Rescue Technician - Basic

Student Manual

Technical Rescue
47 (9/00)

STATE OF NEW YORK DEPARTMENT OF STATE
OFFICE OF FIRE PREVENTION AND CONTROL

ELIOT SPITZER
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Welcome to the New York State Fire Training Program

Rescue Technician - Basic

The Department of State recognizes that providing training for paid and volunteer firefighters and related officials is an important part of the services it makes available. Our Office of Fire Prevention and Control (OFPC) places a very high priority on training because we believe it is essential for the men and women of the fire and emergency services in New York State.

The Office of Fire Prevention and Control's programs include the most complete progression of training available today -- beginning with probationary firefighters and extending the full length of a firefighter's career with the fire service. While our training programs address specific fire and arson prevention and control issues, we also encourage expansion and improvement of local training facilities and programs in cooperation with fire companies, municipal corporations and districts.

The Rescue Technician - Basic course provides a base from which to prepare students for a wide variety of possible rescue operations. Based on objectives from National Fire Protection Association (NFPA) 1006 - Rescue Technician, Chapter 3, course contents include an overview in areas of specialized rescue, search, technical rescue management, risks and priorities; use of ropes, knots and rope systems in a low angle environment, and establishment of landing zones for helicopter operations. Demonstrations, practice sessions and testing for certification are included.

Your comments and suggestions about this student manual, our training classes or any OFPC program are always welcome. Your input will help us build on our successes and make needed changes, when appropriate.

On behalf of the citizens you serve, we want you to know that your participation and commitment are greatly appreciated.

FIRE PREVENTION AND CONTROL
NEW YORK STATE

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Training Policy-Firefighter Safety Training Required by the Public Safety and Health Act

Date of Issue: 07/01/00

An evaluation of the Office of Fire Prevention and Control's Outreach Training Programs was conducted by the New York State Department of Labor to determine what course components meet the initial fifteen hour and annual eight hour safety training required for firefighters under the Public Employees Safety and Health Act. This listing provides the approved time for each subject area of the designated courses. Students completing the listed courses should receive credit as listed below:

Based on OSHA Safety Training Requirements
CFR 1910.156 & CFR 1910.134

COURSE #	COURSE TITLE	SUBJECT AREA	TIME
03	Fire Behavior and Arson Awareness	General Hazard Recognition	60 min.
06	Ladder Company Operations	General Hazard Recognition	30 min.
		Fire Scene Safety	30 min.
		Tool and Equipment Safety	30 min.
		Total	90 min.
23	Commanding the Initial Response	Fire Scene Safety	30 min.
24	Rescue Operations (until 10/21/00)	General Hazard Recognition	30 min.
		Fire Scene Safety	30 min.
		Protective Clothing	15 min.
		Tool and Equipment Safety	60 min.
		Total	135 min.
26	Apparatus Operator-Emergency Vehicle Operation	Response Safety	60 min.
		Scene Safety	30 min.
		Tools and Equipment	60 min.
		Total	150 min.
27	Mask Confidence	SCBA	120 min.
		Recent Developments in Fire Safety	60 min.
		Total	180 min.
29	Incident Command System	General Hazard Recognition	30 min.
		Response Safety	15 min.
		Fire Scene Safety	45 min.
		Total	90 min.

continued on reverse

35	Confined Space Awareness and Safety	General Hazard Recognition	15 min.
		Response Safety	15 min.
		Fire Scene Safety	45 min.
		Protective Clothing	30 min.
		SCBA	15 min.
		Total	120 min.
38	Water Supply Operations	General Hazard Recognition	15 min.
		Response Safety	30 min.
		Fire Scene Safety	45 min.
		Protective Clothing	15 min.
		Tool and Equipment Safety	30 min.
		Total	135 min.
45	Introduction to Fire Officer (effective 4/01/01)	General Hazard Recognition	30 min.
		Fire Station Safety	30 min.
		Response Safety	30 min.
		Scene Safety	60 min.
		Protective Clothing	30 min.
		Total	180 min.
47	Rescue Technician - Basic (effective 1/1/01)	General Hazard Recognition	30 min.
		Fire Scene Safety	30 min.
		Protective Clothing	15 min.
		Tool and Equipment Safety	60 min.
		Total	135 min.
78	Apparatus Operator - Pump (effective 1/1/01)	Response Safety	30 min.
		Fire Scene Safety	30 min.
		Tool and Equipment Safety	30 min.
		Total	90 min.
91	Basic Firefighter	Subject matter in Basic Firefighter exceeds both the fifteen-hour initial and the eight-hour annual refresher safety training requirements.	
92	Intermediate Firefighter	Subject matter in Intermediate Firefighter exceeds both the fifteen-hour initial and the eight-hour annual refresher safety training requirements.	
93	Advanced Firefighter	Subject matter in Advanced Firefighter meets the eight-hour annual refresher safety training requirement.	
80 81 82 83	Refresher Courses	To be determined at the local level after the content of the presentation has been evaluated.	

RESCUE TECHNICIAN - BASIC

ACKNOWLEDGMENTS

The preparation of this course was made possible through the assistance, cooperation and dedication of many people. The Department of State's Office of Fire Prevention and Control wishes to thank the following persons for their role in the development of this course.

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Unit 1: Introduction to Technical Rescue

Course Overview and Objectives

Course Overview

The Rescue Technician – Basic course consists of eight lessons totaling 24 hours. This course is designed to provide information to form a base from which to prepare you for a wide variety of possible rescue operations. As you progress through this course, it will become apparent that our most important role in rescue is that of being responsible for safety. The overall objective of the Rescue Technician - Basic course is to improve rescuer awareness of the safety concerns at a variety of specialized rescue situations. Topics include: overview of specialized rescue; search; technical rescue management; risks and priorities; use of ropes, knots, and rope systems; ladder rescue systems; and establishment of landing zones for helicopter operations. Demonstrations, practice sessions and testing for certification are included.

Rescue Technician - Basic is part of a series of courses designed to develop and enhance your skills as a rescuer. A series of courses offered at the New York State Academy of Fire Science as residential program offerings will allow you to continue your education and training as rescue specialist.

Course Objectives

At the completion of this course, the student shall:

1. Demonstrate an understanding and ability to perform the procedures and requirements of the size-up of a rescue incident.
2. Demonstrate an understanding and ability to perform the procedures and requirements of identifying and managing incident resources and hazards.
3. Demonstrate an understanding and ability to perform the procedures and requirements of conducting a search.
4. Demonstrate an understanding and ability to perform the procedures and requirements of ground support operations for helicopter operations.
5. Demonstrate an understanding and ability to perform the procedures and requirements of incident termination.
6. Demonstrate an understanding and ability to perform the procedures and requirements of victim access, assessment, stabilization, triage, packaging, movement and transfer.
7. Demonstrate an understanding and ability to perform the procedures and requirements of inspection and maintenance of PPE and rescue equipment.
8. Demonstrate an understanding and ability to perform the procedures and requirements of tying the assigned knots, bends and hitches.
9. Demonstrate an understanding and ability to perform the procedures and requirements of construction, operation and supervision of rope rescue operations including a single point anchor system, simple mechanical advantage system, lowering system, belay system and system safety check.

The 24 hour Rescue Technician – Basic course consists of 8 units of instruction covering the following subjects::

Unit 1 - Introduction to Technical Rescue
- 1.1 Introduction/Overview/Objectives
- 1.2 Knots for Rope Rescue
- 1.3 Introduction to Technical Rescue

Unit 2 - Rescue Management & Psychology
2.1 Unit 1 Quiz & Knot Exercise
2.2 Technical Rescue Management
2.3 Introduction to Search
2.3 Psychological Aspects of Rescue

Unit 3 - Rescue Equipment & Victim Packaging
3.1 Unit 2 Quiz & Knot Exercise
3.2 Personal Protective & Rescue Equipment
3.3 Rope, Webbing and Hardware
3.4 Victim Packaging for Transportation

Unit 4 - Low Angle Rope Rescue
4.1 Unit 3 Quiz & Knot Exercise
4.2 Low Angle Rope Rescue Theory
4.3 Introduction to Low Angle Rescue Anchor Systems
4.4 Low Angle Evacuation: Raising and Lowering Systems

Unit 5 - Low Angle Rescue Practical Skills Evolution
5.1 Knot Evaluation
5.2 Practical Evolution

Unit 6 - Low Angle Rescue Practical Skills Evolution & Evaluation
6.1 Practical Evolution & Skills Evaluation

Unit 7 - Ladder Rescue Systems
7.1 Review Units 5-6
7.2 Ladder Rescue Systems

Unit 8 – Helicopter Operations
8.1 Introduction to Helicopter Operations
8.2 Unit 4 Review
8.3 Units 4 & 8 Quiz

Knots for Rope Rescue

Introduction

Knot tying is a skill. The knots learned in this lesson must be practiced by each individual team member to ensure that you can tie any of the needed knots without mistake or delay. **All** team members must be able to tie **all** knots used by the team.

A rescue team should rely on a small selection of knots that do their jobs well. By standardizing the knots used, there will be fewer knots for the team members to learn. During a rescue, checking the knot is much easier since a particular knot will be expected at a given position. This lesson utilizes the most common name for a given knot although the same knot may be known by several names.

The knots for rope rescue which are used throughout this course are:

Figure eight family of knots

- Simple Figure of 8
- Figure of 8 on Bight
- Figure of 8 Follow Through Loop
- Figure of 8 Bend - Join 2 Ropes
- Double Loop Figure of 8

Other knots

- Double Fisherman
- Prusik Hitch
- Overhand Knot
- Safety Knot
- Square Knot
- Clove Hitch
- Butterfly Knot

Webbing knots

- Water Knot
- Mariner's Knot

What Makes A Good Knot

Strength

Knot strength is a measure of how much the knot will weaken the rope. Bending weakens rope and knots are nothing more than tight bends. The following table of relative strengths shows the strength (Figure 1-1) of a rope with a particular knot in it and is given as a percentage of the strength of that rope without the knot.

Figure 1-1

Relative Strength Of Knots For Single Kernmantle Rope

	Strength in lbs.	Percent Lost
Bends		
Double Fisherman's Knot	8,440	21%
Figure 8 Bend (Flemish Bend)	8,640	19%
Loops		
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%
Rope With A Loop In It (*)		
Figure 8 Loop	6,960	35%
Inline Figure 8 Loop	6,280	41%
Butterfly Loop	7,360	31%
Knots In Web		
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%
Web Slings		
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.

Securing a knot

Some knots, like the double fisherman and water knot, tend to be self-locking. Some knots, like the bowline, are not particularly secure and tend to loosen when loaded. Because of this, the bowline has been eliminated from the knot selection for rope rescue.

Rescue Knots

Knots are grouped according to what they do. The most common knot family is the Figure 8 family of knots. In webbing, knots based on the overhand family work best. These knots have been chosen for ease of use, minimal loss in strength and test results proving the reliability of the knot.

As part of this course, given 8' of rope of minimum 1/2-inch diameter, you shall properly tie each of the following knots completing all operations in sequence without safety violations and with 100% accuracy.

Simple Figure of 8 (Figure 1-2)

This knot is the basis for the other figure 8 knots. It is also commonly used as a stopper knot.

Figure 1-2

Figure of 8 on Bight (Figure 1-3)

This is a strong knot and is less bulky than double loop figure 8.It is used primarily for anchor systems and for attaching single person loads on to the rope.

Figure 1-3

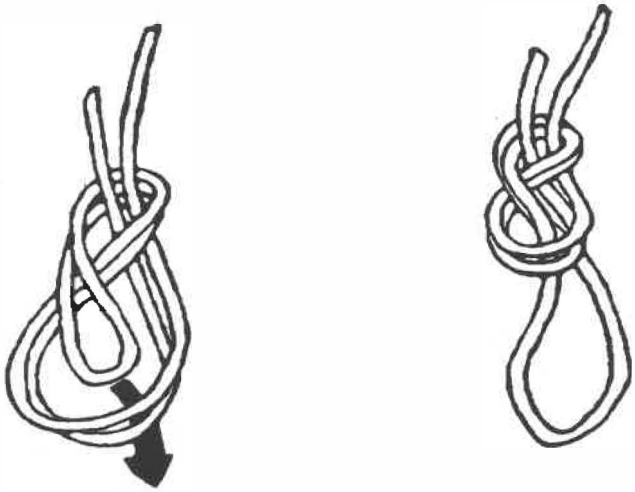


Figure of 8 Follow Through Loop (Figure 1-4)

This knot is used to tie around an anchor and tie into a harness when the loop in the rope cannot be put over or through to object (although we usually use a figure 8 on bight or double loop figure 8 with a carabiner).

Figure 1-4

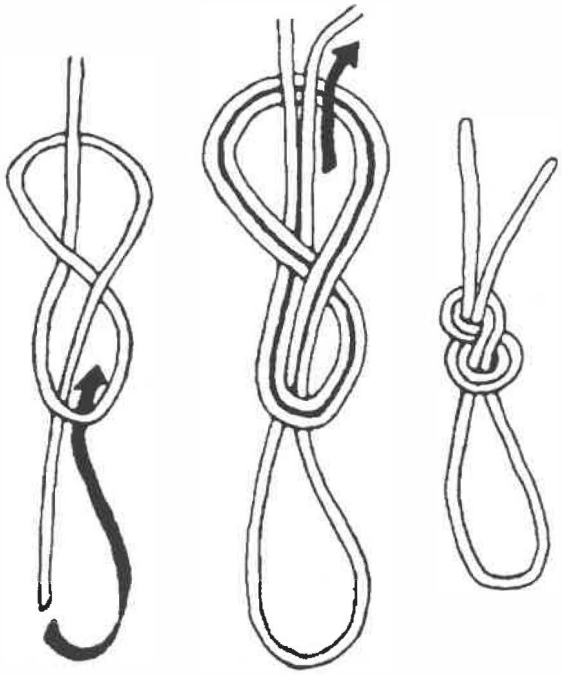
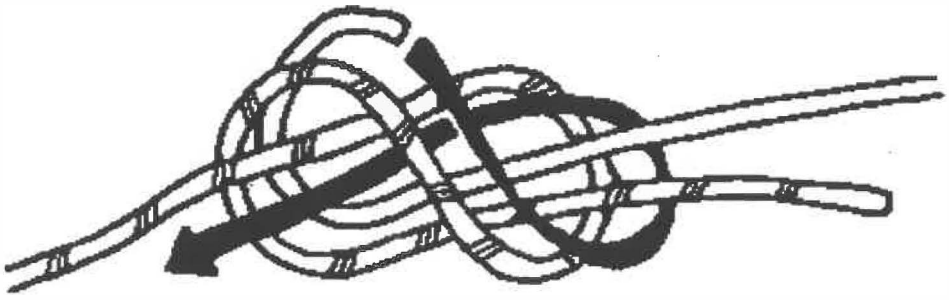


Figure of 8 Bend - Join 2 Ropes (Figure 1-5)

Used to join 2 ropes together.

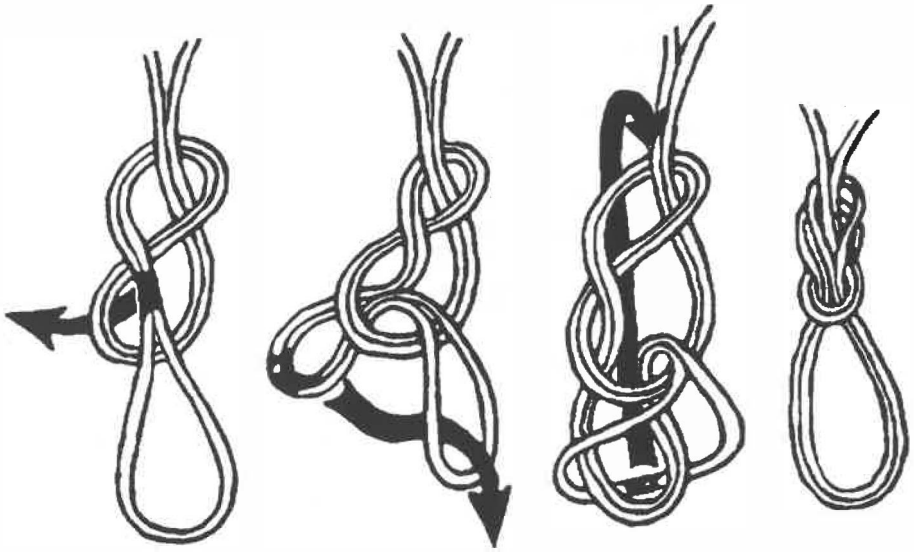
Figure 1-5



Double Loop Figure of 8 (Figure 1-6)

This is a strong knot and the double loop reduces wear and strength loss from the rope being bent around a carabiner. It adjusts easily and is a versatile knot for anchor systems. It works well for anchor systems having two, three, or more points and the self-equalizing and omni-directional efficiency of the knot is increased when it is tied in rope rather than web. This knot can be tied in the end of the main line, or you can use a separate anchor rope. You can also have a ring incorporated for stretcher attachment.

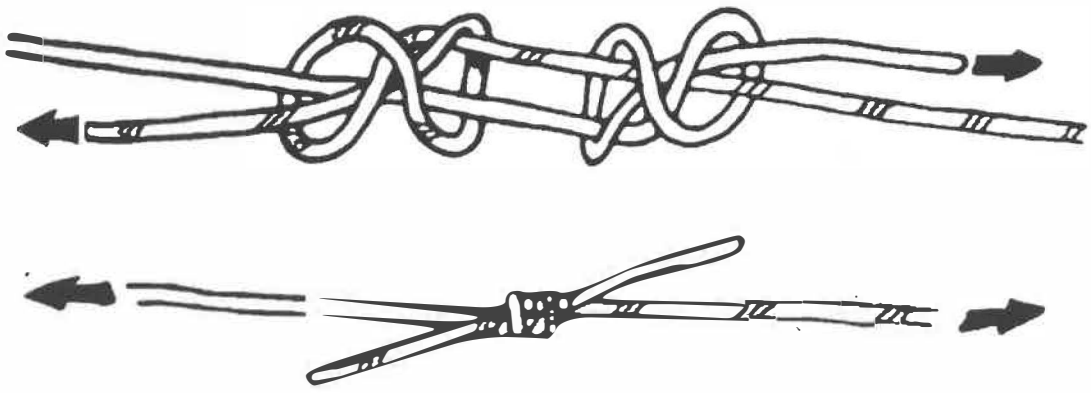
Figure 1-6



Double Fisherman Knot (Figure 1-7)

Used to connect two ropes or to make a rope into a loop. It is a strong, self-locking, very secure knot. This knot is primarily used with prusik cord in this course.

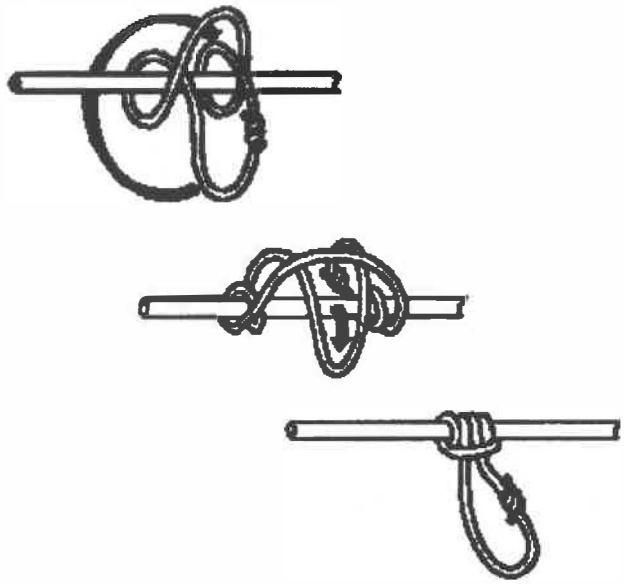
Figure 1-7



Prusik Hitch (Figure 1-8)

Used to secure a prusik loop to a rope. The knot holds when loaded but slides when loose. We use dual wraps for personal use and triple wrapped tandem lines for rigging and system use.

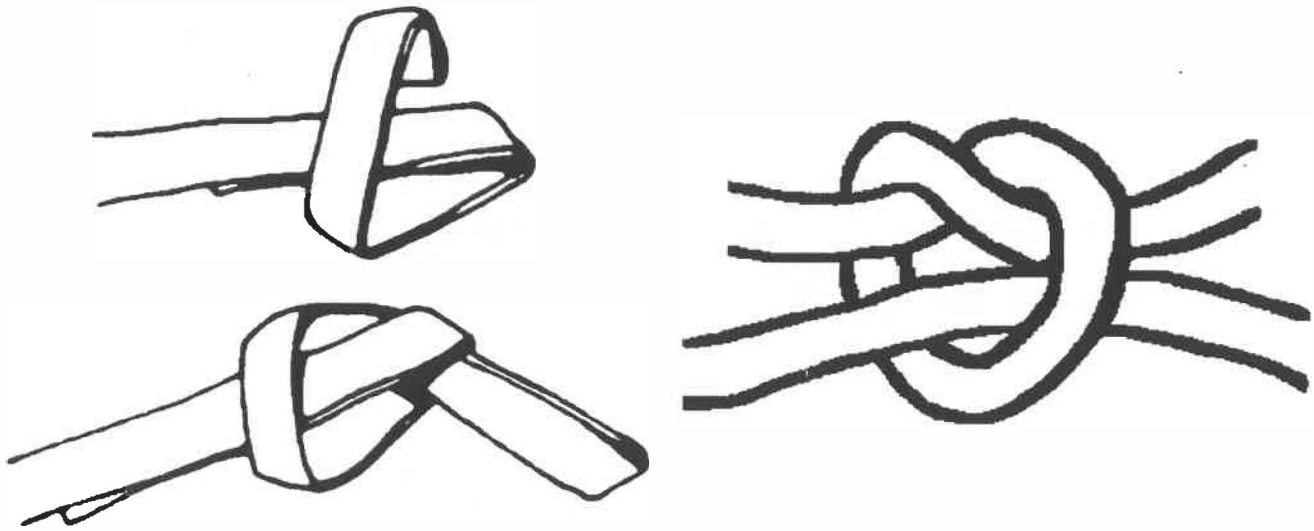
Figure 1-8



Overhand Knot (Figure 1-9)

Good choice for use with webbing. Is also used as back-up / safety knot with rope

Figure 1-9



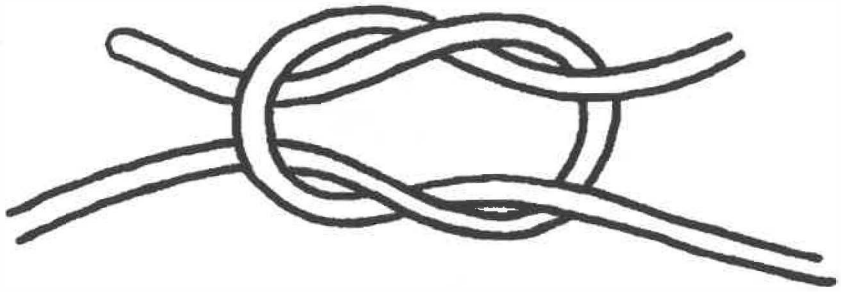
Safety Knot (Half Double Fisherman)

Used as a back-up/safety knot with rope.

Square Knot (Figure 1-10)

Used in some victim packaging systems. MUST BE BACKED UP WITH A SAFETY KNOT.

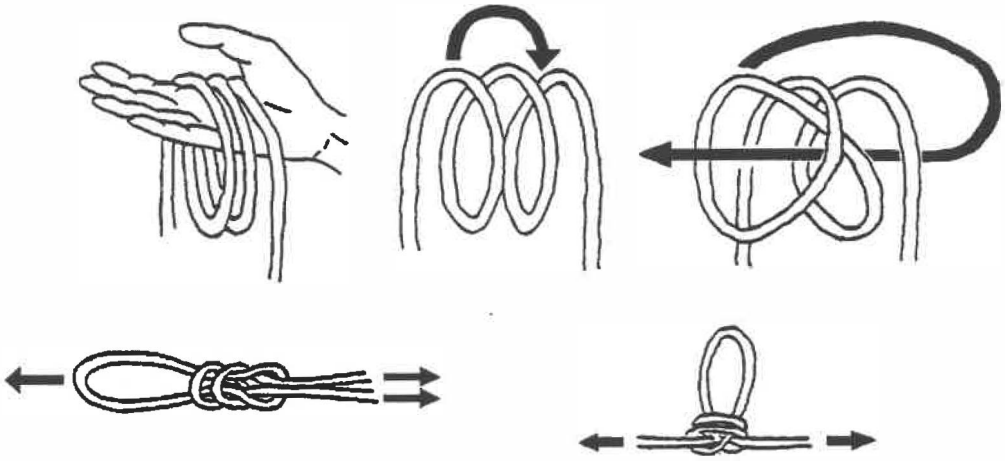
Figure 1-10



Butterfly Knot (Figure 1-11)

Used to create a loop in the middle of the rope. Often used for attachment of removal devices or victims to the rescue rope.

Figure 1-11



Clove Hitch (Figure 1-12)

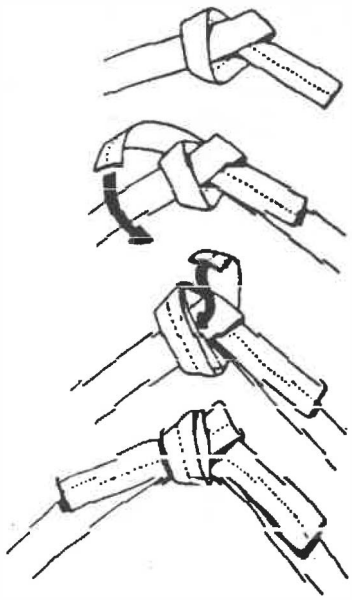
Used as a tie-off in stretcher lashing and in ladder rescue systems..

Figure 1-12

Water Knot (Figure 1-13)

Used with webbing. The knot is secured by tying an overhand safety knot on each side of the water knot unless you set the knot very tightly before use.

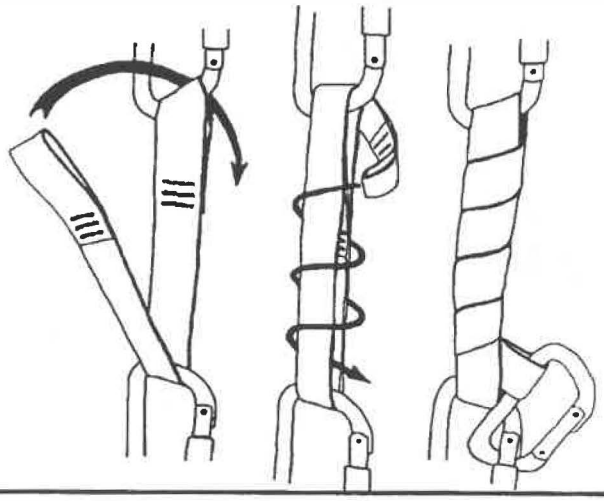
Figure 1-13



Mariners Knot (Figure 1-14)

Actually a knot system that can be releaded under load. It is primarily used to connect the brake to the anchor. If you need to release the brake while it is still under load, such as when it is holding a system, the Mariners' knot will free the brake. To untie the knot while it is under load, start by unclipping and removing the carabiner (the loose one) and push the loop back through the web, opposite of how you tied the knot. Start unwrapping the web carefully. As the web starts to slide, let the load transfer gently onto the lowering device or rope. This knot is not the preferred load release device in a high angle environment unless used in conjunction with a rated shock absorbing device.

Figure 1-14



Introduction to Technical Rescue

Introduction To The Rescue Process

To best understand the rescue process, it is important that you first understand the following definitions:

Rescue: is to locate and extricate trapped victims, transferring the victims to a stable and safe area while providing basic life support. A secondary function is to restore the area to a safe condition, thus precluding an additional rescue at the incident site.

Technical Rescue: The application of special knowledge, skills and equipment to safely resolve unique or complex rescue situations.

Determining Technical Rescue Needs and Capabilities

An analysis of need is performed because the provision of technical rescue services may get rather involved and should not be taken lightly. Often you will have to "sell" it to the organization and/or community leadership. It can be costly (money & time) to provide the service so you must look at a number of factors and give honest answers to many questions

Before an organization decides to offer technical rescue response capabilities, a number of factors should be considered. These include a hazard analysis, a risk/benefit assessment and an organizational analysis.

✓ Analysis Components

- Hazard analysis.

Defined as: "the process of identifying situations or conditions that have the potential to cause injury to people, damage to property or damage to the environment" (in other words, is there a hazard to protect against?). You will also need to determine the probability of various types of incidents occurring within your jurisdiction.

A list of possible rescue incidents which could occur within ones jurisdiction includes but is not limited to:

1) Building collapse.
2) Rope rescue.
3) Trench collapse.
4) Wilderness search & rescue.
5) Elevator rescue.
6) Vehicle & machinery rescue.
7) Water rescue.
8) Ice rescue.
9) Confined space rescue.

- Risk / Benefit analysis.

Defined as: " an assessment of the risk to the rescuers vs. the benefits that can be derived from their intended actions". All rescue work is a relative risk, but some operations have higher risks than others. In other words, what is the likelihood that the benefits will outweigh the risks?

- Organizational analysis

The final step in the analysis process is an organizational analysis. This process will include a review of personnel nee ls, training, resources, time commitment, money and regulatory compliance issues and the ability of the organization and its' members to met the these requirements.

✓ Determination of response levels

After the determination is made that there is a need for a specific technical rescue capability, the next step in the process is to decide what level of service is to be provided. This subject is covered in more depth later in this unit as it pertains to NFPA 1670.

Regulations and Standards

✓ Regulations

Note: The following regulations are enforced by the NYS Department of Labor and may or may not pertain to a specific rescue category. It is ultimately the departments responsibility to ensure that these regulations are complied with where appropriate. This subject is covered in more depth in the training programs offered in the various specialty areas.

OSHA 29 CFR 1910.133 - Eye and Face Protection

OSHA 29 CFR 1910.134 - Respiratory Protection

OSHA 29 CFR 1910.135 - Occupational Head Protection

OSHA 29 CFR 1910.136 - Occupational Foot Protection

OSHA 29 CFR 1910.120 - Hazardous Waste Operations and Emergency Response

OSHA 29 CFR 1910.1030 - Bloodborne Pathogens

OSHA 1910.146 - Permit Required Confined Spaces for General Industry

OSHA 29 CFR 1910.147 - Control of Hazardous Energy (Lockout/Tagout)

OSHA 1926.650 – 652 & Subpart P Appendix A-F – Excavation Standards

OSHO 1926.500 – Fall Protection

✓ Standards

- NFPA 1670 – Operations and Training for Technical Rescue Incidents

This national consensus standard is designed to assist organizations in developing a technical rescue capability in their community. It is commonly referred to as an "organizational standard" because the organization as a whole (as compared to individual members) must comply with the requirements of the standard.

Designed as a core + (plus) standard, the core requirements have provisions for all specialties including: medical care, hazard analysis & risk assessment, incident response planning, equipment, safety, Safety Officer, incident management system and fitness.

Specialty specific requirements are also included for: structural collapse, rope rescue, confined space, vehicle & machinery, water, dive, ice, surf, swift water, wilderness search & rescue and trench & excavation. The core and each one of these specialties includes 3 response levels: Awareness, Operations and Technician.

All members of any type of emergency response organizations (EMS, Police, Fire) should have at least the awareness level of training. Fire departments that respond to emergencies should be trained at least to the Operational level.

- NFPA 1006 – Rescue Technician Professional Qualifications

The purpose of this national consensus standard is to specify minimum job performance requirements for service as a rescuer in an emergency response agency. Commonly referred to as an "individual standard", this standard requires both knowledge and skills be demonstrated in various subject areas to become certified as a "Rescue Technician" in a given specialty.

Also designed as a core + (plus) standard, this course, Rescue Technician – Basic, with the addition to basic EMS training, is designed to meet the core requirements of this standard.

Core requirements for all specialties include: site operations (resource management, action planning, incident management system, search, helicopter ops and record keeping), victim management (victim access, stabilization, triage, packaging, moving and transfer) and ropes & rigging (low-angle rope rescue).

Specialty specific requirements are also included for: rope rescue, surface water, vehicle & machinery, confined space, structural collapse and trench & excavation.

Unit 2: Rescue Management and Psychology

Technical Rescue Management

Introduction

A technical rescue operation will run more effectively and safely when an Incident Command System (ICS) is utilized. By employing an incident command system to organize all rescue incidents, rescuers will gain the necessary confidence to organize even the most complex technical rescue incidents.

In this lesson we demonstrate ways in which the familiar model ICS plans (Figure 2-1) used to organize fire operations can be modified to manage a rope rescue incident. The techniques discussed in this lesson are continually reinforced during the practical applications of this course.

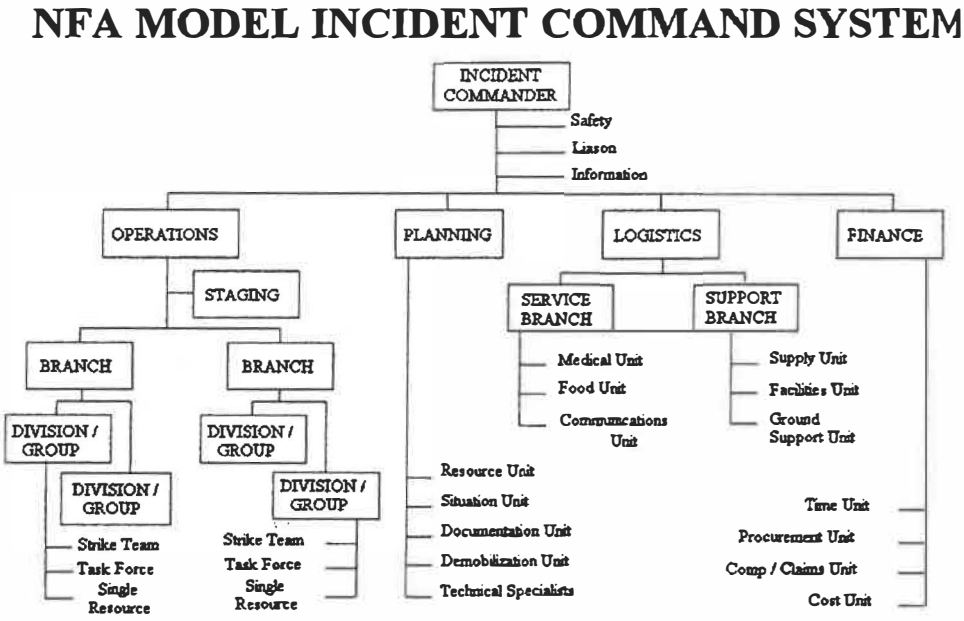


Figure 2-1

The Incident Command System

A rescue scene can be one of confusion if a command system is not established early in the incident. The command system must be versatile, adaptable to any type or size of emergency or incident, relatively familiar if it is going to be useable throughout the state and be expandable in a logical manner if changing conditions dictate. The majority of technical rescue operations will be most efficiently managed with a pared down version of the full blown ICS model. It will be the rare technical rescue incident that will require filling positions such as Planning, Logistics, Finance, etc. (Figures 2-2 and 2-3).

Figure 2-2

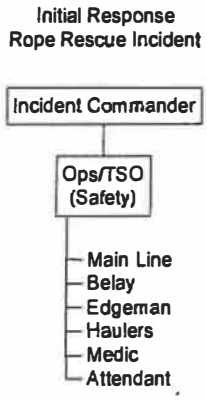


Figure 2-3

Span of Control

The ICS allows for a manageable span of control of people and resources. Utilizing an ICS takes much of the pressure off of the Incident Commander. The **maximum** span of control is 7 (seven) persons while the **recommended** effective span of control of 5 to 1 allows for the most effective management. The system is set up so that the IC is only **communicating to** and **receiving information from** a maximum of five people, rather than the whole assignment of personnel at the scene. Individual managers of personnel and resources within ICS are also working within a manageable span of control.

ICS Positions for the Typical Rope Rescue Scenario

The **Incident Commander** (IC) or "command" is the individual responsible for the management of all incident operations. The IC does not need to be well versed in technical rescue, however he/she should be well versed in the ICS. The IC should be stationed at a command post remote from the incident. On large, complex, and or protracted incidents, the **I.C**. may delegate functional responsibilities by appointing an:

- Operations Officer (Operations)
- Planning Officer (Planning)
- Logistics Officer (Logistics)
- Finance Officer (Finance)

The IC also communicates directly with Command Staff:

- Public Information Officer (PIO)
- Safety Officer (Safety)
- Liaison Officer (Liaison)

The **Operations Officer** is responsible for direction and coordination of all tactical operations. On modest sized rescue incidents, Operations may fulfill the functions of a Technical Rescue Officer (TRO). At large scale rescues, Operations may designate a TRO. Operations may also interface with the media and other appropriate agencies as necessary in the absence of the PIO and Liaison Officer.

The **Safety Officer** (SO) is responsible for enforcing general safety rules and developing measures for ensuring personnel safety. When manpower is limited the SO position may be combined with the TRO and/or Operations positions. The SO can bypass the chain of command when necessary to correct unsafe acts immediately.

The **Technical Rescue Officer** (TRO) or "Team Leader" is responsible for the rescue operation. This person is normally the most experienced rescue technician on the team and assumes the lead role in designing and setup of the necessary rescue systems. When the set-up is complete the TRO will check the entire system. The TRO is the liaison between the rescue site and the command post and designates "tactical" level positions in the ICS as needed.

The **Main Line** sets up main line anchors and systems for lowering and raising and operates the lowering and raising system. They are responsible for managing the change over when the main line is transitioned from a lowering system to a raising system.

The **Belay Line** sets up belay line anchors and the belay system. They operate the Tandem Prusik belay system and any other belaying that may be required.

The **Medic** initially descends or ascends to the patient and performs medical assessment and stabilization. If the victim is in a precarious position, the medic will apply a rescue harness if appropriate, secure the victim to the medic line, provide a belay if the victim is on his own line or otherwise secure the victim to prevent a further fall. Getting the necessary lines or systems in place to get the medic to the patient should be the first tactical priority. Medics should be trained to at least the CFR level and will usually be the team member most comfortable "on rope".

If a litter evacuation is necessary, the **Attendants** rig the litter and patient packaging systems and are raised or lowered with the litter. They then package the patient (usually with the assistance of the Medic) and tend the litter. The Attendants should, as a minimum, be trained to the CFR level.

The **Medical Officer** oversees the medical care of the victim/victims. The MO makes triage, treatment and transport decisions on multiple victim rescues, advises the Medic and Attendants on medical issues and provides advanced life support care for patients who have been removed to grade.

The **Staging Area Manager** position is especially useful if personnel resources allow. This person assembles and keeps track of all available rescue equipment on a tarp in a neat organized manner.

The **Edge Person** is usually a member of the main line group. He/she maintains visual contact with the attendant and the litter from the edge and assists the attendant and litter over the edge. The edge person must be secured to topside anchors for safety. This position plays a vital role in relaying communications between the medic and litter attendants and the TRO who is controlling the pace of lowers and raises.

Haulers are also usually members of main line group. They set-up and operate the hauling systems. A haul team leader is used to answer for the haul team and resets the hauling system. Untrained personnel may be used as haulers when manpower is limited.

Operations at Technical Rescue Incidents

Operations at technical rescue incidents are no different than other emergency situations in that a consistent approach in dealing with an incident will produce a more favorable outcome. The following is intended to provide you with a step by step approach to preparing for, assessing and responding to technical rescue incidents.

✓ Preparation: Includes training, equipment and personnel.

✓ Initial Response: The first arriving unit should:

- establish command,
- keep apparatus an appropriate distance,
- determine utility involvement if any,
- establish victim contact and;
- set up initial safety zones.

✓ Assessment and Planning (initial size-up):

- Verify who is in command.
- What happened and when did it happen?
- What was done prior to arrival?
- How many victims?
- Potential for non-entry or victim self rescue?
- Victim location?
- Hazards?
- Type of injuries?
- Initial assessment of rescue vs. recovery.

✓ Development of the Incident Action Plan (IAP). An IAP should deal with the following as a minimum:

- Establishment of "safety" zones.
- Complete risk/benefit analysis.
- Safety of the scene and general area.
- Establishment and confirmation of the incident strategy and tactics.
- Establishment and assignment of operational and support tasks.
- Establishment of a Rapid Intervention Team.
- Must be trained in the type of rescue being performed.
- Hazard mitigation.
- Resource staging.
- Selection and use of protective systems where appropriate.

✓ Gaining access - should be appropriate to the type of rescue. An example of trench considerations would be the placement of pads, ladders, panel placement, voids behind the panels, etc. An example of low angle rope rescue considerations is the establishment of contact with the victim., finding bomb-proof anchors, setting up a medic line for quick access, etc.

✓ Disentanglement - may involve the lifting or removal of large or heavy objects. Situations may exist where you may not be able to move or cut the item the victim is entangled in and alternate techniques must be utilized.

✓ Victim packaging and removal – the victim is packaged before removal if practical and you should package with consideration for EMS needs.

✓ Incident termination – includes the removal of equipment from the scene, cleanup and replacement of equipment on the vehicles, completion of documentation and reports, incident debriefing and stress debriefing as appropriate.

Long Term Operations

Firefighters are accustomed to incidents that terminate quickly, often within an hour of onset. Many short term incidents can be effectively directed and controlled utilizing an ICS system structured using an IC, Safety Officer, Technical Rescue Officer and Medical Officer.

However, technical rescue incidents can extend well beyond these relatively short time periods. The Incident Commander needs to consider both immediate and anticipated need for all phases of the incident. Remember, whatever functions and responsibilities the IC doesn't assign to others in the ICS system, stay with the IC (the IC becomes easily overwhelmed).

Use of an expanded ICS system will assist the IC with planning and functioning in the long-term incident environment. This should include staffing of the Planning, Logistics, and Finance / Administration Sections.

A rescue team can typically work up to 24 hours without downtime, but then must have at least 24 hours down for rest and equipment maintenance. If the rescue effort is expected to go beyond 24 hours, plans must be made for long term operations. This determination can depend on:

- Extent of rescue required
- Training level of the rescue team.
- Available resources.
- Rescuers physical condition.
- Rescuers psychological condition.

The IC must also consider needs supported by other ICS functions. Planning is concerned with resources, tracking the situation, documentation and demobilization. Logistics is concerned with all of the supply concerns, current and projected. Finance / Administration tracks current and expected costs of the operation.

Hazard and Risk Assessment

The components of a hazard and risk assessment include:

✓ Preplan Information

The first component of your pre-plan is the information obtained from a site survey. Sample items that should be included in the site survey are: terrain, anchors and accessibility.

The second component of your pre-plan is an analysis of past incidents. Examples include: Where have past incidents occurred? How have past incidents occurred (are they college students being places they shouldn't or are they stuck recreational climbers)? Also of consideration is the probability of survival. Have past incidents always been fatal because the drop is 200 feet?

The third component is an assessment of available resources. Included in this assessment should be in-house resources and available mutual aid. Mutual aid can take many forms in addition to fire departments including specialized rescue teams, individuals with special expertise or equipment etc.

The final component of your pre-plan should include the lessons you have learned and information obtained from training at the site. This can provide valuable information on conditions and situations you may encounter.

✓ Determination of Rescue verses Recovery.

Rescue involves the moving of victims to a safer environment. When it is unknown if a victim is alive, the operation should proceed as a rescue. Recovery is the removal of a body from a trapped location to a location where it can be examined and identified. It is unfortunate that there are times when we cannot tell with assurance that there is no possibility of rescue. The following list may help in understanding the decision process to be followed. This list is not intended to be exhaustive, and you are encouraged to add to the list based on your own knowledge and experience.

- Know victim is alive.
  - Can see or hear victim.
  - Report from a reliable source.

- High probability victim is alive.
    - No known toxic conditions.
    - Air space available.
    - Victim fell less than 25 feet onto a moderately soft surface.
- Low probability victim is alive.
    - Victim exposed to toxic or hazardous gases or highly probable exposures.
    - Minimal chance of air space remaining.
    - Victim fell 50 feet or more onto a moderately hard surface.
- Certain victim is dead.
    - Victim exposed to high concentration of toxic gases.
    - Trapped with no air voids (example: sand bank or farm grain silo).
    - Victim fell 100 feet or more onto a hard surface.
- Body decapitated or dismembered

✓ Determination of Hazards

Hazards present at a scene may prohibit rescue of live victims. Hazard assessment of the scene may dictate whether the incident is a rescue or a recovery. A size-up or scene survey to identify potential or existing hazards can assist the decision-making process and must include the entire area. Typical general hazards present or potentially present include: unsafe ground or unsafe footing, inadequate anchors, improper equipment, potential for falling objects and potential for damage to equipment from the work environment

✓ Determination of Risk verses Benefit.

Another way of analyzing the "rescue" versus "recovery" issue is to weigh the risks versus the benefit. All rescue work involves some risk, but some operations are riskier than others.The following should be considered when calculating risk vs. benefit:

- Danger to rescuers.
- Number of victims.
- Are the victims salvageable?
- Capabilities of the department.
- Anything overlooked?

Introduction to Search

Search is defined as "making a thorough examination of (something) in order to find something" or to "make a careful investigation". Search is considered by many to be the classic mystery – all of the clues are there to be discovered by investigation, interviews and assimilation of all available information.

Much research has been performed regarding search theory. In fact, entire training programs have been developed and books written on this subject (typically on a single type of environment). Search can be an expensive proposition – money, people and time - so it is important that you have at least a basic understanding of the search process. The purpose of this lesson is to develop this understanding and also to introduce you to some basic components that may be of some use at an incident involving a search for victims.

Search Environments

Different environments require the use of different search strategies and tactics. Even so, some basic methodologies remain the same. Some sample environments include: wilderness, structural collapse, excavation / trench collapse, water, vehicle / machinery incidents and cave / tunnel / confined space.

Search Tactics

The decision determining search tactics depends on a number of considerations including the urgency of the mission, search resources, existing hazards, and the assumed status of the subject. The two types of search tactics are passive and active.

The objective of a passive search is to make the subject come to you. This includes waiting, confinement and attraction.

The objective of an active search is for you to find the subject. Within this category, 3 search types have been identified. A Class I search is based on speed. This involves the rapid response to areas of high probability by immediately available resources. A Class II search is based on efficiency. This is a fast, systematic search that focuses on high probability segments of the search area. This type typically produces high probabilities of detection per searcher-hour of effort and is often effective in locating clues. Finally, a Class III search is based on thoroughness. This is a slower, highly systematic search and should be used as a last resort This type tends to be labor intensive and may use untrained searchers. Because of this lack of training, it is not unusual that clues are missed or destroyed.

This course uses a seven step approach to search is used in both passive and active modes.

✓ Investigation / Size-up – This is a process of collecting information (clues) that will help define the search and should be ongoing to collect new information. Information collected might include (depending on search particulars):

- Last known location.
- Last known direction of travel.
- Subject condition (mental & physical).
- Capabilities of the lost individual (i.e. lost hiker with significant wilderness experience).
- Available resources (i.e. lost hiker with full camping gear and sufficient food).
- Negative life events (criminal history, financial problems or family/personal problems).

✓ Interviewing – Interviewing is initially performed by first arriving responders. Additional interviews and follow-up by trained interviewers (investigators) is performed if possible. Interviewees might include:

- Witnesses
- Friends
- Relatives
- Co-workers

✓ Evaluate search urgency – This helps to determine speed, nature and level of response. Factors affecting urgency include:

- Subject profile (young vs. old, medical condition, number of missing subjects, etc.).
- Environmental (short /long term).
- Subjects experience and available equipment.
- Terrain/hazards.
- History of incidents in the area/site.
- Time elapsed.
- Other examples based on specialty.

✓ Confine (or define) the search area – This is an initial tactic used to limit the probability of area of victim location (make sure the person you are looking for is spotted should they leave the search area). In other search environments, this may be to determine where the victim cannot be. As an example, in a structural collapse incident, this could be that the victim must be in specific area of the building because that is where they were seen when the eathquake hit. This step requires prompt initial reaction when searching for a mobile subject.

✓ Segment the search area – This involves breaking the search area down into manageable pieces. Boundaries should be defined by what can be seen and identified by the searchers such as manmade objects and/or natural boundaries.

✓ Conduct the search – You need to determine which segments will receive what resources and in what order. This is based on many factors including:

- **Probability of Area** - What is the probability that the person is in the area to be searched. This is really a guess based on all of the available information.
- **Probability of Detection** - If the person is in the area being searched, what is the probability that the person will be found using the planned resources and methods. Decisions are based on things such as (but not limited to): victim condition, terrain, resource training level, equipment and number of rescuers.

✓ Termination / Demobilization

This process is not necessarily a reverse image of mobilization. It needs to be planned for and may be continuous during search operations as resources are no longer needed or deployed.

Demobilization considerations include:

- Incident needs and probabilities
- Timing
- Resource control
- Staffing
- Communications
- Transportation
- Funding

✓ Critique

This is a review process intended to identify the lessons learned from the incident and is a complete review of the response from start to finish to determine:

- How and why did the incident occur.
- How could it have been prevented.
- Assess the effectiveness and efficiency of the entire operation.

Search Resources

Resource identification is part of the planning process and will help in determining your needs and capabilities. Resource types include personnel, equipment and other specialized resources.

Personnel resources might include incident management / support teams, trained searchers, specialized searchers and EMS. Equipment includes specialized visual and acoustic devices. Other specialized resources include dogs that may be air scent or trailing capable. Dogs & handlers should be trained and certified to nationally accepted standards.

Psychological Aspects of Rescue

Critical Incidents

Emergency responders are continually exposed to and have to function at situations outside the norm of daily living. Responders develop various skills to assist them in coping with these incidents. Sometimes however, the call is so tragic or traumatic that the responder's skills are not sufficient and critical incident stress reactions develop.

Frequently victims will also show signs of stress and will require more than just physical rescue. They may be so emotionally overwhelmed that their reactions become exaggerated and they become dangerous to themselves and others. Family anxiety is natural because of their need to have their hunger for information satisfied. If emotional support is given promptly to victims and family members, you may prevent such reactions as persons collapsing from shock, family members injuring themselves, and hysteria spreading to the crowd.

It is important to be able to identify the types of situations that can result in critical incident stress. This section will outline these types of incidents. A critical incident is **any incident** causing a stress reaction that has a negative impact on an emergency responder. The incident is usually a tragic or traumatic event.

A Critical Incident has the following characteristics:

- The incident causes a profound emotional reaction in those responding to the call.
- The incident is unexpected and is seen as unfair, illogical or senseless.
- The emergency responder perceives that his/her efforts have **little control or effect** on the outcome of the incident.
- The outcome is **negative**.

It is not possible to predict whether a call will cause a critical incident stress reaction. Critical incidents range from mass casualty events to calls involving single victims. The following types of events carry a high probability of causing stress reactions in the responders involved in the rescue efforts.

- Serious injury or **death of a colleague** in the line of duty.
- **Mass casualty** incidents (e.g. airline disaster).
- Violence to, or death of, an **infant or small child**.
- Incidents that **"shouldn't have happened".** Calls which violate the responder's sense of right and wrong, how the world should be (e.g. a family on the way to a picnic killed in a car accident).
- Situations where **"nothing worked"**, where everything goes wrong and the outcome is negative.
- Death of a patient after a **prolonged rescue attempt**.
- Excessively **violent incidents** (e.g. rapes, murders).
- Incidents where the responder **knows** or identifies with the victim (e.g. fatality in a small community).
- **Natural disasters** (e.g. tornado, Hurricane, Andrew, flood).
- Serious injury to or the **death of a person** while in the responder's care.
- Working in a potentially **dangerous situation** (e.g. risk of exposure to a fatal disease; hazardous chemicals; unsafe conditions).
- Incidents with **unusual and disturbing sights and sounds** (e.g. body parts).

Critical Incident Stress

Critical incident stress is a set of stress reactions caused from involvement in, or exposure to, a critical incident. Critical incident stress occurs when the emergency responders' **coping abilities are overwhelmed** by the event. The stress reactions can be physical, cognitive, emotional, or a combination of these. The reactions can range from mild to severe. The more intense reactions have the potential to interfere with the responder's ability to function at the scene or can later affect the person's personal and/or professional life.

Critical incident stress reactions are normal and expected. They result from normal individuals being involved in abnormal events. Most responders involved in critical incidents will develop **some** stress reactions. Not all responders involved in the same incident experience the same degrees of severity or type of stress reaction. Some responders may not experience any stress reactions and this is also normal.

Stress reactions may start at the scene. Usually stress reactions are delayed, beginning hours, days, weeks or even years after the incident.

Stress reactions most often start after leaving work, when the responder is alone and has time to think. The stress reactions are usually **temporary**, subsiding in three to six weeks. When the stress reactions persist beyond four weeks, cause the responder some concern, or interfere with the responder's ability to cope with his/her personal or professional life, a mental health professional should be consulted. The responder's physician should be made aware of any symptoms of concern to the emergency responder.

✓ Factors affecting the severity of stress reactions

There are conditions or factors which can affect the severity of the stress reaction. Some of the factors are related to the responder's role at the scene and others to the responder's internal state.

Emergency responders at greater risk for stress are those who;

- Are the first on the scene. Emergency responders who arrive later on the scene have more information and more time to psychologically prepare for the incident.
- Have more direct involvement with the incident. The more direct exposure to the incident, the greater the potential for stress.
- Spend the most time at a scene.
- Have decision-making responsibilities.
- Have a strong identification with the victims, and/or the incident.

✓ State of the emergency responder

Resources available to the emergency responder will affect stress reaction. The resources include:

- Responders with **prior exposure** to high stress incidents will have already learned coping skills and may experience less intense or shorter stress reactions.
- Responders with **training** in critical incident stress and stress management techniques will have more coping skills which may help decrease the stress reactions.
- Emergency responders with personal pressures, or depleted internal resources are at greater risk of a stress reaction. **The current state of the person.**
- Responders experiencing **cumulative or chronic stress** are at greater risk.

✓ Critical incident stress reactions

The following is a list of the most frequently reported signs and symptoms of critical incident stress;

- At the scene: physical signs

Physical symptoms are often the first stress reactions the responder notices. These can include muscle tremors, shaking, weakness in legs, profuse sweating and/or need for a washroom.

- At the scene: cognitive symptoms

Cognitive symptoms are how the stress reaction is affecting the thinking patterns of the responder. These symptoms can include difficulty making decisions (e.g. deciding what to do/how to proceed),short term memory problems (e.g. forgetting the name of frequently-used equipment), poor concentration (e.g. difficulty focusing on problem at hand), tunnel vision (e.g. being unaware of nearby events, looking down a tube or tunnel).

- At the scene: emotional symptoms

Critical incidents can cause a wide range of emotional reactions. The most common emotional reaction for emergency responders is **emotional numbness**: the responders shut down their own feelings in order to function at the scene. Other emotional symptoms include frustration, self doubt (questioning oneself: if one has the necessary skills to deal with the incident), irritability, as well as anger and resentment.

- Affects on victims during the incident

Rescuers should expect victims to be emotional and possibly combative or hostile. Efforts to offer reassurance to victims that everything is being done that is possible may be beneficial. Personnel should give honest answers if possible, but try not to give specific information about any victims condition. The emotionally distraught victim's emotional state could change instantly if they are told something unpleasant even if it is factual. If you feel that an honest answer would not be in the best interest of the victim, use a neutral response: that is, if you are asked about the condition of another person who you know is dead, you may choose to respond, I'm not sure, but I do know that everyone is being cared for." Never ever use the blanket comment "you'll (he'll) be fine".

Rescuers should attempt to convince victims to help you in caring for themselves. Keep them aware of what you are doing, and what other help is on the way. Ask personal questions such as name, age, jobs, hobbies, favorite sports team or TV show, etc. to occupy their mind. Be careful what you say to other rescuers when you are away from your victim. Your victim may hear you and misinterpret your conversation, which could further upset them emotionally.

- Post-incident delayed critical incident stress reaction

The majority of critical incident stress reactions are delayed, occurring hours, days, weeks or even years after the incident. A physician should be contacted regarding any symptoms of concerns to the emergency responder that last more than 48 hours.

Physical symptoms can include difficulty falling asleep, early morning wakening, waking up through the night, waking up in a cold sweat, overall sense of fatigue. Fatigue can occur in spite of "a good night's sleep". Stress reactions can also produce nightmares, most of which are repetitive and unpleasant.

Cognitive symptoms relate to the emergency responder's thought process. Cognitive symptoms may include concentration problems such as difficulty reading a newspaper or favorite magazine. Short term memory problems may also develop such as when the individual forgets the TV show that was just watched. Other thought process problems may cause the individual difficulty in making decisions, even simple routine ones such as the inability to decide where to eat or which bills to pay.

Poor attention span and flashbacks that cause the individual to re-experience the incident may be triggered by visual, olfactory, or auditory events.

Emotional reactions can vary widely, from sadness to anger and guilt. Often the emergency responder will experience a number of emotional reactions to the incident. Emotional symptoms can include sadness, irritability, anger, guilt, grief, and the feeling of "if only".

Critical incident stress reactions often affect the behavior of the emergency responder. Behavioral consequences include withdrawal from family members, friends, and/or colleagues, an increase in interpersonal conflicts such as an increase in tension/arguments at home and work.

A rescuer may suffer a loss of interest in the job. This person is more likely to take time off from work, or to avoid coming to the fire station for any training, meetings, or emergency calls. Behavioral consequences also include loss in interest in home life or family, increased use of alcohol, tobacco and other drugs, a job change, increased accidents/illness, decreased sexual drive, and a change in eating habits (increase or decrease in appetite).

- Debriefing for significant stress reactions

When emergency responders are exposed to incidents which cause a significant stress reaction, the effects on the responder can last for days, weeks, months or even years. Personal lives and professional careers can be negatively affected by severe critical incident stress reactions.

Responders can be assisted in coping with these stress reactions through participation in a debriefing session. A debriefing is a structured psychological and educational process designed to assist individuals with critical incident stress. This process helps to mitigate the stress reactions resulting from the critical incident.

Emergency responders directly involved in the incident meet together with individuals trained in the debriefing process. The debriefing is a confidential, non-evaluative discussion of the effect of the incident on participants. Debriefings start the healing process by providing emergency responders with the opportunity to express their feelings about the incident and to learn ways of coping with adverse effects.

✓ Managing critical incident stress

During a stressful event, rescue personnel must take care of their physical needs. Take advantage of breaks when offered. Eat the healthiest food available to you at the scene and steer away from coffee and donuts if possible.

To build your confidence, tell yourself you are doing well and that you know how to do this. Take a few seconds to organize and itemize what you must do and set your priorities. Try your utmost to complete one task before moving on to the next.

If you feel overwhelmed, stop for a moment, to breathe deeply - count 1, 2, 3, 4, on the inhale, through your nose and out through your mouth. Focus your thoughts on a time when you felt strong, confident and competent. Picture the event or accomplishment that made you feel that way. Try to capture the feelings of competence and carry them with you.

After a stressful event, take care of your physical needs. Eat regular meals stressing proteins and complex carbohydrates (e.g. pasta and bread), not refined sugars. Try to rest when tired. Burn off some of the tension through exercise. Don't do vigorous exercise less than one hour before trying to sleep.

Don't increase your use of potentially harmful chemicals, such as caffeine, alcohol, nicotine, medications. There is a tendency to "double up" the consumption of alcohol and nicotine. Don't change your normal rate of taking medication unless advised to do so by your physician.

Watch for signs of critical incident stress and know these are normal. Talk to other people who care about you. Don't limit your talking to colleagues alone. Try to share some of your thoughts and feelings with loved ones - it is easy to isolate yourself from others by withdrawing after a critical incident. Attend debriefing sessions if they are available.

Use your relaxation techniques. Breathing deeply and progressive relaxation are particularly helpful when you are having trouble falling asleep. Use techniques that have helped you in the past. If symptoms become overwhelming, consult a mental health professional such as a clinical social worker. You can be referred to someone through your Employee Assistant Program or your family physician.

Unit 3: Rescue Equipment & Victim Packaging

Personal Protective and Rescue Equipment

Introduction to Rescue Tools & PPE

Hundreds of tools and appliances are used by emergency service personnel to free persons trapped at rescue incidents such as automobile accidents, farm rescues, elevators, building collapses or trench rescues.

This rescue equipment can be grouped into several categories or 'families' based on how they operate. This lesson discusses the tools comprising each family, their important safety considerations and basic maintenance considerations. Additionally, this lesson will also cover personal protective equipment used while performing different types of rescue.

Those directly involved in using rescue equipment must:

- Be trained in its safe and proper application.
- Be able to understand and operate a multitude of different types and styles of equipment.
- Have the depth of knowledge to initiate "primary" and "backup" alternative techniques as necessary.
- Have a basic knowledge of the care and maintenance requirements of the equipment.

Rescue Tool Families

Rescue tools can be divided into groups based on their primary method of operation. These groups, or "families", are frequently referred to as follows:

- Hydraulic-powered rescue equipment:
- Pneumatic (air) tools
- Electric tools
- Fuel-powered tools
- Vehicle-mounted tools
- Hand tools
- Rope Rescue Equipment

✓ Hydraulic-powered rescue equipment family consist of two distinct groups – the power rescue tool group and the hydraulic jack tool group. Both are operated by the flow of a hydraulic fluid under pressure.

The hydraulic jack tool group includes the standard hydraulic jack and the remote-controlled hydraulic jack commonly referred to by the trade name Porto-Power.

The power rescue tool group is manufactured by a number of companies and listed below are common components found on typical tool systems:

- Power Plant
- Spreader
- Power Cutters
- Power Rams

Hydraulic tool safety - Know the tool (includes: uses and limitations, proper accessories, remove keys, chucks, etc. and use correct fluid). Use safety equipment / proper clothing including safety glasses, gloves and proper clothing (avoid baggy clothes) Keep clear of moving parts and keep guarded where possible.

Hydraulic tool maintenance - Follow manufacturers instructions and department SOPs. Keep equipment clean, check equipment for damage or leakage of fluid and only use fluid approved for that tool.

✓ Air-Powered (Pneumatic) Rescue Equipment Family

This type of tool uses compressed air as its source of power. Included are the air chisel, air gun, air impact wrench, air jacks, air bags, air cushions, and other specialized air-powered tools. In addition to the tool and air source, a pressure regulator is typically required to control the air pressure entering the tool. When using air bottles for a source , the air tool consumption rate should be determined to ensure adequate air supply. Air consumption is

measured in cubic feet per minute (cfm) so you divide the consumption cfm into air bottle size (in cu. ft.) to determine working time per bottle.

Air Bags resemble a rubber pillow when inflated and operate with a pressure of between 116 and 145 psi When calculating the lifting capacity of a bag (Figure 3-1), length times width times the internal psi air pressure yields the maximum force output of that bag. (Example: A bag with a working area of 30 in x 30 in has 900 square inches of working surface area. If 118 psi air pressure is provided inside the bag, the total air bag force can then be calculated at 106,200 lbs. (118 psi multiplied by the 900 square inch surface area). This particular bag would be rated by the manufacturer as a 53-ton capacity bag). The same bag may also carry a height rating of 18 inches maximum. As a rule, an air bag will exert its maximum-rated capacity until the center of the bag has lifted 2 inches. As the bag continues to expand, the contact surface area begins to diminish, thereby reducing the total lifting capacity to the point that at full inflation height the bag generally has only 50% of its original working surface area (and thereby its lifting capability) still in contact with the surface below.

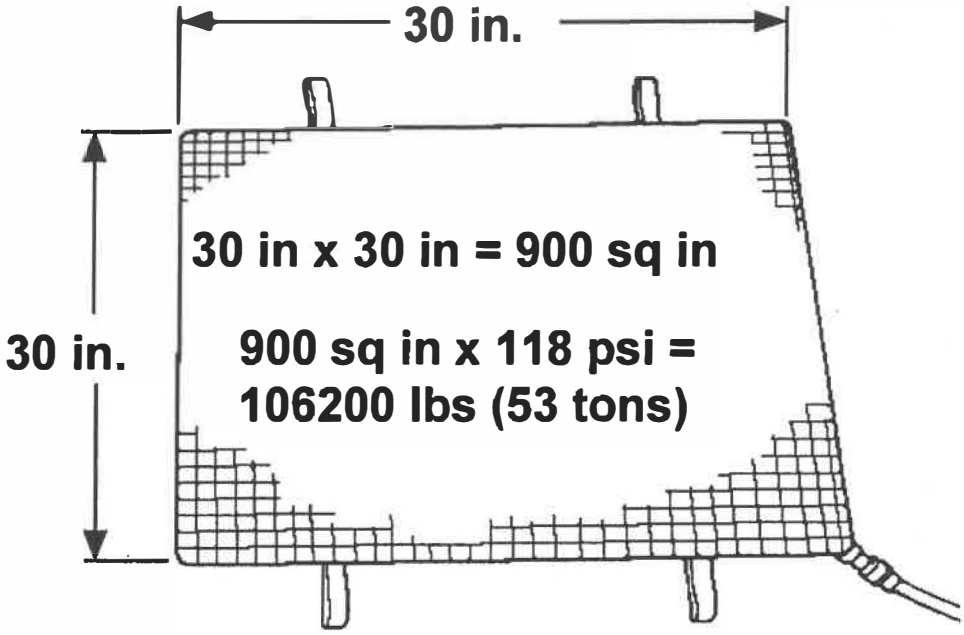


Figure 3-1

Air tool safety - Know the tool (includes: its uses and limitations, proper accessories and remove keys, chucks, etc). Use safety equipment / proper clothing including safety glasses, gloves and proper clothing (avoid baggy clothes) Keep clear of moving parts and keep guarded where possible

Air tool maintenance - Follow manufacturers instructions and department SOPs. Keep equipment clean and check for any damage.

✓ Electric-Powered Rescue Tool Family

These tools may be AC or DC and come in various voltages. Generally, the higher the voltage, the more powerful the tool. Electric-powered equipment includes: cutting tools (i.e. saws, grinders and plasma cutter), drills & hammers, pumps and lighting.

Electric tool safety - Know the tool (includes: its uses and limitations, proper accessories and remove keys, chucks, etc). Use safety equipment / proper clothing including safety glasses, gloves and proper clothing (avoid baggy clothes). Keep clear of moving parts and keep guarded where possible. Pay attention to the possibility of electrical shock (damaged cord, overload, short circuit, proper grounding & short circuit protection).

Electric tool inspection/maintenance - Follow manufacturers instructions and department SOPs. Keep equipment clean and check for any damage (i.e. damaged cord insulation, cord strain relief, plug and make sure the ground plug (where provided) has not been removed or damaged).

✓ Fuel-Powered Tool Family

These tools derive their power from burning or exploding fuel. Included in this category are cutting tools (i.e. rotary power saw and cutting torch / slicing torch), driving tools (i.e. powder-hammer gun and fuel gas nailing gun) and gasoline powered accessory equipment (i.e. generators, compressors and pumps).

Fuel-Powered tool safety - Know the tool (includes: its uses and limitations, proper accessories and remove keys, chucks, etc). Do not use in an flammable or enclosed atmosphere. Use safety equipment / proper clothing including safety glasses, gloves and proper clothing (avoid baggy clothes) Keep clear of moving parts and keep guarded where possible.

Fuel-Powered tool maintenance - Follow manufacturers instructions and department SOPs. Keep equipment clean and check for any damage and check and change fluids as appropriate. Check & clean or change filters as appropriate.

✓ Vehicle-Mounted Rescue Tool Family

This family includes tools permanently mounted to and powered solely by the vehicle to which they are attached. An examples include a vehicle-mounted winch, lighting system, air system or hydraulic system.

Vehicle-mounted tool safety - Know the tool (includes: uses and limitations, proper accessories and use correct fluid). Use safety equipment / proper clothing including safety glasses, gloves and proper clothing (avoid baggy clothes) Keep clear of moving parts and keep guarded where possible

Vehicle- mounted tool maintenance - Follow manufacturers instructions and department SOPs. Keep equipment clean and check for any damage. Chech and clean/change filters or fluids as appropriate.

✓ Hand Tool Family

This family contains the most basic rescue tools of all. They receive their power by simple, mechanical means directly from the tool operator. They use no electricity, hydraulic fluid, compressed gas, or fuels of any type. Grouped according to prime function, this family includes: cribbing blocks, forcible entry tools, cutting tools, pulling tools, safety control equipment and basic medical equipment.

Hand tool safety - - Know the tool (includes: uses and limitations and proper accessories). Use safety equipment / proper clothing including safety glasses, gloves and proper clothing (avoid baggy clothes).

Hand tool maintenance - Follow manufacturers instructions and department SOPs. Keep equipment clean and check for any damage.

✓ Rope Rescue Equipment – This equipment is dealt with in more detail in the next section: "Rope, Webbing and Hardware".

Rescue Vehicles.

Some departments use one large vehicle designed to carry adequate quantities of equipment so everything is together at a scene. They are usually powerful enough for towing capabilities. They are less maneuverable than small vehicles and a mechanical failure means no equipment.

Other departments use several smaller vehicles. While they carry less equipment and have less towing capacity, they are more maneuverable and resources are not all committed to one vehicle or area.

In either case, possible built in equipment includes: air supply (breathing and/or tool), hydraulic rescue tool compressor, electrical power, high powered lights and winches.

Personal Protective Equipment

What you wear to the rescue is based on your personal experience as to what works and what does not. The terrain, weather, type of calls and duration all have an influence. Department standard operating procedures dictate what you wear or use for personal protection. PPE commonly used include:

✓ Body Protection
- Structural fire fighter clothing - Includes protective coat and possibly pants and protects against short duration extremes of temperature as well as some protection against cuts, abrasions and certain chemicals.Bulky construction may present mobility problems.
- Coveralls - may be flame resistant or non-flame resistant. Some are available with insulation to protect against the cold. Coveralls are preferred in many situations because of a lack of bulk and easy mobility.
- Chemical protective clothing - Provides protection from direct chemical contact. For use in situations where chemical exposure is an issue. Can be very bulky and may not work in some situations.

✓ Respiratory Protection
- Self-contained breathing apparatus (SCBA) - self contained breathing air and full facepiece provide much greater level of protection than an air purifying respirator. Available in 30 to 60 minute versions, SCBA comes with a full facepiece for eye and face protection. It may have a supplied air connection to allow for extended work time. May be a disadvantage in confined spaces because of the bulk of the backframe and bottle as well as limited air supply (non-airline types).
- Air line respirator/ supplied air respirator (SAR) - available in a sling harness type or full body harness type. Breathing air is supplied from either a compressor or stored air (bottle) system located outside the space.

✓ Helmets

Protects from falling debris, rocks and equipment. Types of helmets include: climbing helmets, fire service helmets and hard hat type helmets.

✓ Eye Protection and Face Protection
- Respirator facepiece - provides maximum protection (full face coverage)
- Safety glasses or goggles - good for areas where respirators are not needed. Should include a retainer strap (chums) and side shields.
- Helmet faceshield

✓ Gloves

A rescuer's hands need protection from rope, especially when rappelling, as well as from other hazards found in a rescue situation. Any durable leather glove will work, but we want to mention two specialty types of gloves. Depending on the type of work involved and the environment, heavy duty gloves with extra leather patches on the palms and light, tight-fitting deerskin glove with a double palm are typically used and recommended.

✓ Boots

The purpose of selecting an appropriate boot for rescue is to protect and support your feet as well as provide traction on poor surfaces. The typically recommended type for rope rescue is a moderately heavy mountaineering boot (the stiffness and narrow sole helps in climbing situations). Steel toe and shank work boots are good for most other rescue situations. In any event, the boot must provide good support for the foot and ankle, the boot should fit well and the sole should provide good traction.

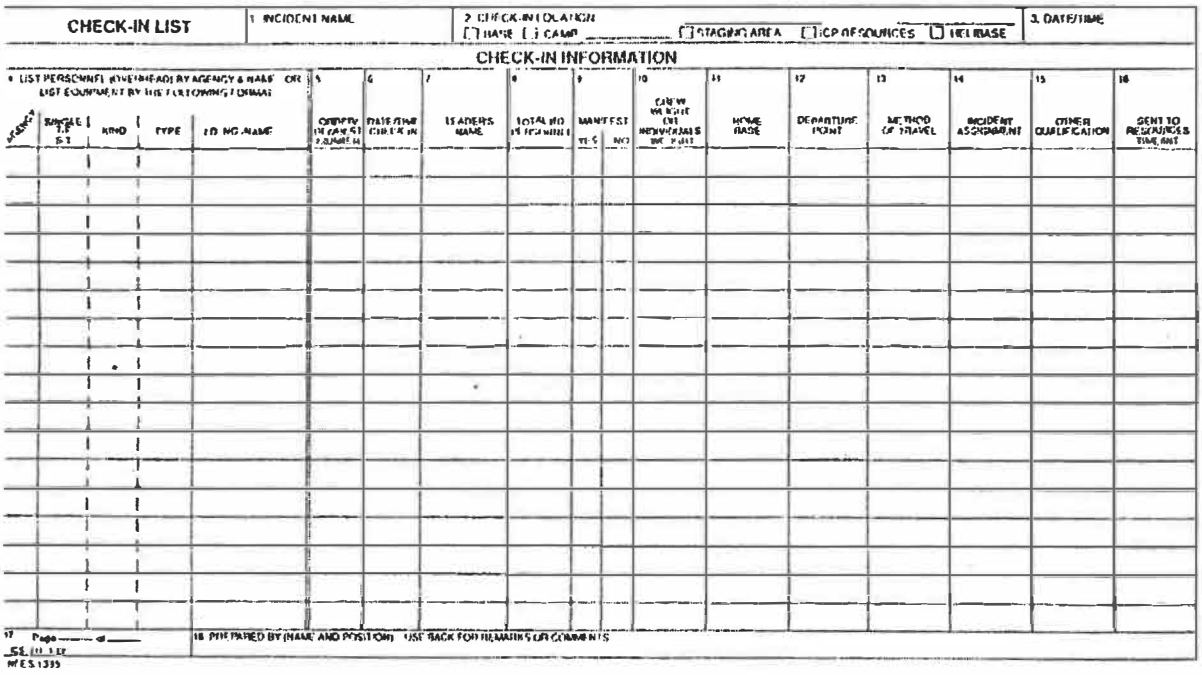
✓ Miscellaneous Equipment
- Hearing Protection - protects against hearing damage from loud noises and echo.
- PASS devices - should be worn during into spaces where you cannot be seen.
- Personal lighting – Includes: helmet mounted lights, battery operated handlights and chemical lightsticks

PPE Inspection and Maintenance - Follow the manufacturers directions and department SOPs on frequency of inspection. PPE should be inspected before and after each use for any damage that may have occurred such as: rips and tears, cracks and missing or damaged parts. Additionally PPE should be inspected periodically for any damage that may have occurred during storage. Follow manufacturers directions on inspection , cleaning and repair methods. PPE should be cleaned and sanitized according to manufacturers directions and department SOPs. All inspection and maintenance activities performed on PPE shall be documented as per SOP.

Equipment Accountability & Resource Tracking

In addition to documentation on the purchase, maintenance and use of equipment, many technical rescue organizations maintain certain records during an incident. These records, in combination with each other, provide a comprehensive resource use and accountability system. Usually under the supervision of a logistics officer, a good system can be used on a minute by minute basis to determine equipment status and needs.

Accountability & tracking systems typically fall into one of two types – manual or computerized. Manual systems may include lists, sign-out sheets or T cards (Figures 3-2 & 3-3). Computerized systems may be used in conjunction with manual systems. Some systems use bar codes for equipment and personnel signing out equipment and some can also track individuals and apparatus.



CHECK-IN LIST

1 INCIDENT NAME

2 CHECK-IN LOCATION
☐ BASE ☐ CAMP _____ ☐ STAGING AREA ☐ ICP OR SOURCES ☐ HELIBASE

3. DATE/TIME

CHECK-IN INFORMATION

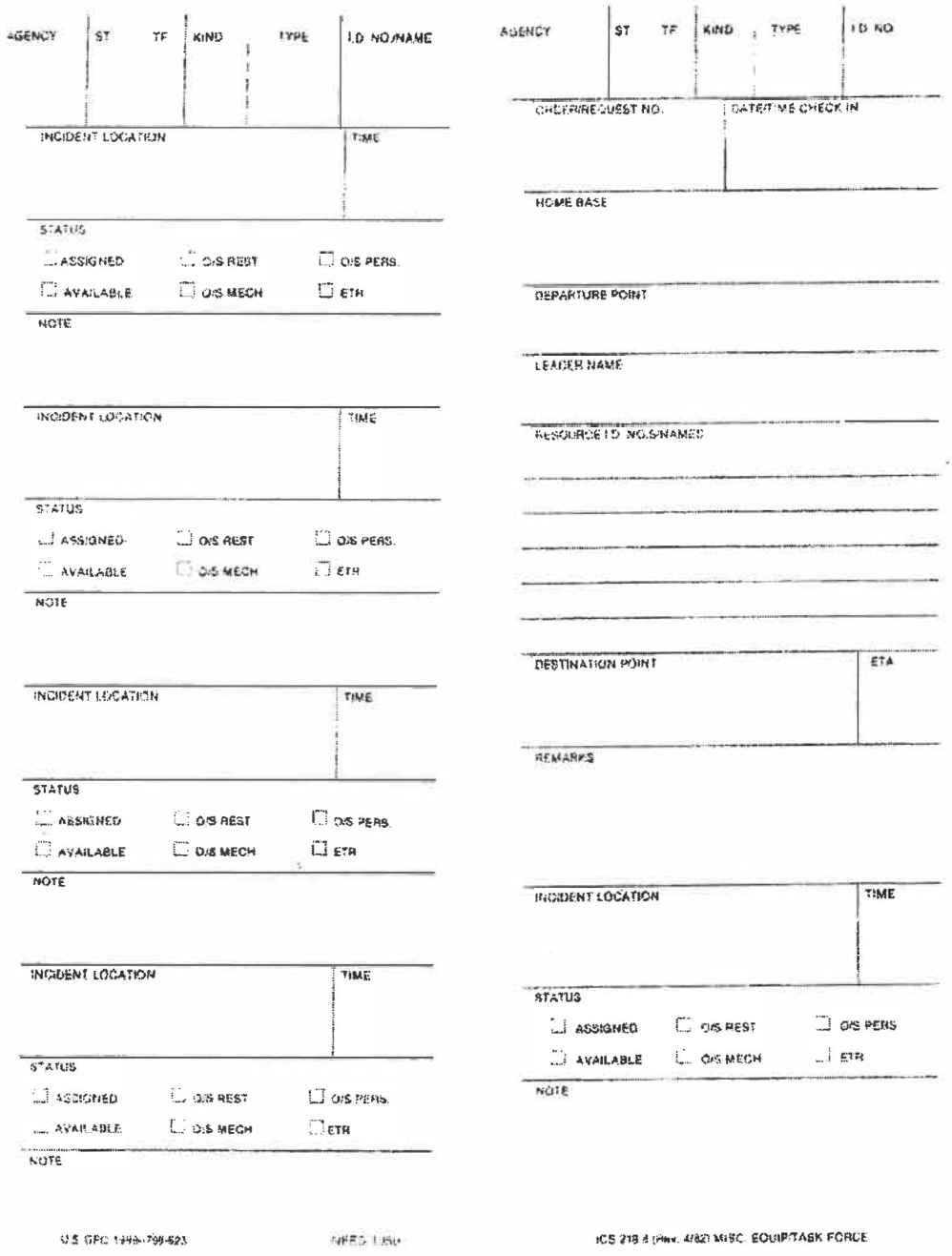
4 AGENCY	RANGE T.F. S.T.	KIND	TYPE	I.D. NO./NAME	5 ORDER #	6 DATE/TIME CHECK-IN	7 LEADER'S NAME	8 TOTAL NO. OF PERSONNEL	9 MANIFEST YES	9 MANIFEST NO	10 CREW WEIGHT OR NUMBER OF INDIVIDUALS	11 HOME BASE	12 DEPARTURE POINT	13 METHOD OF TRAVEL	14 INCIDENT ASSIGNMENT	15 OTHER QUALIFICATION	16 SENT TO RESOURCES TIME/INT

17 Page ____ of ____

18 PREPARED BY (NAME AND POSITION) USE BACK FOR REMARKS OR COMMENTS

ICS 211
NFES 1339

Figure 3-2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I.D. NO.
CHECK-IN/REQUEST NO.
DATE/TIME CHECK-IN
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DEPARTURE POINT
LEADER NAME
RESOURCE I.D. NOS./NAMES
DESTINATION POINT
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NOTE
U.S. GPO 1993-799-623
NFES 1350
ICS 218-4 (Rev. 4/82) MISC. EQUIP/TASK FORCE

Figure 3-3

Rope, Webbing and Hardware

Rope Rescue Software

Rope rescue equipment referred to as software includes:

- Rope
- Prusik Cord
- Webbing
- Harnesses
- Other auxiliary equipment such as straps, etriers, runners, etc.

✓ Rope

There are two types of rope commonly in use for rope rescue, rappelling or climbing:

- Static Kernmantle Rope - rope used for rescue.
- Dynamic Kernmantle Rope - used by rock climbers and is designed for more stretch in case of a fall.

Its uses include: to raise, lower, traverse, provide safety, and constructing/rigging of mechanical advantage raising or lowering systems.

Elements comprising a rope.

The primary fiber used in the manufacture of almost all Kernmantle rescue ropes is nylon in either braid-on-braid or three strand laid ropes. Different manufacturers use different types of nylon . The premier nylon is DuPont 707, Type 6,6. Other rope fibers available are polyester or polypropylene. A rescue rope can have different fibers in the core or center area than in its outer covering or sheath. Manila is no longer acceptable as a fiber in life rescue ropes.

Rescue Rope Construction Techniques.

Braided rescue ropes have a braided core covered by a braided sheath. This is technically described as a kernmantle rope. Static kernmantle rope has little stretch (no more than 20% elongation at breaking). Approximately 75 % of the strength of the rope is in the core. It is made of parallel fibers and is the load bearing part of rope (the design of the core determines whether it is static or dynamic). The sheath provides 25% of the strength of the rope and its primary function is to protect the core. The percentage of load carried by the core of a kernmantle rope can vary from 70 to 90 percent depending on the braid of rope and its diameter (braid-on-braid ropes can have as low as 50 percent of the load carried by core (the inner braid) and the rest carried by sheath).

The major advantages to using static kernmantle rope include: low stretch, good resistance to damaging dirt and grit, good resistance to abrasion and high tensile strength. Disadvantages include: not as easy to handle and tie knots in as some other rope types and it is not designed for severe shock loading.

Sample Breaking Strengths

Rope:	
5/16" static kernmantle	4,270 lbs.
3/8" static kernmantle	5,900 lbs.
7/16" static kernmantle	7,800 lbs.
1/2" static kernmantle	10,000 lbs.
5/8" static kernmantle	12,700 lbs.
Prusik Cord	
7mm prusik cord	2,992 lbs.
8mm prusik cord	3,630 lbs.
9mm prusik cord	3,670 lbs.

Webbing/Straps:

1" tubular spiral stitched	4,000 lbs.
Pick-off strap & stretcher strap	10,000 lbs. (buckle slips at 4,500 lbs.)
Anchor Strap	8,000 lbs.
Rescue runner	6,800 lbs. (breaking strength of loop 5,000 lbs.)

Rescue Rope Strength.

The strength rating given for a rope is the load required to break the rope (called tensile breaking strength). The working load is less than the breaking strength. We use a 15:1 ratio for safety and a person weight of 300 lbs. This means that a 1 person rope must be rated for at least 4, 500lbs. and a 2 person rope must be rated for at least 9,000 lbs. When constructing mechanical advantage systems care must be taken as they can generate great force. Exceeding the working load of a rope causes damage to some of the fibers and rope ages faster if it is abused. Also, the rope's ability to resist abrasion, water absorption, chemicals and sunlight become as important as pure strength.

Abrasion Resistance

Study of mountaineering and caving accidents has shown that broken ropes are often the direct result of abrasion (such as rope being abraded over an edge or from the rope receiving an impact load while it is bent over an edge). The advantage of high resistance to abrasion is that the rope retains its strength longer and is safer. The use of edge pads and edge rollers will further increase safety and the rope life but it is never possible to eliminate all sources of wear.

Elongation

This is referred to as stretch and exists in all ropes. It is measured as percentage of increase in rope length under a given load specification for rescue rope elongation (usually given for a load of 200 pounds)

Size

American rope manufacturers typically use inches to state rope size while European manufacturers use millimeters. The following chart shows the rope size equivalents.

Inches	mm	Actual mm
1/4	6	6.35
9/32	7	7
5/16	8	7.94
11/32	9	9
3/8	10	9.53
7/16	11	11.11
1/2	12.5	12.70
9/16	14	14.29
5/8	16	15.88

Larger diameter ropes are stronger and easier to grip while providing a slower rappel. Smaller diameter ropes have lower weight, less bulk and fit a wider variety of rope rescue accessories.

Length

The length of a coil of rescue rope is actually determined by department standard operating procedures. Rope is available in uncut spools of 300 and 600 foot lengths. Most rescue crews cut their rope into lengths of 150, 200 or 300 feet (depending on need).

Knotability

Balance is needed between a knot being easy to tie and its ability to be untied after use. Rescue ropes are designed for a middle ground where knots can be set by hand, but do not tighten excessively under rescue loads. Soft, flexible ropes tie easily and knots can be set tight by hand. Unfortunately, knots become impossible to untie after loading. Stiff rope, on the other hand, is hard to work with and knots cannot be set tight by hand. There is a possibility of coming untied or slipping before the load has set them.

✓ Webbing

Webbing is available in two types – flat or tubular. Sizes range from 1/2 inch up to 3 inches in width and are usually available in nylon or polyester. Tubular web, particularly one inch, is popular for rescue work. Heavy duty flat web comes in 2 and 3 inch widths, is stronger than one inch tubular, and is typically used for harness construction and various types of straps.

Nylon webbing is strong and is a light weight synthetic material. It is typically of a spiral weave - continuous strand wrapped around horizontal strands. As mentioned before, one inch tubular web is preferred by rescue teams and has a military specification rating of 4000 pounds. Its high abrasion resistance makes it excellent for tying anchors. The softness of webbing makes it more comfortable when used as a stretcher tie-in or an improvised harness as compared to rope

One word of caution is in order regarding webbing construction. If you can hold the web by the edges and flatten it to reveal a row of stitching holding the two layers together to make the web tubular, you have a problem. This type of web is considered unacceptable by a large number of rescue teams and should not be used.

Length and care of webbing

Department SOPs determine the length of webbing used, although the recommended lengths are:

- 12' - 15' - for anchors
- 20' - 25' - for anchors and harnesses
- 30' - 35' for basket stretcher lacing

Care of webbing is the same as rope. It is recommend that different colors be used for different lengths. This provides for easy identification.

Considerations In The Selection Of Rope And Web For Rescue

It will be your life on the line, not the manufacturer's, the salesman's, or your purchasing agent's. Read the advertisement carefully and ask questions. There are several good brands of rescue rope on the market. Depending on your rescue needs, a particular brand or type may have particular advantages over the others. Rope tests and results should be in compliance with NFPA 1983 "Standard on Fire Service Life Safety Rope and System Components".

The type of rope selected will be determined by need. Abrasion resistance, as an example, is very important to some organizations. Rope suffers abrasion in many different ways. Static kernmantle ropes perform better than other types of construction. Braided ropes and three strand ropes have their load bearing fibers exposed to abrasion causing the rope to lose strength faster . In general, the stiffer a kernmantle rope is, the greater the abrasion resistance. Also, the heavier sheaths on the American manufactured ropes give a better abrasion resistance than the European rescue/caving ropes.

✓ What To Use

For rescue applications, American made, static kernmantle ropes are the best choice for nearly every rescue situation. It has a high strength core, is protected from abrasion by a sturdy sheath and has good knotability. The sheath also helps the rope resist effects of chemicals, dirt and sunlight. The rope tends to be stiffer but it holds up better under use. Knotability is a good balance between good handling characteristics and knots that set well but do not become impossible to untie.

The nylon fiber used by all manufacturers of kernmantle ropes made for rescue have high strength, high abrasion resistance and are relatively durable. Nylon has significantly better resistance to aging than manila rope and allows even a static rope to still have enough give to withstand an impact load without failure. Polyester fiber is used occasionally for the sheath of the kernmantle rope

Although special rope rescue circumstances can require different ropes, if you are standardizing use static kernmantle rescue rope for everything. Knowing your rope's capabilities and limitations is still the key to safe use.

- Snow Rescue - wet and frozen ropes disappear in low visibility. Loads on rope in these incidents tend to be lower and surfaces that cause abrasion are usually buried under snow. Polyester braid-on-braid ropes are often used due to high strength and low water absorption.
- River Rescue - Rope with polypropylene is recommended to be used only as a water rescue throwline, and never in rescue systems or rappels. If the rope is primarily used for rescue systems and only occasionally subjected to dunking, the strength and abrasion resistance of a rescue quality static kernmantle rope are required. If a nylon rope is left in the water long enough to get saturated, you could lose up to 15 percent of the strength. But the resulting strength may still be greater than a polypropylene rope.
- Rivers can generate surprisingly high forces and ropes are going to get wet. Nylon fibers absorb water and will eventually sink. Also, soaking will also cause some loss in strength. Rope with polypropylene will float although strength and abrasion resistance are not has high as desired. A compromise is to use rope with a polypropylene core with a nylon (or polyester) outside sheath This provides increased strength and abrasion resistance.
- Environmental considerations - polyester ropes offer the best resistance to chemicals, chemical atmospheres, and sunlight. Nylon is highly resistant and, in the case of alkalis it is better. Static kernmantle rescue ropes remain the best choice. All ropes should be stored away from exposure to UV light and contaminants.

Prusik Rope / Cord

Prusik cord is of a polyester braid on braid construction. Sizes of 7 – 9 mm are typically used depending on application. 7mm is usually used for personal prusik, 8mm is used for system (braking) prusiks and 9mm is used in the construction of the BC load release hitch. It is very strong for its diameter and its softness allows it to hold well.

The diameter of prusik cord used as a rope grab should be not less than 1/3 but no more than 1/2 of the diameter of the rope it is to be used on. Length will be determined by application. Care and maintenance is the same as rope.

Anchors and Slings

A long run out from the anchor point to the system tie-in should be done with rescue rope. Attachments to rocks, trees, or vehicles can be done with one inch tubular webbing or straps. Sewn web or straps can make anchor setting faster, has a higher abrasion resistance for use as anchors, is less bulky to work with than rope and its softness and large surface area allows web to grip the anchor point (which prevents slipping).

✓ Rope and Web Care

New Rope

Inspect rope carefully before placing it in service. Be sure to read the manufacturer's literature carefully and save it. Tape the ends of the rope to identify the coil (a product called **Whip-End Dip™** can be used to protect the tape or to color code the end of the rope). Write important data on the tape such as: date purchased, rope number, length in feet, rope diameter, owner and whether it is a lifeline or utility line. A rope does not need to be broken in but a new rope will be faster than one that has seen some use.

Rope Bags

The best way to store rescue ropes is in a rope bag. The bag protects rope from ultraviolet rays and contamination. Rope is stuffed into bag, not coiled, for ease of deployment. Data provided on the outside of the bag

can include: rope length, diameter and ID number. Bags should be stored in a cool, dry place out of direct sunlight and be kept away from chemical atmospheres.

Rope Logs

Keeping track of the rope's history is one of the best ways to know whether the rope is in good condition or not. Start a rope log for each of your ropes and relevant data is to be recorded on a rope log. Log when the rope leaves the rescue vehicle and when it is back in. Note use made of the rope, any suspected damage, any shock loading incidents, any observed fraying and if the rope was hit by a rock or sharp object.

Inspection of Rescue Rope

There is no non-destructive test that will tell you how much strength your rope has lost. After each use, the rope shall be inspected before placing it back in service, even if there was no actual damage or misuse. The decision to retire a rope or to keep it in service relies on good judgment which comes only from experience in working with rope. The physical inspection must include checking the sheath for visible damage, such as necking down of the core (core shrinks at one spot). All inspections should be noted on the rope log.

When checking for sheath damage, what do you see and what do you feel? If damage looks like it came from impact or from abrasion over a sharp edge with a full load on the rope, retirement should be considered. If the rope feels like the core is missing or has an unusually soft spot compared to rest of the rope, damage may have occurred and retirement should be considered. Potential for rope damage includes: abrasion and sharp edges, dirt and glass, walking on the rope, caustics and ultra violet rays.

Maintenance of Rope

Rope inspections should be done both visually and physically. A visual inspection includes: sheath damage, rope core showing through the sheath as well as checking for dirt and contaminants. A physical inspection includes checking for soft spots in or necking down of the rope core.

- Washing - The best way to wash a rescue rope is with a product designed for use with rescue ropes or by using a mild soap. Chain the rope and put it in washing machine. Use caution on front loading washers that have a plastic window. The rope rubbing against the window can possibly damage the rope by melting the nylon rope fibers.
- Rope can also be placed in a tub with the cleaner and agitated by hand This does not clean as well as a washing machine.Fabric softener can be added to help help keep rope fibers soft and provide a certain amount of lubrication between the fibers. After washing, air dry the rope by hanging it in a loose coil in the shade. Inspect the rope again when it is ready to go back into service.

Rope Classification

Rescue rope is normally the newest ropes in the best condition and are reserved for rescues only. Training rope are those ropes taken out of service only because it is being replaced by new rope. These ropes should still meet the requirements for a life support rope. Black taped ends is the color often used to designate training equipment.

When To Retire A Rope

Reasons for retiring a rope are: age, extensive use, damage or suspected damage (such as impact or shock load, visual damage to the software and situations such as the rope being smashed between a stretcher and a wall) as well as loss of faith.

✓ Harnesses

Used as a quick clip-in point, for a belay or emergency rappel, as fall protection, as a work platform and as a means of transporting the victim.Only use harnesses certified as NFPA 1983 compliant. Harnesses are classified as one of 3 types:

- Class I – Fastens around the waist & thighs or buttocks. Designed for emergency escape with a one person load.

- Class II – Fastens around the waist & thighs or buttocks. Designed for rescue where a two person load may be encountered.
- Class III –Fastens around the waist & thighs or buttocks and over the shoulders. Designed for rescue where two person loads and/or inverting may occur.

Inspection of rescue harnesses - It is the responsibility of the user to inspect the harness. Look for worn or broken stitching and rivets torn out of the holes. Check the material for damage from abrasion, cuts or chemicals. **If it does not look safe, do not use it!**

Rope Rescue Hardware

✓ Carabiners

A carabiner attaches pieces of equipment together such as joining ropes and anchors. They are also sometimes used as a friction device. They take the load on their long axis. The gate is not intended to take the load and are rated only with the gate closed and secured.

Carabiners are constructed of either steel or aluminum. Steel is used in rescue work because of its high strength. Aluminum should only be used for a one person load - never in systems. There are two types of carabiners available, locking and non-locking. The locking type should be used in rescue applications. The pin lock type has a lock configuration that prevents the gate side from opening in a high force situation. It loses 10 - 20% of its strength when left unlocked. The machined lock type has a gate matching mechanism that holds the gate in line with the latch for alignment of the gate lock. It loses 50 - 90% of its strength when left unlocked. You should standardize on one type/kind for your department. The specifications for carabiners include a minimum breaking strength (NFPA - Major Axis - Gate Closed) :

- Personal use device - 6000 lbf.
- General use device - 9000 lbf.

Care and Maintenance of carabiners - cautions with carabiners include:

- Do not drop or throw (a drop of more than 5 ft. – retire).
- Do not attach to hard edged metal anchor points if possible - can dent/or burr the carabiner.
- Keep clean.
- Inspect for dents/burrs, rust, proper gate function, proper lock function and department markings.

Cleaning should be done by wiping clean with a cloth and using a small file or emery cloth for metal burr removal.

REMEMBER:

- Strength is from end to end - no side loading.
- Always lock the carabiner after attaching equipment.
- Do not hard link

✓ Pulley

Pulleys are used for the following applications:

- Change of direction/directional pulley.
- Mechanical advantage pulley.
- Reduce friction over edge.
- Provide rope tension.

Pulleys are constructed of a metal sheave (wheel) mounted on a bearing or metal bushing and can be aluminum or steel bodied with a steel axis. A rescue pulley should have a minimum pulley diameter of four times the ropes diameter. For example: a 1/2" rope requires a 2" pulley. A 5/8" rope requires a 3" pulley. There are 2", 3" or 4" sizes available as standard. A 4" is much more efficient than 2" because the rope bends less and has less friction.

Minimum breaking strength (NFPA 1983) for pulleys are:

- Personal use device - 1200 lbf minimum load test without permanent damage to device or rope, 5000 lbf minimum load test without failure.

- General use device - 5000 lbf minimum load test without permanent damage to device or rope, 8000 lbf minimum load test without failure.

Do not drop or throw pulleys and keep them clean. Pulleys should be inspected noting proper movement of cheeks and sheave. Any egg shaped attachment holes indicate the pulley has been over stressed. Check the tightness of nuts or bolts holding the pulley together. Wipe clean with a cloth.

Remember to use the proper diameter rope for the size of the pulley (four times the rope diameter). Use a steel pulley as a change of direction because the forces created may be compounded in this situation.

✓ Figure Eight Plate / Figure Eight Plate with Ears

A figure eight plate can be constructed of high strength plate aluminum for low overall weight or can be all steel, which is more expensive, heavier but nearly impossible to wear out.

Figure Eight Plate specifications:

- Typical breaking strength: Aluminum - 12,000 lbs., Steel - 45,000 lbs.
- Minimum breaking strength (NFPA 1983):

1. Personal use device: 1200 lbf minimum load test without permanent damage to device or rope. 3000 lbf minimum load test without failure.

2. General use device: 1200 lbf minimum load test without permanent damage to device or rope. 6000 lbf minimum load test without failure.

The figure 8 plate is designed to create friction and is typically used for rappelling where the load is not expected to exceed one person. It is considered to be height limited because it imparts spin to the rope (most noticeable over 200 ft) and excessive weight, such as a long length of rope hanging below creating a lot of weight, will act as a brake not allowing movement.

Do not drop or throw a plate. Keep them clean and inspect regularly. Check for dents and/or burrs, cracks, sharp edges caused by rope wear and distortion of holes. Wipe with a cloth and use a small file or emery cloth for sharp edges or metal burrs. Dirty ropes cause accelerated wear of figure 8 plates. When a plate is worn to more than 1/3 the diameter of the original material it should be discarded.

✓ Brake Bar Rack

A brake bar rack can be of aluminum or steel construction. Aluminum bars give a slower rappel but wear faster than steel. Racks work by generating friction based on the number of bars used and the space between the bars. The types available include 5 or 6 bar styles with a straight or twisted frame. The top bar is 1" in diameter and has a "training groove" which guides the rope. The second bar is 3/4" with a straight slot which allows the bar to fall out if improperly rigged. The 3rd - 6th bars are 3/4" with an angled slot which snaps in place.

As mentioned before, the brake bar rack works by generating friction. The amount of friction generated by the descender can be varied over a wide range. It allows the operator to reduce the friction for long rappels with less twisting. The rate of descent can be controlled by the spread of the bars as well as by rope running through the brake hand of the operator. Caution: angled bars may hold while you test the rigging, then pop loose after you have committed yourself over the edge. The training groove on the first bar (or the first and third bars) will help to keep the rope in center of rack. Racks will accept two ropes, even if some of the bars have training grooves

Do not drop or throw a rack. Keep clean and inspect regularly for dents and/or burrs, cracks, wear of bars, integrity of the weld eye, tightness of the frame nut and distortion of the frame. Clean by wiping with a cloth and a small file or emery cloth can be used to remove sharp edges or metal burrs.

✓ Ascent Devices

Ascent devices are an auxilliary equipment system component used as a friction or mechanical device to allow ascending a fixed line. They shall withstand a minimum test load of at least 1200 lbf without permanent damage to the device or rope.

The most common type of ascent device found in rope rescue is the cam (Gibbs) ascender. It is available in cast aluminum, forged aluminum and forged stainless steel and comes in sizes to accomadate 3/8 inch to 3/4 inch rope. They can be free running or spring loaded and consist of a sleeve, cam, pin and spring (for spring loaded types). The capacity of a cam ascender depends on construction. The typical breaking strength for a 1/2" size is:

- 2,550 lbs. - cast aluminum
- 5,000 lbs - forged aluminum
- 5,400 lbs - forged stainless

The use of any ascender as a pulling cam or braking cam should only be done in accordance with the manufacturers recommendations. As a pulling cam, it pulls the rope into motion. As a braking cam, it stops the rope from moving. To install on the line, remember that the arrow points toward the load. This should be double checked by pulling in the intended direction.

Do not drop or throw any ascender and keep them clean by wiping with a cloth. Inspect the cam ascender by looking for worn cam teeth, egg shaped holes for pin placement, cracks around the holes for pin placement and worn cord or chain holding the pin and cam to the sleeve. Keep the cam connected to the sleeve with the pin when stored. Make sure you check that the pin is through both sides of the sleeve during use.

✓ Edge Protection

Edge protection protects rope and webbing from abrasion and sharp edges. Rescuers can use covers, tarps, sleeves, old fire hose or edge roller devices. Edge rollers reduce friction caused by running rope over the edge. Rollers are typically constructed of aluminum. Edge protection should be secured and anchored and a person should be in place to monitor the device so that is stays in place. Mechanical edge protection devices should be kept clean and inspected for tightness of any nuts and/or bolts, worn rope contact points and that moving parts move smoothly.

✓ Stretchers

The most widely used type of stretcher today is the wire basket (stokes basket) and the plastic basket. Other specialty stretcher types commonly in use include the SKED™, Res-Q-Mate™.

The wire basket stretcher consists of the following components: main frame, ribs, skids and chicken wire lining. The plastic basket stretcher consists of a main frame and plastic shell. Better stretchers have metal support ribs which provide better structural integrity. It is highly recommended that you NOT use stretchers that do not have these reinforcing metal support ribs.

When inspecting a wire basket, plastic stretchers and others, you should look for bends or cracks in the main frame, broken welds, torn or loose wire, broken or cracked shell or ultra violet ray deterioration of plastic units.

Patient Packaging

Introduction

The proper securement and packaging of the victim serves two purposes: stabilization of injuries and providing methods for removing the victim to a safe area.

Backboard securement

The need for full backboard securement with high and low angle litter basket techniques are very much related to each other. Medical considerations also play a role in the method used. Spinal immobilization and backboard securement for high and low angle transport are two different procedures. In most cases, both work "hand in hand". First follow the NYS DOH procedures and local protocol for "C"-Spine immobilization procedures. Backboards may have a different configurations. Using a backboard with runners underneath makes it easier to pass the straps through the holes.

Consider the following securement options:

- Strap Method
- Diamond Lash – This works well when straps are not available but is time consuming. This method is used for patient securement to the board - you will still need to diamond lash into the litter.
- Spider – These are a manufactured strap that is very quick, easy to use and effective. They are a rated and shielded seat belt type strap arrangement.

Victim Lashing – Steel Litter Basket

Depending on the injuries of the victim, their weight should be supported within the stretcher by one of the following methods:

- Foot support (Figure 3-4) - Used where leg injuries are not present.
- Harness support (Figure 3-5) - This method is used when the victim has injuries to the lower extremities that prohibit the use of the foot support mentioned above. This method must be put on the victim prior to securement to the backboard. The harness is then secured to the backboard. This method is also used in conjunction with the foot tie in as a secondary attachment to the stretcher and also as an additional safety when attached directly to the belay line. Once the backboard is placed into the basket stretcher, the victim is secured into the stretcher by the use of a 30 - 35 foot piece of webbing. Use the following procedure (Figures 3-6 and 3-7):

    1. Begin by finding the middle of the webbing. Make a girth hitch around the rail at the foot end of the basket. You now have two equal lengths of webbing.
    2. If a foot wrap is to be used, pass the working ends up between the feet and proceed to make an ankle wrap. Otherwise proceed to the nearest upright cross member on the same side as the webbing.
    3. After the ankle wrap, proceed to the nearest upright cross member of the basket on the same side of the corresponding ankle wrap.
    4. Pass the webbing around the cross member and begin to cross it in a shoelace fashion to the other cross members until it ends up at the head of the basket. Never wrap the webbing over the top rail of the basket, instead, pass it around the upright cross members.
    5. From the head end of the basket, tighten each length of webbing securely and tie two clove hitches (or other acceptable method of securement) with each end of the webbing.

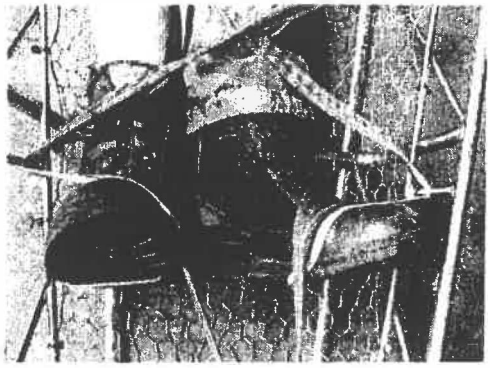

Figure 3-4

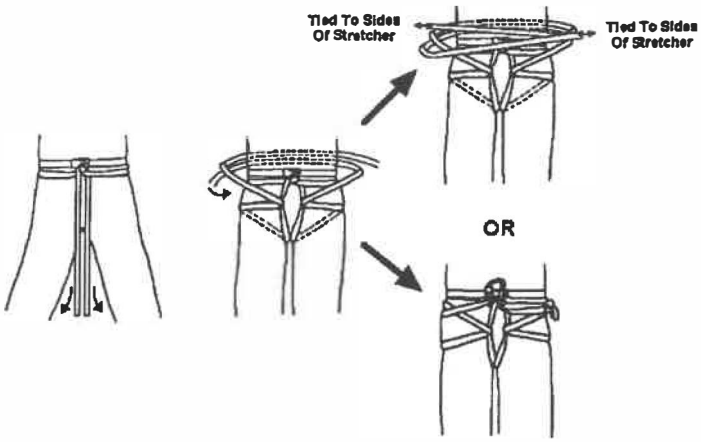

Figure 3-5

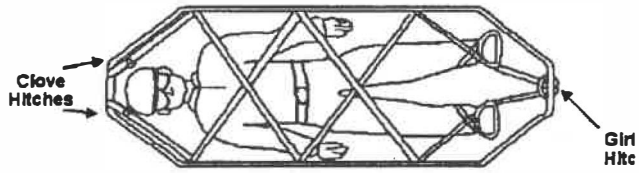

Figure 3-6

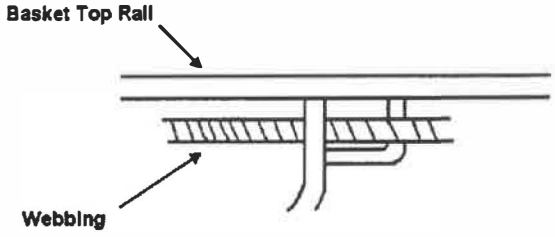

Figure 3-7

Some rope teams will girth hitch a number of pieces of webbing 15-20' in length at various spots on each side of the stokes basket, daisy chaining up the ends of each piece. This allows rescuers numerous options as to where lacing begins and ends thus accounting for the victim's injuries. A frost knot (an overhand knot tied in doubled loops of web) is used to create a loop at one end of the lacing crossties. The remaining end of the web is fed through the loop and secured with either an overhand knot or a "trucker's hitch"

Whatever specific method is used to fasten the victim to the stokes basket, the end result must be to avoid causing futher injury while at the same time insuring that the victim is SECURLY attached. There are many different types of steel baskets and in some cases the cross section of webbing near the head area may be too close to the neck. You may have to adjust the cross sections or skip a cross to remedy this problem.

Scree Bridle

Regardless of the method chosen, the head should be slightly higher than the feet (this is better for the patient). In all cases, a safety line should be considered.

✓ Commercial Bridle

Manufactured bridle that is very quick, easy to use and effective. 2 and 3 point commercial bridals are in common use. In a low angle environment, the bridal is connected to the top of the stretcher above and to each side of the head.

✓ Rope Bridle (Figure 3-8)

This method uses a 25 - 30 foot piece of static kernmantle rope (3/8" or greater) and is constructed in the following way:

1. Tie a single or double loop figure eight knot in the middle of the rope (this knot will serve as the attachment point to the lowering line).
2. Place the knot of the bridle rope at the head of the basket.
3. Wrap each of the two legs of rope extending from the knot around the top rail several times.
4. Continue to wrap the ropes around the railing, moving downward towards the feet. There should be one rope wrapped around the railing on either side of the basket and in between uprights.
5. When the ropes have reached the approximate level of the patients knees, wrap the rope on each side around the railing at least twice.
6. Bring the ropes together over the patients knees and tie them together with a square knot.
7. Back the square knot up with an overhand safety knot on each loose end.

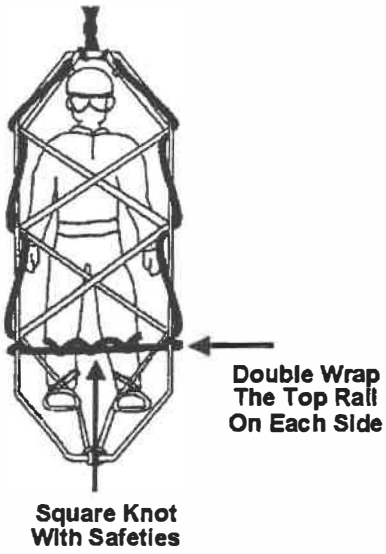

Figure 3-8

Adding Attendants

Adding an attendant to a litter basket is a common practice. It offers the patient assurance and also allows the attendant to provide medical attention if necessary. The attendant can also help move the litter around obstructions. In a low-angle environment, 4 attendants (stretcher bearers) are commonly used. The attendants must, to a degree, carry a portion of the victims weight.

Attaching Attendants

- An attendant is attached at each end of the straight portion of the side of the stokes basket (one attendant adjacent to the head should be the medic).
- Stretcher straps are adjusted in the following manner:

1. Each attendant stands adjacent to the stretcher with the stretcher strap fully extended and attached to the stretcher and harness.
2. Each attendant gets down on one knee and takes the slack out of the strap.
3. On order from the medic, all stand at the same time.
4. Minor strap adjustments are performed at this time.

Unit 4: Low Angle Rope Rescue

Low Angle Rope Rescue Theory

Theory

As a general rule of thumb, low angle is considered to be a slope of less than 60 degrees. High angle is a slope greater than 60 degrees. Local conditions may vary this slightly.

✓ Access and Stabilization

The first step in low angle rope rescue is to gain access to victim. Quick access will help to reduce the victim's exposure to additional injury, such as to protect the victim from physical exposure, falling or being hit by rocks or debris from above.

While gaining access, you should make every effort to make contact with the victim. Voice contact should be made as soon as possible. Assign a team member to talk to the victim while you are getting set up. Tell the victim not to move. Also, it is best if the team member and victim can see each other.

While gaining initial access, sometimes it is easier to self-lower down to the victim than to try to climb up from below. Self-lowering down depends upon being able to reach a point above the victim and being able to place anchors there. Other routes of access include traversing from the side or to pendulum across.

On approaching the victim, protect the rescuer first and foremost, then protect the victim. Pick a path free from rocks or other debris that might fall or roll. Keep the end of your rope away from the victim (it may hit him, the victim may try to grab it, the victim may miss rope and fall or the victim's pull on rope can stop your lower just like a bottom belay).

Determine the victim's medical condition including the effects of shock, hypothermia or emotional distress. The victim's medical condition will determine the type of evacuation and the victim's ability to assist may significantly reduce manpower requirements and degree of sophistication needed.

✓ Physical Stabilization

Upon accessing the victim, connect the victim to your lifeline, not to your harness. Put a harness and helmet on the victim as appropriate if they are not wearing them. You should also keep the victim shielded to protect him from falling objects from above.

✓ Medical Stabilization

Sophisticated medical treatment cannot be done while hanging on a rope or on a moving stretcher. Basic life support that can be done at the scene is the first priority. For serious injuries, the sooner the victim can be packaged and safely transported to an advanced life support vehicle and to the hospital, the better.

When performing medical stabilization, the following points should be followed:

- Establish communication with victim.
- Let him know who you are and what you will be doing.
- Gather information about the accident and his medical condition.
- Begin the medical survey.
- Start appropriate treatment.
- Summon additional medical gear or manpower from the crew above.
- Prepare the victim for evacuation.

✓ Packaging

Victim packaging is meant to provide a means of transporting the victim while protecting them from further harm. In addition to the points covered in the llesson on victim packaging, the following will also provide some assistance in effective packaging:

- Once in the stretcher, wrap the victim in a blanket or put them in a sleeping bag if appropriate
- Provide a helmet if there is any chance of rocks or debris falling from above.
- A blanket rolled into a horseshoe shape will help stabilize the head and neck.
- Injured parts of the body should be padded.
- Foot stirrups should be used if possible.
- Tie the victim's hands into the stretcher so that a frightened victim cannot grab the rail of the stretcher.
- Secure any EMS equipment in the stretcher such as oxygen or splints.

Low Angle Rescue Anchor Systems

Anchors are defined as a stationary, hold fast to which rigging is attached. Anchors are a critical part of any rope system. Failure of an anchor can result in serious injury or death.

✓ Terminology

Anchor is a generic term which refers to all of the hardware and software components that are combined to attach rope systems to immovable objects.

Anchor Point is the object that webbing or rope is tied into or around when constructing anchors. It could be a tree, bush, piton, fire truck, boulder, guardrail, etc.

Anchor Systems connect anchor points together to create a stronger anchor. The ultimate aim in constructing anchor systems is to create an anchor that is **self-equalizing** (designed so that all anchor points in a system share an equal percentage of the load forces) and **omni-directional** (designed so that the no matter what direction the load is pulled the forces on the anchor points remain relatively equal).

BFR is slang for a very large rock, but also includes big trees, fire trucks, water tanks, stairways and other large, well anchored objects. BFRs are said to be **bomb-proof** or capable of holding the load under any and all circumstances.

Backed Up means that the anchor has a second, independent anchor also connected to the load. If one anchor should fail, the second would hold the load.

Double Anchor Rule A fundamental operational guideline for all rope rescue situations is to **"back up all anchors"** this may involve the use of two independant anchors and or backing up a single bomb-proof anchor with the construction of redundant anchor systems for all live load applications.

Fixed Anchor Systems (also known as **directional, load sharing anchor systems)** distribute the load among several anchor points. Pulling the load in any direction other than perpendicular to the anchor points will place most or all of the load forces on one anchor point.

Omni-Directional means that the load forces at each anchor point are equalized regardless of shifts in the direction of pull from one side to the other.

Picket Holdfast Anchor is a series of stakes driven into the ground to form an anchor. This is used when other anchors are not available.

✓ Examples Of Anchor Points

Natural anchors are most frequently associated with "wildland" environments, but have urban applications also. You must check to make sure they are solid and estimate their holding ability based on their size and the condition of the soil. Examples of natural anchors include: trees, boulders and brush/root systems. Large bushes can be used, but almost always as part of a self-equalizing system.

When using natural anchors, tie the web as low to the base as possible. This reduces the leverage on the root system. Make sure the tree or bush is alive. Watch out for sharp edges and pad if necessary. Wet ground can reduce the holding power of both rocks and plants so be even more conservative after (or during) a storm.

Man made anchors include buildings, bridges and structural steel as well as vehicles. Building components commonly used as anchors include: window washer stanchions, steel trusses, doorways (deadman technique), windows (in one out another), interior furnishings, standpipes, stairwells, fire escapes and ladders.

When using vehicles be sure to tie to the axles – not the bumpers. Place the vehicle in park (standard transmission in reverse with parking brake set). Additionally, disable the vehicle from starting i.e. remove keys, post a guard, etc.

In an urban environment, rescuers must be prepared to locate and/or rig man made anchors. Locating anchors might consist of pulling plaster walls, ceilings and/or ripping up floors to gain access to structural components. Rigging an anchor could also consist of placing a desk in a door opening lengthwise and attaching the system to the center of the desk or rigging a deadman or picket anchor. In any event, make certain that whatever you are wrapping is secure and that all sharp edges are padded.

✓ Pickets as anchors (Figure 4-1)

Pickets are primarily used in the wilderness environment. Their use is limited in the urban/suburban environment. They are primarily used as anchors for snow, sand or dirt conditions. A picket line can also provide a relatively solid anchor where nothing else will work. When constructing a picket system, three pickets are usually needed for an anchor point.

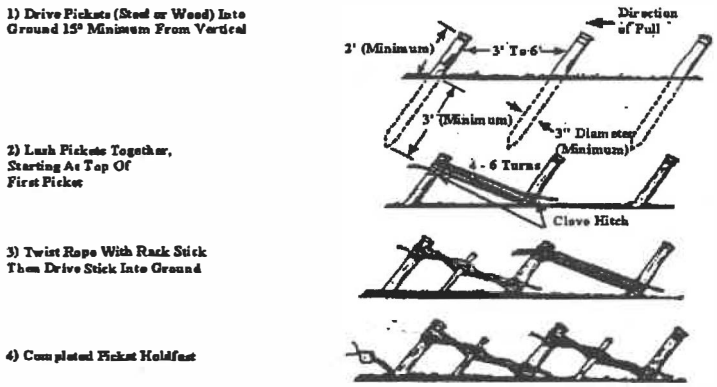

Figure 4-1

✓ Selecting Anchors

The rescuer must give careful consideration to the selection of any anchor(s) to be used in a rescue system. Care must be taken to consider the following:

- Purpose of the system.
- Amount of the load.
- Direction of pull/loading.
- Strength of the anchor.
- Mass of the anchor.
- Contour of the anchor.
- Location of the anchor.

Double Anchor Rule

All life support lines should have two independent anchors or, if absolutely bomb proof, should have redundant hardware and software connections to the anchor point. Anchor points are often out of sight so any potential failure cannot be seen in time to be prevented. Anchors are normally backed up by tying to another anchor that is also capable of holding the expected load. An anchor is considered to be backed up if each anchor point can support the load.

The term "BFR" or "Bomb Proof" describes a totally 'failure proof' anchor. It should be used for both the main anchor and back up. Use a second piece of web or rope to back up the first in case a mistake is made in tying the knot or if something else causes a failure. (Figures 4-2 and 4-3)

Figure 4-2

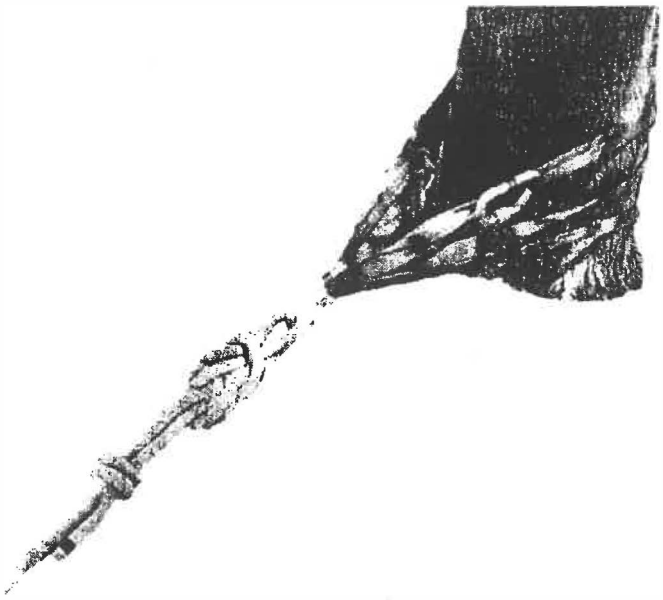

Figure 4-3

✓ Anchor Strength

Think about what kind of loads the anchor will have to hold. A rappel anchor set up to access the victim must be re-evaluated as a rescue anchor if it will be used for a stretcher system. Hauling systems generate higher loads than lowering systems due to the forces generated by the haul team. Putting all the considerations together, set the anchor to handle the highest expected load.

Most teams use web for tying anchor points. This is because it is light in weight, the wide surface area provides a good grip on anchor points and it offers high abrasion resistance. One inch tubular webbing should always be looped and doubled to insure necessary safety margins. Never use a girth hitch. To avoid the potential for side loading the carabiner used to attach a rope to an anchor sling, use one carabiner to make the web sling a continuous loop and use a second carabiner to connect the rope.

Watch the interior angles (Figure 4-4). If the angles become too large, the load on the web will be multiplied. Keep the web as close to the base of the anchor point as possible (this maximizes the strength of the anchor). Finally, tie the web so it does not slip off the anchor object.

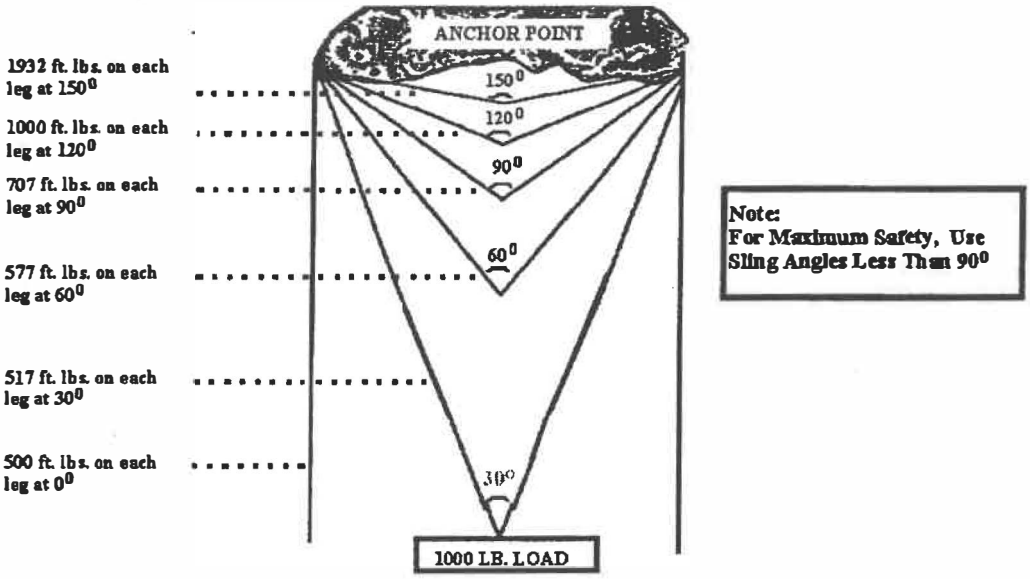

Figure 4-4

When setting up anchors, check the direction that the load will be pulling. (Figures 4-5 thru 4-8)) Make sure that the anchor point will handle the load in that direction. Check carefully for any looseness, cracking or other weak points before committing yourself to anchor. If the anchor point is not strong enough, you will need to combine several anchor points to make an anchor system.

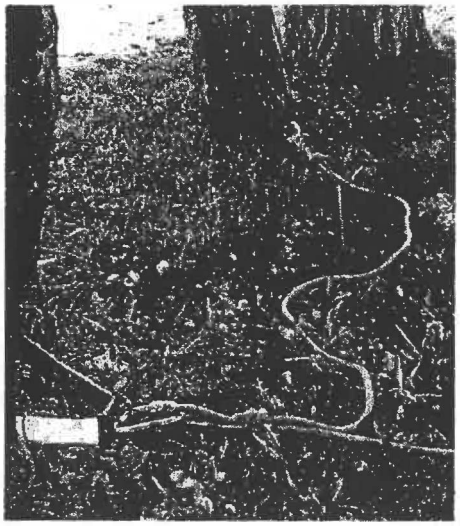

Figure 4-5

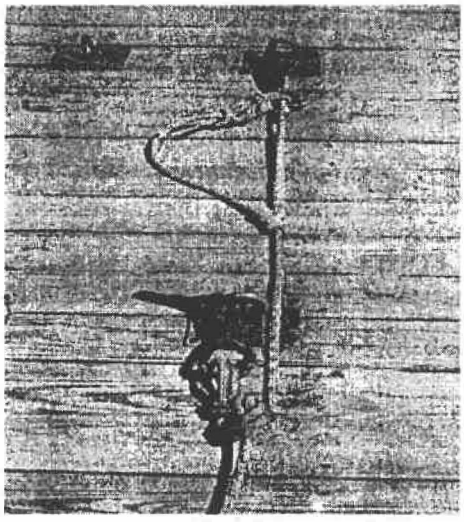

Figure 4-6

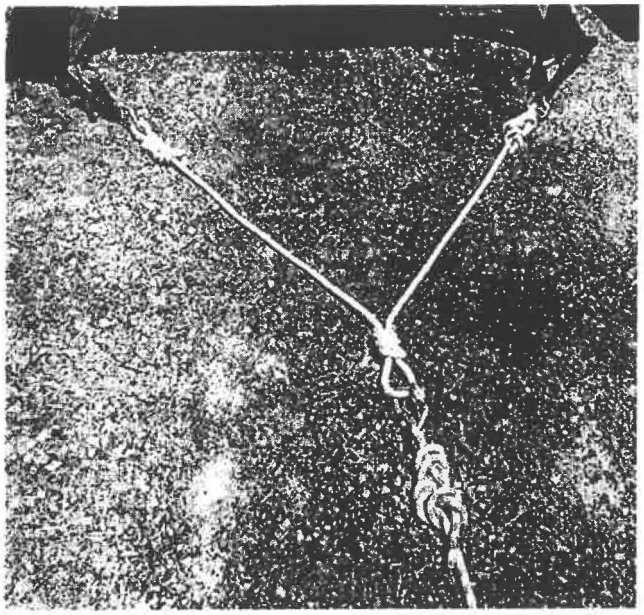

Figure 4-7

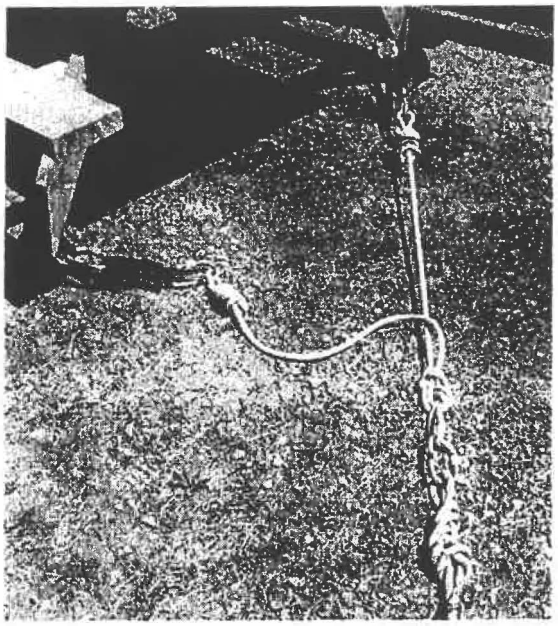

Figure 4-8

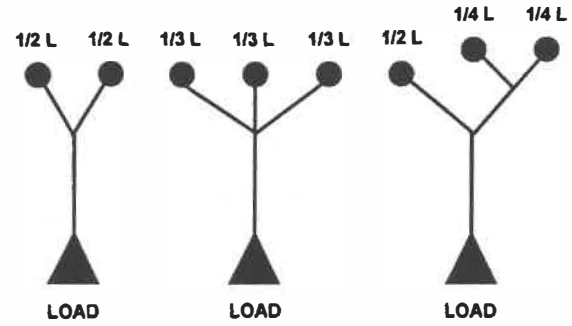

Figure 4-9

Anchor Systems

Anchor systems perform two functions, share or equalize the load on each of the anchor points used in the system and make the distribution of forces "omni-directional". (Figure 4-9) The load on individual anchor points still remain equal should the direction of pull change. In theory, a three point system should place 1/3 of the load on each of the three anchor points. Rope drag and other friction in the system will prevent the load forces from being precisely equal in actual applications. Because the distribution of forces among anchor points happens automatically, the system is said to be "self equalizing".

✓ When You Need An Anchor System

You need an anchor system whenever you do not trust any one of the available individual anchor points to hold the entire load. Anchor Systems distribute the load so that when the direction of the load will be changing , such as in a pendulum across a cliff or snow field, the load will be distributed among the anchors. The omni-directional nature of an anchor system will keep the load even on the various anchor points.

✓ When Not To Use An Anchor System

If a single anchor point will hold the load (is **bomb-proof),** the anchor point can be backed up to another anchor point or additional webbing slings and hardware can be used to make the connections redundant. If anchor slings are nearly the same length, there will be very little movement if the primary anchor point should fail. The trade off to tieing directly to two anchor points is that the anchor becomes non-directional. Directional movement may cause the load to be shifted from one point to the other.

✓ Multi-Point Anchor System

Muti-point anchor systems connect two or more anchor points together. They are frequently tied with anchor extensions connected to a short webbing loop that is crossed so that, if one anchor fails, the carabiner does not slide off of the webbing. (Figure 4-10)

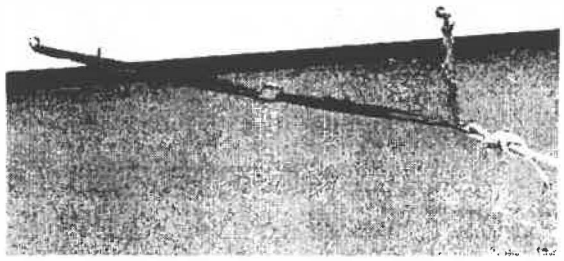

Figure 4-10

✓ Fixed Anchor Systems (Figures 4-7 and 4-8)

This is a two point anchor system that provides a non-directional anchor system. 1" tubular web is normally used and should be wrapped around the anchor in the same manner as the two point self equalizing anchor system. Each end of the webbing loop is secured to its own anchor. Care should be taken to insure that the interior angle never exceeds 90 degrees.

Low Angle Evacuation: Raising & Lowering Systems

Raising Systems and Mechanical Advantage

In many rescue situations that may be encountered, sheer strength may not be enough to move a victim, the rescuers or an object. In fact, this method may be one of the least safe methods available to us. Because of this, we use mechanical advantage systems that are designed specifically for rescue work. These systems provide the lifting or moving ability necessary, while at the same time giving us a great level of control and safety. The choice of equipment that is available for use is wide and a thorough understanding of this equipment and its limitations is very important.

In theory, a 3 to 1 mechanical advantage system will reduce the force needed to pull the load to one third of the original weight. In other words, a 100 pound pull would raise a 300 pound weight. Due to friction and other factors, however, the system does not operate at its theoretical value. The actual mechanical advantage is just below 3 to 1.

Another consideration is that, because of the way the rope is rigged, you have to pull a proportionally greater distance for each foot that the load is moved. With a 3 to 1 System, you have to pull in three feet of rope for each foot that the load moves (in other words, the rope moves 300' through the raising system to move the victim just 100 feet).

✓ Simple Mechanical Advantage Systems

The pulley system selected will depend on the amount of weight to be moved, the available personnel, the equipment available and the system configuration necessary for the particular site. The mechanical advantage of a simple system is determined by counting the number of ropes supporting the load (Figure 4-11).

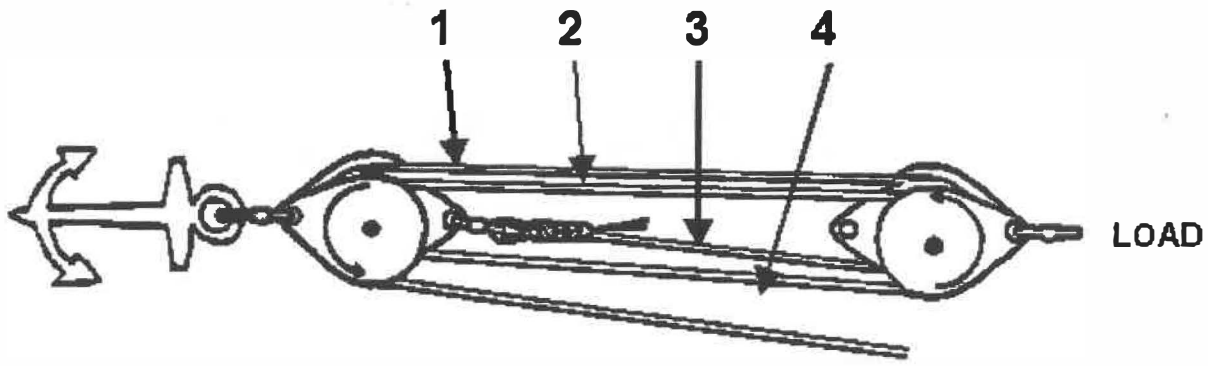

Figure 4-11

One common system for raising a load is the 3:1 Z-System (Figure 4-12). With a three or four member haul team, it will usually do the job. If more mechanical advantage is required, systems can be rigged together to multiply the advantage. Be careful though: rigging two 3:1 Z systems together will create a 9:1 mechanical advantage!

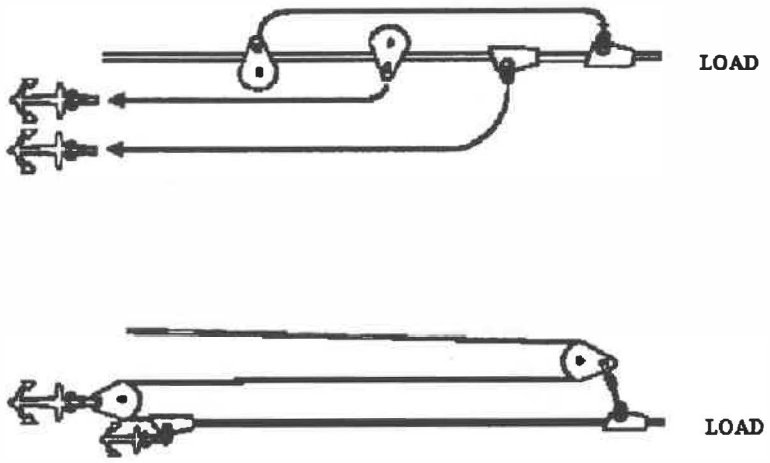

Figure 4-12

Another common system is the 4:1 add on system (Figure 4-13). Many teams like this system because it is one of the quickest ways to convert a lowering system to a raising system and back again and is good for pre-rigging. This system is a simple or compound mechanical advantage system that is attached to the main line and has a separate anchor.

Figure 4-13

Belaying

When performing a rope rescue it is recommended that the rescue team use a belay. To belay, by definition, is to secure a person at one end of the rope. A belay is also described as a safety, or backup system used in the event the primary system fails. In low angle rope rescue, we use two types of belays:

✓ Conditional Self Belay - Rope under tension from part or all of the load and is managed by the person needing it. An example of this is the use of a prusik attached to the rappel line (Single Line Technique). It is commonly used in low angle by the medic on the initial descent to the victim. This is often used as an alternate method when a standard belay will not work or it creates a greater danger than the use of the conditional self belay will.

✓ The Raising Belay -

The primary concern with the Raising Belay is to keep slack out of the belay line. The Raising Belay that we use is designed to be as easy to pull as possible and is often used with more than one belayer. If the main system fails, the tandem prusik (2 – triple wrapped 8mm prusiks) will catch the load since the belay line will probably be pulled out of the belayer's hands. If the belay team is doing its job, any shock load on the belay system should be minimal.

Before any life is put on any system, a system safety check MUST be performed. This check is to ensure that all components are constructed properly, appropriate equipment is used, equipment is locked where necessary and the system is capable of performing the intended task.

Constructing a raising (tandem prusik) belay (Figure 4-14):

- Step 1 - Connect the end of the rope to the anchor with a locking carabiner and a Double Loop Figure Eight.
- Step 2 - Attach the tandem prusik to the anchor with a Mariners Hitch. Put the tandem prusiks on the rope and take the slack out as needed.
- Step 3 - Rig the rope through a pulley and connect the pulley to the anchor with a locking carabiner (this may be accomplished by connecting to the same carabiner as the prusiks). When the belayer (or the belay team) are in position, tell the team leader that you are **on belay**.

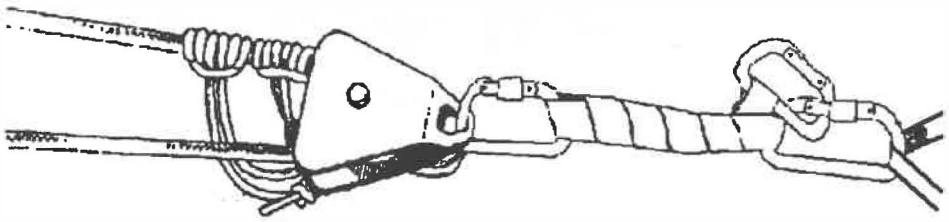

Figure 4-14

Lowering

In most rope rescue situations, the safest and most appropriate method of gaining access to and removing the victim to a safe place is with the use of a lowering system. The purpose of a lowering system is to provide for the controlled descent of the rescuer, victim or both. The two major types of **lowering systems** for low angle are:

- Figure eight lowering system – this is recommended for single person loads only. The lack of ability to adequately control friction is the main reason for this.
- Brake bar rack lowering system – this is recommended for single and multi-person loads. It provides for better control of friction as compared to the figure eight lowering system and it doesn't coil or twist the rope.

✓ **Self-Lowering** – Figure Eight with Ears Descender

Rigging the figure eight with ears (Figure 4-15):

- Hold the figure eight descender in your brake hand. (your brake hand is usually your strongest hand, the right hand for most "right handers")
- Face the anchor with the rope running past you on the brake hand side.
- Grasp the rappel line near the anchor, take a bight of the rope in your guide hand.

- Slide the figure eight descender over the bight (hard over soft).
- Bring the bight up into the large opening in the descender, continue over the end of the small ring and across the waist of the descender (this process can be repeated if additional friction is needed).
- Attach the figure eight descender to the carabiner on the harness "D" ring and lock the carabiner.

Figure 4-15

Self-descent

- Grasp the rope trailing from the figure eight descender in your dominant hand. This is the brake hand. This hand will always stay on the rope unless you are locked off.
- Grasp the rope and prusik hitch above the figure eight descender in your remaining hand. This is the guide hand. This hand is used for balance, not support.
- Remove the slack between the figure eight descender and the anchor.
- Grasp the rope below the figure eight descender with your brake hand and pull it taut against your hip with the hand about 6 inches below the waist (This position is used when stopping. The rope should be held away from the hip while rappelling to avoid abrading the harness).
- While still on a flat surface, lean back away from the anchor and let the line draw taut. Do a visual check of the rigging, carabiner, descender, gloves, etc.
- Begin walking backward, letting the rope slide slowly through the figure eight descender with the brake hand, while grasping the ropeand prusik above the descender in your guide hand.
- Begin your descent by taking slow and deliberate steps backward, releasing rope through the brake hand at a rate that will allow a gradual and controlled descent speed.
- Keep your body turned slightly toward your brake hand, looking down to pick a path for the descent.
- If you lose your footing while lowering, grasp the rope in your brake hand tight against your hip to arrest your fall.

Locking off (Figure 4-16)

It is possible to stop and secure oneself while lowering at any point in a descent. By locking off the descent device, a rescuer can be suspended from the rope with both hands free to work at other tasks. The trick to a

successful tie off is to be as fluid as possible while locking off rather than coming to a stop while descending and then trying to hold oneself in place and lock off at the same time. The following procedure should be followed:

- Anticipate the lock off procedure by grasping the eight plate near the point at which the plate is connected to your harness with a carabiner.
- Grasp the rope with your brake hand and allow the rope to travel through the eight plate until your brake hand is approximately a foot from the descender.
- Holding the rope taut with your brake hand, pull the rope in a sweeping arc from the lowering position, across the front of your body, and over the top of the eight plate, trapping the rope between the front of the rappel line and the back of the eight plate.
- Continue the arc bringing the rope around the far ear of the eight plate.
- Repeat this procedure twice more, then tie a large overhand knot on a bight, around the base of the figure eight plate.
- To unlock, reverse the process, using the "ear" for leverage if necessary. Keep the line in the brake hand taut so as to maintain control when the system is unlocked.

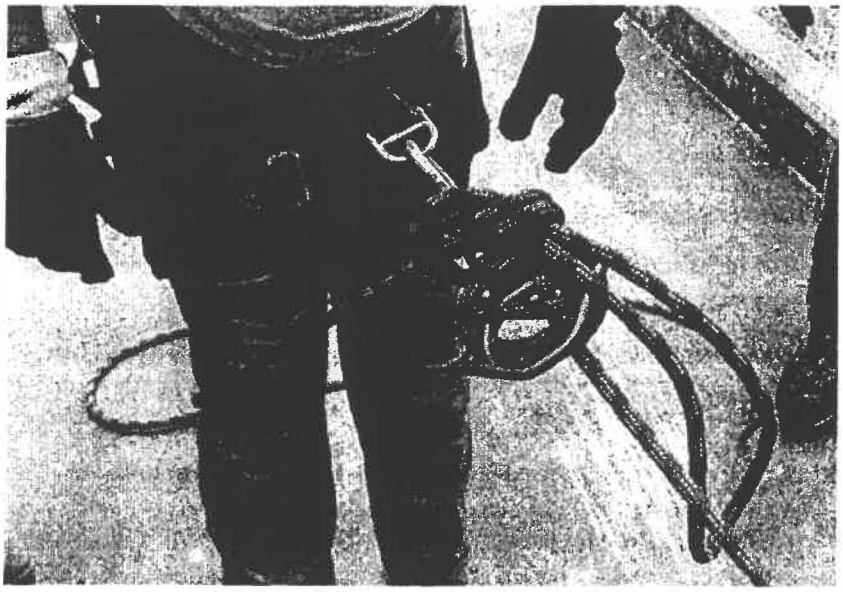

Figure 4-16

✓ **Self-lowering** – Brake bar rack

Rigging the brake bar rack (Figure 4-17):

- Clip the brake bar rack into the seat harness carabiner and lock the carabiner. (If the carabiner is on a horizontal plane, attach the rack so the short leg faces down. If the carabiner is on a vertical plane, attach the rack so the short leg is on the brake hand side)
- Face the anchor with the rope running past you on the brake hand side.
- Disengage all bars on the rack except the top one.
- Pick up the rope with the brake hand and drape it on top of the top bar and then down between the two legs of the rack.
- Remove the slack between the rack and the anchor. Hold the rope down and away from you.

- With the other hand, swing the second bar up, snap into place and move it upwards toward the first bar, trapping the rope.
- Pull the rope up between the legs of the rack, pulling away from you so the second bar is snugged against the first bar.
- Repeat this process until all bars are locked into place.

Fugure 4-17

Lowering

- Grasp the rope trailing from the brake bar rack in your dominant hand. This is the brake hand. This hand will always stay on the rope unless you are locked off.
- Take the brake bar rack in your less dominant hand. This is the guide hand. The hand stays on the rack to control the spacing of the bars.
- Grasp the rope below the brake bar rack with your brake hand holding it in the same position as you would while rappelling with a figure eight.

NOTE There are two ways that braking occurs while using a brake bar rack: 1)With the brake hand, pull the rope away from the front of your body, towards the anchor. This is called the "quick stop". 2) With the guide hand, push the bottom bar, along with the other bars, toward the top of the rack. This is called the stop position. This is also a method of adding more friction without stopping.

- While still on a flat surface, lean back away from the anchor and make the line taut. Do a visual check of the rigging, carabiner, descender, gloves, etc.
- Begin walking backward, letting rope slowly through the brake bar rack with the brake hand, while holding the bars in position with the spread fingers of your guide hand. If you do not move, remove one bar and try again. Remove a second bar if necessary.
- Keep your body turned slightly towards your brake hand, looking down to pick a path for the descent.
- If you lose your footing while lowering, grasp the rope in your brake hand tight against your hip to arrest your fall.

Locking off (Figure 4-18):

- Slide all bars tight toward the training bar.
- With your brake hand, pull the rope toward the top of the rack.
- Pass the rope over the side of the rack by the guide hand so that the rope runs across the top bar between the curve of the rack and the rope coming from the anchor.
- Continue to move the rope in an arc towards the carabiner and, from the under side of the rack, pull the rope up between the two legs of the rack.
- Repeat the procedure while maintaining constant tension on the rope. Once you have gone "around the rack" at least twice, snug all of the bars together. The rack is now in the "stop" position.
- Form a large bight on the rope with your brake hand (with assistance from your guide hand if necessary) and, treating the bight as one rope, tie an overhand knot around the body of the rack.
- To unlock the rack, reverse the above procedure. Make sure that no slack is allowed in the brake end of the rope.

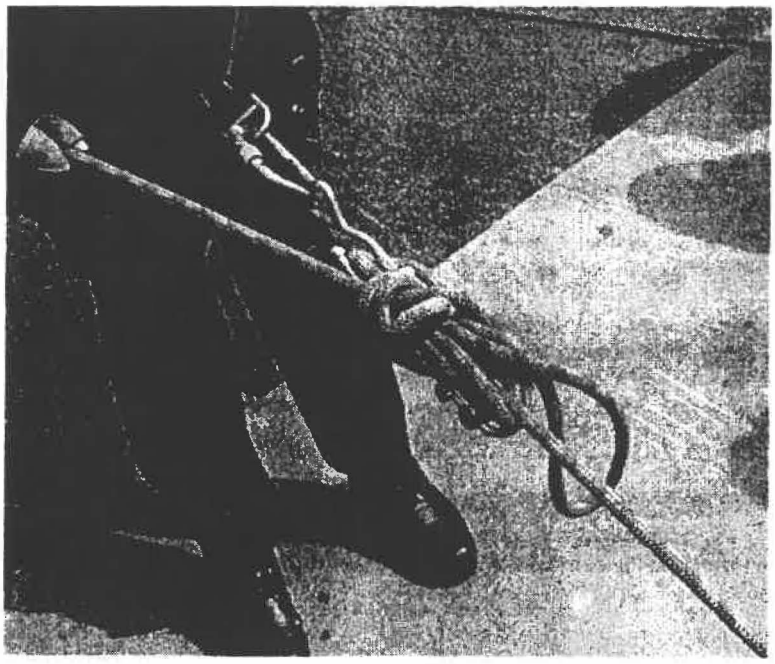

Figure 4-18

Changing The System Direction – Z System

The procedures in this lesson will allow you to change the direction of the z system -- even with a full stretcher load. One of the most important rules to insure that the operation is carried out without any reduction in your margin of safety is to communicate. Telling the team leader what you are doing before you do it helps him coordinate the action. With practice and good communication, the conversion from one system to the other takes only a few minutes.

✓ Lowering System To A Raising System

Step 1 - Lock off the descender on the Lowering Line. Put the brake cam on using a Mariners Knot. Set the brake cam by pulling it as far from the anchor as possible.

Step 2 - Set the prusiks on the belay by pulling them as far from the anchor as possible.

Step 3 - Unlock the descender on the Main Line and replace it with a pulley.

Step 4 - Insert a second pulley in the slack end of the rope. Connect the pulley to a cam with a locking carabiner. This cam becomes the haul cam and is attached to the Main Line. Pull the haul cam as far from the anchor as possible. You now have a 3 to 1 Raising System in place of the Lowering System. When the haul team is in position, tell the Team Leader that you are **Ready To Raise**.

Step 5 - When the belayer is ready, tell the Team Leader that you are **On Belay**.

✓ Raising System To A Lowering System

Sometimes the nature of the problem requires you to raise the stretcher to the victim then lower him back down. Anchors will have to be set above the victim, but the stretcher can start from below. While the victim is being loaded, the systems are converted for lowering. As above, the change can be made while the system is fully loaded. Remember, the Main Line always changes first.

Step 1 - Set the brake cam on the haul line by pulling it as far as possible away from the anchor.

Step 2 - Set the brake prusiks on the belay line by pulling them as far as possible away from the anchor.

Step 3 - On the haul line, remove the haul cam and the second pulley and put them in a safe place.

Step 4 - Remove the first pulley and replace it with a descender. Rig the rope through the descender and lock it off. Now release the cam by undoing the Mariners Knot. Gently transfer the load from the cam to the descender. If possible, retie the Mariners Knot in case you need it again. Tell the Team Leader that you are **Ready To Lower**.

Step 5 - Release the belay prusiks if necessary by undoing the Mariners Hitch. Re-tie the mariners and reattach to the belay line prusiks. Tell the Team Leader **Belay On**.

Changing The System Direction – Add on System

With an add on mechanical advantage system, changing from a lowering to a raising system and then from a raising to a lowering is a fairly simple process.

✓ Lowering to a raising system (Figure 4-19):

Step 1 – Hold both the main line and belay line lowering systems static.

Step 2 – Attach the mechanical advantage system to the main line using either a cam or prusik.

Step 3 - On command, the mechanical system will be hauled to raise the load. While the load is raising, all slack will be removed from both the main & belay lines by pulling the slack through the lowering device.

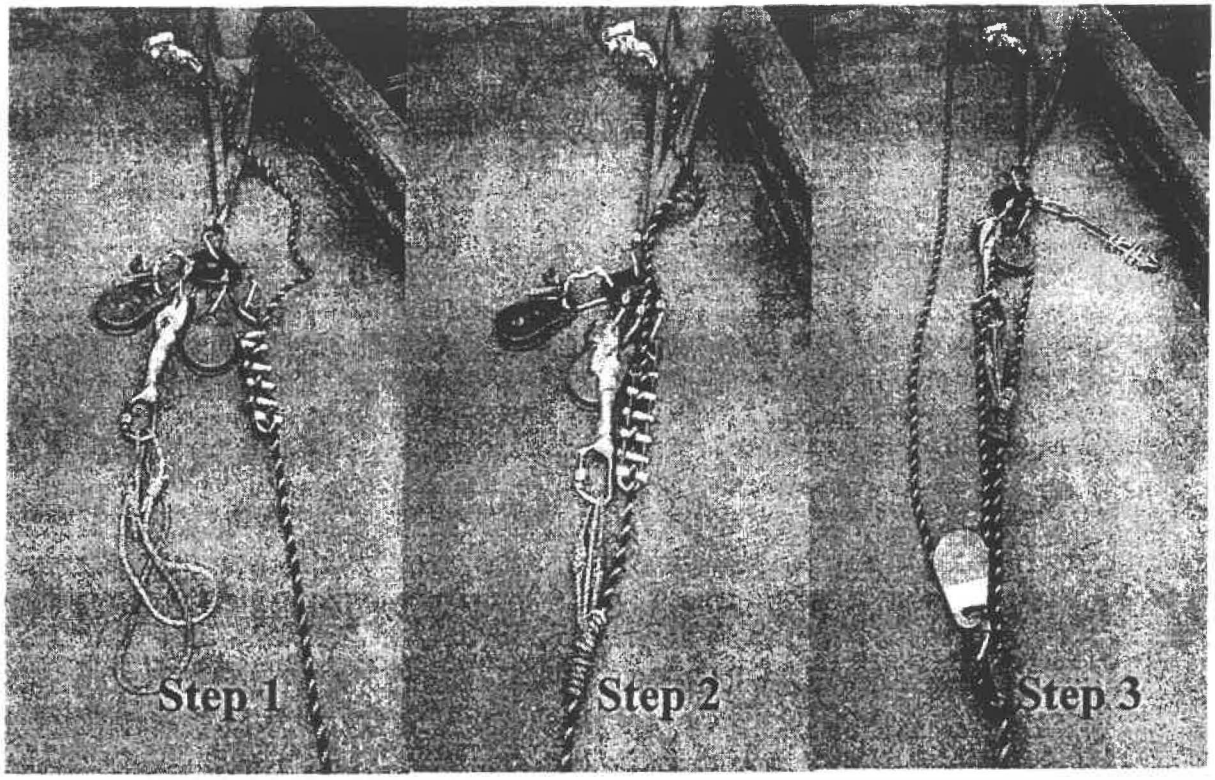

Figure 4-19

✓ Raising to a lowering

Step 1 – All slack will be removed from both the main & belay lines and the lowering devices locked off.

Step 2 – Release the tension on the mechanical advantage system and then removed it from the main line.

Step 3 – Release the lowering devices and lower the load.

System Safety Check

A system safety check should ALWAYS be performed before a live load is put on a system. The system check consists of 3 components:

- Physical or visual check – This includes checking PPE, checking for proper system configuration, making sure that the equipment components are secure and system components are inspected for damage.
- Load test - Pre-load the system in a safe manner (i.e. standing away from the edge while pre-loading).
- Audible or visual confirmation – There should be a prearranged signal to confirm that the first two steps have been completed and all was found to be OK. You should address other rescuers and receive confirmation by one or more of them.

Unit 7: Ladder Rescue Systems

Ladder Rescue Systems

Introduction

Successful performance of heavy rescue requires the rescuer to utilize every available tool, sometimes in a non- traditional manner. Ground ladders are one of the most versatile tools available to rescue personnel. They are readily available and fire personnel are very familiar with them.

Two rescue systems involving ladders are presented during this lesson: the ladder gin and the ladder A-frame. Others include (which are not shown): the cantilever ladder, leaning ladder and ladder jib.

The Ladder Gin is one of the most useful of these ladder systems. It requires minimal equipment and personnel, is quickly rigged and has numerous applications. The two basic types of applications that are taught in this program are the open field and off a vehicle methods.

The ladder A-frame is designed to span an opening. It is stronger and more stable than a ladder gin.

Ladder Gin

A gin is an upright spar which is supported at the top to keep it in a near vertical position and is equipped with a mechanical advantage rig for hoisting. It may be formed with a ground or aerial ladder but this lesson centers on ground ladders (Figure 7-1).

✓ Components Of Ladder Gin

- Ground Ladder - must satisfy NFPA standards for fire service ladders (1931 and 1932) including annual testing and must receive regular, routine maintenance. Generally, a 12-16' straight ladder is best for light loads but a shorter extension ladder can also be used.
- Mechanical advantage system rigging – the 4:1 simple mechanical advantage system and 3:1 "Z" system are the most common systems used.
- Safety (belay) line – Sometimes this line is reeved under/over the rungs to gain friction but many organizations now use a standard pulley with prusiks.
- Support and Guy lines hold the ladder in a near vertical position. One rope serves as parallel supports and a second rope serves as 90 degree guy lines. The guy line should be formed with life rope but utility rope may be used if necessary. Five anchor points are necessary: one for each guy line and one for the butt of the ladder.

Figure 7-1

✓ Ladder Gin Application

A ladder gin is designed to lift or lower vertically. Examples of this include lifting a load off of a victim or lifting a victim out of vault/manhole, etc. It can be set up in various areas including: out of windows, against buildings, against curbs, etc.

✓ Ladder Gin Limitations

- Loading – utilize common sense and refer to the manufacturer's specs and guidelines for climbing. Generally, 12-16' straight ladders are rated at maximum loading of 400-500 lbs.
- Rigging – the ladder should be rigged at the climbing angle. The strength of a ladder gin is based upon transfer of the load to the ground via the beams. All loads must remain within the beams and the system will not accept side loading.
- Operations - All hauling must occur within the beams (side loading might topple the ladder). Use of a directional pulley at the base will allow the haul crew to move to one side.

✓ Constructing a ladder gin – open field method.

- Locate center of rope and form a bight.
- Tie a figure eight on a bight in the center of each rope (this is used to create an attachment point for the main and belay lines. If using webbing slings instead, disregard this step).
- Position and extend the ladder. Place the base of the ladder near the object it will butt against when the ladder is raised into position (tailboard of apparatus, rear tire of vehicle, etc.). In an open field arrangement the base of the ladder, instead of being secured against the vehicle, will be secured as follows:

  1. Dig a small hole at the base of each ladder beam.
  2. Place each ladder beam in the holes.
  3. Drive a picket into the ground next to each beam of the ladder.
  4. Secure the beams of the ladder to the picket with tie ropes or webbing.

  Place the ladder on a beam, extend to the desired height and ensure dogs of ladder are locked.

- Attach a clove hitch to each ladder tip (Figure 7-2). With the ladder laying flat on ground, center the figure eight on a bight so that it will form a sling with an interior angle of less than 90 degrees. (Disregard this step if using webbing slings.) If creating slings with both ropes, have the slings at slightly different lengths. Tie a clove hitch around each tip of the ladder.

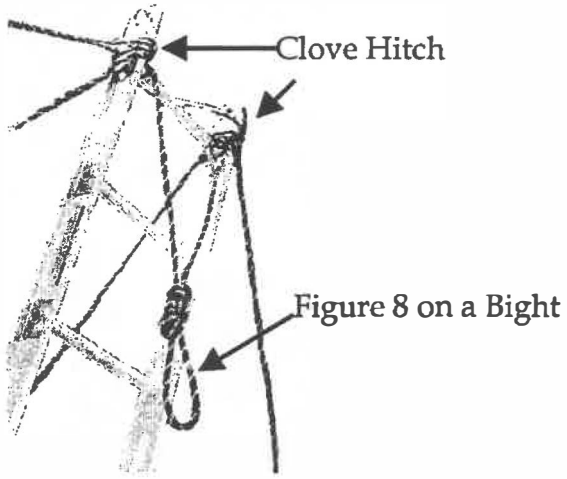

Figure 7-2

- Build the ladder mechanical advantage rig.
- Attach the mechanical advantage rig to ladder.
- Attach the safety (belay) line.
- Position guy line anchor points. Attach the guy lines to the anchor points (anchor points are a picket hold fast with a webbing and a carabiner attached to the base of the front picket).

✓ Constructing a ladder gin – off the vehicle method. Follow these directions in addition to the appropriate open field sections.

- On the opposite side of the vehicle from the ladder, attach a 12' webbing to vehicle strong points. These strong points should be two places an equal distance apart from where the middle of the ladder will be (approximately 45 degrees) and two points as close as possible opposite the beams of the ladder. Attach a prusik or cam ascender to the anchor slings with a carabiner.
- Position the guy lines. Place the ends of the guy lines over to the opposite side of the vehicle. Attach the prusik or cam ascender on the center left side anchor sling to the center left side guy line. Attach the prusik or cam ascender on the center right side anchor sling to the center right side guy line. Repeat the above procedure for the outside left and outside right guy lines.
- Position and secure the ladder. Tend each guy line coming from the tip of the ladder near the anchor points. Foot the base of ladder and flat raise or beam raise the tip of ladder to the proper climbing angle. Pull the guy line slack through the prusiks or cam ascenders until snug.
- Safety test the ladder gin. Load the ladder gin by pulling down on the ladder mechanical advantage rig. Check for a good climbing angle and possible ladder twist with the ladder loaded. Adjust the guy lines to correct any problems.
- Reeve the safety (belay) line. Attach a second web sling to the tip of the ladder and attach a pulley to the sling. The safety line is passed through the pulley. Attach another web sling to a beam of the ladder near the base and attach the safety line to the web with a prusik or cam ascender.

A-Frame Ladder

A Ladder A-Frame is a rig constructed of two ladders that are connected at the top to form an "A" shaped construction (Figure 7-3). It is stronger and more stable than a ladder gin and is designed to span a hole so an attached mechanical advantage system can be used to lower rescuers and remove a victim and rescuers from the hole. It may also be used to lift objects that it can span.

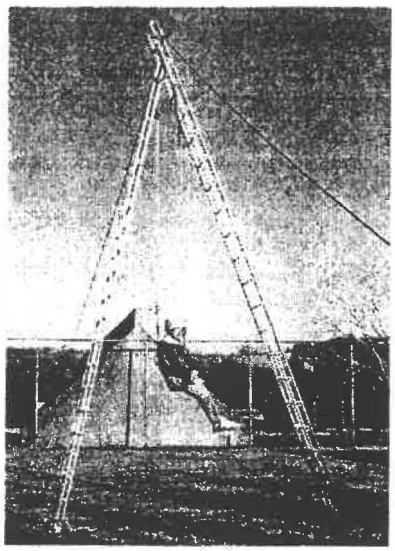

Figure 7-3

✓ Constructing a Ladder A-Frame

- Position the two ladders on the ground near the point of operation. If the ladders are uneven, place the shorter ladder on top of the longer ladder. Keep the butts of ladders as close to even as possible while aligning the top rung of the shorter ladder with the closest adjacent rung of the longer ladder.
- Place ladders on their beams.
- Separate the butts of the ladders keeping the two above mentioned rungs and beams together.
- Lash the two top rungs together (Figure 7-4). This is accomplished using one 12' piece of webbing. Form a round lash making sure rungs are as close as possible, the beams are locked together and the lashing is tight and secure.
- Prepare the guy lines. Because there is not a significant load being placed on the guy lines, it is acceptable to use utility line.
- Attach the guy lines to the ladders (Figure 7-5). Tie a clove hitch at the top of each beam and extend the guy line out away from the ladder.
- Prepare the mechanical advantage system.
- Attach the mechanical advantage system to the Ladder A-Frame using a webbing (Figure 7-6) or rope sling.
- Attach the safety line (same as used for the ladder gin).
- Install the anchor pickets at a proper distance and location.
- Attach the anchor slings. Use 5' webbing and Tie securely with the webbing formed into a loop.
- Prepare to raise the Ladder A-Frame – place the guy lines at the proper location.
- Spread and secure the base of the A-Frame. Spread the base of the ladder to1/3 the height and tie a 20' webbing around opposite beams of ladders close to ground level.
- Raise the Ladder A-Frame. After placing the A-Frame at the proper location, spread the ladder butts to the proper position.
- Secure the Ladder A-Frame to the anchors with the guy lines.

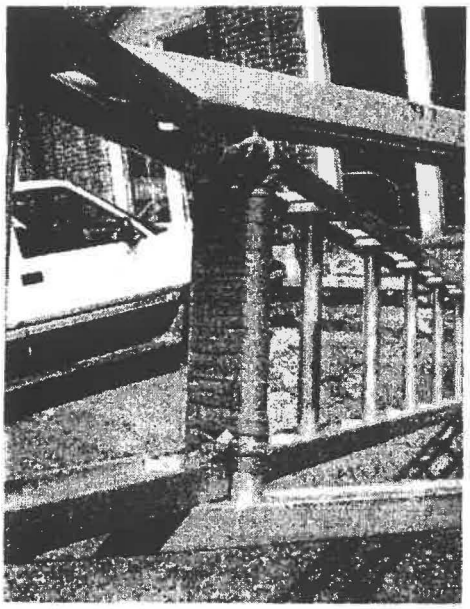

Figure 7-4

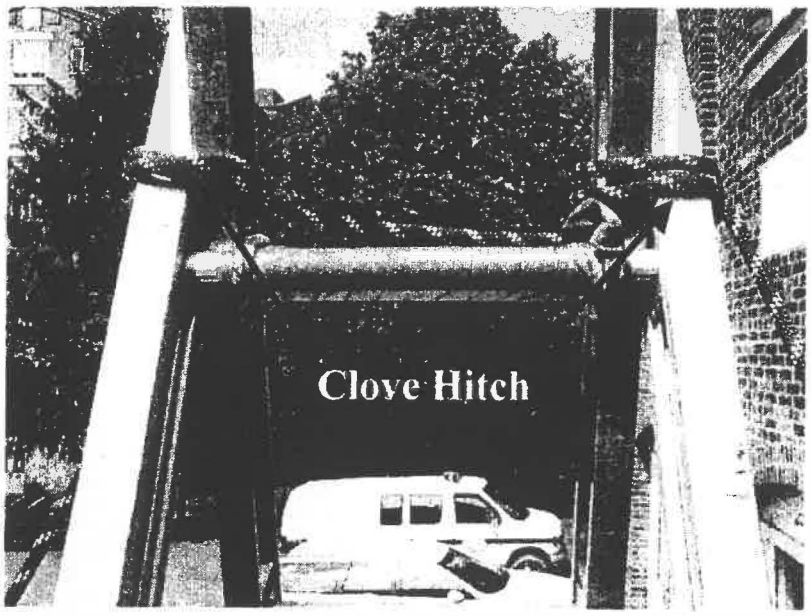

Figure 7-5

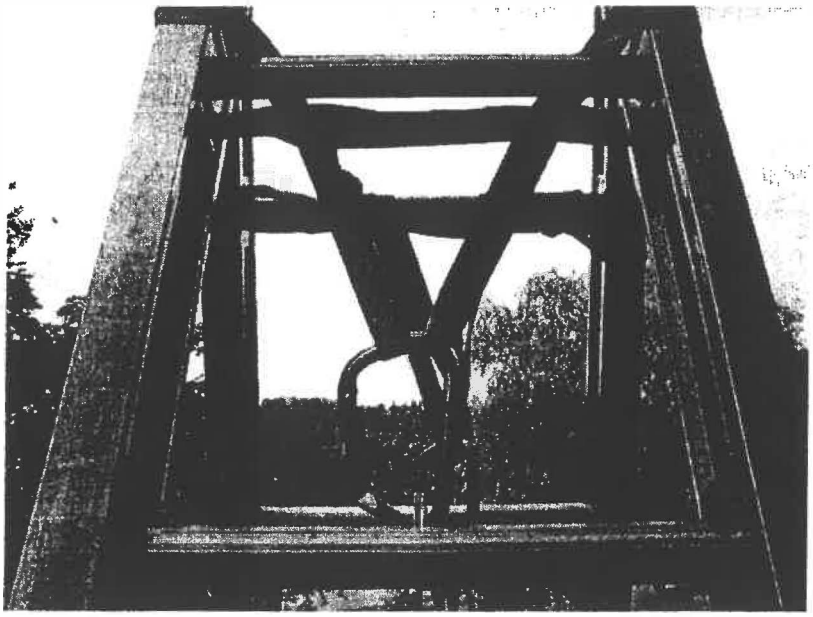

Figure 7-6

Unit 8: Helicopter Operations

Introduction to Helicopter Operations

Note: The criteria and guidelines shown in this lesson are examples only. Various agencies providing helicopter services may use different guidelines. It is highly suggested that you contact your local agencies to determine their criteria.

Introduction

The uses of helicopters (rotary winged aircraft) in rescue include search & rescue and medical evacuation / transportation. Search and rescue uses include wide area search (such as large bodies of water or wilderness) and when accessibility is a problem (such as long travel distance and limited access sites). Medical evacuation / transportation uses include accident victim and critically ill patients.

An example of criteria used for determining the use of helicopters in rescue are:

- Operational
    1. Ground transport time exceeds 30 minutes.
    2. Prolonged extrication.
    3. Remote location.
    4. Patient requires Advanced Life Support level of care.
- Physiological (medical)
    1. Glascow Coma Scale of 13 or less.
    2. Trauma score of 14 or less.
    3. Compensated or decompensated shock.
    4. Head injury with altered mental status.
    5. Chest trauma with respiratory distress.
    6. Penetrating injuries to body cavity.
    7. Amputations proximal to hand or foot.
    8. Burns to face or over 15% of body.

Preparing for Helicopter Operations

✓ Choosing the Landing Zone

There are many factors to take into consideration when choosing a landing zone. Many departments have these sites pre-chosen but you should be prepared to evaluate additional sites as required by operational considerations. These factors include:

- Proximity – The LZ should be adjacent to the scene if possible. If not, provide intermediate transportation. In any event, consider the rotorwash. If hazmat is involved, notify the pilot before touchdown of the aircraft. Every effort should be made to help avoid aircraft contamination.
- Elements – the surrounding area (space above & around touchdown site) needs to be evaluated for any obstacles that the aircraft has the potential to come in contact with. This includes both altitude (which begins at ground level) and the radius (which is centered around the touchdown area and extends approximately ¼ mile in any direction). Obstacles to be considered include, but is not limited to: towers, poles, wires and trees.
- Approach/departure path (Figure 8-1) - at least one path should be provided. It is preferable to have an approach angle with some forward speed instead of landing and takeoff straight up and down. Additionally, the path should be clear of towers, poles, wires, trees, signs, etc.

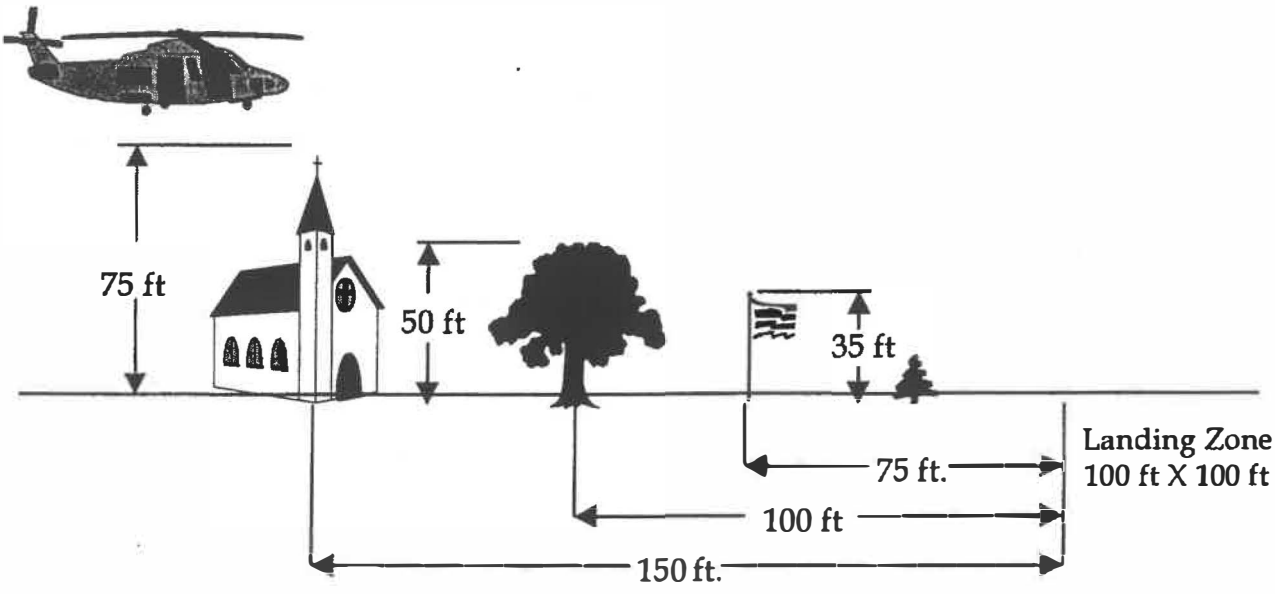

Figure 8-1

- Touchdown area – should be a minimum of 100 ft. x 100 ft. and clear of obstructions including: signs, posts, markers, etc. The ground surface should be firm with vegetation less than 2 ft. and a slope no greater than 5 degrees.

✓ Marking the Touchdown Area

Day - Use flares, panel markers, cones etc. and secure them so as to not blown them around by the rotorwash.

Night - use flares, chemical lightsticks, battery-powered flashing lights etc. that can be secured from being blown around by the rotorwash.

- Mark the 4 corners
- Caution when using flame or heat producing devices – fire hazard.
- At night, you may use the headlights from two rescue vehicles pointing toward the wind and away from the helicopter approach. In any event, DO NOT point lights at the aircraft – these may blind the pilot. Leave your red emergency lights on but avoid using spotlights, white, blue or strobe lights.

✓ Preparing the Touchdown Area

- Secure loose debris
  1. Ground cover - if there is a large amount of loose dirt or gravel – wet it down. Pack snow down by walking or driving over the area.
  2. Surrounding items - there should be no obstructions or obstacles in the Landing Zone. Secure all items within the touchdown area including: car doors, trunk lids, medical cases, rescue equipment, stretchers and linens/sheets. If in doubt – secure it.
  3. Personal items or clothing - secure all clothing and remove hats or other items that can blow away.
- Personal protective equipment - wear goggles or face shields to protect your eyes from blowing debris. If these are not available, turn and face away from the helicopter until the rotorwash diminishes.

- Secure nearby activity.
    1. Adjacent traffic should be stopped until the aircraft is on the ground.
    2. Protect workers and patients from flying debris if near the touchdown area.
    3. If an ambulance is near the touchdown area, keep the doors closed as the aircraft lands to keep debris out of the ambulance.
    4. Crowd control - keep spectators at least 200 feet away and emergency personnel at least 100 ft away.

✓ Landing Zone Report

A landing zone report should be provided to the helicopter agency or crew (as directed by protocol and communications capability). Aircraft operate on a different frequency and band (between 108 – 136 mhz) but they may carry radios on emergency service frequencies (this should be determined ahead of time and a protocol established).

The landing zone report should include:

1. GPS position if available.
2. A description of the landing zone in relation to the terrain (such as the top of a hill or in a valley).
3. A description of major landmarks near the landing zone such as rivers, highways, factories or water towers.
4. An estimate the distance between the landing zone and the nearest town.
5. A description of landing zone conditions such as the location of wires or other obstructions and direction of winds.

Safety Considerations for Helicopter Operations

Only personnel assigned to protect the aircraft or handle patient(s) should come closer than 100 ft.

- You should only approach the aircraft as directed by the pilot or crew. Rotor blades may dip low during startup and shut down so do not walk under or around slow turning rotor blades. If you must approach a running helicopter always crouch down when near the main rotor but always stay clear of the tail rotor.
- No smoking within 100 ft of the aircraft.
- Follow other guidelined as described earlier regarding scene security and PPE.

Appendix: Skill Sheets

Skill Sheet 2.1
Site Operations

Skill Competency

Name _____ Date _____

Evaluator _____

NFPA 1006, Chapter 3, Section 2 – Site Operations
3-3.1 – Identify the needed support resources.
3-2.2 – Size-up a rescue incident.
3-2.3 – Manage incident hazards.
3.2.4 – Manage resources in a rescue incident.
3.2-7 – Terminate the incident

3	2	1	X	Skill
☐	☐	☐	☐	Track equipment inventory.
☐	☐	☐	☐	Manage rehabilitation needs including shelter and personnel rotations.
☐	☐	☐	☐	Ensure adequate lighting
☐	☐	☐	☐	Gather and relay information.
☐	☐	☐	☐	Use information gathering sources.
☐	☐	☐	☐	Use resource materials as appropriate to the incident.
☐	☐	☐	☐	Identify resource capabilities and limitations.
☐	☐	☐	☐	Identify hazards.
☐	☐	☐	☐	Perform risk/benefit analysis.
☐	☐	☐	☐	Place scene control barriers and operate control & mitigation equipment as necessary to the incident.
☐	☐	☐	☐	Implement an incident management system.
☐	☐	☐	☐	Complete tactical worksheets.
☐	☐	☐	☐	Evaluate incident information.
☐	☐	☐	☐	Match resources to operational needs.
☐	☐	☐	☐	Operate equipment and manage incident communications.
☐	☐	☐	☐	Communicate so objectives are met.
☐	☐	☐	☐	Provide scene security
☐	☐	☐	☐	Complete recording documentation of the incident.

☐ ☐ ☐ ☐ Apply local medical transportation protocols.

Competency Rating Scale

3 – Skilled	**1 – Unskilled**
2 – Moderately Skilled	**X –Not Performed**

All skills must receive a 3 or 2 to obtain a passing evaluation for this job performance requirement.

Skill Sheet 2.5
Search

Skill Competency

Name _____ Date _____

Evaluator _____

NFPA 1006, Chapter 3, Section 2 – Site Operations

3-2.5 – Conduct a search.

3	2	1	X	Skill
☐	☐	☐	☐	Enter, maneuver in, and exit the work environment.
☐	☐	☐	☐	Provide for and perform self escape/rescue

Competency Rating Scale

3 – Skilled
2 – Moderately Skilled
1 – Unskilled
X –Not Performed

All skills must receive a 3 or 2 to obtain a passing evaluation for this job performance requirement.

Skill Sheet 2.6
Helicopter Operations

Skill Competency

Name _____ Date _____

Evaluator _____

NFPA 1006, Chapter 3, Section 2 – Site Operations

3-2.6 – Perform ground support operations for helicopter activities.

3	2	1	X	Skill
☐	☐	☐	☐	Provide ground support operations.
☐	☐	☐	☐	Review SOPs for helicopter operations.
☐	☐	☐	☐	Use PPE.
☐	☐	☐	☐	Establish and control landing zone.
☐	☐	☐	☐	Communicate with air crews.

Competency Rating Scale

3 – Skilled
2 – Moderately Skilled
1 – Unskilled
X –Not Performed

All skills must receive a 3 or 2 to obtain a passing evaluation for this job performance requirement.

Skill Sheet 3.1
Victim Access

Skill Competency

Name _____ Date _____

Evaluator _____

NFPA 1006, Chapter 3, Section 3 – Victim Management

3-3.1 – Access a victim.

3	2	1	X	Skill
☐	☐	☐	☐	Manage hazards.
☐	☐	☐	☐	Properly use provided tools.
☐	☐	☐	☐	Properly use PPE.
☐	☐	☐	☐	Choose safe entry and escape routes.
☐	☐	☐	☐	Choose safe equipment and tools.

Competency Rating Scale

3 – Skilled **1 – Unskilled**

2 – Moderately Skilled **X –Not Performed**

All skills must receive a 3 or 2 to obtain a passing evaluation for this job performance requirement.

Skill Sheet 3.5
Victim Packaging

Skill Competency

Name _____ Date _____

Evaluator _____

NFPA 1006, Chapter 3, Section 3 – Victim Management

3-3.5 – Package an ill or injured victim.

3	2	1	X	Skill
☐	☐	☐	☐	Select and apply packaging from those available devices.
☐	☐	☐	☐	Protect the victim.
☐	☐	☐	☐	Immobilize injuries.
☐	☐	☐	☐	Apply PPE as appropriate to the victim.

Competency Rating Scale

3 – Skilled **1 – Unskilled**

2 – Moderately Skilled **X –Not Performed**

All skills must receive a 3 or 2 to obtain a passing evaluation for this job performance requirement.

Skill Sheet 3.6
Victim Removal

Skill Competency

Name _____ Date _____

Evaluator _____

NFPA 1006, Chapter 3, Section 3 – Victim Management

3-3.6 – Move a victim in a low angle environment.
3-3.7 – Transfer a victim to EMS.

3	2	1	X	Skill
☐	☐	☐	☐	Secure a victim to transport equipment.
☐	☐	☐	☐	Assemble and operate environment-specific victim removal systems.
☐	☐	☐	☐	Choose an incident-specific transport device.
☐	☐	☐	☐	Report the victim's condition and history to the EMS provider.
☐	☐	☐	☐	Complete reports and checklists.
☐	☐	☐	☐	Demonstrate verbal communication skills.

Competency Rating Scale

3 – Skilled
2 – Moderately Skilled
1 – Unskilled
X –Not Performed

All skills must receive a 3 or 2 to obtain a passing evaluation for this job performance requirement.

Skill Sheet 4.1
Equipment Maintenance

Skill Competency

Name _____ Date _____

Evaluator _____

NFPA 1006, Chapter 3, Section 4 - Maintenance

3-4.1 – Inspect and maintain hazard specific PPE.
3-4.2 – Inspect and maintain rescue equipment.

3	2	1	X	Skill
☐	☐	☐	☐	Identify wear and damage indicators for equipment & PPE
☐	☐	☐	☐	Evaluate operational readiness of equipment & PPE
☐	☐	☐	☐	Complete logs & records.
☐	☐	☐	☐	Use cleaning equipment, supplies and reference material as appropriate.
☐	☐	☐	☐	Select and use maintenance tools appropriate to the task.

Competency Rating Scale

3 – Skilled **1 – Unskilled**
2 – Moderately Skilled **X –Not Performed**

All skills must receive a 3 or 2 to obtain a passing evaluation for this job performance requirement.

Skill Sheet 5.1
Knots for Rope Rescue

Skill Competency

Name _____ Date _____

Evaluator _____

NFPA 1006, Chapter 3, Section 5 - Ropes/Rigging

3-5.1 – Tie knots, bends and hitches.

3	2	1	X	Skill
☐	☐	☐	☐	Tie a Figure 8 Knot
☐	☐	☐	☐	Tie a Figure 8 on a Bight
☐	☐	☐	☐	Tie a Figure 8 Follow Through Loop
☐	☐	☐	☐	Tie a Figure 8 Bend – Join 2 Ropes
☐	☐	☐	☐	Tie a Double Loop Figure 8
☐	☐	☐	☐	Tie a Double Fisherman Knot
☐	☐	☐	☐	Tie a Prusik Hitch
☐	☐	☐	☐	Tie a Overhand Knot (Rope)
☐	☐	☐	☐	Tie a Overhand Knot (Webbing)
☐	☐	☐	☐	Tie a Clove Hitch
☐	☐	☐	☐	Tie a Butterfly Knot
☐	☐	☐	☐	Tie a Square Knot
☐	☐	☐	☐	Tie a Water Knot (Webbing)
☐	☐	☐	☐	Tie a Mariners Hitch (Webbing or Strap)

Competency Rating Scale

3 – Skilled
2 – Moderately Skilled
1 – Unskilled
X –Not Performed

All knots must receive a 3 or 2 to obtain a passing evaluation for this job performance requirement.

Skill Sheet 5.2
Anchor Systems

Skill Competency

Name _____ Date _____

Evaluator _____

NFPA 1006, Chapter 3, Section 5 - Ropes/Rigging

3-5.2 – Construct a single point anchor system.

3	2	1	X	Skill
☐	☐	☐	☐	Select required rope and equipment
☐	☐	☐	☐	Tie appropriate knots
☐	☐	☐	☐	Rig assigned system
☐	☐	☐	☐	Evaluate the chosen anchor point for desired strength, location and surface contour.
☐	☐	☐	☐	Perform a safety check

Competency Rating Scale

3 – Skilled
2 – Moderately Skilled
1 – Unskilled
X –Not Performed

All skills must receive a 3 or 2 to obtain a passing evaluation for this job performance requirement.

Skill Sheet 5.3
Mechanical Advantage Systems

Skill Competency

Name _____ Date _____

Evaluator _____

NFPA 1006, Chapter 3, Section 5 - Ropes/Rigging

3-5.3 – Construct a simple rope mechanical advantage system.
3-5.4 – Direct a team in the operation of a simple rope mechanical advantage system.

3	2	1	X	Skill
☐	☐	☐	☐	Select appropriate rope and equipment for the assigned task.
☐	☐	☐	☐	Tie knots appropriate to the task
☐	☐	☐	☐	Choose and rig a system appropriate to the task.
☐	☐	☐	☐	Attach the mechanical advantage system to the anchor system and the load.
☐	☐	☐	☐	Direct personnel effectively.
☐	☐	☐	☐	Use appropriate operational commands.
☐	☐	☐	☐	Analyze system efficiency.
☐	☐	☐	☐	Identify safety concerns
☐	☐	☐	☐	Perform a system safety check

Competency Rating Scale

3 – Skilled **1 – Unskilled**
2 – Moderately Skilled **X –Not Performed**

All skills must receive a 3 or 2 to obtain a passing evaluation for this job performance requirement.

Skill Sheet 5.5
Lowering Systems

Skill Competency

Name _____ Date _____

Evaluator _____

NFPA 1006, Chapter 3, Section 5 - Ropes/Rigging

3-5.5 – Construct a lowering system.
3-3.6 – Direct a lowering operation.

3	2	1	X	Skill
☐	☐	☐	☐	Tie knots appropriate to the task.
☐	☐	☐	☐	Rig system appropriate to the task.
☐	☐	☐	☐	Properly attach to the descent control device.
☐	☐	☐	☐	Properly attach to the anchor system.
☐	☐	☐	☐	Properly attach to the load.
☐	☐	☐	☐	Direct personnel effectively.
☐	☐	☐	☐	Use appropriate operational commands.
☐	☐	☐	☐	Analyze system efficiency.
☐	☐	☐	☐	Manage the movement of the load.
☐	☐	☐	☐	Identify safety concerns.
☐	☐	☐	☐	Perform a system safety check.

Competency Rating Scale

3 – Skilled **1 – Unskilled**
2 – Moderately Skilled **X –Not Performed**

All skills must receive a 3 or 2 to obtain a passing evaluation for this job performance requirement.

Skill Sheet 5.7
Belay Systems

Skill Competency

Name _____ Date _____

Evaluator _____

NFPA 1006, Chapter 3, Section 5 - Ropes/Rigging

3-5.7 – Construct a belay system.
3-5.8 – Operate a belay system during a lowering or raising operation.
3-5.9 – Belay a falling load.

3	2	1	X	Skill
☐	☐	☐	☐	Select an appropriate belay system
☐	☐	☐	☐	Tie knots appropriate to the task.
☐	☐	☐	☐	Rig the assigned chosen system.
☐	☐	☐	☐	Attach the belay system to the anchor system and load.
☐	☐	☐	☐	Tend the belay system as designed.
☐	☐	☐	☐	Assess system effectiveness.
☐	☐	☐	☐	Properly attach a belay line to a belay device.
☐	☐	☐	☐	Manage and communicate belay system status effectively.
☐	☐	☐	☐	Operate the belay system as designed to catch a falling load.
☐	☐	☐	☐	Recognize and rapidly react to a falling load.
☐	☐	☐	☐	Communicate belay system actuation.
☐	☐	☐	☐	Perform a system safety check.
☐	☐	☐	☐	Don & use task specific PPE.

Competency Rating Scale

3 – Skilled **1 – Unskilled**
2 – Moderately Skilled **X –Not Performed**

All skills must receive a 3 or 2 to obtain a passing evaluation for this job performance requirement.

Skill Sheet 5.10
System Safety Check

Skill Competency

Name _____ Date _____

Evaluator _____

NFPA 1006, Chapter 3, Section 5 - Ropes/Rigging

3-5.10 – Conduct a system safety check.

3	2	1	X	Skill
☐	☐	☐	☐	Apply and use PPE
☐	☐	☐	☐	Inspect rope system components for damage.
☐	☐	☐	☐	Assess a rope rescue system for improper configuration.
☐	☐	☐	☐	Secure equipment components.
☐	☐	☐	☐	Inspect all rigging.
☐	☐	☐	☐	Perform a system safety check.

Competency Rating Scale

3 – Skilled **1 – Unskilled**

2 – Moderately Skilled **X –Not Performed**

All skills must receive a 3 or 2 to obtain a passing evaluation for this job performance requirement.