holding.

If ground conditions are unsuitable for even the largest stake you have, use a 4"-diameter spar that's buried 36" in the ground at a 30° angle and anchored in place with a stake (see figure 86).

Figure 86

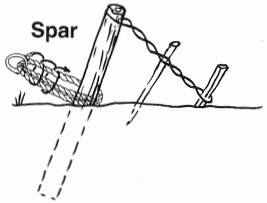
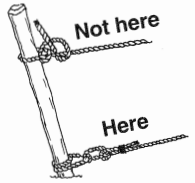


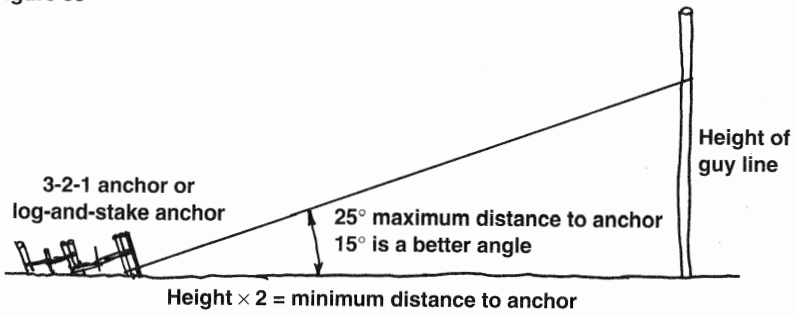
Figure 87



Guy Line

Always attach the guy line around the stake as close to the ground as you can get it. If the guy line is placed or slips higher on the stake, there will probably be enough leverage to pull the stake loose (see figure 87).

Figure 88

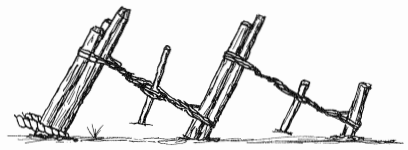


Angles for Guy Lines

Both the 3-2-1 anchor and the log-and-stake anchor should be positioned so that the guy line is at a 15° angle, or at a maximum of 25°. To determine this, measure the height at the point where the guy line is attached. Double this distance to determine the minimum distance required between the base and the anchor. For example, if the guy line is attached 10' up on a pole, the anchor should be a minimum of 20' from the base (see figure 88). If your line is long enough, it won't hurt to place the anchor a few feet farther out.

3-2-1 Anchor

Figure 89



3-2-1 anchor

As the name implies, the 3-2-1 anchor is made by driving stakes in a series: three stakes, then two stakes, and then one stake to form the anchor (see figure 89). All six stakes are 30" long and are driven 18" into the ground at a 20° angle.

First, drive in the set of three stakes. Next, drive in the set of two stakes about 24" away from the first set. Then tie a rope from the top of the three-stake set to the bottom of the two-stake set using at least two loops of ¼" manila rope, or six to eight loops of binder twine. Then use a small stick to twist the rope tight as in a tourniquet. After the rope is twisted tight, push the end of the stick in the ground to keep it from unwinding.

Finally, drive a single stake in the ground about 12" from the two-stake set. Once again, use a twisted rope or binder twine as a tourniquet to hold the two-stake set tightly in place.

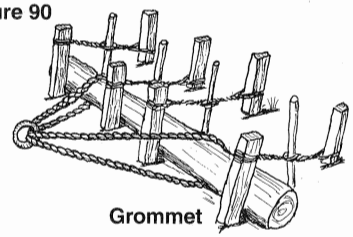
Depending on the strain, you can use other configurations, such as 2-1-1, or even 1-1 for a light strain. When using any stake anchor, be sure that it is in direct alignment with the strain being applied.

Log-and-Stake Anchor

The log-and-stake anchor is easy to make and can hold a considerable pull. You can tie the line directly to the log, or use a ring-and-rope grommet as shown in figure 90.

To make the log-and-stake anchor, place a log 4" to 6" in diameter perpendicular to the pull on the line. Then drive in four large stakes in front of the log. Next, slip the rope grommet through the ring and then slip the ends of the grommet around the log (see figure 90).

Figure 90



Drive a second row of stakes 24" behind the front stakes. Then anchor the front stakes to the rear stakes with a tourniquet made of binder twine or rope.

Strops

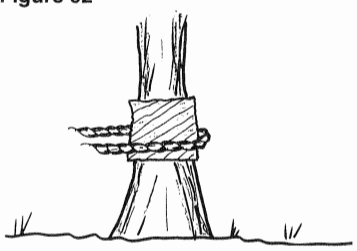
It is good practice to use a device called a strop to avoid damage to your long lines. It also makes it easier to tie off your long lines and to make adjustments.

A strop can be made by using a 10' length of ½"-diameter manila or polypropylene rope. To make a strop, splice a thimble and ring into one end of the rope (see figure 91), or use a screw pin shackle with a thimble.

The strop can then be wrapped around a rock or tree to attach the line (see figure 92). It can also be used around a spar that is anchored between two trees (see figure 93).

Figure 91

Figure 92



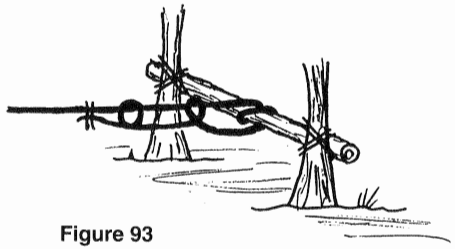


Figure 93

Note: Be sure to use a piece of canvas or burlap to protect your rope from the sharp edges of a rock or to protect the bark of the tree from rope burns.

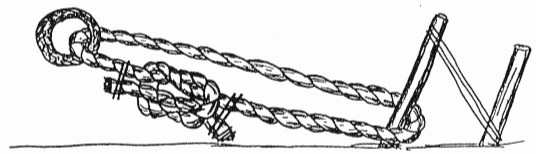
Grommets

A grommet is often used in conjunction with an anchor. A large grommet can be made by splicing together the ends of a 10' length of ½" manila or polypropylene rope. If you don't have a spliced grommet in your pioneering kit, tie the ends of the rope with a square knot or a carrick bend. Be sure to secure the ends of the rope.

The completed grommet is useful when attaching a long line to an anchor of stakes. It provides a strong and more convenient way to attach a guy line or other long line.

The grommet you use must be made of a larger-diameter rope than the guy line to avoid creating a weak link in the chain between the structure and the anchor.

Figure 94



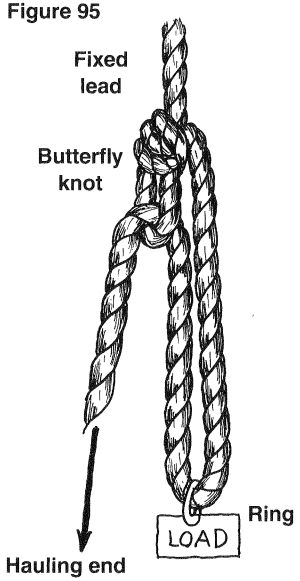
Rope Tackle

When you want to lift or pull more than your own strength will permit, or when you want to make a heavy lifting job a little easier, the rope tackle is a device that can be used.

The idea behind a rope tackle is similar to that of a tackle using blocks or pulleys. In a rope tackle, one lead (end) of the rope has to be fixed. That is, it has to be anchored around a spar or tied through a ring or other piece of hardware that does not move.

Loop knot. Then a *loop knot* is tied along the standing part of the rope. The butterfly and the bowline on a bight are suitable for making a loop knot because they can be tied in the standing part of the rope and they are both easy to tie and fairly easy to untie even after being put under a strain. If you have no other reason to become proficient in tying these two knots, the use of the rope tackle should convince you. (Refer to the "Knots" section, page 17.)

Figure 95



Connect with the load. After you've tied the loop knot (butterfly knot as shown in figure 95), it forms a fixed loop that acts as the wheel in a block. If you're using the rope tackle to lift or pull an object, pass the running end through a ring or other hardware that's attached to the object (load). The ring (or other hardware) is used so that the rope is free to slide as you pull on the hauling end of the rope as the tackle takes effect. If you want to use the rope tackle to tighten a line, pass the running end around a fixed object such as a spar, a stake, or a tree.

Finally, the running end of the rope is passed through the fixed loop in the loop knot. The running end becomes the hauling line which is pulled to make the tackle work.

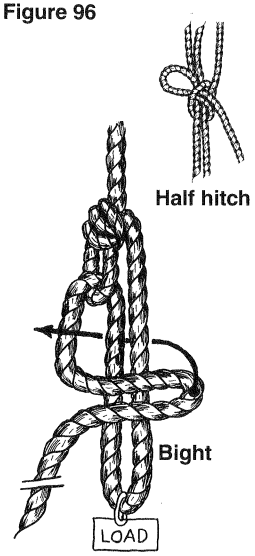
Principles. The rope tackle works on the same principles as any other tackle using mechanical blocks or pulleys. The rigging method shown in figure 1 develops twice the lifting or pulling power that's applied to the hauling end. In other words, you can lift a fifty-pound weight using only twenty-five pounds of force on the hauling end.

To determine how much force is needed to lift a weight, the general rule is that you count the number of ropes passing through the ring where the object (load) is. In this case there are two ropes passing through the ring that's attached to the load (see figure 95). Then divide that number into the weight being lifted. Let's assume that the weight being lifted is fifty pounds. The answer is twenty-five pounds, which is the amount of pull required to lift the fifty pounds with the rope tackle.

When you take into consideration the friction of the ropes rubbing together, you will have to apply a bit more than the twenty-five pounds to make the lift. But even with the loss caused by friction, the rope tackle is quite effective.

Sometimes it is better to actually experience the effect of how the rope tackle works than it is to understand the technical explanation of the process. Setting up a rope tackle will convince you.

Figure 96



Tying off. When using a rope tackle, if you want to hold the position of a load being lifted or pulled, or if you want to hold the strain on a line being tightened, form a bight in the hauling end of the rope and tie it off with a tight half hitch below the fixed loop in the butterfly knot (see figure 96).

Types of rope. The type of rope you choose for a rope tackle should have a low stretch factor, such as pure manila rope. Ropes that stretch like polypropylene and nylon, even though they are strong, require that you pull the stretch out of the rope before your tackle takes effect.

Note: When in use, the rope tackle can put considerable strain on the fibers of the rope. Therefore, repeated use of the same section of the rope for this purpose should be avoided. The ropes used to make the tackle should be inspected for damaged fibers on a regular basis.

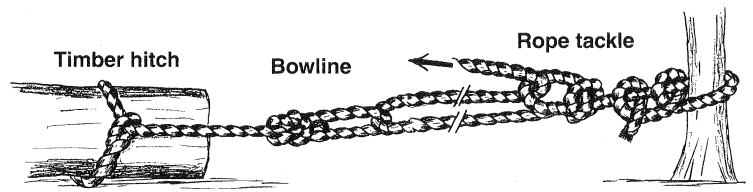
Uses of the rope tackle. The wide range of uses for a rope tackle by a number of different craftsmen speaks for its effectiveness. Each craft seems to use a lightly different knot or hitch to form the loop that makes a rope tackle. The lorryman's hitch, the linesman's hitch, the stagehand's hitch, are all samples of different knots or hitches used to form the loop. The only difference between these hitches is that in some of them the type of knot used to make the loop is more easily tied and untied than others after a hard pull. But they all do essentially the same thing. That is, they form a fixed loop for the rope to be used as a tackle.

The extent to which the rope tackle has been used by craftsmen and tradesmen in their daily work can be better understood from the following list of the uses and the various names by which it is called:

- The linesman's hitch is used to put a strain on a line in the process of stringing electric or telephone lines. It was used as far back as the building of the telegraph lines that opened up the western states during the 1800s.
- The stagehand's hitch is used to adjust the height of the curtains on a theater stage.
- The wagoneer's hitch is an English reference to the hitch used to secure the load on a wagon or lorry.
- The load binder is what the farmer called the hitch he used to tie down a load of hay on his wagon.

Pulling a log. One of the uses of a rope tackle is to pull a heavy load such as a log. To do this, you need two ropes. Tie a short (6' to 8') length of rope to the end of the log with a timber hitch (see figure 97). Then tie a bowline at the other end of this rope.

Figure 97



To pull the log, tie a long line to a tree or other anchor point with a roundturn and two half hitches. Then tie a butterfly knot in the long line to form the loop for the rope tackle. Run the end of the long line through the bowline and back through the butterfly loop. Then pull on the end of the long line to pull the log.

Pioneering Uses

- To adjust the strain on the guy lines of a pioneering project or a flagpole (see figures 98 and 99)
- To put a strain on a picket line used for tying up horses or canoes
- To tie down and secure your equipment on a trailer or truck (see figure 100)
- To hoist or lower equipment in rock climbing
- To tie a line to air your sleeping bag or to make a clothesline for wet clothes
- To tighten hold-down ropes on large tents and flies

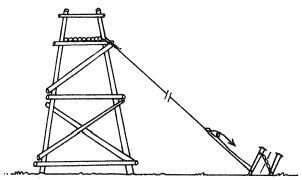


Figure 98

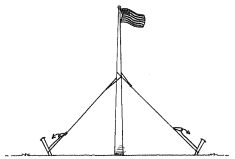


Figure 99

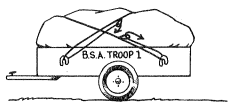


Figure 100

Lashing

We could imagine that the first lashing made by man was wrapping a few strips of bark around a stone to hold it to a tree branch to make an ax to hunt and build with. Even today with all our modern ways to hold things together, it is still fascinating to lash sticks or spars together to make a camp gadget or useful structure.

There are still areas in the world where lashing spars (or bamboo poles) is the basic means of building structures. In Scouting, we use the same methods but have replaced strips of bark and vines with natural and synthetic fiber ropes.

The best choice of rope to use for lashing the type of pioneering projects shown in this pamphlet is pure manila rope. Therefore, all references to rope used for lashing in this section refer to manila rope.

Yet, sometimes we are faced with a problem—we have to use what is available and economical to get the job done. When making camp gadgets for temporary use, for example, you could use lesser quality, less expensive rope or even binder twine for small projects.

Square Lashings

The basic type of lashing for most projects is some form of a square lashing. This lashing is used to join two spars together, usually at a right angle, but not always. For example, square lashings are used when building a trestle to join the ledger and header to the legs at right angles. But it is also used to hold the ends of the X bracing to the legs at an angle. (Refer to the "Making a Trestle" section, page 73.)

In this section, three different square lashings are shown: (1) the traditional square lashing, (2) the modified square lashing, and (3) the Japanese Mark II. All three types of square lashings accomplish the same thing by making three wraps and two frapping turns around the spars being held together.

The only difference between these three different square lashings is the type of knot that is used to start and complete the lashing.

You may learn that one of these knots is easier to tie; if so, you can stick with the one you are most comfortable with.

In addition to square lashings, you will most likely need to know how to make diagonal and shear lashings. Some methods of making these types of lashings are also shown later in this section.

Terms

No matter what type of lashing you're making, there are two basic terms you should be familiar with: wraps and fraps. The basic difference between the two terms is that a wrap is made around the spars, while a frap is made around the rope itself.

Wrap. A *wrap* is a turn made around the two spars to hold the spars tightly together. Usually, three wraps are made to form a square lashing. Some other lashings require more wraps.

Frap. A *frap* is a turn made between the spars. It goes around the wraps to pull the wraps tighter. Usually two frapping turns are made on a lashing.

Good lashings are not made in a hurry. Each wrap must be made with a strain on the rope. Frapping turns should be pulled up as tightly as possible before the final knot is tied.

Rope Length

When you set out to make a lashing, the size and length of the rope you need are among the first questions you have to answer. To determine the length of rope needed for a lashing, add the diameters (in inches) of the two spars at the point where the lashing is being made. If one spar is 2½" in diameter and the other is 3½" in diameter, the total equals 6". Multiply by 3' to get the length of the rope needed for the lashing.

If you use a rope that is too short to make the three wraps and two fraps needed for a lashing, you should add (splice or join with a square knot) a length of rope to complete the lashing with three full wraps and two fraps. For safety, don't leave the lashing short.

If you find you have extra rope, make more wraps or fraps to use up the rope to avoid cutting the rope or leaving long loose ends hanging out.

Rope Diameter

In most cases ¼"-diameter manila rope should take care of lashing two spars together as long as the combined diameter of both spars is 6" or less. When the combined diameter is over 6", use ⅜"-diameter rope.

Pioneering Kit

Later in this pamphlet, we refer to a pioneering kit. If your troop or camp puts together a pioneering kit, it should contain lashing ropes that are cut to standard lengths: 10', 15', 20', 30', and 50'.

Both ends of these lashing ropes should be properly whipped. It also helps to color-code the ends of all ropes with a bit of paint to denote each length. When storing ropes, make sure they are dry and properly coiled. Never "hank" ropes for storage. That is, don't wrap them around your hand and elbow to form a coil. Tie each coil with a short piece of cord and store the coiled rope on pegs or in a ventilated storage box.

Traditional Square Lashings

In Scout pioneering in the United States we most often see the square lashing started with a clove hitch. The clove hitch is tied on the vertical spar, just below where you want to join the crossing horizontal spar (see figure 101).

Using a clove hitch to start this lashing allows for two things. First, you can rest the crossing spar on the clove hitch to help support it as you begin the lashing while building your structure. Second, the clove hitch helps keep the structure from racking (twisting out of shape), causing the lashing to loosen as it is moved or hoisted into position.

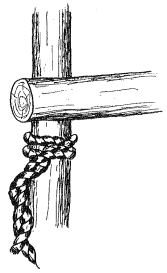


Figure 101

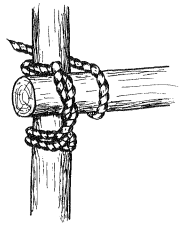


Figure 102

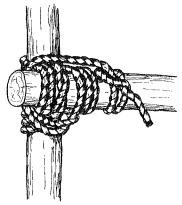


Figure 103

After the clove hitch is tied, wrap the excess short end of the rope around the standing part of the rope (see figure 1). Hold the crossing spar up to the vertical spar and make three wraps around the spars using the long end (see figure 102). Pull each wrap tight to hold the spars together. Make two frapping turns around the wraps (between the spars) to pull the wraps tight and finish with another clove hitch on the horizontal spar (see figure 103).

The square lashing is a good strong lashing. Its only disadvantage is that you must work with the full length of the rope as you lash.

One other point to make about the square lashing is that you shouldn't be fooled by or limited by its name. Although two spars can be lashed together at 90° using a square lashing, it can also be used to lash two spars together at any angle. For example, a square lashing is used to lash the ends of two light spars to the uprights of a trestle to form the X bracing. A diagonal lashing is used at the center of the X to hold the crossed spars together.

Modified Square Lashing

The modified square lashing was developed because of the difficulty usually experienced when tying a clove hitch to complete the traditional square lashing. The clove hitch that starts the lashing is easy enough to make, but tying a clove hitch at the end of the lashing is a different matter.

As shown in figure 104, the modified square lashing starts with a clove hitch. When tying the clove hitch, let the running end of the clove hitch extend about 12". Also, do not twist the short end around the standing part of the rope as on the traditional square lashing.

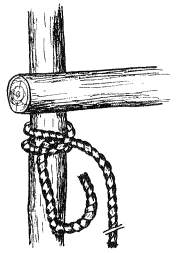


Figure 104

Figure 105

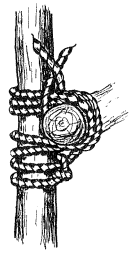


Figure 106

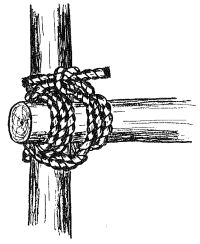


Figure 107

After tying the starting clove hitch, proceed as usual using the long end of the rope to make three wraps (see figure 105). Then make two frapping turns (see figure 106).

To complete the lashing, bring up the short end of the rope that extends from the clove hitch and tie a square knot (see figure 107). Bring the short end up in the opposite direction of the frapping turns.

As in the traditional square lashing, there is some disadvantage in having to make the complete lashing using the one end of the rope.

Japanese Mark II Square Lashing

The Japanese Mark II square lashing has found its way into Scouting in the United States through Wood Badge training in England, and because of the work of John Thurman, camp chief of Gilwell. He observed it on one of his many world trips related to Wood Badge training.

This lashing is a straightforward approach to the task of lashing two spars together. Begin by placing the spars in the desired position. Now fold your lashing rope in half.

The midpoint of the rope is placed around the vertical spar and just under the crossing spar (see figure 108). Now work both ends of the rope at the same time to make three wraps around the spars (see figure 109).

After completing the three wraps, bring the two ends up between the spars in opposite directions to make the frapping turns around the wraps (see figure 110). Pull the frapping turns tight, and complete the lashing by tying the two ends with a square knot (see figure 111). It's that simple.

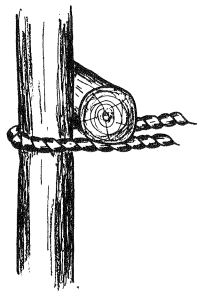


Figure 108

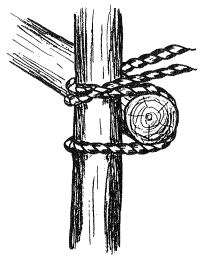


Figure 109

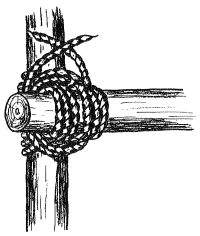


Figure 110

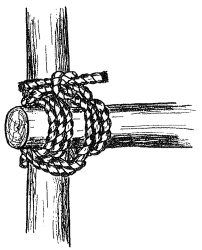


Figure 111

The advantage of this lashing is that you're working both ends of the rope at the same time. This makes it much quicker to tie since each hand has less rope to pull through. This lashing has the same holding effect as both the traditional and modified square lashings.

If more support is needed for the crossing spar, a clove hitch can be tied at the midpoint of the rope. Tie the clove hitch to the vertical spar just below the crossing spar. You can rest the crossing spar on the clove hitch as the lashing is being made. Then use both ends to complete the lashing as described above.

Diagonal Lashing

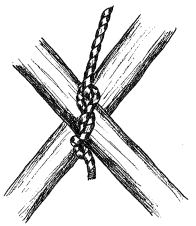


Figure 112

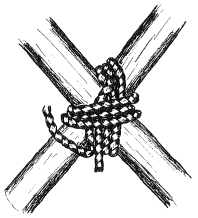


Figure 113

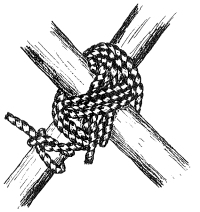


Figure 114

When putting crossed braces on a structure to keep it from racking (as used when making a trestle), the most important lashing is the diagonal lashing where the spars cross. (Refer to the "Making a Trestle" section, page 73.)

When the cross spars are properly assembled on the trestle, they will be standing apart where they cross. That is, there will be a few inches of space between the spars where they cross at the center of the X. To pull them tightly together, a timber hitch is used to start the lashing (see figure 112). As the timber hitch is pulled tight, the spars are sprung together. Next, three wraps are made in each direction across the X (see figure 113). To complete the lashing, make two frapping turns between the spars, pulling the wrapping turns tightly together and taking up any slack (see figure 114). Finally, tie a clove hitch on one spar to complete the lashing (see figure 114). When this lashing is added to the cross braces, it helps keep the trestle from racking.

West Country Shear Lashing

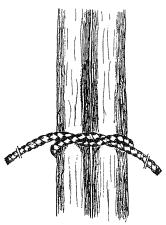


Figure 115

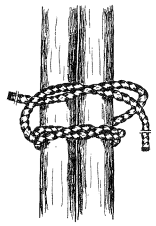


Figure 116

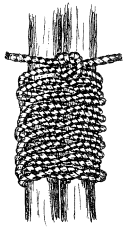


Figure 117

You probably remember the term *West Country* in the section on whipping. The pattern you make with the rope to form this lashing is the same as the one to make the whipping. The only difference is that this lashing is tied around two spars to hold them together.

To make this lashing, tie a series of half-knots (overhand knots) around the two spars (see figure 115). Tie one half-knot in front and the next half-knot in back (see figure 116). Make sure each half-knot is pulled up as tight as possible. After tying six to ten half-knots, finish off the lashing with a square knot (see figure 117). By using six to ten half-knots in this lashing, it makes it very strong and effective, but can be a little difficult to untie.

The West Country shear lashing is usually used to lash two spars together to extend the overall length of the spars. When this is done, you should make two sets of lashings, not just one lashing. Make one lashing at each end of the overlapping spars.

Two-Spar Shear Lashing

There are two applications for the two-spar shear lashing. One is where it is necessary to extend the length of one spar by lashing another spar to it. The second application is when spar legs are to be spread apart to form an A frame.

In the first application (extending a spar), two lashings are made where the spars overlap. The amount of overlap of the two spars should be determined by the diameter and length of the spars being used. The lashings should be placed as far apart as possible to maintain the strength needed.

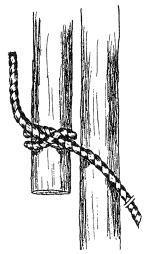


Figure 118

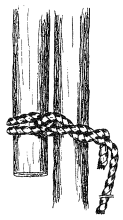


Figure 119

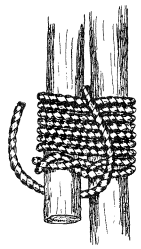


Figure 120

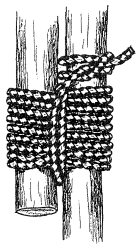


Figure 121

The two-spar shear lashing starts with a clove hitch on one spar (see figure 118). After making the clove hitch, wrap the excess part of the short running end around the standing part of the rope (see figure 119).

Unlike square lashings, the shear lashing requires eight or ten wraps around the spars before making the frapping turns between the spars to pull the wraps tight (see figure 120). This lashing then ends with a clove hitch on the other spar (see figure 121).

If you're making an A frame, start with the spars side by side and tie a clove hitch on one spar about 1' from the top end of the spars. Then make ten wraps around the spars, making the wraps somewhat loose. The legs are then spread to the required distance. This should put a strain on the wraps.

With the legs apart, make the frapping turns around the wraps to pull them tight. Finally, complete the lashing by tying a clove hitch on the opposite spar.

Strop Lashing

In some pioneering situations all that's needed is a few wraps with a rope, a light cord, or binder twine to hold two small spars or sticks together. Wrap the rope or cord around the spars a few times and finish with a square knot. This is called a strop lashing.

A strop lashing can be drawn down tight, or it can be made as a loose wrap so that it allows movement or acts as a hinge.

The strop lashing can have several simple applications at camp. For example, if you don't want to dig a hole for the staff of your patrol flag, drive a tall stake in the ground. Then use a light cord or binder twine to make two strop lashings about 1' apart to hold the staff to the stake (see figure 122).

If your patrol just completed a signal tower and you want to show who did it, lash your patrol flag to the top of one of the legs with a strop lashing.

When you're adding walkways to a bridge, they need to be joined to the trestle to form a single unit. The way to do that is to lash the two walkways to the transom at the center of the bridge with two or three strop lashings (see figure 123).

The ends of the walkways also need to be held to stakes. Use a strop lashing to hold the ends of the walkway to the stakes (see figure 124).

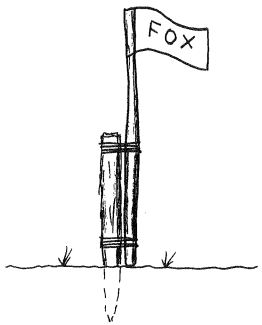


Figure 122

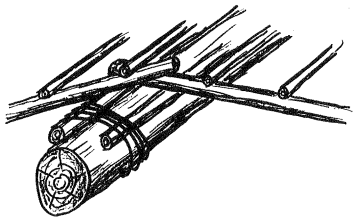


Figure 123

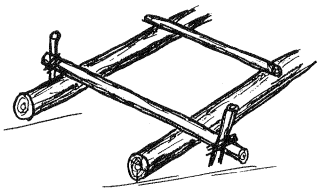


Figure 124

Making a Trestle

A trestle is the basic component for building a bridge in a pioneering project. It is used to support the walkways.

The most basic form of a trestle is an H frame. It consists of two legs, two ledgers, and two cross braces (see figure 125). When building a bridge, the top ledger is also called a transom. This is the part that supports the walkways.

To make an H-frame trestle, the two ledgers are lashed near the top and bottom of the legs and the cross braces are added, lashing them to the legs.

All of the lashing on an H-frame trestle is done with two types of lashings: a square lashing and a diagonal lashing. The ledgers are lashed to the legs with square lashings. Although it might not look like it, the cross braces are also lashed to the legs with square lashings, not a diagonal lashing. A diagonal lashing is used to lash the two cross braces together where they cross in the center.

When setting out to build an H-frame trestle, choose the two spars for legs first. These spars can be almost any length, depending on the type and height of the structure you're building.

To build a basic H frame, lay the two legs on the ground with the two butt ends of the spars at the same end and even with each other. Then add the ledgers.

Ledgers. The ledgers are spars that are typically 2" to 2½" in diameter. They are lashed to the legs with square lashings. Any of the three square lashings shown in this pamphlet can be used. The position of the ledgers on the legs will depend on the structure you're building. There are a couple of general rules to keep in mind.

First, always keep the legs parallel and the butt ends of the legs even with each other as you're lashing on the ledgers. If you don't, the trestle will stand crooked when you stand it up. As you add the ledgers, they should not stick out too far beyond the legs. You must leave enough room at the ends to tie the lashing. Any more will get in the way.

When using a square lashing or a modified square lashing to tie the ledgers to the legs, be sure the starting clove hitch is placed on

the leg so it's beneath the ledger. When the clove hitch is below the ledger it will help support it when the trestle is stood upright. As you tie the lashings, make sure they are all very tight.

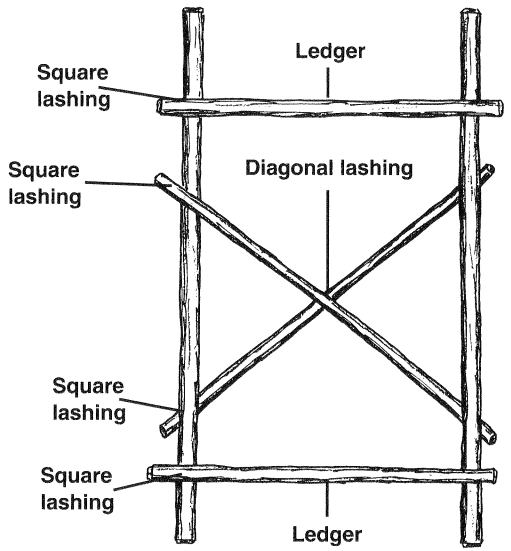
If you use a Japanese Mark II lashing, you can start this lashing with a clove hitch in the middle of the lashing rope to help support the ledger.

Cross braces. Next, the cross braces are added. The cross braces are spars that are usually 2" in diameter. They are lashed to the legs in a particular sequence.

First, flip the trestle over and work on the **opposite** side from the ledgers (see figure 125). Lash one cross brace to the back side of both legs. As mentioned before, use a square lashing (not a diagonal lashing) to attach the ends of the cross braces to the legs.

The second cross brace is added so that the bottom end is on the same side as both ends of the first cross brace. The other end is placed on the front side, the side with the ledgers (see figure 1). This is done so that the cross braces are standing slightly apart. There will be a gap where they cross at the center.

Figure 125



Diagonal lashing. After the ends of the ledgers and the cross braces are lashed to the legs, stand the trestle up on end. Adjust the trestle so that the legs are parallel. Also check to see that the top ledger is parallel to the ground. If it's not, lower the trestle, untie the lashing, and adjust it.

When the legs are parallel and the top ledger is parallel to the ground, you're ready to tie the diagonal lashing to the cross braces while the trestle is standing upright. This lashing is very important to the strength of the trestle.

The diagonal lashing creates triangles that are important to stiffen the arrangement of the spars and to keep the trestle from racking. Look around at steel towers, bridges, or buildings being erected and you will see the triangle used in many places for the same reasons as we use it to build a trestle.

When the cross braces are lashed to the legs, there is a slight gap between them where they crossed at the center. A diagonal lashing is used here because it starts out with a timber hitch. The timber hitch pulls the cross braces tightly together. This adds strength to the whole trestle. You have to keep a strain on the lashing rope as you complete the diagonal lashing with three wraps in each direction around the X. Then make two frapping turns between the cross braces to pull the wraps tight. Finally, finish by tying another clove hitch on one cross brace.

Once the possibility of racking has been taken care of with the diagonal lashing, the trestle's vertical legs provide support for a large downward load. Since this is a downward force, also known as a shearing force, the legs don't have to be very big. In fact, the overall shape of the trestle is an engineered structure that is able to support quite a bit of weight with rather small-diameter spars for the legs.

Walkways

Bridges are very popular pioneering projects. Essentially, a bridge consists of one or more trestles that support some sort of walkway. In the case of a monkey bridge, the walkway is just a rope that you walk on. But for many other bridges, you can build a walkway from spars that's easier to walk on than is a monkey bridge.

Three of the bridges shown in this pamphlet use the same type of walkway. Each walkway is 10' long and consists of two lateral spars and several cross spars. You can also add a 10' length of 2" × 10" construction lumber as the plank to walk on.

The lateral and cross spars are lashed together to form a walkway as a subassembly. Then the walkways and the trestles are taken to the assembly site—the creek or ravine over which you're building your bridge—and lashed together to complete the bridge. In most cases, there are at least two walkways on each bridge.

Making a Walkway

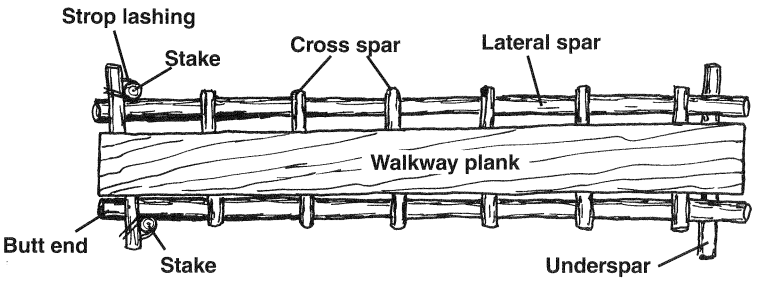
To make a 10' section of walkway, select two spars with a butt diameter of 3½". These spars should be matched in the amount of sag they have when you stand on them with the ends supported above the ground. If one spar sags more than the other, it will make the walkway slant from side to side, making it hard to walk on.

Cross spars. The cross spars for the walkway should be approximately 2" to 2½" in diameter and 3' long. You will need two additional cross spars that are 3½' long for each walkway section. (The longer spars go at each end of the walkway.)

All of the cross spars are lashed to the lateral spars with ¼" rope. Since the lashing is made only to hold the cross spars in position and not support weight, you can use a double strand of binder twine.

If you use binder twine, double it over and twist it a few times before you start the lashing. Make sure you have enough to complete the full lashing with the doubled-over binder twine. Don't finish the lashing with only one strand if you run short. Instead, tie on more binder twine to complete the lashing.

Figure 126



Each of the cross spars is lashed to the lateral spars with a square lashing, making three wraps and two fraps. (Refer to the "Lashing" section, page 63.) You can use any one of the three variations of square lashings mentioned in this pamphlet for the cross spars. The Japanese Mark II is the easiest and quickest to tie.

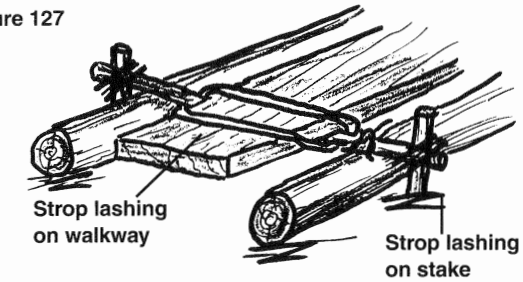
There are two ways to approach lashing on the cross spars. If you are going to add a plank over the top of the cross spars, you will need a total of eight cross spars for each walkway. That is, six 3'-long cross spars, and two 3½'-long cross spars (see figure 126).

Start by lashing one of the 3½'-long cross spars about 6" from the butt end of the lateral spars. Place this spar on top of the lateral spars so that the ends of the cross spar extend 3" to 4" out over both sides of the lateral spars (see figure 126). This additional length hanging out is used to lash the cross spar to the stakes, which anchors the ends of the walkway in place.

After the first cross spar is lashed in place, add six more 3'-long cross spars every 16" to 18" down the length of the lateral spars. The last cross spar should be lashed about 12" from the end of the lateral spars to allow room for the "underspar."

Underspar. An important feature of this type of walkway is to lash one cross spar to the underside of the lateral spars 6" from the end. When the two walkway sections are placed on the trestle to form the bridge, these underspars should contact the transom of the trestle. Then the three spars (two underspars on the two walkways and the

Figure 127



transom spar on the trestle) are lashed together at three points using a strop lashing (see figure 127).

Walkway plank. Before lashing the walkway to the trestle, the walking plank should be lashed to the cross spars in at least three places using a strop lashing.

To make a strop lashing, use a length of doubled-over binder twine. Reach down and wrap the middle of this length of binder twine under one of the cross spars (see figure 127). Then wrap the binder twine over the walkway plank and down around the cross spar at the other side of the plank. Do this two or three times and finish with a square knot.

If you are going to walk directly on the cross spars (with no plank on top), you will need enough cross spars to make a safe walkway, one that your foot cannot slip through. Start making the walkway as described before by lashing a 3½'-long cross spar at the butt end of the lateral spars. Then lash the 3'-long cross spars about 3" apart, using as many cross spars as necessary to go the entire length of the walkway, ending about 1' from the other end. Finally, add the 3½'-long underspar.

Anchoring the walkway. After the walkway is assembled, the butt ends are placed on the bank of the creek or ravine. This end of the walkway is anchored in place by driving stakes in the outside corners formed by the lateral spars and the first cross spar. Lash the cross spars of the walkway to the stakes with a strop lashing.

The small ends of the walkway are attached to the trestle to form the bridge. On most bridges, walkways come from both directions to meet at the trestle. The ends of the walkways rest on a transom spar

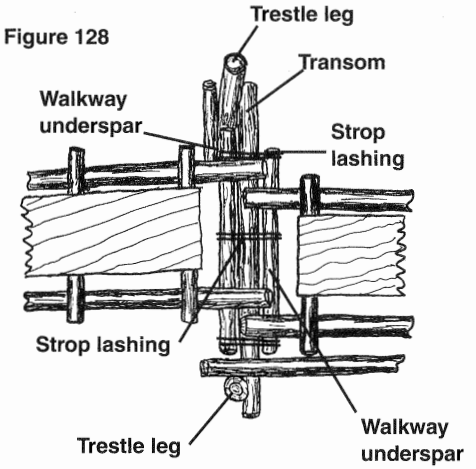
of the trestle. Then the two underspars on the walkways are lashed to the transom spar at three points with a strop lashing (see figure 128).

When the walkways are lashed to the stakes and to the trestle, all the walkway sections become joined to form a single unit that is very strong.

If you put together a pioneering kit, take some time to save the matched lateral spars to be used for walkways only. (Refer to the "Pioneering Kit" section, page 96.)

While the above text describes how to make 10' walkways, you can make 8' or 12' sections the same way. If you use the longer walkways, be sure to test the strength of the spars before lashing them into a walkway that could be unsafe.

Figure 128



Pioneering Projects

The craft of building with ropes and spars continues in remote areas throughout the world today. Scouts can apply the skills of knot tying and lashing to build pioneering structures that are needed to make living in camp a little more comfortable. Whether you build a simple gadget, or a bridge to provide a shortcut to the swimming pool, pioneering can be rewarding and fun.

The pioneering projects shown here, along with the suggested sizes and lengths of spars, are intended for building "boy-size" structures; that is, projects that can be built by boys of Boy Scout age.

You don't have to build a huge tower to learn the skills and enjoy the fun of pioneering. These projects are designed so that you can build them in a few hours with a minimum of equipment and supplies. Yet, you will still learn how the basic pioneering skills of knot tying and lashing must work together with the design of a structure to produce a sound, safe pioneering project.

Building these projects will be much easier if you put together a pioneering kit first. (Refer to the "Pioneering Kit" section, page 96.) The success of any pioneering project is directly related to the planning and preparation you put into the project from the beginning.

Here are some things to take into consideration before you build a pioneering project:

- Decide on the type of project you want to build. Take into consideration the equipment, the number of people needed, and the time required to build it.
- Check the site where the project is going to be built. Collect all the information that you will need when building the project. For example, are there any natural anchors for guy lines? How wide and deep is the creek where a bridge is to be built?
- Make a rough sketch of the project or work from an approved plan drawing. Along with the sketch, have a list of materials that includes all the equipment you'll need. You don't want to start a project and later learn you need something you don't have.

- Select the necessary spars you'll need for the project, making sure that you have enough spars with the proper butt diameter and length to build a safe project.
- Determine the sizes and lengths of all the ropes needed for lashings, guy lines, etc.
- Before you start building, determine if the project can be divided into subassemblies for ease of lashing and erecting. Assign crew members and a crew leader to each of the subassemblies, based on skill level and experience.
- Go over the plans with all the crew members. Assign only one person to give signals when raising all or part of the structure.
- As you're building the project, frequently check the progress to make sure it is being done with safety in mind.

A word about the appearance of the project: Part of the skill in building with ropes and spars is to select the spars that are best suited to the structure. In some situations, the supply of spars might be limited.

It is not necessary for your project to be picture perfect, but rather that it is structurally sound. If one or two spars are a bit longer than required, that's fine as long as the lashings are in the proper location for strength and the diameter of the spars will carry the load applied.

Try to avoid cutting off the ends of the spars and ropes just to fit a certain project, especially if you're working with spars from a pioneering kit. The next crew might want to build a different project and could use the spars and ropes at their original lengths.

The spars used for a pioneering project should have the bark removed for two reasons. Bark beetles and other boring insects can seriously decrease a spar's strength, and inspection is easier with the bark removed. Also, if the project racks, the bark under the lashings can be loosened, which in turn makes the lashing loose and adds to the possibility of making the whole project wobbly and unsafe. (And, bark under a lashing can be rubbed off in the process of setting up a project.)

Note: Any pioneering structure that is to be a permanent camp improvement should not be left with only lashings. It needs to be bolted together for safety and maintenance.

Single Trestle Bridge

This simple crossing bridge uses only a single trestle and two walkways. The legs of the trestle are extended up above the walkway to provide a way to attach a handrail. The length of the spars listed for the walkways and trestle will be enough to build a bridge to span a creek or ravine that's up to 4' deep and 18' wide.

This project can be broken into three subassemblies: the trestle, the two walkways, and the four light spars for handrails.

Trestle. Begin by building the trestle. The legs for the trestle should be spars that are about 3" in diameter and 8' to 10' long. When choosing these spars, take into account the depth of the creek you're crossing.

The distance from the base of the legs to the top ledger (transom) on the trestle should be about 1' higher than the level of the banks of the creek. This will allow the walkways to slant up. Then allow an additional 4' in height on the legs from the top ledger up to the top of the legs for attaching the handrail.

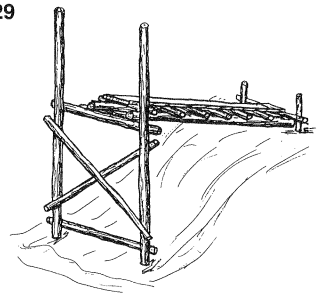
The top ledger of the trestle should be about 3" in diameter since it also acts as the transom and carries all the weight of the walkways and the person using it. The bottom ledger can be smaller; a 2"-diameter spar will work here.

The trestle is assembled with square lashings to hold the ledgers and the ends of the cross braces to the legs. The center of the cross braces are lashed together with a diagonal lashing. (Refer to the "Making a Trestle" section, page 73.)

Walkways. The two walkways are assembled as separate subassemblies. (Refer to the "Walkways" section, page 76.) Be sure to make the cross spar at the end of the walkway long enough to attach to both the stakes and the handrails without getting in the passageway.

Assembly. To assemble the bridge, set the trestle in the center of the creek. Heel in the bottoms of the trestle legs by setting them in holes approximately 4" to 6" deep (see figure 129). This will prevent the trestle from shifting, and is also a way to level the transom spar as the trestle is set in place so that the walkways are level.

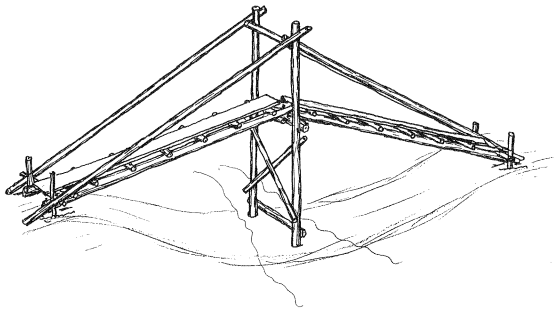
Figure 129



Next, put the walkways in position from both sides and lash the walkways' underspars to the transom (top ledger) of the trestle. Then drive stakes at the other end of the walkways. Lash the ends of the cross spars on the walkways to the stakes.

Handrails. Finally, handrails are provided to help those crossing the bridge and also to add strength to the structure of the bridge. When the handrails are added, they form triangles with the walkway and the trestle leg. These triangles produce a strong structure that prevents the bridge from racking. Lash the handrails to the top of the trestle legs and to the stakes with simple strop lashings (see figure 130).

Figure 130



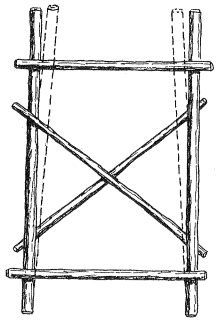
List of Materials for a Single Trestle Bridge

2	3" × 8' or 10' trestle legs
1	3" × 4' trestle top ledger (transom)
1	2" × 4' trestle bottom ledger
4	3" × 10' walkway lateral spars
12	2" × 3' walkway cross spars
4	2" × 3½' walkway cross spars
2	2" × 10" × 10' walkway planks
4	2½" × 12' handrails
4	stakes

Single Lock Bridge

The single lock bridge shown here is a well-established and basic design. The list of spars shown for this project should build a bridge to span a creek or ravine approximately 4' deep and 18' from bank to bank.

Figure 131

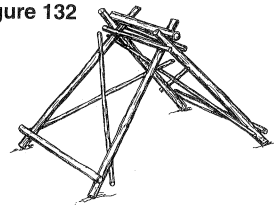


Trestles. The bridge consists of two trestles and two walkways. Begin by building the two trestles as subassemblies. Adjust the length of the spars for the trestles so that when they are placed in the creek, as shown in figure 132, the tops of the ledgers will be about 1' above the level of the banks of the creek. This will give a comfortable slant to the walkways.

When constructing the two trestles, build only one trestle first. Then as the second trestle is being built, make sure that the legs are narrower at the top and fit between the legs of the first trestle (see figure 131).

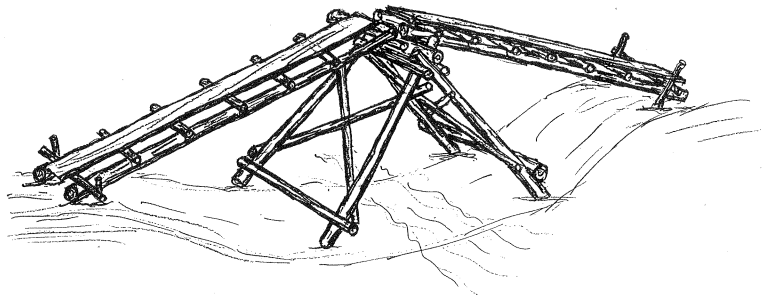
Walkways. Next, the two walkways are constructed as subassemblies. Each walkway consists of two lateral spars, six cross spars, and two longer cross spars. One of these two longer cross spars is used as an underspar at the end of the walkway that attaches to the transom. The other longer cross spar is used to attach to the stakes. (Refer to the "Walkways" section, page 76.)

Figure 132



Assembly. After building the trestles and walkways, take them to the assembly site (the creek or ravine). Place the trestles in the center of the creek so that the tops of the trestles are interlocked (see figure 132). Then lift a 3"-diameter transom spar to fit on top of the interlocked trestle legs. Now, heel in the bases of the legs in holes 4" to 6" deep. As you're heeling in the legs, level the transom spar so that the walkways don't slant when they're added.

Figure 133



Next, the two walkways are put into position (see figure 133). Lash the underspars on the walkways to the transom spar with strop lashings at three points. Finally, the cross spars at the ends of the walkways are lashed to the stakes.

By lashing the walkways to the transom spar and lashing the ends of the walkways to the stakes, you make a complete walkway unit that will prevent movement and provide a sturdy bridge deck.

List of Materials for a Single Lock Bridge

4	3" × 6' trestle legs
4	2½" × 4' trestle ledgers
1	3" × 4' trestle transom
4	2" × 6' cross braces
4	3" × 10' walkway lateral spars
12	2" × 3' walkway cross spars
4	2" × 3½' walkway cross spars
2	2" × 10" × 10' walkway planks
4	stakes

Single A-Frame Bridge

Building this bridge is quite simple because there are very few lashings needed for the center A frame. The A frame is a triangular shape that resists racking and provides strength to the structure.

A frame. Start this project by determining the depth of a creek or ravine to be spanned. You have to add 8' to that measurement to get the total height of the legs for the A frame. For example, to span a creek 4' deep, the legs of the A frame should be about 12' or longer.

This total length allows for the distance from the butt ends of the A-frame legs up to the transom that supports the walkways. The transom should be about 1' higher than the banks of the creek. It also allows for the height of the A frame from the walkways up to the tops of the legs to permit free passage for a person along the walkways.

Lay the A-frame subassembly out on the ground to check if the spars are long enough when lashed together for the two requirements mentioned above.

A-frame legs. When you've determined the length of the spars for the legs of the A frame, lash them together at the top with a shear lashing, not a diagonal lashing. This lashing should be made somewhat loose so that you can spread the spar legs apart to form the A frame. As you spread the spar legs, the shear lashing will tighten. A little practice will show you how loose to make the shear lashing initially in order for it to be tight when the A frame is formed.

Ledger and transom. To complete the A frame, use a square lashing to lash the bottom ledger across the legs about 1' from the bottoms of the legs. Then lash a transom spar to support the walkways at the proper height in relation to the banks of the creek.

Walkways. The two 10' walkway sections are made as separate subassemblies. (Refer to the "Walkways" section, page 76.)

Assembly. After the walkways are made, take them to the assembly site along with the A frame. Place the A frame in the center of the creek and heel in the legs in holes about 4" to 6" deep. As the legs are being heeled in, level the transom to accept the walkways in a level position.

Figure 134

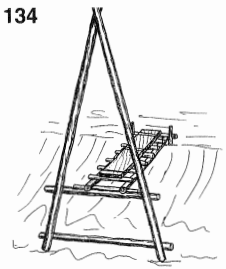


Figure 135

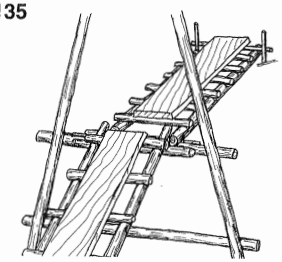
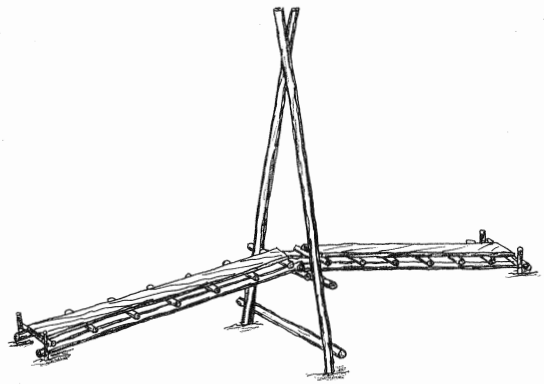


Figure 136



When the A frame is upright and the transom is level, lash both underspars on the walkways to the transom with strop lashings at three points. Finally, lash the cross spars at the ends of the walkways to stakes on the banks of the creek with strop lashings.

For safety, it's best to add a light ¼" guy line from the top of the A frame to both sides of the creek to prevent it from tipping over.

List of Materials for an A-Frame Bridge

2	3" × 12' A-frame legs
1	2" × 6' bottom ledger
1	3" × 6' transom
4	3" × 10' walkway lateral spars
12	2" × 3' walkway cross spars
4	2" × 3½' walkway cross spars
2	2" × 10" × 10' walkway planks
4	stakes

Double Ladder Tower

This project solves the old problem of wanting to build a signal tower when there aren't enough big spars to do the job. The double ladder tower requires four 14' spars and several smaller spars, but not nearly the amount needed for a four-leg signal tower. It also cuts down on the number of lashings required.

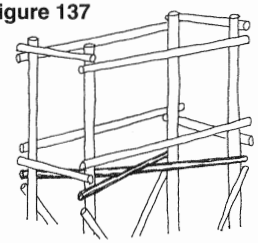
This tower is not free standing. It requires the use of guy lines to hold it steady. Review the sections on anchors and rope tackle if this is your first encounter with guy lines.

Assemble the ladders. This project begins with building two ladders: a climbing ladder and a supporting ladder. Lay out two pairs of spars on the ground for the legs of the ladders. Be sure the butt ends are even at the bottom so that the tower will stand up straight. Before you begin any lashing, mark the positions where the spars that will hold the top platform are to be lashed onto the legs. This is about 4' from the top ends of the legs.

To make the climbing ladder, lash ten rungs on one pair of legs at about 1' intervals. The top rung should be lashed on where you marked the position of the platform, 4' from the top. Also, the top handrail is lashed on to complete the climbing ladder.

To make the supporting ladder, lash three spars on the other set of legs to serve as the bottom, center, and top spreaders. The top spreader should be lashed at the point you marked for the platform, 4' from the top. Then lash on the top handrail, as on the climbing ladder.

Figure 137



Platform X brace

Lash the ladders together. Now you have to join the two ladders to form the tower. Turn the two ladders up on their sides so they're parallel to each other and approximately 6' apart. Check to see that the bottoms are even. Now lash on the base spreader to join the bottoms of the two ladders.

Lash on the platform supporting spar just above the top rung and top spreader on the ladders. Before proceeding, check the measurements from the bottoms of the legs to the platform supporting spar to make sure they're equal on both legs so that the platform will be level.

Continue by lashing on the top long handrail. Then lash on the two side X braces diagonally between the legs using square lashings to lash the ends to the legs, and a diagonal lashing where they cross.

Lash the other side. To make the lashings on the other side, you have to get the whole crew together to roll the tower over 180° so that it's laying on the X braces and the other sides of the ladders are up where they will be easier to get to.

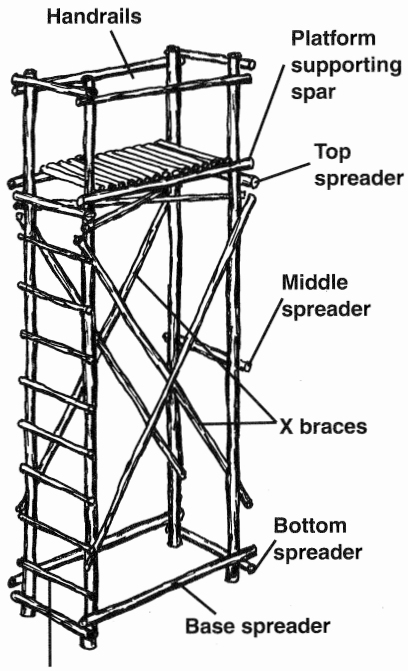


Figure 138

Then proceed as before. Lash on the base spreader spar and the platform supporting spar. Again, measure to make sure there's equal distance from both ends of the platform support spar to the bottoms of both legs. Continue to lash on the top long handrail and finish with the X braces.

Lash two more platform X braces under the platform. These braces go diagonally across the legs just under the platform to help the tower resist racking (see figure 138). Use square lashings to lash them to the legs and a diagonal lashing where they cross.

Before standing the tower upright, lash on the spars to form the platform floor.

Anchors and guy lines. When all the lashings are done, move the tower to where it will be hoisted. Before actually hoisting the tower, lay out the position of the four legs on the ground. Then determine where the four anchors for the guy lines will be placed to steady the legs of the tower. (Refer to the "Anchors" section, page 55, to determine the position of the anchors.)

If the tower is positioned to make use of a natural anchor (such as a tree), prepare anchor strops to attach the guy lines. For any guy lines that won't be using natural anchors, build anchors using pioneering stakes. At a minimum, you will need to build well-constructed 1-1 anchors at all four corners. (Refer to the "Anchors" section, page 55, for more on 1-1 anchors.)

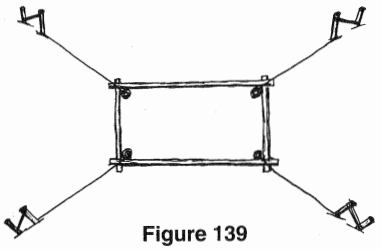


Figure 139

Attach the four guy lines to the legs just above the platform. The guy lines should be ⅜"-diameter manila or polypropylene rope. They're attached to the legs of the tower using a roundturn and two half hitches, and securing the running end of the rope.

Note: For safety reasons, never use a taut-line hitch on guy lines, or in any pioneering work for that matter. If the tension is eased, the knot can slip.

Hoisting the tower. Hoisting the tower up into a vertical position is done with separate ropes. Do not use the guy lines. Tie two lines on the side of the tower being lifted and one line on the opposite side to prevent overpulling and toppling the tower.

You will need a whole crew to do the hoisting. First, there should be a safety officer who observes for all safety considerations and signs of trouble during the hoisting. There should also be a signal caller who tells the crew members when and how fast to pull on the hoisting ropes, and when to stop pulling. Two or more Scouts should be on each of the two hoisting ropes. And one or two Scouts should be on the rope on the other side to prevent overpulling the tower.

When everyone is in position, the signal caller should direct the Scouts on the hoisting ropes to hoist the tower into position. As soon as it's up, temporarily tie the guy lines to the anchors using a roundturn and two half hitches.

Heel in the legs. With the tower upright, heel in the butt ends of the tower legs in holes about 4" to 6" deep. This is done to steady the tower and can also help in leveling the tower to make sure that the platform is level and the tower itself is vertical.

Tighten the guy lines. To hold the tower steady, gradually apply strain to each of the four guy lines at the same time. One of the easiest ways to adjust the strain is to use a rope tackle on the anchor end of the guy lines.

As soon as the tower is in position and the legs are heeled in, go to each of the anchors and untie the roundturn and two half hitches and replace it with a rope tackle.

Do this by tying a butterfly knot in the guy line about 6' to 8' from the anchor. (Refer to the "Rope Tackle" section, page 60.) Then wrap

the running end of the guy line around the forward stake of the anchor and back through the loop in the butterfly knot. When rope tackles are tied at all four anchors, gradually tighten the lines. Apply enough strain to each of the guy lines to hold the tower firm and in a vertical position. Then tie off the rope tackle and secure the running ends with half hitches.

Test the structure. Before the tower can be put into general use, make a test climb while the safety officer and the whole crew observes all lashings and anchors to ensure they are all secure.

Note: Some people are not comfortable climbing up to a high place. They should not be encouraged to climb if they are not sure of themselves. Do not pressure anyone to climb the tower if they don't want to.

List of Materials for Double Ladder Tower

4	4" × 14' ladder legs
10	2" × 3' climbing ladder rungs
3	2" × 3' support ladder spreaders
2	2½' × 3' base spreaders
2	2½' × 3' platform supporting spars
2	2" × 3' platform handrails
2	2" × 6' platform long handrails
4	2½' × 10' side X braces
2	2½" × 8' platform X braces
18	2" × 3½' platform floor slats
8	pioneering stakes for four 1-1 anchors

Double A-Frame Monkey Bridge

Using a double A frame to build a monkey bridge is a departure from the usual X frame that supports the foot rope and hand ropes. This new method has two distinct advantages over the X-frame version.

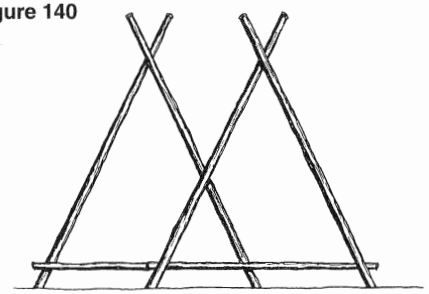
First, the double A frame provides a wider base, making it less likely to tip over. The second advantage is that the positions of the A frames can be adjusted so that the span between the hand ropes can be narrowed for better balance as you make the crossing.

Building the A frames. The first step in building this monkey bridge is to build four A frames using the 8' spars for the two legs, and 6' spars for the ledger.

Lay out the first set of three spars (two legs and one ledger) on the ground in position for lashing. Before lashing, drive three stakes, as follows, to help you to make all four A frames the same size: Drive a stake at the top to mark where the leg spars cross. Then drive stakes to mark the positions of where the bottom ledger crosses the legs. This will also indicate how far the legs are spread apart.

Now you can lash the four A frames together, laying them out one at a time using the stakes. Remember that all three lashings on the A frames are square lashings, even though the spars cross at less than a 90° angle.

Figure 140



Double A frame. When you have four A frames, you can lash two of them together to form a double A frame (see figure 140). Lay one A frame on the ground and then put another on top so that the bottom ledgers overlap one-half their length (approximately 3').

The first step in lashing the A frames together is to go up to where the two legs cross (the X formed by one leg from each A frame). Then with a good tight square lashing, lash the two legs together.

Note: The point where these legs are lashed together is where the foot rope will rest. You can adjust the overlap of the two A frames to adjust how high the foot rope will be off the ground. Also note where the tops of the A frames are because this is where the hand ropes will be.

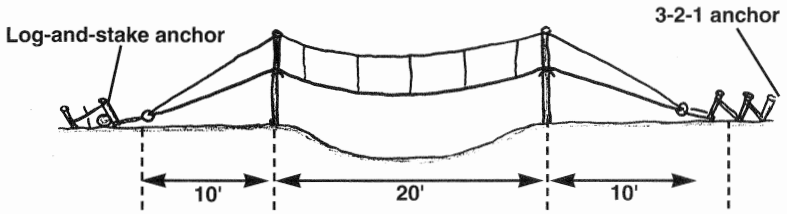
To complete the double A frame, stand it up so that the butt ends of all four legs rest solidly on level ground. Lash the two bottom ledgers together where they overlap with three strop lashings.

Now repeat this entire process to build the second double A frame.

Site preparation. Before you can erect the double A frames, you need to prepare the site. Begin by stretching a length of binder twine along the center line of where the monkey bridge is to be built.

Working from the center, measure out 10' toward each end to mark where the A frames are to be placed. They should be 20' apart. Then mark out another 10' from each A frame to where the anchors are to be built (see figure 141).

Figure 141



Note: These dimensions are for building a bridge with a 20' span. This is the maximum span for a bridge using a 50' rope. The extra 30' of rope is needed to have 15' of rope at each end for the proper distance from the A frames to the anchors (10'), and for the knots at the anchors (5').

Build the anchors. The foot rope will be attached to anchors at both ends. Before erecting the double A frames, build a 3-2-1 anchor, or a log-and-stake anchor 10' from where the double A frames will be erected (see figure 141).

Rope grommet. After the anchors are built, attach a rope grommet with a ring or shackle in it. (You can make the rope grommet with a 10' length of ½"-diameter polypropylene rope. Refer to the "Anchors" section, page 55, for more about rope grommets.)

Position the A frames. Prepare to erect the bridge by moving the A frames into position no more than 20' apart. Lay them down on the binder twine that marks the center line of the bridge.

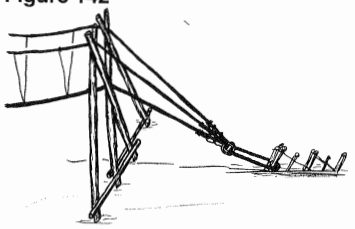
Hand and foot ropes. Now you can prepare the foot and hand ropes for the monkey bridge. Lay the foot rope in a straight line off to the side of where the A frames are laying. Then lay the two hand ropes

on the ground next to each other so they're parallel to the foot rope and 42" away.

Stringer ropes. Now you can add the stringer ropes that will go from the foot rope to the hand ropes. Start by tying the center of an 8'-long stringer rope (use ¼" manila rope) at the center of the foot rope, using a clove hitch. The stringer rope is tied around the foot rope so that both ends are 4' long. Add two more stringer ropes on both sides of the center stringer rope (so there are five stringer ropes in all), tying them about 4' apart.

Tie one end of each stringer rope to one of the hand ropes, again using a clove hitch. Then do the same with the other ends of the stringer ropes, attaching them to the other hand rope.

Figure 142



Assemble the bridge. You're just about ready to assemble the bridge. First place a piece of heavy canvas (called a "saddle") in the V formed by both double A frames. This will protect the foot rope and allow it to slide a little in the V without interfering with the lashing rope.

Now get the crew together to erect the bridge. You will need a safety officer to watch for any problems that might occur, and a signal caller to tell the crew members what to do.

You will need two Scouts to lift and hold each double A frame in place, two more Scouts to lift the foot rope into the V of the double A frames, and two more Scouts to lift the two hand ropes into place at the tops of the A frames.

Lift everything into place. Then while holding the A frames steady, temporarily tie the hand and foot ropes into the rings on the grommets using a roundturn and two half hitches (see figure 142).

Tighten the foot rope. Now you can put a strain on the foot rope. It's not necessary to use block and tackle since this will put too much strain on the lashings, the anchors, and the foot rope itself when there is a load on the bridge.

Whatever strain three or four Scouts can put on the foot rope by pulling it by hand will be enough. As soon as the bridge is used a few times, there will be a sag in the rope. This is fine because it means that you are working with a reduced strain on the foot rope as a safety measure.

Tighten the hand ropes. Next, tie the hand ropes to the top ends of the A frames. First, loosen one end at a time from the anchors. Then use a clove hitch to tie the hand rope to the top end of the leg of the double A frame. As you're tying these clove hitches, adjust the strain on the sections of the hand ropes between the double A frames to match the sag of the foot rope. Also adjust the length of the stringer ropes so there is even strain between the foot rope and both hand ropes.

After the hand ropes are tied to the tops of the A frames, move down and retie the ends of the hand ropes to the rings in the grommets using a roundturn and two half hitches.

Final testing. With caution, one crew member can get on the bridge as all lashings, anchors, and knots are observed by the safety officer and all other crew members. Make adjustments as required. Then secure the running ends of the hand ropes and foot rope with a piece of cord.

Safe operation calls for only one Scout to be on the foot rope of the monkey bridge at a time.

List of Materials for Double A-Frame Monkey Bridge

8	4" × 8' A-frame legs
4	3" × 6' ledgers
15	¼" lashing ropes
1	½" or ¾" × 50' rope
2	½" × 50' hand ropes
5	¼" × 8' stringer ropes
6	pioneering stakes for each 3-2-1 anchor
8	pioneering stakes for each log-and-stake anchor
1	5" × 4' spar for log-and-stake anchor
2	½" × 10' polypropylene ropes for anchor strops
1	½" × 3" welded ring, or ⅜" screw pin shackle
2	pieces of scrap canvas for foot rope saddle
	binder twine for anchor tieback straps

Pioneering Kit

The easiest way to make sure that you have all the necessary ropes, spars, and equipment ready to build a pioneering project is to put together a pioneering kit. It saves a lot of time if the pioneering kit is organized and ready to go so you don't have to spend time gathering all your equipment every time you want to build a pioneering project.

The pioneering kit described here consists of enough spars and ropes to build the projects shown in this pamphlet. It is designed to be used by a troop at summer camp to build "boy-size" structures; that is, projects that can be built by boys of Boy Scout age. This kit is also ideal to provide the equipment necessary for teaching pioneering skills to new Scouts.

The sizes and quantities of ropes and spars described here should be a good starting point for your pioneering kit. You can always add more equipment as the number of Scouts participating increases, or if some Scouts become more skilled and interested in building a wider range of projects.

Spars

Knowing that this pamphlet might be used by Scouts all over the world presents some problems concerning availability of suitable species of trees to use for spars. Generally, pine makes the best spars because pine trees are straight. Also, when pine is stripped of its bark and dried out, it makes spars that are not too heavy, therefore suitable for "boy-size" projects.

If pine is not available, cut spars from the straightest trees you can find. It might be to your advantage to make spars from hardwood species of trees. Given the strength of hardwoods, you might be able to use slightly smaller diameters as a weight-saving measure. Don't overlook softwood spars for light, smaller projects.

Some lumberyards and farm supply stores carry round, treated fence posts that can be used for short lengths. Barn poles might also be available for a few of the longer lengths. Remember that barn poles are quoted at the top diameter, not the butt end. The supply yard might let you select and match what you need.

On all spars, you should remove the bark and cut the ends square. It is recommended that you cut all the spars to exact, even lengths, regardless of their butt diameter, as shown in the chart below.

There are several combinations of lengths and diameters of spars suggested for this pioneering kit. This is because various projects might require the same length spar, but in different diameters depending on where it is to be used in the structure.

Quantity	Butt Diameter	Length	Quantity	Butt Diameter	Length
50	2" to 2½"	2'	20	3½"	10'
30	2" to 2½"	3'	8	4"	10'
15	2"	4'	10	3½"	12'
10	3"	4'	6	4"	12'
10	2"	6'	6	4"	14'
8	3"	6'	4	5"	14'
15	2½"	8'			
10	3"	8'			

Both ends of the spars in your pioneering kit should be color-coded with a band of paint to denote length. Here are the colors that can be used to easily show the lengths of the spars without having to measure them each time.

Length	Color
2' and 3'	no paint
4'	white
6'	red
8'	blue
10'	black
12'	green
14'	yellow

Ropes

The best all-around rope to use for pioneering projects is pure manila, three-strand, twisted. (Refer to the "Rope" section, page 12.)

All the ropes in your pioneering kit should be whipped on both ends. (Refer to the "Whipping" section, page 52.) In the case of plastic rope, whether it's twisted or braided, it must be first melted back and then whipped.

Quantity	Diameter	Length	Type
30	¼"	10'	manila
15	⅜"	10'	manila
10	½"	10'	manila
10	½"	10'	polypropylene
40	¼"	15'	manila
10	⅜"	15'	manila
8	¼"	20'	manila
8	⅜"	20'	manila
8	¼"	25'	manila
10	¼"	30'	manila
10	⅜"	30'	manila
10	⅜"	30'	polypropylene
15	¼"	40'	manila
12	⅜"	40'	manila
10	¼"	50'	manila
8	⅜"	50'	manila
8	⅜"	50'	polypropylene
6	½"	50'	manila

Ropes cut to the standard lengths shown above should have the ends color-coded with a dab of paint to denote the length. Here is a recommended color-coding system for all rope, regardless of diameter of the rope:

Length	Color
10'	white
15'	red
20'	blue
25'	green
30'	black
40'	silver
50'	yellow

You might also have a need for some ropes of specific diameters and lengths that are used for projects that are built often. These should be identified with a tag and coiled separately. These ropes, along with slings, grommets, strops, and anchor ropes should be stored in a separate box.

Other Equipment

In addition to spars and ropes, your pioneering kit should contain some basic equipment needed for building projects. This equipment includes

- 2 round-point long-handle shovels
- 4 wooden mallets
- 50 pioneering stakes
- 4 binder twine boxes
- 1 bow saw
- 1 hand ax
- 10 wooden cleats and nails
- 8 welded steel rings, ⅜" × 3"
- 8 screw pin shackles, ⅜"
- 10 quick links, 5/16"

You might also find that putting all of this equipment on a trailer that can be pulled by a truck will help get your pioneering kit to your project site. The trailer will also help you move your pioneering kit to a dry shelter when not in use.

Acknowledgments

Thanks to Adolph E. Peschke, Eagle Scout, for writing this pamphlet. Mr. Peschke has more than sixty years' tenure in the St. Louis Area Council, and is a Wood Badge course director with more than twenty course staff experiences. He has designed thirty original "boy-size" pioneering projects, some of which are in this pamphlet. As a design engineer for five national Scout jamborees, he was responsible for the theme development, site layout, and staff training for the Action Center's pioneering areas. He also developed the pioneering kit with its color-coded system to identify rope and spar lengths for building pioneering projects, and he has contributed to the BSA *Fieldbook, Program Helps,* and *Boys' Life* and *Scouting* magazines.

Thanks also to Donald B. Peschke, Eagle Scout, for editing this pamphlet. He brings to this process a long tenure in Scouting and current membership on the Mid-Iowa Council Executive Board. Additionally, he has firsthand knowledge of publishing and editing as president of Woodsmith Corporation of Des Moines, Iowa, an award-winning company recognized in the publishing industry for excellence as publisher of *Woodsmith* and *ShopNotes* magazines.

Thanks to the many Wood Badge Scouters in the St. Louis Area Council who, for the past twenty years, have been a part of developing a pioneering training program for council Scoutmasters so that their boys can participate in a hands-on activity of knots, lashings, and project-building of "boy-size" pioneering projects.

At the 1993 National Scout Jamboree, Fort A.P. Hill, Virginia, the Action Center's pioneering staffs conducted broad-based boy-testing of everything in these new requirements and the materials included in this revised pamphlet.

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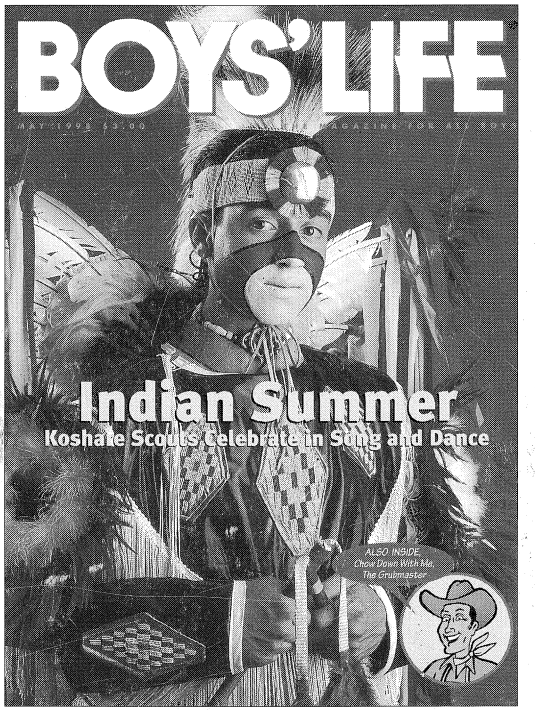

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