

The Ascending Multi-System

Reuse most components and easily switch among all major ascending systems: Frog, Rope Walker, Mitchell, and Texas.

by
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Bennett Lee's Guide to the Ascending Multi-System

Reuse most components and easily switch among all major ascending systems: Frog, Rope Walker, Mitchell, and Texas.

Disclaimer: This guide is not a substitute for proper training by a qualified instructor. Your local caving organization is excellent place to start. Even if you are trained, always test your system on rope just above the ground to ensure it works and is sized properly. Most importantly, do not make the mistake of rappelling into a pit with an untested ascending system as your only way out.

Whether you use a Frog, Rope Walker, Mitchell, or Texas, we all share many of the same vertical components. What I am presenting here is a way to tweak your vertical system that will allow you to quickly and easily switch among multiple vertical systems, even in the field at the base of an ascent. Some components or setups presented here may be atypical, but they allow us to reuse gear.

This article is not a complete discourse on any single system. For detailed information on vertical systems and techniques, I highly recommend the book *On Rope* by Bruce Smith and Allen Padgett, ISBN 1-879961-05-9.

What is an Ascending Multi-System?

An ascending multi-system is a set of vertical gear that easily switches among multiple vertical systems. It's a term that I coined because I don't know anyone specifically optimizing a set of vertical systems for fast and easy switching.

The multi-system presented here can easily convert to Frog, Rope Walker, Mitchell, or Texas. Since most components for the individual systems overlap, there are very few extra components to carry. Upgrading from a single-purpose Rope Walker or Mitchell adds virtually nothing in terms of weight and bulk, while upgrading from a Frog adds about 50% more weight but can build four different ascending systems, as well as have redundancy in case components fail. However, to accomplish all this, we need to tweak a few systems.

Changes to the Typical Frog System

Frog Chest Harness

I replace the troublesome Frog chest harness with a bungee. The Frog chest harness is typically a tangled mess and needs additional tightening on rope. In contrast, a bungee takes only a second to slip on and off and doesn't need to be readjusted.

Note that the Frog chest harness is not designed to keep your body upright. If you need that, try a Rope Walker or a Mitchell.

Frog Cow's Tail

Only the short cow's tail is available because the long connects to the handled ascender. However, a complete second cow's tail is available but isn't shown in the diagrams.

Frog Foot Loop

Instead of the typical Frog foot loop, by necessity this Frog system uses a rope connected to two foot straps with chicken loops. You do not have to use the chicken loops while using the Frog, but they are required for all the other systems.

So Many Rope Walkers...

There are numerous Rope Walker systems, identified by their bungee configuration: Double Bungee, Single Bungee, Bungee and a Half, or No Bungee. The Rope Walker that best fits our goal of reusability is the Double Bungee using a Petzl Croll as the foot ascender and a Petzl Basic as the knee ascender.

Additionally, instead of the typical single roller chest harness, you will need a double roller variety to reuse for the Mitchell.

Which Vertical System is Best?

The "best" system depends on the specific ascent. What is best for one ascent might not be best for another. This is why the Ascending Multi-System is so beneficial. Frog and Mitchell are both great all-purpose systems, but Mitchell is bulkier. Frog is inefficient if done improperly, while Mitchell and Rope Walker are easy for beginners or tired cavers to do correctly. If you need to wear your gear between climbs, Frog and Texas are good choices. Texas is small and simple but horribly inefficient. For long ascents, Rope Walker is *by far* the most efficient.

Table 1: Comparison of ascending systems per task.

| Task | Frog System | Rope Walker | Mitchell System | Texas System |
|---------------|-------------|-------------|-----------------|--------------|
| Efficiency | Good | Best | Good | Poor |
| Heavy loads | Best | Good | Good | Poor |
| Size/weight | Good | Poor | Poor | Best |
| Fast on/off | Good | Poor | Poor | Best |
| Ease of fit | Poor | Good | Good | Best |
| Crossing lips | Good | Best | Poor | Poor |
| Knot/Rebelay | Best | Poor | Good | Good |
| Downclimbing | Good | Poor | Best | Poor |
| Versatility | Good | Good | Best | Poor |
| Changeover | Good | Poor | Best | Good |

Comparing System Weight and Components

Since all the systems use overlapping components, upgrading to an ascending multi-system has only a minor impact on size, weight, and additional components. See Table 2 for details.

Note that Table 2 lists two cow's tails, but these also serve as tethers for knee ascenders. Furthermore, I have two different sizes: 2:1 sides for my Frog cow's tail and Mitchell and Texas knee ascender, and 1:1 sides for my Rope Walker knee ascender and optional safety. Your ratios may vary.

Also note that my foot straps (OnRope1 Stiff Step™) require delta screwlinks. Your foot straps will likely need either the deltas or two additional oval screwlinks.

Screwlinks (a.k.a., maillons or quick links) are used to connect components. This allows quick and easy configuration changes. I use stainless steel Péguet Maillon Rapide. Stainless resists corrosion and is stronger so I can use thinner screwlinks. For my half-round, I prefer an aluminum Petzl Omni carabiner.



Half-Round

Note: the correct name for the carabiner at your seat harness is a **half-round**, not a D biner! These are two different devices with different purposes, so be sure to use the correct names to avoid confusion.

Table 2: Component and weight comparison by ascending system using the ascending multi-system as a base. Your individual systems may vary in components and weight.

| Components | Wt. ¹ | Max Qty. | Frog System | Rope Walker | Mitchell System | Texas System |
|--|------------------|----------|----------------|----------------|-----------------|----------------|
| Frog seat harness | 697g | 1 | 1 | 1 | 1 | 1 |
| Double-roller chest harness | 675g | 1 | × ² | 1 | 1 | × |
| Foot strap with chicken loop | 170g | 2 | 2 | 2 | 2 | 1–2 |
| Handled ascender, left | 207g | 1 | 1 | opt. | 1 | 1 |
| Petzl Croll | 130g | 1 | 1 | 1 | 1 | 1 |
| Petzl Basic | 135g | 1 | × | 1 | opt. | × |
| Locking carabiner | 57g | 1 | 1 | opt. | opt. | 1 |
| Half-round locking carabiner or 9mm half-round screwlink | 86g | 1 | 1 | 1 | 1 | 1 |
| 5–6mm long oval screwlink | 42g | 3 | 2 | 1–2 | 2–3 | 2 |
| 5mm delta screwlink | 24g | 2 | 2 | 2 | 2 | 1–2 |
| 3.5mm oval screwlink | 8g | 2 | 2 | 2 | × | × |
| Long line, 8–11mm rope, ~10ft (3m) | 153g | 1 | 1 | × | 1 | × |
| Cow's tail, 8–11mm rope, ~10ft (3m) | 153g | 2 | 1 | 1–2 | 1–2 | 2 |
| 4–6mm bungee, ~6ft (2m) | 35g | 1 | 1 ² | 1 | × | × |
| 1/8" steel swivel pulley | 24g | 1 | × | 1 | × | × |
| 2" (50mm) spring link | 13g | 1 | × | 1 | × | × |
| Min Weight¹ | | | 2.00kg (4.4lb) | 2.39kg (5.3lb) | 2.57kg (5.7lb) | 1.76kg (3.9lb) |
| Max Weight^{1,3} | | | 2.00kg (4.4lb) | 2.85kg (6.3lb) | 2.96kg (6.5lb) | 1.96kg (4.3lb) |
| Multi-System Weight^{1,3} | | | 3.05kg (6.7lb) | | | |

¹ Weight based on my personal system.

² Bungee replaces troublesome Frog chest harness.

³ Includes all optional components.

Optional (But Highly Recommended)

- Extra locking carabiners and screwlinks.
- 1in tubular webbing, 6ft (2m) and 10–15ft (3–5m). Use as slings. Replaces cow's tail or long line. Makes foot straps, chicken loops, chest or seat harness, or 4-step etrier.
- Three Prusiks, 7–8mm rope, 3ft (1m) each. Use as slings. Substitutes for ascenders. Makes foot straps and chicken loops. Helps cross obstacles. Holds steps, ladders, or pads.

Build a Multi-System

Know Your Knots!

These knots are used in this guide. Know them by heart.

| | | |
|-----------|--------|------------|
| Figure 8 | Barrel | Grapevine |
| Butterfly | Prusik | Water knot |

Custom Fit Your Components

Buy three 10ft (3m) sections of 9mm dynamic rope and one 6ft (2m) section of 3/16in (5mm) bungee.

For reference, I am 6ft tall and my final ropes are 8ft long. My long line is 4.5ft tied. One cow's tail has 2ft and 1ft sides (2:1). My other has 1.5ft sides (1:1). My bungee is 5ft long and 3.5ft tied. Your lengths and cow's tail ratios may vary, but I will refer to the two different cow's tails as 2:1 and 1:1.

Measure Your Mitchell Long Line

The long line has figure 8 loops on both ends and extends from your foot strap to just above your chest harness.

1. Tie a figure 8 loop in one end and attach it to your foot strap.
2. Put the rope through a roller in your chest harness.
3. Tie another figure 8 loop about 2in (5cm) above your chest harness when standing. *Do not cut off the excess rope!*

Measure Your Cow's Tails

Our cow's tail has figure 8 loops on both ends and a butterfly knot offset from the middle. Do not use half-barrel knots for the ends. These cinch down, making it difficult to reconfigure.

1. Tie a figure 8 loop in one end of a rope.
2. Tie a butterfly knot in the middle of the rope so the figure 8 in step 1 is about level with your chin when the butterfly knot is attached to your seat harness.
3. Tie another figure 8 loop in the other end of the rope so that side is half the length of the side you just tied (2:1).
4. Test the cow's tail on rope with both a Frog and a Mitchell.
You want to balance these opposing factors:
 - a. *Priority:* Long side must keep the top of the Frog handled ascender within reach of your fingertips.

Secondary: Long side should allow you to reach the top of knee ascender. If not possible, use a small tether.

- b. Short side should be short enough to perform a Frog changeover but long enough to allow you to stand with the knee ascender for the Mitchell or Texas.
5. Tie a second cow's tail with both sides the same length (1:1). Attach this to your Rope Walker knee ascender.
 - a. The side to your foot strap must be long enough to prevent your ascenders from hitting during steps but still keep the knee ascender below your half-round.
 - b. The side to your half-round should be long enough to allow you to stand.

Make Your Rope Walker Bungee

1. Put on your Rope Walker system without the bungee.
2. Tie a figure 8 loop or half-barrel knot in one end of the bungee and attach it to your Croll with a 3.5mm screwlink.
3. Feed the other end of the bungee through the pulley and to your knee ascender. *Note: pulley always remains on bungee. When not in use, move it to rear above your seat harness.*
4. Raise your knee ascender as you step up and tie a figure 8 loop in the bungee 4–6in (10–15cm) above the ascender.
5. Attach the bungee to the ascender with a 3.5mm screwlink.
6. Take several test steps up, alternating feet. The bungee should be slightly tight, keeping both ascenders upright.
7. Cut off any excess bungee and heat seal.

Cut and Retie Your Ropes

1. Mark the potential ends of both cow's tails and the long line. Untie all knots and find the longest mark.
2. Cut all ropes to the longest mark (making all the same max size adds redundancy). Be sure to properly seal the ends.
3. Retie your long line and both cow's tails. To fit, you may need to adjust the loop diameter or tail length of the knots.

Recheck Sizing

1. Load all knots on rope (crucial to final sizing).
2. Recheck the sizing of all your systems.
3. If necessary, adjust the knots then repeat these three steps.

Frog System

Good general purpose.

Bungee from top of Croll, over shoulder, to back of seat harness

Always use a *left-handed* ascender to prevent lockups with Croll

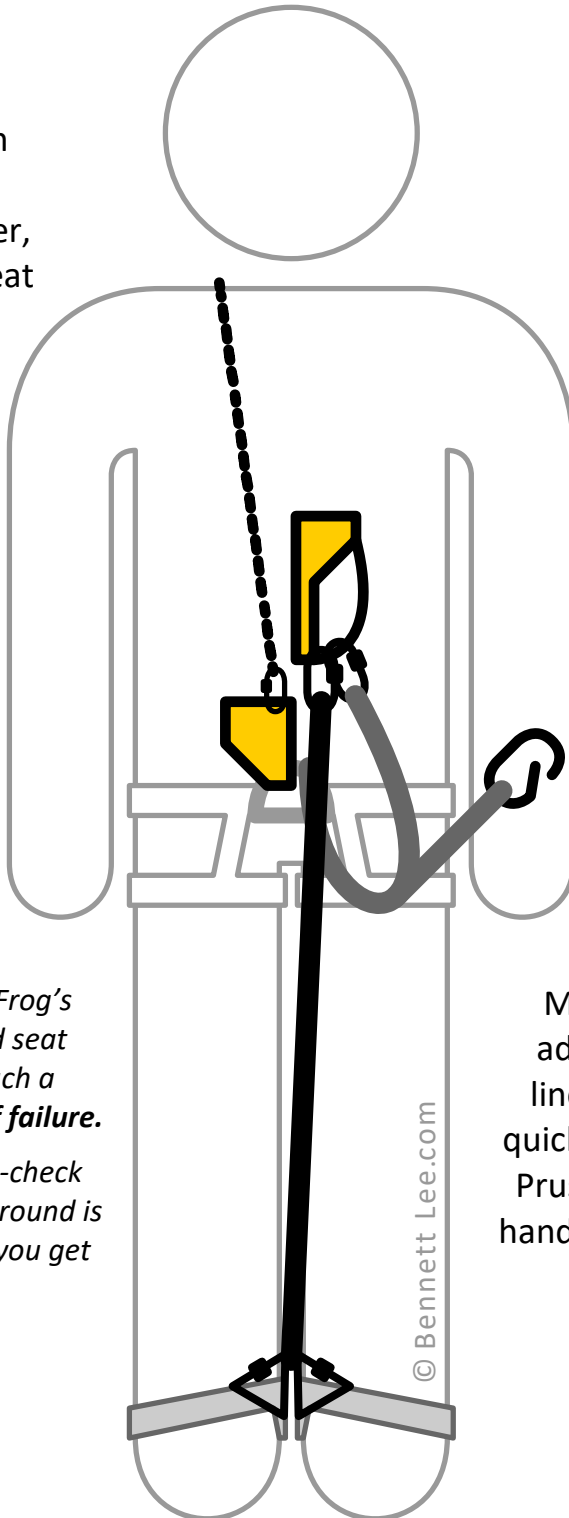
Petzl Croll to right of all other gear

Warning: the Frog's half-round and seat harness are each a **single point of failure.**

Always double-check that your half-round is locked before you get on rope!

Make an easily adjustable long line by adding a quick-adjustment Prusik below the handled ascender

Long line to both feet



Frog System

Most popular. Good general purpose. Small and lightweight. Proper sizing and technique is critical to efficiency.

| | | |
|-------------------|-------------|----------------|
| Frog seat harness | Petzl Croll | Cow's tail 2:1 |
| Handled ascender | Bungee | Carabiner |
| L/R foot straps | Long line | Screwlinks |

Assembly

1. Croll on half-round to the right of all other gear.
2. Bungee on top of Croll with 3.5mm screwlink, over shoulder, to back or side of seat harness with screwlink or carabiner.
3. Handled ascender on long line with 5–6mm screwlink to both deltas on foot straps (chicken loops optional).
4. Cow's tail mid on half-round, left of Croll; handled ascender on long side with 5–6mm screwlink; carabiner on short.

Sizing

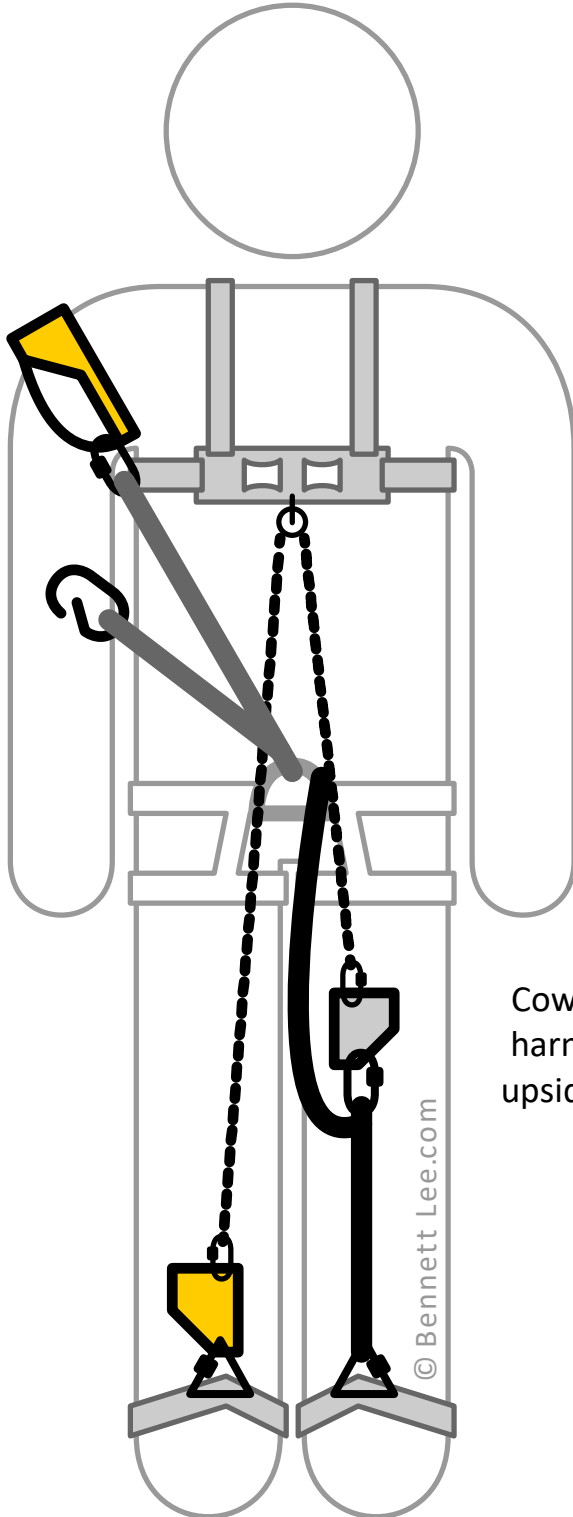
- Long line should place upper ascender slightly above the Croll when standing upright.
- Cow's tail to ascender should allow full squat but keep top of ascender within reach. Short side is generally half long.
- Bungee should be tight enough to keep Croll upright when squatting and very tight when standing.
- To quickly shorten long line or bungee, tie overhand knots.

Emergency Repair

- **Bungee:** (1) use one hand to hold Croll upright during sit-stand, (2) make a carabiner chest harness, or (3) replace bungee with rope or webbing. **Warning:** do not loop around only neck because of the choking hazard during falls. Instead, go over shoulder to seat harness.
- **Cow's tail:** use without. *Dangerous if Croll fails. Use chicken loops!*
- **Long line:** (1) retie cow's tail as long line, (2) add cow's tail and convert to Texas, or (3) add chest harness and convert to Rope Walker.
- **Foot strap:** (1) use one foot, (2) retie large loop at end of long line for both feet, or (3) make a cinch strap.
- **Seat harness:** (1) make a diaper harness and resize system, or (2) switch to a Mitchell or Rope Walker without a seat harness.
- **Ascender:** Use Basic or Prusik. To replace Croll, either use Basic on far left of half-round or use short-handled Prusik and manually advance.

Rope Walker

Most energy efficient.



Safety
*(optional,
but cannot
sit to rest
without it)*

Cow's tail to seat
harness prevents
upside-down foot
hang if chest
harness fails

Petzl Croll

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Rope Walker

Most energy efficient but bulky. Excellent crossing lips. Chest harness helps maintain upright position. Safety can be used while ascending for three points of contact.

| | | |
|-----------------|-------------|-------------------------------|
| Seat harness | Petzl Croll | <i>Optional Safety</i> |
| Chest harness | Petzl Basic | Handled ascender |
| L/R foot straps | Spring clip | Carabiner |
| Cow's tail 1:1 | Pulley | Cow's tail 2:1 |
| Bungee | Screwlinks | |

Assembly

1. Croll on delta of right foot strap.
2. Petzl Basic on cow's tail 1:1 mid with 5–6mm screwlink; one side to delta on left foot strap; other on half-round.
3. Bungee to tops of Croll and Basic with 3.5mm screwlinks.
4. Pulley attaches to bottom of chest roller with spring clip.
5. *Optional safety*: cow's tail 2:1 mid on half-round; handled ascender on long with 5–6mm screwlink; carabiner on short.

Rope path: (1) optional safety to (2) chest roller to (3) knee ascender to (4) foot ascender.

Sizing

- Knee ascender should be high enough to step without ascenders touching but remain below the seat harness.
- Bungee should be tight at full step, very tight when standing.
- Top of safety ascender should be within reach when loaded.

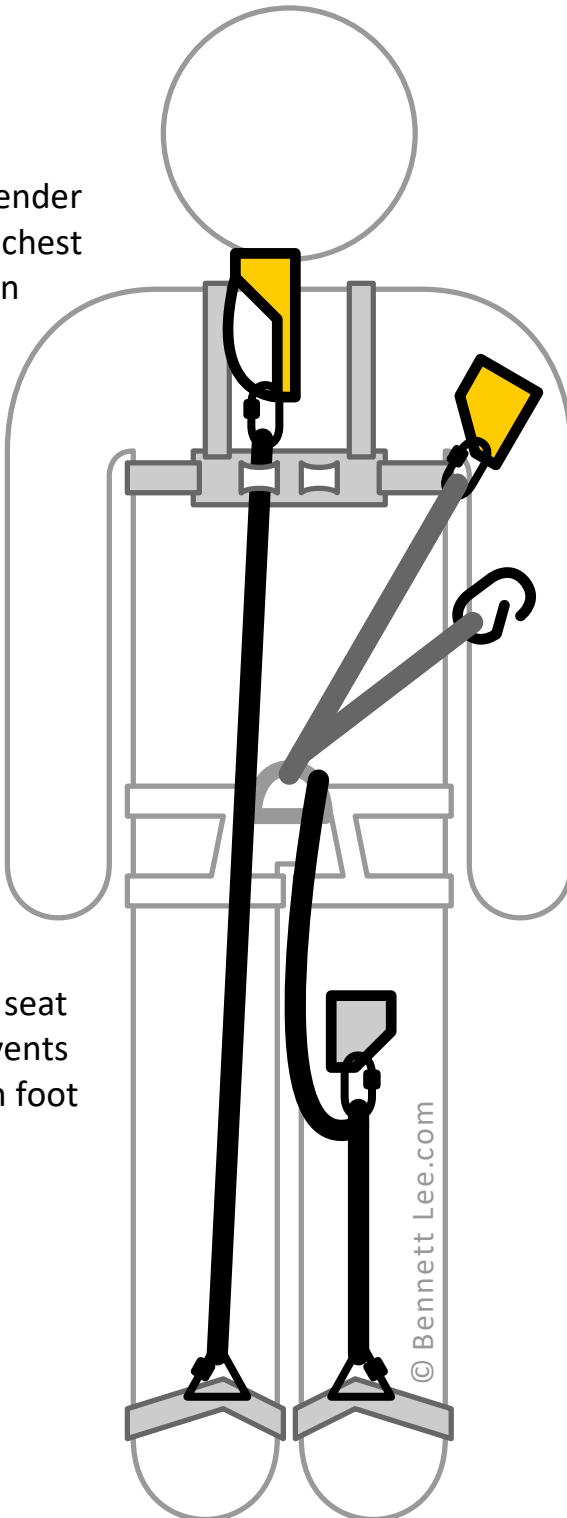
Emergency Repair

- **Chest harness:** (1) make a carabiner chest harness, (2) attach bungee through safety ascender and use without chest harness, (3) retie cow's tail or add long line and convert to Frog, or (4) convert to Texas.
- **Seat harness:** (1) make a diaper harness or (2) use without seat harness but note upside-down foot hang can occur if chest harness fails.
- **Bungee:** (1) convert to Texas, (2) if short, connect bungee from Croll to seat harness and manually raise Basic, (3) add long line and convert to Mitchell, (4) attach rope or webbing to ascenders and manually raise each ascender, or (5) reach down and manually raise each ascender.
- **Pulley:** (1) use a carabiner or screwlink, or (2) use second roller.
- **Cow's tail:** (1) retie long line as safety, or (2) use without safety.
- **Foot strap:** (1) convert to Texas, or (2) make a cinch strap.
- **Ascender:** (1) convert to Texas, (2) replace with handled ascender, or (3) move Basic to foot and use Prusik for knee ascender.

Mitchell System

Good general purpose but bulky.

Handled ascender should clear chest harness when standing



Safety
*(optional,
but cannot
sit to rest
without it)*

Cow's tail to seat harness prevents upside-down foot hang if chest harness fails

Petzl Basic within reach of left hand

Mitchell System

Good general purpose but bulky. Chest harness helps maintain upright position and increases efficiency.

| | | |
|------------------|----------------|------------------------|
| Seat harness | Petzl Basic | Optional Safety |
| Chest harness | Cow's tail 2:1 | Cow's tail 1:1 |
| L/R foot straps | Long line | Petzl Croll |
| Handled ascender | Screwlinks | Carabiner |

Assembly

1. Handled ascender on long line with 5–6mm screwlink, through right chest roller, to delta on right foot strap.
2. Petzl Basic on cow's tail 2:1 mid with 5–6mm screwlink; long side to delta on left foot strap; short on half-round.
Optional: switch feet and use Croll instead.
3. *Optional safety:* cow's tail 1:1 mid on half-round; Croll on one side with 5–6mm screwlink; carabiner on other.

Rope path: (1) handled ascender to (2) left chest roller to (3) knee ascender. Also, (4) handled ascender long line through right chest roller to right foot.

Sizing

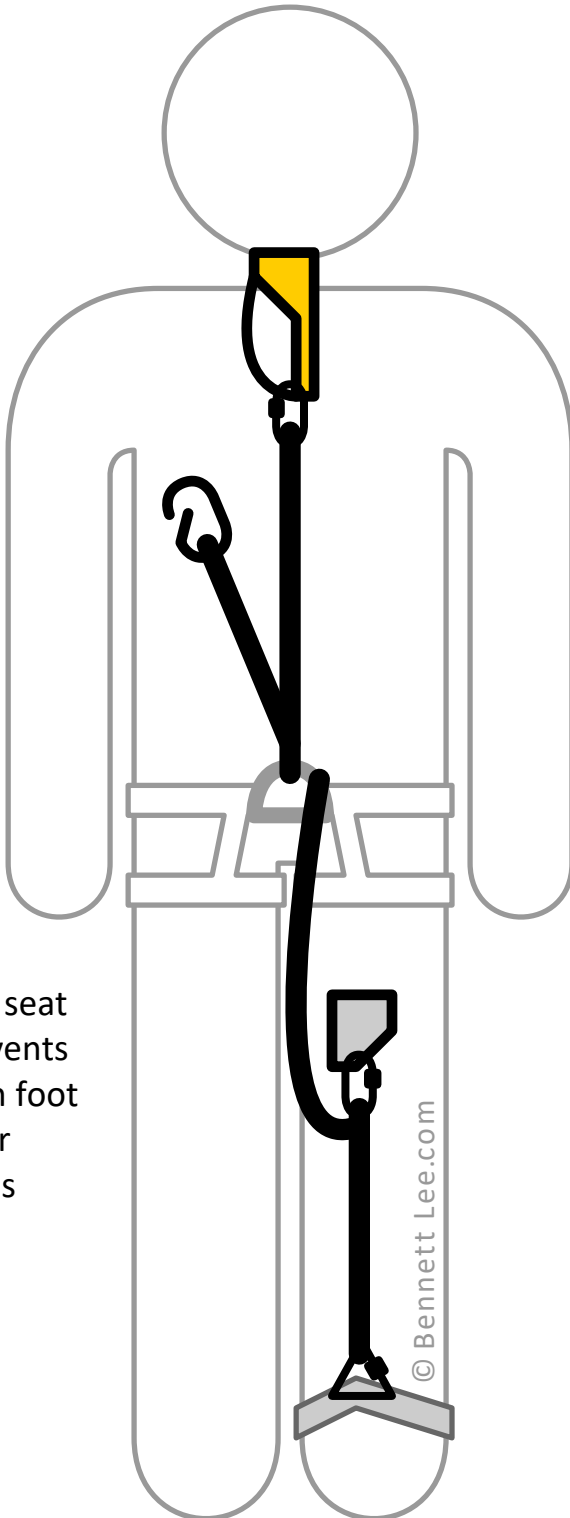
- Upper ascender should be just above chest harness when standing upright.
- Knee ascender should be within reach of hand.
- Top of safety ascender should be within reach when loaded.

Emergency Repair

- **Chest harness:** (1) convert to Texas, (2) add bungee and convert to Frog, or (3) make a carabiner chest harness.
- **Seat harness:** (1) make a diaper harness or (2) use without seat harness but note upside-down foot hang can occur if chest harness fails.
- **Long line:** (1) convert to Texas, (2) retie safety as long line, or (3) add bungee and convert to Rope Walker.
- **Cow's tail:** (1) use with no safety, or (2) add bungee and convert to Frog or Rope Walker.
- **Foot strap:** (1) convert to Texas, (2) add bungee and convert to single foot Frog, or (3) make a cinch strap.
- **Ascender:** (1) use Croll or Prusik, or (2) add Croll and bungee and convert to either Rope Walker or Frog.

Texas System

Inefficient. Good for short climbs.



Cow's tail to seat harness prevents upside-down foot hang if upper ascender fails

Petzl Basic within reach of left hand

Optional: attach both foot straps to increase efficiency

Texas System

Small and lightweight. Fast to put on and take off. Inefficient on rope. Best suited for short climbs (less than 30ft or 10m).

| | | |
|----------------|------------------|------------------|
| Seat harness | Handled ascender | Optional |
| Cow's tail 2:1 | Left foot strap | Right foot strap |
| Cow's tail 1:1 | Carabiner | |
| Petzl Basic | Screwlinks | |

Assembly

1. Cow's tail 1:1 mid on half-round; handled ascender on one side with 5–6mm screwlink; carabiner on other.
2. Petzl Basic on cow's tail 2:1 mid with 5–6mm screwlink; long side to delta on left foot strap; short on half-round.
Optional: switch feet and use Croll instead.
3. *Optional:* attach right foot strap with delta next to left for increased efficiency.

Sizing

- Top of upper ascender should be within reach when loaded.
- Knee ascender should be within reach of hand.

Emergency Repair

Uh oh! I hope you brought extra gear!

- **Cow's tail:** (1) add long line and retie as cow's tail, (2) add long line and convert to Frog, (3) add chest harness and long line and convert to Mitchell, (4) add chest harness and bungee and convert to Rope Walker, or (5) retie remaining cow's tail to long line and convert to Frog without tether to handled ascender. *Use chicken loops as backup!*
- **Seat harness:** (1) make a diaper harness, (2) add chest harness and foot strap and convert to either Mitchell or Rope Walker, which are both functional without a seat harness.
- **Foot strap:** make a cinch strap.
- **Ascender:** use Croll or Prusik.

Emergency Components

- **Seat harness:** make a diaper sling using a 10–15ft (3–5m) webbing loop tied with a water knot.
- **Chest harness:** make a carabiner chest harness using a 6ft (2m) webbing loop tied with a water knot.
- **Foot strap:** make a cinch strap using a 3–6ft (1–2m) webbing or rope loop. *Use only in dire circumstances.*
- **Ascender:** make a Prusik using a 3ft (1m) rope loop tied with a grapevine or barrel knot. Ideally, the Prusik rope should be 70% the size of the rope to which it attaches. E.g., 11mm rope = 7–8mm Prusik, 9mm rope = 6–7mm.

