

ANCHOR TECHNIQUES

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INTRODUCTION

Anchor systems should be Solid, Redundant, and Equalized, and allow No Extension (SRENE). We discussed solid anchor points in the last chapter. In this chapter, we will discuss techniques for equalization and preventing extension. We will discuss redundancy to a certain extent, but will leave the full discussion to the Anchor Systems chapter.

Equalization is the technique of ensuring that the weight of the anchor system and any forces generated by falling, lowering or rappelling are distributed equally between each anchor point. In order to build a redundant anchor system, you must have at least two or three anchor points, depending on the anchor system. We will discuss how to equalize two points and three points.

CONNECTIONS

When you apply these techniques, there are several ways to connect the biner, sling and rope components of an anchor system: biner to sling, biner to rope, sling to sling, etc. Here are some guidelines on how to connect various pieces.

Generally, don't connect biner to biner (sometimes called "ganging biners"). Some biners can disconnect from each other under certain conditions. Adding a sling between biners allows an "independent suspension" system that helps prevent biners from getting cross-loaded, hung up on the nose, etc.

Do not bunch up too many slings in a biner. It may cause the biner to load in a strange way. There are also sharp edges on the inside of some biners: excess slingage does not settle well into the bottom of a biner and can come in contact with these sharp edges.

Never use slings or rope to hold moving nylon (the rope). Generally, the rope is the only component that will be moving in the anchor system. Moving a rope through a sling can burn the sling and may cause it to fail. The rules are:

1. Moving nylon on stationary nylon is unsafe (e.g., moving rope through a stationary sling).
2. Moving nylon on moving nylon is somewhat okay, but avoid it; it can turn into moving nylon on stationary nylon (for practical purposes, this should not occur in an anchor, but it is how a Muentner hitch works).
3. Stationary nylon on stationary nylon is safe (e.g., two slings girth-hitched together).

If there is any doubt about the safety of a carabiner connection, reverse and oppose two biners in the connection. For practical purposes, it is almost impossible to fail this combination in climbing usage.

Never use slings to girth-hitch small diameter material, such as the wire cable on a wired nut. The small diameter can cut the sling under load.

KNOTS

We teach several different knots in the AMC Basic School. They are reviewed on the next page (fig 13-01a). The new knots for the Anchors School are illustrated in the following pages.

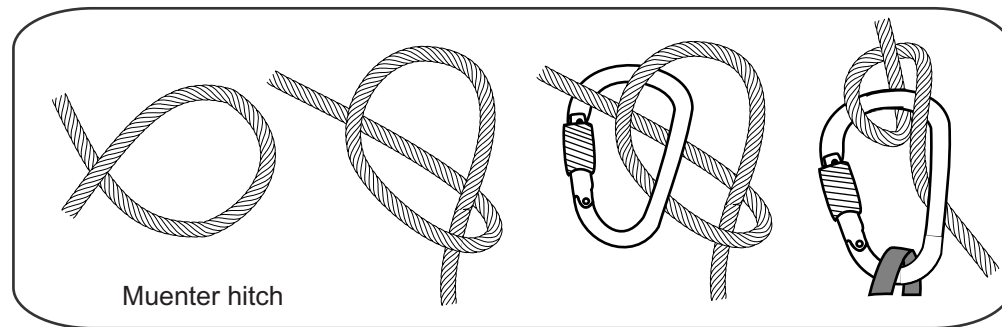
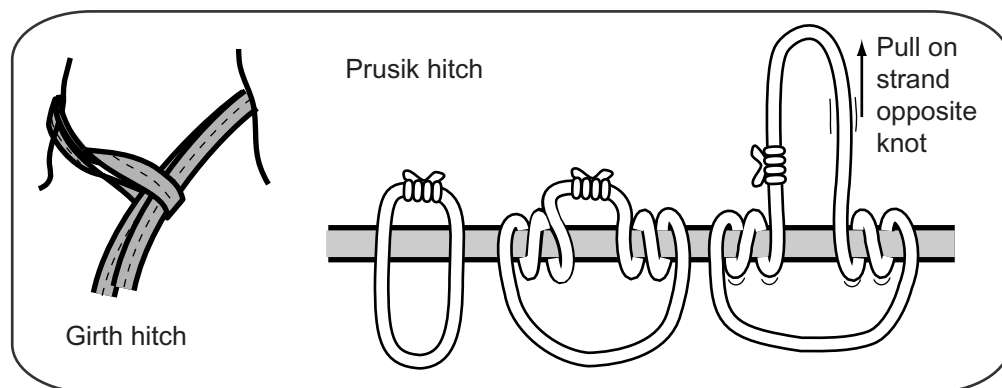
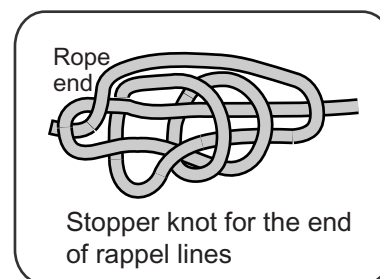
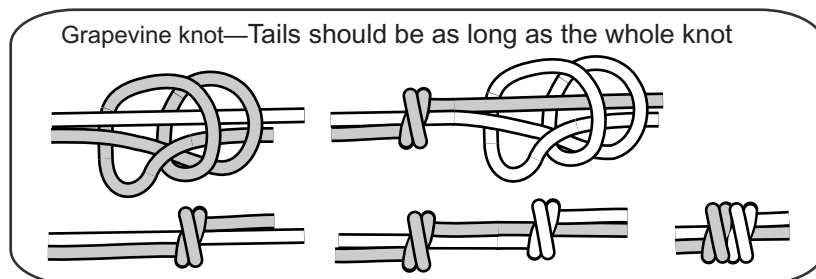
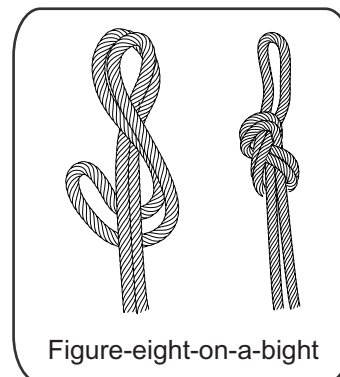
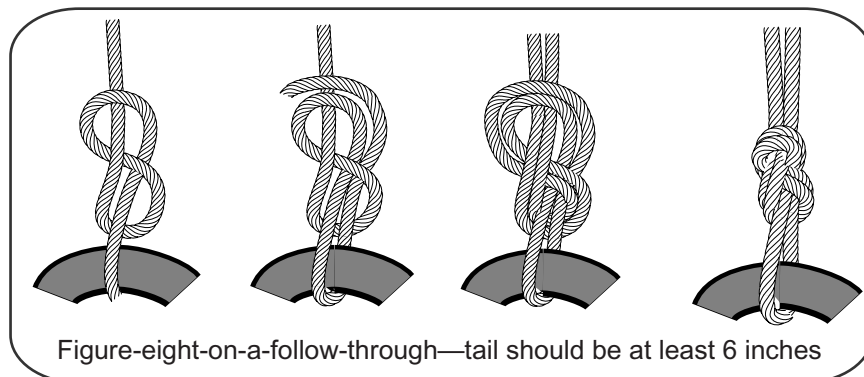
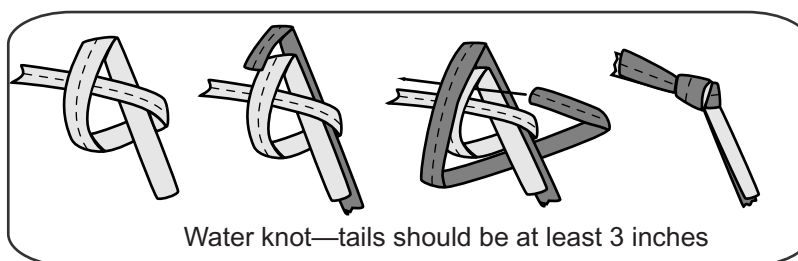
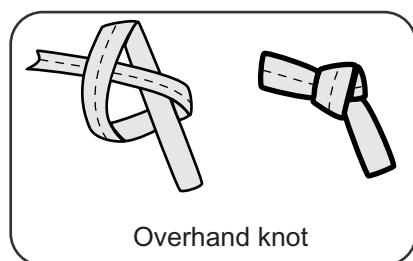


Fig 13-01a—A review of the knots we teach in the AMC Basic School

CAUTIONS ABOUT KNOTS

- Tie knots correctly; don't allow them to be sloppy. A properly tied knot is stronger, won't shake loose as easily, and will be easier to untie after holding falls.
- Check all knots often, especially any that are left unattended like those in a slingshot anchor, or tied webbing which may have loosened up while riding in your pack.
- Make a habit of finishing any knots you start, including buckling your harness. Several well-known climbers have fallen or nearly fallen to their death after interrupting the knot-tying process and using incomplete knots.

Slip Hitch

Use the slip hitch (fig 13-01b) for wrapping rock features, tying off rigid-stem cams or pitons, and as a releasable knot under load.

Butterfly Knot

Use the butterfly knot (fig 13-01c) to tie in to the middle of the rope, to shorten a sling or prusik, or to isolate a damaged section of rope.

Clove Hitch

Use the clove hitch (fig 13-01d) to create an adjustable attachment, such as a tether between you and your anchor, a connection between anchor pieces, or a quick way to temporarily anchor a rope. Strength tests on this hitch have shown that it can start to slip at about 1000 pounds of force, or a heavy top-rope fall, so the clove hitch should not be used for the main belay anchor unless it is backed up. Use a butterfly or figure-8 instead. The clove hitch is more useful in top rope belay stations where you must move around.

Bowline Knot: Basic, High-Strength, Candy-Stripe

The bowline (fig 13-01e) is an end-of-rope knot like the figure-8, but can be undone more easily. Always tie off the tail on a bowline; if you don't, the tail can creep through the knot after repeated loading. Tie the high-strength version by making two loops to start instead of one. Tie the candy-stripe bowline by wrapping the tail multiple times around the anchor point; it is useful on upward tapering anchor points and on trees, where it helps to prevent damage to tree bark if the load direction changes.

Flat Overhand

The flat overhand (fig 13-01f) is ideal for rappel situations where the rappel anchor is on flat ground above the edge of the cliff. In these situations, trying to pull the rope down after rappelling can be tricky because the knot catches on the edge of the cliff and hangs up. The flat overhand rotates up in the air and allows the rope to pull smoothly. Make sure the knot is well-dressed and the tails are about a foot long.

Klemheist hitch

This is an alternative to the prusik hitch. The Klemheist (fig 13-01g) unlocks as soon as it is unweighted, unlike the prusik. The prusik, Klemheist and autoblock can be used to vary friction depending on your purpose. The prusik uses the most friction, the autoblock the least. All can be done with slings as well, with narrower slings being easier to use. Always test the hitch before trusting your weight to it, especially if you are using a material you have not used before.

Mule Knot

Use the mule knot (fig 3-01h) to tie off your belay (when using a device such as the ATC or Sherriff) or to free your hands in emergencies. It is a slip hitch tied around the load side of a Muenster hitch with the rope passed through the belay carabiner first. The knot can be used to tie off a rappel, but the autoblock is much better. If you don't have an autoblock, keep in mind that the mule knot can come untied from the weight of the rope. Back it up with an overhand and a biner through the overhand before trusting it to hold.

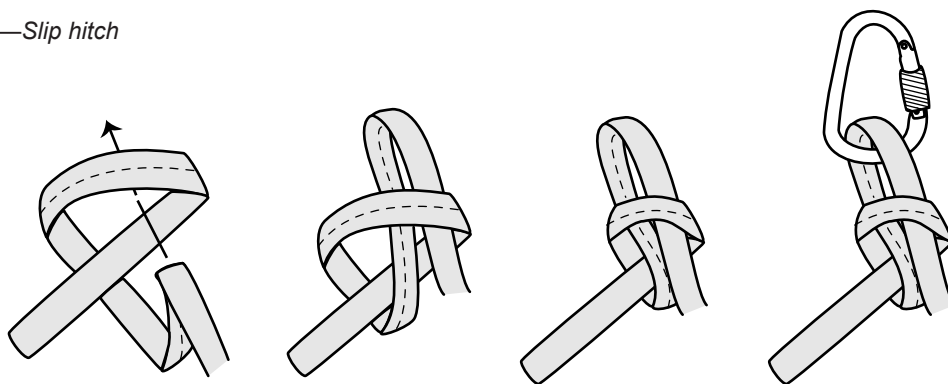
Muenster Mule Knot

Use the Muenster mule knot (fig 3-01i) to free your hands from a Muenster hitch belay or rappel. It is a slip hitch tied around the load side of a Muenster hitch. This is one of the most useful knots for emergency applications. Always back it up with an overhand and a biner through the overhand.

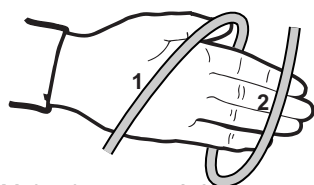
Mariner Hitch

Use the mariner hitch or Muenster mariner hitch (fig 3-01j) to tie off loads that need to be released while still under load.

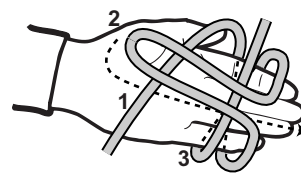
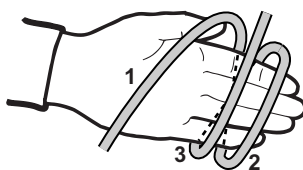
Fig 13-01b—Slip hitch



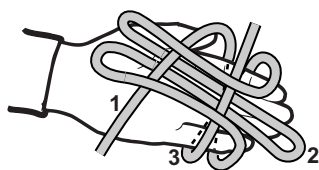
13-01c —The butterfly knot



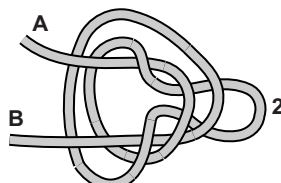
Make the wraps 2-3 times larger than your hand; don't wrap the hand tightly



Pull the second strand from right to left over all other strands



Now run the second strand under everything else, left to right

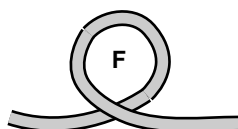


Pull on ends A and B making sure strand 2 stays separate

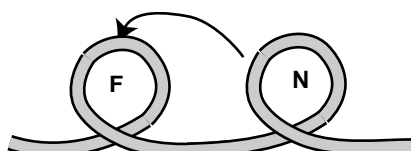


The butterfly can be loaded in either direction

13-01d—The clove hitch



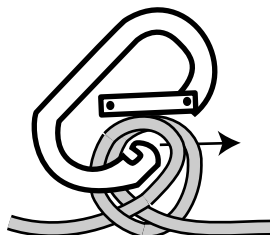
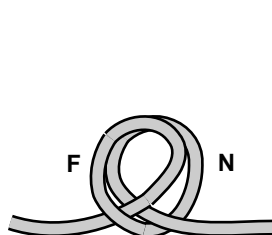
Make two loops . . .



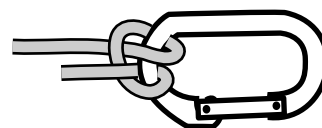
. . . the far loop . . . and the near loop



Place the near loop behind the far loop

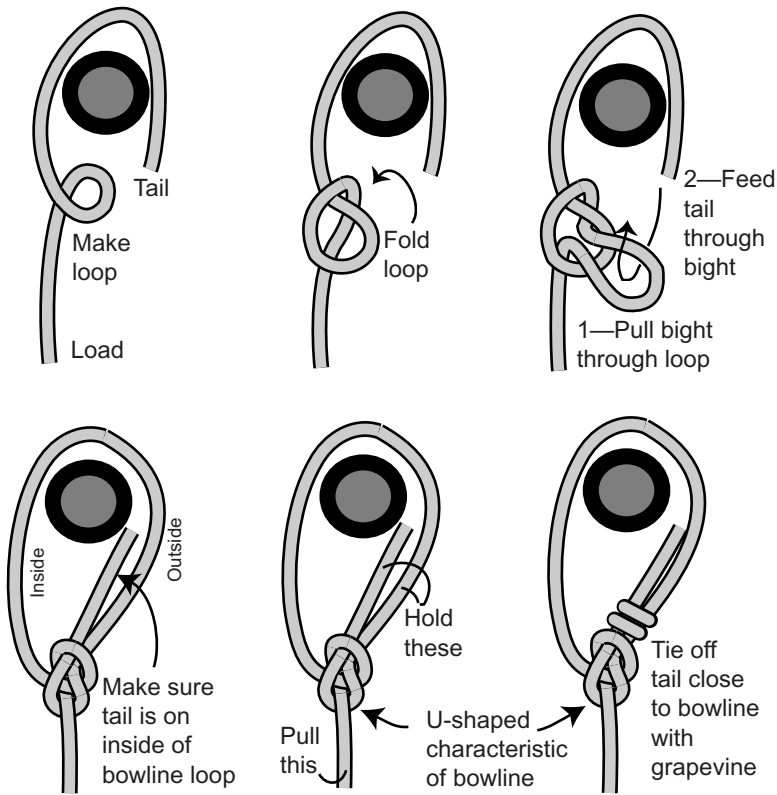


Clip a biner into both loops

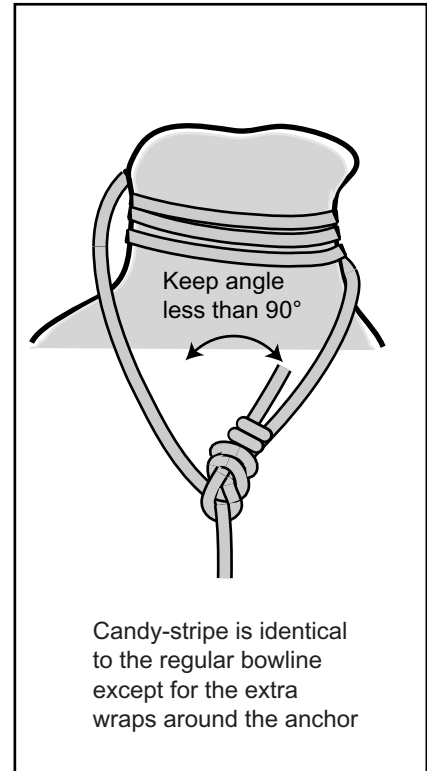


Pull tight

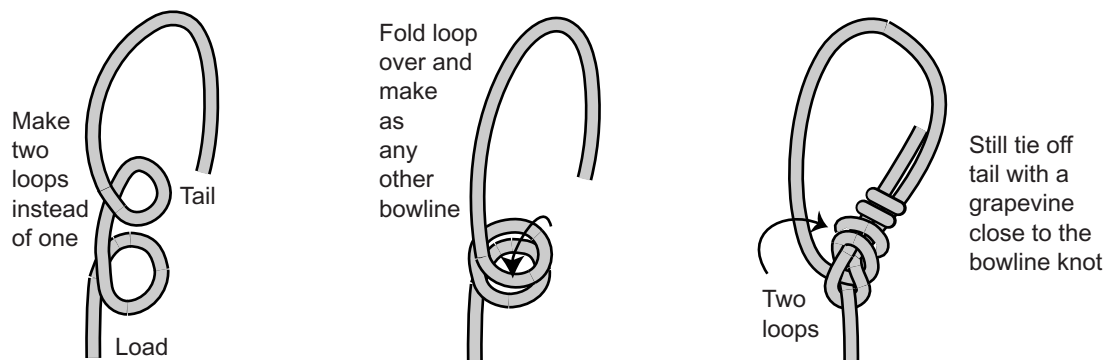
13-01e—The bowline family of knots



Standard bowline

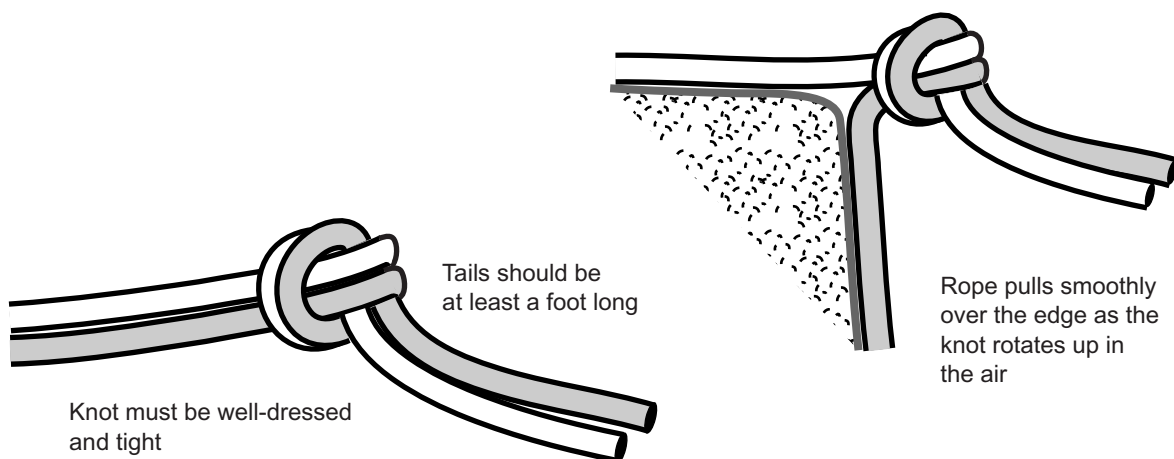


Candy stripe bowline

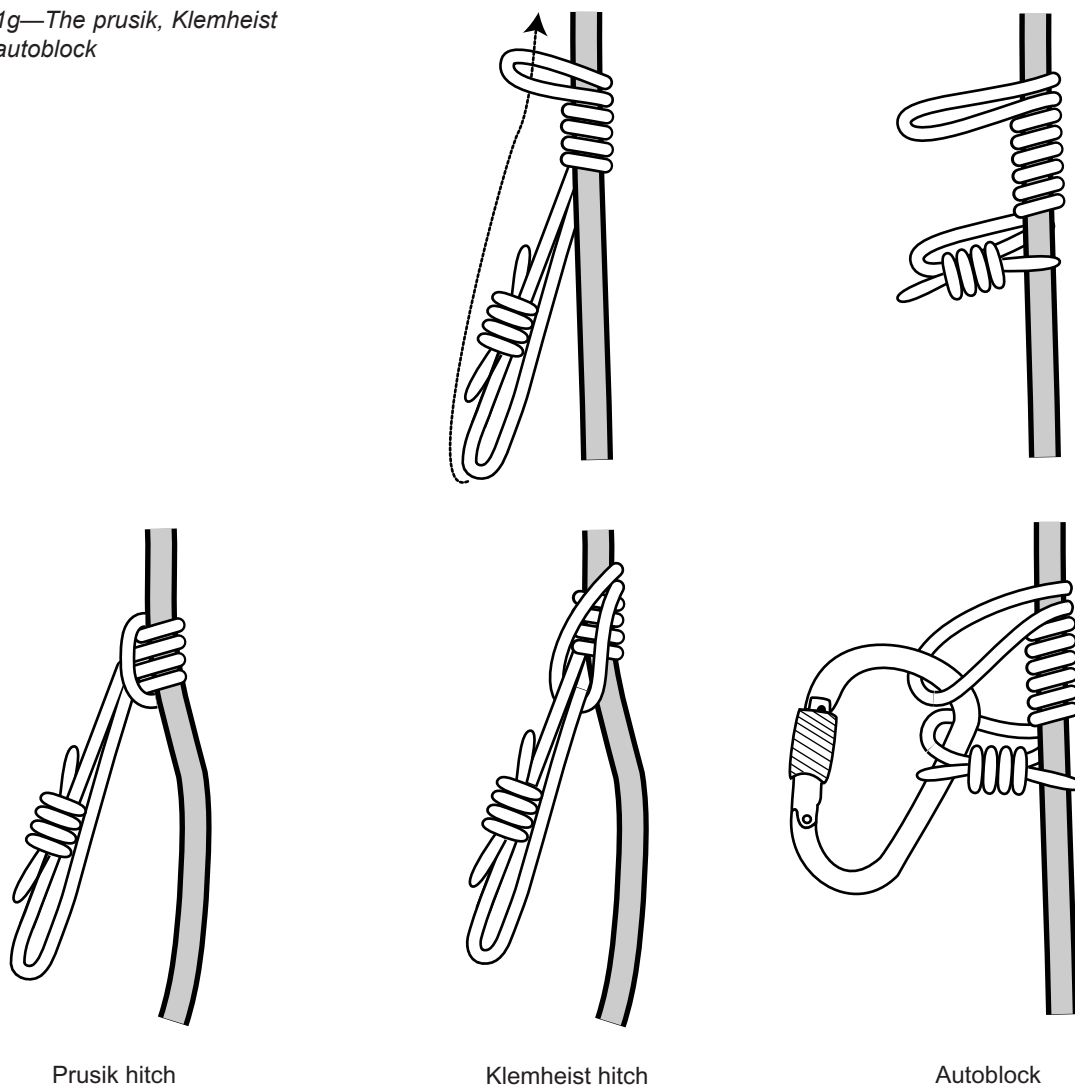


High-strength bowline (about 6% stronger than the standard)

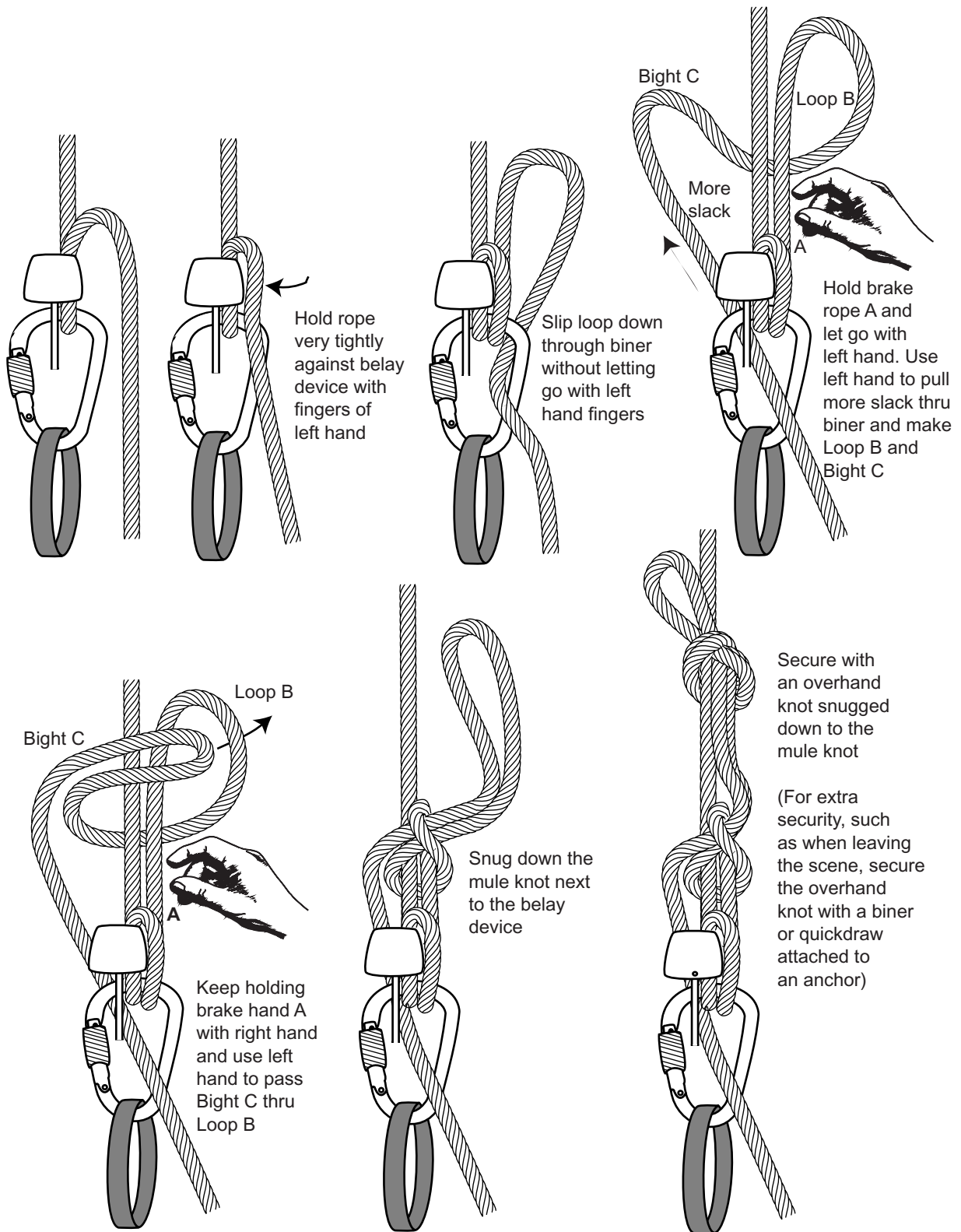
13-01f—The flat overhand



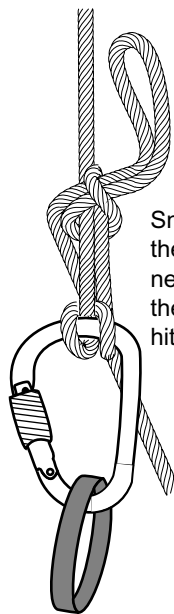
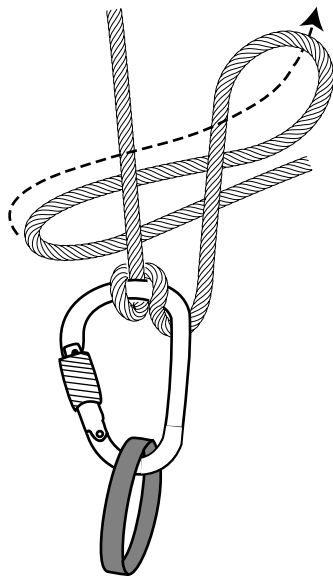
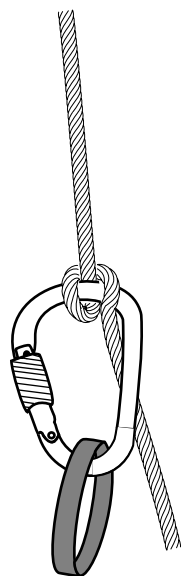
13-01g—The prusik, Klemheist and autoblock



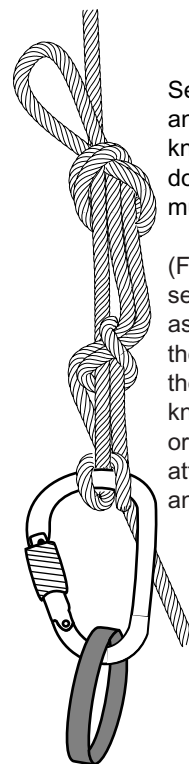
13-01h—The mule knot



13-01i—The Muenster mule knot

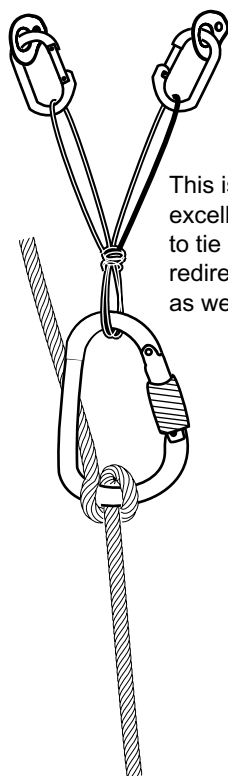


Snug down
the knot
next to
the Muenster
hitch

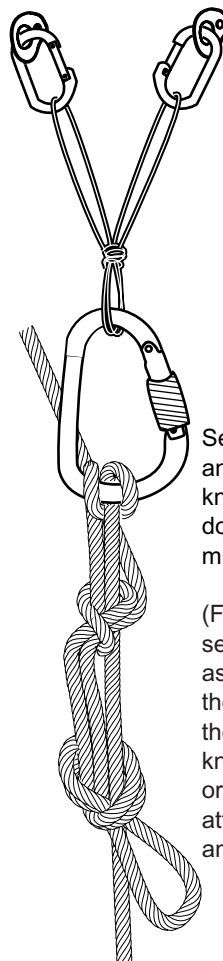
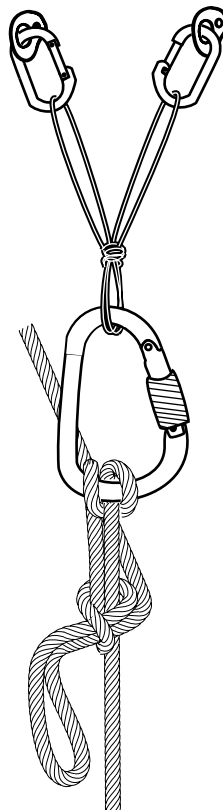
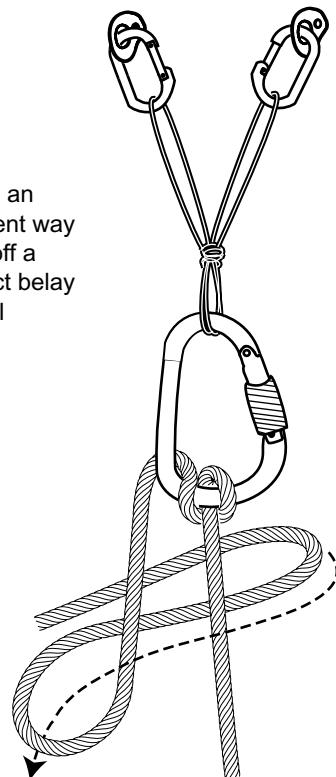


Secure with
an overhand
knot snugged
down to the
mule knot

(For extra
security, such
as when leaving
the scene, secure
the overhand
knot with a biner
or quickdraw
attached to
an anchor)



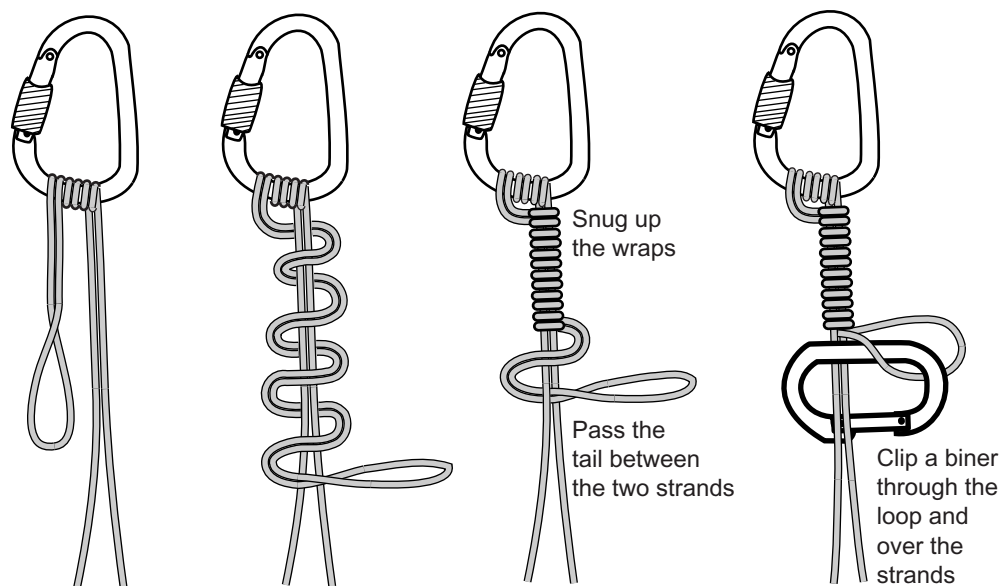
This is an
excellent way
to tie off a
redirect belay
as well



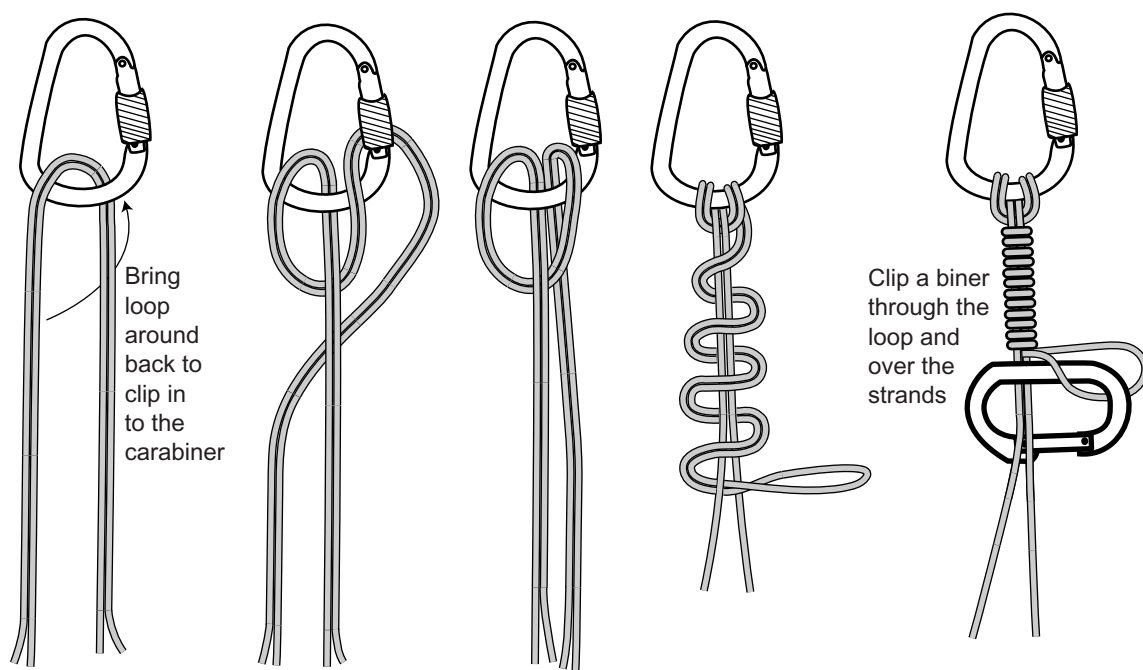
Secure with
an overhand
knot snugged
down to the
mule knot

(For extra
security, such
as when leaving
the scene, secure
the overhand
knot with a biner
or quickdraw
attached to
an anchor)

13-01j—The mariner hitch



Mariner hitch—can be done with a sling or long prusik



Muenter mariner hitch

EQUALIZATION

Equalization is the equal sharing of the climbing load by each individual anchor point. The techniques for equalizing between two points (fig 13-02) and between three points (fig 13-03) are very similar. In considering how to equalize points of an anchor, it is helpful to think in terms of bolted and non-bolted anchors.

Bolted anchors are the easiest to set up because the anchor points are fixed. Place one quickdraw on each bolt and run the rope through both lower quickdraw biners. Reverse and oppose the lower (rope-bearing) biners; the easiest way to do this is to clip the top biners in the quickdraws with the gates facing each other. It is also easy to clip a biner on each bolt, a runner in each biner, and a second biner in each runner, simulating the quickdraw setup; adjust the runners to a length that weights each bolt equally. A short cordelette (fig 13-02) works well. Placing one biner on each bolt and running the rope through each biner is not a good idea. In cold shut and chain anchors, we prefer to use quickdraws or runners with biners hung from the bolt hanger to save wear and tear on the anchor, then thread the rope through the cold shuts or chains for a rappel at the end of the day.

Non-bolted anchors allow numerous choices in technique, but they are generally variations of those listed above. First, determine how many anchor points there will be. This could be a single large tree, a tree and a boulder, two trees, a tree and two pieces of pro, three pieces of pro (minimum recommended for a pro-only anchor), four pieces of pro or some other similar combination. Build a line of gear from each anchor point to the position where the rope-bearing biners will be, then equalize between the lines using a cordelette or runners adjusted to the right length. A line of gear will usually consist of runners girth-hitched together to reach from the anchor point to the edge; sometimes, one runner works, but on longer distances, more than one runner will be needed. Or, if the anchor is four pieces of pro, equalize between the first two pieces, equalize between the other two pieces, and then run a line of runners from each equalization to the edge and equalize between the two lines, again with a cordelette or the proper length slings (fig 13-04). In all cases, the angle created by the two outermost equalizing strands should be less than 90 degrees.

The orientation of the biners in these setups can make a difference. The lower biners (the rope-bearing biners) in all cases should be reversed and opposed, and generally nose down. Sometimes, these biners rotate so the nose is up. Sometimes this can be corrected by the climber prior to being lowered and sometimes not. Since the biners are reversed and opposed, however, there is usually little risk involved.

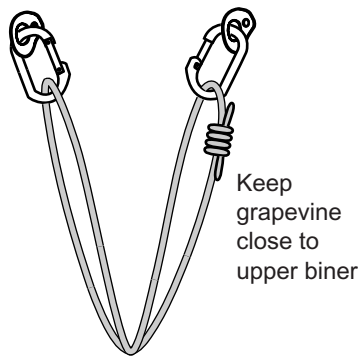
In bolted anchors, the orientation of the upper biner doesn't matter unless there is an irregularity in the rock that may interfere with the gate. Each biner will be rotated slightly toward the opposite bolt. If the gate pushes against the irregularity when the bottom biners are brought together, reverse the biner so the spine pushes against it instead. If it looks like the irregularity will open the gate if the other bolt fails and the biner swings downward, then orient the spine in the direction of the swing.

In non-bolted anchors, it is generally better to orient the biner nose down and the gate away from the direction of swing. Since the parts in a non-bolted anchor move around more, it is possible that the nose of the biner could get hung up on a projection of rock and break under a relatively small load. It is also more likely that the biners will move from side to side as the anchor moves around, opening the possibility that the gates will run into something.

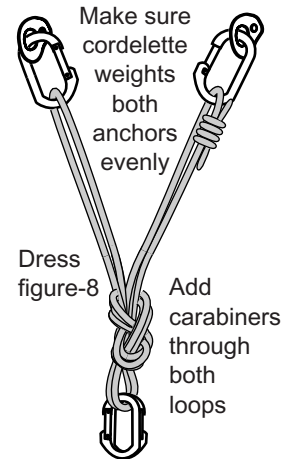
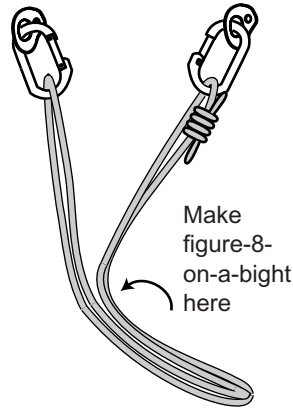
Recommendations:

- The best overall technique is the cordelette. It is fast, redundant and prevents shock loading. The feature of allowing side-to-side movement to handle zig-zags is not needed very often. The only caution about using the cordelette is that it may need a slight adjustment to ensure that it is truly equalized.
- A cordelette anchor can be created with cord or sling, but works best with cord (6mm or 7 mm).
- Twenty feet is the most popular length for a cordelette. Too short a cordelette may limit available anchor placements and too long a cordelette can become unwieldy to handle. Experiment with different lengths if you like.
- The easiest technique for a bolted anchor is a pair of quickdraws, which are already equal lengths.
- Do not use the single sling with a twist by itself for the rope-bearing biners, as it is not redundant.
- Do use a single sling with a twist to equalize between pieces being used as a part of the anchor.
- Do use short slings (less than 10') in a single sling with a twist to limit the extension of a failed anchor.
- There is a dangerous technique sometimes used as an anchor itself or to back up another technique such as the single sling with a twist. This is a triangular configuration sometimes referred to as an "American triangle" (fig. 13-02). We recommend avoiding it.
- Make sure the outer strands of the setup are less than 90 degrees.

13-02—Two-point equalization techniques

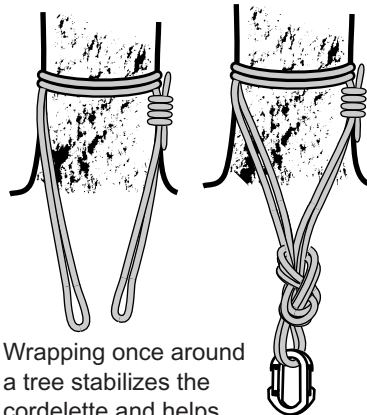
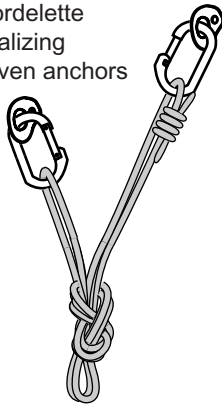


Pull down in center on both strands to even them out

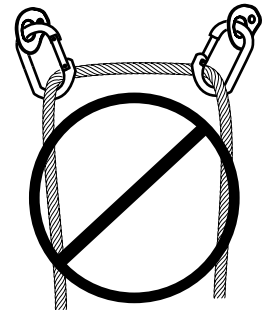


The cordelette is usually about 20 feet long and made of 6 mm or 7 mm cord

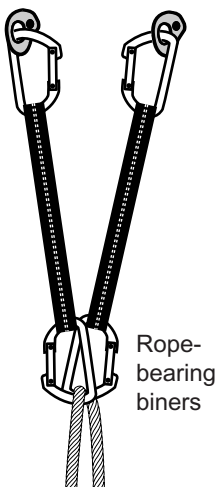
A cordelette equalizing uneven anchors



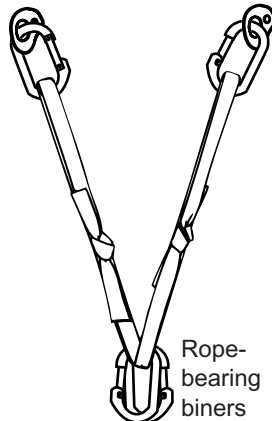
Wrapping once around a tree stabilizes the cordelette and helps protect the tree bark



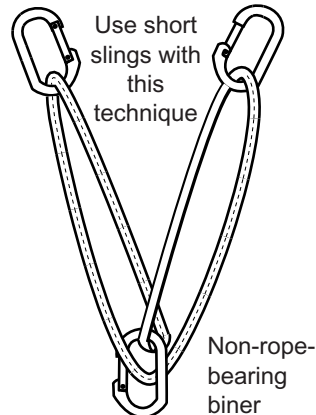
Never use just a biner on a bolt for a climbing anchor



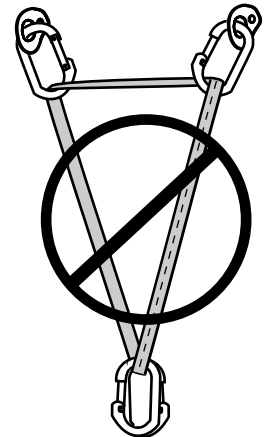
Two quickdraws with lower biners reversed and opposed



Two runners adjusted to the same length

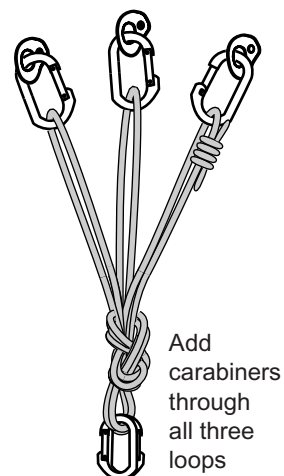
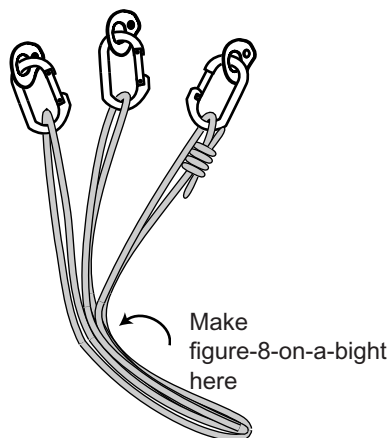
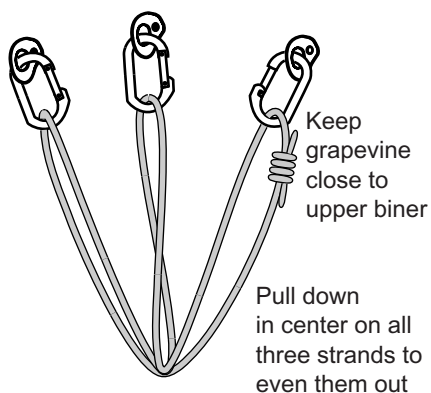


Do not use a single sling with a twist ("sliding X") for the rope-bearing biners

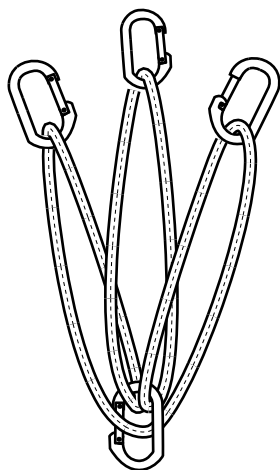


The "American triangle" is considered unsafe

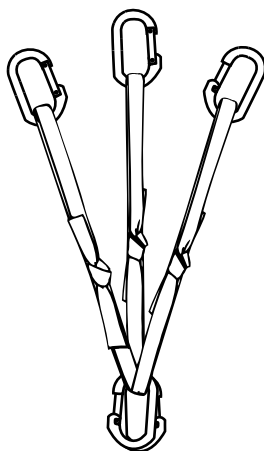
13-03—Three-point equalization techniques



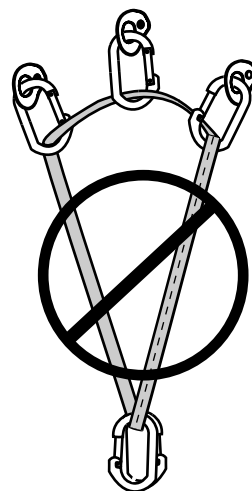
The cordelette can equalize between two or more points depending on its length



Do not use a single sling with two twists ("sliding X") for the rope-bearing biners

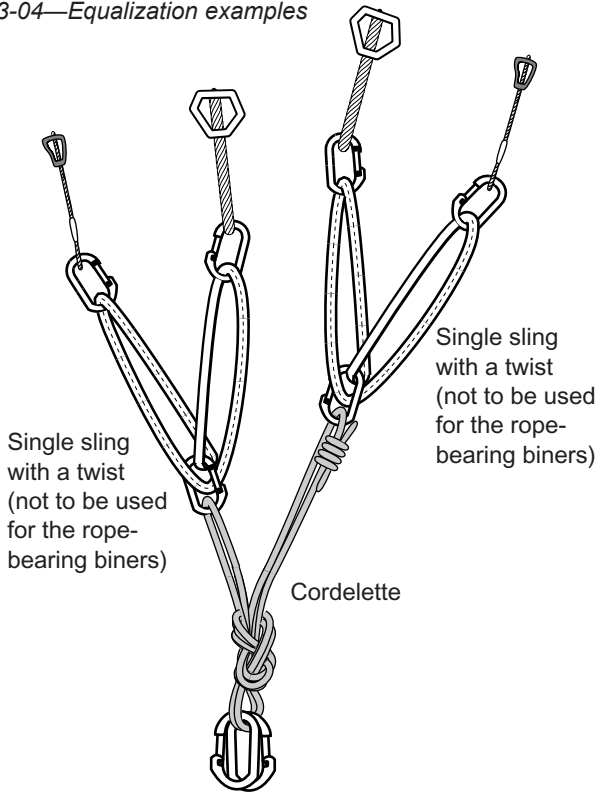


Three slings adjusted to the proper length takes a little longer, but it is redundant



The "American triangle" is considered unsafe

13-04—Equalization examples



Examples of how to equalize pieces of pro. Equalize smaller groups using any of the techniques, then equalize those groups. Or, equalize the pieces directly. Biners are oriented nose down and with the spine in the direction of swing should part of the anchor fail.

