

Basic Haul Systems

Rope Rescue For First Reponders



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Student Guide

**Basic Haul Systems:
Rope Rescue for First Responders**

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Course Learning Outcome:

The students of this course, after successful completion, shall be able to successfully use rope, rope hardware, webbing and anchors to successfully establish a basic haul system.

Note: This is a basic knowledge course covering low angle applications. However, the techniques and tools learned during this course will act as a basis for future advanced and high angle rope rescue courses.

Course Objectives:

The student, upon completion of this course, shall:

- ⇒ Be able to understand and use rope rescue terminology and equipment.
- ⇒ Be able to list many uses of rope and rope hardware.
- ⇒ Be able to recognize and list all safety considerations associated with rope rescue operations.
- ⇒ Recognize and list all components of a haul system.
- ⇒ Be able to describe and calculate mechanical advantage.
- ⇒ Be able to describe proper basic maintenance and care of rope and rope equipment.
- ⇒ Be able to describe and tie basic life safety knots.
- ⇒ Perform a rescue operation utilizing a rope rescue haul system.

So that 100% of the critical items on the performance checklist are achieved, and that a minimum score of 70% is achieved on a written exam.

This course is offered in compliance with the following NFPA Standards:

- ***NFPA 1983 - Standard for life safety ropes and safe working loads***
- ***NFPA 1006 - Standard and recommended practices for Rescue Technicians***

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Haul Systems Defined:

Haul Systems: Simple or compound rope systems, labeled by their mechanical advantage, used to forcibly pull or haul an object over certain distance.

Haul Systems

- ⇒ Consist of a static kern mantle rope, an anchor point, pulleys, carabineers and prussic cords or mechanical cams.
- ⇒ Haul systems must utilize ½ inch static kern mantle rope, meeting NFPA 1983 specifications.

NFPA 1983

The standard for life safety rope and safe working loads

- ⇒ A single person working load is 300 lbs.
- ⇒ Two person working loads by are 600 lbs.
- ⇒ Rescue Rope should always utilize a 15:1 safety ratio (load x 15).
- ⇒ Two person working load: (600 x 15 = 9000 lbs.).

Common Rope Construction

- ⇒ **Laid Rope** - made of multiple strands of naturally occurring materials such as manila and hemp. These fibers are five to 14 ft. in length and twisted together to form a length of rope.
- ⇒ **Braided** - cotton fiber ropes are constructed by braiding the strands into a single length of rope.
- ⇒ **Braid-on-braid** - used in the marine trades, braid-on-braid utilizes a hollow core.
- ⇒ **Kernmantle**— two component design
 - ◇ The *kern*, is a high strength inner core constructed of a continuous synthetic material that runs the entire length of the rope.
 - ◇ The *mantle*, is a braided outer cover or sheath which protects the kern from abrasions and cuts.
 - ◇ *The core of kernmantle rope makes up 75% of the rope's overall strength.*

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Static vs. Dynamic Kernmantle

Kernmantle rope can be made of parallel filaments or filaments spiraled into cords.

- ⇒ **Dynamic** – stretches 20% to 40% its length when under a load.
- ⇒ **Static** - stretches only 2% to 3% its length when under a load.

Types of Rope

- ⇒ **Utility Rope** – Any rope used for applications other than life safety.
- ⇒ **Water Rescue Rope** – made of polypropylene, water rescue ropes cannot be used for rappelling.
- ⇒ **Life Safety Rope** – any rope meeting the NFPA standard 1983 for life safety applications.

Factors That Affect Rope Strength

- ⇒ Any bend, hardware or knot weakens overall rope strength.
- ⇒ Water - nylon and manila both absorb water and therefore lose strength when wet.
- ⇒ Extreme temperatures or chemical exposure will cause ropes to break down and fail.
- ⇒ Abrasives such as rocks, tree bark and concrete will also affect rope strength, especially when under a load.
- ⇒ ANY ROPE THAT HAS RECEIVED A SHOCK SHOULD BE TAKEN OUT OF SERVICE IMMEDIATELY!

Care and Maintenance

- ⇒ Ropes should be inspected for abrasions or eviscerations after every use.
- ⇒ Use mild soap and water for cleaning ropes or approved rope cleaners.
- ⇒ Never wash ropes while lying on the ground or in top loading wash machines.
- ⇒ Machine wash ropes only in approved extractors, making sure to daisy chain ropes prior to washing them.
- ⇒ DO NOT DRY ROPES IN THE SUN - Hang ropes in an area that will allow them to air dry naturally.

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Rope Storage

- ⇒ Rope should be stored in bags away from abrasives and chemicals which could break the rope down.
- ⇒ Rope should be stored away from sunlight.
- ⇒ Ropes should be taken out periodically and inspected for tears or avulsions.
- ⇒ Pre-packed haul systems should be taken out and rebuilt periodically.

Webbing

- ⇒ Webbing is made of nylon and primarily used for anchor points.
- ⇒ There are two type of webbing
 - ◇ *Tubular* – the strongest type of webbing, tubular webbing form a tube and rated at 4,000 lbs end to end. Each time tubular webbing is doubled, it's strength doubles.
 - ◇ *Edge Stitched* – never to be used for life safety.
 - ◇ *Anchor Straps* – Used for anchoring haul systems. Anchor Straps are double edge stitched webbing that is rated at 5,000 lbs end to end and 9,000 lbs when doubled up.

Carabiners

- ⇒ Carabiners - metal components that link the different components of a rescue system together.
- ⇒ There are five basic parts to a carabiner: spine, latch, gate, lock sleeve and hinge pin.
- ⇒ Locking carabiners should be double checked that they are locked prior to putting them under a load.
- ⇒ Carabiners are made of Steel or Aluminum
 - ◇ Aluminum carabiners
 1. Used for sport type applications.
 2. Lighter, less expensive.
 3. Do not rust or wear out like steel.
 - ◇ Steel Carabiners
 1. *Should ALWAYS be used for rescue.*
 2. Stronger, less susceptible to abrasion.
 3. More expensive.
 4. Require more maintenance.

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Carabiners Cont'd

- ⇒ *Aluminum* carabiners have a breaking strength up to 6,000 lbs.
- ⇒ *Steel* carabiners have a breaking strength between 9,000 and 13,000 lbs.

Descent Control Devices

Descent control devices provide control of a ropes movement using variable levels of friction.

⇒ **Figure-8**

1. Designed as descent or rappelling device.
2. Only for rappels of 100ft. or less.

In applications over 100 ft. the rescuer must push the rope through a Figure-8 device.

⇒ **Rescue Figure-8**

1. Has “ears” which prevents the rope from slipping up, creating a girth hitch in the device
2. Can be tied off, preventing slipping of the rope.

⇒ **Rappel Racks** - consists of several steel or aluminum bars mounted on a U-shaped rack.

1. Rope is threaded through the various bars on the rack creating variable degrees of friction.
2. Because the rope is threaded straight through the rack, this eliminates the “turning” found in using Figure-8 devices.

⇒ *NFPA 1983* requires that general use DCDs with stand a 2,400 lbs load without damaging the rope.

⇒ DCDs must withstand 5,000 lbs loads without failure.

Ascending Devices

Ascending devices are used for “one-way” movement of a rope and are also used for climbing ropes.

⇒ Examples of ascending devices

1. Cam ascenders
2. Handled ascenders
3. Prusik ascenders

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- ⇒ **Mechanical Ascenders**
 1. Can be applied to any rope system.
 2. Work by applying pressure perpendicular to the rope.
 3. Mechanical ascenders can “de-sheath” ropes with as little as 1,000lbs of pressure.
- ⇒ **Prusik cords**
 1. Can be used as “soft rope grabs.”
 2. Handle up to 3,000 lbs.
 3. Can be used under shocked loads without fear of “de-sheathing” the rope.

Pulleys

- ⇒ In rope rescue, pulleys are used to:
 1. Change direction of force on a running rope.
 2. Reduce friction.
 3. Create mechanical advantage for haul systems.
- ⇒ **Pulley Sheaves** are the part of the pulley that the rope runs on and should be large enough for minimum rope strength loss as it bends around the pulley
- ⇒ **Pulley Side Plates** should be moveable so that the pulley can be placed anywhere in the system.
- ⇒ **Pulley Axles** should be attached with rounded bolts to prevent damage to other equipment
- ⇒ **Pulley Bearings** should be sealed ball-bearing type so as to move freely and not get contaminated with dirt.
- ⇒ **NFPA 1983** requires that general-use pulleys withstand a static test loading of 5,000 lbs. with out distortion and 8,000 lbs with out failure.

Special Pulleys

There are some pulleys specially designed to solve technical rope rescue problems.

- ⇒ **Prusik-minding pulleys** work with prusiks to make a self-tending brake system safety lines and ratchets for mechanical advantage pulley systems
- ⇒ **Knot-passing pulleys** allow knots to pass through the pulley. (This is important when two lines are tied together)
- ⇒ **Double or Triple Sheave Pulleys** have multiple pulleys within a single unit.

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Edge Protectors

Up to 90% of all rope failure is due to improper edge protection!

Edge Protectors

1. Are used to reduce abrasion on ropes.
2. Static protectors may be canvas tarps, turnout coats, commercial rope covers or even carpet squares.
3. Dynamic protectors are used where the rope is moving across the surface and can be roof rollers or edge rollers.
4. Dynamic protectors can also help reduce friction applied to the rope.

Harnesses

NFPA 1983 provides classification and construction specifications for harnesses used in rescue.

All NFPA harnesses must have permanent labeling with harness class, date of manufacture and sizing information.

⇒ **NFPA Class I Harnesses**

1. Seat style harnesses
2. For emergency escape or one person loads.
3. **NOT FOR RESCUE!**

⇒ **NFPA Class II Harnesses**

1. Seat style harnesses for rescue.
2. Can handle two person loads.

⇒ **NFPA Class III Harnesses**

1. Full body harnesses.
2. Used for rescues in which inversion may occur.
3. One or two person loads
4. Requires no prior knowledge on the part of the patient once in the harness.

⇒ **NFPA Ladder/Escape Belts**

1. Waist belts.
2. May be used as positioning devices or
3. For emergency self rescue devices only.

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Rescue Knots

Knot Terms:

- ⇒ *Running end*
The part of the rope used for work such as hauling, pulling or belaying.
- ⇒ *Working end*
The part of the rope used to tie a knot.
- ⇒ *Standing part*
The part of the rope between the running end and the working end.
- ⇒ *Bight*
Formed by making a U-shaped curve in the rope with out crossing the ends.
- ⇒ *Round Turn*
Made when the ends of a bight's "U" are crossed.
- ⇒ *Bend*
A knot used to tie two ropes of equal or greater diameter together.
- ⇒ *Hitch*
A knot used to fasten a rope to an object
- ⇒ *Anchor*
An immovable object.
- ⇒ *Safety*
A knot used to prevent the running end from untying the knot, such as an overhand knot or fisherman's knot.
- ⇒ *Whip*
A wrap done at the end of a rope to keep the end from unraveling.

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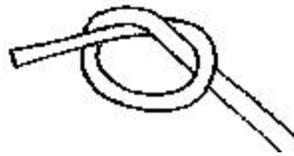
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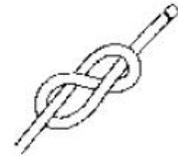
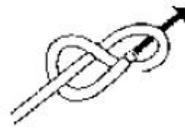
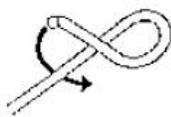
Tying Rescue Knots

Each of the following knots are use for rope rescue and each knot must be successfully completed for this course.

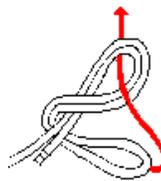
⇒ *Overhand Knot* - used as a safety knot to prevent rescue knots from coming untied



⇒ *Figure 8 Knot* - also called the “stopper knot” this knot is the basis for many of the life safety knots used in rope rescue



⇒ *Figure 8 On-a-bight* - this knot forms a loop and can be used to attach to an anchor point.



⇒ *Figure 8 Bend* - this knot is used for joining two ropes..



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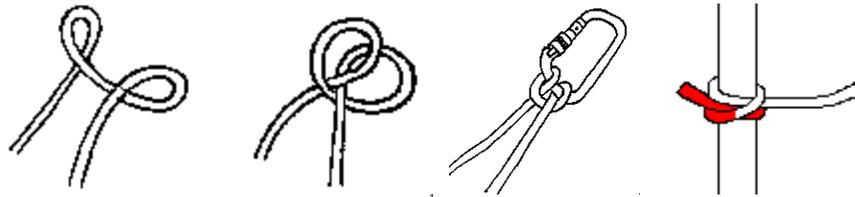
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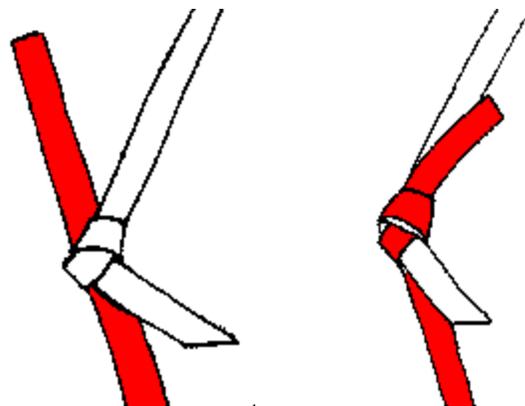
⇒ *Figure 8 Follow-through* - also called the *Figure 8 re-weave* this knot is used for tying the figure eight around an object.



⇒ *Clove Hitch* - this hitch can be tied and dropped over an object.



⇒ *Water Knot* - a re-woven overhand knot, this is the only knot use for tying webbing.



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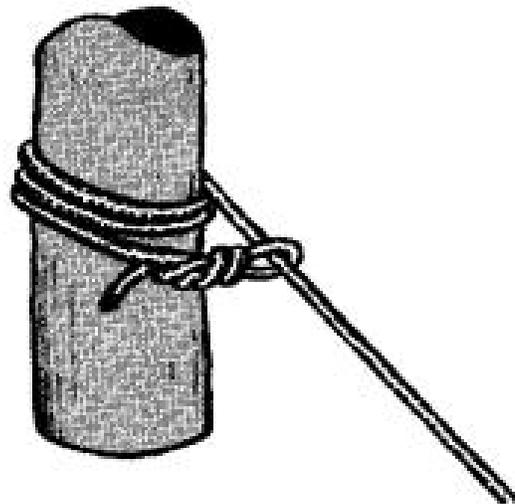
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⇒ *Munter Hitch* - a belay knot that turns over on itself allowing the rope to travel in either an up or down direction.



⇒ *Tensionless Wrap* - A wrap used for tying to anchor points that cinches tighter to the anchor as a load is applied.

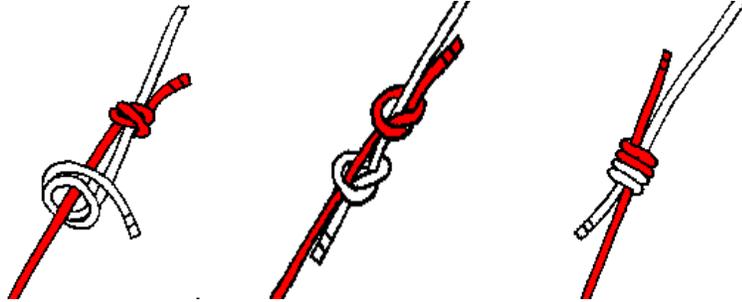


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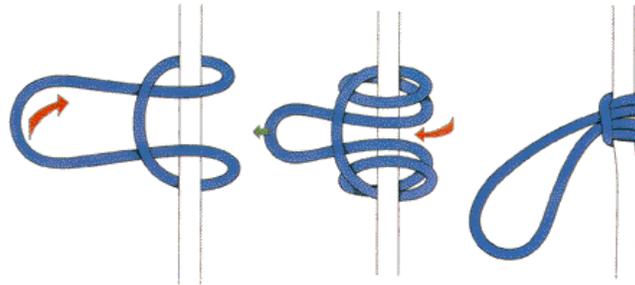
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Prusik Knots

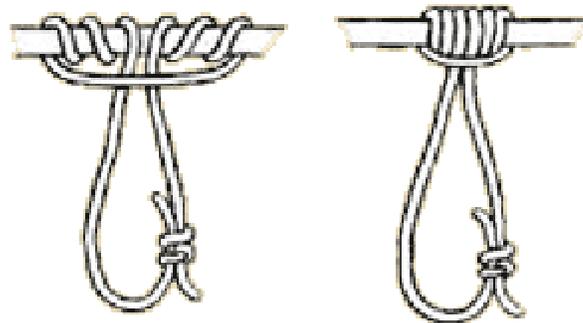
⇒ *Double Fisherman's Knot* - this knot is used for tying the ends of a rope together, including prusik cords.



⇒ **Double Wrap Prusik**



⇒ **Triple Wrap Prusik**



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Student Activity #1 : Knot Tying

Given lengths of rope, students will break up in to groups of four. Each group member shall tie each of the knots listed on pages 10 - 14.

Students are encouraged to work with their peers who are having difficulties in tying the prescribed knots.

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Anchor Points

Types of Anchor Points

- ⇒ *Type I* - Natural anchor points
 1. trees
 2. boulders
 3. root systems
 4. rock outcroppings
- ⇒ *Type II* - Manmade anchors such as vehicles (tow eyes, frame members), guard rails, utility poles, fire escapes or fixed ladders and structural members of buildings.

Anchor Considerations

- ⇒ How much is the anticipated load?
- ⇒ Is the anchor suitable given the direction of the load?
- ⇒ Does the anchor have sharp edges?
- ⇒ Is the anchor rusted, rotten or broken? - NEVER ASSUME!
- ⇒ How will you attach to the anchor?
- ⇒ Does the anchor have sufficient mass?

Attaching to an Anchor

When establishing anchor points, there are several key points that must be observed

- ⇒ Anchors can be attached to using 1" tubular webbing joined at the ends by a water knot.
- ⇒ Be sure to double up the webbing to maintain proper break strength.
- ⇒ A Figure 8 follow through can also be used to form a fixed loop around the anchor.
- ⇒ The angle the rope or webbing approaches the anchor must not exceed 120 degrees as this increases the load on the anchor significantly.
- ⇒ While a 0 degree angle is best, 90 degrees is considered optimal for field use.

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- ⇒ A tensionless wrap can be used to attach to an anchor as well, by wrapping the mainline around the anchor at least five times and tying the rope back into itself using a carabiner or a figure eight follow through.
- ⇒ Use a 15:1 safety ratio in case of a system shock.
- ⇒ Anchors should only be used if they are “Bomb Proof” – an anchor should be able to withstand a close proximity blast without faltering
- ⇒ Anchor points should always weigh the same or more than the anticipated shock load
- ⇒ Trees should only be used if they have a diameter greater than four inches
- ⇒ Vehicles:
 - *Vehicles should only be used as a last resort!*
 - When anchoring to vehicles, keep anchor straps and rope away from hot surfaces such as exhaust pipes and sharp edges
 - When anchoring to a vehicle:
 - 1) Chock all wheels.
 - 2) Shut off the engine. (to prevent inadvertent movement)
 - 3) Remove the keys, shut off batteries.
 - 4) Post a “guard” at the vehicle to ensure it will not be moved.

All anchors, regardless of type or location should be edge protected.

Secondary Anchors

If an anchor appears it could be inadequate, the anchor can be “backed up” with a secondary anchor.

- ⇒ Run the mainline from the primary anchor to the secondary anchor and tie it off.
- ⇒ Secondary anchors should be as close to in-line with primary anchors as possible
- ⇒ Two anchors parallel to one another may be used together as a primary anchor, these two anchors will split the overall load.

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Terrain

When raising, lowering or hauling victims, the type of rescue being performed is defined by the angle of the terrain.

⇒ **Flat Terrain**

1. Terrain with an angle of 0 to 15 degrees.
2. Rescuers may carry litter by hand with no assistance.
3. No external rope systems required to move patient.
4. No need for rescuers to be tied in to maintain footing.
5. No technical equipment or training required.

⇒ **Low Angle**

1. Terrain with an angle of 15 to 40 degrees.
2. Rescuers may carry litter with difficulty due to incline or environmental conditions (i.e. weather, footing, etc.).
3. Tag line or anchored haul system required stabilize or move litter.
4. Rescuers are not required to tie in to litter
5. Risk of further injury to rescuer or patient due to falls.

⇒ **Steep Angle**

1. Terrain with an angle of 40 to 65 degrees.
2. Anchored haul system required to move patient.
3. Rescuers unable to carry litter unassisted.
4. Any failure of a haul system would have catastrophic results to rescuers or patients.
5. Rescue load is shared by rescuers and patients.
6. Rescuers required to tie into litter.

⇒ **High Angle or Vertical**

1. Terrain with an angle of 65 to 90 degrees.
2. An attendant is required to tie into litter.
3. Rope system for raising and lowering litter and attendants is required.
4. Attendant is suspended on a line separate from the litter bridle.
5. Failure of rope system would likely result in serious injury or death

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Mechanical Advantage

- ⇒ Haul systems are labeled by their mechanical advantage.
- ⇒ Mechanical advantage is defined in ratios; i.e. 3:1, 4:1 etc.
- ⇒ Each turn built into a haul system, using pulleys, will give you one unit of mechanical advantage.
- ⇒ In a 3:1 haul system; for every one unit of input force you put into it, you gain three units of output force.
- ⇒ Conversely, for every three feet of rope you pull, the load will only move one foot.
- ⇒ Simple haul systems should never exceed a 5:1 mechanical advantage

** Compound systems should be utilized for applications requiring more than a 5:1 mechanical advantage – Compound Systems will not be covered in this course*

Haul System Uses

Haul Systems have many uses from low angle and high angle terrain applications to vehicle rescue and water rescue applications

- ⇒ Auto rescue
- ⇒ Heavy Machinery
- ⇒ Trench and Confined Space
- ⇒ Water Rescue
- ⇒ Structural Collapse
- ⇒ Train Rescue

Components of a Haul System

The following is a list of the most basic Haul System components.

- ⇒ Carabiners
- ⇒ Pulleys
- ⇒ Prusiks or Cams
- ⇒ Anchor Point
- ⇒ Rescue Rope
- ⇒ Load

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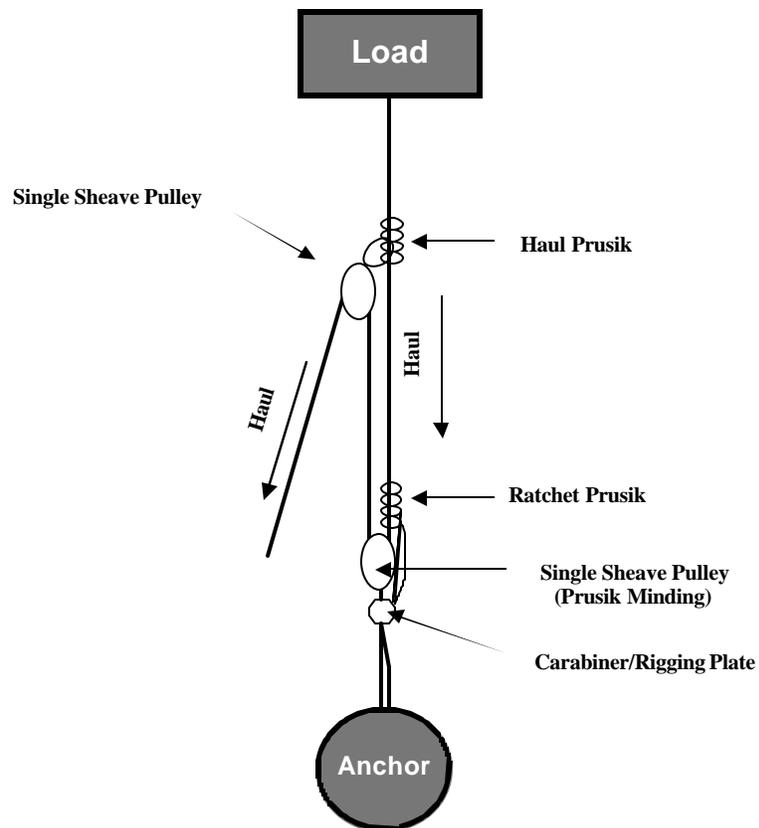
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Constructing a "Z-Rig" 3:1 Mechanical Advantage

- ⇒ The 3:1 "Z-rig" is the most common mechanical advantage haul system used.
- ⇒ To construct a "Z-Rig" perform the following steps:
1. Lay out your rope in the shape of a "Z"
 2. Place a pulley in the two bends of the "Z"
 3. Establish an anchor using an anchor strap or 1" tubular webbing.
 4. Using a carabiner, attach the anchor to the pulley directly in line with the "load"
 5. Tie a triple wrap prusik around the mainline below the pulley attached to the anchor.
 6. Hook the prusik's loop into the carabiner that is attaching the anchor to the pulley.
 7. Tie a second triple wrap prusik to the mainline near the load.
 8. Attach the second prusik to the second pulley using a carabiner



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Student Activity #2 : Constructing a 3:1 "Z" rig

Given the necessary equipment, students will break up into their groups of four. Each group shall construct a 3:1 "Z" rig and become familiar with the workings of the system as well as the systems advantages.

Students are encouraged to work with their peers to build team confidence for practical examination.

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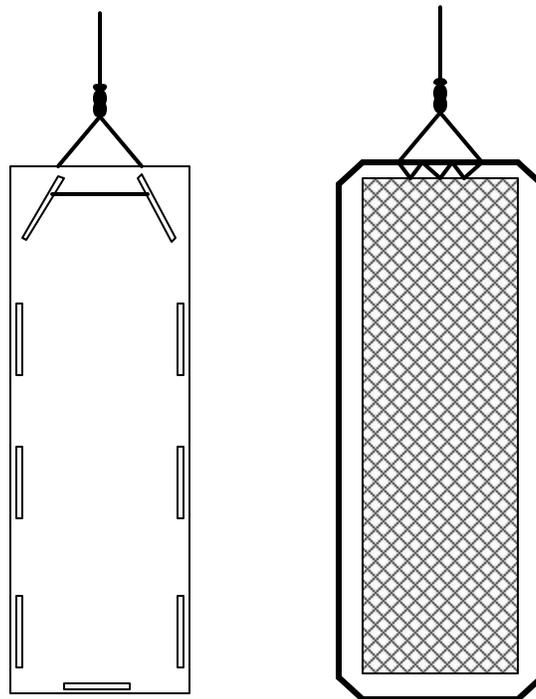
Notes

Hauling a Victim

Once the haul system has been established, the patient must be moved in a manner in which spinal precautions can be taken. In order facilitate successful movement of a patient without causing further harm, a litter basket, backboard or SKED should be employed.

Direct Tie-in method (Litters & Backboards)

1. Tie a Figure 8 and leave approx. four feet of running end from the knot.
2. String the running end through the angled hand-grip at the patient's head.
3. Run the running end under the backboard and through the opposite hand grip.
4. Reweave the running end through the Figure 8 and tie a safety completing a Figure 8 Follow Through knot.
5. Be sure to protect the rope under backboards with some type of edge protection. (Old fire hose a can be cut to two foot lengths and serve as excellent edge protection.)

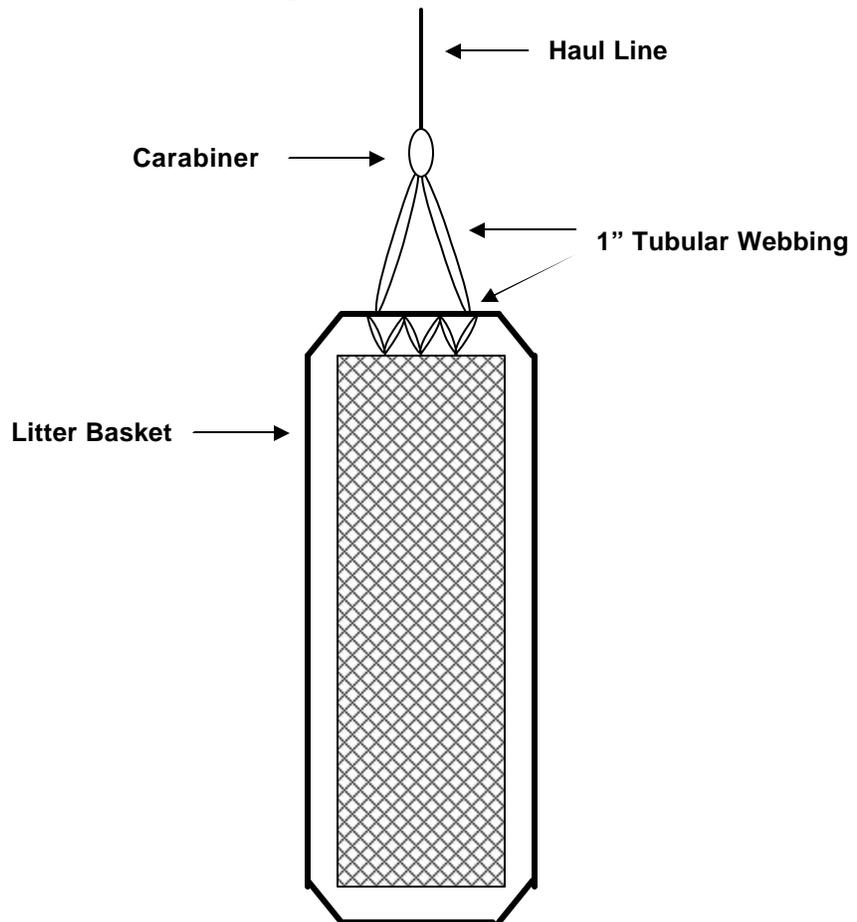


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Bridle Method

1. Tie a piece of 1" tubular webbing 10 to 12 feet in length into a fixed loop.
2. Form the webbing into a bight and weave the webbing in a spiral fashion across the top of the litter basket (form a girth hitch through the top of the hand holds for plastic litters)
3. Clip the two ends of the webbing together using a locking carabiner.
4. Tie a Figure 8 On-a-bite in the end of the haul line.
5. Clip the bight into the carabiner as well.



The bridle method provides ease of disconnecting the haul system from the litter and provides an even pull, which eliminates "binding" with the Direct Tie-in method.

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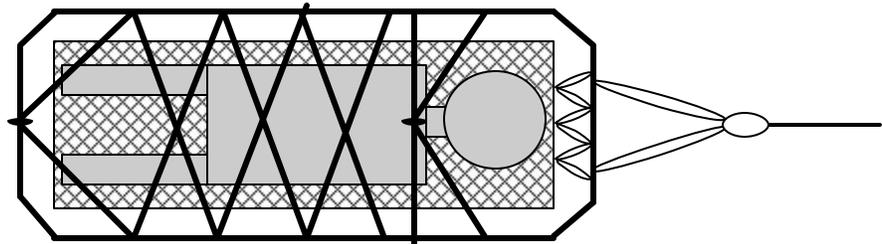
Notes

Securing the Patient

Once the haul system has been built, properly anchored and the haul line attached to the litter, the patient should then be packaged for the haul.

Litter Basket

1. Secure the patient on a backboard using C-spine precautions.
2. Wrap a piece of 1" webbing around both patient's feet, forming stirrups, and lash the running ends to each side of the litter basket to immobilize the patient's feet, leaving no slack in the webbing.
3. Apply an "exterior lashing" by making a girth hitch in the center of the top rail or bar at the foot of the litter using a 25 to 30 foot piece of 1" webbing or rope.
4. Weave each of the running ends of the webbing or rope around the top rail of the litter in an X pattern up to the top of the patient's chest
5. Lash the webbing to the top rail even with the patient's shoulders.
6. Make a girth hitch with a separate piece of webbing in the center of the webbing crossing the patient's chest.
7. Using a half hitch, weave the running end around the top rail and lash the webbing to the rail on each side of the patient's head.



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Student Activity #3 : Securing a patient

Given the necessary equipment, students will break up into their groups of four. Each group shall choose one member to be a victim.

Students will perform the necessary tasks to properly secure a patient in a litter basket. Students will also perform the Direct Tie-in and Bridle Methods for attaching a litter to a haul system.

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Haul System Safety Considerations

All personnel operating with or around Rope Rescue Equipment should always follow these safety rules.

- ⇒ Establish a plan prior to building or loading a haul system
- ⇒ Be completely familiar with all of the equipment involved
- ⇒ Operating commands and principles
- ⇒ Mechanical Advantage
- ⇒ Limitations and shock loads
- ⇒ Ensure enough manpower is on scene prior to attempting a rescue with a haul system
- ⇒ Never use mechanical devices such as winches or vehicles to haul patients or rescuers.

Rope Safety Considerations

- ⇒ Follow specific manufacturers guidelines for all aspects of Rope Rescue Equipment:
 - ◇ Maintenance
 - ◇ Storage
 - ◇ Service life
- ⇒ Keep all equipment clean and away from abrasives, sharp edges, corrosive chemicals and open flames or cigarettes
- ⇒ Always have an adequate length of rope and hardware available for the task before initiating rope operations.
- ⇒ Rope hardware should be taken out of service immediately if dropped from a height of approx. waist level.
- ⇒ Remove all knives, keys and dangling jewelry
- ⇒ Pads made of a thick rubber, canvas, hose, roller assemblies or a turnout coat should always be employed to protect ropes
- ⇒ ALWAYS WEAR GLOVES, HELMETS AND EYE PROTECTION!
- ⇒ Use one rescuer designated as the “edge man” to watch the ascent/descent and give commands to the haul team
- ⇒ Watch for signs of falling rocks, landslides, fraying ropes or other obstructions
- ⇒ The haul team should only follow commands from the “edge man”
- ⇒ Never let go of the mainline until the system is set and the “set” command is given by the “edge man”

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Verbal Commands While Hauling

- ⇒ The following is a list of commands that should be used when hauling a victim.
- ⇒ These commands should only be given by the “edge man or edge officer” to the haul team.
- ⇒ The only person the haul team should obey commands from is the “edge man.”

Verbal Commands

- ⇒ **On Belay** - Litter is attached to the system and ready for ascent.
- ⇒ **Belay on** - Response given by a belay person or signifying he is ready to catch the load.
- ⇒ **Prepare to Haul** - Haul team should have haul line in hand awaiting the command to haul.
- ⇒ **Haul** - The haul team should begin to pull the haul line through the system.
- ⇒ **Set** - Haul team stops hauling, and the safety is set to prevent the load from slipping.
- ⇒ **Safety is set** - The haul team may let go of the haul line without the load slipping and prepare to haul again.
- ⇒ **Slack** - The safety has been set and the haul system may be reset to it's fullest possible length in preparation for another haul.
- ⇒ **STOP** - The only command any member may use - All activities cease immediately and any problems are identified.
- ⇒ **Off belay** - The litter has reached the desired location and has been removed from the system.
- ⇒ **Belay off** - The belay person is no longer tending the line.

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References

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Irish Climbing News Page, "Knot Dictionary,"
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Appendix A:
Student Written Test

Basic Haul Systems
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Student Test

Name: _____ **Date:** _____
Score: _____

Follow the instructions for each section.
A minimum of 70% is required to successfully pass this exam

True/False: Read the following statements, and circle true or false to the left of the question. (5 points)

- 1) True or False: According to NFPA 1983, a single person working load is 300 lbs.
- 2) True or False: Static Kernmantle rope is known for its elasticity, stretching 20% to 40% its length when under a load.
- 3) True or False: Up to 90% of all rope failures are due to inadequate edge protection.
- 4) True or False: Terrain is considered low angle when it has an incline of 0 to 15 degrees.
- 5) True or False: A 10:1 safety ratio should be employed when establishing anchor points in case of shock.

Multiple Choice: Read the following statements and circle the answer that correctly completes the statement. (5 points)

- 6) According to NFPA 1983, a two person working load is _____.
a. 300 lbs. b. 1,200 lbs. c. 600 lbs. d. 11,000 lbs
- 7) The type of rope construction in which cotton fiber ropes are constructed by braiding the strands into a single length of rope is called _____.
a. braid b. braid on braid c. kern mantle d. laid
- 8) Descent control devices provide control of a ropes movement using variable levels of _____.
a. speed b. pressure c. heat d. friction

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9) The Munter Hitch is a useful knot because it _____.

- a. acts as a safety
- b. takes the place of mechanical cams
- c. turns over on itself allowing rope travel in two directions
- d. joins two rope of unequal length

10) The knot which can be tied and dropped over an object is the _____.

- a. clove hitch b. girth hitch c. tensionless wrap d. overhand knot

Fill in the blank: Read the following statements and fill in the correct answer.
(5 points)

11) The NFPA standard for rescue ropes is _____.

12) Rescue ropes should on be cleaned with mild soap and water or cleaners approved by the _____.

13) Using the _____ method, the rope is woven through the litter without a bridle of webbing.

14) Rope rescue hardware should be taken out of service immediately if it is dropped from _____ level.

15) _____ is the verbal command that signals the litter is attached to the system and ready to be hauled.

Matching: Correctly match the following terms with their definitions in the space provided. (5 points)

- | | |
|--|------------------|
| ___ 16) A small piece of cord used as a rope grab or ascender. | A. Cam |
| ___ 17) A device used to connect rope to hardware. | B. Pulley |
| ___ 18) A mechanical device used as a rope grab or ascender. | C. Utility Strap |
| ___ 19) A device used for change in direction. | D. Prusik |
| ___ 20) A piece of webbing used to attach to anchor points. | E. Carabiner |
| | F. Swivel |

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Essay: Explain in your own words how mechanical advantage systems are labeled and what those labels mean. (5 points)

Appendix B:
Skills Checklist

Basic Haul Systems
Rope Rescue for First Responders
Student Skills Checklist

Name: _____ **Date:** _____

Please write PASS or FAIL in the box provided. All items are considered critical, therefore students are required to achieve 100% PASS rate on the items listed.

	PASS/FAIL
Given a locking carabiner, the student will name each of it's parts, the material of which it is constructed and describe how to properly load a carabiner	
Given a length of rope successfully tie a Figure 8 On-a-Bite with a safety.	
Given a length of rope and a carabiner; successfully tie a Munter Hitch.	
Given a length of rope; successfully tie a Figure 8 Follow Through around an object.	
Given a length of rope; successfully tie a clove hitch around an object.	
Given a length of prusik cord; successfully tie a Double Fisherman's knot creating a Prusik ascender.	
Given a length of prusik and a length of rope; successfully triple wrap a prusik around the rope to facilitate a soft rope grab.	
Given a length of rope and a carabiner; successfully tie a tensionless wrap.	
Given a length of 1" tubular webbing; successfully tie a water knot.	
Given all the necessary equipment; construct a 3:1 "Z" rig and successfully complete a mock low angle rescue scenario with a haul of no less than 100 feet.	

Instructors Signature: _____ **Date:** _____

Appendix C:
Course and Instructor Evaluations

Class Evaluation

Class attended: **Basic Haul Systems: Rope Rescue for First Responders**

Location: _____

Instructor: _____ Date: _____

Please circle the appropriate number provided in the boxes below. If there are any additional comments you would like to make, please use the space provided below.

Class	<i>Not Applicable</i>	<i>Strongly Agree</i>	<i>Agree</i>	<i>Unsure</i>	<i>Dis-agree</i>	<i>Strongly Disagree</i>
Activities were helpful	0	5	4	3	2	1
Class content was informational	0	5	4	3	2	1
Practical exercise was educational	0	5	4	3	2	1
Practical exercise was realistic	0	5	4	3	2	1
Handout was useful	0	5	4	3	2	1
Visual aids were useful	0	5	4	3	2	1
Class size was appropriate	0	5	4	3	2	1
Classroom was appropriate	0	5	4	3	2	1
Practical evolution sight was appropriate	0	5	4	3	2	1
Instructor	<i>Not Applicable</i>	<i>Strongly Agree</i>	<i>Agree</i>	<i>Unsure</i>	<i>Dis-agree</i>	<i>Strongly Disagree</i>
Was knowledgeable	0	5	4	3	2	1
Encouraged class participation	0	5	4	3	2	1
Answered questions completely	0	5	4	3	2	1
Made class objectives clear and understandable	0	5	4	3	2	1
Stayed on track with subject material	0	5	4	3	2	1

Comments: