Technical Rescue Riggers Guide

By Rick Lipke

TECHNICAL RESCUE TECHNICIAN

Second Edition

Waterproof / Tear Resistant

Briefing for Technical Rope Operation - Quick Reference

General**
1) Here's What I think we face;
2) Here's what I think we should do;
3) Here's why;
4) Here is what we should keep an eye on;
5) Now talk to me...

**Adapted from Dr. Karl Weicke. University of Michigan. 1995

Specific
• Assign a Safety officer (if possible)
• List special safety concerns
• Establish hazard zone
• Establish edge transition location
• Establish a line of direction for mainline
• Explain mainline specifics
• Explain needed edge transition techniques
• Explain expected time frames
• Assign package operators
• Designate anchors
• Assign a Control officer (if possible)

Commands for Technical Rope Operation Quick Reference**

To Begin

1) QUIET ON THE SET! (All operators quiet, with attention on Rigger [or Control])

2) READY! (Indicates that a package portion of the system is ready to operate. Must receive a repeat ready from all FOUR packages to continue).

3) APPROACH THE EDGE! (Bring the Patient Package Into operational position [on belay])

4) PREPARE TO TENSION! (Mainline operators remove any slack from the system, and hold the line tight)

5) TENSION THE SYSTEM! (Force is applied to mainline by easing over the edge, vectoring [see below] or raising)

During the Operation

VECTOR! (Lateral force is applied to mainline to aid in a transition).

RELEASE VECTOR! (Lateral force is slowly released).

DOWN! (Lower the patient/rescue package. Speed of lower is dictated by cadence: DOWN... DOWN...DOWN...).

DOWN SLOWLY! (Slow and gentle lower).

UP ! (Raise the Patient/ Rescue Package).

Reset! (allow the mainline ratchet to set and the pulley system to be reset [no stop command is necessary here])

STOP! (stops the system in an emergency, or for a safety concern. Can be given by anyone in the system).

WHY STOP? (Asked by package operators to get information after the STOP command is given).

Rock! Rock! Rock! (Object is falling, DO NOT LOOK UP).

**(More command and communication systems on page 184)

Property of:

If you would like to order more copies of this guide, have questions or comments about this guide, or would like a catalog of our complete line of EMS and rescue equipment, please contact us at:

CONTERRA TECHNICAL SYSTEMS INC.
1600 Kentucky Street # A-3•Bellingham, WA 98229
PH (360)734-2311•FAX (360) 738-2241
EMAIL info@conterra-inc.com
WEB www.conterra-inc.com

Authors note:
This guide contains information on basic rescue techniques only. Many important skill and concepts cannot be properly shown in a guide of this kind, and have therefore been omitted. For complete instruction, please contact a reputable rescue school.

First edition:
1st printing.....3/97
2nd printing.....7/97

Revised first edition:
1st printing.....10/97
2nd printing.....1/98
3rd printing.....7/98
4th printing.....7/00
5th printing.....10/01
6th printing.....1/02
7th printing.....7/03
8th printing.....7/04
9th printing.....9/05
10th printing.....1/06
11th printing.....7/07
12th printing.....7/08

Second edition:
1st printing.....3/09
2nd printing.....5/11

ISBN 0-9665777-1-X

WARNING!

Read this Carefully:

The skills and techniques shown in this guide are for expert use only! Even when properly performed, loss or injuries may result, you could die, or you could kill someone else. It is your responsibility to seek competent hands on instruction in rope rescue, and the specific techniques shown in this book before ever trying them in the field. Conterra Inc. and/or the author accept no responsibility for loss, damage, injury, or death, resulting from information contained in, or omitted from, this guide.

What this guide is-

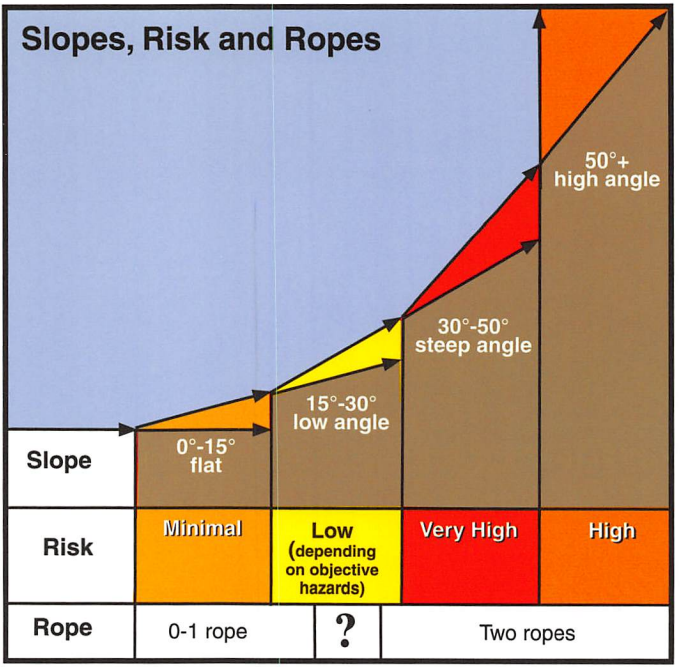
The techniques shown within this guide represent a "paradigm shift" in modern rope rescue. Since the mid 1980's, a new generation of rescue techniques have evolved, borrowing heavily from work done by Rigging for Rescue in Canada- focussing on light equipment, quick response, and a high degree of safety and flexibility. These techniques have been found to work equally well in the back country as well as the industrial setting. If your rescue team is not currently using some or all of the techniques shown in this guide, we highly recommend that you update your training. There are several excellent rescue schools located around N. America that are skilled in these techniques. If you have questions or need updated training, please feel free to contact Conterra Inc. for recommendations on a school near you.

How to use this Guide-

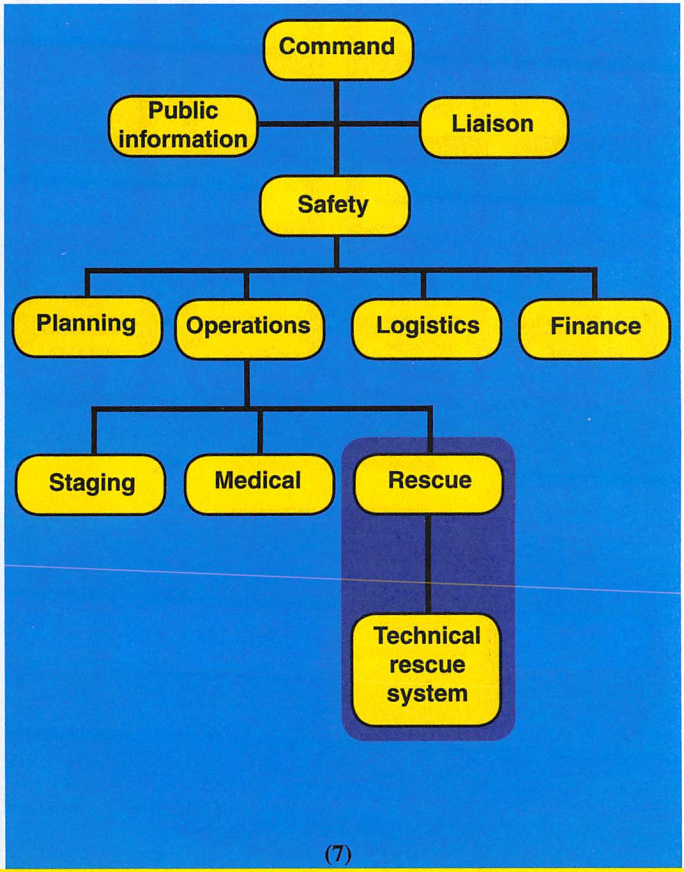
This guide is intended as a field reference for rescuers already trained in, and familiar with, these techniques. The technical illustrations are cross referenced by page number, so that you can quickly zero in on the exact rigging technique in question. Starting at an overview page (High Angle Raise, for example), follow the page references to the subject you wish to view.

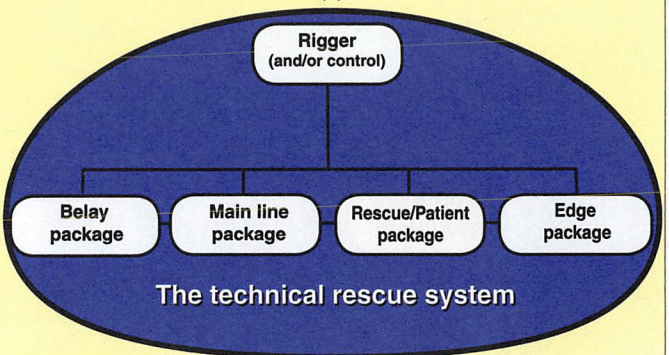
Risk Assessment

Risk assessment on this page is based on probability of a mishap + consequences of a mishap + personnel in harms way + objective hazard [eg rockfall].

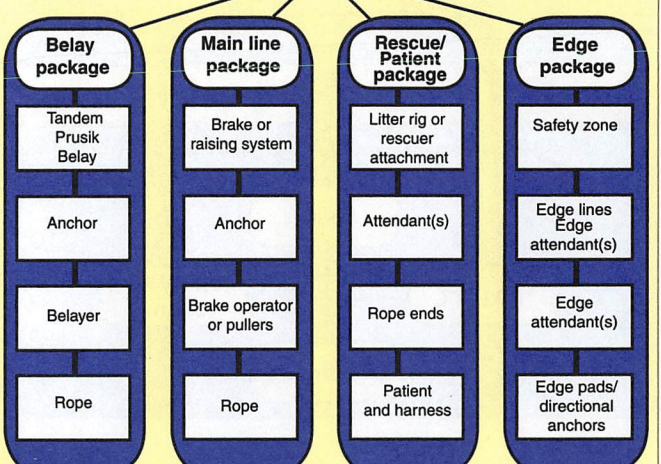


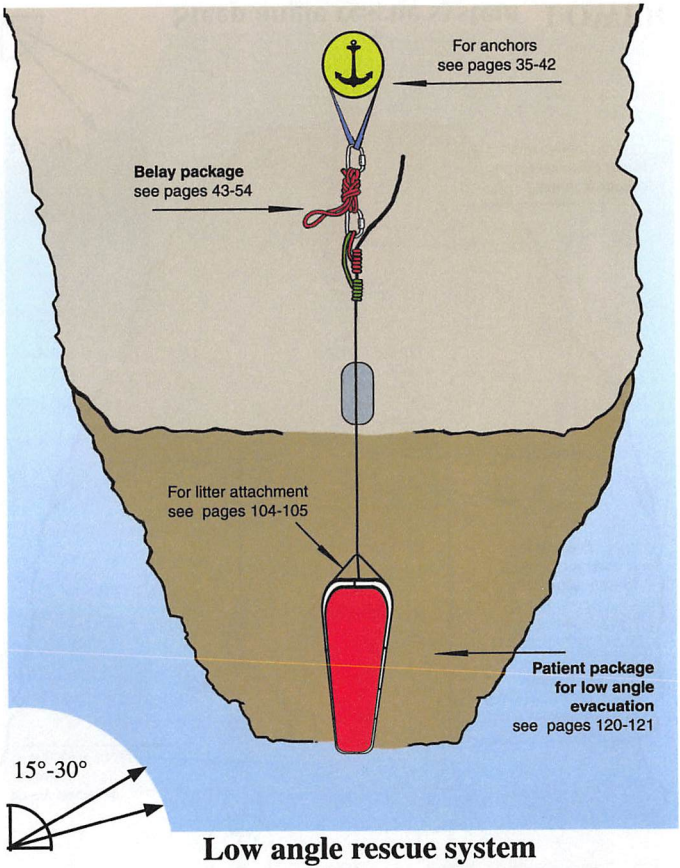
Incident Command System





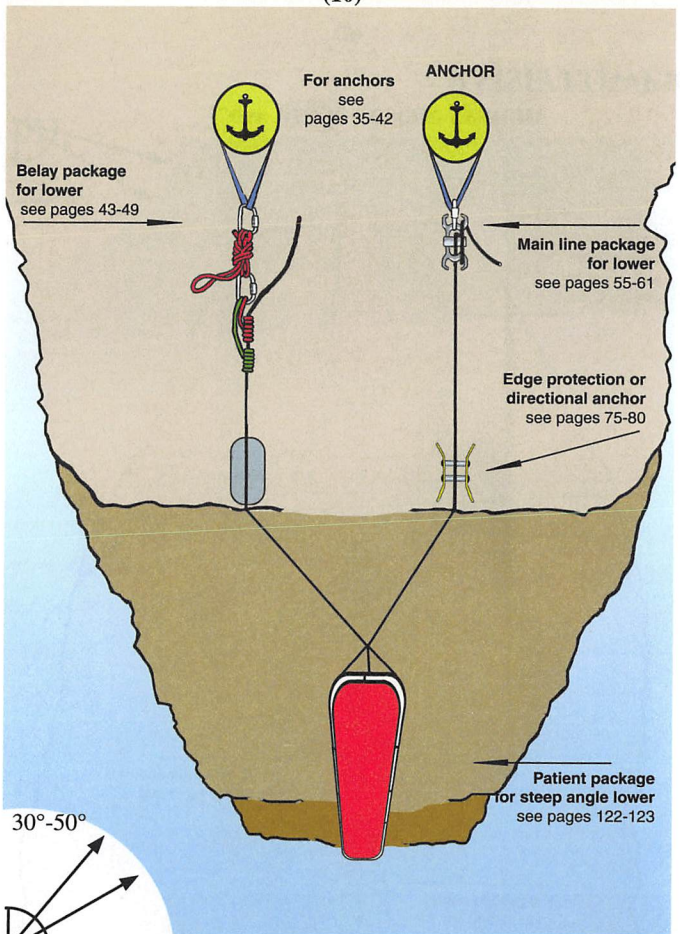
System components



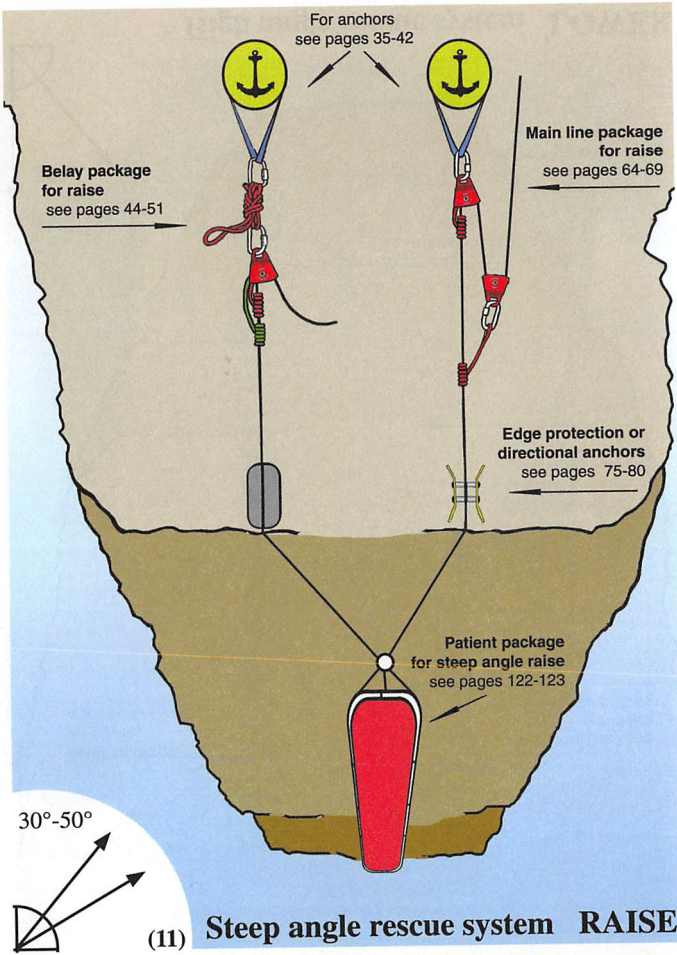


Low angle rescue system

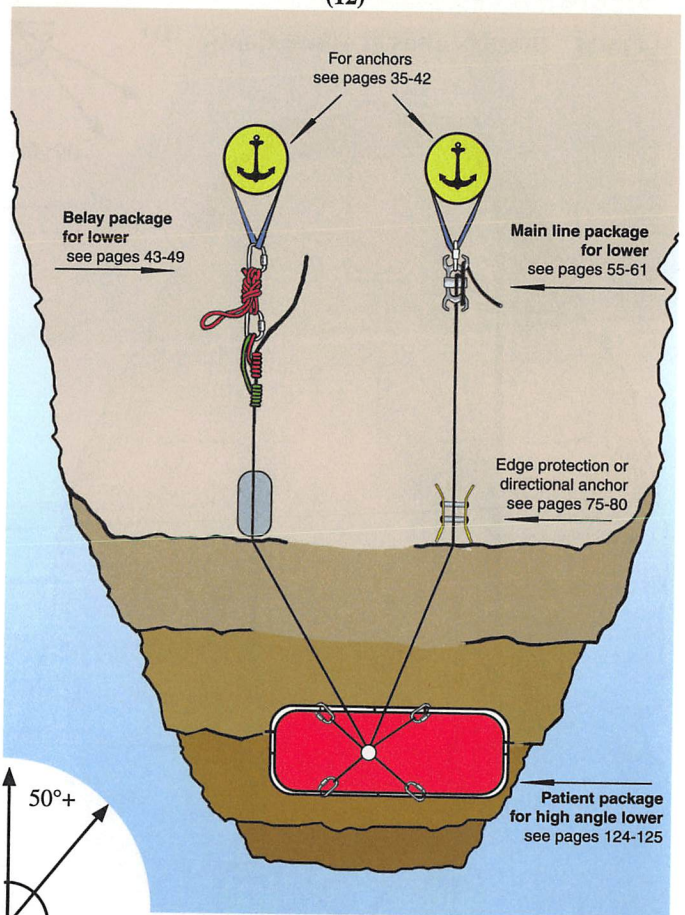
RAISE/ LOWER



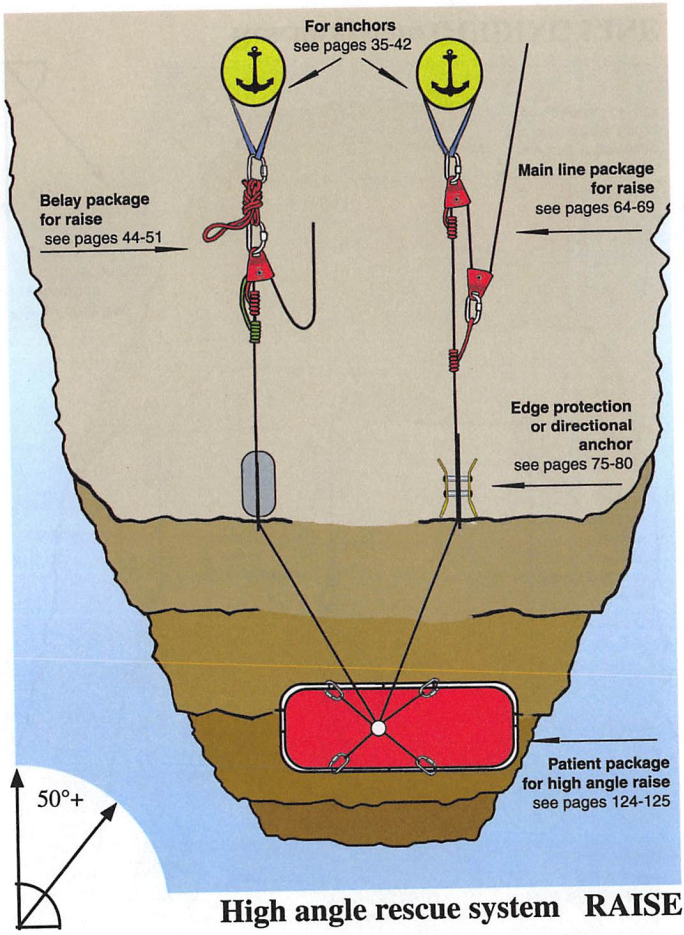
Steep angle rescue system LOWER



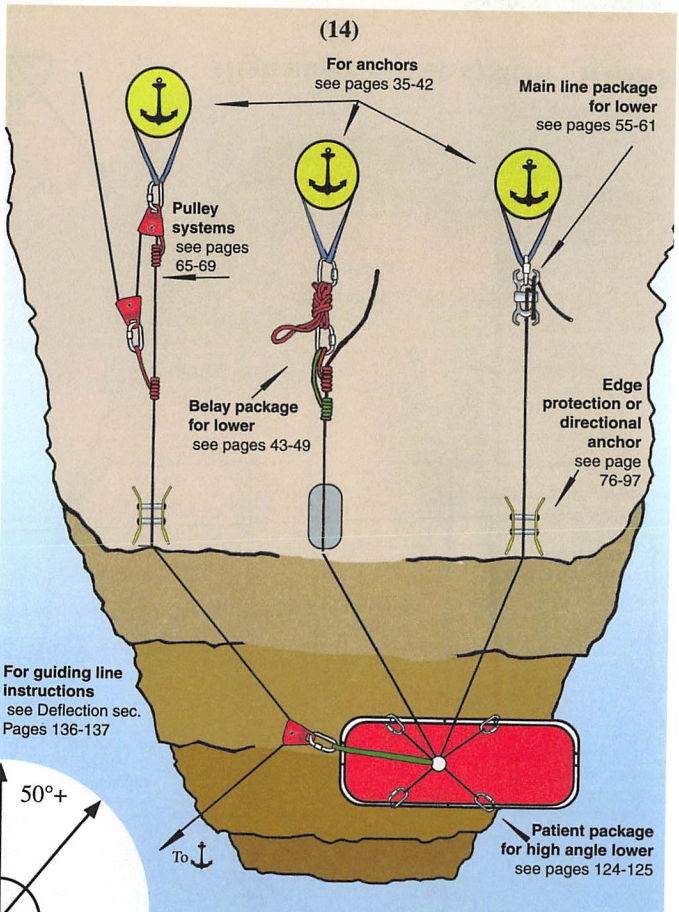
(11) **Steep angle rescue system RAISE**



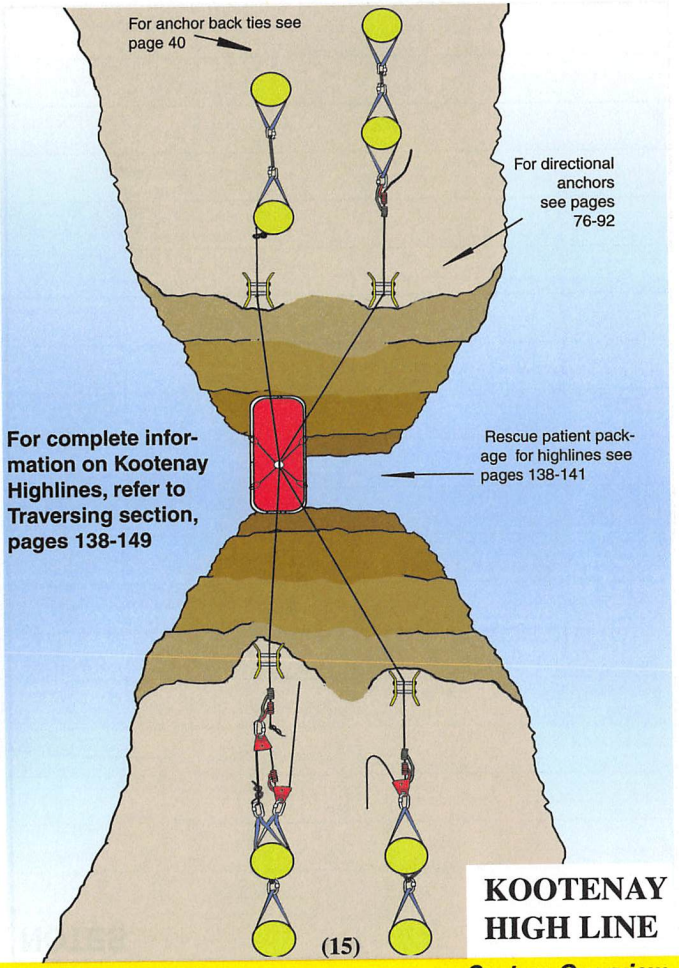
High angle rescue system LOWER



High angle rescue system RAISE



Rescue system GUIDING LINE


For anchor back ties see page 40
For directional anchors see pages 76-92
For complete information on Kootenay Highlines, refer to Traversing section, pages 138-149
Rescue patient package for highlines see pages 138-141

NOTES

Knots-

(a "knot" is a general term for tieing knots, bends and hitches. More descriptive terms are listed below)

Definitions:

Knot- when a strand of material is tied to itself.

Bend- when two or more strand ends of material are tied to each other.

Hitch- when a strand (or strands) of material is tied around another object in such a manner that if that object were removed, the hitch would undo itself.

Running end- the end of the rope or material that is being worked with (i.e. the threading end).

Standing part- The part of the rope to be tensioned.

Bight- A 180° turn in the strand of rope or material.

Loop- A 360° turn in the strand of rope or material.

Round Turn- a 540° turn in the rope.

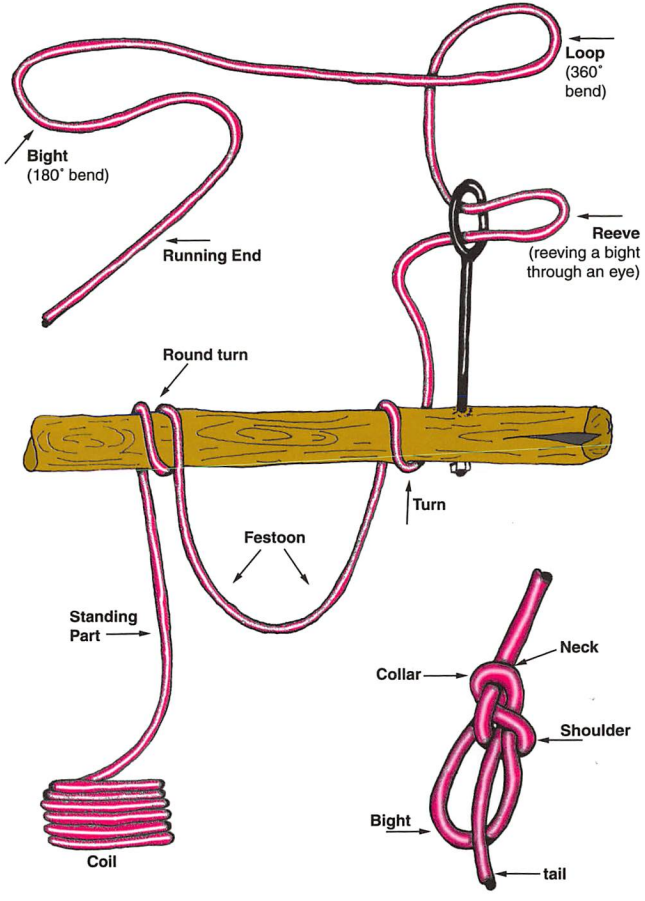
Reeve- Pushing a bight of rope through an eye or loop.

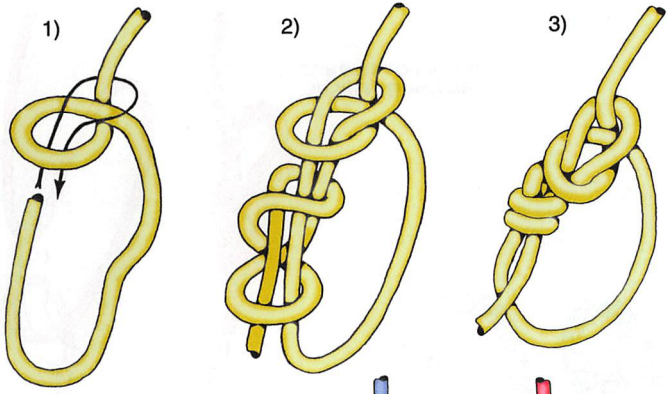
General rules

- Dress and stress all individual strands that enter and leave the knot, i.e. make sure that there are no loose spots, twists or turns that are not supposed to be there.
- After dressing and stressing there should be a minimum of one hand width of tail leaving the knot for 11 and 12 mm rope, as well as 25mm webbing. For smaller diameter cordage, the length of tail should be about 6 times the cord diameter.

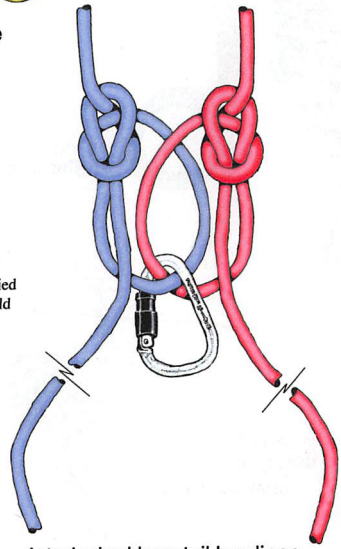
- Some knots require a safety tie off at the end, others do not. Follow the illustrations carefully. Knots of the bowline family (bowlines, sheet bends, etc.) should always have the tail(s) anchored in some manner, either a safety tie off, or attached to another part of the system.
- Inspect all knots by sight AND touch before allowing a system to function.
- A general rule of thumb for engineering rope rescue systems is that ALL knots and bends in round nylon and polyester cord decrease the overall breaking strength of the cord by **about 30%.** Knots and bends in tubular webbing decrease the webbing strength **by nearly 50%**

General Terminology for Rope Handling



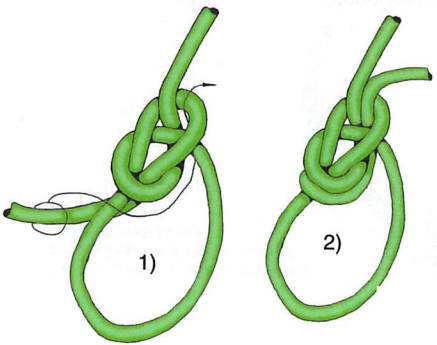


Bowline with standard safety tie



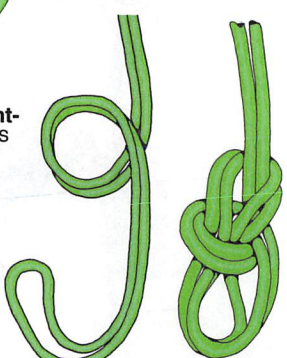
(Interlocking longtail bowlines shown tied with large loops for clarity. These should be tied with small loops.)

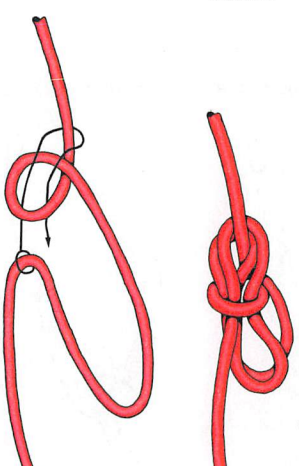
Interlocked long tail bowlines



Bowline with Yosemite finish
(single body weight only)

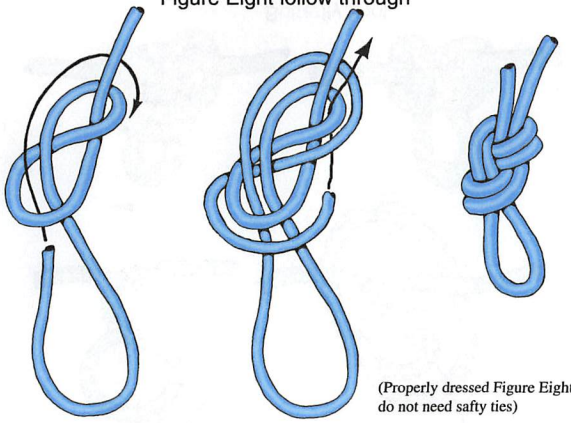
Bowline on a bight-
CLIP ALL THREE LOOPS to secure





"In line" Bowline-
CLIP BOTH LOOPS to secure

Figure Eight follow through



(Properly dressed Figure Eight knots do not need safty ties)

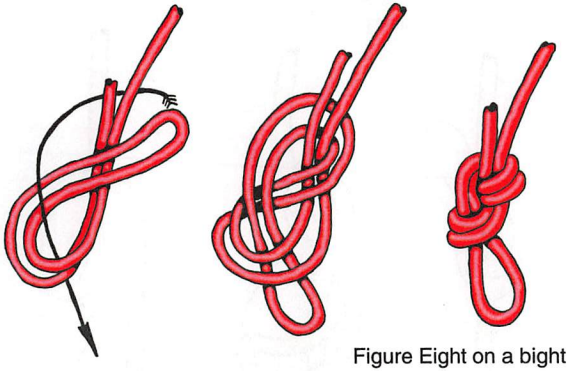
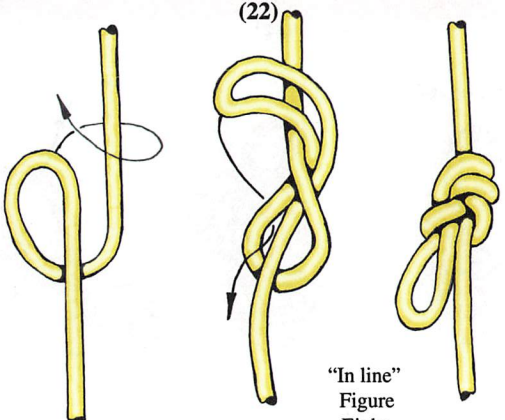
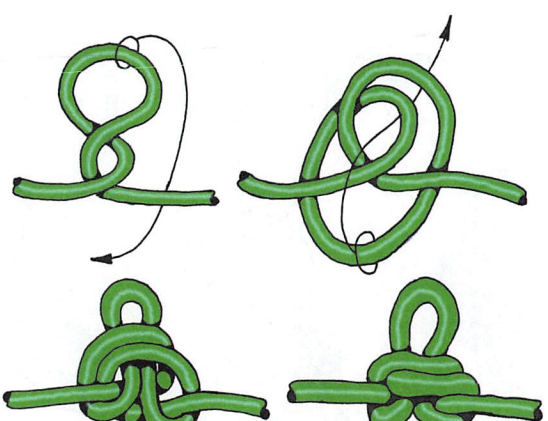


Figure Eight on a bight



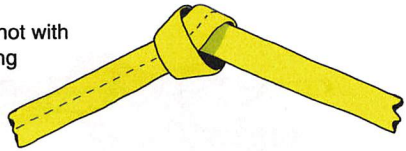
"In line"
Figure
Eight



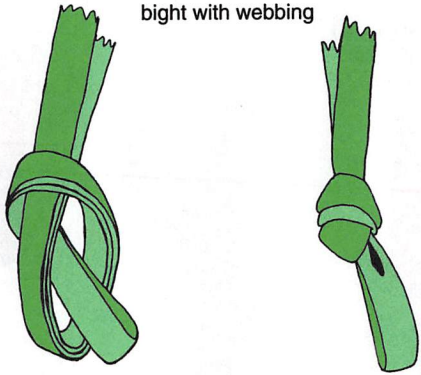
Butterfly knot

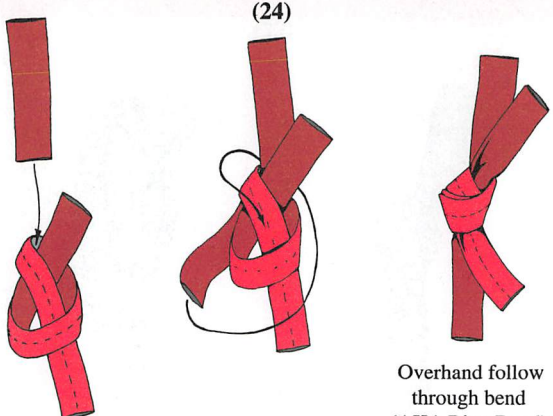
Overhand knot

Overhand knot with webbing

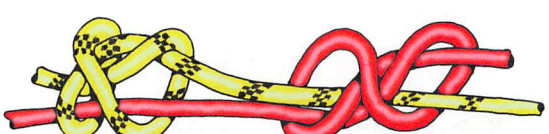


Overhand knot on a bight with webbing





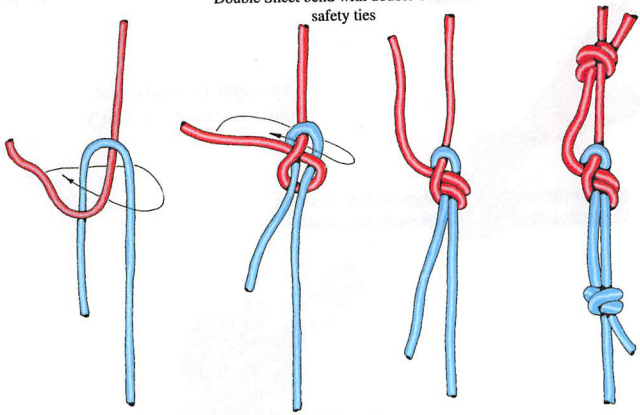
Overhand follow
through bend
(AKA Ring Bend)

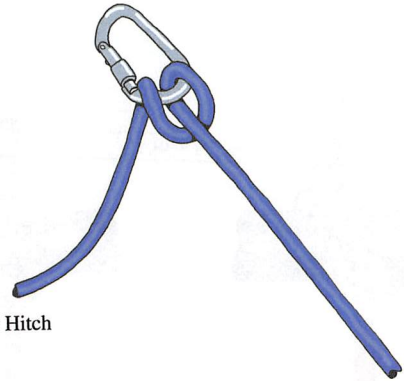


double overhand
bend

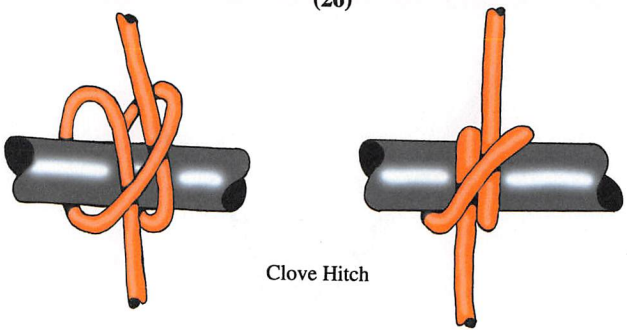
Bends

Double Sheet bend with double overhand safety ties

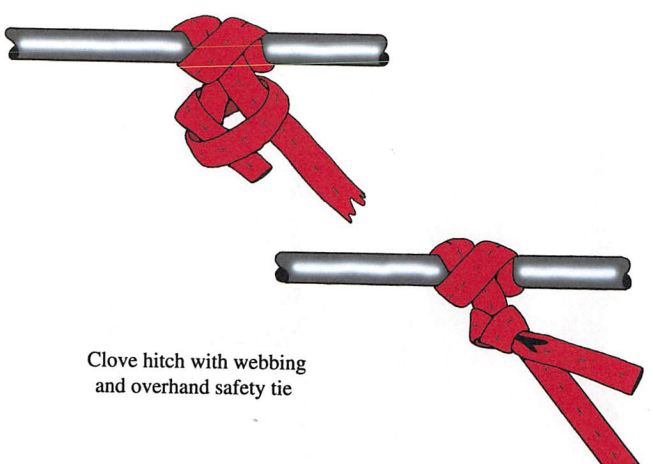




Münter Hitch

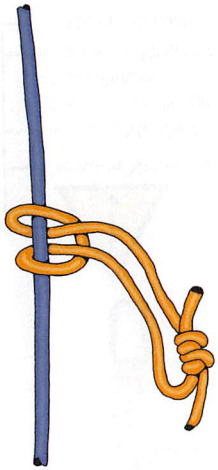


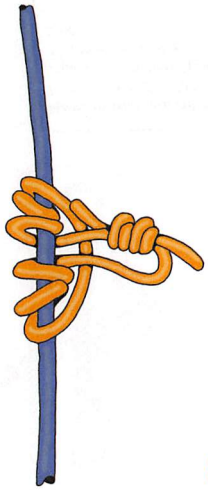
Clove Hitch

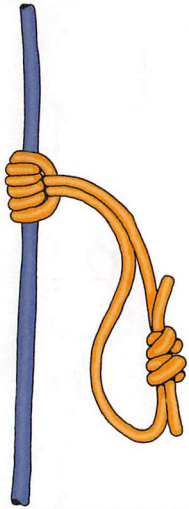


Clove hitch with webbing
and overhand safety tie

Triple wrap Prusik Hitch



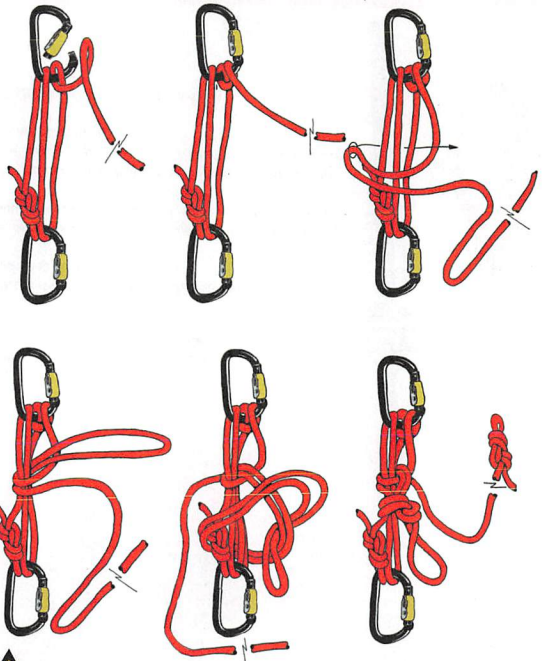




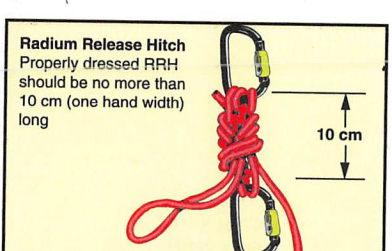
- A Prusik Hitch should be dressed so that all round turns stack neatly beside one another.
- The Prusik hitch should be snugged tight enough so that a crisp hissing sound is made when the hitch slides over the host rope.
- The double overhand bend that creates the Prusik loop should be rigged off to the side of the bight, so that it will not interfere with carabiner attachment.
- Only use Nylon Prusik cord on rescue ropes

3:1 Radium Release Hitch

(for general rescue use)



- Use 8mm Nylon cord
- Infeed of Munter hitch should be on the gate side of Carabineer
- Dress hitch Properly
- Attach tail to anchor



The author and Dr. David Johnson help a civil defense worker don his harness, La Paz, Bolivia

General rules

The idea of personal rigging is that every technical rescuer should have enough gear to not only protect themselves, but also to harness up, rappel, ascend, build their own travel limiting system, and patient package attachment, without the need to borrow from the group equipment cache. Listed below is the gear need to achieve this.

Personal gear

- Helmet with chin strap
- Eye protection (from falling and flying debris)
- Ear protection (for helicopter and industrial work)
- Leather gloves with clip loops
- 3 locking carabiners
- Rappel device (preferably one that does not twist the rope)
- 1 complete set of Purcell Prusiks
- 1 full body harness (or webbing to tie one)
- EMT shears

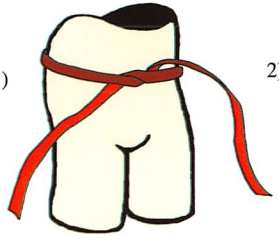
Modified "Swiss Seat" sit harness

Equipment needs:

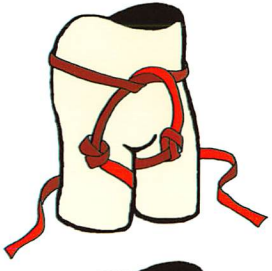
1 x 6M (20ft) tubular webbing strap

Tie off the harness with a square bend, and finish each end with an overhand safety tie

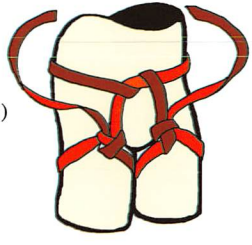
1)



2)

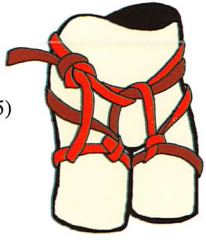


3)



4)

5)



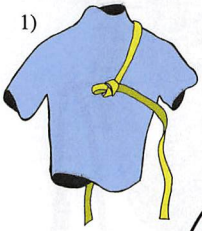
6)

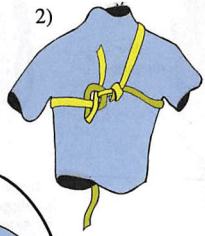
Rescue chest harness

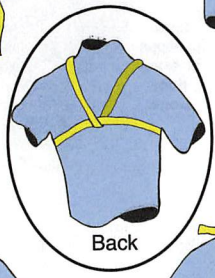
Equipment needs:

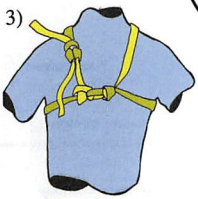
1 x 3.5M (12ft) tubular web strap
1 x 1.5M (5 ft.) tubular web strap

Tie off the harness with a square bend, and finish each end with an overhand safety tie









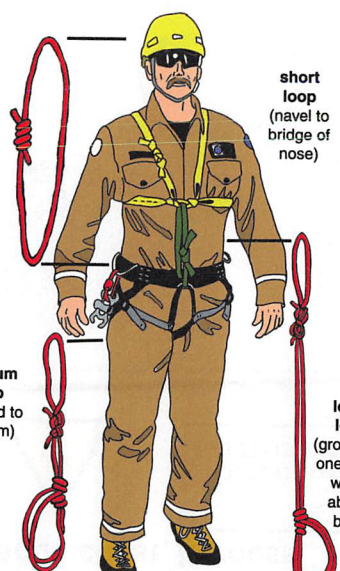
For Rescue work, attach chest harness tightly to sit harness with a connector strap, and use strap as primary attachment point (Belay line mirrors attachment)

Purcell Prusik system

Some uses:

- *Litter tending
- *Personal protection (travel limiting)
- *Ascending fixed lines
- *Improvised rigging
- *Crevasse rescue
- *Adjustable daisy chains

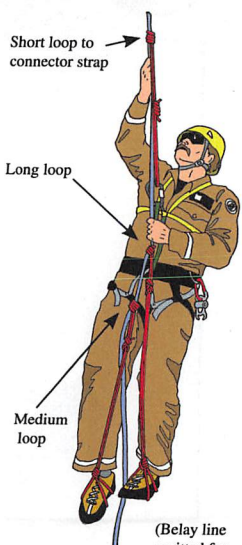
Size your Purcell Prusiks as shown (size with leg loops snugged around feet)



short loop (navel to bridge of nose)

medium loop (ground to inseam)

long loop (ground to one hand width above belt)



Short loop to connector strap

Long loop

Medium loop

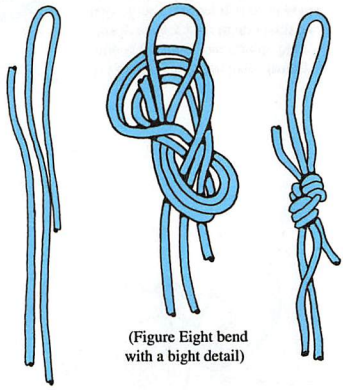
(Belay line omitted for clarity)

Purcell Prusik system

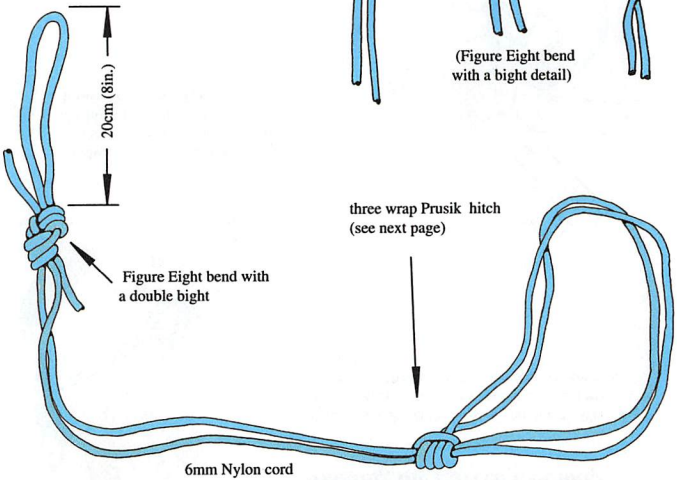
Equipment needs:

32.5 ft. (10m) x 6mm Prusik cord (enough to make all three component parts).

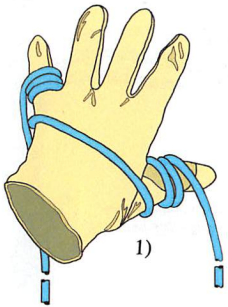
- Always carry a full set of Purcells into the field on any rescue.
- When using as foot loops, snug Prusik hitch down on top of foot
- When using as foot loops, spread strands under foot as wide apart as possible for maximum support.



(Figure Eight bend with a bight detail)

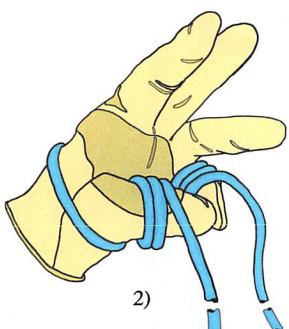


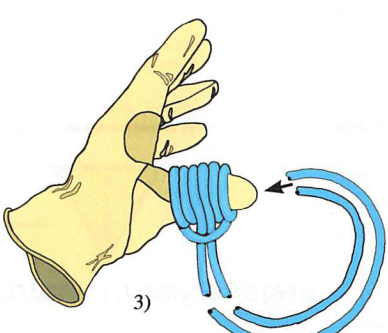
Building the Purcell foot loop-



1) Place a bight on the back of your hand. Wrap a tail around your thumb, and another around your little finger. These should be wrapped in opposite directions.

2) Place your thumb and little finger together as shown. Carefully slide the bight from the back of your hand forward over your fingers.





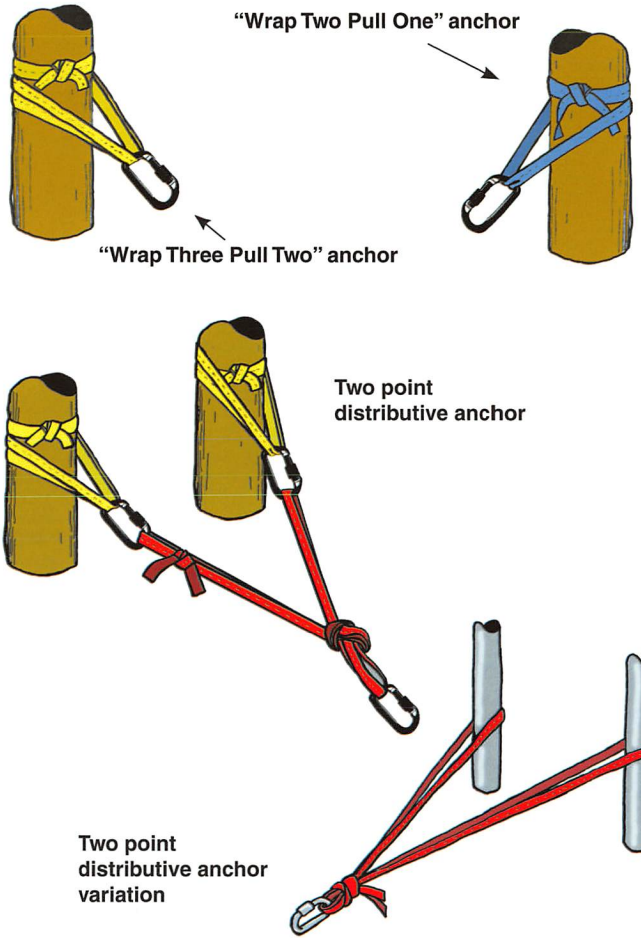
3) Carefully slide the loops from your little finger onto your thumb. Now slowly replace your thumb with the tails of the cord, being careful not to lose any Prusik loops. Pull slack cordage through and dress the hitch neatly. You can now finish sizing and tying your Purcell Prusik by tying a Figure eight bend with a bight as shown on page 37

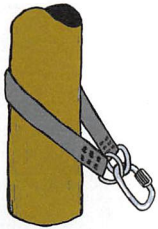
Anchoring systems

Fixed and focussed tie back anchor, Invermere B.C. Canada

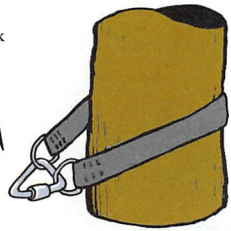
General rules

- Focus anchoring system to a central point that is in line with the direction of force caused by the rescue system.
- When using multiple anchors, make sure that the force is distributed as *appropriately* as possible across all anchors
- As a rule of thumb (when connecting to a *single* strand of webbing), the angle of deflection of the webbing that connects the carabiner to the anchor should be 90° or less.
- Avoid using ANY anchoring system that loads a carabiner in any direction but directly along its spine (use of pre-sewn anchor straps or "quick straps" often results in carabiner "side loading", be aware of this risk and avoid it).
- Make sure that the anchoring object does not have sharp edges that may damage anchor material.
- Make sure that the anchoring object is not hot to the touch.
- Make sure that the anchoring object is free of chemical and petroleum products, which can damage anchoring material.
- When in doubt of an anchor's strength, use multiple anchors.

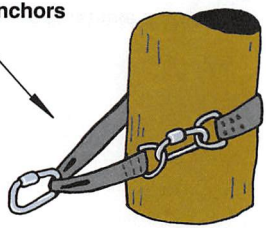

"Wrap Two Pull One" anchor
"Wrap Three Pull Two" anchor
Two point
distributive anchor
Two point
distributive anchor
variation

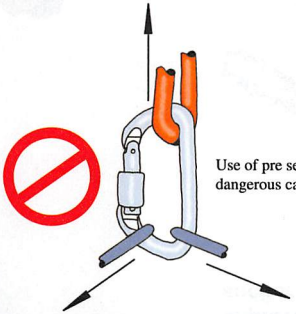


"Quick strap" anchor



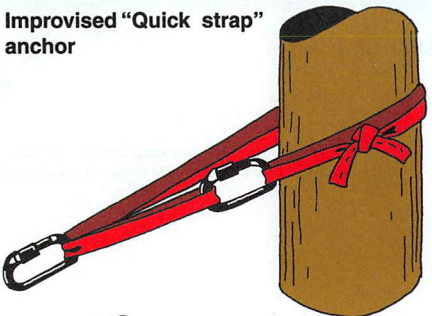
"Quick strap" anchor variations for wide anchors

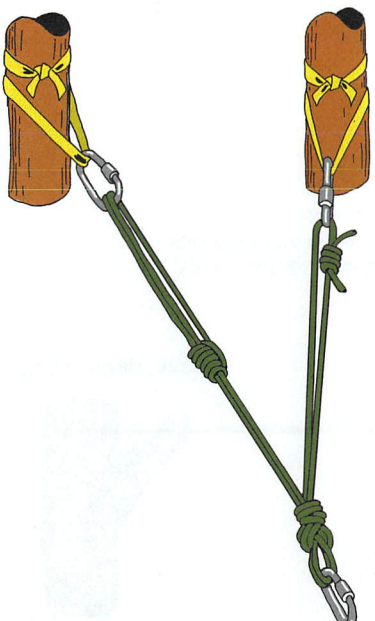




Use of pre sewn anchor straps or "quick straps" can often result in dangerous carabiner "three way loading". *Avoid this!*

Improvised "Quick strap" anchor

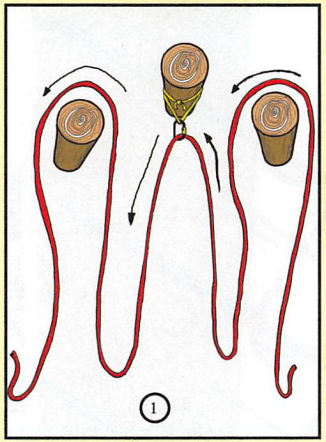




Adjustable distributve anchor

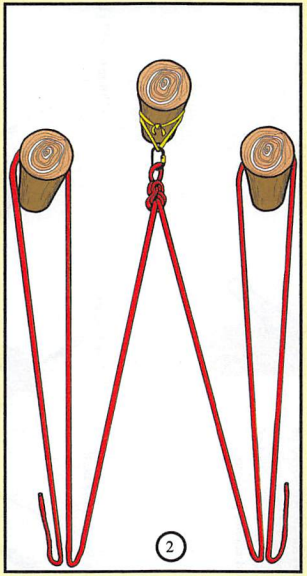
(For instructions on how to tie a Prusik on it's doubled self, see page 34)

Quick Systems Anchor with Rescue Rope

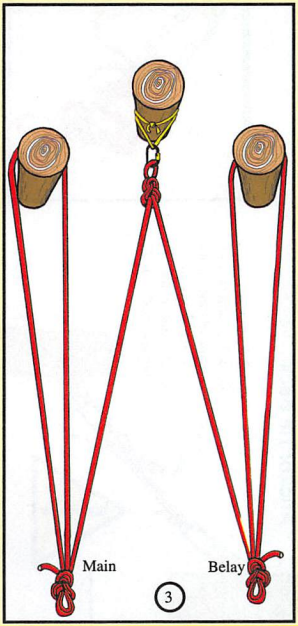


EQUIPMENT:

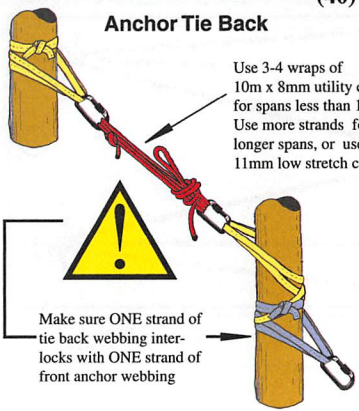
1) 11mm or 12.5mm rescue rope
1) 25mm webbing strap
1) locking carabiner
3) Big Trees

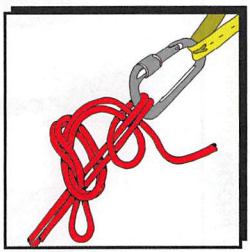


(Many variations are possible)

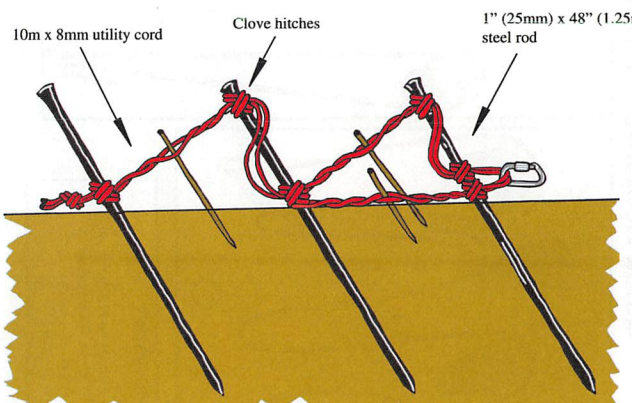


Anchor Tie Back



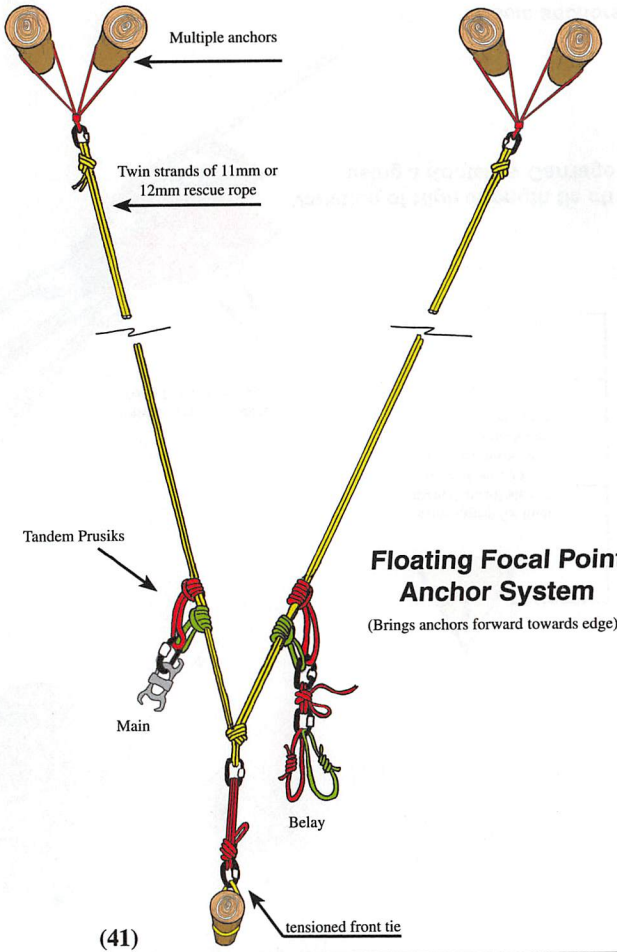


Anchor Tie back: tie off detail



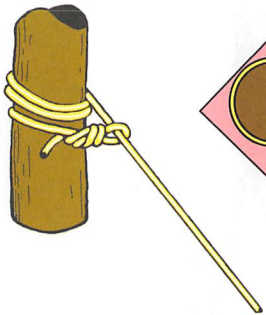
Picket "holdfast" anchor

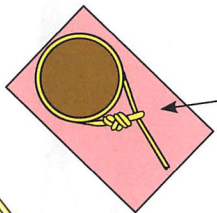
(Picket rods should be driven down 2/3 of their length in firm soil, and 3/4+ in soft or sandy soil)



Floating Focal Point Anchor System

(Brings anchors forward towards edge)



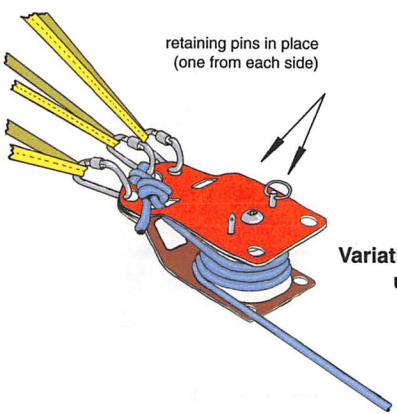


Rig with a slight deflection in the mainline when anchoring around trees

Anchor object for high strength tie off should be at about 10 x the diameter of the rope i.e. 4.5"(10cm) for an 11.1mm rope

Rope should wrap around trees two to three times

Rope should wrap around smooth objects up to four times



retaining pins in place (one from each side)

Variation of High strength tie off using a Kootenay Carriage

Belay Systems

Belay raise in Canyonlands, Utah

General rules

- Always have an attentive belayer; do not leave belay system unattended.
- Use a "skyward tilt of the hands" and insure approx. 8in. (20cm) slack in belay line when using a tandem Prusik Belay
- Never belay off your harness if catching a rescue load (200kgs+)
- Do not wrap thumbs around belay line when belaying a rescue mass, use a "hitch hikers grip" instead.
- During a fall or system failure, quickly push Prusiks in direction of force, when using a Tandem Prusik Belay.

Do not use metal cammed ascenders as ANY part of a belay system for rescue loads (200kg+). Rope damage or breakage can result.

Do not use figure 8 plates in either rappel or slot mode in a belay system for rescue loads (200kg+) The human hand cannot generate enough force to reliably stop a falling rescue load.

- Do not substitute webbing for the 8mm cord in the load releasing hitch. (Webbing can create melting problems, making deployment choppy or impossible)

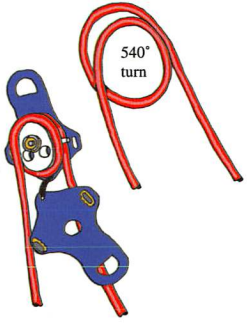
Belay- Raise/Lower

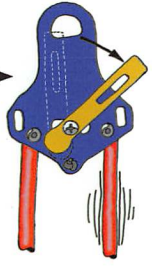
(Traverse Rescue 540 Belay)

Equipment needs:

- **1 Traverse Rescue 540 Belay device**
- **1 Locking carabiner**
- **Anchor (see anchor section)**

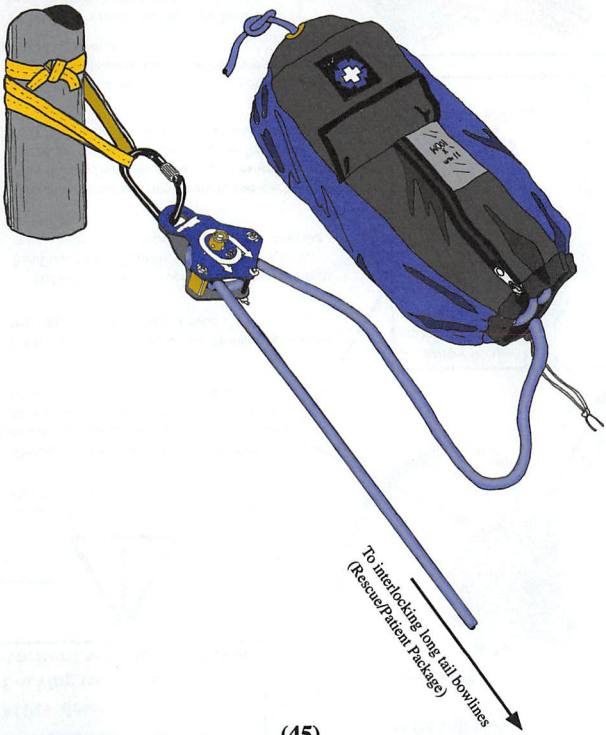
- Always have an attentive belayer, do not leave belay system unattended.
- Never belay off your harness if catching a rescue load (200kgs+)
- Load the Traverse Rescue 540 by making a full "round turn" (540˚) around the oval sheave.
- Be sure that the protruding spring pins in the oval pulley divide the strands of rope in the round turn.
- Align the side plate holes with the pulley axle and stationary wedges, and click into place.
- When letting out or taking in rope, smooth motions are key. Jerky movements may trigger the device.
- Release a "triggered" 540 by slowly swinging the release lever toward the tensioned strand of rope. ***Do this only when transferring to a locked off main line.***
- If the Traverse Rescue 540 is only "lightly triggered" due to rope feed difficulties, a quick change of feed direction can return the pulley to its neutral position.
- Use the Traverse Rescue 540 only with ropes that have less than 5% stretch at 2kN of tension.





Belay- Raise/Lower

(Traverse 540 Belay)

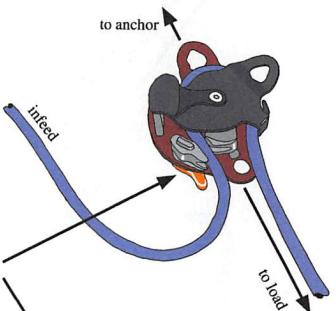


Belay- Raise/Lower

(MPD Belay)

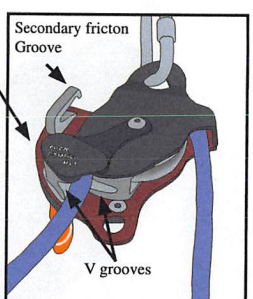
Equipment needs:

1 MPD device
1 Locking carabiner
Anchor (see anchor section)



Read and understand complete directions that come with device.

Thread by swinging open the side plate and placing a bight of rope around pulley sheave. Be sure that the infeed of the rope goes in between the V grooves as shown. Close side plate.

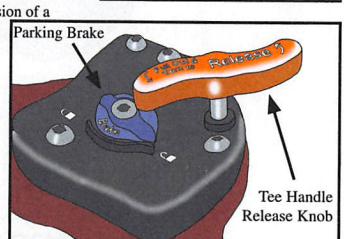


Do not let go of the infeed side of the rope without first engaging the Parking Brake.

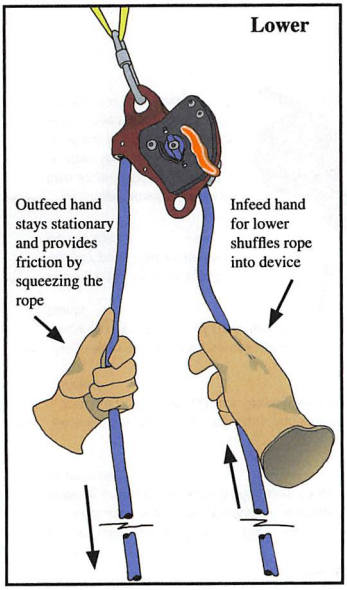
To Belay for lower, let rope slide through Outfeed hand providing slight friction (back tension) on rope, while feeding rope into the device with the infeed hand.

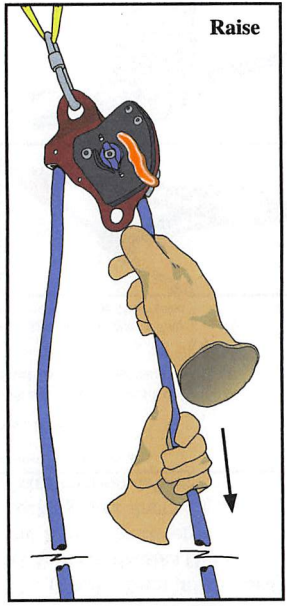
After about 10M you may begin to use the MPD belay to share the load with the main line by switching from friction of the outfeed hand to using the Tee Handle release lever. This helps account for rope stretch on long lowers.

In the event of a lockup (or hard fall) pull out and turn Tee Handle Release Knob to release the tension of a locked up system.



To belay for a raise, pull the rope hand over hand up through the device. A 3:1 pulley system may be added for long raises, but use only hand tight tension on the belay (no pulley system) for final edge transition.





Belay- Raise/Lower

(MPD Belay)

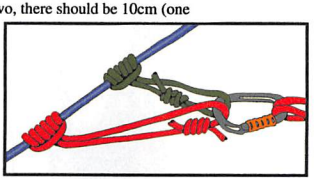
Belay- Lower

(Tandem Prusik Belay)

Equipment needs:

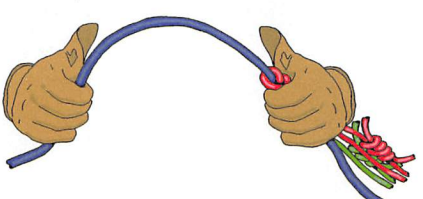
1 33ft. (10m) x 8mm utility cord
1 set Tandem Prusiks (1.4m and 1.7m respectively)
2 Locking carabiners
Extra friction device**

- Always have an attentive belayer, do not leave belay system unattended.
- Never belay off your harness if catching a rescue load (200kgs+)
- It is good practice to have an extra load releasing hitch and Prusik set standing by for knot passing (see end of this section) and for Tandem Prusik Belay change out, should a fall occur.
- Prusiks should be sized so that when each Prusik is snugged tight in position of function, and the tension balanced between the two, there should be 10cm (one hand width) between the Prusiks.



- Do not substitute webbing for the 8mm cord in the load releasing hitch. (Webbing can create melting problems, making deployment choppy or impossible)
- Do not wrap thumbs around belay line when using a Tandem Prusik Belay, use a "hitch hikers grip" instead.

- Use a "skyward tilt" of the hands, and keep a bow of approx 20cm of slack line between hands
- During a fall or system failure, quickly push Prusiks in direction of force.



- **On longer lowers (greater than about 30M) a Scarab® or other friction device can be added behind the T.P.B. to aid in rope management and account for rope stretch.

Belay Package (lower)

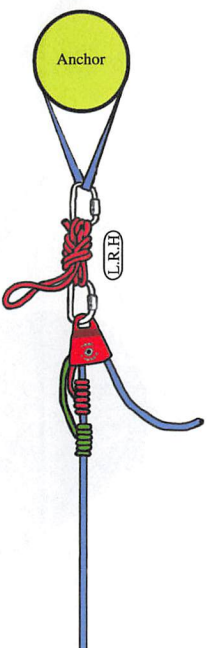
Belay- Raise

(Tandem Prusik Belay)

Equipment needs:

- **1 32Ft. (10m) x 8mm utility cord**
- **1 Set Tandem Prusiks (1.4m) and 1.7m respectively)**
- **2 Locking carabiners**
- **1 PMP pulley**

- Always have an attentive belayer; do not leave belay system unattended.
- Do not wrap thumbs around belay line when using a Tandem Prusik Belay; use a "hitch hikers grip" instead.
- Always have an extra Prusik set and load releasing hitch standing by for knot passing (see end of this section) and for Tandem Prusik Belay change out, should a fall occur.
- PMP pulley may be omitted if pulley needed elsewhere.
- Never belay off your harness if catching a rescue load (200kgs+).
- During a fall or system failure, quickly push Prusiks in direction of force.
- Aggressive belay skills may be necessary in extremely wet or icy conditions.
- Do not substitute webbing for the 8mm cord in the load releasing hitch. (Webbing hinders shock absorption, and can create melting problems).

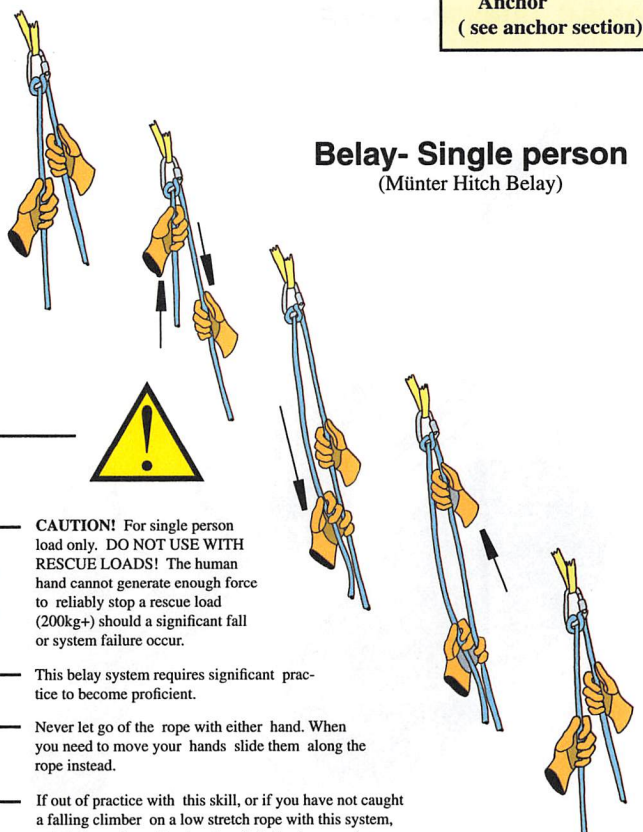


Belay Package (raise)

Equipment needs:
1 Large carabiner
Anchor
(see anchor section)

Belay- Single person

(Münter Hitch Belay)

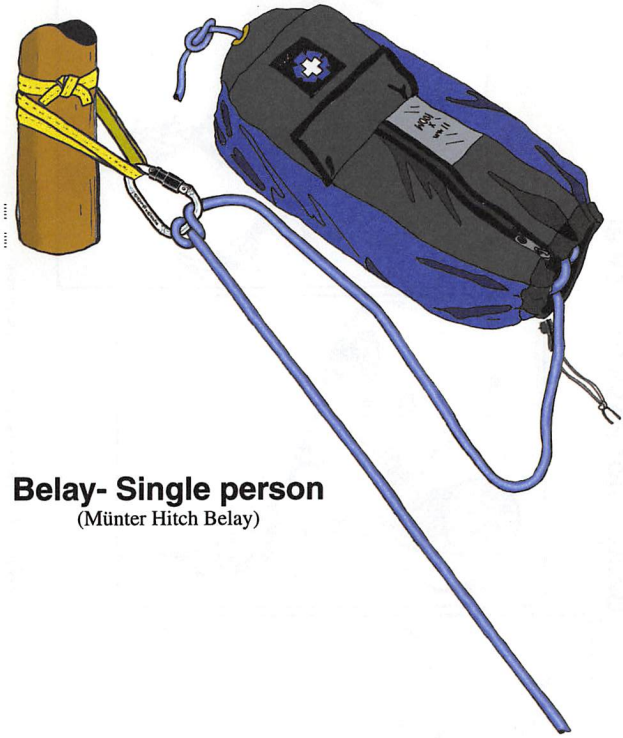


CAUTION! For single person load only. DO NOT USE WITH RESCUE LOADS! The human hand cannot generate enough force to reliably stop a rescue load (200kg+) should a significant fall or system failure occur.

This belay system requires significant practice to become proficient.

Never let go of the rope with either hand. When you need to move your hands slide them along the rope instead.

If out of practice with this skill, or if you have not caught a falling climber on a low stretch rope with this system, switch instead to a Tandem Prusik Belay (see previous page).

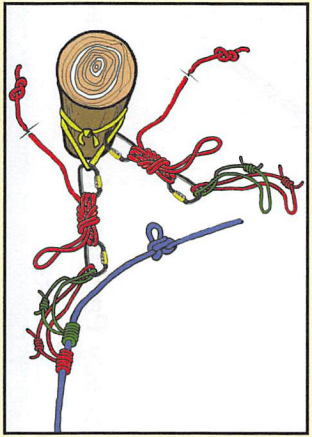


Belay- Single person

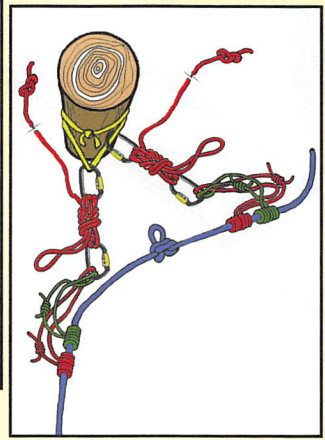
(Münter Hitch Belay)

Belay Package (single person)

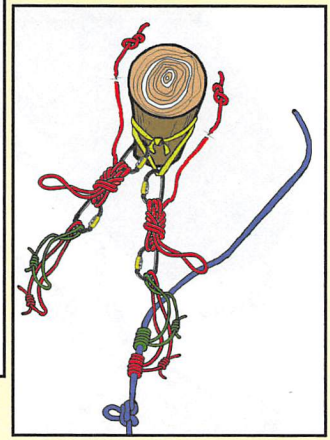
Belay Knot Pass for Lower



1



2



3

(For Belay Knot Pass Raise, just reverse the process)

Main Line package

Rescue at British Petroleum Refinery

General rules

- All main line carabiners should open DOWN and away from obstacles. Micro oscillations caused by a tensioned main line running over objects can vibrate gate collets open.
- Use High Directional Anchors (HDA) when ever possible with the Main line (see Edge section)
- As a rule of thumb, try to keep maximum main line loads below 2kN (440lbf) for 11.1mm rope, and 2.8kN (600lbf) for 12.5mm rope.
- Have an extra load releasing hitch and Prusik standing by for knot passing (see end of this section).

Metal cammed ascenders are not recommended for use on the main line. They can be easily overloaded, causing rope damage and possible system failure.

Figure 8 plates are not recommended as brake devices on main lines. It is difficult to add or subtract friction during an operation, and excessive rope twisting can occur during multiple station lowers.

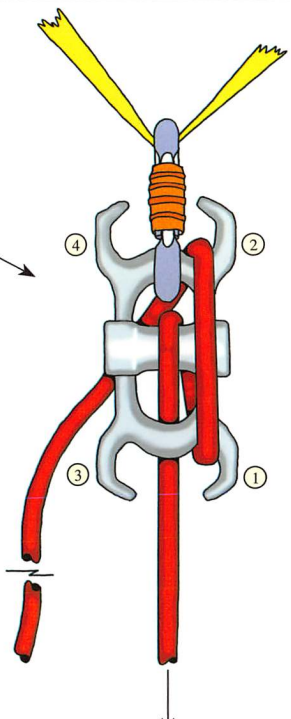
Main Line package (Scarab® Lower)

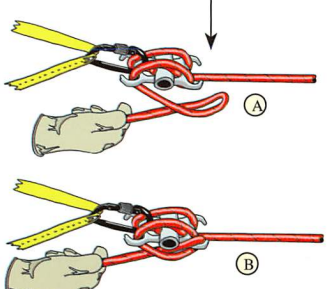
Equipment needs:

1 SCARAB® rescue tool
1 Locking carabiner

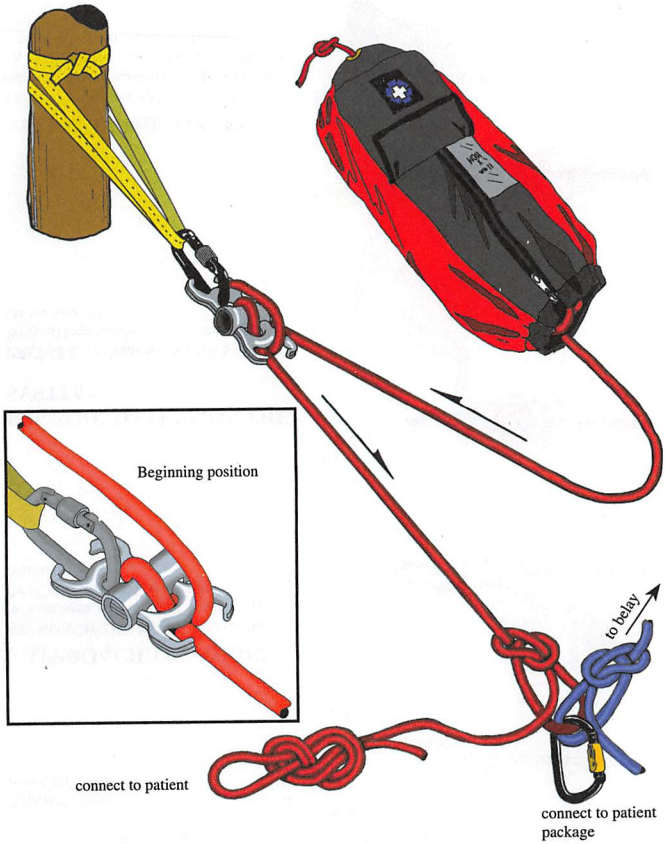
Anchor (see anchor section)

- Carabiners should open downward and away from obstructions.
- Have a load releasing hitch and Prusik handy in case you need to pass a knot (see end of this section)
- Load SCARAB® by capturing a bight of rope with the crossbar. Wrap the Hyperhorns in the order shown. Always start by wrapping a FORWARD horn (# 1 or #3 on outfeed end of device).
- Wrap all horns, then slowly unwrap until desired speed of descent is reached.
- To lock off a SCARAB® rescue tool, wrap all four hyperhorns and place a bight with a twist over a forward horn (see below).





SCARAB® lockoff



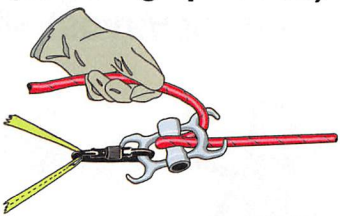
Main line package (SCARAB® lower)

(57)

Main line package (Lowering operation)

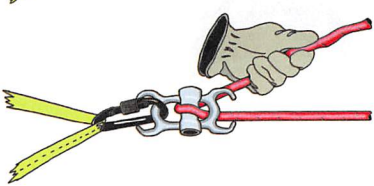
READY!

READY!- Ready position with rope hooked over ONE FORWARD horn.



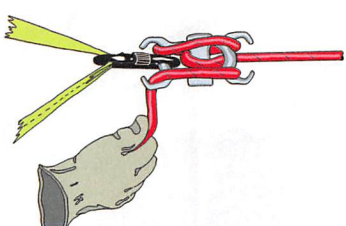
APPROACH THE EDGE!

APPROACH THE EDGE- Unwrap the forward horn, allow rope to flow through the SCARAB® until rescue package is in position.



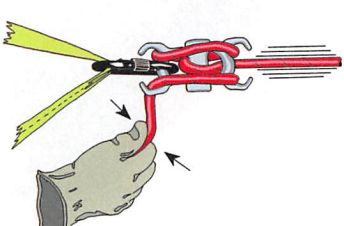
PREPARE TO TENSION THE SYSTEM!

PREPARE TO TENSION THE SYSTEM- Wrap all hyperhorns in order (see page 56). Do not lock off.



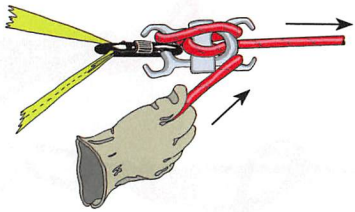
TENSION THE SYSTEM!

TENSION THE SYSTEM- Hold the rope tightly in gloved hand to resist the force being applied to the rope as the rescue package is put into hanging position. You do not need to lock off.



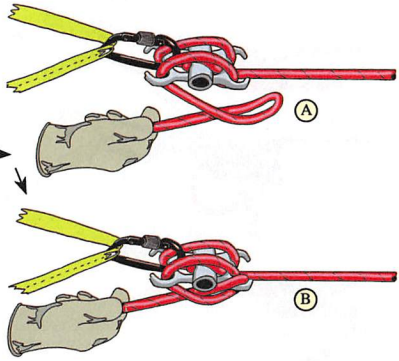
DOWN!

DOWN- Allow rope to slide through gloved hand to achieve desired speed. You may slowly unwrap horns to adjust for changes in terrain etc.



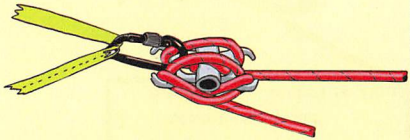
Lock off

For an extended stop, you may lock off a SCARAB® rescue tool by wrapping all four hyperhorns, then place a bight with a twist over a forward horn. This is a "soft lock" and is appropriate for all non emergency situations. You can now let go of the rope.



Unattended Lock Off

If the Main line must be left unattended in an emergency, a second bight with a twist can be added to a rear horn. This is a "hard lock" and will hold an 11mm or 12.5 mm rescue rope until the rope breaks.

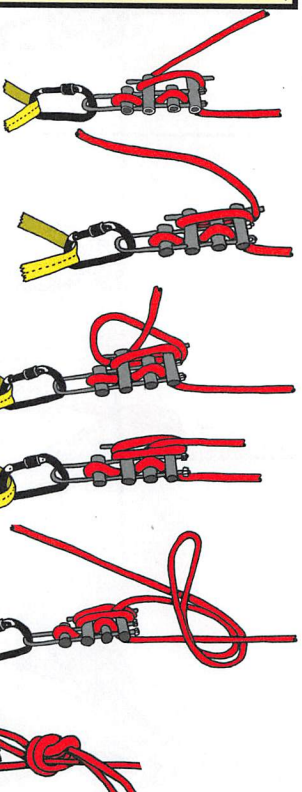


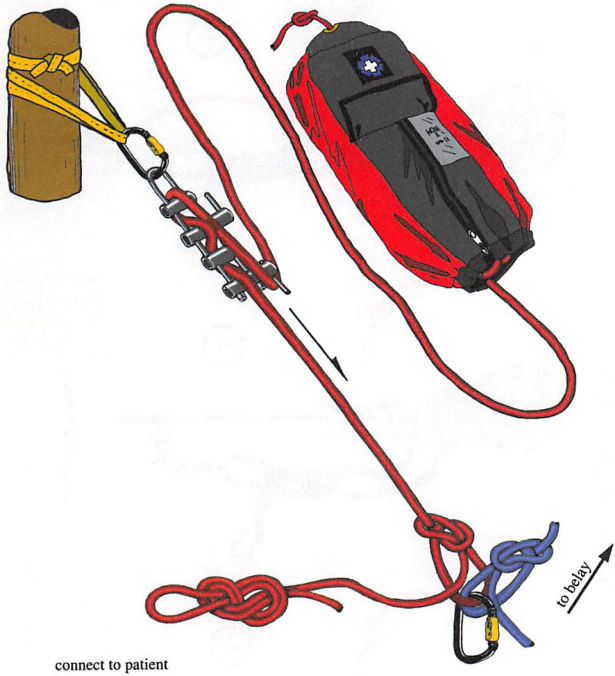
Main Line package (Brake rack Lower)

Equipment needs:

1 "Hyperbar"Four bar brake rack
1 Locking carabiner
Anchor (see anchor section)

- Carabiners should open downward and away from obstructions.
- Make sure the rope is NOT passed between the first bar and BEND in the rack!
- Have a load releasing hitch and Prusik handy in case you need to pass a knot (see end of this section)
- If left unattended, lock off brake rack

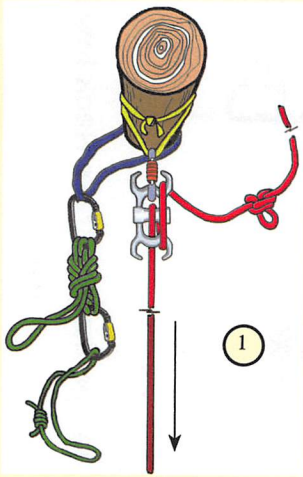




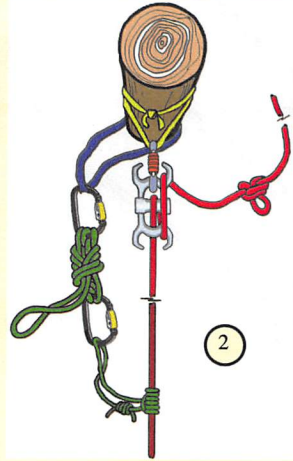
Main line package (Brake Rack lower)

(61)

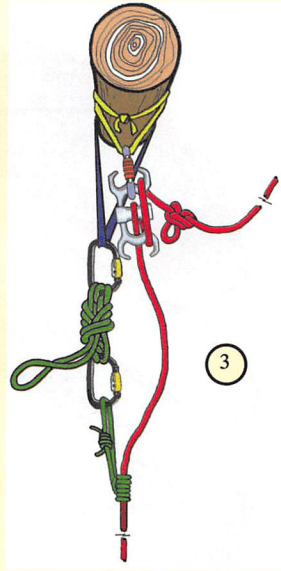
Knot Pass- Main Line Lower



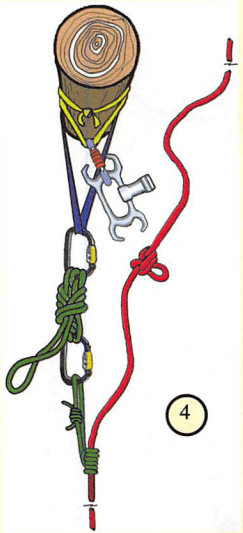
1) Ready for knot pass



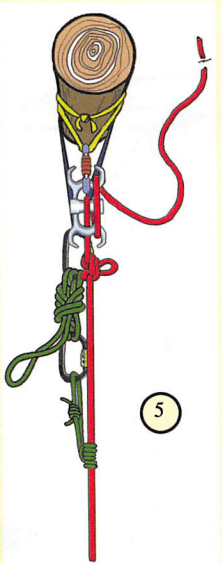
2) Attach LRH Prusik



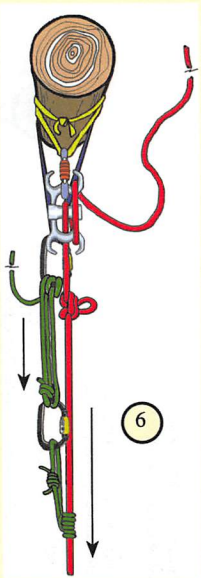
3) Let LRH Prusik hold the Load



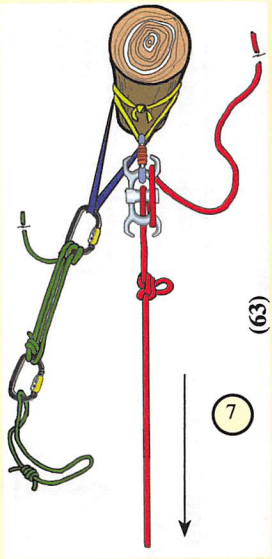
4) Un-thread brake device



5) Re-thread brake device with knot on out-feed end



6) Deploy LRH until load is held on brake device



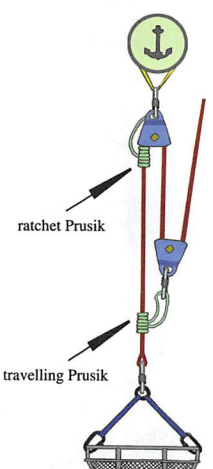
7) Remove LRH and Prusik, and continue lower

Main line package (Raise)

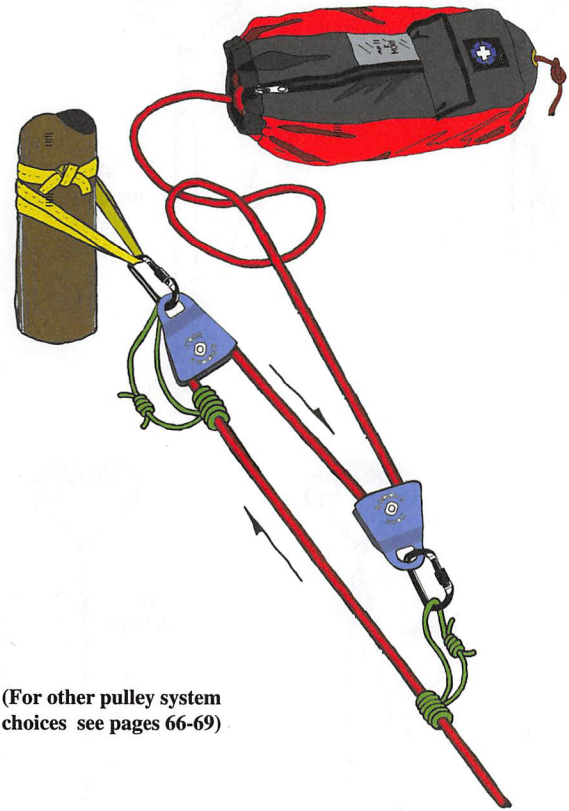
Equipment needs:
(for pulley system shown below)
2 PMP pulleys
2 Locking carabiners
2 System Prusiks (see Gen. sec.)
Anchor (see anchor section)

- Carabiners should open downward and away from obstructions.
- Prusik should clip into the carabiner before attaching pulley (Prusik should be against the carabiner spine).
- Use just one Prusik for the ratchet Prusik portion.
- Use the smallest mechanical advantage pulley system needed to do the job. This speeds up the operation and decreases the number of resets

Substituting metal cammed ascenders for Prusiks on the main line can cause rope damage and possible system failure, should the system be overloaded. "Prusiks can clutch, cams can cut".



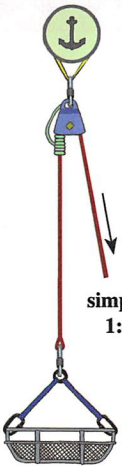
For other Pulley system choices see pages 66-69



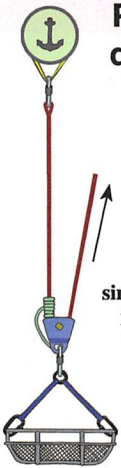
(For other pulley system choices see pages 66-69)

Main line Package (raise)

Pulley systems quick reference

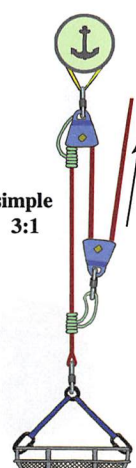


simple
1:1

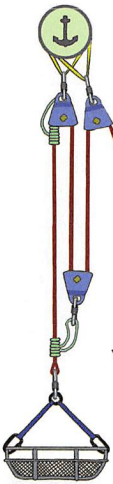


simple
2:1

simple
2:1
w/ directional
change

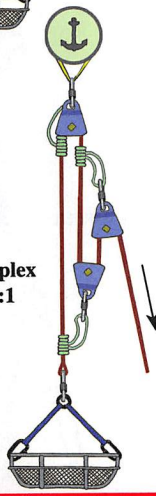


simple
3:1

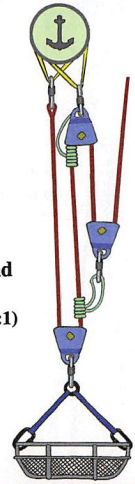


simple
3:1
w/ direction
change

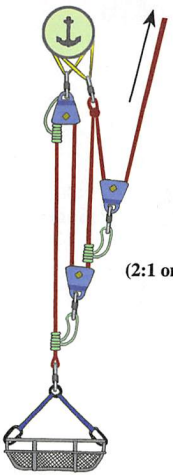
simple
4:1



complex
5:1

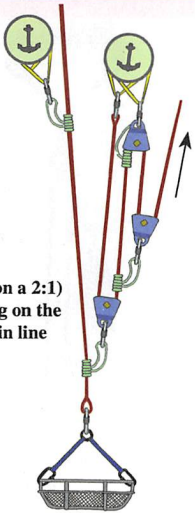


compound
6:1
(3:1 on a 2:1)

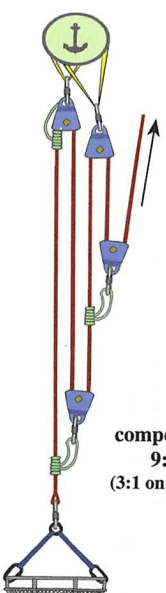


(2:1 on a 3:1)

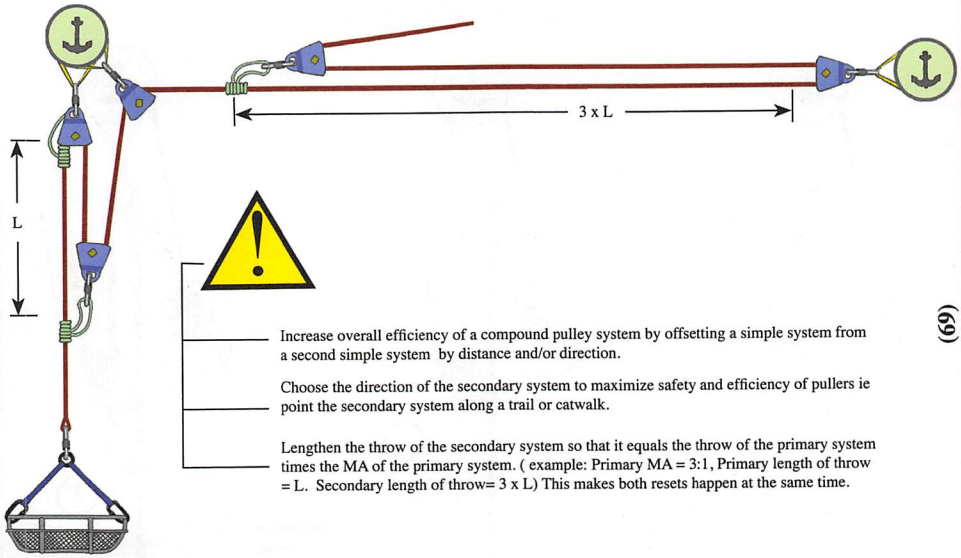
compound
6:1
variations



(3:1 on a 2:1)
acting on the
main line



compound
9:1
(3:1 on a 3:1)



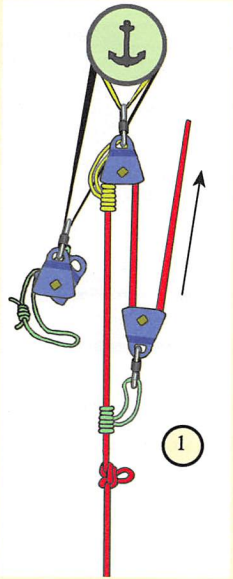
Increase overall efficiency of a compound pulley system by offsetting a simple system from a second simple system by distance and/or direction.

Choose the direction of the secondary system to maximize safety and efficiency of pullers ie point the secondary system along a trail or catwalk.

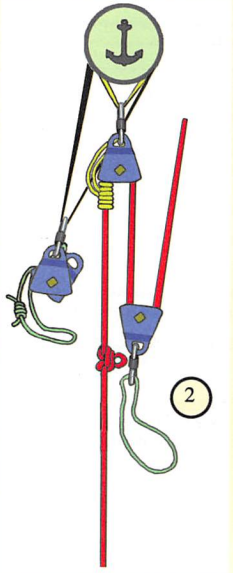
Lengthen the throw of the secondary system so that it equals the throw of the primary system times the MA of the primary system. (example: Primary MA = 3:1, Primary length of throw = L. Secondary length of throw= 3 x L) This makes both resets happen at the same time.

Offset Pulley Systems

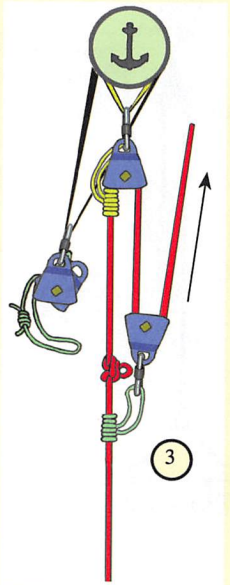
Knot Pass- Main Line Raise



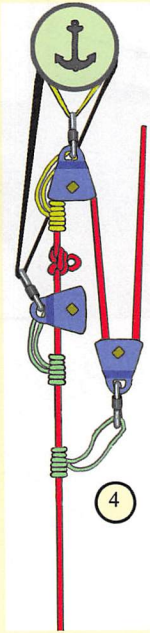
1) Prepare to pass knot with extra pulley and Prusik



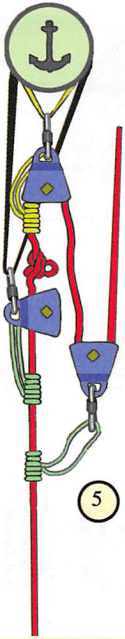
2) Undo travelling Prusik from Mainline



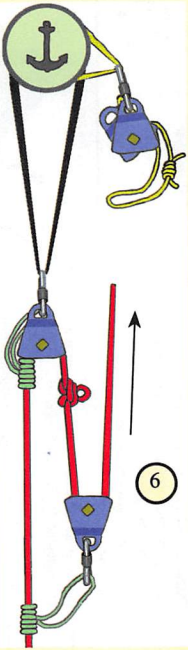
3)Re-attach travelling Prusik under knot



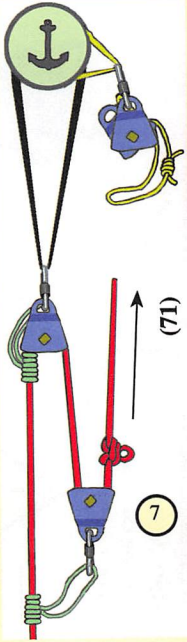
4) Attach new pulley and ratchet Prusik below knot



5) Allow new ratchet Prusik to grab the load



6) Remove original pulley and ratchet Prusik



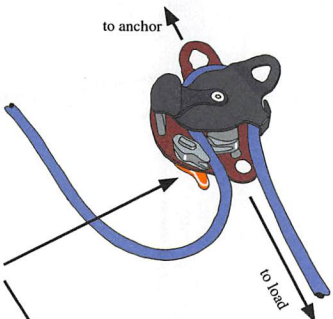
7) To pass remaining pulley(s), repeat steps two and three

Raise/Lower

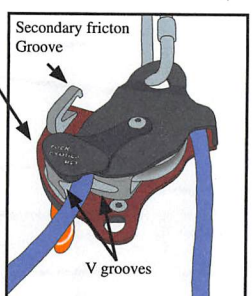
(MPD Belay)

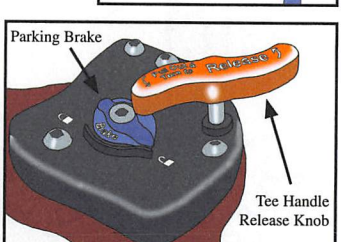
Equipment needs:

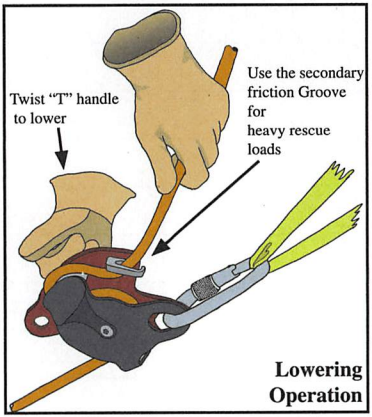
1 MPD device
1 Locking carabiner
Anchor (see anchor section)



- Read and understand complete directions that come with device.
- Thread by swinging open the side plate and placing a bight of rope around pulley sheave. Be sure that the infeed of the rope goes in between the V grooves as shown. Close side plate.
- Do not let go of the infeed side of the rope without first engaging the Parking Brake.
- To lower; undo the parking brake, pull out the Tee Handle Release lever and carefully turn counter clockwise to control speed, while training the infeed rope against the fixed V groove with the other hand. For heavy rescue loads, place infeed rope into the Secondary Friction groove.
- To Raise, set the parking brake, build the appropriate pulley system using the slack end of the main line. Release Parking Brake and pull up on the main line, using the MPD as a change of direction pulley and progressive capture device.







Lowering Operation

Raising Operation
(Simple 5:1 shown)

NOTES

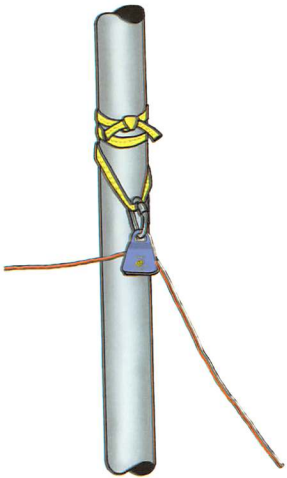
Edge package

High angle transition, Mt Rainier WA

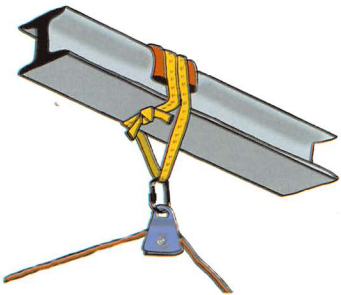
General rules

- Obey the HAZARD ZONE. Always have a Secondary Safety Source if crossing into the Hazard Zone set by the Rigger.
- If you are working near tensioned ropes within a body length of an edge, you should be tied in, even if you are behind a railing.
- Make sure that your secondary Safety Source acts as a travel limiter, stopping you from being able to fall over the edge.
- If touching moving ropes or litters, wear leather gloves, not synthetic gloves.
- Use High Directional Anchors whenever possible at edge transitions.

- Use HDAs at edge transition areas
- Do not run belay line through the same HDA that the mainline goes through. Run belay line at ground (deck) level, or use a separate HDA.
- Carabiners should have gates opening downward and away from obstructions.
- Be careful that the resultant force caused by the mainline as it passes through the pulley does not over stress the anchor material.

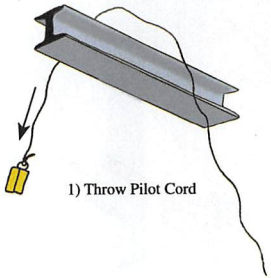


High Directional Anchors (HDAs)

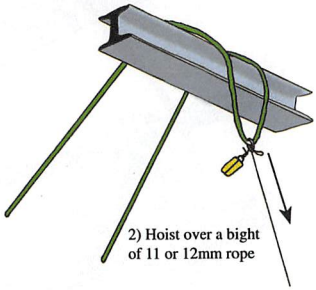


Directional anchors

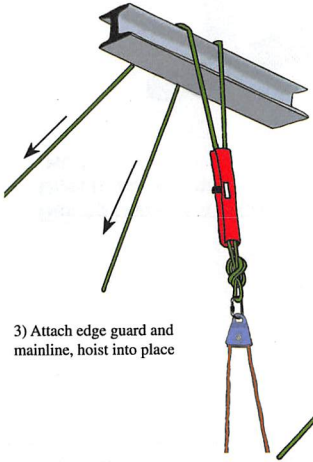
HDA for an inaccessable beam



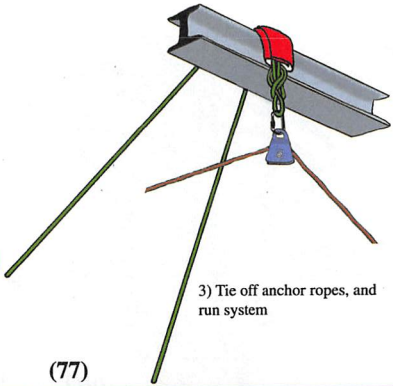
1) Throw Pilot Cord



2) Hoist over a bight of 11 or 12mm rope



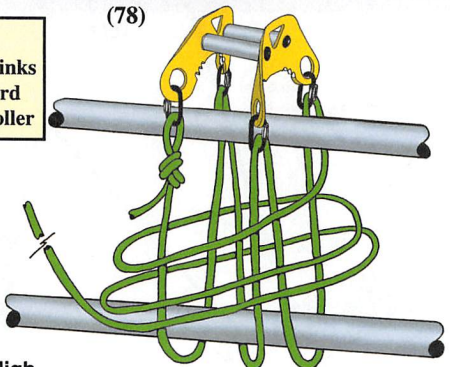
3) Attach edge guard and mainline, hoist into place



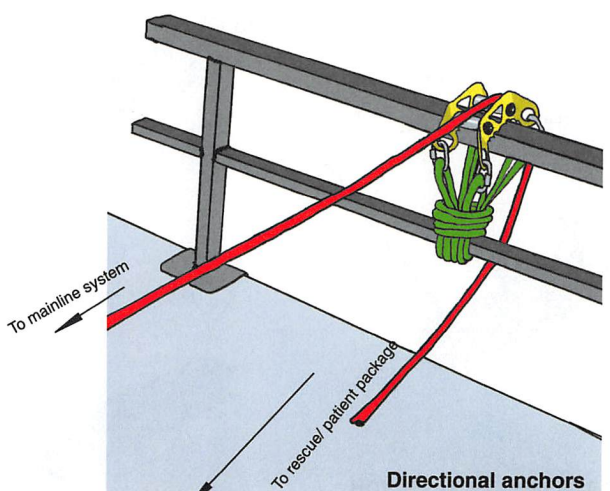
3) Tie off anchor ropes, and run system

Equipment needs:

4 Carabiners or screw links
1 8mm x 10m utility cord
1 Edgebot™ or Roof roller



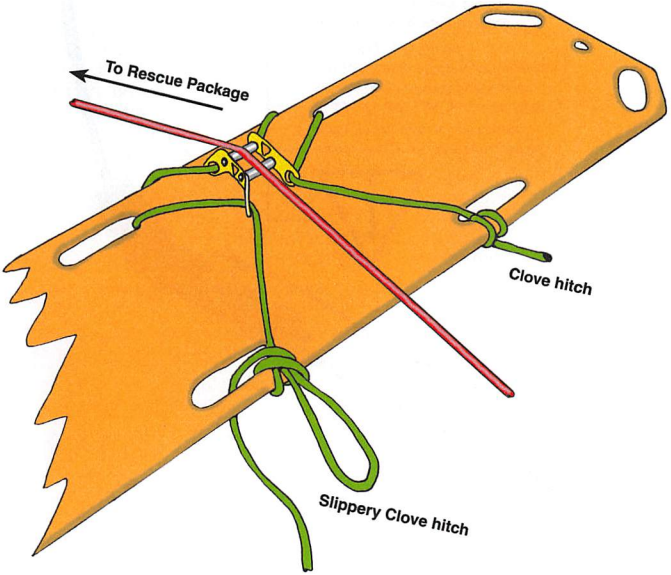
Railing used as a High Directional Anchor (HDA)



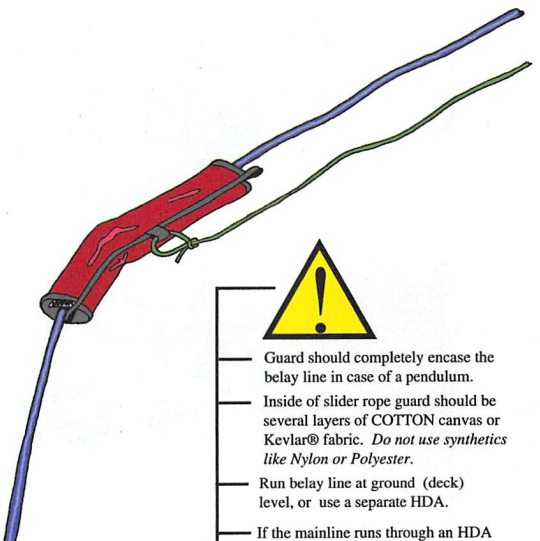
Equipment needs:

1 Edgebot™
1 8mm x 10m utility cord
1 spine board

Edgebot™ and spine board used for edge transition on soft soil or snow

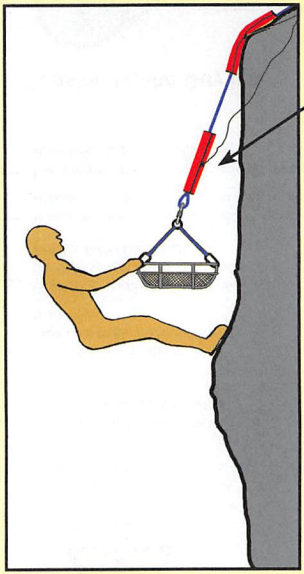


Slider Rope Guards for the Belay

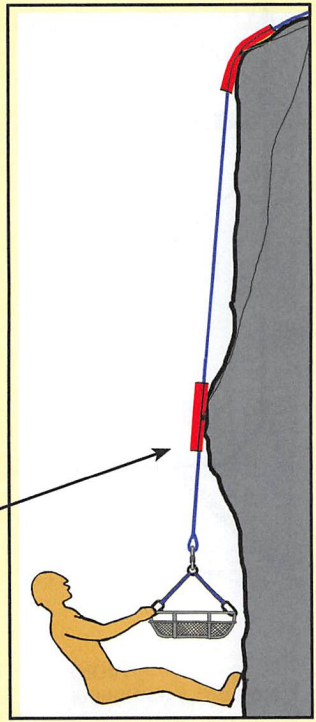


- Guard should completely encase the belay line in case of a pendulum.
- Inside of slider rope guard should be several layers of COTTON canvas or Kevlar® fabric. *Do not use synthetics like Nylon or Polyester.*
- Run belay line at ground (deck) level, or use a separate HDA.
- If the mainline runs through an HDA more than a meter above ground level, use separate slider rope guards for the main and belay.
- Tie off the keeper cord to secure the rope guard in place.

Travelling Edge Guards for Main and Belay



Allow guards to rest on apex of litter bridle, with slack keeper cords. (stack as many slider edge guards as necessary.) Main and Belay may be encased in one guard (See caution on page 80).

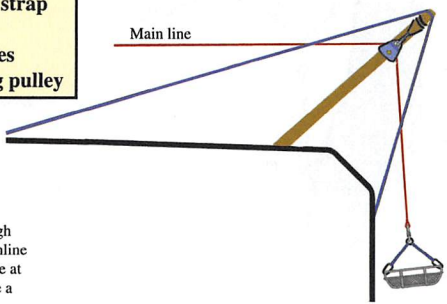


At a sharp spot, tie off keeper cord and allow main and belay line to pin the slider edge guard into the face.

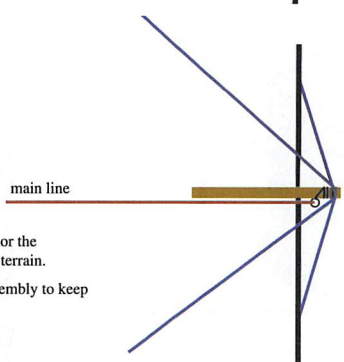
Mono-pod ("Gin pole") (HDA)

Equipment needs:

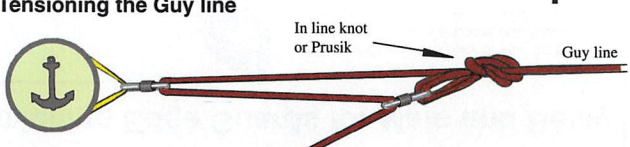
- 1 10ft (3m) pole
- 1 8mm x 10m utility cord
- 1 12ft (3.5m) webbing strap
- 7 Carabiners
- 2 Low stretch guy ropes
- 1 PMP or knot passing pulley

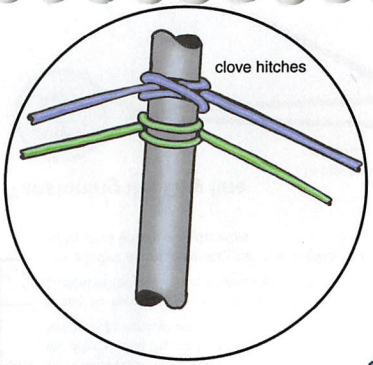


- Do not run belay line through the same HDA that the mainline goes through. Run belay line at ground (deck) level, or use a separate HDA.
- Pre tension upper guy ropes with a modified truckers hitch or similar.
- Mono-pod angle should bisect the angle made by the main line.
- Place Mono-pod system in from the edge so that the main line *just* touches the vertical wall.
- It may be necessary to stake out or anchor the bottom of the Mono-pod, depending on terrain.
- Use a tether during assembly and disassembly to keep HDA from falling over the edge

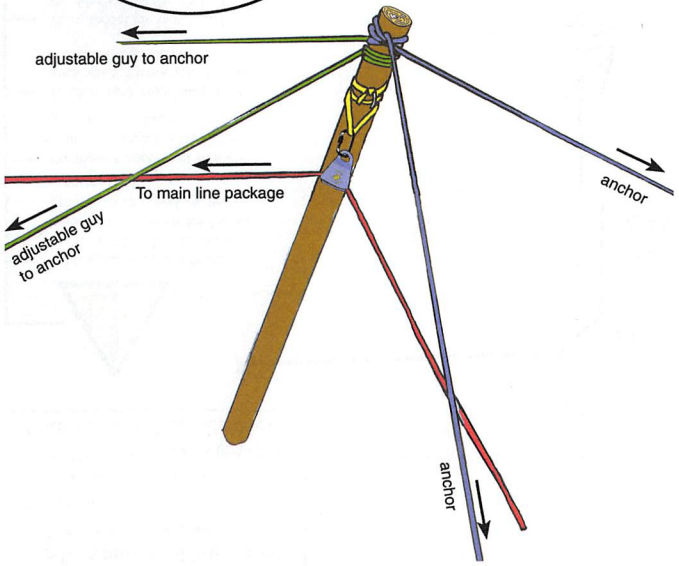


Tensioning the Guy line





Mono pod ("gin pole")
(HDA)

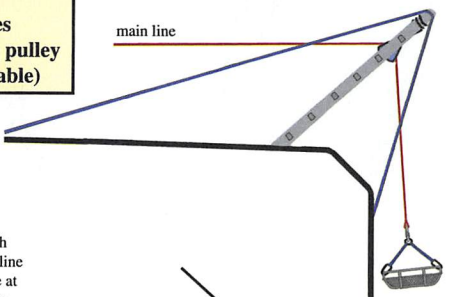


Directional anchors

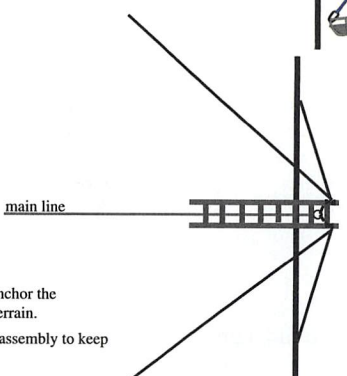
"Ladder Gin" (HDA)

Equipment needs:

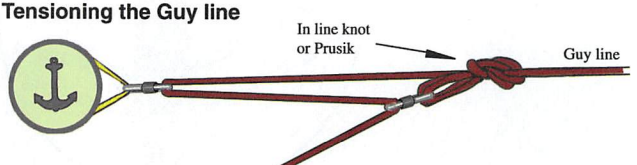
1 10ft (3m) Rescue ladder
2 5 ft (1.5m) webbing straps
1 12ft (3.5m) webbing strap
5 Carabiners
2 Low stretch guy ropes
1 PMP or knot passing pulley
2 Steel stakes (if applicable)



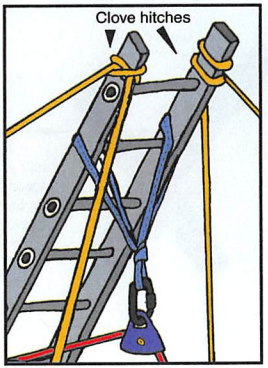
- Do not run belay line through the same HDA that the mainline goes through. Run belay line at ground (deck) level, or use a separate HDA.
- Pre tension upper guy ropes with a modified truckers hitch or similar (see below).
- Ladder angle should bisect the angle made by the main line as it runs through the pulley.
- Place ladder gin system in from the edge so that the main line *just* touches the vertical wall.
- It may be necessary to stake out or anchor the bottom of the ladder, depending on terrain.
- Use a tether during assembly and disassembly to keep HDA from falling over the edge

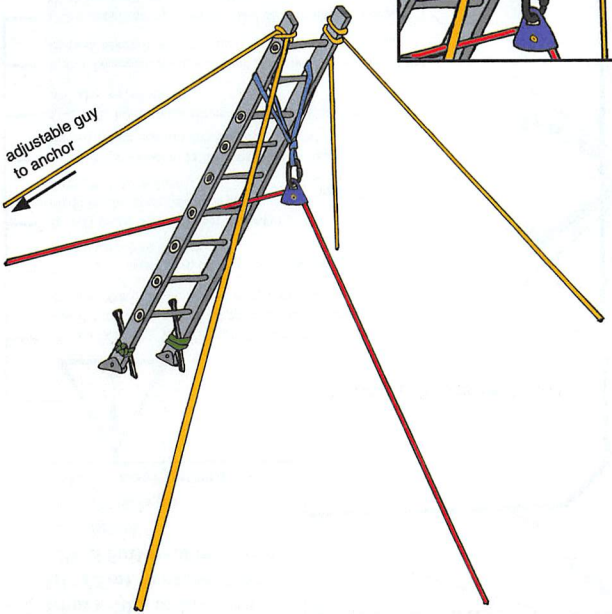


Tensioning the Guy line



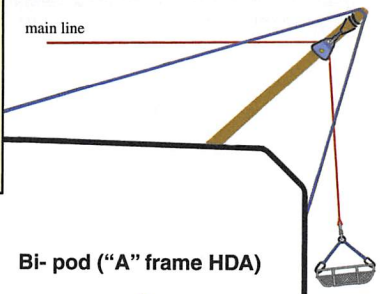
"Ladder Gin"
(HDA)





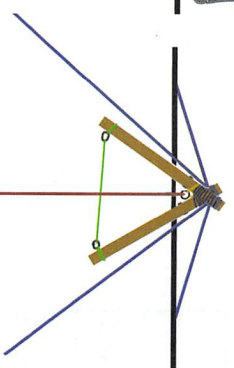
Equipment needs:

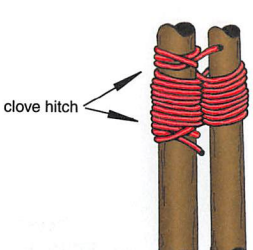
- 2 10ft (3m) poles
- 2 8mm x 10m utility cord
- 2 5ft (1.5m) webbing straps
- 1 12ft (3.5m) webbing strap
- 9 Carabiners
- 2 Low stretch guy ropes
- 1 PMP or knot passing pulley



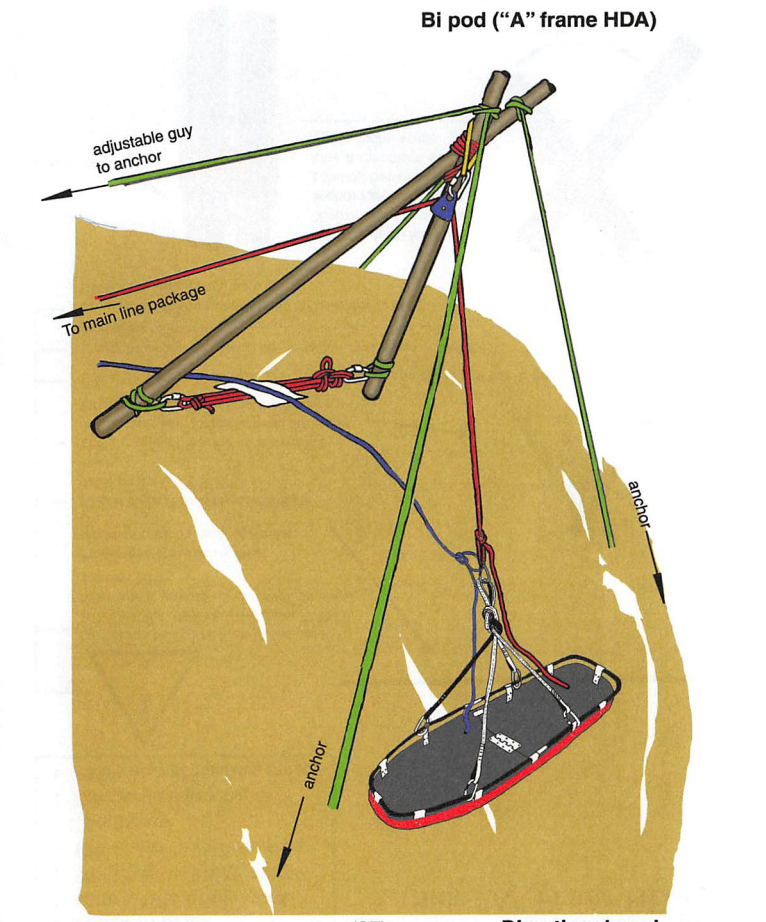
Bi- pod ("A" frame HDA)

- Do not run belay line through the same HDA that the mainline goes through. Run belay line at ground (deck) level, or use a separate HDA.
- Pre tension upper guy ropes with a modified truckers hitch or similar.
- Bi-pod angle should bisect the angle made by the main line as it passes through HDA pulley.
- Place Bi-pod system in from the edge so that the main line *just* touches the vertical wall.
- Use a Tie back arrangement (see page 40) to connect the feet of the Bi-pod.
- It may be necessary to stakeout or anchor the bottom of the Bi-pod, depending on terrain.
- Use a tether during assembly and disassembly to keep HDA from falling over the edge





Wrap detail: Use a "figure eight" wrapping technique, crossing the strands between poles. Use a minimum of nine figure eight wraps

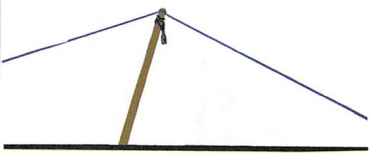


Directional anchors

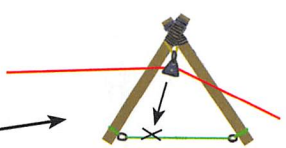
Lateral Bi-Pod
(Side "A" Frame HDA)

Equipment needs:

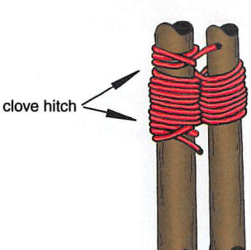
- 2 10ft (3m) poles
- 1 8mm x 10M utility cord
- 2 5ft (1.5m) webbing straps
- 1 12ft (3.5m) webbing strap
- 5 Carabiners
- 2 Low stretch guy ropes
- 1 PMP or knot passing pulley



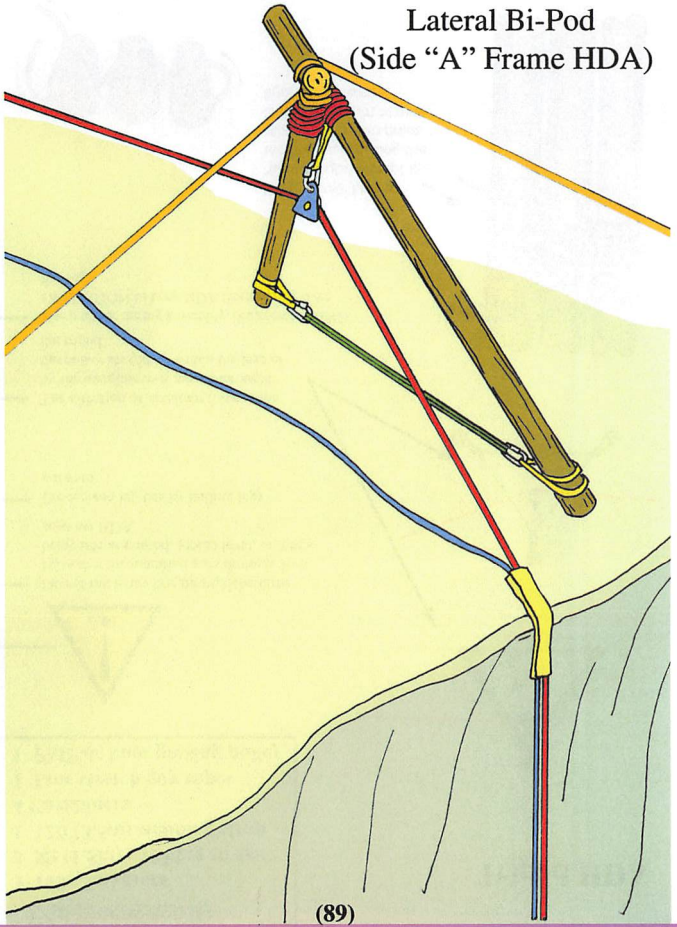
- Do not run belay line through the same HDA that the mainline goes through. Run belay line at ground (deck) level, or use a separate HDA.
- Pre-tension guy ropes with a modified truckers hitch or similar.
- Bi-pod angle should bisect the angle made by the GUY ROPES.
- The direction of *resultant* force made by the mainline as it passes through the pulley should be within the legs of the A frame.



- Use a Tie back arrangement (see page 40) to connect the feet of the Bi-pod.
- It may be necessary to stakeout or anchor the bottom of the Bi-pod, depending on terrain.
- Use a tether during assembly and disassembly to keep HDA from falling over the edge



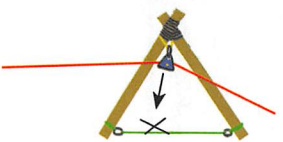
Wrap detail: Use a "figure eight" wrapping technique, crossing the strands between poles. Use a minimum of nine figure eight wraps


Lateral Bi-Pod
(Side "A" Frame HDA)

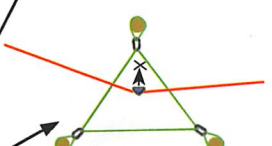
Tripod HDA

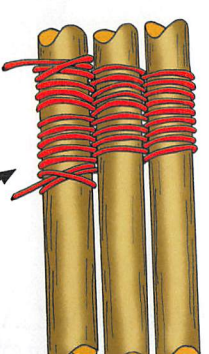
Equipment needs:

- 3 10ft (3m) poles
- 3 5ft (1.5m) webbing straps
- 1 12ft (3.5m) webbing strap
- 4 Carabiners
- 1 Low stretch guy ropes
- 1 PMP or knot passing pulley



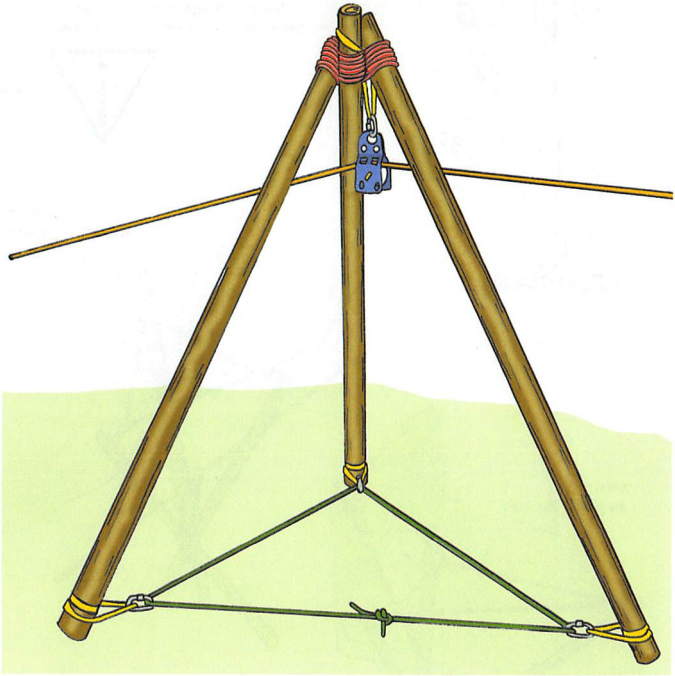
- Do not run belay line through the same HDA that the mainline goes through. Run belay line at ground (deck) level, or use a separate HDA.
- Pre-tension leg ties by pulling legs outward
- The direction of *resultant* force made by the mainline as it passes throught the pulley should be within the legs of the tripod.
- Use a tether during assembly, disassembly AND OPERATION to keep HDA from falling over the edge



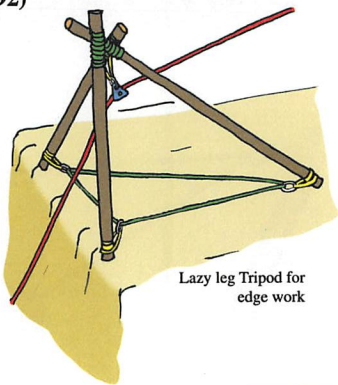


Wrap detail: Use a "figure eight" wrapping technique, crossing the strands between poles. Use a minimum of nine figure eight wraps

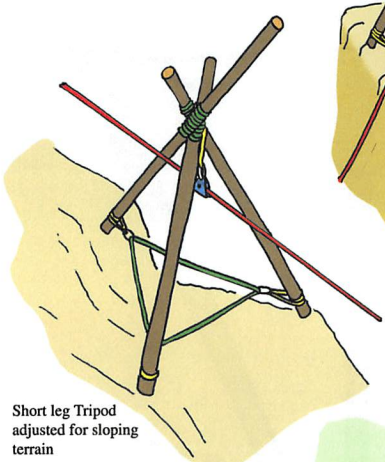
Tripod HDA



Tripod variations

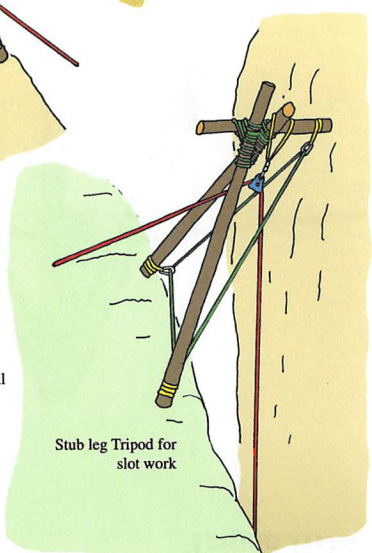


Lazy leg Tripod for edge work



Short leg Tripod adjusted for sloping terrain

Tether back all tripods so they cannot fall over toward the Patient/Rescue package



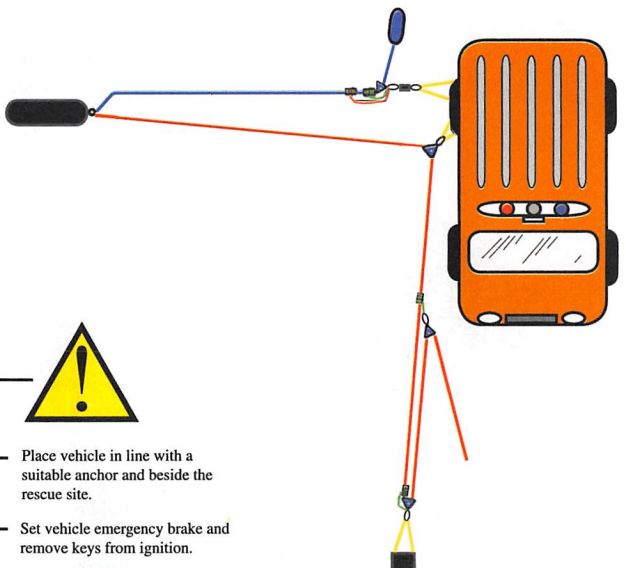
Stub leg Tripod for slot work

Ladder derek

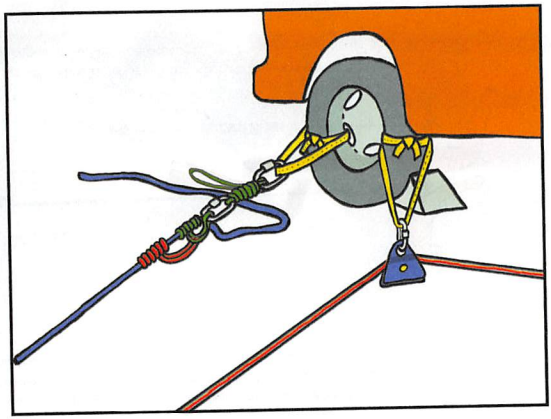
Equipment needs:

- 1 Large vehicle
- 2 12ft (3.5m) webbing straps
- 2 Carabiners
- 1-2 PMP pulleys
- 2-4 Wheel chocks

Vehicle directional anchor



- Place vehicle in line with a suitable anchor and beside the rescue site.
- Set vehicle emergency brake and remove keys from ignition.
- Chock and/or block wheels.
- Check wheel for sharp spots or fluid leaks. Protect webbing as needed.



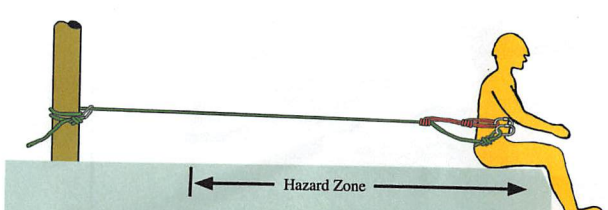
Directional anchors

Equipment needs:

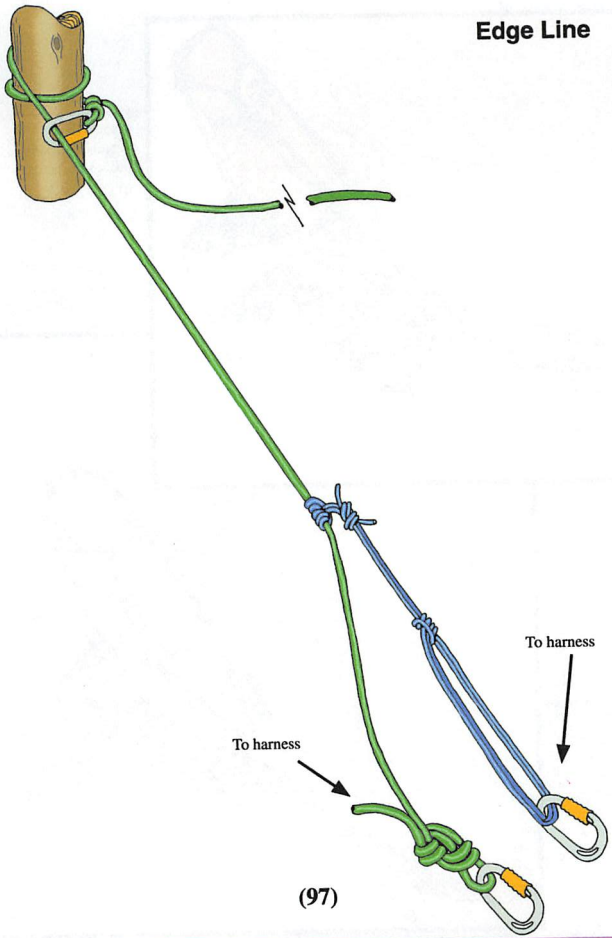
1 8mm or larger Utility cord
1 Purcell Prusik leg loop
3 Locking Caribiners

Edge Attendants

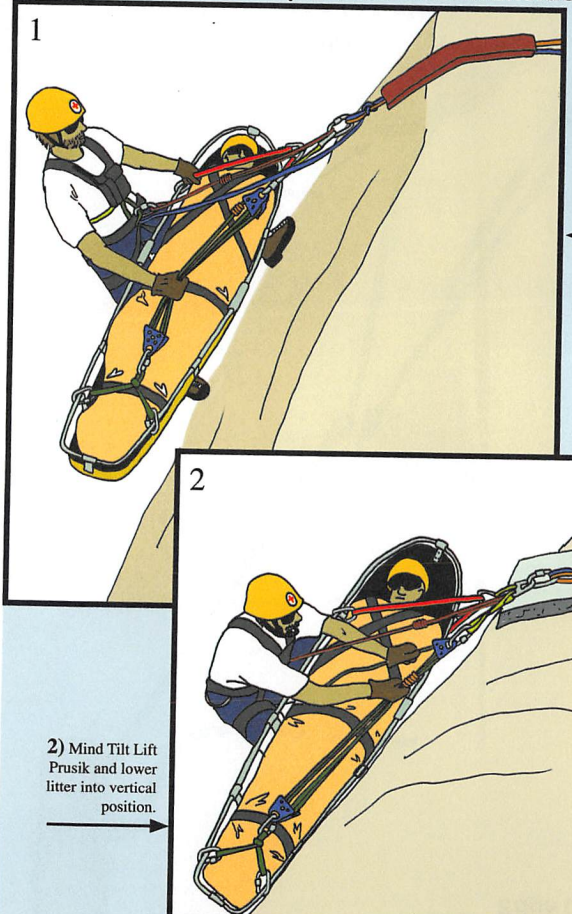
- Edge Attendants must be tied in when entering the hazard zone
- Use separate edge lines for each Edge Attendant
- Edge lines should just reach the edge, so that it is not possible for the attendant to fall over the edge.
- Edge attendants must wear *leather* gloves
- Edge Attendants should be prepared to relay commands from control to rescue package
- Edge Attendants should watch for any hazards to the ropes or rescue package
- Edge Attendants should manage and monitor rollers or other edge guards
- In order to maintain proper tension in the mainline when moving the Rescue Package over the edge, Edge Attendants should push not pull the rescue package.



Edge lines should just reach the edge, so that it is not possible for the attendant to fall over the edge.

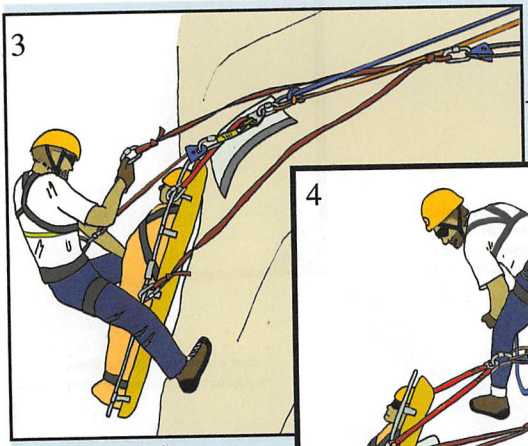

Edge Line
To harness
To harness

Pike and Pivot (Vertical Litter Transition)

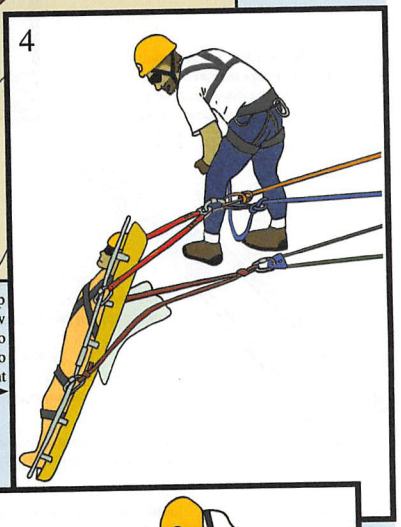


1) With litter rigged for tilt Lift (see Page 127) bring litter up until litter harness contacts edge protection

2) Mind Tilt Lift Prusik and lower litter into vertical position.

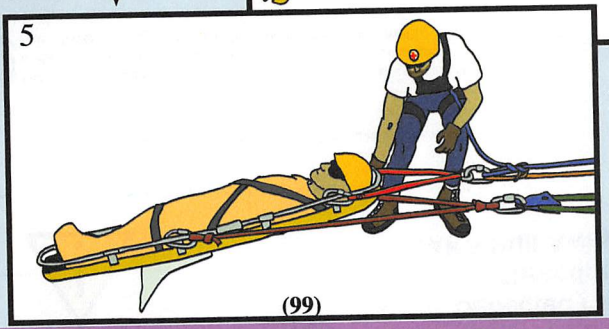


3) Connect Pivot Bridal to each side of litter, just below line of patients pelvis.



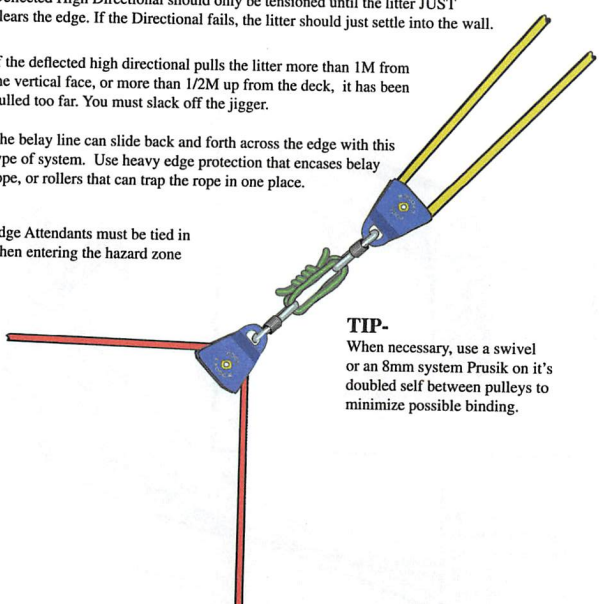
4) Climb litter to top of edge, and allow the Pivot Bridal to pull the litter up to balance point

5) Tip litter to horizontal



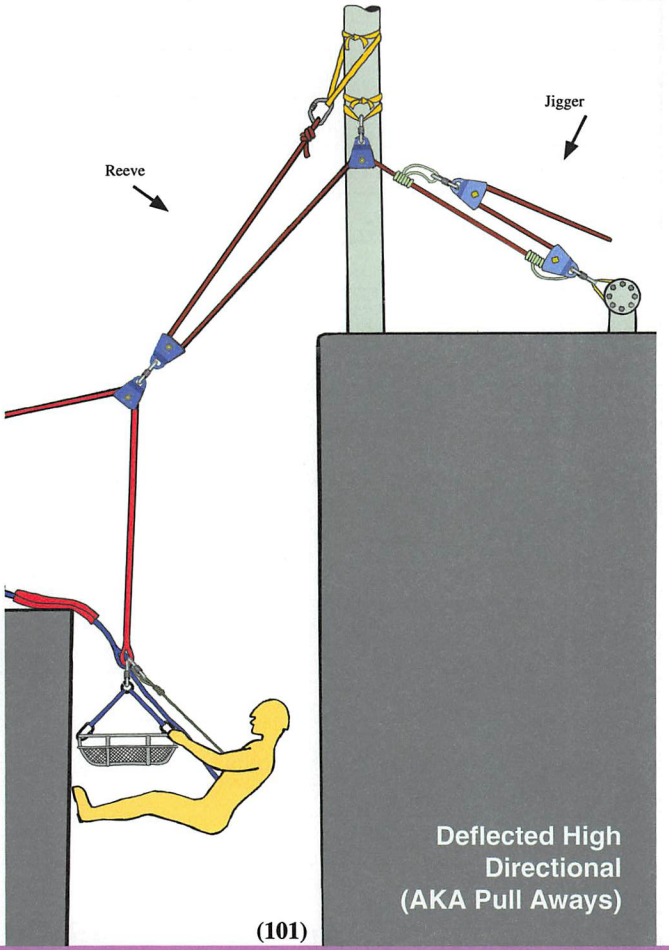
Deflected High Directional (AKA Pull Aways)

- Use for deep slots, crevasses, or industrial towers that are close to each other.
- Deflected High Directionals are laterally unstable. Edge attendants must provide lateral support.
- Deflected High Directionals can be easily overloaded. Pay close attention to the multiplication of force caused by pulleys and pulley systems. A 10:1 Static System Safety Factor should be maintained at all times.
- Deflected High Directional should only be tensioned until the litter JUST clears the edge. If the Directional fails, the litter should just settle into the wall.
- If the deflected high directional pulls the litter more than 1M from the vertical face, or more than 1/2M up from the deck, it has been pulled too far. You must slack off the jigger.
- The belay line can slide back and forth across the edge with this type of system. Use heavy edge protection that encases belay rope, or rollers that can trap the rope in one place.
- Edge Attendants must be tied in when entering the hazard zone



TIP-

When necessary, use a swivel or an 8mm system Prusik on it's doubled self between pulleys to minimize possible binding.



(101)

NOTES

Rescue / Patient Package

Packaging a patient, Split Rock Monolith

General rules

- Rescuer(s) must always be attached to the rope system itself, not just the litter, during steep and high angle operations.
- Patients should be internally lashed to protect them from ejection out of the ends of the litter.
- Use plenty of padding beneath, and around patient in litter.
- Try to keep severely hypothermic patients and cardiac patients as horizontal as possible
- Always protect the rescuer and patient from falling debris

Rescuers should NOT use metal cammed ascenders as their ONLY attachment point to the system when tending the litter. During a severe fall, the ascender could damage or even break the attachment rope.

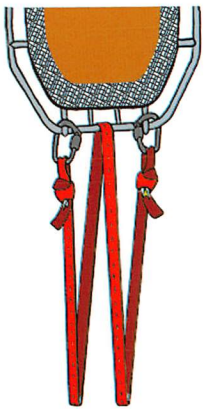
In line litter harnesses for low, steep and high angle systems

Equipment needs:

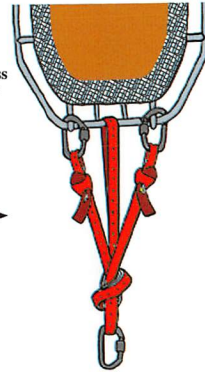
1 Litter
3 Locking carabiners
1 6M (20ft red) web strap
(or 3.5M yellow strap for O.P.S. litter)

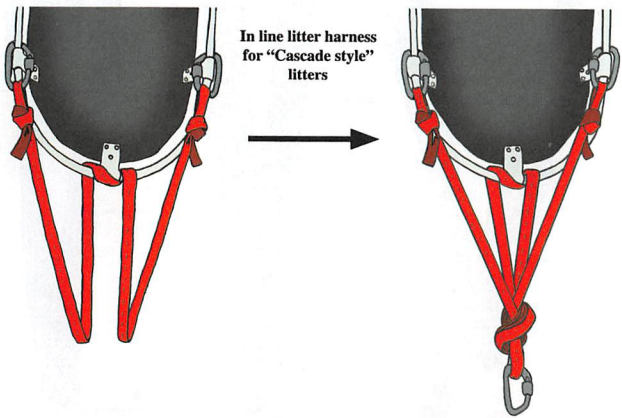
- Carabiners should open downward and away from the ground.
- When tieing main knot, attempt to make all strands connecting litter equally loaded.
- Make sure all carabiners are properly loaded and will not bind or side load.
- Use caution when using O.P.S. style litters for technical rescue. Some styles and models are inherently weak

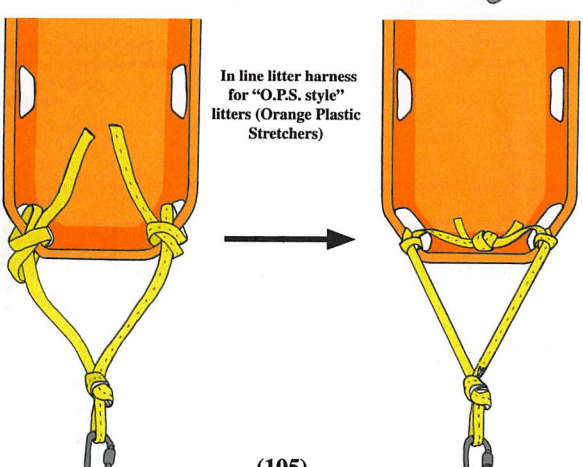
TIP; You can use an extra carabiner as a "marlin spike" to ensure that you can untie the knot after the operation



In line litter harness for "Stokes style" litters




In line litter harness for "Cascade style" litters


In line litter harness for "O.P.S. style" litters (Orange Plastic Stretchers)

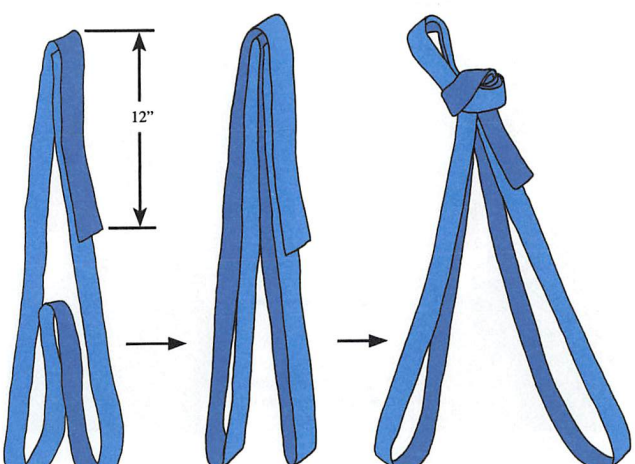
Horizontal litter harnesses
for high angle systems
(Improvised field construction)

Equipment needs:

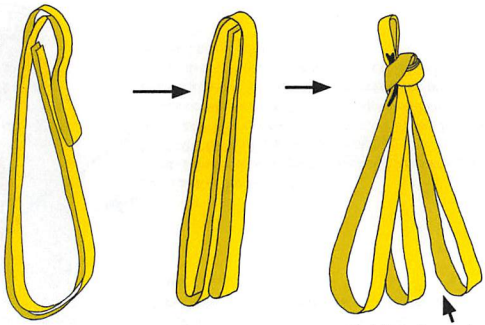
1 Litter
6 Carabiners
2 12 ft. (3.5M yellow) webbing
1 15 ft (4.4M blue) webbing

- All carabiners attaching to litter should have gates opening down and facing in toward the litter.
- Make sure carabiners are properly loaded, and will not bind or side load.
- For Industrial rail work or heli-hoist operations, remove center connector, and replace with a Tri link.

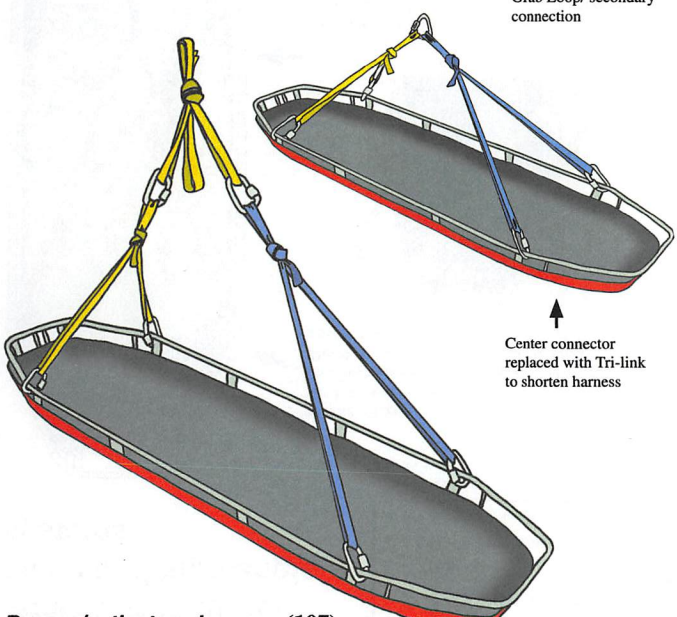
Harness Legs-
Modified Frost knot
Tie one with 3.5M yellow strap.
Tie one with 4.5M blue strap



Center Connector-
Frost knot w/doubled
3.5M yellow strap.



Grab Loop/ secondary
connection



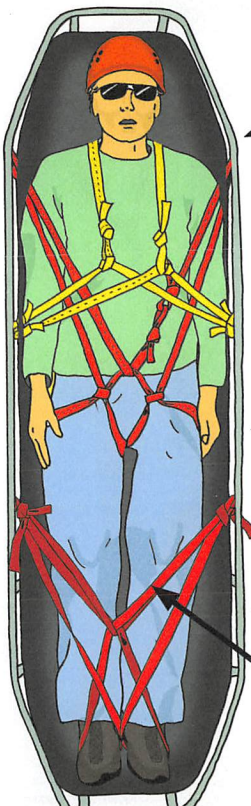
Center connector
replaced with Tri-link
to shorten harness

Internal lashing for steep and high angle systems

Equipment needs:

1 Litter
2 12 ft. (3.5m) web strap
2 20 ft. (6m) web strap

(For long term technical evacuation, see lashing, on page 114)

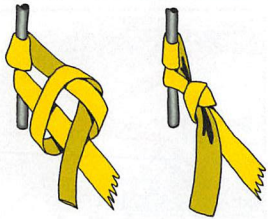


Shoulder Lash- (Two 3.5M yellow web straps)
Goal- Protect Patients head from contacting head of litter, and protect from ejection out of head end.
Tip- If possible, pre place shoulder webbing before placing patient in litter .

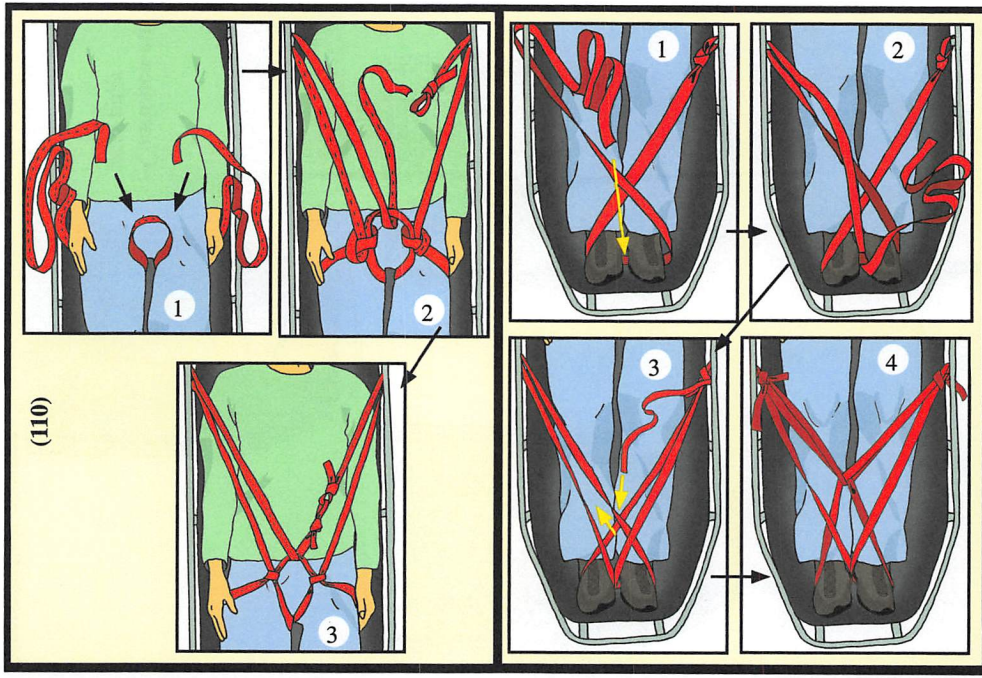
Hip Lash- (One 6M red web strap)
Goal- Support body mass during in line operations, and protect from ejection out of foot end.
Tip- Crotch padding is necessary for longer operations.

Leg Lash- (One 6M red strap)
Goal- Provide foot support, share body support with Hip lash, and keep knees from buckling.
Tip- Lateral Strap should go just below knees. Placing a pack or other high volume padding behind knees pushes legs into lateral strap. For very steep operations, place a slider rope guard or SAM splint here for patient knee padding.

Webbing tie off on litter bar
round turn + overhand



Continued on
next page



(110)

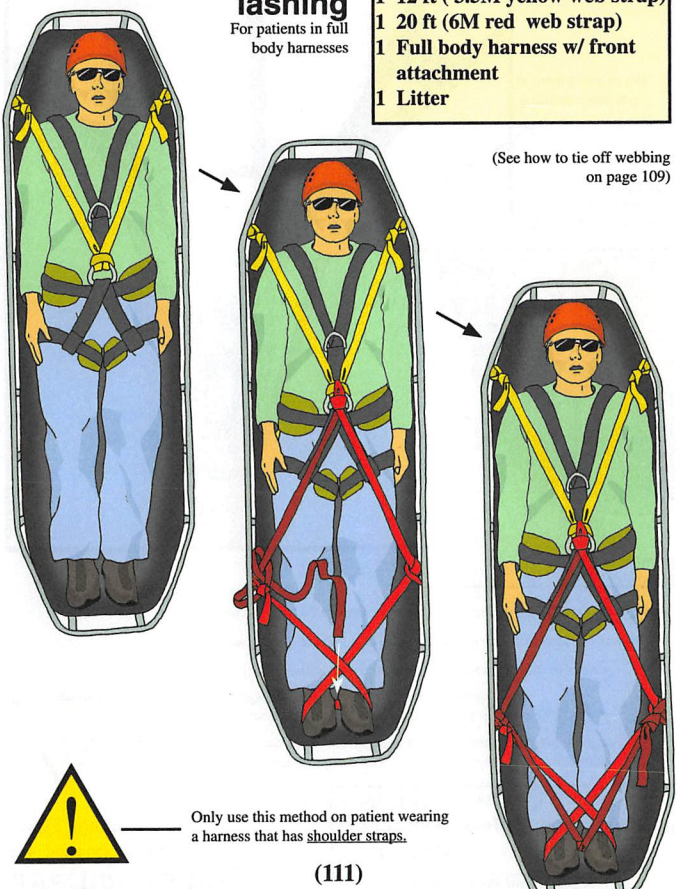
Industrial Internal lashing

For patients in full body harnesses

Equipment needs:

1 12 ft (3.5M yellow web strap)
1 20 ft (6M red web strap)
1 Full body harness w/ front attachment
1 Litter

(See how to tie off webbing on page 109)



Only use this method on patient wearing a harness that has shoulder straps.

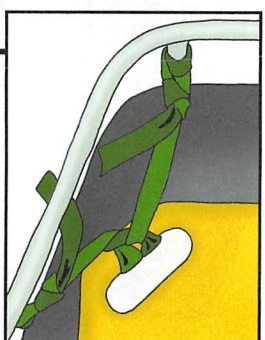
Internal lashing

For patients with spine or pelvic injuries

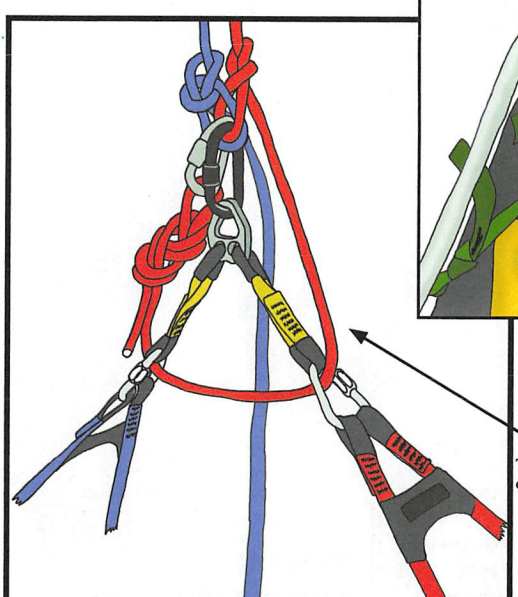
Equipment needs:

1 spine board)
2 14 ft spine straps (1,000 lb buckle)
4 5ft (1.5M green Web straps)

- Do not place a harness on a patient with spine or pelvic injury. Instead, incorporate spine board, litter and litter harness AS patient harness.
- Use "smart straps" (14 ft web straps with 1,000 lb buckles) to immobilize patient to back board, as shown below.
- Tie all four corners of spine board to corners of litter as shown.
- Thread Bowline end through litter harness and terminate as shown.
- External lashing or litter straps must be used to hold spine board down in litter.



Clove hitch with round turn/overhand tie offs



Terminate long tail of main line like this

Strap #1

Strap #2

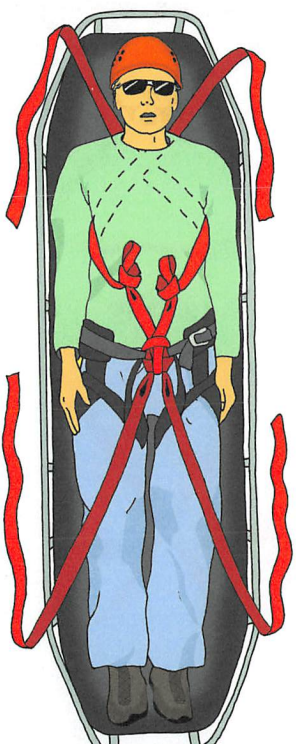
(114)

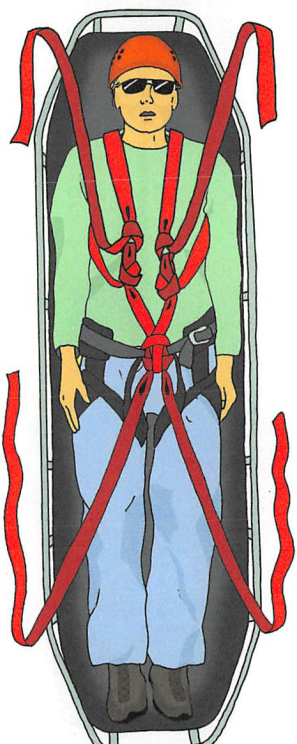
Long term internal lashing for technical evacuations

To be used with Hypo wrap on pages 115-117

Equipment needs:

1 patient harness (if tied, see page 34 for instructions)
2 20 ft (6M red web strap)
1 Litter





Hypo-wrap patient package

For prolonged technical transport, snow travel, and hypothermia treatment.

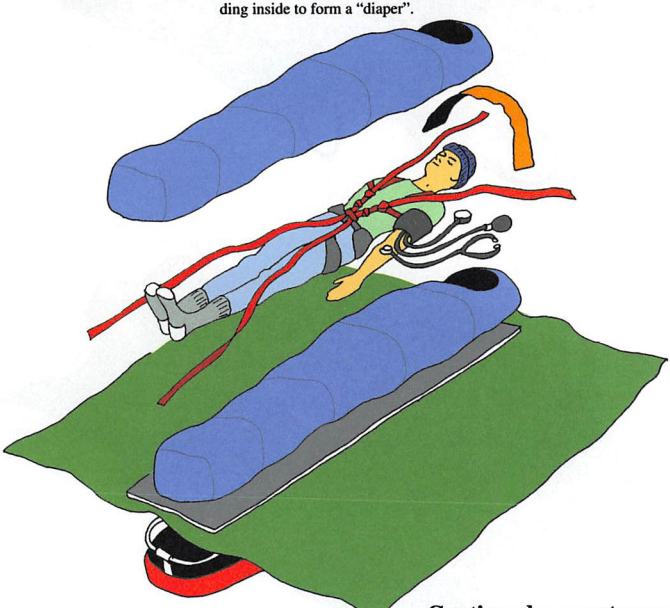
Equipment needs:

- **1 Litter**
- **1 Patient internal lash**
- **1 Large tarp**
- **2 Sleeping bags**
- **2 Ensolite pads**
- **1 S.A.M. splint**

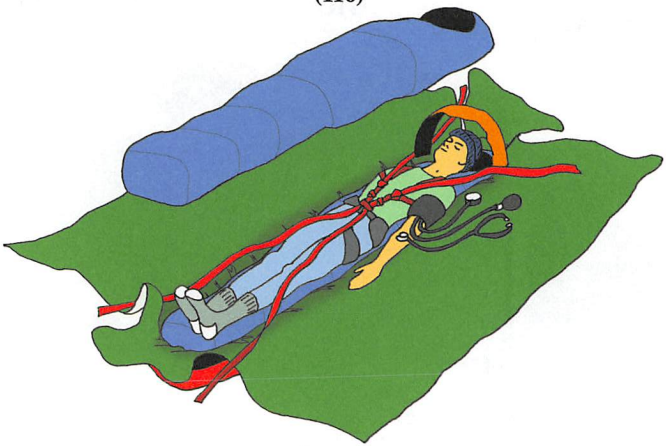
Place generous padding (rope bag, pack etc.) under patients knees.

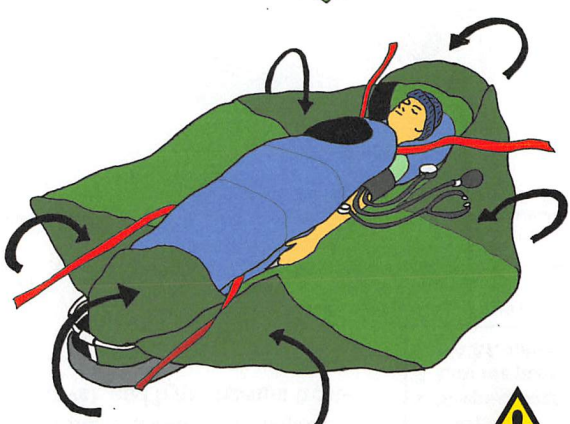
Stethoscope and B/P cuff can be added to allow assessment without opening patient package (tape stethoscope to arm).

If necessary, a trash bag can be cut and slipped on patient with padding inside to form a "diaper".

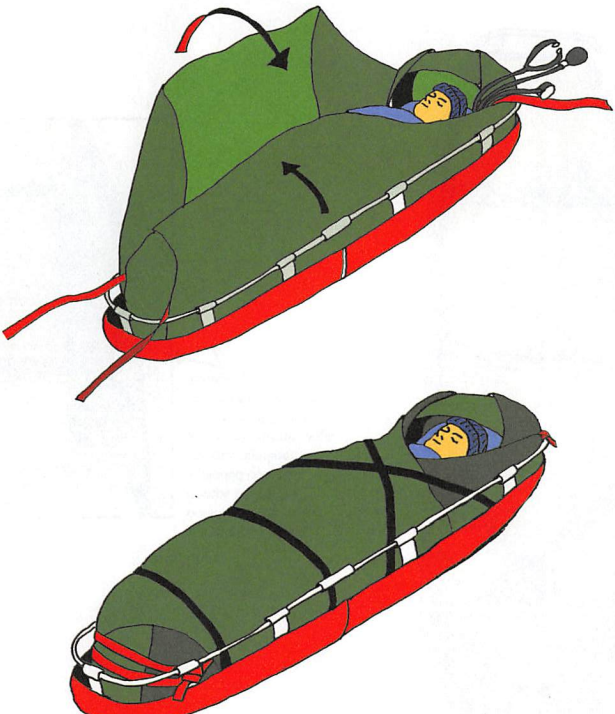


Continued on next page





Fold corners as neatly as possible, creating straight creases (aids in shedding rain and snow).



Finish by tieing off all four web straps. Foot straps can be crossed to provide lower support .

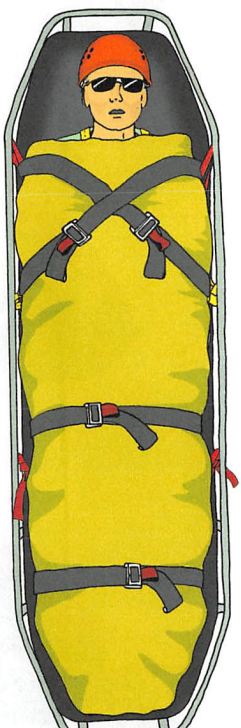
SAM splint can be rocked back to assess patient, or rocked forward to provide protection from weather.

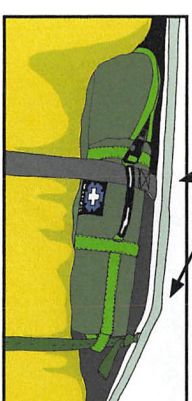
External lashing

For litters with built in restraint systems

External lashing is intended to retain patient padding, and to keep patient from thrashing about. It is NOT intended as primary fall protection for the patient. Always use a harness attached directly to the rope system. Add internal lashing(see pages 108-114).

Top straps should always be crossed in an "X" to protect patient from possible choking





If Oxygen is transported with patient, it must be stowed in a padded case that encases regulator. It also needs strong loops that external lashing can thread through in multiple places.

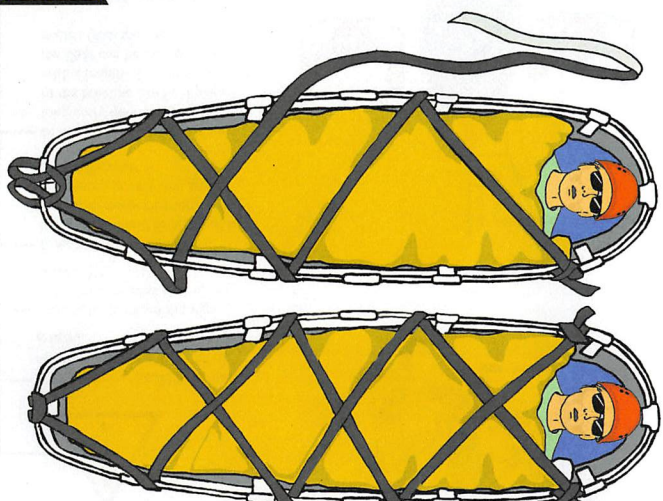
External lashing

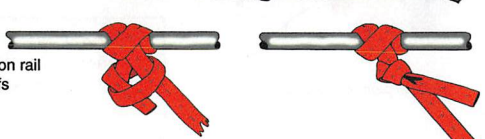
For litters without built in restraint systems

Equipment needs:

1 Litter
1 25 ft. (7.5m) web strap

External lashing is intended to retain patient padding, and to keep patient from thrashing about. It is NOT intended as primary fall protection for the patient. Always use a harness attached directly to the rope system. Add internal lashing(see pages 70-73) if there is a possibility that the patient could be ejected from the ends of the litter.





Finish clove hitches on rail with over hand tie offs

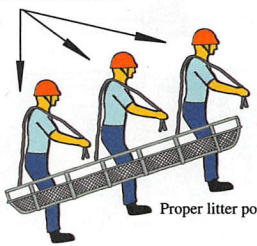
Equipment needs:

1 Litter
4 Carabiners
3 Litter harness, or
1 x 20 ft (6 M) web strap
(see pages 104-105 for details)

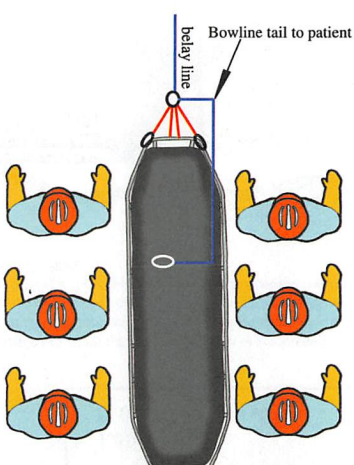
(120)

- All carabiners should have gates opening down and away from ground.
- The angles between the legs of the litter harness should not exceed 90°.
- Long tail bowline of the belay line should be attached to patient in steeper terrain.(It may be omitted in very low angle, simple terrain).
- In heavily forested terrain, or long carry outs, the long tail of the bowline can be replaced with a length of webbing, so that the litter can be quickly disconnected from the rope.
- The attendants should not be attached to the litter or the system.
- There should be little or no tension on the belay line.
- **If there is risk of serious injury or death to any of the rescuers should they slip or fall, change to a two rope (steep angle system).**

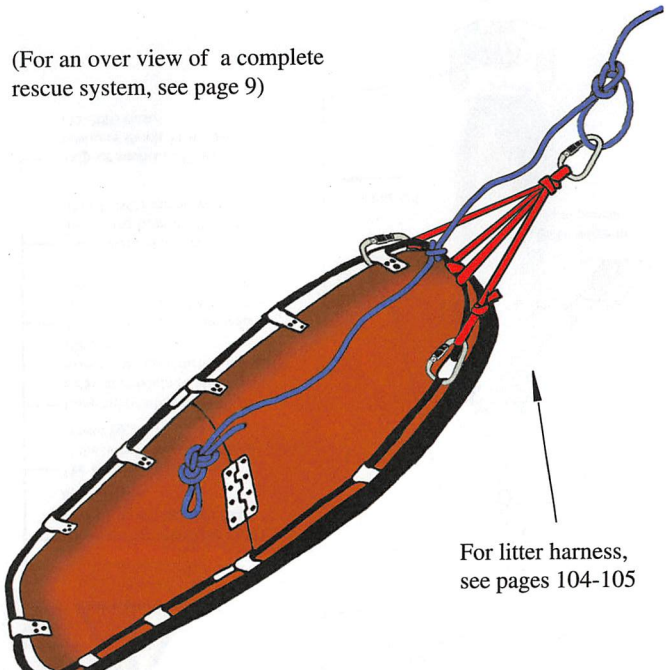
Webbing looped around litter rail. and carried over shoulder



Proper litter position

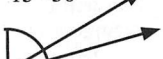


(For an over view of a complete rescue system, see page 9)



For litter harness, see pages 104-105

15°-30°



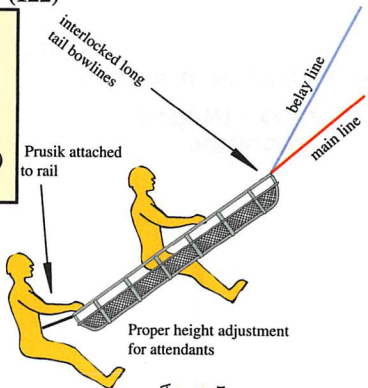
Rescue/patient package

RESCUE/ PATIENT PACKAGE

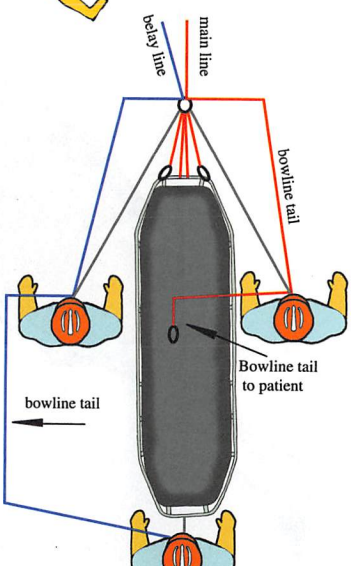
Low angle, six attendants

Equipment needs:

1 Litter
4 Carabiners
1 Litter harness, or
1 x 20 ft (6 M) web strap
(see pages 104-105 for details)
3 Sets Purcell Prusiks

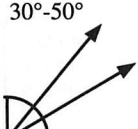


- All carabiners should have gates opening down and away from ground.
- The angles between the legs of the litter harness should not exceed 90°.
- Long tail bowline of the belay line should be attached to one side attendant and rear attendant.
- Long tail bowline of the main line should be attached to one side attendant and the patient.
- The weight of the attendants must hang from the Purcell Prusik, NOT the belay lines.
- Tails of interlocked long tail bowlines should be 4.5m-6m (15-20ft) each.



(For an over view of a complete rescue system, see pages 14-15)

30°-50°



RESCUE/ PATIENT PACKAGE

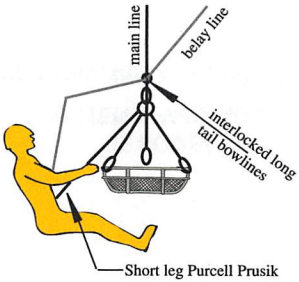
Steep angle, three attendants

(123)

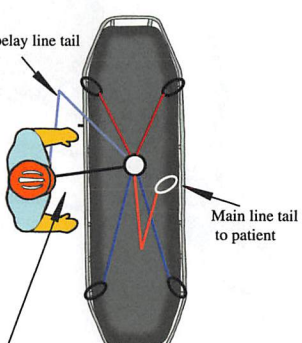
Rescue/patient package

Equipment needs:

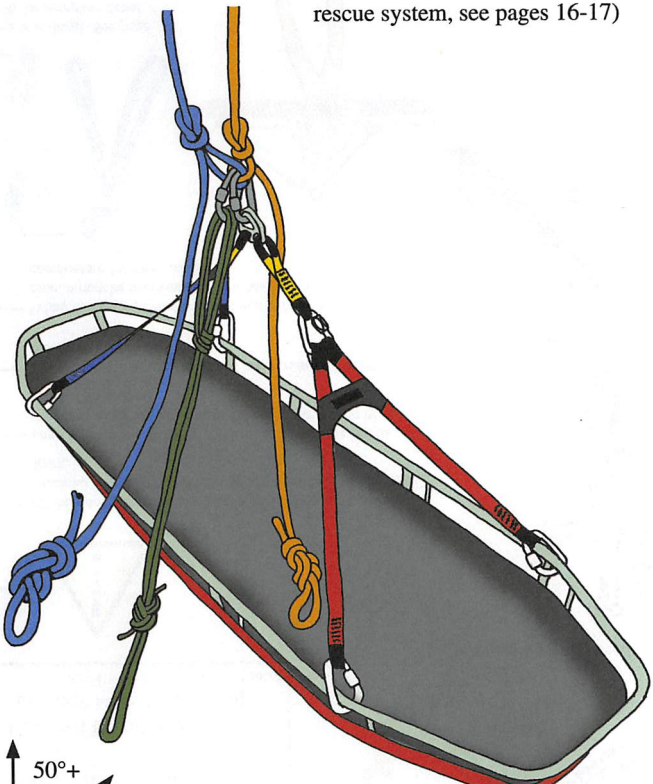
1 Litter
6 Carabiners
1 Litter harness
1 Set Purcell Prusiks



- All carabiners should have gates opening down.
- Carabiners attaching litter harness to litter should open toward litter AND down.
- The angles between the legs of the litter harness should not exceed 90°.
- The apex of the litter harness should be centered over the patient's navel.
- Long tail bowline of the belay line should be attached to the attendant.
- Long tail bowline of the main line should be attached to the patient.
- The weight of the attendant must hang from the Purcell Prusik, NOT the belay line.



(For an over view of a complete rescue system, see pages 16-17)

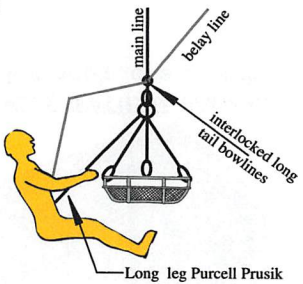


RESCUE /PATIENT PACKAGE
High angle, one attendant
(125)

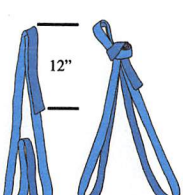
Rescue/patient package

Equipment needs:

1 Litter
7 Carabiners
1 15 ft (5.5M blue) web strap
2 Mini double PMP pulleys*
1 32 ft (10M) x 8mm utility* cord
1 Purcell Prusik loop, or small 6mm Prusik loop
*Aztek style kit may be substituted



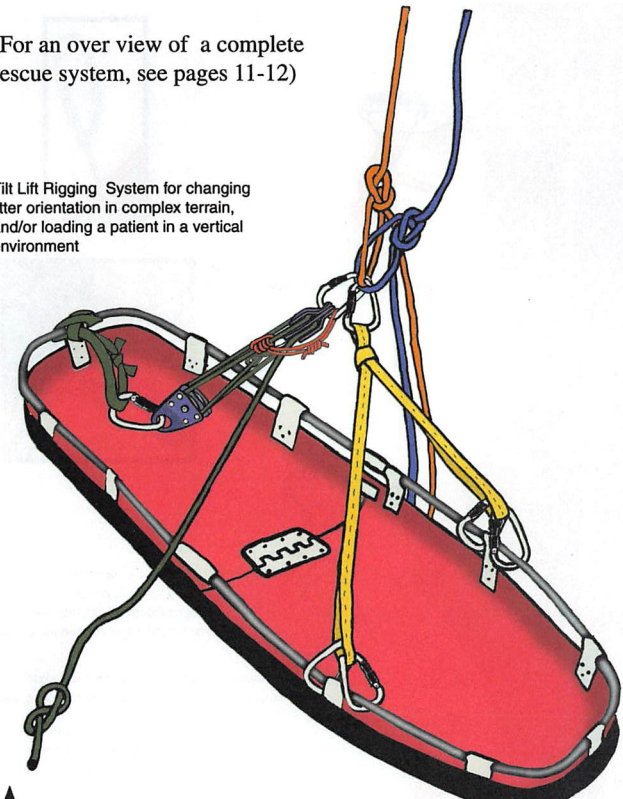
- All carabiners should have gates opening down. Carabiners attaching litter harness to litter should open toward litter AND down.
- Long tail bowline of the belay line should be attached to attendant. Long tail bowline of the main line should be attached to patient.
- The weight of the attendant must hang from the Purcell prusik, NOT the belay line.
- When loading a patient who is hanging from a LONG rope, it may be necessary to rig a raising system to compensate for rope stretch.

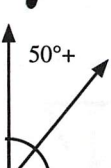


Harness detail- See page 106 for complete detail

(For an over view of a complete rescue system, see pages 11-12)

Tilt Lift Rigging System for changing litter orientation in complex terrain, and/or loading a patient in a vertical environment





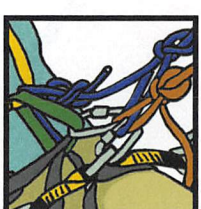
RESCUE/ PATIENT PACKAGE

High angle, Tilt / lift

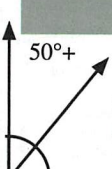
(127)

Rescue/patient package

- Use for complex vertical and overhanging terrain
- Connect sternal attachment or connector strap to interlocking bowlines for upper attendant position.
- Leave primary attachment (Purcell Prusik) in place for transitioning back to standard position.
- A second Percell Prusik can be girth hitched to litter rail to aid in transitioning from standard to upper position.



Upper attendant attachment



RESCUE/ PATIENT PACKAGE

Upper Attendant Position

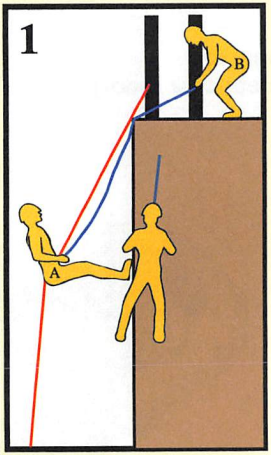
(129)

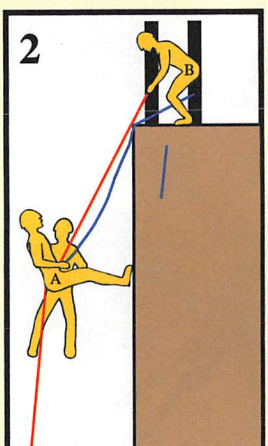
Rescue/patient package

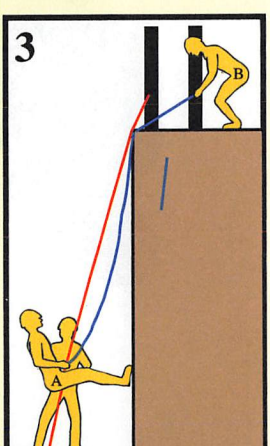
1 (A) Rappels to subject and connects subject to Main and Belay.
(B) Operates belay

2 (B) Sets belay, pulls up on Mainline pulley system
(A) Disconnects subject from subjects system.

3 (B) Operates Belay
(A) Rappels to ground.

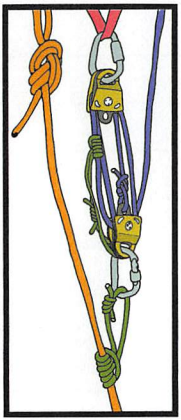






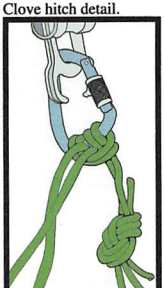
Only raise mainline just enough to slack subjects line.

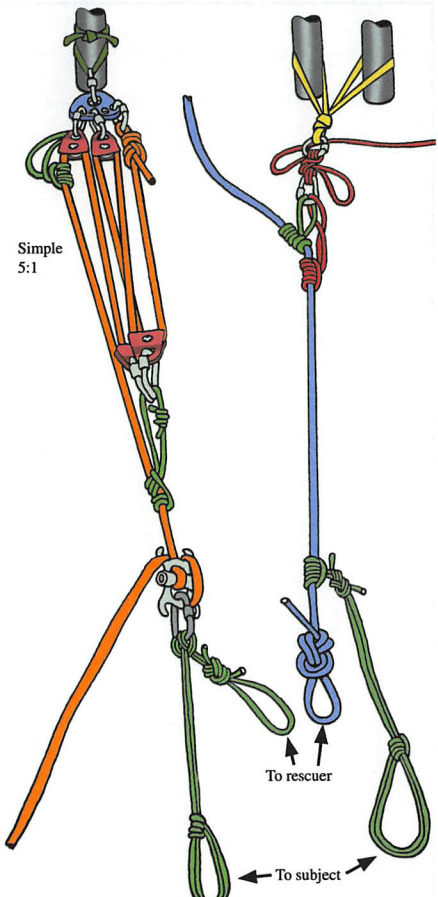
Do not raise mainline more than 1M without resetting the belay.



A 5:1 Jigger or Aztek style pulley system can be substituted for the pulley system shown at right.

Clove hitch detail.





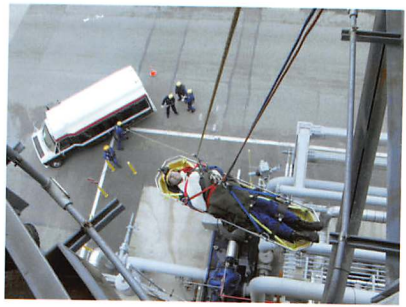
(131) **Panorama Pick Off**

Rescue/patient package

NOTES

Deflection Systems

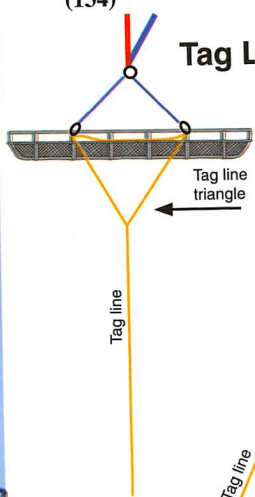
Kootenay highline, Deception Pass area

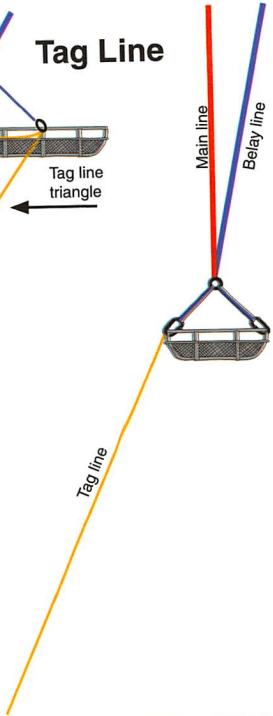


Guiding Line,B/P refinery

WARNING! If performed improperly, deflection systems can easily generate enough force to cause catastrophic system failure, or dangerous pendulums. If you have ANY questions regarding deflection systems, please contact a rescue school that fully understands deflection systems and regularly teaches them.

Litter lower with tag line in a petro chemical plant





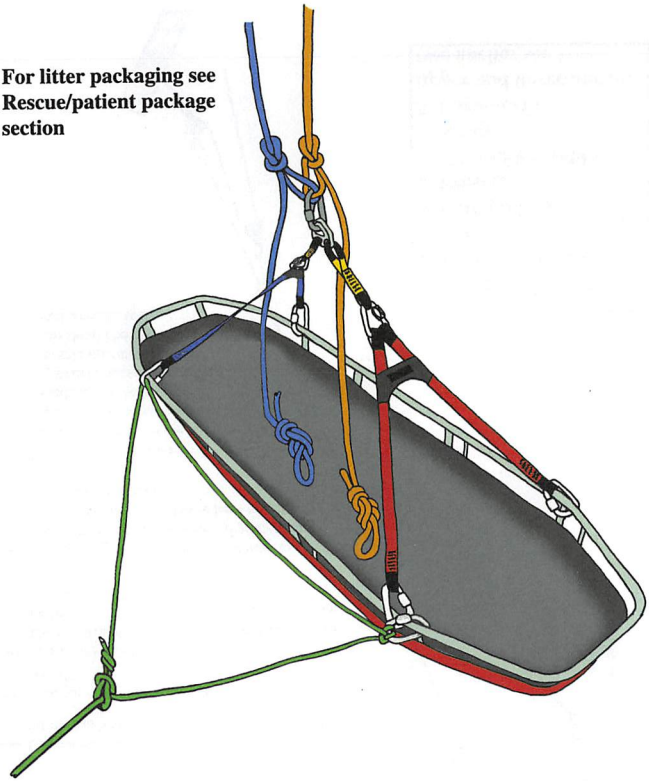
- Center the apex of tag line triangle roughly at patients navel
- Anchor corners of tag line triangle to litter rail with a clove hitch (can be on a separate carabiner).
- Use unassisted human power only to pull tag line.
- Pull tag line only enough for litter to *just barely* clear obstacles.
- Maximum practical length of a tag line is 30m (100ft)

Equipment needs:

1 Litter and harness

1 8mm accessory rope

For litter packaging see Rescue/patient package section

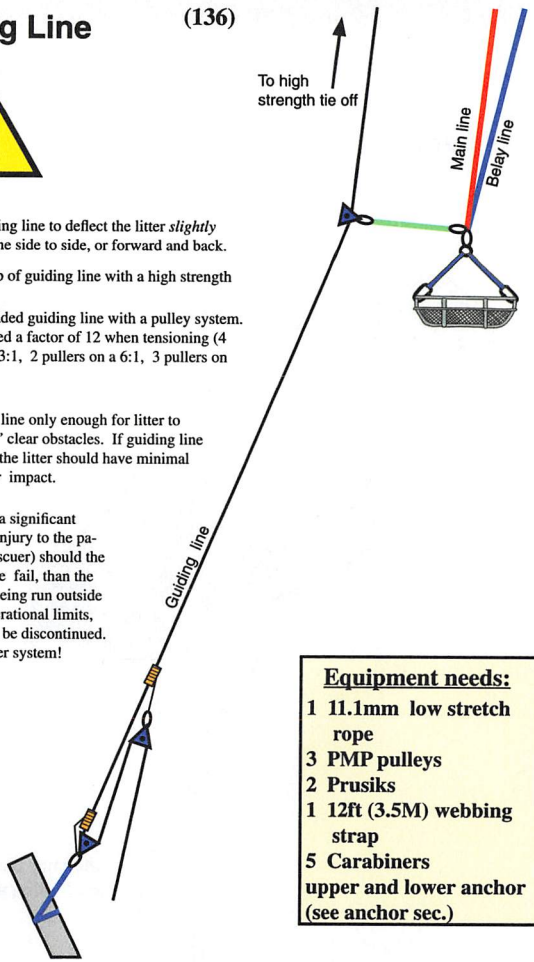


TAG LINE

DEFLECTION

Guiding Line

- Use the guiding line to deflect the litter *slightly* off the fall line side to side, or forward and back.
- Anchor top of guiding line with a high strength tie off.
- Adjust a loaded guiding line with a pulley system. Do not exceed a factor of 12 when tensioning (4 pullers on a 3:1, 2 pullers on a 6:1, 3 pullers on a 4:1 etc).
- Pull guiding line only enough for litter to *"just barely"* clear obstacles. If guiding line were to fail, the litter should have minimal swing and/or impact.
- ! If there is a significant chance of injury to the patient (or rescuer) should the guiding line fail, than the system is being run outside its safe operational limits, and should be discontinued. Pick another system!



Equipment needs:

1 11.1mm low stretch rope
3 PMP pulleys
2 Prusiks
1 12ft (3.5M) webbing strap
5 Carabiners
upper and lower anchor (see anchor sec.)

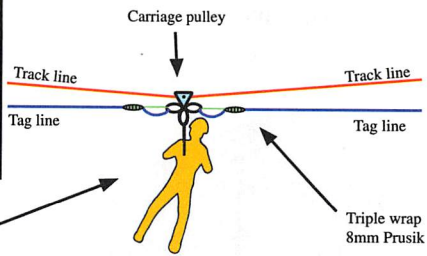
For litter packaging see Rescue/patient package section

(137)

GUIDING LINE

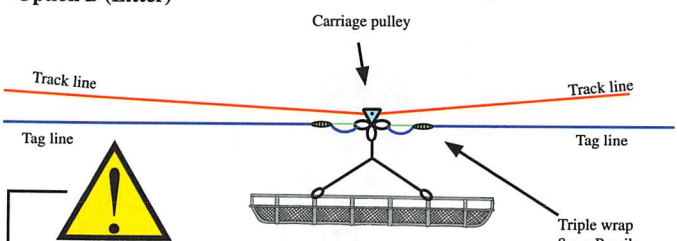
Equipment needs:

1 Litter or full body harness
4 Carabiners
1 5 ft (1.5M) web strap
2 8mm System Prusiks
1 PMP or Kootenay Carriage pulley



Option A (single rescuer)

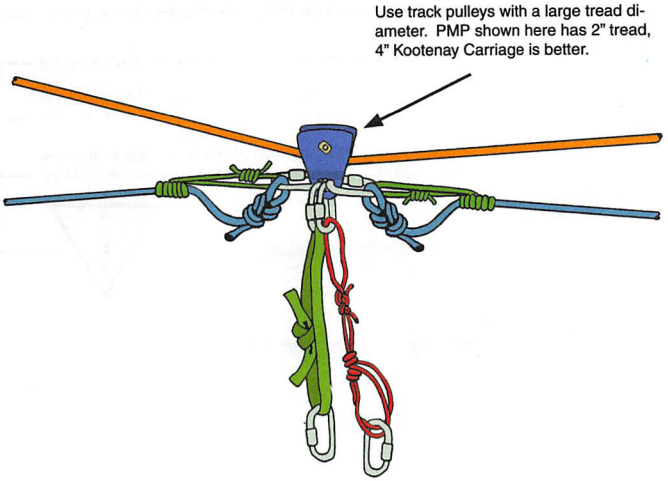
Option B (Litter)



- All carabiners should have gates opening down. Carabiners attaching litter harness to litter should open toward litter AND down.
- The angles between the legs of the litter harness should not exceed 90°.
- Rig the head end of the litter slightly higher that the foot end.
- There should be a small amount of slack between where the Prusik grabs the tag line and where the tag line attaches to the carriage pulley.
- The maximum practical length of a Kootenay highline in the field is 100 meters. Longer highlines are possible, but require pre-engineering and precise measurements.
- **WARNING! The Kootenay highline system and its component parts are advanced skills. Pay close attention to the skills listed in the Deflection section. If unfamiliar with any of them, seek competent instruction. Improper use of these skill could cause system failure!**

RESCUE/ PATIENT PACKAGE FOR KOOTENAY HIGHLINE

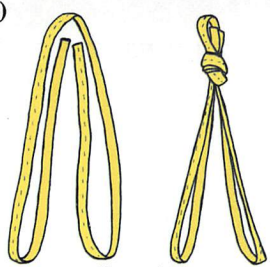
(For an over view of a complete rescue system, see page 15)



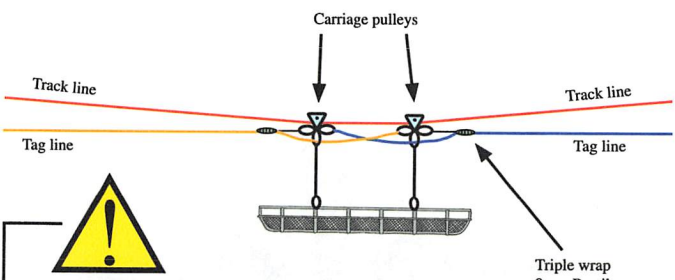
Single Carriage rigging

Equipment needs:

- 1 Litter
- 14 Carabiners
- 2 12 ft (3.5M) web straps
- 2 8mm System Prusiks
- 2 PMP or Kootenay Carriage pulleys



Harness detail

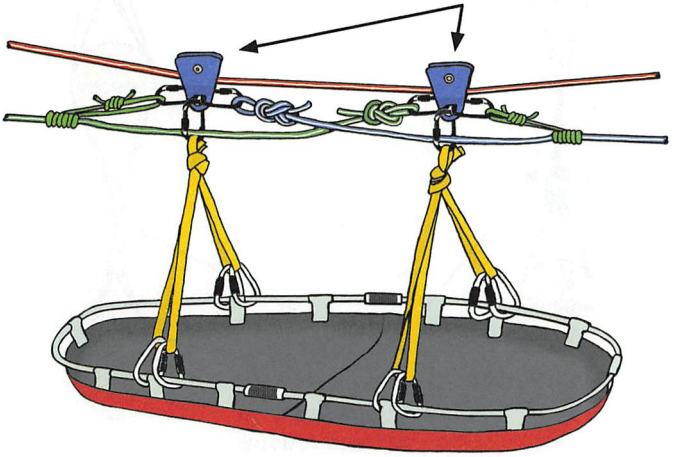


- All carabiners should have gates opening down. Carabiners attaching litter harness to litter should open toward litter AND down.
- Carabiners that attach to litter must be captured so that they cannot slide along the rail. If necessary, use two carabiners bridging a stanchion, as shown below.
- Rig the head end of the litter slightly higher that the foot end.
- There should be a small amount of slack between where the Prusik grabs the tag line and where the tag line attaches to the opposite carriage pulley.
- The maximum practical length of a Kootenay highline in the field is 100 meters. Longer highlines are possible, but require pre-engineering and precise measurements.
- **WARNING! The Kootenay highline system and its component parts are advanced skills. Pay close attention to the skills listed in the traversing section. If unfamiliar with any of them, seek competent instruction. Improper use of these skill could cause system failure!**

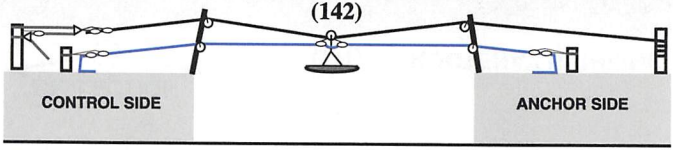
RESCUE/ PATIENT PACKAGE FOR KOOTENAY HIGHLINE

(For an over view of a complete rescue system, see page 19)

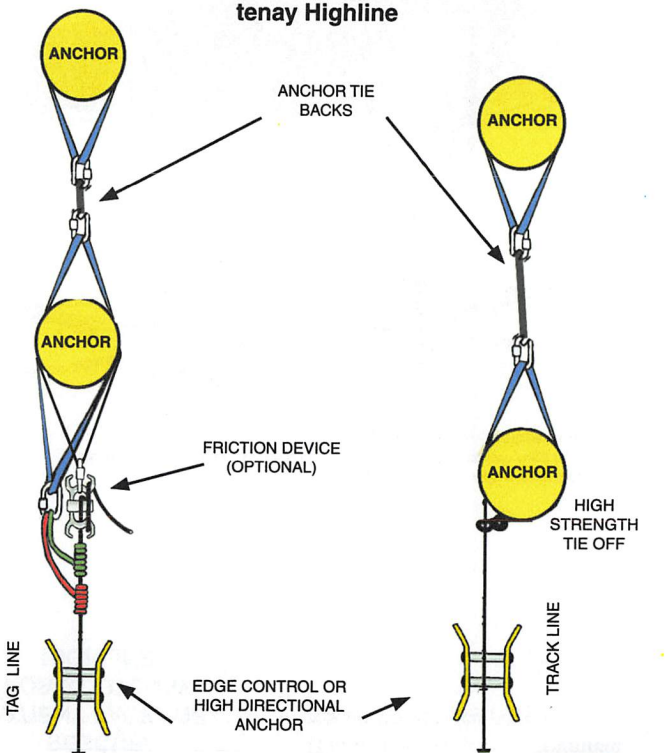
Dual Carriage rigging

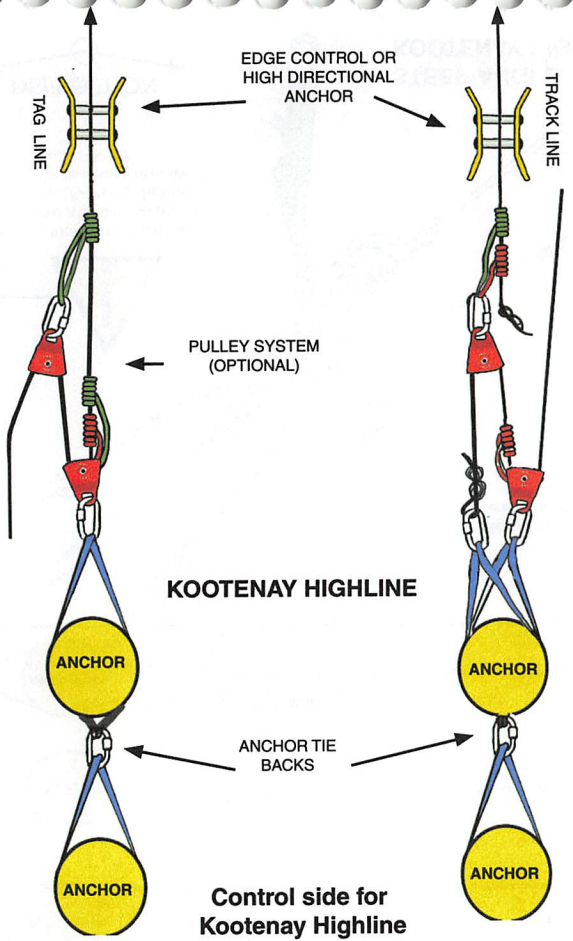


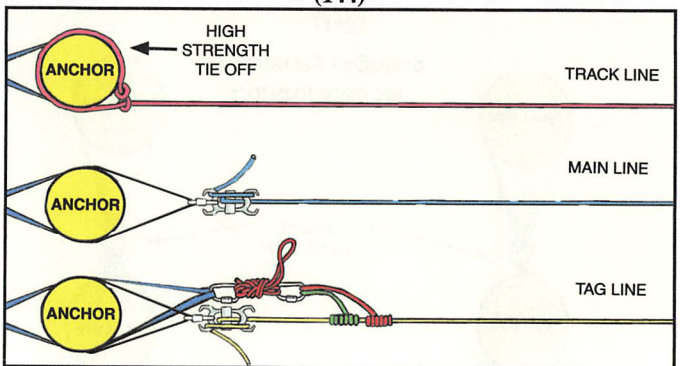
DEFLECTION

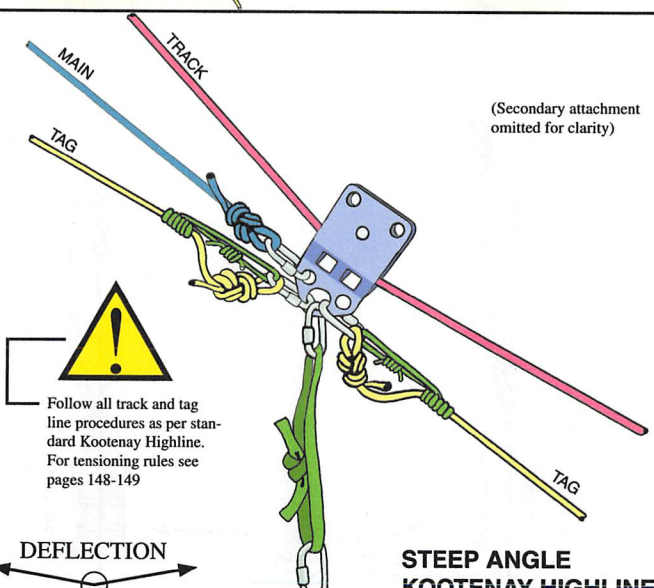


Anchor side for Kootenay Highline




EDGE CONTROL OR
HIGH DIRECTIONAL
ANCHOR
TAG LINE
TRACK LINE
PULLEY SYSTEM
(OPTIONAL)
KOOTENAY HIGHLINE
ANCHOR
ANCHOR
ANCHOR TIE
BACKS
ANCHOR
ANCHOR
Control side for
Kootenay Highline





(Secondary attachment omitted for clarity)

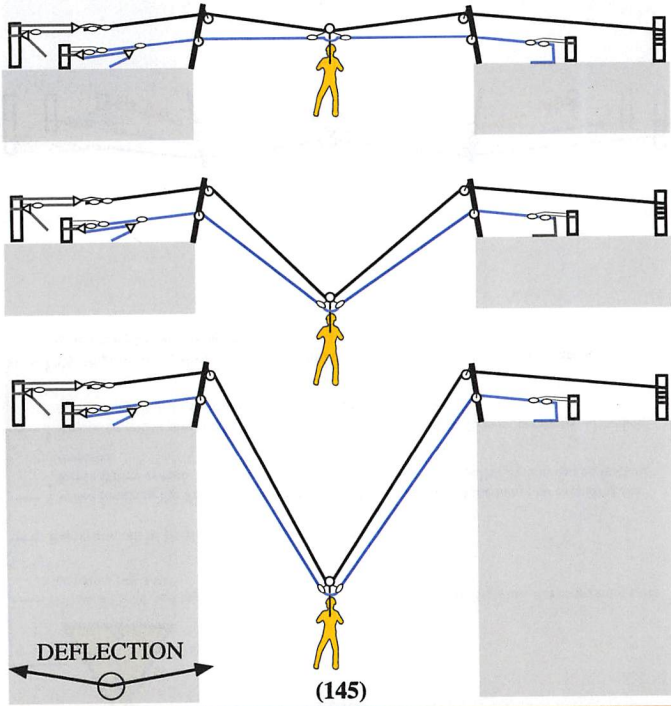
Follow all track and tag line procedures as per standard Kootenay Highline. For tensioning rules see pages 148-149

DEFLECTION

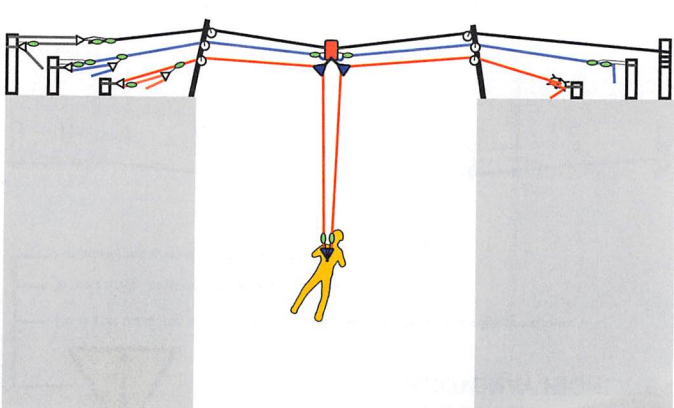
STEEP ANGLE KOOTENAY HIGHLINE

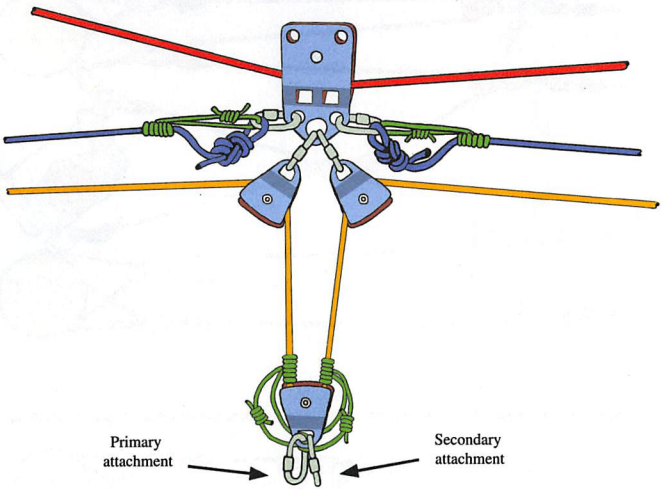
DROOPING
KOOTENAY HIGHLINE

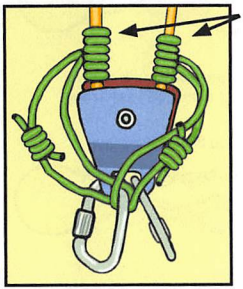
- Do not let track line or tag lines touch edges. Always use proper edge protection.
- When raising, hoist on both track and tag lines
- For tensioning rules see pages 148-149



- Follow all track and tag line procedures as per standard Kootenay Highline. For tensioning rules see pages 148-149
- Reeve line can be hoisted or lowered from either side.
- ! When lowering the Reeve line to water, finish the last portion of the lower by extending the Reeve pulley system. If the rescuer touches the water, the reeve pulley system can be instantly reversed.
- ! Rescue attendant must mind both Reeve carriage Prusiks during Reeve operations. Attendant must release Prusiks if there is a reeve line failure (see below).
- ! The English Reeve Highline is and advanced technique. Practice with an experienced instructor is necessary before attempting it in the field.



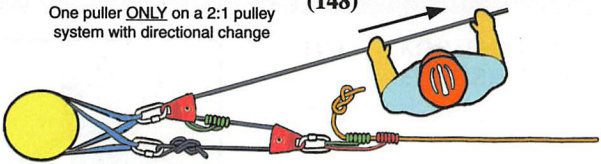




Rescue attendant must mind both Prusiks during Reeve operations. Attendant must release Prusiks if there is a Reeve line failure.

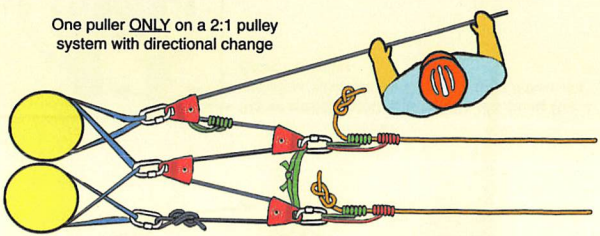
(147) **ENGLISH REEVE**
KOOTENAY HIGHLINE

One puller ONLY on a 2:1 pulley system with directional change

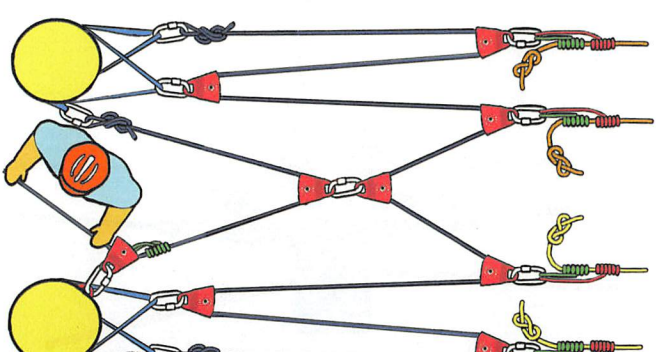


Initial tensioning of Kootenay Highline with NO weight on Highline

One puller ONLY on a 2:1 pulley system with directional change



Variation on initial tensioning of Kootenay Highline with NO weight on Highline- Twin track highline.



Variation on initial tensioning of Kootenay Highline with NO weight on Highline- Quad track highline.

Tensioning of the Kootenay Highline System

Use ONE PULLER ONLY to tension the track line in preparation for loading. Use only a 2:1 pulley system to tension the unweighted track line. Failure to follow this rule could overstress the track line when weight is hung from it and cause system failure!

After the mass is hanging from the track line, additional pullers may be used to help tension the line and lift the litter over edge obstructions etc:

- 11mm rope: You may use up to a multipule of 12 (i.e. 2 rescuers pulling on a 6:1 system, or 3 rescuers on a 4:1 system)
- 12mm rope: You may use up to a multipule of 18 (i.e. 3 rescuers pulling on a 6:1 system)

The tension should be backed off again when the obstruction is passed. Again, ONLY use extra pullers when the load is already hanging from the highline.

The above rules also apply to twin and quad track highlines.

The maximum practical length of a Kootenay highline in the field is 100 meters. Longer highlines are possible, but require extensive pre-engineering and precise measurements.

Tips for the Kootenay Highline System

A messenger cord twice the length of highline span with a floating center tie should be left in place after highline is placed, to aid in de-rigging, and to reset the highline in the event of track line failure.

If the track line fails, the rescue package will drop about 1/5 the length of span before being arrested by the Tag lines. Rig accordingly.

For longer highlines, the weight of the tag lines can be suspended on the track line by using "Tagline Hangers". These can be made with short cords girth hitched to tag line and attached to the Track line with non locking carabiniers.

A good rule of thumb for highlines is that if the high directional anchor for the track line is 2M back from the edge, it must be greater than 2M high for the rescue package to clear the edge.

When operating a highline, the side letting out the rescue package must begin BEFORE the opposite side begins pulling in.

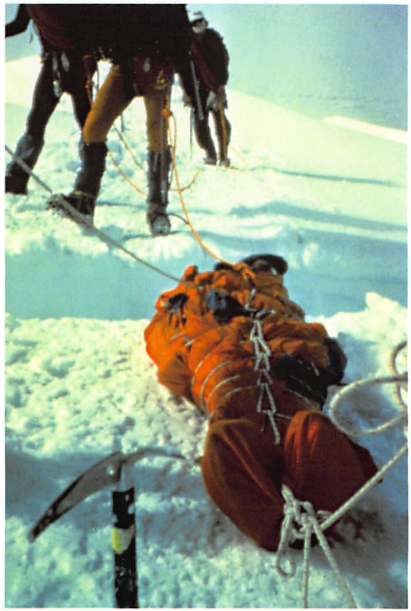
If the Track line cannot be sufficiently slacked to land the rescue package, a Prusik attached to the track line can be pulled on with a jigger pulley system. This pulls down the track line and lands the package.

A Track line jigger can be applied to temporarily deflect a highline sideways to clear obstructions , such as a tall tree.

It is highly recommended that a team receives proper instruction from an *experienced* Kootenay highline rigging instructor before attempting a Kootenay highline in the field.

NOTES

Mountain Rescue



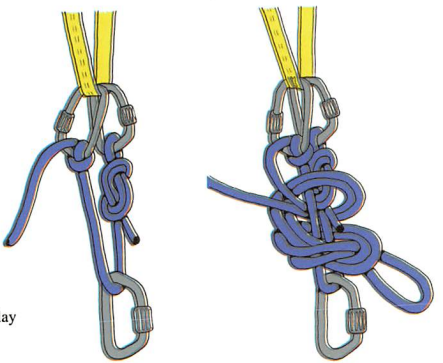
Improvised rescue in the Andes

Mountain rescue is designated in this guide as technical rescue that takes place more than three hours from motorized ground transport. Additionally, patient access requires specialized climbing or skiing skills.

WARNING! Mountain rescue requires very specialized training in addition to technical rope work, including, but not limited to; avalanche forecasting, snow pack analysis, winter survival skills, technical rock protection and glacier travel. If unfamiliar with any of these skills, seek professional training.

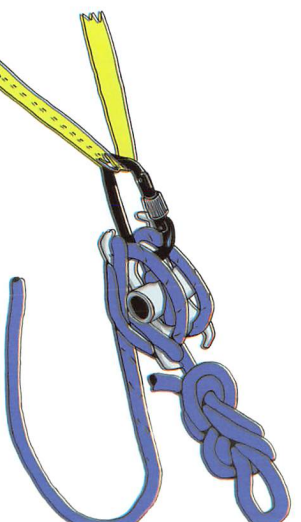
Improvised Release Hitches (using the rope end)

Modified Parks Canada Hitch



- Tie off with a Half hitch and Overhand bight
- Use with 11 and 12mm rope
- Can be used for Main and Belay packages

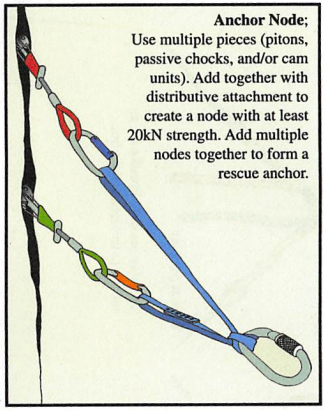
Release Hitch using a SCARAB® descender



- Use with 11 and 12mm rope
- Tie off SCARAB® in "hard lock" configuration (see page 61 for instructions)
- Can be used for Main and Belay packages
- Do not substitute an open "U" frame brake rack in this configuration for a belay. If shock loaded, an open "U" frame rack can catastrophically fail.

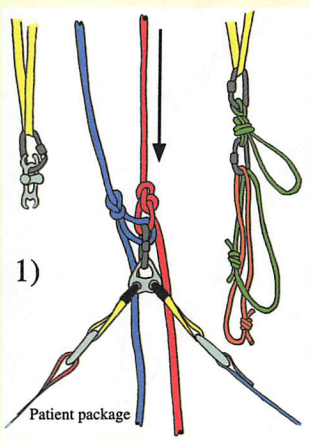
Artificial Rock Anchors

- Distributive anchor should incorporate at least two "nodes". The goal is that each node should have a theoretical strength of 20kN. Focus and distribute nodes as per standard anchors.
- Use the rated breaking strength of your rock protection to figure node strength. Build nodes with multiple pieces to achieve 20kN nodes.
- Nodes most in line with the direction of pull tend to take the most strain. Rig accordingly.

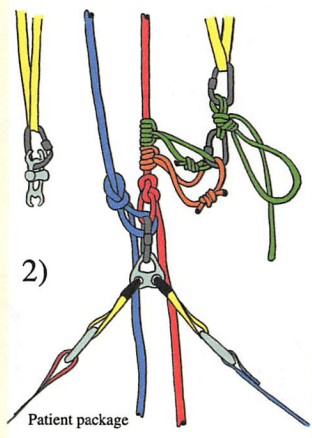


Anchor Node;
Use multiple pieces (pitons, passive chocks, and/or cam units). Add together with distributive attachment to create a node with at least 20kN strength. Add multiple nodes together to form a rescue anchor.

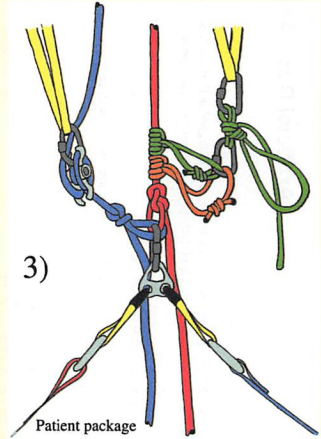
Mid- Face Transitioning



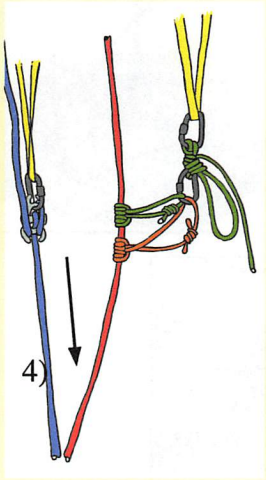
1) Rescuers place Main and Belay packages at mid station, ready to receive patient package



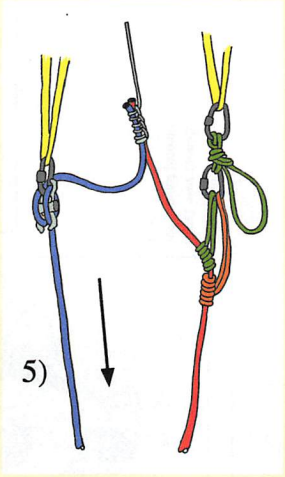
2) Belay package Prusiks are attached to tensioned main line.



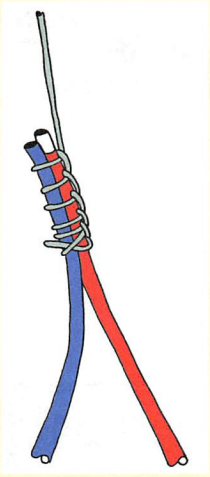
3) Non tensioned Belay line is threaded through SCARAB®



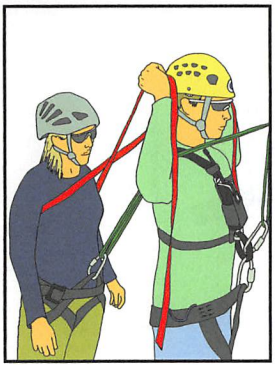
4) Patient package is lowered until it is hanging from the mid-face main line package. The original belay line is now the main line, and the original belay is now the main. Lowering can continue another rope length.



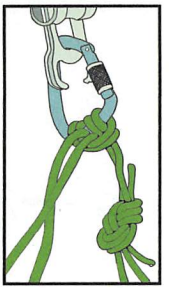
5) During the mid-face lower, the excess ropes can be managed from above with a pilot cord. This guards against tangles at the mid-station.

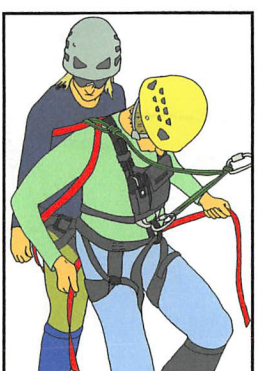


Pilot cord detail

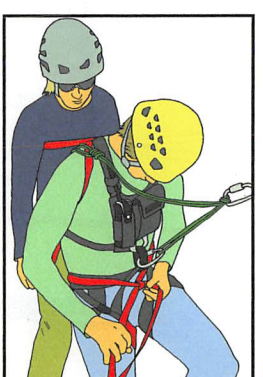


Use 6m web. Cross webbing under arms.

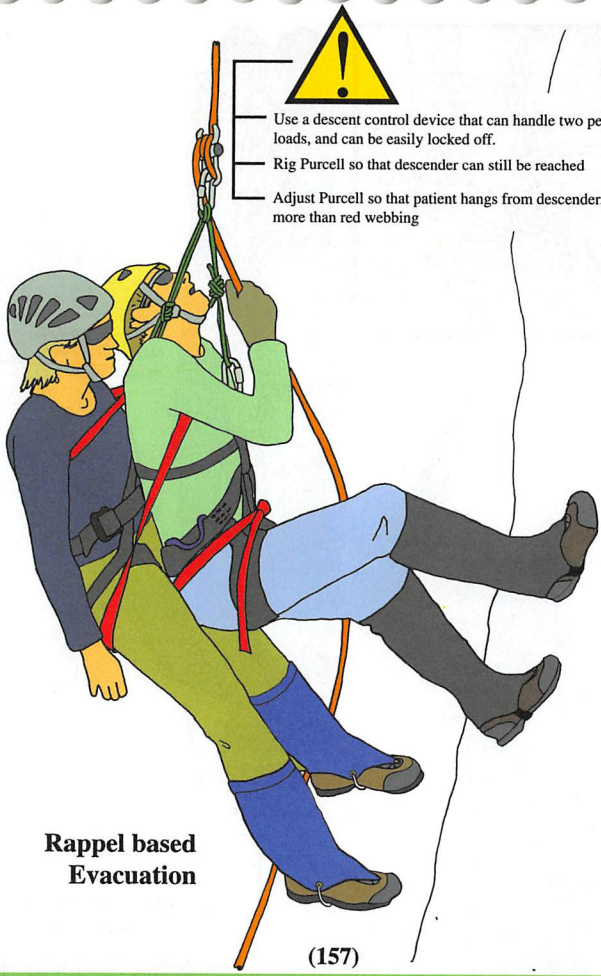




Bring over shoulders, and around patients legs.



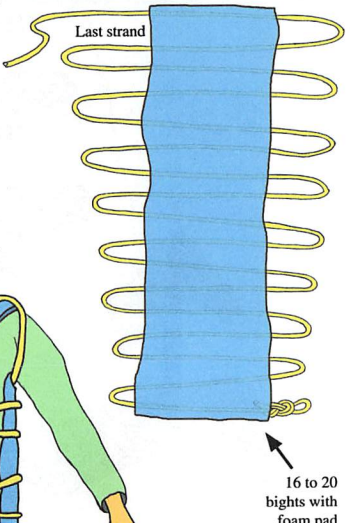
Crouch down and tie off.

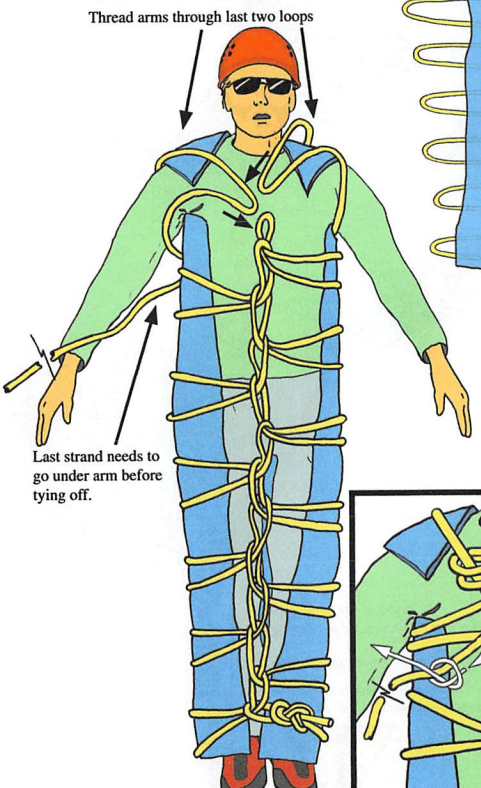


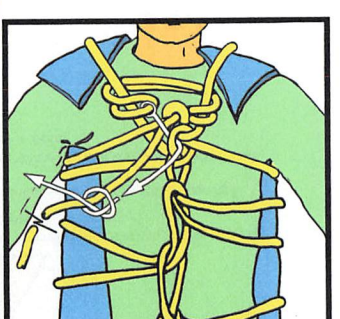
Rappel based Evacuation

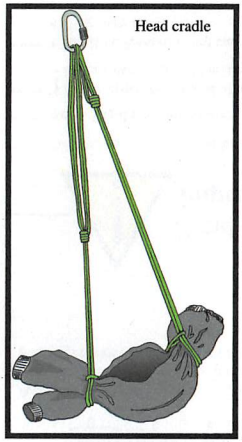
Equipment needs:

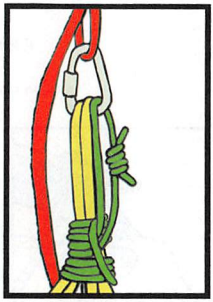
- **1 Climbing rope**
- **1 Set Purcell Prusiks**
- **1 Fleece jacket**
- **4 Carabiners**



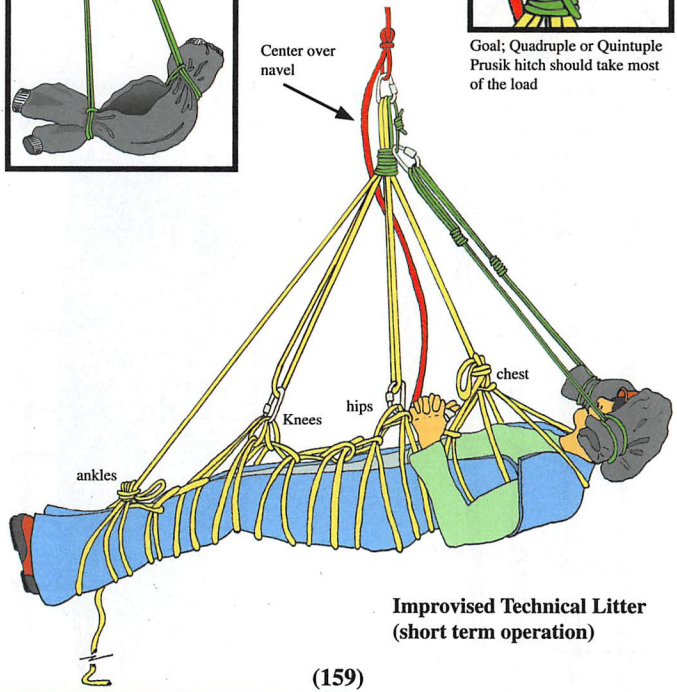




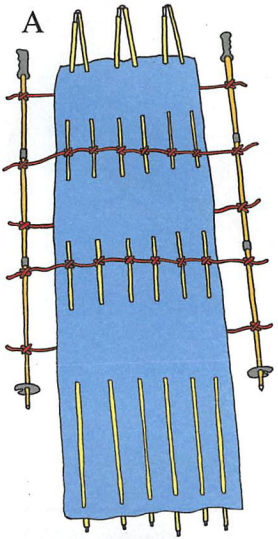




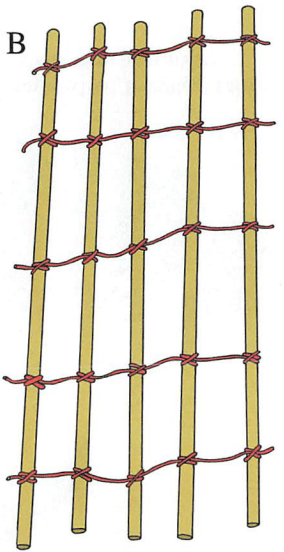
Goal; Quadruple or Quintuple Prusik hitch should take most of the load



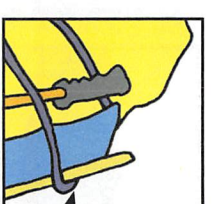
Improvised Technical Litter (short term operation)



A) Alpine style rigid structure; utilizes tent poles, trekking poles and blue foam pad. Light cord ties structure together.



B) Back country style rigid structure; utilizes spruce poles, skis, raft oars etc. Light cord ties structure together.



Rigid structure for improvised litter below

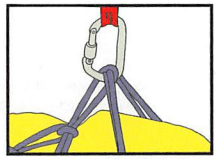
- Package patient as per instructions on pages 115-117
- Add a Rigid structure (above) and lace litter closed as on page 172.
- ! As the arms are not available, you must trap top of the rigid structure with the last two bights of the lacing rope to act as shoulder straps.
- Extra Blue foam or a tarp can be rigged outside the improvised litter if sliding over snow.

Practice these litter techniques in a controlled environment before ever attempting them in the field.

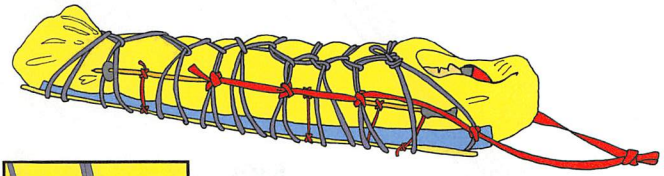
Improvised litters can loosen and weaken over time. Check and readjust often.

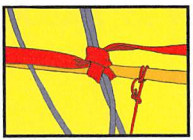
Always have the patient in harness attached to a separate belay when using an improvised litter.

Center over navel



Trap both bights with the carabiner

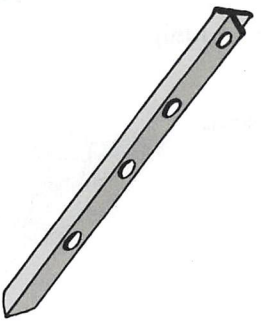




Trap both the ropes and the rigid structure within the clove hitch

Rigid improvised litter

Snow / ice anchors



General rules

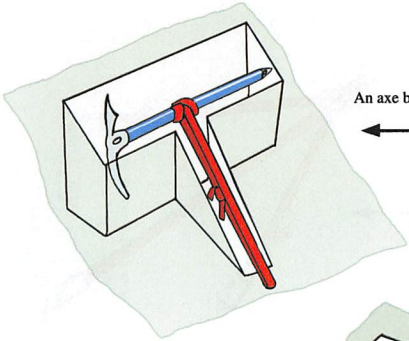
A thorough knowledge of the snow pack at the elevation, direction and aspect of your anchor placement is essential. When in doubt, dig a pit and look. Consistent firm snow is best, inconsistent soft layers and/or ice layers should be suspect.

Never trust a single snow anchor. Multiple distributive anchors are better.

Snow anchors can change with time. Be suspect of any anchor that has been in the sun, had force applied to it over a period of time, or has been in place during a warming trend.

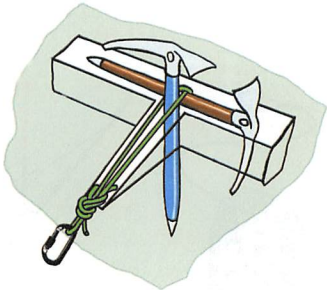
Try to keep the overall force applied to a snow anchor as minimal as possible (keep your system light!).

Do not use pulley systems or techniques that allow rescuers to pull directly against a snow anchor (i.e. counterbalance rescue). Choose instead techniques that help to minimize the force on the snow anchor.

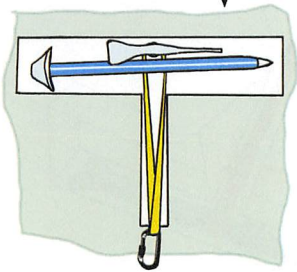


An axe buried in a "Tee Slot"

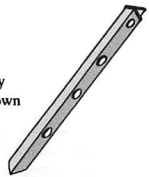
A reinforced "Tee Slot" anchor with two axes.

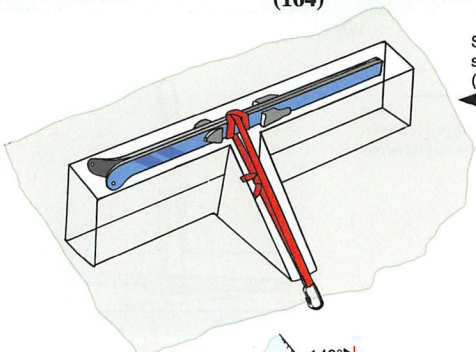


A variation on the reinforced "Tee Slot" anchor with two axes.



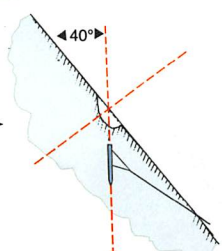
(Snow Pickets could easily replace any of the axes shown here)

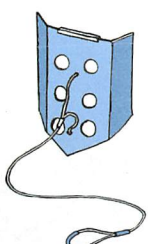


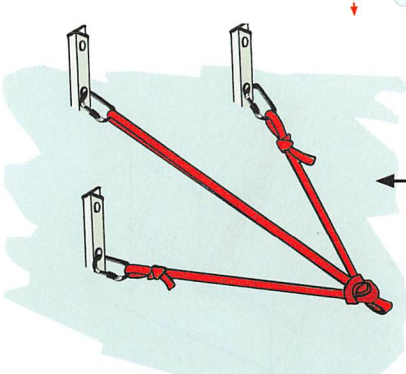


Skis buried to form a strong "Tee Slot" anchor (1M to 1.5M deep slot)

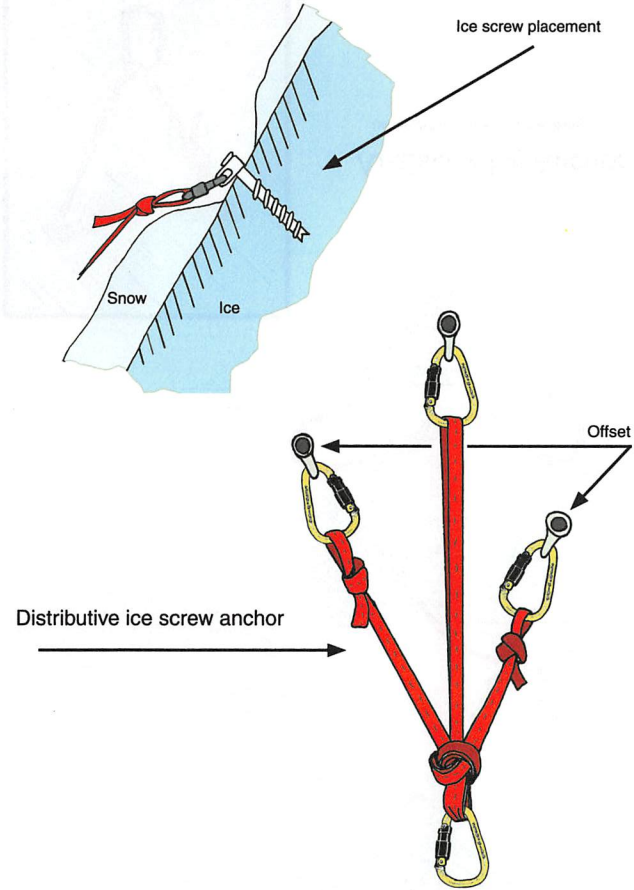
Snow Fluke (use only in firm, consistent snow)

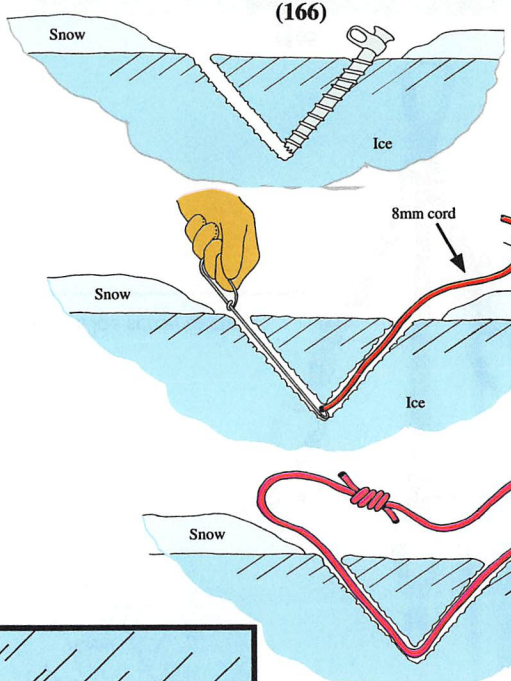


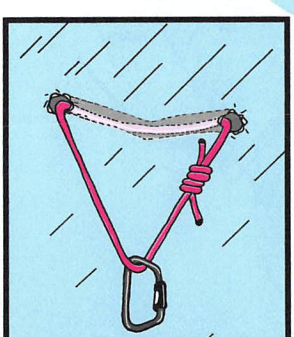




Distributive Picket anchor in hard snow

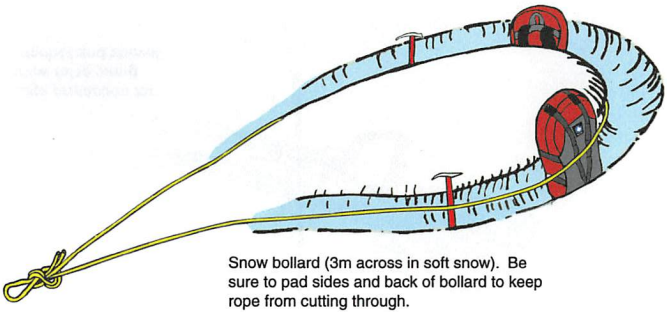

Ice screw placement
Snow
Ice
Offset
Distributive ice screw anchor



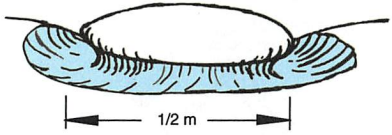


Abalakov Ice Anchor

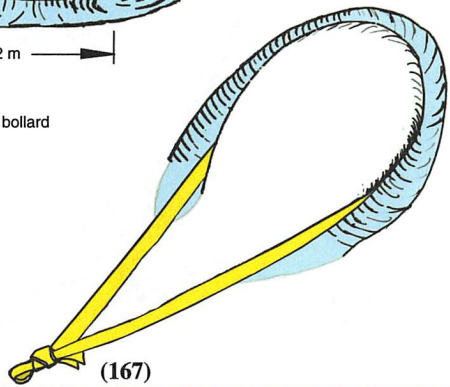
(using 30cm screw and coat hanger)

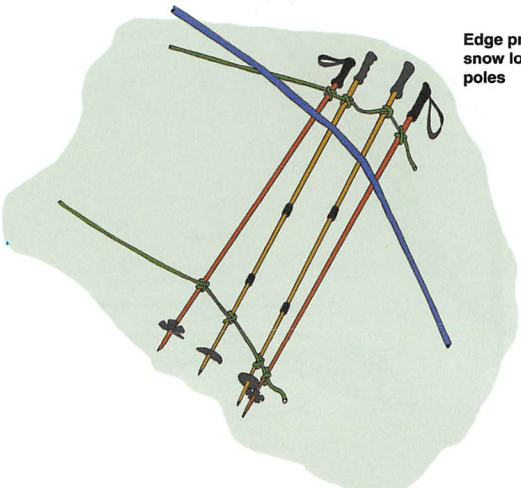


Snow bollard (3m across in soft snow). Be sure to pad sides and back of bollard to keep rope from cutting through.

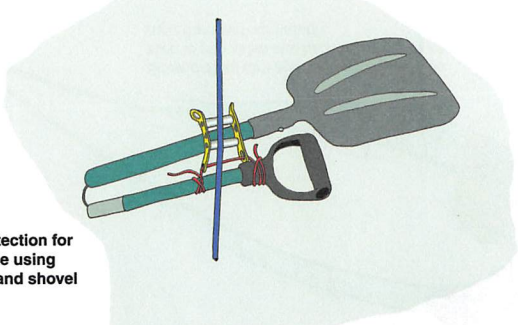


Ice bollard





Edge protection for snow lower using ski poles

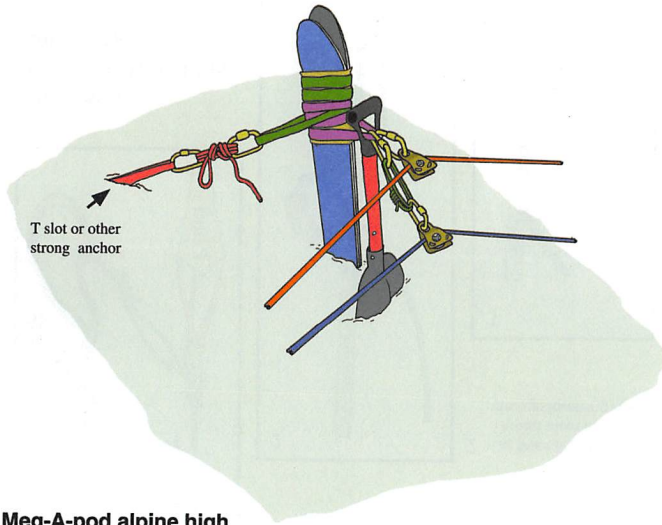


Edge protection for snow raise using Edgebot and shovel

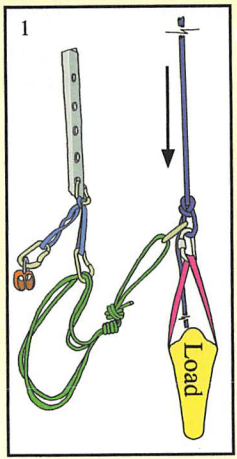
Equipment needs:

Pair of skis
T slot anchor
Shovel
Anchor webbing
Tie back

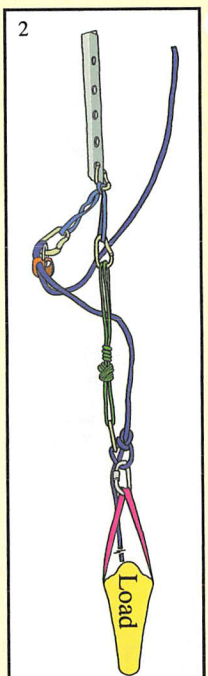
- Use as a high directional on a snow slope edge.
- Use for lower or raise.
- Cant skis slightly back towards the pre tension back tie.
- Pad ski edges with rope guard or ski skins.
- Shovel helps keep webbing from sliding down skis.



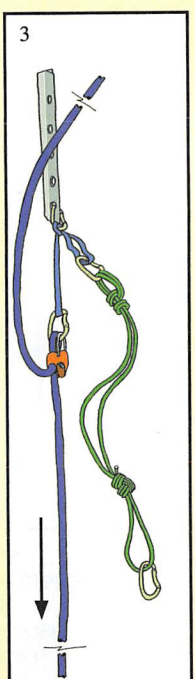
Meg-A-pod alpine high directional



1 Attach contracted Purcell Prusik to package as it passes

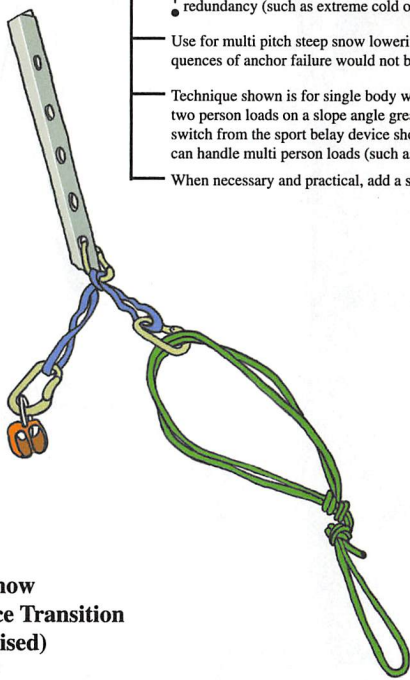


2 Let Main line go slack. Thread main line through lowering device.



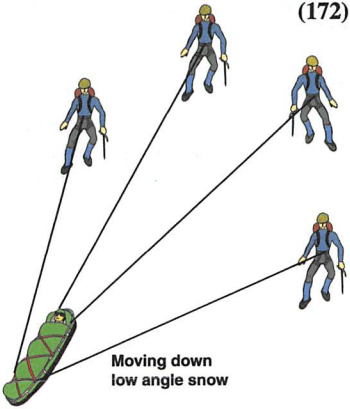
Steep Snow
Mid Face Transition
(improvised)

3 Bump/slide Prusik Hitch until load is hanging from lowering device. Unclip Prusik and continue lowering to next anchor station.

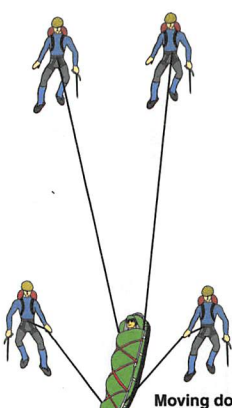


- Caution, this is an improvised emergency technique. Use in environmental conditions when speed is more critical than redundancy (such as extreme cold or extreme altitude)
- Use for multi pitch steep snow lowering where consequences of anchor failure would not be fatal.
- Technique shown is for single body weight only. If lowering two person loads on a slope angle greater than about 30°, switch from the sport belay device shown to a device that can handle multi person loads (such as a SCARAB®)
- When necessary and practical, add a separate belay system

Steep Snow
Mid Face Transition
(improvised)

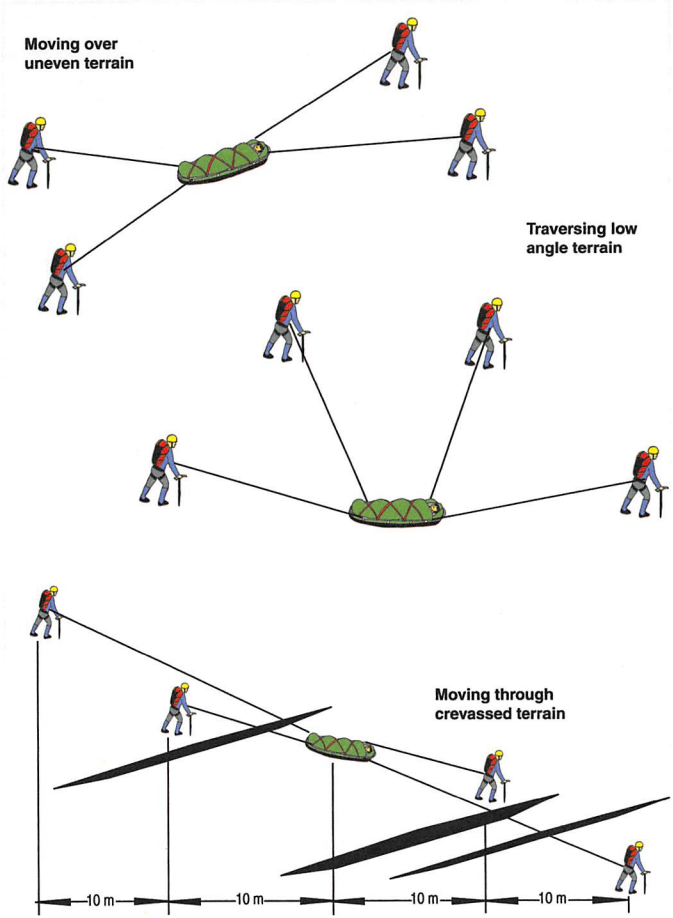


Moving down low angle snow



Moving down low angle terrain in heavy or powdery snow

Patient package for technical overland snow travel (for long term packaging, see pages 115-118)


Moving over
uneven terrain
Traversing low
angle terrain
Moving through
crevassed terrain
10 m
10 m
10 m
10 m

NOTES

eference Section

Air rescue on the Matterhorn, Switzerland

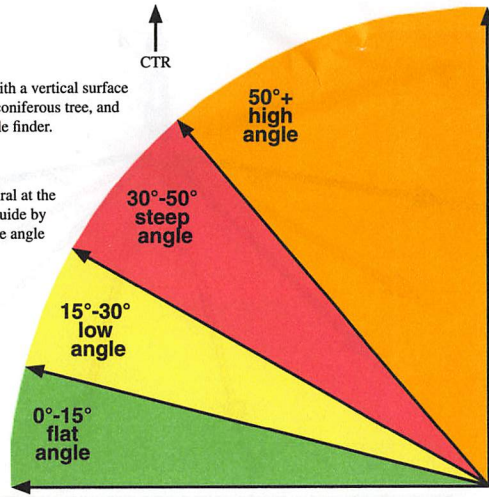
Drop testing Prusiks

Contents:

Slope Angle	Mass (kg)			
	200 kg (2 people)	300 kg (3 people)	400 kg (4 people)	500 kg (5 people)
10°	.34	.51	.68	.85
20°	.67	1.01	1.34	1.68
30°	.98	1.47	1.96	2.45
40°	1.26	1.89	2.52	3.15
50°	1.50	2.25	3.00	3.76
60°	1.70	2.55	3.44	4.25
70°	1.84	2.76	3.69	4.61
80°	1.93	2.90	3.86	4.83
90°	1.96	2.94	3.92	4.90

11 & 12mm rope
12mm rope only
overload (all ropes)

Force (kN)

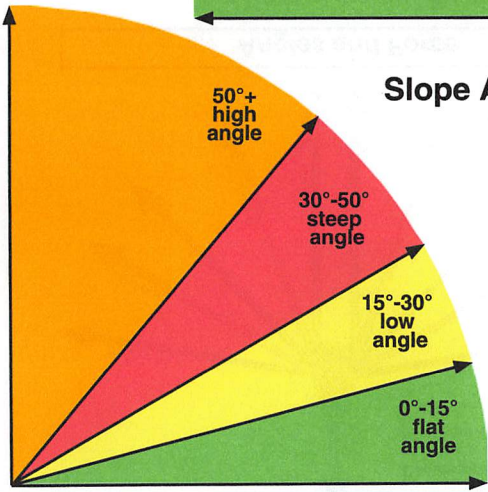


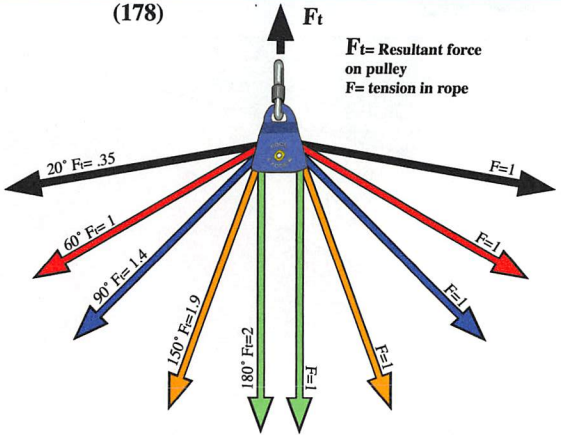
Align edge of guide page with a vertical surface such as a signpost, wall or coniferous tree, and compare slope angle to angle finder.

OR

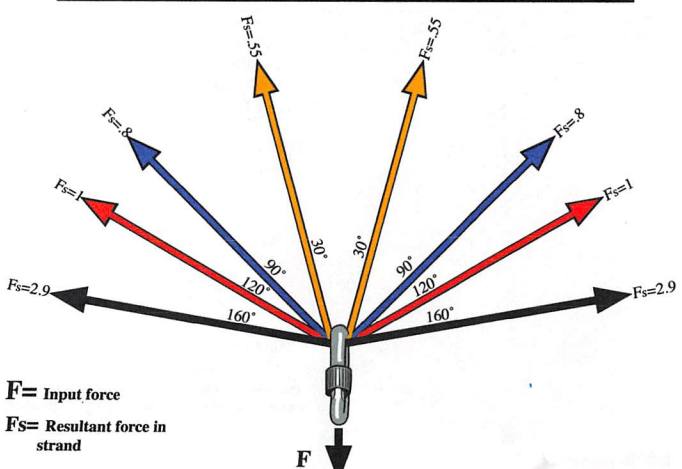
Tie a string to the center spiral at the top of the guide, hold the guide by the string and compare slope angle to angle finder.

Slope Angle Finder

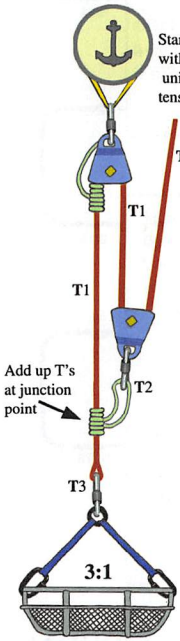




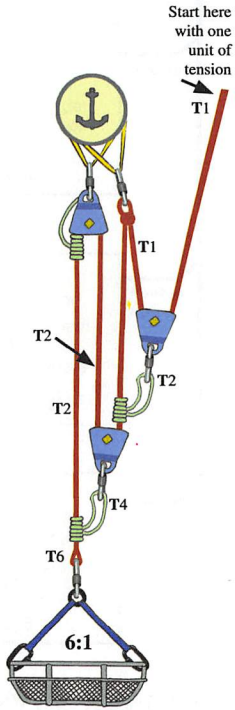
Angles and Force



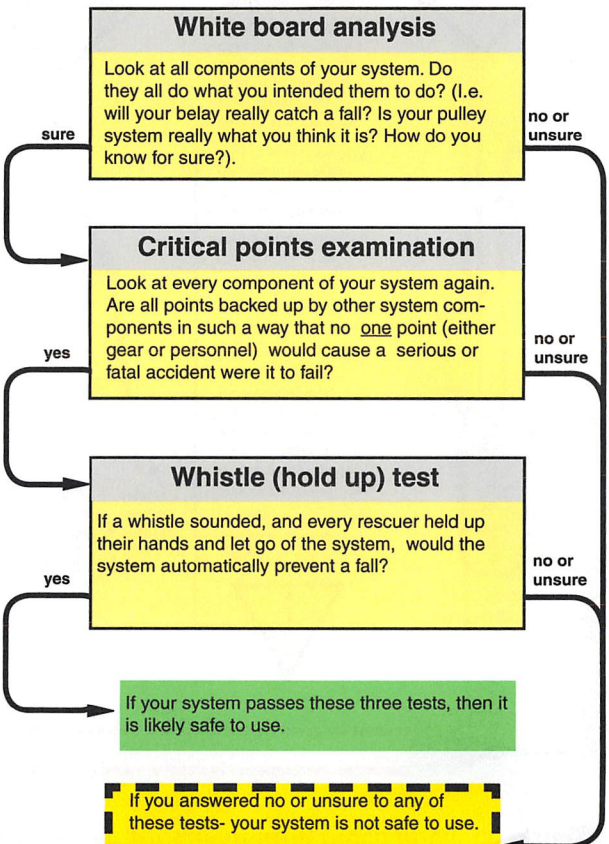
T method for calculating mechanical advantage



- Assign one unit of tension to the end of the rope
- Follow the flow of rope around pulleys until it hits a junction point where multiple units of tension collide (like at a traveling Prusik)
- Add the colliding units of tension at the junction point. The result is a new unit of tension beyond the junction.
- Continue doing this until the load is reached
- The ratio of the final theoretical tension at the load to the beginning tension is the M/A.
- NOTE; The T method is for calculating theoretical mechanical advantage. It does not calculate the actual tension in the rope, which will be less than or equal to the force caused by the load.



THREE FIELD TESTS OF A SAFE RESCUE SYSTEM



Static System Safety Factor (SSSF)

It is recommended that each of the four packages that make up your overall rescue system has a static system safety factor of **10:1**.

Make sure that each component in your system is strong enough to hold ten times the force that you intend to place on it, IN POSITION OF FUNCTION.

Knots, directional changes, rope grabs, descent control devices and varying angles, all act to change the overall strength of your system.

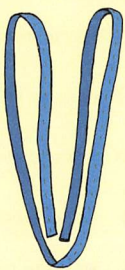
Do not assume that your system has an acceptable safety factor just because the components carry "national certifications". **ALL** components and systems can be overloaded depending on how they are rigged.

A good rule of thumb for calculating the force applied to your system is that each person hanging on the system exerts *one kilo Newton* of force (1kN).

Material	Unknotted strength	Appx. knot reduction	Appx. Knotted strength
6mm NLSK cord	7kN	30%	5kN
8mm NLSK cord	14kN	30%	10kN
9mm NLSK cord	16kN	30%	11kN
11mm NLSK rope	28kN	30%	20kN
12.5mm NLSK rope	40kN	30%	28kN
25mm tubular web	18kN	45%	10kN

Standardized color codes for 25mm tubular Nylon webbing

(Metric and English equivalents are approximate)



Green → 1.5 m (5 ft)

Yellow → 3.5 m (12 ft)

Blue → 4.5 m (15ft)

Red → 6 m (20ft)

Black → 7.5m (25ft)

Standardized lengths for 8mm Nylon Prusiks for use on 11 and 12mm rope

(expressed as untied strands)

Tandem Prusik Belay → Short → 1.4 m (55")

Tandem Prusik Belay → Long → 1.7 m (67")

System (utility) Prusik → 1.4 m (55")

- Use only Nylon kernmantle Prusiks
- DO NOT use Spectra™ cord Prusiks for rescue loads, Under shock load they can catastrophically fail.

Standardized length for 8mm Nylon utility cord

(expressed as untied strands)

Each cord → 10 m (33ft)

Basic equipment Check list for a light / fast technical rescue response team

(does not include personal gear or medical equipment)

Software:	
6	green webbing
6	yellow webbing
2	blue webbing
6	red webbing
2	black webbing
6	short Prusiks
6	long Prusiks
6	10M x 8mm Utility Cords
3	100 m x 11.5 mm low stretch ropes (12.5 mm if having to meet NFPA requirements)
1	60 m x 8 mm tag line
1	100 m pilot cord
2	Nylon tarps

Hardware:	
24-36	locking aluminium carabiners (steel if having to meet NFPA requirements)
12	PMP pulleys
6	rope guards
3	Edgebot rollers
2	SCARAB or similar descenders
1-2	Kootenay carriages
2	Tri-links
1	pocket saw
1	Roof roller (can be omitted for back country teams)
1	Litter ("break apart" style if for back country use)

Recommendations for carrying basic technical rescue equipment listed above (team of 6 rescuers).

6 "System Bags" (small nylon stuff bags).
Each bag contains the following →

1	green web	1	long Prusik
1	yellow web	1	utility cord
1	red web	1	Edgebot roller
4	carabiners	2	PMP pulleys
2	short Prusiks		

1 "Accessory Bag" (large heavy nylon stuff bag).
Bag contains the following →

2	blue web	2	rope guards
2	black web	2	SCARAB racks
6	short Prusiks	1-2	Kootenay carriages
1	60M tag line	1	pocket saw
1	100M pilot cord	2	tarps
2	tri-links	12	Carabiners

Disperse the load as follows:

Rescuer #1	Rescuer #2	Rescuer #3	Rescuer #4	Rescuer #5	Rescuer #6
1 "System Bag"	1 "System Bag"	1 "System Bag"	1 "System Bag"	1 "System Bag"	1 "System Bag"
Accessory bag	1 100 m rope	1 100 m rope	1 100 m rope	1 litter	Medical gear

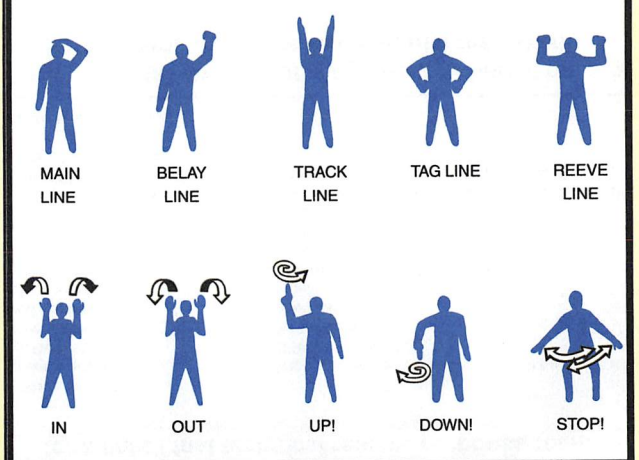
This should balance the load more or less evenly throughout the rescuers, keeping them fast and efficient, while providing enough equipment to pull off nearly any rescue.

Alternative Signalling for Technical Rope Rescue

Whistle

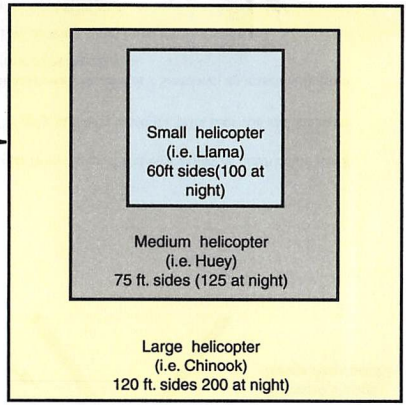
ONE LONG BLAST	stop!
TWO SHORT BLASTS	system up!
THREE SHORT BLASTS	system down!
THREE LONG BLASTS	Help!

Hand

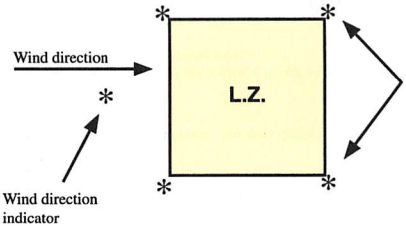


Setting up a helicopter landing zone

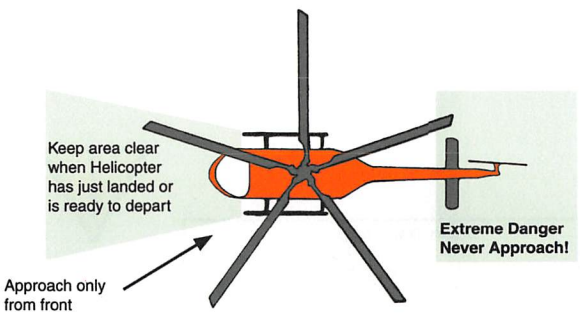
Proper dimensions of an on scene L.Z.



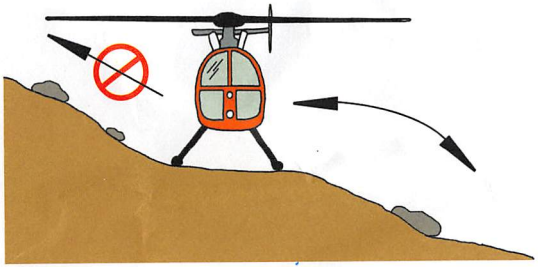
- Landing sight should be clear of people, vehicles and obstructions.
- Area should be clear of wires. They cannot be seen from the air.
- Area should be level and clear of brush, posts, rocks, and loose debris.
- In dusty conditions, wet area down with fire hose, if possible.
- Pick a spot that has a clear path up wind and down wind of the L.Z. (Helicopters take off and land into the wind).



If possible, mark corners of L.Z. with four lights or road flares (flares are an ignition source and could roll away under prop wash; use with caution). Chemical light sticks work very well. A fifth light or smoke canisters should be used as a wind direction indicator. In back country snow conditions, raspberry Jello powder mixed with water makes an excellent dye for marking an L.Z.



- NEVER approach a helicopter from the rear! Extreme injury or death could result.
- Approach from the front/side only, and only when the pilot sees you and indicates that you can approach.
- If working with an H-60 (Blackhawk / Pavehawk / Seahawk) approach only from the SIDE, and only when crew chief directs you.
- Keep head and equipment low, as wind could force rotors downward.
- Remove all sharp objects from outside of packs or bags (i.e. crampons & ice axes) before entering the aircraft.
- Obey all pilot and crew chief instructions.



- On a slope, always approach and depart a helicopter on the down hill side, never on the up hill side.
- If a helicopter is raising or lowering anything by a line, always let the line contact the ground first, before touching it.

HELICOPTER LZ HAND SIGNALS


Wind


Move Back


LZ Unsafe


Go Down


Go Up


Move Forward


Night Op


Move Right


Move Left


Shut Down

- Keep spectators at least 200 ft from the touchdown area.
- Keep EMS personnel at least 100ft away from the touchdown area.
- Everyone working around the L.Z. should have eye protection.
- If helmets are worn, chin straps must be securely fastened.
- At night, make sure that no spotlights or headlights are pointed at the aircraft.
- Before the helicopter has landed, tell helicopter crew if the rescuers or patient that will ride in the ship have been exposed to hazardous or poisonous materials.
- Before the helicopter takes off tell the crew if the patient has chest wall injuries.
- In dusty or snowy conditions have one person (with their back to the wind) guide the helicopter to the ground, using the above hand signals.
- Rescuers working around helicopters should wear Nomex™ outer clothing.
- If possible, have fire extinguishers or other fire suppression at L.Z. site.

NOTES

NOTES

NOTES

Instruction and Gear

There are some fine rescue schools located around N. America that are versed in the techniques shown in this guide. Call or click Conterra for recommendations on a schools or programs that will best meet your needs.

If you are interested in some of the unique gear shown in this guide, such as the SCARAB®, Fix Litter harness, Edgebot, Smart straps or Slider rope guard, contact your local Conterra dealer, or contact Conterra directly.

EMERGENCY NUMBERS	

On the Matterhorn, Switzerland

About the author

Rick Lipke is an internationally known expert on rope rescue. He has been involved in emergency pre-hospital care and technical rescue for over 30 years. He has taught courses in wilderness and urban emergency care throughout North and South America, as well as high angle rescue programs for industry. He is a technical advisor and field team leader for Washington Mountain Rescue, performing dozens of technical rescues a year. He also works as an alpine ski patroller for Mt. Baker Ski Area in the North Cascades. An active climber and mt. biker, he lives with his wife Wendy, and twin sons in Bellingham, WA

Acknowledgments-

First and foremost, thanks to Jim Morrissey, for his suggestion to create this guide. To Kirk Mauthner, Mike Gibbs, and John Dill for technical input. To Kurtis Schultz and Ian Roote for their advice and support. To Skagit Mountain Rescue, for years of on the job experience. To Ray Pruiett for showing the way. *And a special thanks to Arnör Larson for his vision and perseverance in the face of ignorance and prejudice.*

Conterra Inc. is a proud sponsor of the Mountain Rescue Association.

A percentage of the sales of this guide go to support Mountain Rescue.

For more information on a certified M.R.A. unit in your area or to learn how to become a member, please contact:

Mountain Rescue Association
www.mra.org

Mountain Rescue Association, Inc.
"Saving lives through rescue and mountain safety education"

Printed in Canada

CCSAR-3

9 780966 577716