

*Vocational Education & Extension Board  
Of the County of Suffolk*

# *Suffolk County Fire Academy*



## **Rope Rescue Operations**



***Vocational Education and Extension Board  
of the County of Suffolk***

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**Suffolk County VEEB is in compliance with Title IX  
of the Education Amendment of 1972**



## FOREWARD

The Firefighter who enrolls in this course should have *at least a minimum of three years* in the fire service. Be willing to put the necessary time in at home, reviewing the knots and mechanical advantage systems that are being taught. The assumption will be made that the student enrolled in taking this course meets these requirements.

The goal of this supplemental manual is to help the student understand how to tie the needed knots and build the required mechanical advantage systems.

At the conclusion of this course the student must pass a practical skills station.

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- 1) Intermediate Rope Schedule
- 2) Relative Strength of Knots
- 3) Knots with pictures of:
  - Bowline knot & Clove Hitch
  - Square Knot & Figure 8 Stopper Knot
  - Figure 8 Follow Through
  - On a Bight
  - Bend
  - Double Loop
  - Butterfly Knot
  - Water Knot & Munter Hitch
  - Double Fisherman Knot
  - Prusik Knot
  - Mariner Knot
- 4) Anchoring:
  - Tensionless Hitch
  - Multi – Anchor Point
- 5) Rappel Rack & Figure 8
- 6) Patient Packaging
  - Diamond Lashing
  - Bridle for Vertical Lowering
- 7) Course Evaluation Form
- 8) Student Evaluation Form
- 9) Stamp Sheet

## Intermediate Rope Rescue Schedule

### Night 1:

- Unit 1 Program Orientation
- 1.1 Introduction and Orientation
- 1.2 Course Overview and Objectives
- 1.3 Safety Orientation
- 1.4 Risk Assessment 1 hr.
  
- 2.1 NFPA 1983 Overview and Personal Protective Equipment
- 2.2 Software (Rope, Cordage, and webbing) 1.5 hr

### Night 2:

- Unit 2.3 Hardware
- 2.4 Rescue Knots 2.5 hr

### Night 3:

- Unit 4.1 Intro. To Rope Rescue Systems
- 4.2 Anchoring
- 4.3 Belaying
- 4.4 Incident Management
- 4.6 High Angle Theory – Lowering 2.5 hr

### Night 4:

- Unit 4.5 Patient Packaging
- 4.7 Mechanical Advantage 2.5 hr

### Night 5: FIELD

- Unit 3.1 Rappelling, Overview
- 3.2 Rappelling Practical
- 3.3 Rappelling Breakdown / Inventory 2.5 hr

**Day 6: FIELD**

Unit 5.1	Anchoring, Belaying, Mechanical Advantage And Practical Applications	
5.2	Breakdown and Inventory	8 hr

**Day 7: FIELD**

Unit 6.1	High Angle System Practical Application	
6.2	Breakdown and Inventory	8 hr

**Night 8:**

Unit 8.1	Written Test	
8.2	Practical Application	
8.3	Breakdown and Inventory	
<u>8.4</u>	Course Evaluation and Graduation	<u>2.5 hr</u>

**Total 32 hours**



## Relative Strength Of Knots For Single Kernmantle Rope

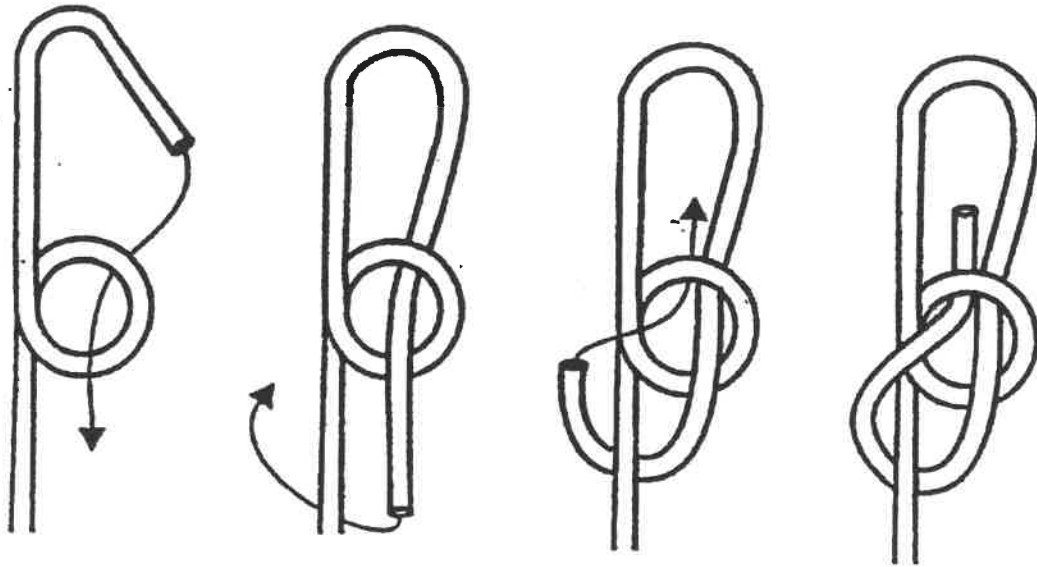
	Strength in lbs.	Percent Lost
No Knot		100%
Clove Hitch		60% to 65%
Bowline		70% to 75%
Control Rope	10,705	-----
Control Web	4,800	-----
<b>Bends</b>		
Double Fisherman's Knot	8,440	21%
Figure 8 Bend (Flemish Bend)	8,640	19%
<b>Loops</b>		
Figure 8 Loop (with a bight)	8,560	20%
Figure 8 Loop (follow through)	8,640	19%
Double Figure 8 Loop	8,820	18%
Figure 9 Loop	9,760	9%
Inline Figure 8 Loop	8,000	25%
Butterfly Knot	8,000	25%
Bowline	7,180	33%
Overhand Loop (with a bight)	9,060	15%
Overhand Double Loop	7,900	26%
<b>Rope With A Loop In It (*)</b>		
Figure 8 Loop	6,960	35%
Inline Figure 8 Loop	6,280	41%
Butterfly Loop	7,360	31%
<b>Knots In Web</b>		
Water Knot	3,060	36%
Overhand Loop	3,120	35%
Figure 8 Loop (with a bight)	3,360	30%
Figure 8 Loop (follow through)	3,560	26%
<b>Web Slings</b>		
Water Knot-Single Loop	5,700	
Water Knot-Double Loop	12,920	
Water Knot-Triple Loop	22,860	

(\*) *Rope pulled end to end*

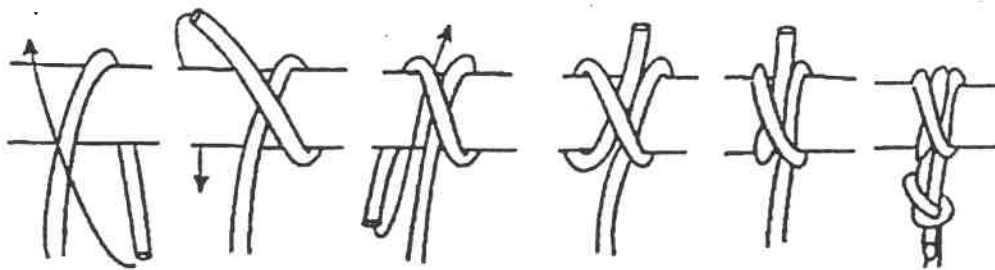
### Dressing a knot

Neatness counts when tying a knot. Making the rope run smoothly without any extra bends or twists is called "dressing" the knot. When you dress the knot, it is stronger and easier to check.

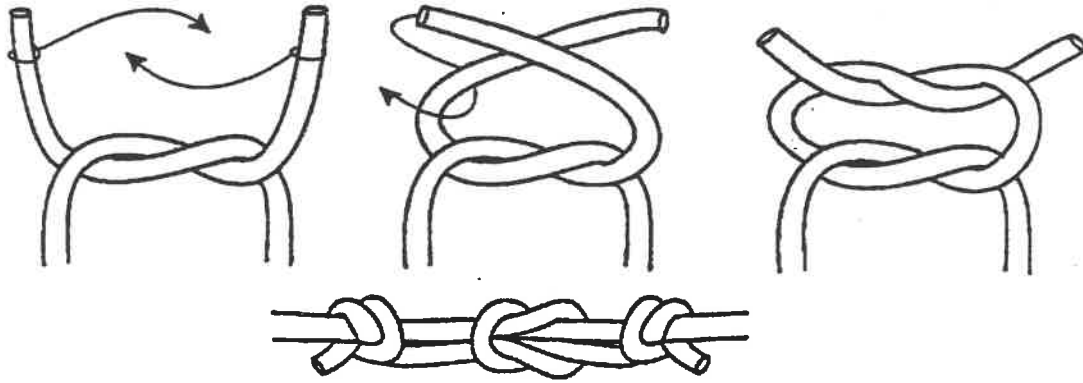
# Bowline Knot



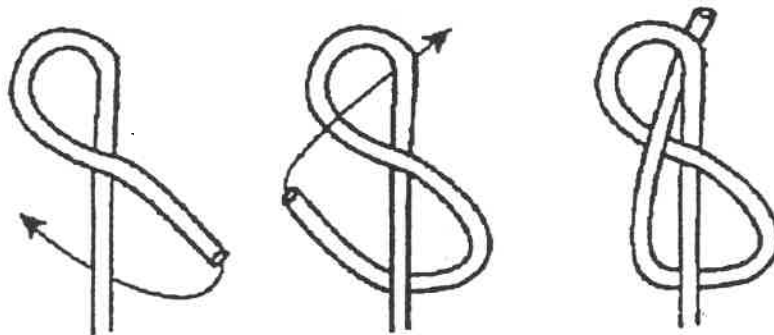
# Clove Hitch



# Square Knot

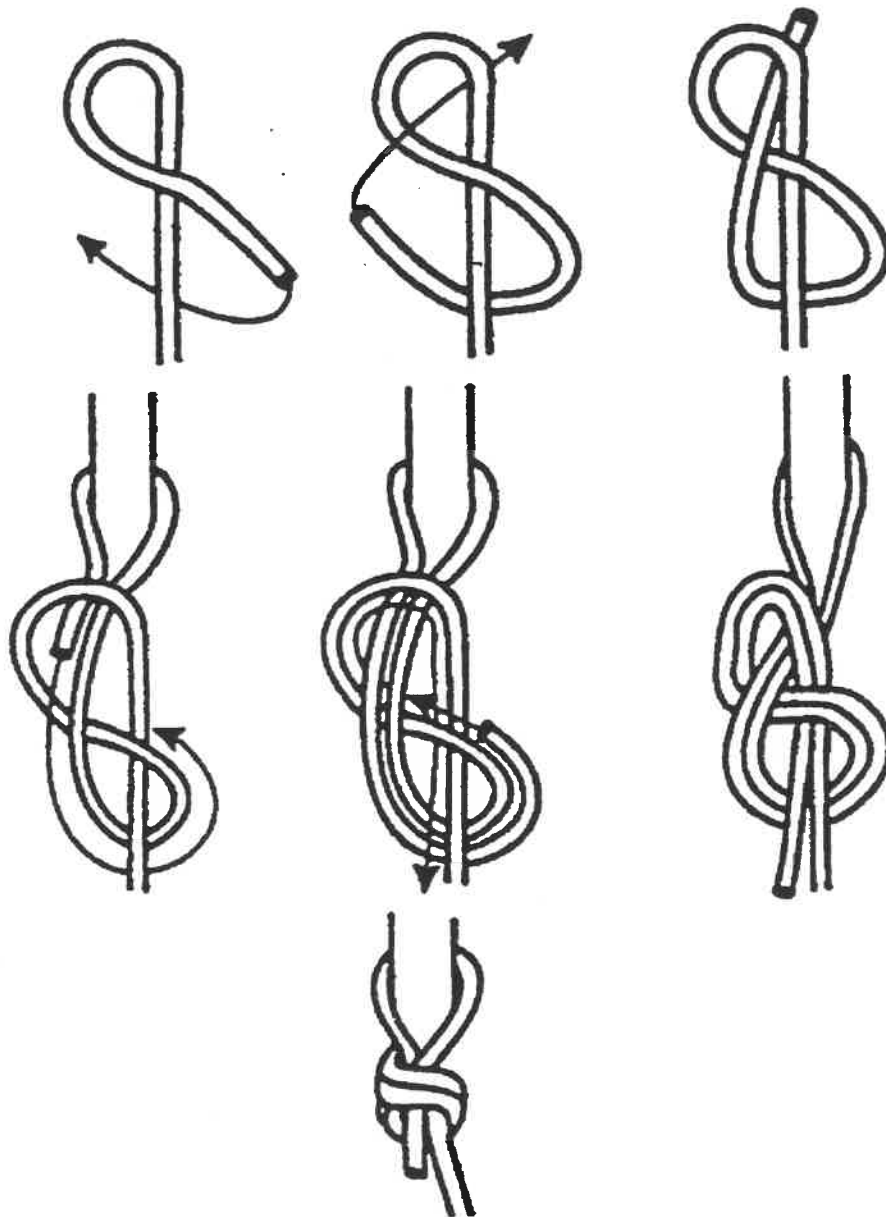


# Figure 8 Stopper Knot



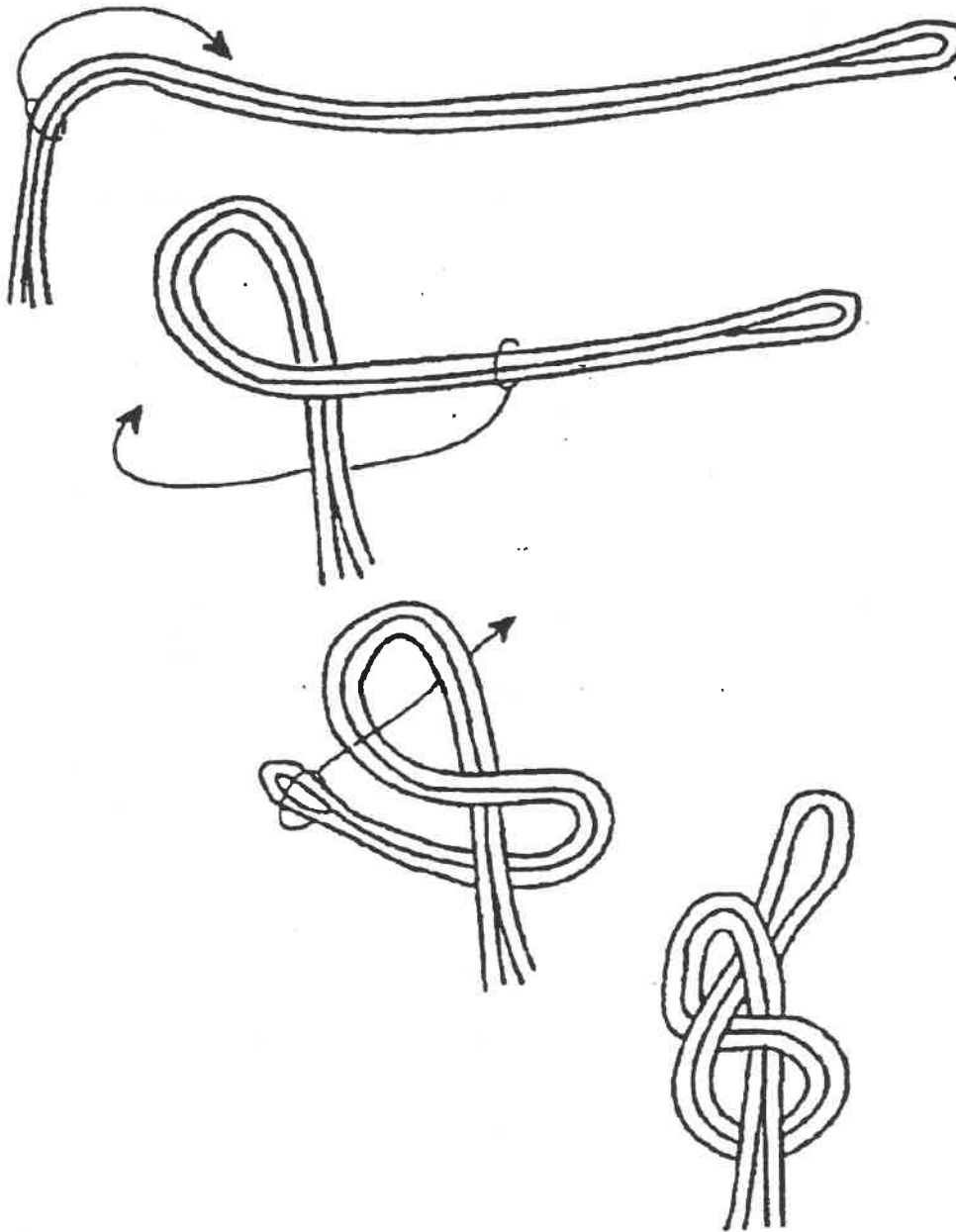
Used to stop the rope end from moving through a device (rope bag)

# Figure 8 Follow Through



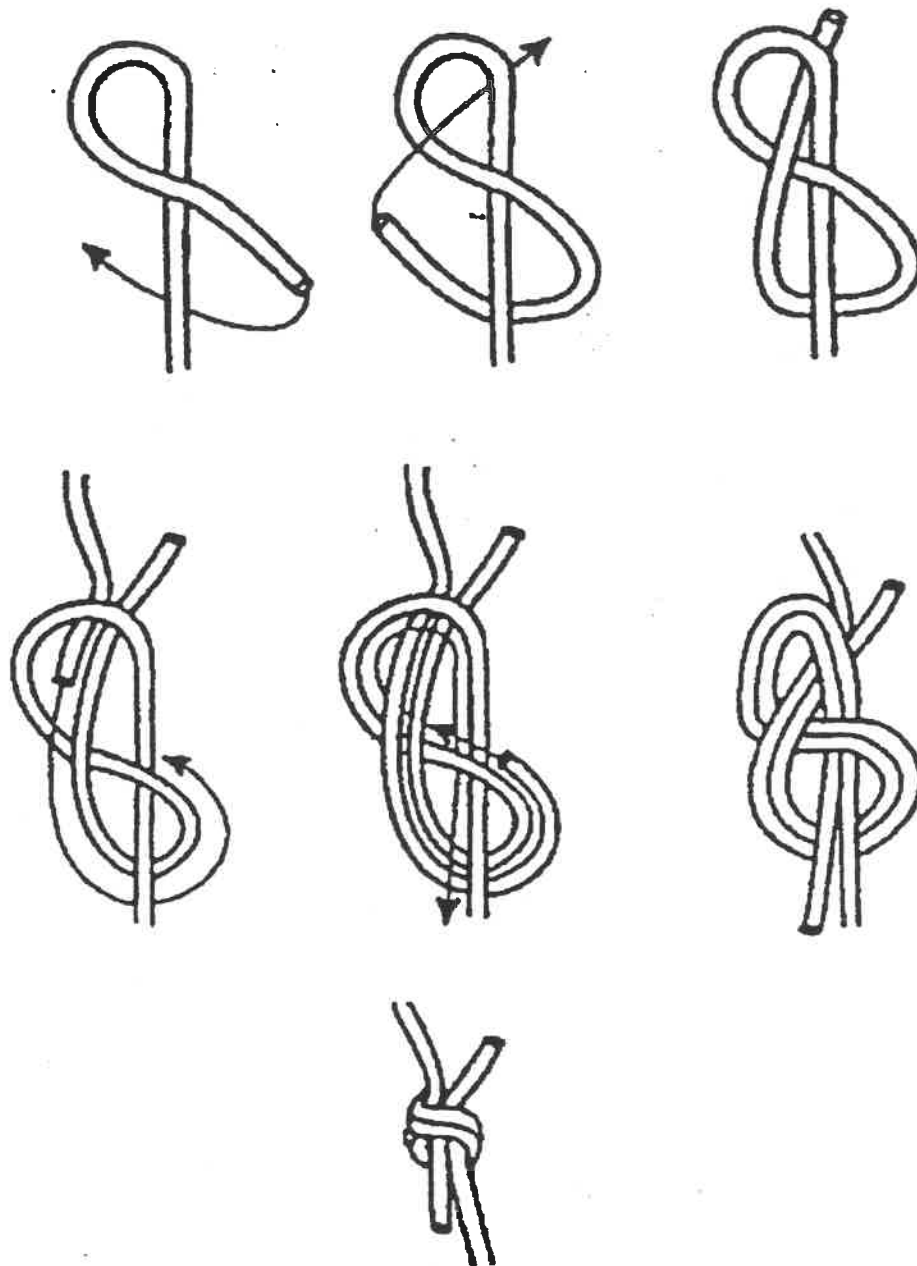
An anchor knot similar to the figure 8 on a bight, allows you to tie the knot around an anchor point with no open ends.

## Figure 8 on a Bight



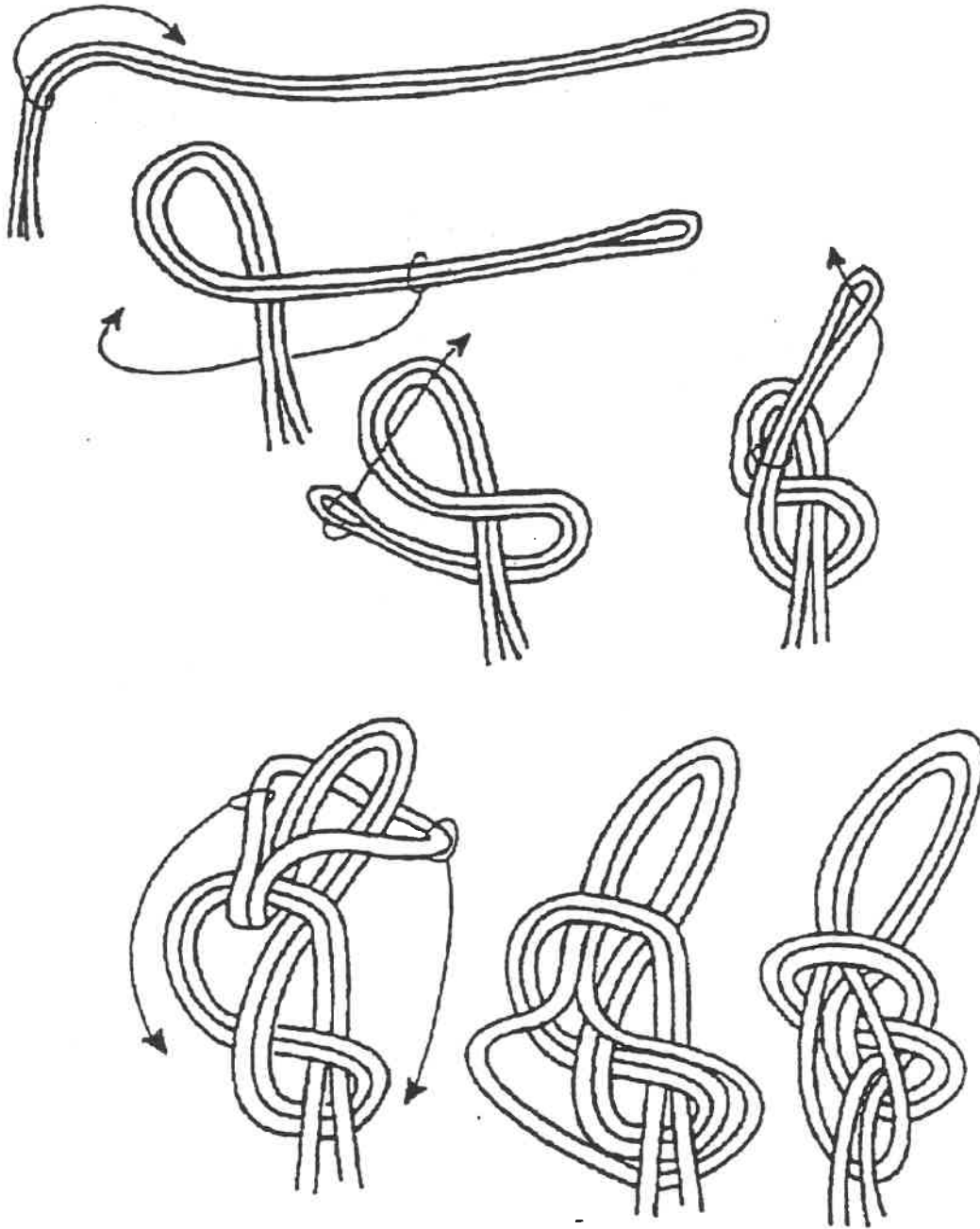
An anchor knot that maybe attached to various components of the Rescue System with carabiners.

## Figure 8 Bend



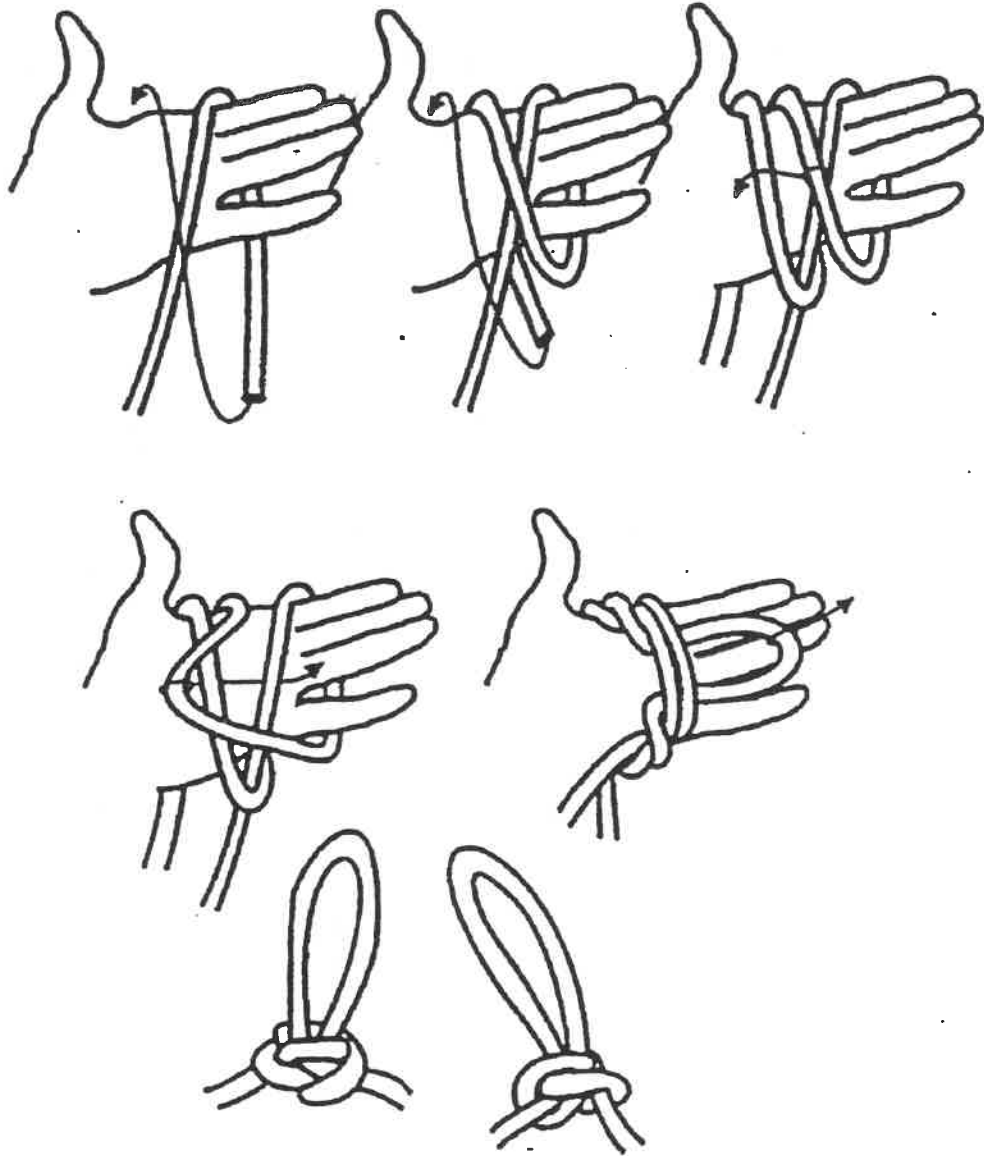
Used to join two load bearing ropes of equal or slightly unequal diameters together.

## Double Loop Figure 8



An anchor knot (like the fig 8 on a bight). Provides more load bearing surface due to its two – loop configuration.

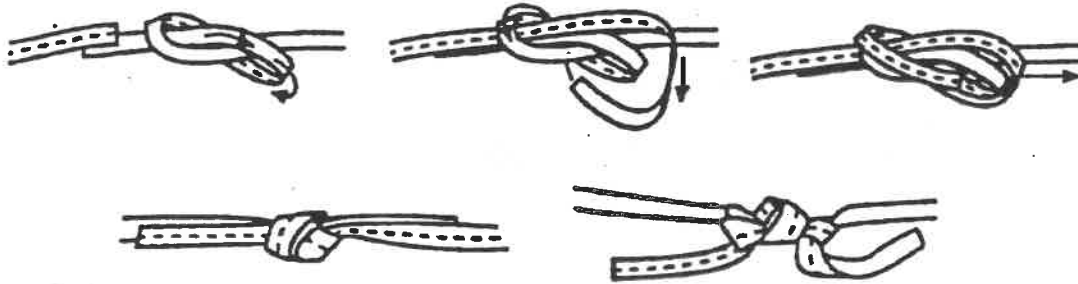
# Butterfly Knot



Designed to take a 3-directional pull

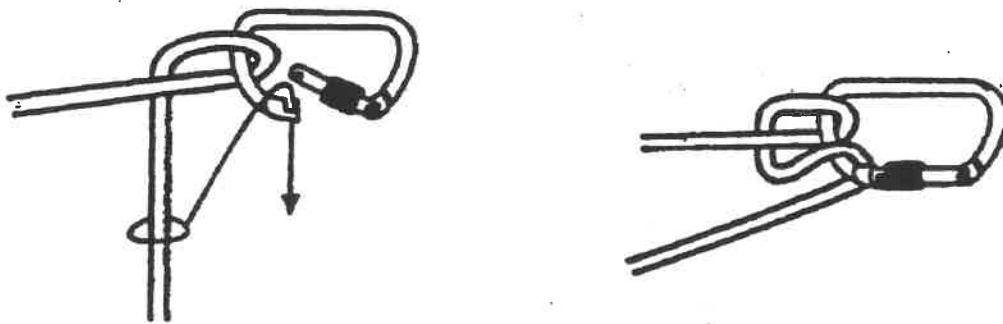


## Water Knot



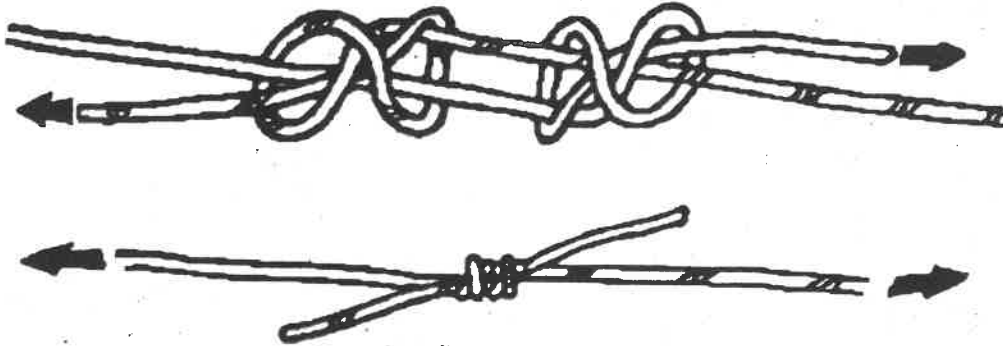
Used to tie two pieces of webbing together for bearing

## The Munter Hitch



Used as a belay hitch with the potential to catch a one person falling load.

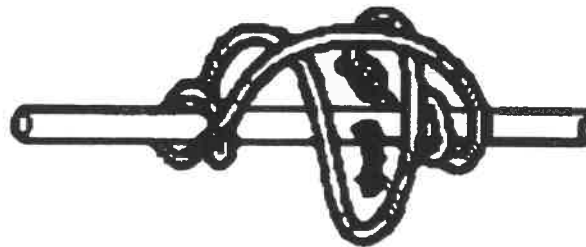
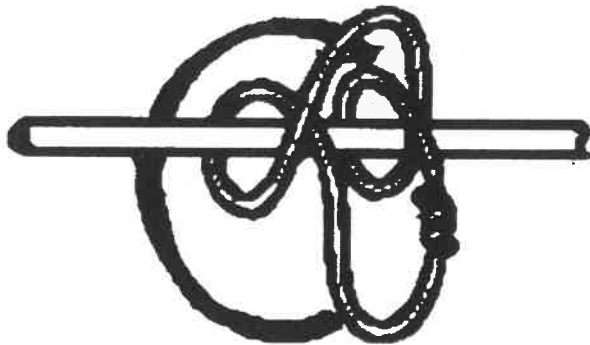
## Double Fisherman Knot



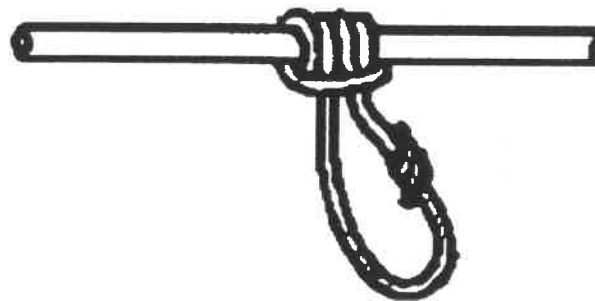
The double fishermans knot connects two ropes or forms a rope into a loop. This is also the knot used with Prusiks.

# Prusik Knot

8mm accessory cord

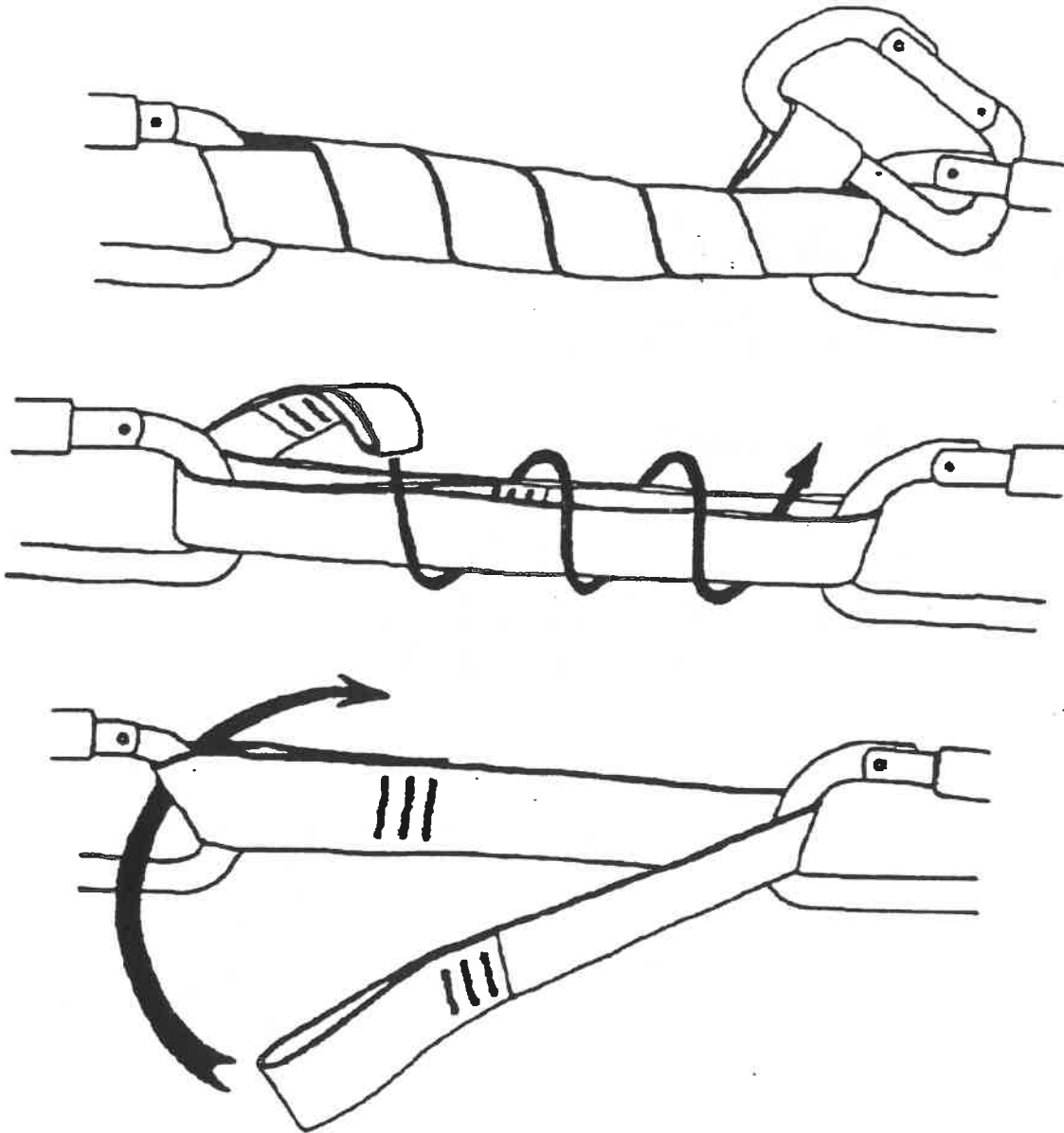


Double or triple wrap  
depending on use



The Prusik Knot secures a object or person to a rope, It is also used as a safety or in place of a cam in rope systems.

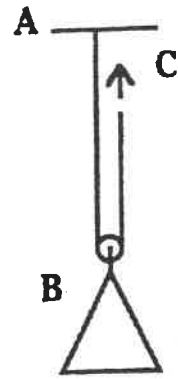
# Mariner Knot



This is a load releasing knot



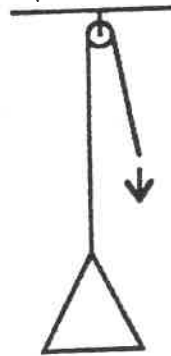
**One to One  
Mechanical  
Advantage**



**Two to One  
Mechanical  
Advantage**



**Three to One  
Mechanical  
Advantage**



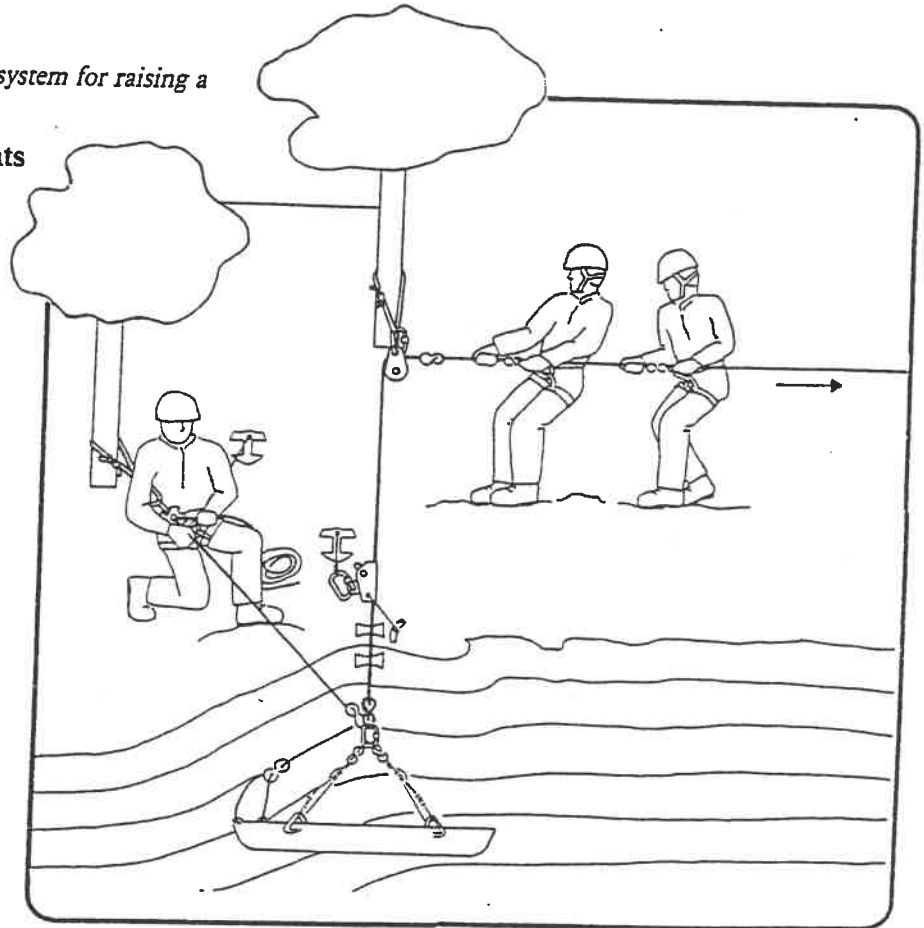
**Directional  
Pulley**

## A 1:1 MA Hauling System

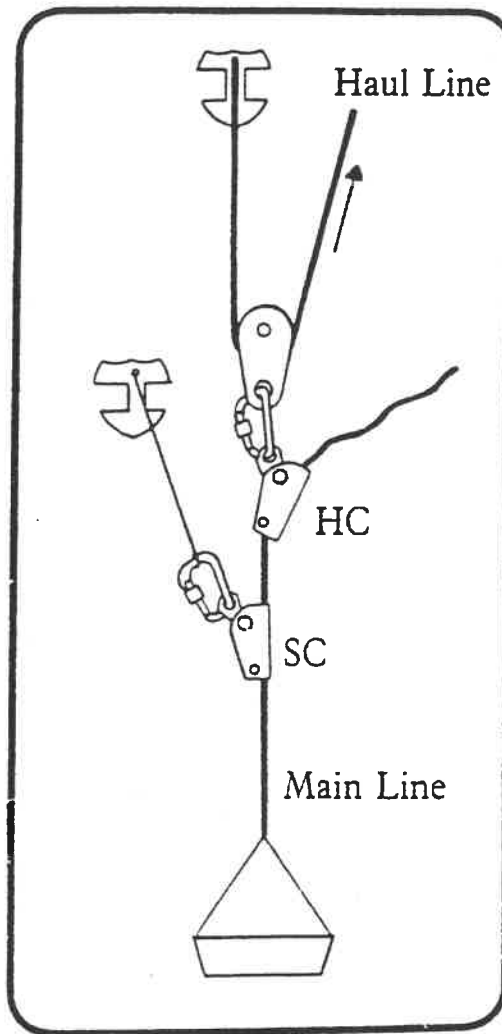
*1:1 hauling system for raising a load up a vertical drop.*

### Minimum Equipment Requirements

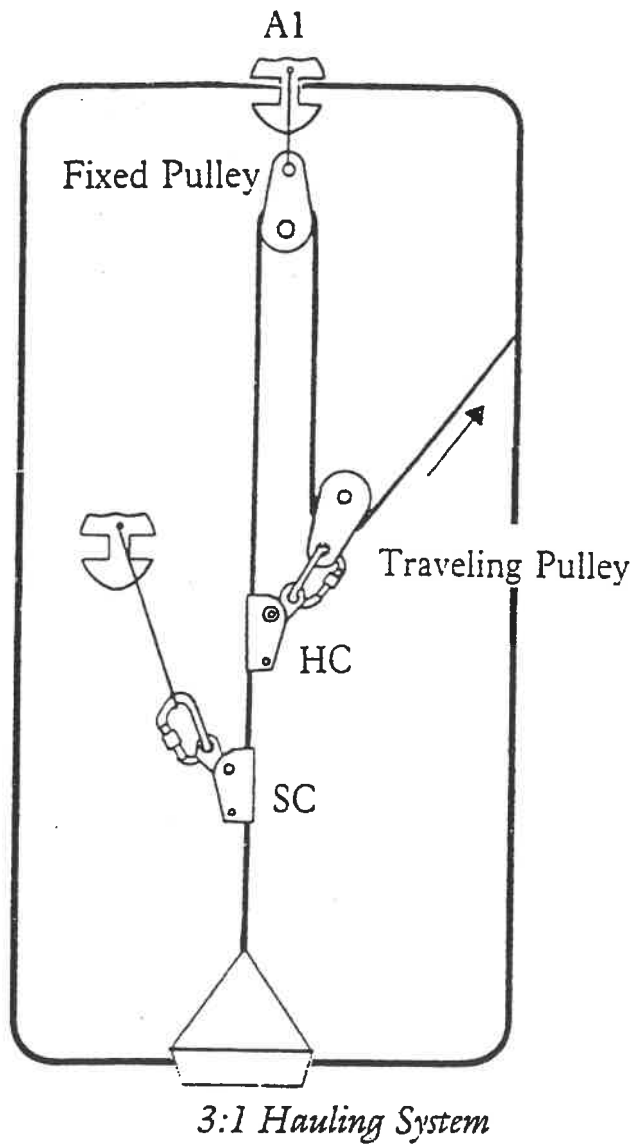
- (1) Main line rope.
- (1) Anchor sling.
- (2) Locking carabiners.
- (1) Cam (safety).



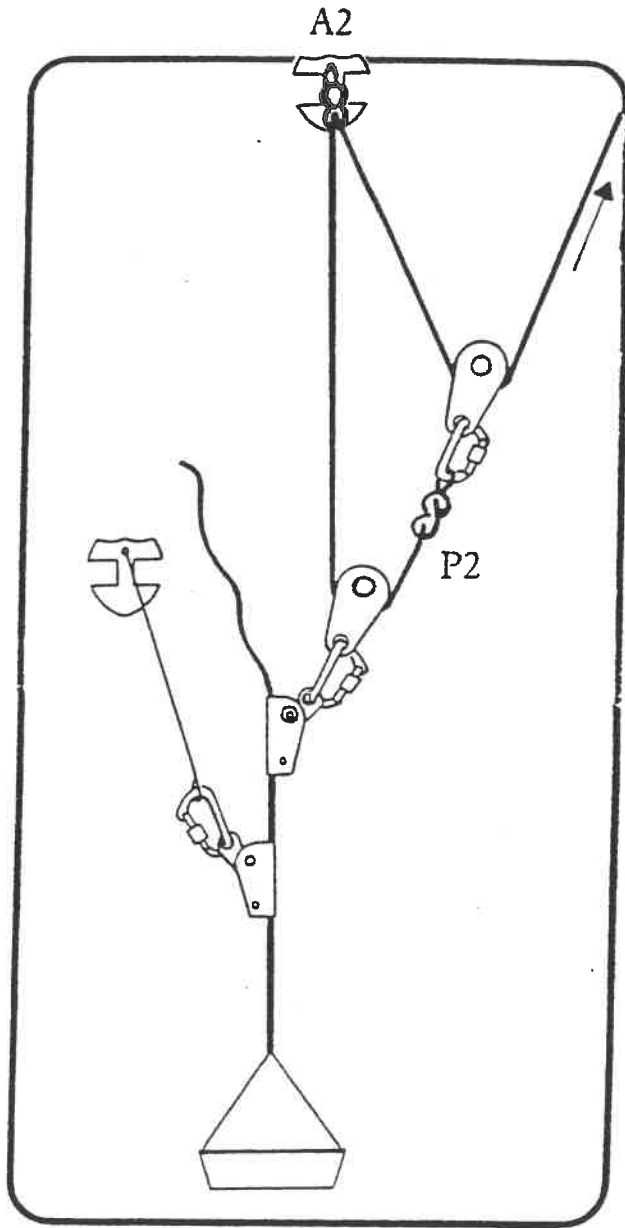
*1:1 Hauling System*



*2:1 Hauling System*

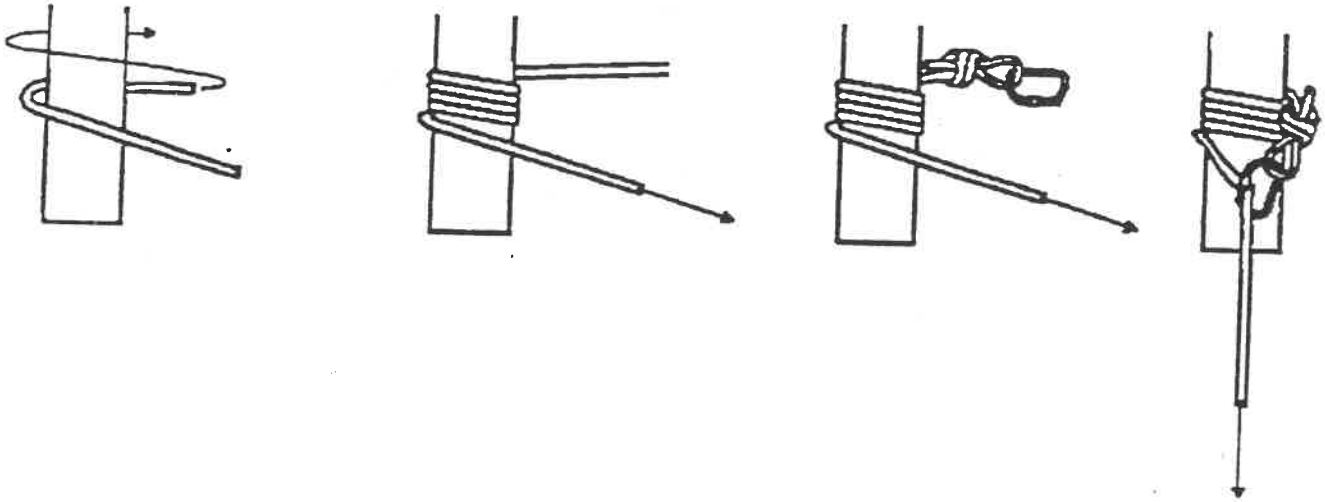




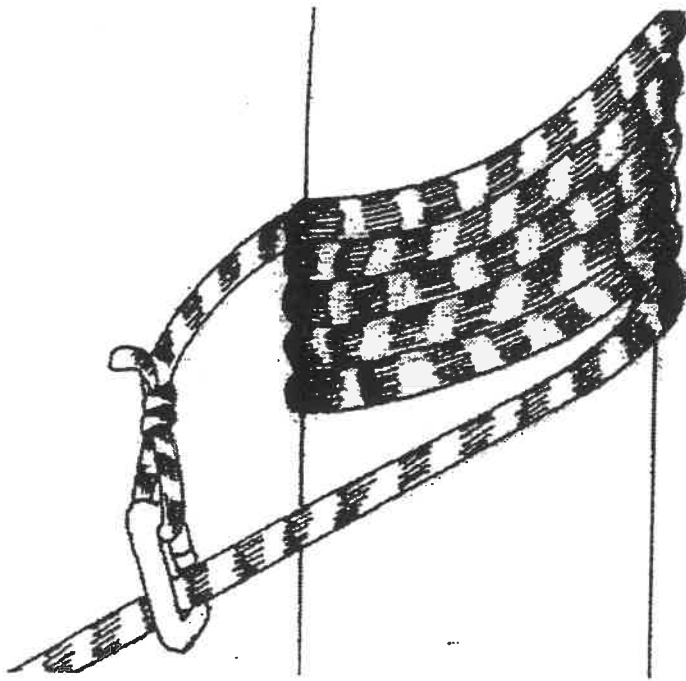


*4:1 Hauling System*

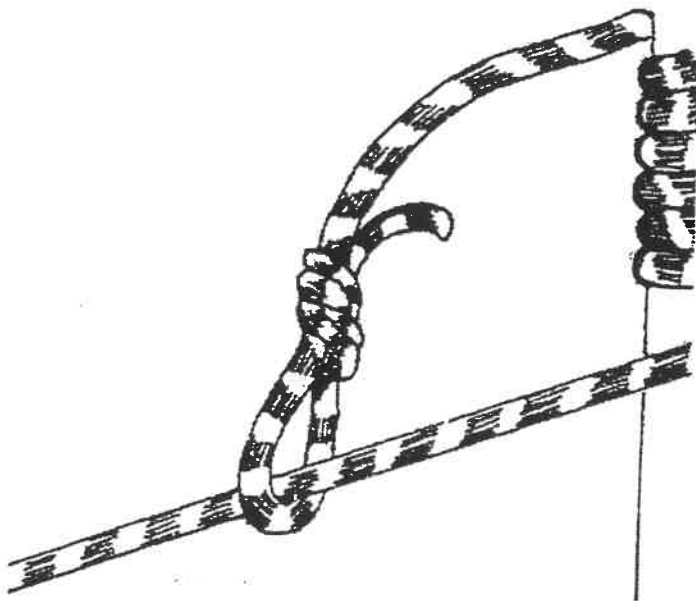
**TENSIONLESS ANCHOR (4-TO-1 WRAP)**



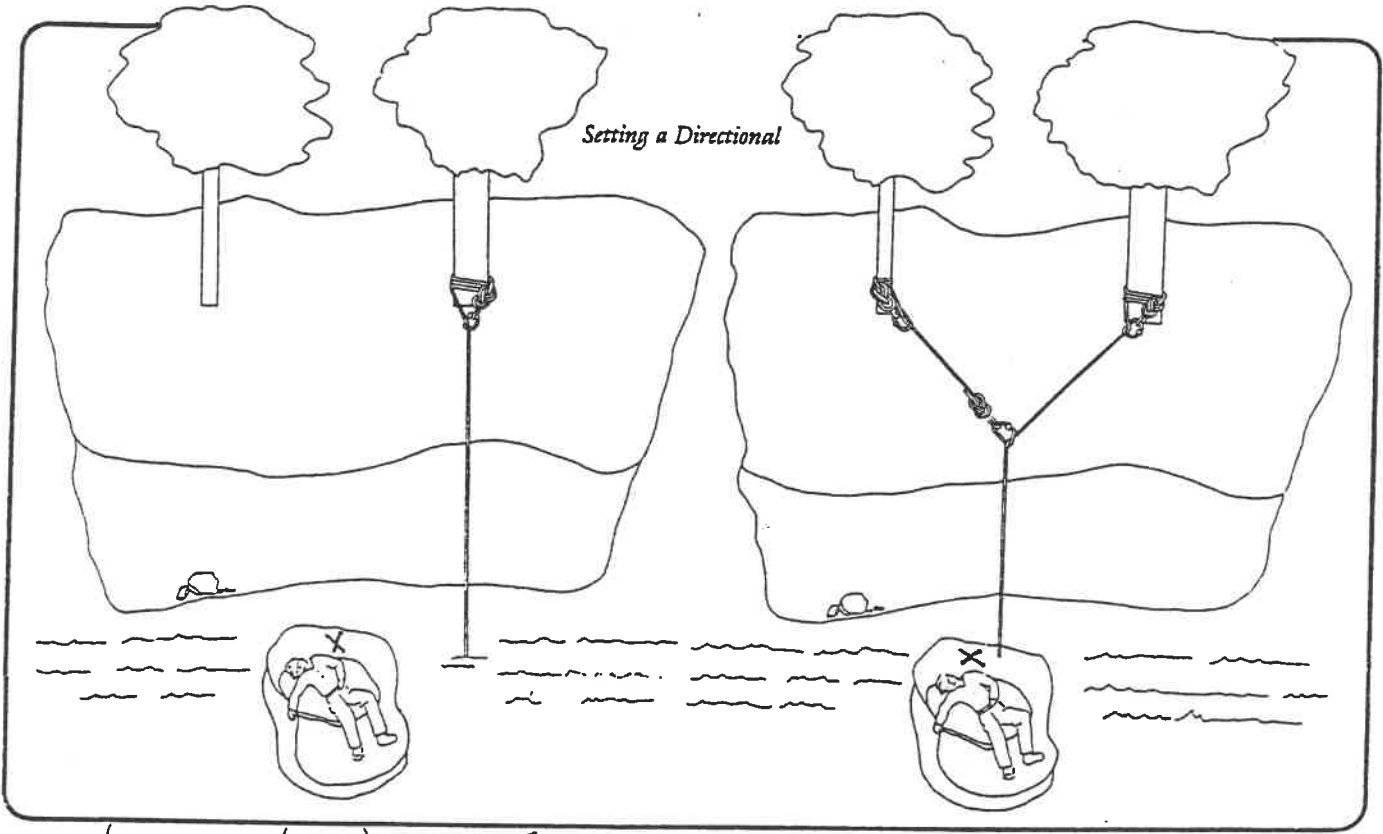
**MOST EFFICIENT MEANS OF ANCHORING A ROPE AS LONG AS IT IS WRAPPED AROUND A SECURE ANCHOR AT LEAST 4 TIMES**

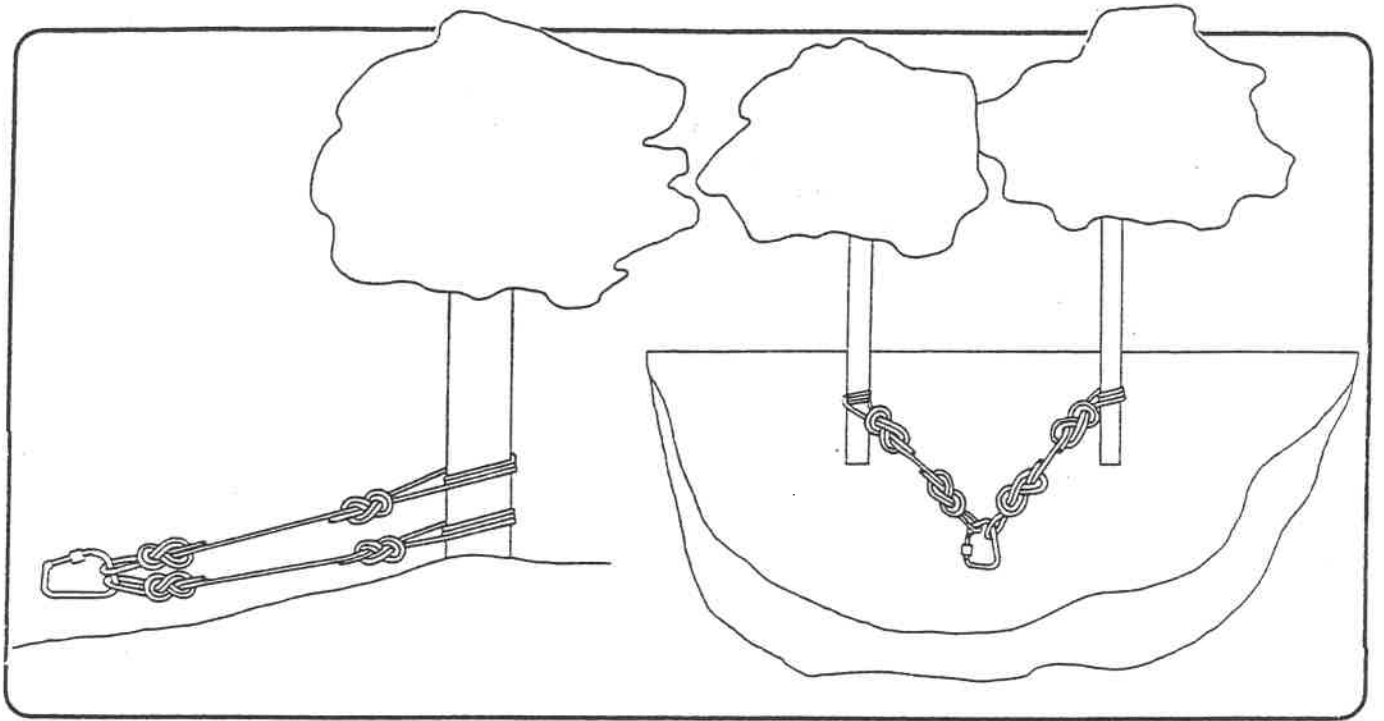


**Tensionless Hitch**

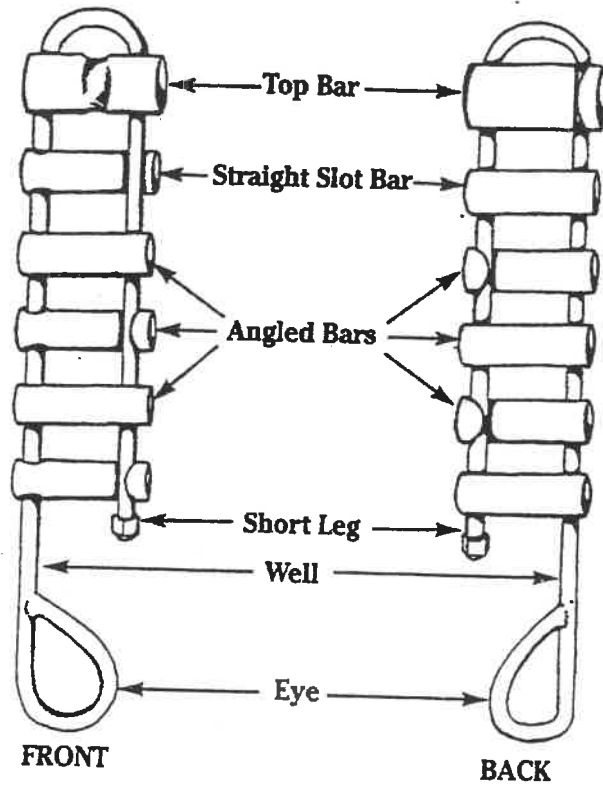


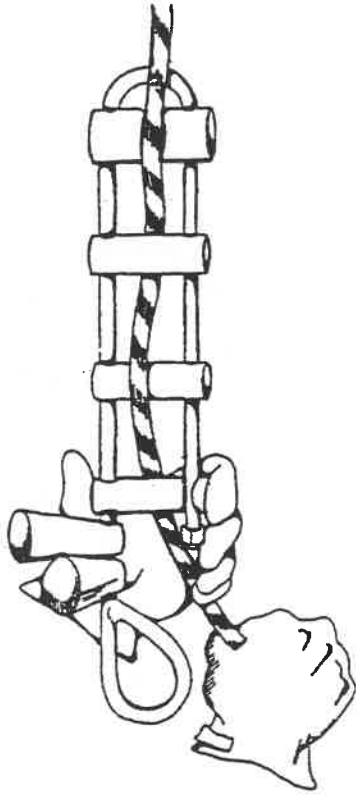
**Tensionless Hitch  
Finished With a Knot**



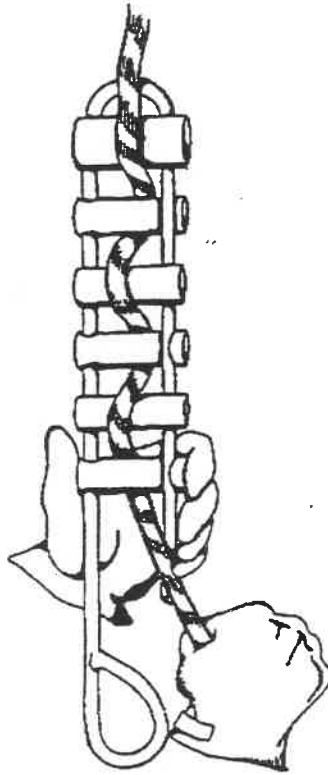


*Backing Up Anchors*





**Minimum friction**

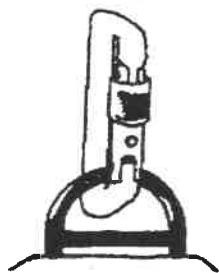
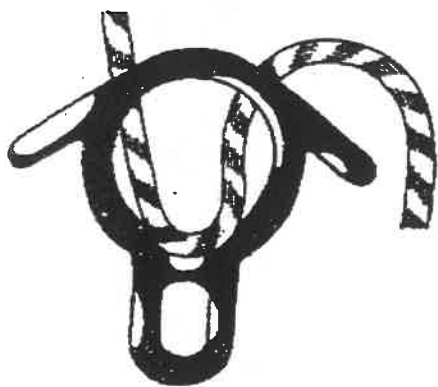


**Maximum Friction**

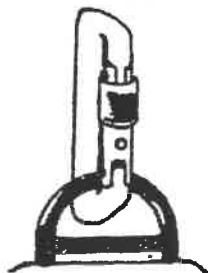


**Locked Off**

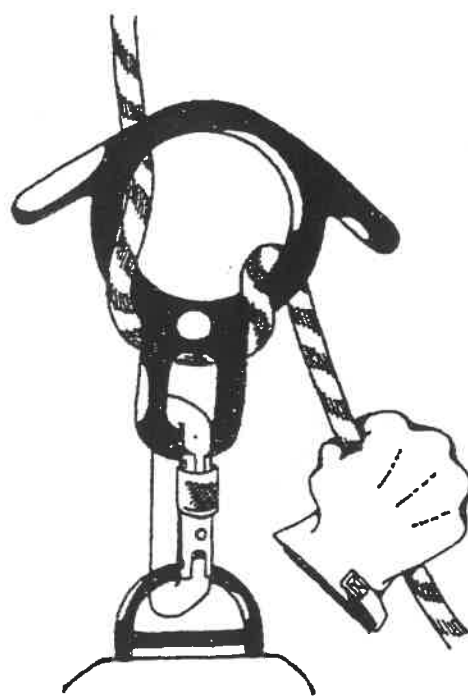
### Rigging the Figure 8 Descender



**Step 1: Push a loop through the large hole of the Figure 8.**



**Step 2: Pull the loop over the small end of the Figure 8.**

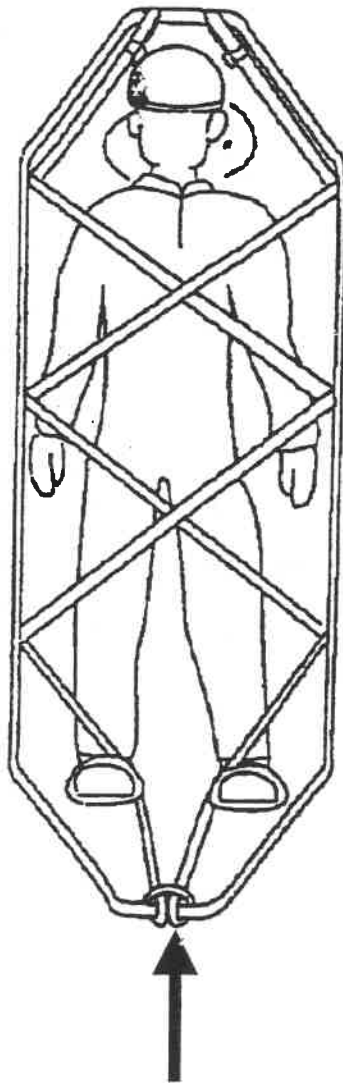


**Step 3: Clip the Figure 8 into your carabiner. Lock the gate.**



# Stokes Basket

Diamond lashing using 1" tubular webbing (35')

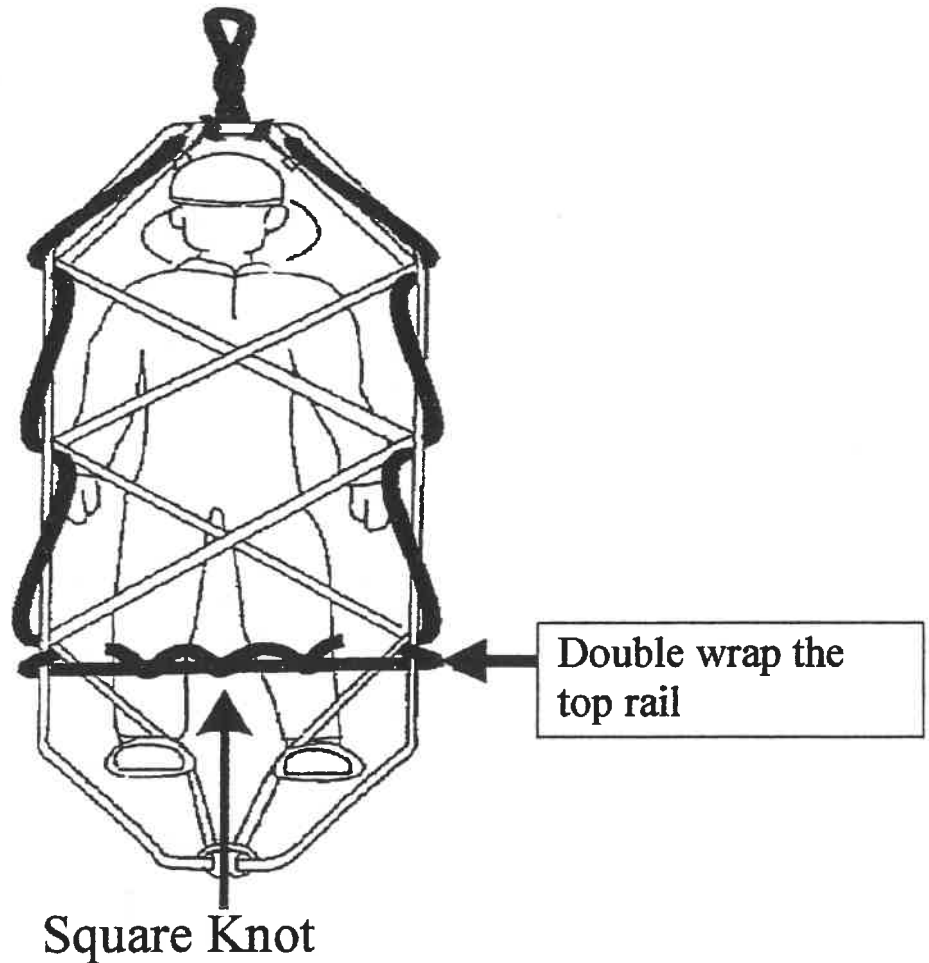


Caution, stay away from the neck and do not make the webbing too tight to obstruct the victim's breathing

Start at feet, using a Girth Hitch

# Stokes Basket

Bridle for Vertical Stokes Lowering  
Use ½" static kernmantle rope (30')



Safety & Tag lines are not Shown