Auto-Locking Hitches

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Introduction:

It is sometimes useful or necessary to build a rope system that can take in rope or slack and capture the progress. For example, securing a belay so a belayer can go hands free, or capturing progress in a haul system (big wall climbing or rescues), or when ascending a rope with minimal equipment (e.g., no ascenders). Consequently, it is useful for riggers to know a few auto-locking hitches they can use to build systems with these properties. This document teaches how to construct nine auto-locking hitches and discusses their strengths and weaknesses. Riggers are encouraged to use the hitch that is most appropriate for their rigging situation.

For those starting to learn how to use ropes and rigging, take care when using these hitches. It is possible to lock some of the hitches, so the load is hanging off the hitch, preventing you from lowering the load. There are numerous ways of combatting this problem; however, if you are unfamiliar with them, you could strand the load. If the load is a friend, fellow climber, or other person, this could be a big problem. As such, only use these hitches when you have a plan for removing the load from the hitch, or have the skills to solve that problem if it arises. Otherwise, these are useful hitches that can easily solve many vexing rigging problems, so constitute a useful addition to the riggers toolbox.

Compatibility:

It is important to note that not all carabiner and rope combinations will function appropriately with all of these hitches. Some hitches will work better with D-shaped carabiners, others work better with HMS or Offset D carabiners. This means that you should check the compatibility of your carabiners and mallions with the rope or cord you plan to use them with. Some hitches will function well, others will not, given different hardware and software combinations. So test your gear before you load it with a human to make sure the equipment is compatible! A good rule of thumb is that smaller carabiners work less well with münter hitch variations, and have a tendency to increase the friction in the other hitches. So consider using larger carabiners if you have a choice. Similarly, stiff rope works poorly in locking hitches, so if you are using a stiff rope, you may consider another rigging alternative than auto-locking hitches.

Auto-Locking Hitches:

Nine locking hitches are described here (Figure 1); the Garda, Lorenzi, Heart Brake, the Mallion, System, the Carabiner Systems, and four versions of the Münter Hitch converted into a one way hitch. Each description includes the strengths and weaknesses of each hitch.

Garda (a.k.a. Alpine Clutch, Heart Knot, Nodo Bloccante Cuore, Noeud En Coeur)

Construction: Construction details are provided in Figure 2a-e. This hitch works better when constructed out of two “D” shaped carabiners of the same size and shape because, when the carabiners are compressed together, they smash up against each other rather than one slipping into the other. “D” shaped carabiners are preferred because the rope slides down and sits in the well next to the carabiner spines creating more friction. Because functionality is based on the two carabiners pressing against each other, this hitch works better when snap gate or wire gate

Figure 1: All nine hitches described here. **A)** The Garda Hitch, **B)** The Lorenzi Hitch, **C)** The Heart Brake, **D)** The Mallion System, **E**) The Carabiner System, and four one way Münter Hitches **F)** Münter Hitch variation #1, **G)** Münter Hitch variation #2, **H)** Münter Hitch variation #3, and **I)** The Remy Hitch.

carabiners are used rather than screw gate carabiners (the gates push each other apart when the locking screw gates are forced together – Figure 2e). It also helps if the two carabiners are held together at the top end (e.g., a girth hitch or larks foot hitch) which keeps the carabiners tight against each other, flush, and in the same orientation. Lastly, it is easier to tie if the carabiner gates face downward, or in the direction the load will be applied (e.g., upward when used for ascending).

Strengths: Fast to tie, relatively easy to remember relative to the other hitches, and easy to construct using the carabiners available (most of us buy multiple carabiners of the same size and shape). It also provides the most friction between the Garda, Lorenzi, Heart Brake Hitches, and

Mallion System, which means it can hold a larger load easier. This is the best known hitch of the seven described here, so when using this hitch, more people will know what you are doing, making inspection easier.

Figure 2: How to tie the Garda Hitch. **A)** Two similar "D" shaped carabiners oriented with gates down, **B)** Clip the rope through both carabiners, **C)** Form a loop of rope on one side of the two carbiners, **D)** Clip the loop of rope into the far carabiner, **E)** Set and dress the Garda Hitch ensuring the two carabiners are snug against each other.

Weaknesses: This hitch must be kept under load once tied, or inspected before loading again. If one carabiner slips inside the other (e.g., slides between the spine and the gate of the other carabiner), the hitch loses its integrity, and the load falls to the ground. As such, this is a great hitch for use when the hitch is not loaded and unloaded frequently (e.g., when hauling a load up a pitch). Because it provides a lot of friction, it is great for holding larger loads, but it is the least

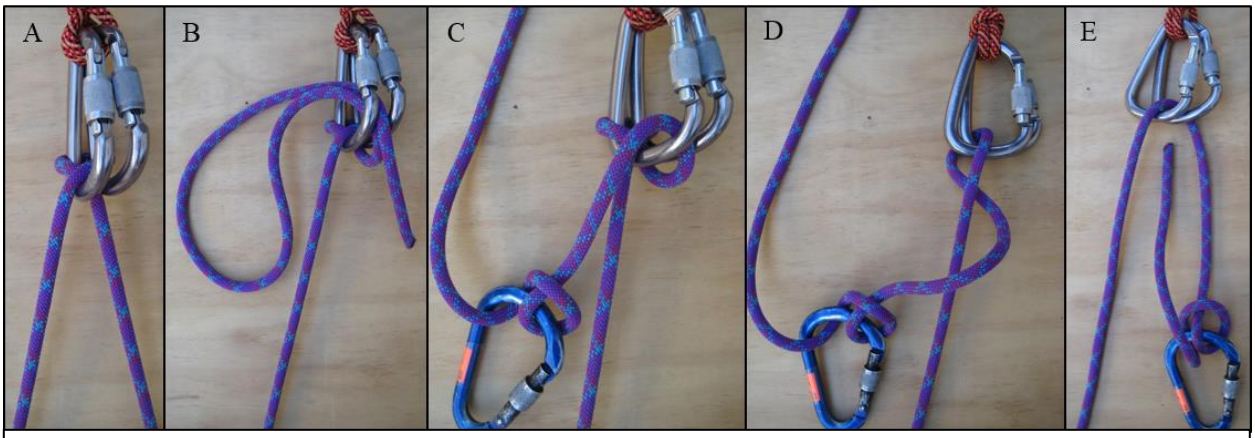

Figure 3: How to convert the Garda Hitch to a fixed brake lower. **A)** Tie the Garda Hitch, **B)** Pull a bight of the slack strand through the carabiner, **C)** Connect a lowering device (Münter Hitch shown here), **D)** Pull down forcefully to release hitch and transfer load to the lowering device, **E)** Lower the load.

efficient if used as progress capture in a pulley system (hard to pull rope through due to the internal friction), and it is the hardest to unlock when loaded.

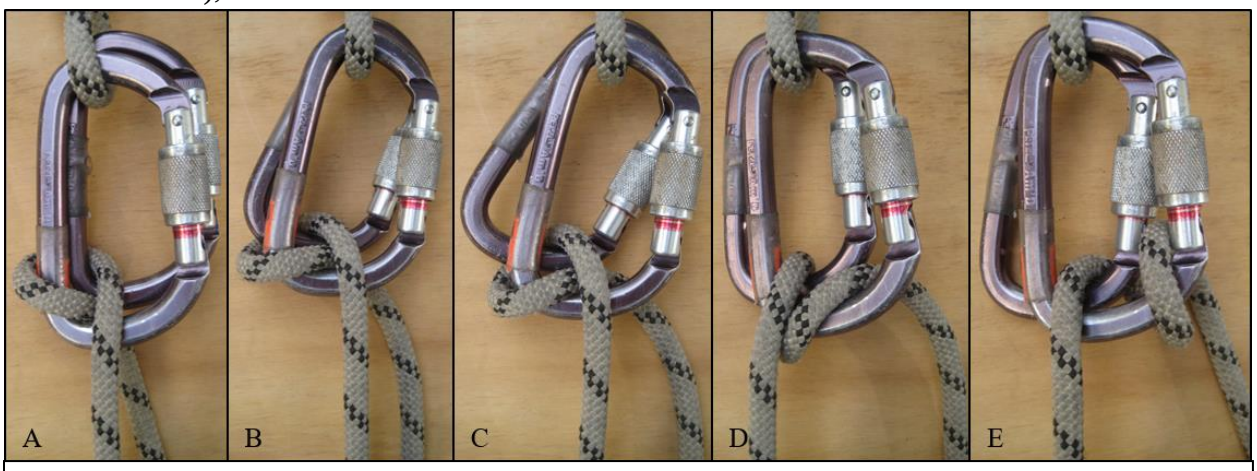

Figure 4: How to unlock the Garda (**A**). Push the carabiner farthest from the load backward (**B,C**), until the hitch collapses (**D**). Lower through the hitch (**E**).

Unlocking the Garda: There are three ways to unlock the Garda Hitch, the first allows the user to convert the Garda Hitch to a fixed brake lower, the second directly converts the Garda to a lower, and the third converts the Garda to a lower with an extra carabiner. Each method is an appropriate solution for different rigging problems. Visual directions for unlocking the Garda Hitch and transferring the load to a fixed brake lower are presented in Figure 3. Identify the slack side of the hitch (the rope pinched between the two carabiners), and pull a bight of the slack line through the carabiner through which it travels. By jerking hard on the line the rope will slide under itself so it is no longer pinched, thus dropping the load. To release the load in a controlled manner, after passing a bight through the carabiner, rig it through a descent control device or a locked off Münter Hitch. Pull on the bight until the rope is freed, then lower the load on the descent control device or Münter Hitch (Marbach and Tourte 2002:78). Converting directly to a lower can be simple if there little load is on the hitch. Push the carabiner pinching the rope backwards until the hitch collapses (Figure 4). If too much load is on the hitch, then a carabiner must be used to open it up. To convert the Garda Hitch directly to a lower when fully loaded, follow the visual directions in Figure 5. Clip a carabiner into the carabiner on the slack side of the hitch, work it between the two strands of rope, and collapse the hitch into one and a half turns around both carabiners. The rope will run smoothly through the hitch, with quite a bit of friction.

Relevant Literature:

Corpo Nazionale Soccorso Alpino E Speleologico (2013:171, 178-179)
Ecole Francaise de Speleologie (2013:204)
Fasulo and Clelland (2011:51-52)
Luebben and Soles (2011:40)
Marbach and Tourte (2002:78)
Merchant (2007:55)
Shepherd (2007:46-47, 167, 221, 262, 263, 323)
Tyson and Loomis (2006:52-53, 56, 113, 133-134)

Figure 5: Converting the Garda Hitch to a lower. **A)** Start by tying a Garda Hitch, **B)** Connect a third carabiner to the carabiner on the slack side of the hitch, **C)** The third carabiner can be used as a lever to torque the first two carabiners apart, **D)** Move the third carabiner between the two strands of rope, **E)** Collapse the Garda Hitch so that the rope no longer pinches against itself, **F)** If you need less friction, move the control strand toward the anchor, which will reduce the friction in the hitch.

Lorenzi Hitch (a.k.a. Edi)

Construction: Construction details are provided in Figure 6a-c. Make sure to clip both strands hanging down from the load bearing carabiner. Clipping both strands prevents the lower strand from lifting up and converting the hitch into a loop around the carabiner, which would drop the

Figure 6: How to tie the Lorenzi Hitch. **A)** Form a loop in the rope, **B)** Clip the X created by the loop with the carabiner, **C)** Clip a second carabiner between the rope and the first carabiner's spine, and capture the two strands of rope hanging below the hitch.

load. So *make sure to clip both hanging strands*. The hitch works better if the upper load bearing carabiner is "D" shaped though it will work with any carabiner shape used.

Strengths: Probably the fastest hitch to tie on the list, and it works with whatever two carabiners you use to construct it. This means you can build it with whatever is hanging from your harness, even if they are different shapes and sizes. When unloaded this hitch does not collapse, so it can be used over and over again without inspection or fear of dropping the load and having to retie it (unlike the Garda). It provides less friction than the Garda, so it is more efficient to use as a part of a haul system.

Weaknesses: This hitch is incredibly difficult to unlock when loaded and has no practical lowering configuration. Because it provides less friction it should be used with lighter loads if possible.

Relevant Literature:
Corpo Nazionale Soccorso Alpino E Speleologico (2013:171, 176-177)

Heart Brake (a.k.a. Freno Cuore)

Construction: Construction details are provided in Figure 7a-e, and Figure 8 shows a fast way of tying the Heart Brake when carabiners are on an anchor. This hitch should be constructed with two carabiners of the same size and shape (ideally the same two carabiners), and with cord or rope that is larger in diameter than ~8.5mm. It works better with two "D" shaped carabiners.

Strengths: This is the only hitch presented here that has a simple method for unlocking/releasing and lowering the load, giving this a big advantage over some of the other hitches because it can be operated in both directions without additional rigging.

Weaknesses: For proper function two carabiners of the same size and shape are needed (preferably "D" shaped) so that the rope runs around the carabiner spines near the bottom of both carabiners. If one carabiner is smaller than the other, the smaller carabiner can shift into the

Figure 7: How to tie the Heart Brake. **A)** Clip a carabiner through the X in a loop of rope, **B)** Clip a second carabiner through the loop of rope with the carabiner gate facing the opposite direction. The carabiner should be clipped on the same side of the first carabiner as the bottom strand of rope comes out. **C)** The two carabiners should be clipped onto an anchor so both lay tight against each other. **D)** The final hitch should look like this panel. **E)** If the hitch looks like this, you should move the second carabiner to the other side of the first carabiner so it looks like panel D.

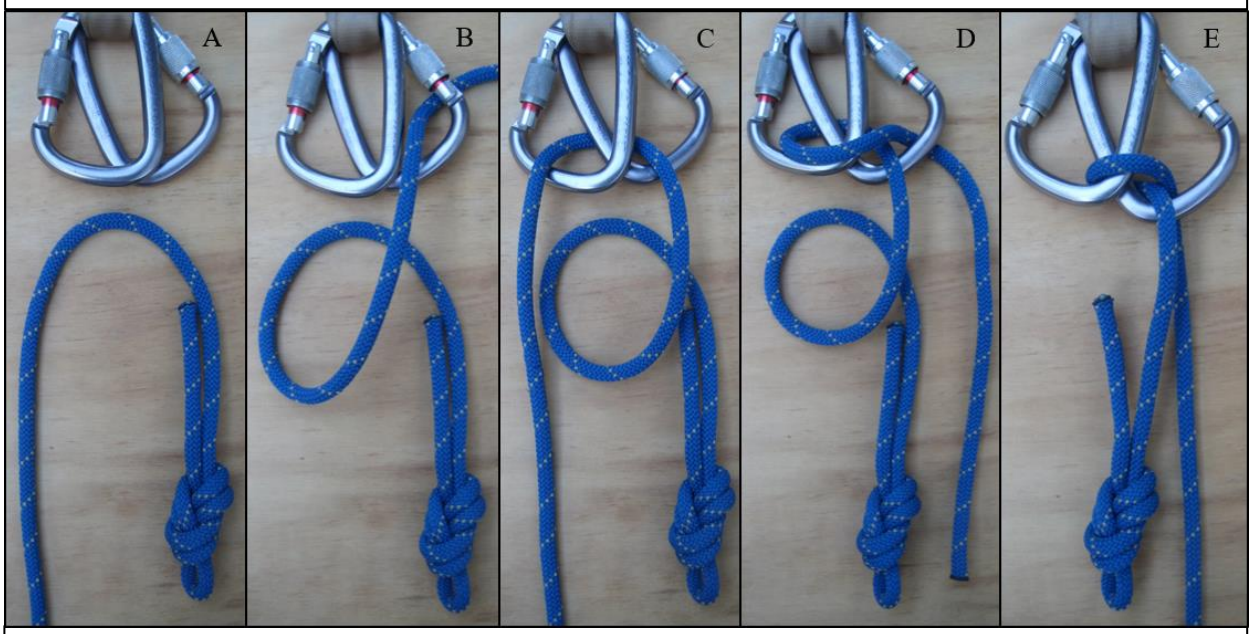

Figure 8: A fast way to tie the Hart Brake hitch when the carabiners are connected to an anchor (**A**). Take the unloaded line and clip it into one of the carabiners (**B**), then wrap the rope around the spines and clip it into the second carabiner (**C**). Continue wrapping back to the original carbiner and clip the rope in (**D**), then dress the hitch (**E**).

second carabiner, collapsing the hitch, and dropping the load. When loaded the backwards facing carabiner keeps the rope from pinching itself as tightly as it would (Figure 7d). As a result, the

rope or cord used needs to be big enough that it produces enough friction to hold a load, hence why this hitch should be constructed using 8.5mm, or larger, rope or cord

Figure 9: How to unlock the Heart Brake. **A)** Tie a Heart Brake, **B)** Pass a bight of the slack end through the carabiner, **C)** Pull down hard to pop the rope out from under itself, **D)** Dress the Heart Brake, which forms a hitch close to the Münter Hitch. Lower the load as needed. To lock up the hitch simply pull hard on the control side which will reform the hitch.

Unlocking the Heart Brake: To release the load follow the visual directions in Figure 9. Pass a bight of rope of the compressed rope strand through the carabiner it passes through. Pull the loop down forcefully so it pops out from under the load bearing strand. What is formed is similar to a Münter Hitch, so you will have some control of the load. If there is more load than can be held easily, add another descent control device or Münter Hitch prior to popping the rope out from under the load strand (similar to Figure 3). Lower as necessary. To reset the hitch after lowering, forcefully jerk the unloaded line, and it will slip back over the carabiner and under the loaded line, thus creating the original hitch again.

Relevant Literature:
Corpo Nazionale Soccorso Alpino E Speleologico (2013:162, 169)

Mallion System

Construction: Construct the hitch as shown in Figure 10. Slide an oval mallion over the end of a locking carabiner; “D” shaped carabiners will work the best, as will any carabiner that provides enough clearance for the mallion to slide down the carabiner enough to provide room for the rope. HMS carabiners are too wide on the large side, but the small end can be used sometimes. Open the carabiner gate and slip a bight of rope around the mallion. Alternatively, thread the rope around the mallion once on the carabiner. Ensure the rope is positioned against the carabiner spine, the rope is not running over the mallion screw gate, and the mallion gate is oriented so that it will be screwed closed if the rope runs over it.

Figure 10: Construction and orientation of the Mallion System. **A)** The correct orientation of the mallion so it will not unscrew when the rope runs over it and with the rope against the carabiner spine. **B)** A side view of the Mallion System to illustrate the path the rope takes around the hardware.

Strengths: This hitch has the least internal friction of all the hitches on this list, so it is an incredibly powerful tool that can be used for ascending or a haul system progress capture device. It can also be constructed from some of the smallest and lightest equipment.

Weaknesses: It takes quite a bit of fiddling to make sure you tie this hitch correctly. Since there are four orientations the mallion can take on the carabiner, often it takes more than one try to get it positioned correctly. If constructed incorrectly, the rope can quickly open the screw link gate, so it must be tied correctly. As such, this method should be used by those who can construct and inspect it correctly. Lastly, this hitch works best on supple rope because such small turns are required. So this is a less useful technique on larger diameter stiff ropes.

Unlocking the Mallion System: Clip a second carabiner between the mallion and the first carabiner. The second carabiner pushes the mallion up, reducing the rope pinch (Figure 11b). This works better with a carabiner made from larger diameter bar stock (Figure 11).

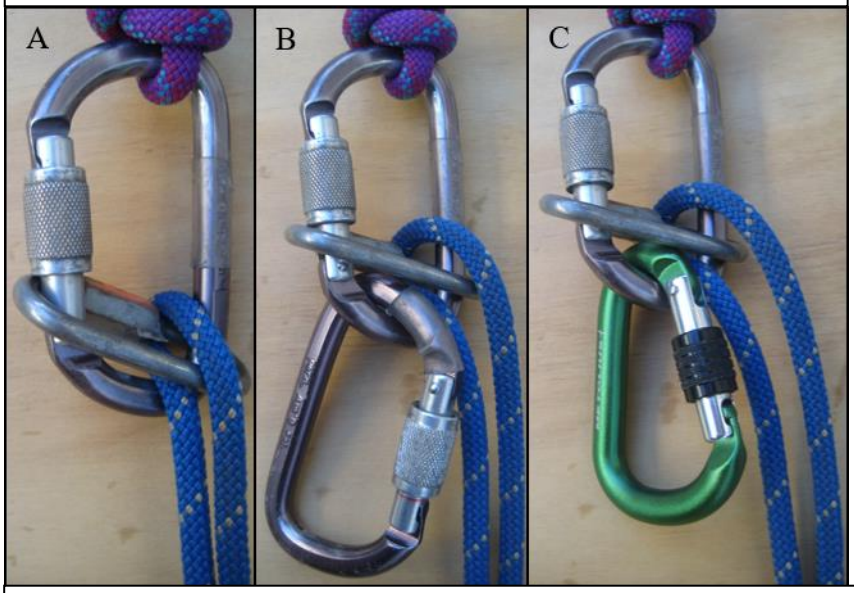

Figure 11: How to unlock the Mallion System (**A**). Clip a carabiner under between the mallion and base of the carabiner (**B**). It is easier to lower when a thicker diameter carabiner (**C**).

Relevant Literature:
Marbach and Tourte (2002:268)

Carabiner System

Construction: This hitch is constructed just like the Mallion System but with two carabiners (Figure 12). Make sure the rope runs parallel to the anchor carabiner spine (Figure 12c) otherwise the hitch can deform and collapse (Figure 12d) releasing the load. This hitch works best when the anchor carabiner has a distinct well the rope slips in, like D shaped carabiners, or small Offset D shaped carabiners. The second carabiner can be nearly any shape as long as the carabiner has a straight spine.

Strengths: This is an incredibly fast hitch to construct, so can be made in seconds. Any two carabiners will work, as long as the second carabiner has a straight spine. This works exceptionally well as a belay on steep slopes where collapse of the hitch would still retain enough friction to catch a slip or fall.

Weaknesses: Reorientation of the second carabiner can lead to the hitch collapsing, thus dropping the load. To prevent this requires keeping the hitch oriented correctly, not bumping it against anything, etc. Because it is such a finicky hitch, it is best used for transporting gear, or belays on steep slopes rather than in high angle terrain, where complete failure would yield dire consequences. To be really secure, this hitch requires a carabiner with a small end that tracks the rope to one location. If one is available, this hitch might be appropriate, if not, then be careful with its use.

Unlocking the Carabiner System: The carabiner system is unlocked the same way the Mallion System is; clip a third carabiner between the original two carabiners. This forces the two apart, releasing rope pinch, and allowing the rope to run smoothly through the carabiner.

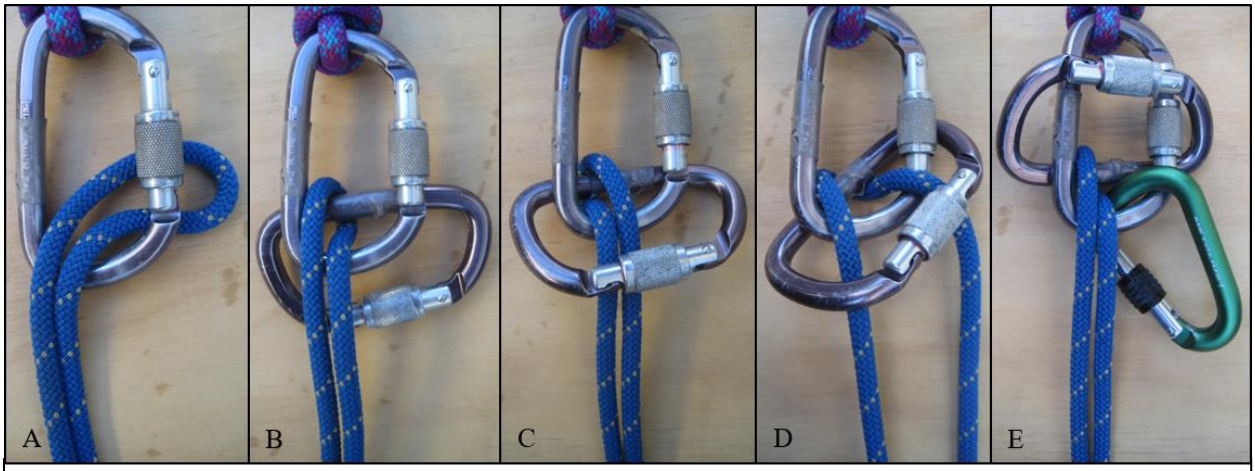

Figure 12: How to construct the Carabiner System. Pass a bight of rope through an anchored carabiner (**A**), clip a second carabiner into the bight (**B**), rotate the second carabiner around the first and clip the two strands of rope going through the first carabiner (**C**). Ensure the rope runs next to the carabiner spine, or the hitch can fall apart (**D**). Unlock by clipping a carabiner between the two carabiners to remove rope pinch (**E**).

Locking Versions of the Münter Hitch

All Münter Hitch locking methods (Figure 13) work by preventing the hitch from flipping if the load moves from one side of the hitch to the other. To convince yourself of this, build them and watch how the locking mechanism works. The addition of a carabiner into the Münter Hitch does increase the friction in the hitch, and the second carabiner should be a locking carabiner if possible, so that the two rope strands do not smash the carabiner gate and open it. Lastly, once loaded, it is impossible to release these without taking the load off the Münter Hitch. So use with discretion!

Figure 13: Münter Hitch locking options. **A)** Variation #1, **B)** Variation #2, **C)** Variation #3, **D)** Variation #4, the Remy Hitch.

One Way Münter Hitch Variation #1

Construction: Clip a second locking carabiner into the Münter Hitch capturing the control strand and the loop of rope just behind it on the other side of the carabiner (Figure 13a).

Strengths: The Münter Hitch can be altered while in use, though probably not when loaded. This option is functionally more or less equivalent to options #2 and #3.

Weaknesses: This version creates more friction in the Münter Hitch than the other two options and it requires a second locking carabiner.

One Way Münter Hitch Variation #2

Construction: Clip a second locking carabiner into the Münter Hitch capturing the load strand inside the hitch, the control strand, and the loop of rope just behind the control strand on the other side of the carabiner (Figure 13b).

Strengths: The Münter Hitch can be altered while in use, though probably not when loaded. This option is functionally more or less equivalent to options #1 and #3.

Weaknesses: It creates more friction in the Münter Hitch than option #3, but less than option #1, and it requires a second locking carabiner.

Relevant Literature:
Element Rescue (2015)

One Way Münter Hitch Variation #3

Construction: Clip a second locking carabiner into the Münter Hitch capturing the control strand, and the loop of rope just behind the control strand on the other side of the carabiner. Clip the load line into the carabiner below the Münter Hitch as well (Figure 13c).

Strengths: The Münter Hitch can be altered while in use, though probably not when loaded. This option is functionally more or less equivalent to options #1 and #2. This option produces the least friction inside the hitch than the other two options, so is favored by the author.

Weaknesses: It creates more friction in the Münter Hitch and it requires a second locking carabiner.

One Way Münter Hitch Variation #4-The Remy Hitch

Construction: Clip a second locking carabiner into the Münter Hitch capturing the bridge of the Münter Hitch , then rotate the second carabiner up parallel to and flush with the original carabiner on which the Münter Hitch was tied (Figure 13d). The hitch only works well when the two carabiners are clipped side by side, similar to a Garda Hitch. Another method of tying this hitch is published in Ecole Francaise de Speleologie (2013:205).

Strengths: This variation works well as a means of ascending a rope without an ascender because it has considerably less internal friction than the other three options provided here.

Weaknesses: This variation does create more friction in the Münter Hitch, so it can be difficult to take in slack. Operation is easier with a smaller diameter rope with less friction. Like the other Münter Hitch variations, this one also requires a second locking carabiner of the same size. The Remy hitch is also incredibly difficult to unlock, so use it when unlocking it is unlikely.

Relevant Literature:
Ecole Francaise de Speleologie (2013:205)
Meredith and Martinez (1986:62)

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