Setting up a Mitchell rope ascending system

Warning! Using any ascending system without expert guidance may cause serious injury or death!

The Mitchell System is a “ropewalking” style, single-rope ascending system. Developed by Dick Mitchell in 1967, it is one of the most versatile and efficient rope ascending systems in the world. It requires a double roller chest box and two ascenders. The Mitchell is a distinctly American rope climbing system and is fully compatible with modern Alpine SRT rigging. It is easily converted to either a Texas or a Frog ascending system when desired. The Mitchell is heavier and bulkier than a Frog system, but testing indicates that it is at least 30% more efficient for climbing a rope. For some climbers, efficiency increases as much as 45% over the Frog System.

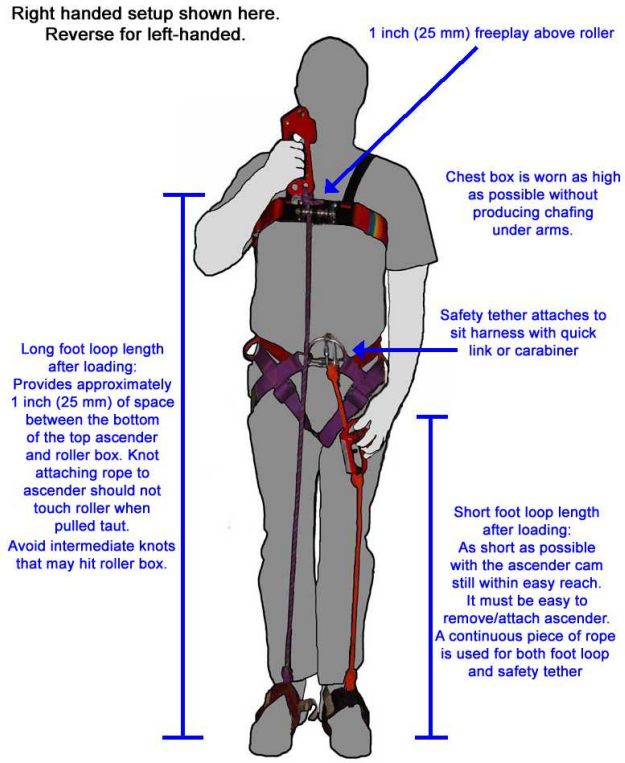


Fig 1: A properly adjusted Mitchell ascending system. There is about 1 inch (25 mm) of free play between the roller box and upper ascender knot. The short foot line must allow access to the lower ascender cam and the safety tether is minimum length.

General setup tips

A materials list may be found at the end of this article.

Although the Mitchell System is not sit-harness dependent, a sit-harness should ALWAYS be worn while ascending. Emergencies may require using a sit-harness at any time. Any caving or climbing harness may be used for the Mitchell System.

Right-handed climbers generally run the long (upper) line from the right foot through the right roller. The main rope runs through the left roller. Left-handed climbers may reverse the system. The Mitchell REQUIRES at least one safety tether to prevent accidental inversion in the event of equipment failure. A short cowtail can serve as the safety tether, but SRT versatility may be compromised. A dedicated tether is recommended.

Be sure to wear your normal caving or climbing boots when adjusting the system. All knots should be LOADED repeatedly to set them. Failure to do so will result in line lengths that are longer than optimum. Lines/knots always stretch with loading and with use. Leave plenty of tail on rope ends. Tails should be trimmed only after the system has been loaded several times.

Tie foot lines directly into ascenders and stirrups whenever possible. Do not use unnecessary hardware because it increases the weight and bulk of the system. Some ascenders have relatively sharp edges at tie-in points and wear protectors will help to reduce abrasion. If the ascender has two holes at the bottom, tie foot lines into the hole that is most directly under the cam.

Sewn foot stirrups are more comfortable, but they are not essential. Rope foot loops can be used in lieu of stirrups for minimum weight and bulk. A double loop knot such as the double figure 8 is recommended because it distributes the weigh more effectively across the bottom of the foot. Because the Mitchell System places full body weight on one foot at a time, rope loops can pinch the sides of the foot unless footwear is stiff. S*ee recommendations for minimizing the system at the end of this article.*

Adjustment of the roller box: Adjust chest box height BEFORE adjusting the rest of the system (See figure 1). Position the chest box as high on the chest as possible without allowing chest straps to chafe under the arms. The chest harness should be adjusted as tightly as possible around the chest without restricting breathing.

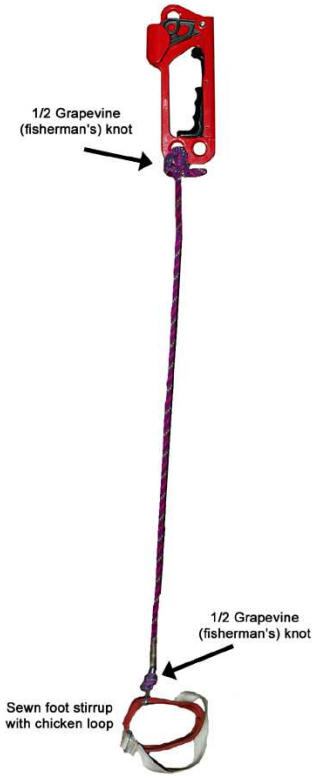


Fig. 2: The long (upper) foot loop. Note the "chicken loop" with buckle in case of inversion should the roller box fail. If a safety tether is used at the upper foot line no chicken loop is required.

Fabricating and adjusting the foot lines

Do not use webbing for the upper Mitchell foot line. Webbing can jam in the roller box or not run freely through it. Attach the foot stirrup to 8mm rope using a ½ Grapevine (fisherman's) knot. *Load the knot* and leave about 6 inches (150 mm) of tail for adjustment. Tie the rope directly into the stirrup if possible. A load-bearing "chicken loop" is required on the upper ascender foot line in case of accidental inversion. Because the lower ascender has a safety tether, a load-bearing chicken loop is not required. Climbers may desire a non load-bearing chicken loop to hold the lower foot stirrup in proper position on the instep.

With one foot in the stirrup and feet together on level ground, run the other end of the foot line though one side of the roller box. Pull the line taut and cut it at least one foot *above* the roller box. Tie this end of the line *directly into the bottom of the handled ascender using a ½ Grapevine or barrel knot* (no hardware). Start by tying the line about 2 inches (50 mm) shorter than the desired length (See figure 3).

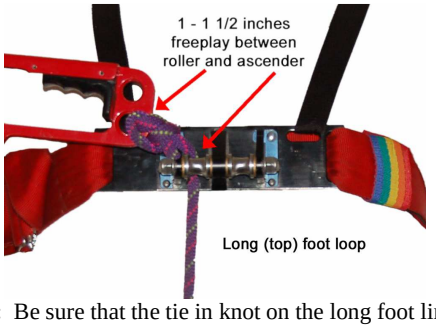


Fig.3: Be sure that the tie in knot on the long foot line just clears the roller pulley when the line is pulled taut. Be sure to load the knots in order to "set" them.

Load the knot several times and readjust the length until correct. The extra tail on the upper line will be cut very short after the knots have been loaded and the system tested. The short tail prevents it from jamming into the roller box pulley. Some ascenders may require abrasion pads over the tie-in holes.

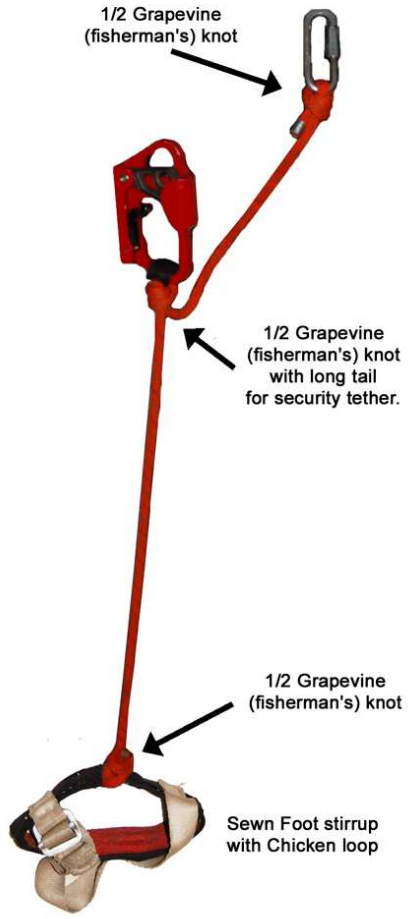


Fig. 4: The short (lower) foot loop and safety tether assembly. A "chicken loop" is not required for the short foot line.

Because it does not run through the roller, a small quick link (delta or oval) may be used to connect the foot loop/safety tether assembly to the lower ascender. Use of hardware for this connection allows the ascender to be used for other purposes without compromising system integrity. If a separate safety tether is desired, the quick link can also serve to attach the safety tether to the ascender. Be sure to leave ample rope tail at the top to construct the tether. The tether will require approximately 2 feet (600 mm) of rope.

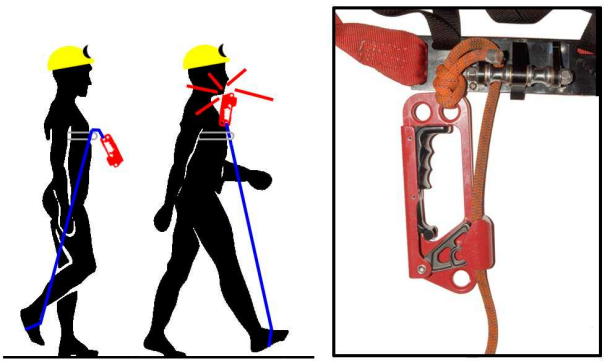
Adjustment of lower (short) foot line

Adjust the upper foot line so that when pulled taut, the bottom of the ascender sits about 1 inch (25 mm) above the chest box AFTER LOADING the knots with full body weight! The tie-in knot must *clear* the roller by about 1/2 inch (15mm). This small amount of free play between the knot and the roller is important (See figure 3). There is no advantage to making the upper foot line shorter, and a short line will prevent the climber from standing upright. If in doubt make the line longer.

After the knots are tightened, the adjustment should be tested by standing upright with both feet together on a level surface with the foot line pulled taut. Be sure that the knots are set (tight). Leave plenty of tail for adjustment. *The use of a quick link or other attachment hardware is NOT recommended for the upper ascender because it may damage the roller if it strikes it repeatedly during the ascent.*

Fabricating the lower (short) foot line/safety tether

Because the lower foot loop and safety tether are usually constructed from a single length of rope, do not use line smaller than 8 mm or the strength of the safety tether will be compromised. Larger diameter rope or 1 inch (25 mm) webbing is O.K. *for the lower foot line only!* Attach the foot stirrup directly to the 8mm line using a ½ Grapevine (fisherman's) knot. **Load the knot** and leave at least 6 inches (150 mm) of tail for potential adjustment. This will be cut off when final lengths are determined. Tie the rope directly into the stirrup. Attach the other end of the 8 mm rope to the lower ascender with a ½ Grapevine knot.



Figs. 5 & 5A: Warning! Tension on the foot line while walking will cause the ascender to pivot abruptly upward and it may strike you in the face! Clipping the ascender into the foot line (right photo) will prevent this.

The distance from the lower ascender to the roller box is the limiting factor of Mitchell step height, but the full distance is seldom used. For maximum step height, adjust the lower foot line until the lower ascender is as low as possible, but the ascender cam MUST remain within EASY REACH! If you prefer

easier changeovers and rebelay crossings, a slightly longer foot line is recommended, but some step height may be sacrificed. Adjustment should be made by standing upright on a level surface with feet together in the foot stirrups and the foot line pulled taut. The ascender will usually be at approximately thigh level (See figure 5 - 5A). The cam should be within reach without forcing the climber to bend or lean over. The climber must be able to attach and remove the lower ascender without difficulty. Be sure to load all knots to remove stretch.

Adjustment of safety tether: A safety tether must connect one of the ascenders to the sit harness to prevent inversion should an ascender or roller box fail. Running it behind the roller box to the upper ascender is safer, but it is easier to foul when negotiating rebelays or other rope obstacles. Attachment to the low ascender is less likely to cause problems. It is most efficient to use a single line for the lower foot line and the safety tether. This minimizes potential "hang-up" points and reduces hardware. The safety tether is too low to be used for resting and a cowtail may be clipped into the upper ascender for resting.

Some published sources have recommended a safety tether of up to 20 inches (.5 meters). This is both unnecessary and unsafe. To reduce potential shock load, keep the tether as short as possible without allowing it to either pull up on the foot loop when standing upright or restrict the maximum step. A tether length of more than 12 inches (300 mm) is excessive for all but the tallest climbers. Most climbers find an 8-10 inch (200 - 250 mm) tether sufficient because it will allow TWICE that distance in step height: 20 inches for a 10 inch tether (500 mm for a 250 mm tether). Most climbers average a 12-14 inch (300-350 mm) step. Be sure to include the quick link or carabiner in the measured length of the safety tether. A short tether also facilitates the crossing of rebelays by keeping the climber closer to the main rope when transferring the upper ascender.

Once everything has been tested and all knots tightened, cut off excess rope tails and secure with duct tape. The only critical tail length is the one attaching the long foot line to the *upper ascender*. This tail should be quite short, about 1-1½ inches (25-40 mm) to prevent it from jamming into the roller. T*his knot must be adequately loaded before trimming so it will "set."* Other tails should be cut to about 2 inches (50 mm) and secured with duct tape.

Minimizing the System for expedition caving

The Mitchell system can be streamlined for expeditions by using non-handled ascenders and rope foot loops instead of sewn stirrups (See figure 6). Climbing efficiency is not affected with rope loops, but foot comfort is reduced. This setup is particularly effective for multi-pitch caving or when pitches are relatively short.

Although the lower foot line does not require a chicken loop, the foot loops should be sized to fit snugly over the boot. This is particularly important when using rope loops due the discomfort that may be caused by the loops slipping off the instep. A snug-fitting, double figure eight knot seldom comes off lug-soled boots. The upper foot line loops should fit loosely around the boots as in a foot loop assembly for a Frog System. Be sure to fabricate a chicken loop for the upper ascender foot line, both for safety and to keep the loops on the instep. When converting the Mitchell to a Frog for short ascents the roller box is not used and the Mitchell upper foot line becomes the Frog foot line.

Fig. 6: Rope foot loops and non-handled ascenders will minimize system weight and bulk. Chicken loops are not shown.

Materials required:

Sit-harness and cowstails are not included in the materials list.

1. *A double roller chest box and appropriate chest harness.*
2. *Two mechanical rope ascenders. A handled ascender is recommended for the upper (long) foot line, but it is not required. A non-handled ascender is recommended for the lower (short) foot line. Gibbs type ascenders are not recommended.*
3. *Twenty feet (Six meters) of 8-10 mm climbing rope. Static rope preferred. Do NOT use small- diameter cord for the upper line. It will not center itself in many roller boxes and will cause unusual wear patterns.*
4. *Two – 2 inch (50 mm) wide, sewn webbing foot stirrups with chicken loops (optional).*
5. *A 6-7 mm oval Maillon Rapide or locking carabiner to connect safety tether to sit harness.*

The Good, the Bad and the Ugly

The Good:

1. The Mitchell requires significantly less energy to ascend than the Frog System. Tests also indicate that it is a *minimum* of 25% faster for any body type when ascending unobstructed ropes. For certain body types, the increase can be up to 45%. It is well-suited to situations when pitches are either relatively long (more than 40 meters) or spaced far apart.

2. Contrary to information published WITHOUT actually testing the system, the Mitchell is very effective in crossing mid-rope obstacles, such as rebelays, deviations and knots.

3. Mitchell system effectiveness is minimally affected by different body types.

The Bad:

1. The Mitchell is heavier and bulkier than the Frog. In addition to two ascenders with foot loops, it requires a double-roller chest box and harness. The type of roller box can significantly affect its performance at mid-rope obstacles.

2. It takes *slightly* longer to cross certain mid-rope obstacles such as rebelays and knots than the Frog System.

3. The cost of a Mitchell System is significantly higher than a Frog.

4. Initial tests show that the Mitchell System (actually all ropewalking style systems) makes carrying heavy (expedition size) caving packs more difficult over long distances. This is primarily because the pack weight must be lifted by one leg at a time.

The Ugly:

1. The Mitchell requires considerably more “gearing up” and “gearing down” in order to travel. It is less suited than the Frog for closely-spaced multiple pitch situations or when pitches are generally short.

2. Lower back fatigue is endemic to the system due to its asymmetry. The climber’s pivot point shifts location with each step, causing a constant rotation of the hips. The fatigue can be minimized by proper technique, but not eliminated.

Resources

On Rope: North American Vertical Rope Techniques for Caving by Bruce Smith and Allen Padgett. National Speleological Society. Second edition, Jan. 1997. ***Author’s note:*** *On Rope’s discussion of the Mitchell System is comprehensive regarding an American approach to SRT. It details how to fabricate a Mitchell system and lauds its versatility, but unfortunately contains no information about how it functions under Alpine SRT rigging conditions.*

Vertical - A Technical Manual for Cavers by Alan Warild. Fourth Edition, 2008. A PDF version can be downloaded at: http://www.cavediggers.com/vertical/ ***Author’s note:*** *This approach to vertical caving contains uninformed speculation, inaccurate descriptions and poor conclusions about the Mitchell System in the context of Alpine SRT rigging. This is obviously due to lack of actual experience with the system. Overall, this is a good, in-depth resource, but regarding the Mitchell System, it is misleading.*

"Typecasting the Vertical Caver" by John Woods. *Nylon Highway #53*, Dec. 2008. National Speleological Society. *On line at: http://www.caves.org/section/vertical/nh/53/Typecasting.pdf* ***Author’s note:*** *This is an ergonomic study of the Frog ascending system. It addresses the topic of different body types and their potential effectiveness with the Frog System. It contains surprising test results for many Frog system devotees.*

"Comparisons of the Frog and Mitchell ascending systems for crossing common mid-rope obstacles" by John Woods. *Nylon Highway #53*, Dec. 2008. National Speleological Society. On line at: http://www.caves.org/section/vertical/nh/53/MitchvsFrogPart2.pdf ***Author’s note:*** *These are real-world comparisons of the Frog and Mitchell Systems for negotiating rebelays, crossing knots, deviations, for changeovers and overall vertical effectiveness. It contains comparative information on relative system sizes, weights, and bulks. This article dispels many myths about the systems.*

“Converting the Mitchell System to a Frog System" by John Woods. *Nylon Highway #53*, Dec. 2008. National Speleological Society. On line at: http://www.caves.org/section/vertical/nh/53/ConvertMtoF.pdf **Author’s note:** A p*ractical method of converting a Mitchell System to Frog system.*