Lesson 10: CONFINED SPACE RESCUE

INSTRUCTIONAL GOAL

Upon completion of this topic, the student will understand the need for an efficient and coordinated response to a confined space rescue operations.

ENABLING OBJECTIVES

Based on the information presented in the classroom and in the student guide, the student will be able to:

1. List the five priorities for emergency rescue operations.
2. Explain the three types of confined space rescue.
3. Identify specific rescue situations requiring special consideration.
4. Explain anchor and rigging systems.
5. Describe basic hand signals used during confined space rescue operations .
6. Described basic rescue safety rules.

OVERVIEW

This lesson discusses procedures for confined space rescue operations and emphasizes the need for safe operating procedures . Practice and proficiency using mechanical- all will advantage systems, anchors, and rescue equipment is critical to the safety of all response personnel involved.

Emergency Rescue - The Change in Perspective

Emergency rescue from a confined space is a matter of life and/or death. To this point we have concentrated upon routine entry and exit procedures. It may have appeared that we have not been making life and death decisions in these routine processes, but in fact, we have. When we routinely evaluate the space and perform the entry in accordance with the permit, we are making decisions that may mean the difference between a problem-free entry and a body recovery. Many of these same thought processes that are required in the emergency rescue are also used in the routine entry. If that is the case, why is it so much more difficult to perform in an emergency setting? Lack of time is the critical factor. A sense of urgency is sometimes used as an excuse for making decisions or performing actions that place others at undue risk. Following are a few emergency rescue operation priorities.

The first priority is to keep all rescuers alive. It may seem callous, but you did not create this situation. It is your job to do everything that you and your fellow rescuers can SAFELY do to help the victim. However, there will be situations that you will not be able to help. It is critical that the person in charge of the rescue effort recognize when the risk to the rescuers surpasses the gain to the victim. When the risk is evaluated to be too great, it is imperative that the person in charge have sufficient character to delay or suspend the rescue effort even when that decision is unpopular.

Do not substitute emotion for intellect. In many cases, the people involved in the emergency will be under a great deal of emotional distress. This is especially true if the victim is a co-worker. Heightened emotion and a sense of urgency can also be a problem for the person in charge of the rescue. Bystanders and co-workers of the victim may exert great pressure to act on the person in charge. If the person in charge is not prepared for this, he/she may well get caught up in a flood of well-meaning but tactically incorrect thinking

Don't take shortcuts. As stated before, time is the enemy in rescue operations. Don't allow rescuers to take shortcuts in appropriate procedures for the sake of saving time. This is especially true in space evaluation. If an emergency occurs in a space, a permit-like evaluation procedure needs to be performed unless the cause for the emergency can be unequivocally identified. Most of the time, short-cuts don't save all that much time anyway. (Ever get lost taking a "shortcut”?) Rather than relying on shortcuts to shave time off of the response, practice, training, and preparation can maximize efficiency and enhance safety.

The person in charge may chose to isolate themselves. By being in a remote location, the person in charge can insulate himself/herself from the emotion of the rescue. Furthermore, this individual can choose with whom they will interact. There are no screaming bystanders or irate supervisors to deal with. Isolation may also improve access to communication facilities, technical information, or other resources that may prove helpful in the effort. Isolation is a matter of personal

choice. If the person in charge chooses to be at the site of the rescue however, they should already have the mental mechanisms in place to deal with the distractions.

Preplanning and training. The more your rescue team knows before the emergency, the safer and more efficient the rescue will be. Especially if you are an on-site rescue team, you should know the hazards that you will be faced with ahead of time. Equipment and personnel requirements should also have been determined in advance. Preplanning will help to identify the needed equipment and personnel. Training will turn equipment and personnel into a functional unit. While it is impossible to anticipate every situation, trained personnel with a well-rounded background in rescue principles will be able to address the emergency in as efficient a manner as possible.

Every person who is involved in a confined space rescue must not only have a mental image of the technical aspects of the rescue, but should also anticipate the entire range of emotional reactions that one would expect to encounter. Most people who deal in the emergency arena daily indicate that the keys to being a successful emergency worker are the ability to concentrate under pressure and the control of personal emotion. Once these hurdles are crossed, one can think clearly and allow their training and experience to dictate their tactical objectives.

Confined Space Rescue

Confined space emergencies are one of the leading causes of multiple deaths in the workplace. In most cases the emergency began with very few people in the space. Then untrained and/or unprotected "rescuers" added to the problem by entering the space and becoming victims themselves. As stated before, about 60 percent of victims are would-be rescuers. Additionally, a majority of these individuals are supervisors and/or senior personnel who should know better. Oddly enough, there are many cases where the initial entrants survive and the would-be rescuers die.

The regulation mandates that an employer ensures the availability of rescue services prior to space entry. The rescue team may be from within the plant or may be from an outside agency. Either way, a specific mechanism needs to be in place prior to entry that guarantees that rescue resources are available if needed. Personnel assigned to an in-plant rescue team are to be provided with, and trained in the proper use of, the personal protective equipment necessary for making rescues from the employer's permit spaces.

If the employer decides to use an in-plant team, the employer shall ensure that the in-plant rescue team is trained to perform the assigned rescue functions and has received the training required for authorized entrants. Rescue teams should practice making permit space rescues at least once every 12 months by means of simulated rescue operations. In these simulated rescue operations, they remove dummies, mannequins or personnel through representative openings and portals.

The size, configuration, and accessibility of these openings should closely approximate those of the permit spaces from which rescues may be required.

Each member of the rescue service shall be trained in basic first aid and cardiopulmonary resuscitation. At least one member of the rescue service holding current certification in basic first aid and cardiopulmonary resuscitation (CPR) shall be available during rescue activities. If the employer chooses to use outside rescue services, the employer shall inform the designated rescuers of the hazards they may confront when called to perform rescues at the employer's facility. While no specific permit is required for rescue, those involved in the rescue should review the entry permit and apprise themselves of the hazards they may encounter prior to entry. This is especially true for any outside services that may not be familiar with the particular space.

OSHA is aware that, from the viewpoint of elapsed time, in-plant rescue services are optimal. They also realize that not all employers have the equipment and/or the personnel for such a team. If an outside rescue service is used, their response time, their continuous availability during the entry, and their rescue capabilities need to be established prior to entry.

A specific mechanism for summoning the rescue service is required. In most cases specific phone numbers, radio frequencies, or other type of communication medium is listed on the entry permit. The attendant is responsible for that communication and should perform a communications check prior to entry.

The employer shall provide access to all permit spaces from which rescue may be necessary so that the rescue service can develop rescue plans and practice operations. The employer shall also evaluate the response cabilities and training of the off-site response team.

Three Types of Rescue

There are three types of rescue that may be employed in the confined space setting:

1. Self-rescue
2. Non-entry rescue - external
3. Entry rescue - internal

Self-rescue is when an entrant is capable of recognizing a hazard and is able to exit from the space with no assistance. Many times self-rescue involves the evacuation of a space when the entrant feels ill. In this situation the assumption is that a hazard within the space is causing the problem and that space evacuation is necessary until the problem is identified.

Obviously self-rescue has many advantages over the other two forms of rescue. With self-rescue, emergency rescue personnel do not have to enter the space. Risky extrication and/or removal techniques are not required if self-rescue can be employed. Also, by virtue of the fact that the individual is still conscious, the chances that the entrant will recover from the emergency are good. Hazard recognition can prevent serious exposure and injury.

The use of retrieval systems can be very effective in assisting in the rescue of an unconscious employee from a confined space. These systems allow rescue from outside the space. Here a problem may arise in that in order to provide the

greatest degree of safety, the final rule requires the use of retrieval systems or methods whenever an authorized entrant enters a permit space except in situations in which retrieval equipment would increase the overall risk of entry or would not contribute to the rescue.

OSHA will use the following guidelines to make the determination for enforcement of this provision when inspecting permit spaces regarding retrieval systems:

1. A permit space with obstructions or turns that prevent pull on the retrieval line from being transmitted to the entrant does not require the use of a retrieval system.
2. A permit space from which an employee being rescued with the retrieval system would be injured because of forceful contact with projections in the space does not require the use of a retrieval system.

A permit space that was entered by an entrant using an air-supplied respirator does not require the use of a retrieval system if the retrieval line could not be controlled so as to prevent entanglement hazards with the air line.

However, exceptions from the use of a retrieval system from this standpoint may not necessarily exempt use of retrieval systems as described in 29 CFR 1910.134 (e)(3)(iii): Persons using air line respirators in atmospheres immediately dangerous to life or health shall be equipped with safety harnesses and safety lines for lifting or removing persons from hazardous atmospheres, or other and equivalent provisions for the rescue of persons from hazardous atmospheres shall be used. A standby person or persons with suitable SCBAs shall be at the nearest fresh air base for emergency rescue.

Non-entry rescue, as the name implies, is rescue performed from outside the space. Prior to entry, retrieval systems and body harnesses should be in place in the event that conditions change. In most cases non-entry rescue involves removal using these lines. It's important to plan and conduct the entry with this form of rescue in mind. Pulley systems, tripods, and space entryways should be arranged so that there is minimal chance for line entanglement. Non-entry rescue cannot be used for an individual who is entangled, trapped, or bound-up within the space; it can be used for engulfment situations as long as the amount of engulfing material is small enough to allow the victim to be unearthed using line tension. In some cases non-entry rescue is another name for body recovery. Individuals who are trapped in "no entry spaces," or are in locations where the risk of entry far outweighs the gain, may have to be removed using grappling lines, poles, hooks, or some other remote means.

Entry rescue is clearly the form of rescue that presents the greatest risk to the rescuer. It entails actually placing an individual into the hazardous space. Entry rescues should be avoided whenever possible. If entry rescue cannot be avoided, then SCBA, lifelines, harnesses, retrieval systems, and appropriate levels of protective clothing are required. Planning and communication are vital in entry rescue. Since an entry is being made, all safety check protocols must be performed and an attendant will be required. If a change in the space is thought to have caused the emergency, appropriate testing and monitoring should be repeated. While a

specific permit is not required, all rescuers involved in the rescue need to be informed of the hazards.

Entry rescue requires a considerable amount of equipment. In addition to usual PPE, there is a need for patient packaging devices, lifting devices, multiple lifelines, and emergency medical gear as well. Availability of the equipment and personnel needed for rescue and support must be ensured.

The extent of patient packaging is always a consideration when dealing with patients in hazardous locations and/or with life-threatening problems. Medical training classes always emphasize the immobilization of the spine for anyone who has been traumatized. Time and conditions may not allow for this in all confined space rescues. Perhaps the most relevant consideration is whether the individual is in an IDLH situation or has a life-threatening affliction. It does very little good to spend time immobilizing a person's spine if the atmosphere they are breathing is toxic, or the victim has no pulse or has severe airway problems.

There are associated risks removing the victim from the space without immobilization. Spinal immobilization should occur whenever conditions permit. Life safety is still your number one priority.

Specific Rescue Problems

There are many confined spaces that would pose significant problems for rescue entry. Some of these rescues may be very complicated, thus pre-planning the rescue of each confined space on the premises will make the rescue procedure go smoothly, efficiently, and safely.

Vertical entry into tanks and vessels is relatively uncomplicated as long as a point of attachment can be made for a lifting device. Attachment to roof members, booms, or tripods on the tank make lifting easy. Tripods, however, are designed to lift from the center. A problem will be encountered if the patient needs to be lowered down the outside of the tank since the center of mass would now be outside the tripod. Another point of attachment or manual lowering will be necessary.

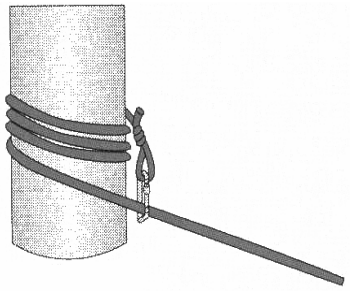
Dikes or vertical walls present a problem in that there is usually no point of attachment for a lifting device. A point of attachment can be made by raising an extension ladder above the wall, or by using a boom truck, forklift, or other elevated platform. If the extension ladder is used, make sure that the ladder is braced against lateral (side-to-side) movement.

Manholes are challenging because of their limited entrance areas. SCBA backpacks may have to be removed and passed though the hole to allow entrance. This is a very dangerous maneuver and should be attempted only by individuals specifically trained in this procedure. Finding a point of attachment for a lifting device may be a problem if a tripod is unavailable. This may be solved by placing two trucks side-by-side with the manhole in between. A ladder could then be placed across the trucks to span the space above the manhole. If this procedure is used, make sure the trucks are turned off and the vehicles isolated so that they do not move and their exhausts do not enter the space.

Atmospheres that contain corrosive chemicals are a threat to the nylon harness and rope material. In other atmospheres where skin exposure poses a threat to the rescuers, chemical protective clothing must be donned prior to entry. The application of a body harness and lifeline to someone in a fully-encapsulated suit has its challenges. The bulky nature of the suit will also impede and restrict movement in the space and in the space opening.

It is really important to determine the objectives of the rescue before making entry. It is imperative for the leader of the rescue group, as well as each rescue team member, to evaluate all potential hazards. The atmospheric conditions, entanglement and engulfment hazards, the circumstances of the accident, the time involved, and the probable victim outcome should all be given consideration prior to entry. Do not put the rescue team at undue risk to try to rescue a victim who may have already died.

Anchor and Rigging Systems



“Anchor” means to secure ropes and equipment of the rescue system to something that is solid and will not fail under the stress of loading. Rigging is the system of rescue ropes and hardware attached to the anchor system.

Anchors must be the strongest link within your system. "Bombproof" is a term for anchors strong enough to withstand any force the system may deliver to the anchor.

"Bombproof" Anchor Rigging

A suspect anchor, or an anchor that may not be bomb proof, should be backed up with a secondary anchor. However, the use of several weak anchor points is

undesirable and should be avoided. If one anchor fails, the shock loading will lead to failure of all points. If a secondary anchor is needed, it should be as strong or stronger than the primary anchor.

Good structural anchors include structural steel, davit arms, beams, stairwells, and heavy hand rails. Bulk concrete anchors are found in supports, columns, and corner walls. Cast or insulated small diameter pipes, corroded metal, small diameter hand rails, old brickwork, light metal supports, and vents are not bomb-proof anchors and should be avoided.

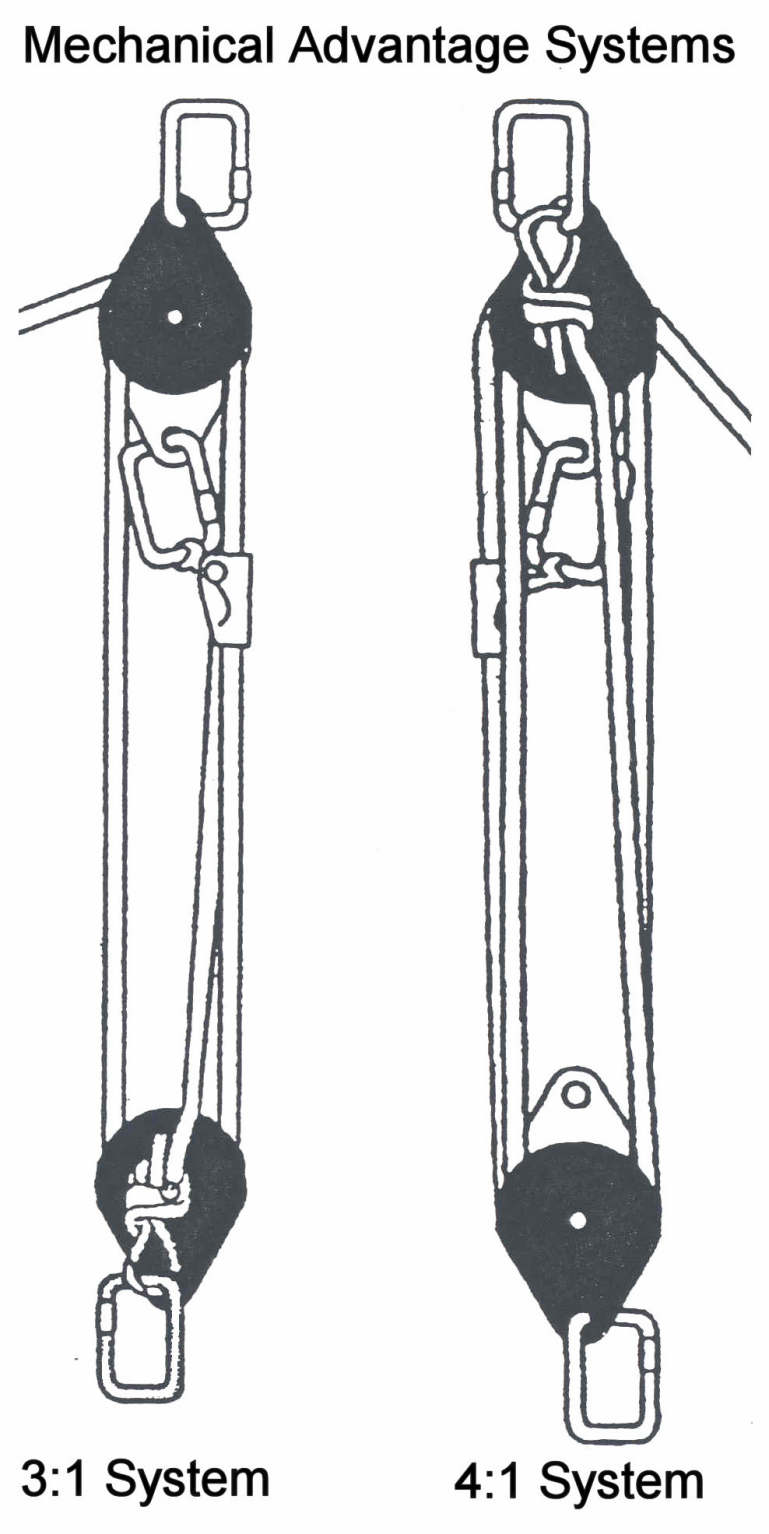
A tensionless tie-off utilizes the friction generated by coils of rope wrapped around the anchor as a means of anchoring a rope. A 4:1 tensionless anchor requires a minimum of three (3) wraps of rope around an anchor that is at least four (4) times the diameter of the rope. All other rigging must have a backup rig. If an anchor point has sharp edges, rigging should be padded.

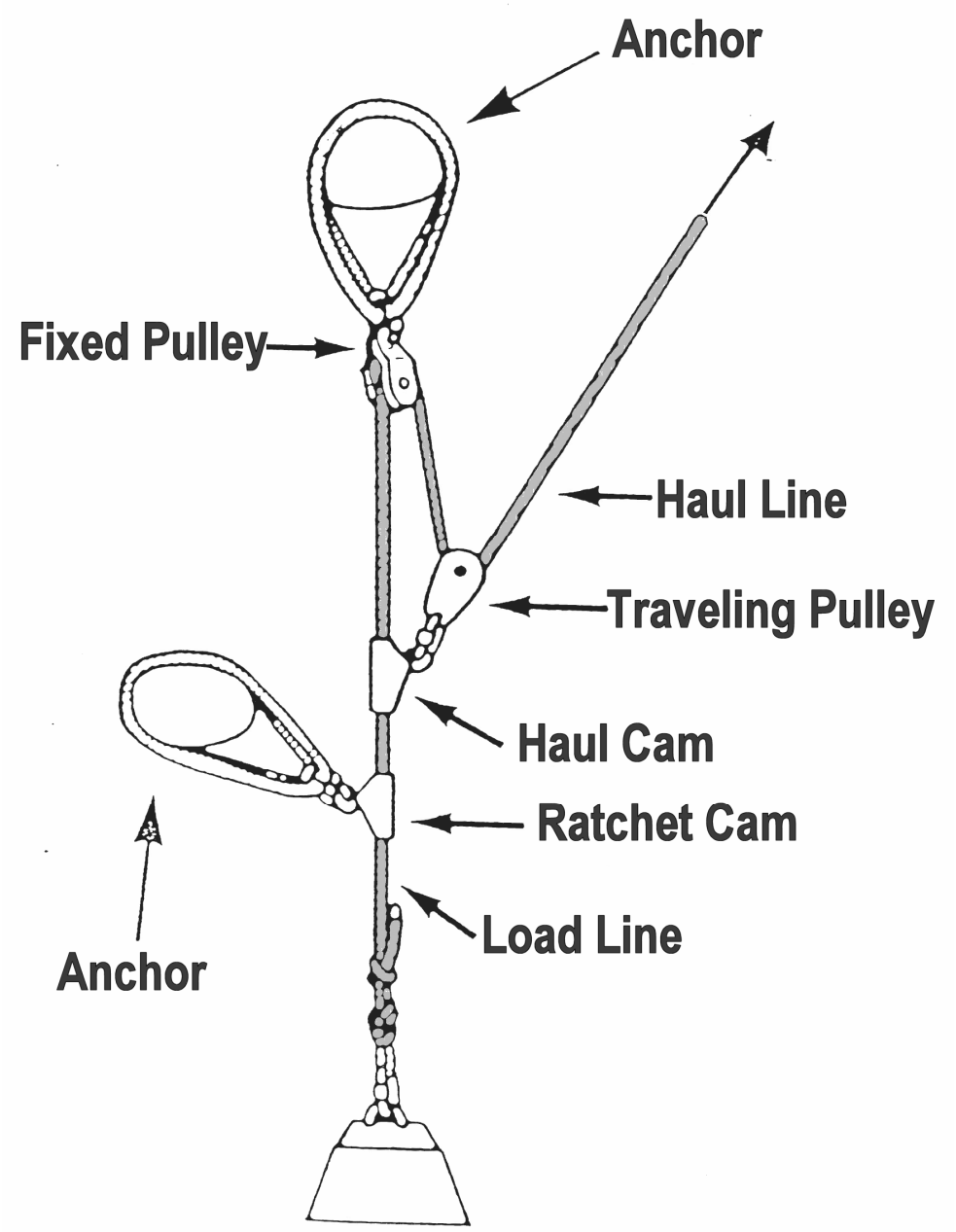
Rigging Cautions

- Do not run nylon over nylon rigging.
- Pad sharp edges as any bend under 4:1 weakens the rope (Spectra kevlar requires 8:1)
- Avoid hard linking, that is, three (3) or more carabiners linked together.
- Double check by sight and touch.
- Keep it simple.
- A pulley in rigging systems should always be backed up.
- Angles greater than 120° cause extra load on anchors.

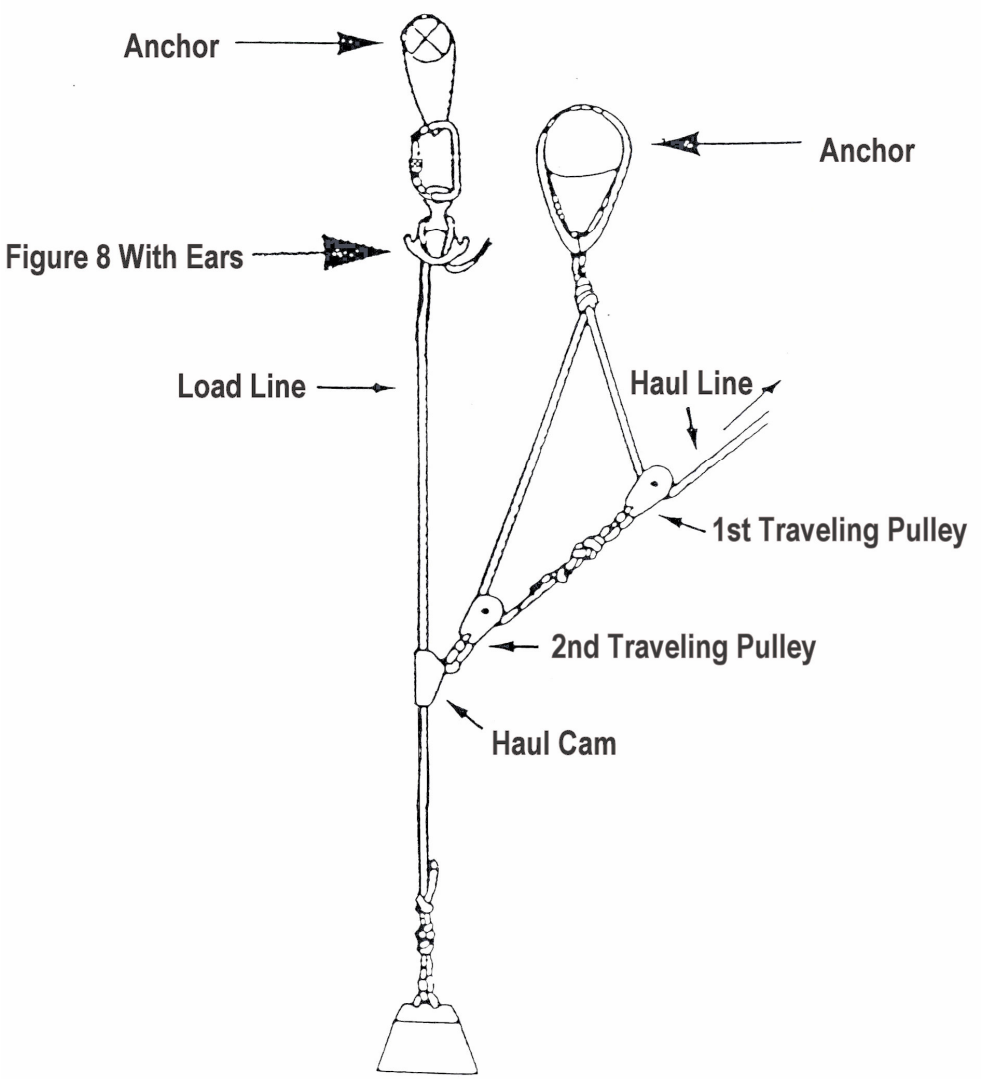
Belaying, Lowering, and Raising Systems

The securing of a person with a rope to prevent a fall is termed “belay.” The use of a munter hitch on a safety line is an example of a simple belay system. Safety lines must be used in training and should be used in actual rescues. Even if a haul cam is attached to the main line, like a piggyback Z-rig, use a safety line at all times.

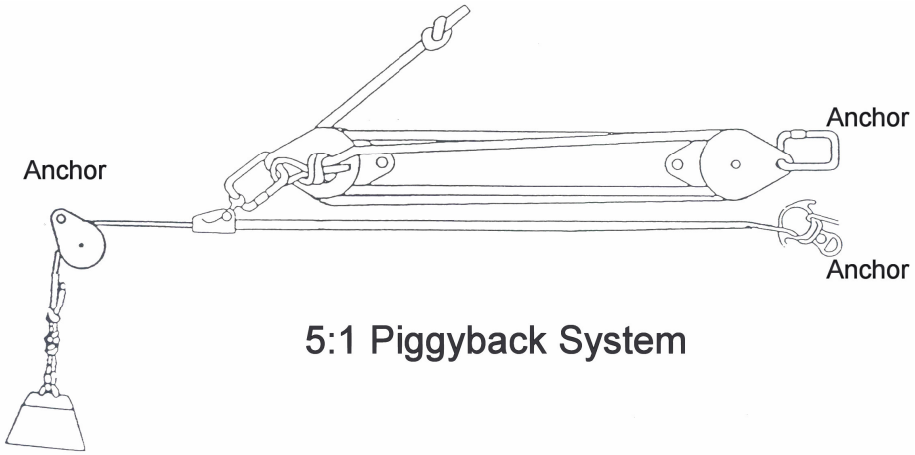

Mechanical Advantage Systems
3:1 System
4:1 System


Anchor
Fixed Pulley
Haul Line
Traveling Pulley
Haul Cam
Ratchet Cam
Load Line
Anchor

3 to 1 Z-Rig



4:1 Raising and Lowering Piggyback System



5:1 Piggyback System

Team Members and Their Duties

A haul or lower team requires two to four people depending upon the mechanical advantage of the system. 4:1 systems require up to 4 people. Where as 5:1, or greater, systems require only two people. Within this team someone needs to be designated for the following duties:

- Person-in-charge or Incident Commander
- Belayer and Safety Line
- Hole watch/Attendant
- Cam-person
- Rescuer

Individuals may be required to cover more than one duty, such as, the Person-in-charge may also need to be the attendant or on the haul team. This is dependent upon the number of personnel available and the type of rescue/rigging system used.

As in any efficient operation, communication is important. Knowing what each individual is doing and their responsibilities is vital. Raising and lowering operations have specific verbal terms used and are said by specific personnel. The following table provides examples of this terminology.

TERM	WHO SAYS TERM	MEANING
On rope	Rescuer	Hooked in the system.
On safety	Safety	Safety line is ready.
On belay	Attendant	Ready to raise or lower.
Lower/raise	Rescuer	Rescuer ready to go.
Lowering on	Attendant	Rescuer is lowered.
Down slow/fast	Attendant	Down slow or fast.
Haul slow/fast	Attendant	Raise slow or fast.
Set	Attendant	Stop raising and set cam.
Slack	Attendant	Prepare to reset the equipment and raise again
Stop	Anyone	Stop the function because of an emergency or safety concern

HAND SIGNALS

SIGNAL	MEANING
Palm up / Thumb up	Raise
Palm down / Thumb down	Lower
Fist	Hold
Hand and arm moving back and forth horizontally	On the ground
Hand taps top of helmet	OK
Hand on throat OK	Emergency

LINE SIGNALS

SIGNAL	MEANING
1 pull or tug	OK
2 pulls or tugs	Advise
3 pulls or tugs	Take up
4 pulls or tugs	Help

*The acronym OATH may assist in remembering the meanings.

Rescue Safety Rules

- Don't proceed without proper PPE, equipment, personnel, and training.
- Make sure the confined space has been isolated.
- Use SCBA/SAR if not certain the atmosphere is safe.
- Do not use power equipment for human loads.
- Attendant never enters the space unless first relieved by another attendant.
- Have back-up rescue personnel available.
- Don't risk a life for a body recovery. Weigh risk vs. benefit.
- Entry rescue team personnel requireme0n is about seven people.