

# General

## Lesson One

### Rescue Rigging

**DOMAIN:** PSYCHOMOTOR

**LEVEL OF LEARNING:** KNOWLEDGE / APPLICATION

#### **MATERIALS**

Delmar Engineering Practical Rope Rescue Systems; NFPA 1931, Standard for Manufacturer's Design of Fire Department Ground Ladders; NFPA 1932, Standard for Testing and Maintaining Fire Service Ladders; International Manual of Basic Rescue Methods, 2004 edition, by Dawson Nethercutt. Laptop computer, multimedia projector, viewing screen, whiteboard or flipchart, and marking pens. A suitable number of various lengths of tied and pre-sewn 1" and 2" flat or tubular untied web slings, (suggest 3', 8', 15', and 20'); a suitable number of various lengths of 7/16" or 1/2" untied rope slings (suggest 7', 14', and 20' lengths); several bags of 100' of lifeline rope or utility rope with a safe working load of 300 pounds for use as guy lines for portable anchors; several 50' sections of rope for lashing portable anchors; 2 fire service grade straight ladders; 1 - 24' fire service grade extension ladder; five 4" x 4" x 12' timbers for creating portable anchors, several steel rods 5' x 1" diameter for use as pickets; several steel rods, several 2 1/2' long x 1/2" diameter for use as spinners, several 12" long x 1 1/4" - 1 1/2" diameter PVC pipe to be used as a protective barrier between the spinners and the lashing rope, several pieces of 20' x 7/16" or 1/2" diameter rope for lashing pickets, sledge hammer, and several fixed anchor points or manmade anchor points (pickets), suitable number of single sheaves pulleys, suitable number of locking carabiners. Several weighted objects for lifting props, 6 - 4" x 4" x 12' timbers, one dozen 2" x 4" x 6" blocks.

#### **NFPA 1006, 2008 edition JPRs**

- 5.3.2 Move a victim in a low-angle environment
- 5.5.3 Edge Protection

- 5.5.6 Direct a team in a simple rope mechanical advantage system in a high-angle raising operation.
- 5.5.8 Construct a lowering system.
- 5.5.9 Direct a lowering operation in a low-angle environment.
- 5.5.10 Direct a lowering operation in a high-angle environment.

**Junior Member Statement:**

Junior Member training activities should be supervised by qualified instructors to assure that the cognitive and psychomotor skills are completed in a safe and non-evasive manner. While it is critical that instructors be constantly aware of the capabilities of all students both mentally and physically to complete certain tasks safely and successfully, the instructor should take every opportunity to discuss with departmental leaders and students the maturity and job awareness each participant has for the hazards associated with fire and rescue training.

**TERMINAL OBJECTIVE**

The Technical Rescuer candidate, when given the appropriate equipment, shall correctly demonstrate the lashing of two or more timbers firmly together so as to construct a derrick, gin pole, "A" frame, and a tripod.

**ENABLING OBJECTIVES**

1. The Technical Rescuer candidate, when given the appropriate equipment, shall correctly identify the basic parts and construction features, shall demonstrate the basic climbing methods of a ladder, and shall demonstrate how to clean and maintain a ladder.
2. The Technical Rescuer candidate, when given the appropriate equipment, shall correctly demonstrate the construction of a picket system.
3. The Technical Rescuer candidate, when given the appropriate equipment, shall correctly demonstrate the construction of a ladder hinge.

4. The Technical Rescuer candidate, when given the appropriate equipment, shall correctly demonstrate the construction of a ladder slide.
5. The Technical Rescuer candidate, when given the appropriate equipment, shall correctly demonstrate the construction of a ladder-as-a-derrick.
6. The Technical Rescuer candidate, when given the appropriate equipment, shall correctly demonstrate the construction of a ladder jib.
7. The Technical Rescuer candidate, when given the appropriate equipment, shall correctly demonstrate the construction of a ladder "A" frame.
8. The Technical Rescuer candidate, when given the appropriate equipment, shall correctly demonstrate the construction of an "A" frame, utilizing timbers.
9. The Technical Rescuer candidate, when given the appropriate equipment, shall correctly demonstrate the construction of a tripod, utilizing timbers.
10. The Technical Rescuer candidate, when given the appropriate equipment, shall correctly demonstrate the construction of a gin pole, utilizing timbers.
11. The Technical Rescuer candidate, when given the appropriate equipment, shall correctly demonstrate the construction of a jib arm, utilizing timbers.

# General

## Lesson One

### Rescue Rigging

#### MOTIVATION

Lashings are used mainly to bind two or more timbers firmly together in the construction of derricks, gin poles, "A" frames, and tripods. Rescue personnel should be proficient in their use. The numerous rescue systems involving lashings require a minimal amount of equipment and personnel, are quickly rigged, and have numerous applications. Once the components are understood, the techniques discussed are easily rigged and safely operated.

#### PRESENTATION

#### ENABLING OBJECTIVE #1

The Technical Rescuer candidate, when given the appropriate equipment, shall correctly identify the basic parts and construction features, shall demonstrate the basic climbing methods of a ladder, and shall demonstrate how to clean and maintain a ladder.

1. Review the individual components of ground ladders, so as to allow each candidate the ability to distinguish which components are common to which ladders.
2. Point out that the design characteristics directly related to the safety considerations for all types of ground ladders.
3. Describe the construction features of the following types of ladders:
  - a) Metal.
  - b) Wooden.
  - c) Fiberglass.
4. Discuss the load limits for fire service ladders.

- a) According to NFPA 1932, Standard for Testing and Maintaining Fire Service Ladders, the working load of a straight wall ladder positioned in an acceptable climbing angle is 750 pounds.
  - b) According to NFPA 1932, Standard for Testing and Maintaining Fire Service Ladders, the working load of an extension ladder positioned in an acceptable climbing angle is 750 pounds.
  - c) According to NFPA 1931, Standard for Manufacturer's Design of Fire Department Ground Ladders, all structural components of ground ladders shall be constructed of materials such that the ground ladder maintains at least 75% of the strength necessary to pass all test requirements in this standard at 300°F.
5. Demonstrate the proper procedures for executing a two-person underarm (a.k.a. hip) lift and carry using a 24' extension ladder that is lying flat on the ground, and emphasize the appropriate use of verbal commands.
- a) Both rescuers position themselves on the same side of the ladder facing the butt end.
  - b) One rescuer is positioned near the tip end and the other rescuer is positioned near the butt end.
  - c) Both rescuers shall kneel beside the ladder and reach across the ladder and grasp a rung near the far beam.
  - d) The rescuers shall tilt the ladder up so that it is resting on the near beam.
  - e) The rescuers shall reach across the upper beam and grasp the nearest rung.
  - f) The command "prepare to lift" and the command "lift" shall be given by the butt end rescuer.
  - g) Both rescuers shall simultaneously stand positioning the upper beam under the shoulder and carry the ladder to the designated work area, butt end first, and place the ladder flat on the ground with the fly section up.
6. Demonstrate the proper procedures for executing a two-person ladder raise using a 24' extension ladder. Emphasize the appropriate use of verbal commands.
- a) The rescuer at the butt end of the ladder shall face the ladder and heel both beams while grasping the nearest rung with both hands.

- b) The rescuer at the tip end shall swing under the ladder and grasp the nearest rung with both hands.
- c) The command "prepare" to "raise" and "raise" shall be given by the butt end rescuer.
- d) The tip end rescuer shall begin raising the ladder using the hand over hand method.
- e) As the ladder moves to the vertical position, the butt end rescuer shall continue to grasp rungs higher up on the ladder until the ladder reaches the vertical position.
- f) Both rescuers shall face each other through the ladder and pivot the ladder to the fly out position.
- g) The outside rescuer shall stabilize the ladder while the inside rescuer raises the fly section to the appropriate height.
- h) Set the ladder at the appropriate climbing angle. When placed in the accepted climbing angle (75.5 degrees), three rungs should extend above the window sill, roof edge, or parapet wall.
- i) Both rescuers shall verify the pawls are locked securely.
- j) The butt end rescuer shall secure the halyard line by wrapping the halyard line at least a full round turn around two rungs and then securing it by tying off to the upper rung using a clove hitch.

## **APPLICATION**

Using ladders provided by the AHJ, have the candidates demonstrate appropriate carrying and raising procedures.

- 6. Discuss the importance of developing a good rhythm when climbing.
- 7. Point out how the rungs should be used for climbing unless you are carrying an object in your hand. Also discuss how you should climb near the center of the rungs on the balls of the feet, keeping the body straight.
- 8. Discuss and demonstrate the correct procedure for safely locking-off to the ladder for hands free operations.

9. Point out how the beams should be used for climbing when you are carrying an object in your hand.
10. Illustrate the fact that for maximum safety when climbing a ladder, the Technical Rescuer must maintain three points of contact with the ladder.

## **APPLICATION**

Using ladders provided by the AHJ, have the candidates demonstrate appropriate climbing procedures.

11. Discuss the inspection procedures for ladders.
  - a) Inspection and cleaning should follow NFPA 1932 guidelines.
  - b) Check the heat sensor label for discoloration indicating excessive heat exposure, heat sensors located at various points on the inside of the beams will activate and turn black at 300 degrees.
  - c) Check the rungs for snugness.
  - d) Check the bolts and rivets for tightness.
  - e) Check the welds for cracks or other defects
  - f) Check the beams and rungs for cracks, splintering gouges, warping or discoloration.
  - g) Check hooks, pawls and halyard for function and damage.
  - h) Check halyards for discoloration, cuts and frays, the halyard diameter should be 3/8".

Reference: IFSTA Essentials of Firefighting, 5th edition, Pages 480 and 481; Manufacturer's Specification manuals.

## **APPLICATION**

Using ladders provided by the AHJ, have the candidates demonstrate appropriate inspection procedures.

12. Discuss the cleaning procedures for ladders.
  - a) Ladders should be cleaned after each use.
  - b) A soft bristle brush and running water is best tool for cleaning.
  - c) Approved solvents may be used to remove greasy residue.

Reference IFSTA Essentials of Firefighting, 5th edition, page 479.

## PRESENTATION

### ENABLING OBJECTIVE #2

The Technical Rescuer candidate, when given the appropriate equipment, shall correctly demonstrate the construction of a picket system.

1. Discuss the use of various types of picket systems.
  - a) A picket system is an alternative anchor used in a natural setting such as soil when no other anchors are available.
  - b) Soft soils do not accommodate a picket system well.
  
2. Demonstrate the steps required in setting up a picket-holdfast system.
  - a) Point out that pickets should be driven into the ground approximately two-thirds their length at an angle of 15 degrees away from the force to be anchored.
  - b) When using a combination of pickets, they should be driven into the ground at a distance apart approximately equal to their length. Pickets should never be less than three feet apart.
  - c) When using a combination of pickets, they should be lashed together with a 1/2" x 25' - 50' rope.
  - d) Start the lashing with a clove hitch in the center of the rope near the top of the first picket. Make as many turns as possible around the first and second picket, going from the top of the front picket (primary anchor) to the bottom of the back-up picket (secondary anchor).
  - e) Secure the lashing with two half hitches on the lashing between the two pickets.
  - f) Take a short steel rod for use as a spinner rod (minimum 2' by 3/8" diameter), and put it through the turns of the lashing rope, twisting until the lashing is tight, and then drive the short picket into the ground.
  - g) Use a short piece of PVC pipe (minimum 1 1/4" diameter) as a buffer between the spinner and the rope.
  
3. Identify sample picket configurations and their load capacities when constructed in average soil.

- a) Single Picket System - 700 pounds.
- b) 1:1 Combination- 1400 pounds.
- c) 1:1:1 Combination- 2000 pounds.

## **APPLICATION**

Upon completing the picket system demonstrations, have the Technical Rescuer candidates break up into teams and repeat the evolutions several times. Rotate the team members through each position of the picket system evolution. Closely monitor the evolutions to insure safety.

## **PRESENTATION**

### **ENABLING OBJECTIVE #3**

The Technical Rescuer candidate, when given the appropriate equipment, shall correctly demonstrate the construction of a ladder hinge.

1. Describe the application, operation, basic safety components, and limiting factors of a ladder hinge.
2. Discuss the use of a ladder hinge.
  - a) This system can be used as a method of rescue employed when there are patients that may need to be lowered or raised in a horizontal position, or when there are several patients.
3. Demonstrate the steps for using a ladder hinge with a Stokes basket.
  - a) The ladder is placed vertically against the wall of a building.
  - b) The tip of the ladder should extend two rungs above the opening.
  - c) Secure two side guy lines to each beam tip of the ladder with a split-locking clove hitch. Anchor with rescuers on the ground at about a 70 degree angle.
  - d) The foot of the stokes basket is secured to the top of the ladder with a body cord. Leave enough slack to allow the stokes basket to stay in a horizontal position as the ladder is lowered.
  - e) Attach a lowering rope to the head of the Stokes basket.

- f) A heel man at the base of the ladder walks back slowly as the ladder is lowered to help keep the ladder stabilized.

## **APPLICATION**

Upon completing the ladder hinge demonstration, have the Technical Rescuer candidates break up into five member teams and repeat the evolution several times. Rotate the team members through each position of the ladder hinge evolution. Closely monitor the evolutions to insure safety and make sure all personnel are wearing the appropriate PPE for the task.

Two instructors are advisable for this evolution, one to monitor activities on the ground, and one to monitor activities on the upper level.

Reference: International Manual of Basic Rescue Methods, 2004 edition, pages 68-71.

## **PRESENTATION**

### **ENABLING OBJECTIVE #4**

The Technical Rescuer candidate, when given the appropriate equipment, shall correctly demonstrate the construction of a ladder slide.

1. Describe the application, operation, basic safety components, and limiting factors of a ladder slide.
2. Discuss the use of a ladder slide.
  - a) Describe how this method of rescue can be employed when manpower might be limited, or when there are several patients. Point out that the patient cannot be lowered or raised in a horizontal position using this technique.
3. Demonstrate the steps required in executing a ladder slide with a stokes basket, and point out the difference between using a stokes basket as opposed to an army litter.
  - a) The rungs should be secured using cloves hitches and round turns at the point where the butt end of the fly section meets the bed section.

- b) Position the ladder so that the tips rest slightly above the windowsill, roof edge or parapet wall. Point out that this is a different tip position than the ladder raise mentioned above,
- c) At the upper level a minimum of three rescuers shall rig the victim into the stokes basket in the same manner as preparing for a vertical lower.
- d) Point out that for this evolution the internal lashing is not necessary.
- e) Secure main line and belay line to the stokes basket using the vertical lowering method.
- f) Secure both lines to separate anchors and appropriate lowering devices.
- g) While one rescuer heels the butt end of the ladder, another rescuer shall climb the ladder to a position eye level to the window sill, roof edge or top of parapet wall and lock-off on the ladder until the basket is setting on the edge of the window sill, roof edge or parapet wall.
- h) Two rescuers will be needed to pass the victim out to the rescuers on the ladder while a third rescuer controls the main line lowering system.
- i) Once the rescuer on the ladder has secured control of the basket, one of the upper level rescuers will control the belay line while the other rescuer will act as a spotter and safety officer and will be responsible for giving the appropriate lowering commands until the victim and rescuer safely reach the ground. These are the same commands used for a vertical lowering operation.
- j) Emphasize that appropriate friction devices, or other suitable means should be used when lowering the patient to keep the weight of the patient off the person on the ladder.
- k) Point out that caution should be exercised that the litter does not get hung up on the ladder as it descends.

## **APPLICATION**

Upon completing the ladder slide demonstration, have the Technical Rescuer candidates break up into five member teams and repeat the evolution several times. Rotate the team members through each position of the ladder slide evolution. Closely monitor the evolutions to insure safety

and make sure all personnel are wearing the appropriate PPE for the task.

Two instructors are advisable for this evolution, one to monitor activities on the ground, and one to monitor activities on the upper level.

## **PRESENTATION**

### **ENABLING OBJECTIVE #5**

The Technical Rescuer candidate, when given the appropriate equipment, shall correctly demonstrate the construction of a ladder-as-a-derrick.

1. Describe the application, operation, basic safety components and limiting factors of a ladder-as-a-derrick.
2. Discuss the demonstrate the use of a ladder-as-a-derrick.
  - a) The ladder-as-a-derrick can be used to lift weights, or used for lowering or raising patients being rescued. It is a very effective method of rescue when the patient needs to be lowered or raised in a horizontal position. Demonstrate the steps for setting up a freestanding ladder-as-a-derrick.
  - b) The aft guy line and side guy lines should be one and one-half to two times the length the ladder is extended, never less than the length. The holdfast or picket anchoring system should be placed forward of the base of the ladder in line with the object being lifted.
  - c) A thirty-five foot three-section ladder may be used in place of the more commonly used 24' foot extension ladder to create a ladder-as-a-derrick.
  - d) If a three-section ladder is used for this procedure, then both fly sections should be secured to one another using round lashing around the rungs or beams, as well as the bed being secured to the first fly section at one or more points.

3. Demonstrate attaching the side guys using two ropes.
  - a) Secure a split locking clove hitch on each beam at the top rung of the ladder, then cross over to the opposite beam and secure a loop over them. The side guys should be tied at the first rung.
4. Demonstrate attaching the side guys using one rope.
  - a) Form a bight in the middle of the rope and slip it under the first rung and back over the beams.
  - b) At each beam form a half hitch and slip it over the top of each beam thus forming a split clove hitch.
  - c) Take each leg of the rope to the opposite beam, form a loop and slip them over each beam.
5. Demonstrate constructing the aft guy.
  - a) Take the standing part of the rope and the remaining running to a point equal to an arm's length above the second rung and tie a self-adjusting bowline with a safety knot.
6. Demonstrate attaching the anchor sling for the upper pulley.
  - a) A rope sling or tubular nylon sling rated for the load; place the sling across the beams just below the third rung.
  - b) Bring each leg of the sling around each respective beam and over the top of the second rung and center up each leg and secure the upper pulley to the sling with a locking carabiner.
7. Point out safety precautions that should be adhered to when using ground ladders for a ladder-as-a-derrick.
  - a) The manufacturer's specifications and guidelines should be referred to regarding the maximum load that can safely be placed on the system.
  - b) It should be remembered that all loads should remain within the beams of the ladder and that this system will not accept side loading.
  - c) It should also be pointed out that the higher the load is raised, the more the load is increased on the system.
  - d) Use of the change of direction pulley at the base of the ladder will allow the haul line to be pulled in such a manner that forces the base of the ladder into the ground.

8. Demonstrate setting up the ladder-as-a-derrick on the tailboard of a vehicle such as a fire truck or heavy crash truck.
  - a) The main difference in setting up a ladder-as-a-derrick on the tailboard of a vehicle as opposed to setting one up which is free-standing is the distance that the guy lines are secured in relation to the length the ladder is extended.
  - b) The guideline of having the length of the aft and side guy lines a minimum of the length the ladder is extended may not be adhered to based upon the length and width of the vehicle being used.
  - c) When using a fire truck, the side guy lines are secured to the booster line reel or other appropriate anchor. If the aft guy line will not crush the light bar located on the cab of the vehicle, then it may be secured to the front bumper or other suitable anchor on the chassis of the vehicle.
  - d) If the aft guy line will not crush the light bar located on the cab of the vehicle, then it may be secured to the front bumper or other suitable anchor on the chassis of the vehicle.
  - e) The manner in which the base of the ladder is secured is based upon what is available at the tailboard of the particular vehicle being used.

Reference International Manual of Basic Rescue Methods, 2004 edition, pages 87-90.

## **APPLICATION**

Upon completing the ladder-as-a-derrick demonstrations, have the Technical Rescuer candidates break up into teams and repeat the evolutions several times. Rotate the team members through each position of the ladder-as-a-derrick evolution. Closely monitor the evolutions to insure safety.

## **PRESENTATION**

### **ENABLING OBJECTIVE #6**

The Technical Rescuer candidate, when given the appropriate equipment, shall correctly demonstrate the construction of a ladder jib.

1. Describe the application, operation, basic safety components, and limiting factors of a ladder jib.
2. Discuss and demonstrate the use of a ladder jib.
  - a) If lowering a patient from a collapse, the jib is for a one-person load (300 lbs) only.
  - b) Only one rung extends beyond the wall.
  - c) A counterweight at the butt end should be used (i.e. lash the butt end to an anchor point, or have two rescuers sit on butt end of ladder.)
3. Demonstrate the steps for setting up a ladder jib.
  - a) The ladder is raised to a level above the departure point using standard departmental procedures.
  - b) The ladder is positioned in such a manner that the tip of the ladder is higher than the base.
  - c) The beams of the ladder should be supported near the tip by the windowsill or parapet wall.
  - d) A rope sling or tubular nylon sling is doubled and laid across the ladder at the first rung in such a way that both ends of the sling come through the ladder and rest on the sling as it crosses the ladder.
  - e) Do not place the ladder sling farther than one rung from the parapet wall or windowsill. Supporting the tip of the ladder as each additional inch of projection increases the leverage at the base of the ladder.
  - f) The bed of the ladder is secured to the fly section at one or more points with round lashing to prevent a separation of the two sections under a load.
  - g) A mechanical advantage system is then secured at this sling to create a mechanical advantage.
4. Describe how this method of rescue can be employed when there are patients that may need to be lowered or raised in a horizontal position, or when there are several patients.

Reference International Manual of Basic Rescue Methods, 2004 edition, page 82.

## **APPLICATION**

Upon completing the ladder jib demonstration, have the Technical Rescuer candidates break up into teams and repeat the evolution several times. Rotate the team members through each position of the ladder jib evolution. Closely monitor the evolutions to insure safety.

## **PRESENTATION**

### **ENABLING OBJECTIVE #7**

The Technical Rescuer candidate, when given the appropriate equipment, shall correctly demonstrate the construction of a ladder "A" frame.

1. Describe the application, operation, basic safety components, and limiting factors of a ladder A-frame.
2. Discuss and demonstrate the use of a ladder A-frame.
  - a) Position the two ladders on the ground on their beams with the heels of the ladder even.
  - b) Align the top rungs of the ladder.
  - c) With the top rungs and beams together, keep the butts of the ladder apart equal to approximately one-half the distance from the heel of the ladder to the sling used to support the pulley system.
  - d) Lash the top rungs or beams together using round lashing. Clove hitch - round turns - clove hitch.
  - e) The two side guy lines are put on with a split clove hitch around the first rung and beam of the ladder with a loop being placed on the opposite beam and the side guy line being secured to a holdfast on that side of the ladder A-frame pulling the beams of the ladder together rather than apart.
  - f) The side guy lines should be one and one-half times the distance from the sling at the top of the ladder to the butts of the ladders.
  - g) The holdfast or picket anchoring system should be placed in line with the object being lifted.
  - h) A rope sling or tubular nylon sling is passed around the beams of one ladder and over the top rung of the connecting ladder so that it rests over the top rungs of the two ladders.

- i) A mechanical advantage system is then secured at this sling to create a mechanical advantage.
- j) The ladders are now ready to be raised over the point of the operation.
- k) To prevent the ladders from spreading further at the base, a rope ledger is attached at the bottom rungs of the two ladders.
- l) Tie a split clove hitch around the beam and bottom rung of one ladder and secure this rope to the beam and bottom rung of the second ladder with a round turn and two half hitches.
- m) Tie a second rope ledger on the opposite side of the two ladders using the same step described above. Pickets can be used in place of a rope ledger.

## **APPLICATION**

Upon completing the ladder A-Frame demonstration, have the Technical Rescuer candidates break up into teams and repeat the evolution several times. Rotate the team members through each position of the ladder A-Frame evolution. Closely monitor the evolutions to insure safety

## **PRESENTATION**

### **ENABLING OBJECTIVE #8**

The Technical Rescuer candidate, when given the appropriate equipment, shall correctly demonstrate the construction of an "A" frame, utilizing timbers.

1. Describe the application, operation, basic safety components, and limiting factors of a A-frame, utilizing timbers.
2. Discuss the use of a A-frame system.
  - a) Are used to lift relatively heavy loads where the use of gin poles is impractical.
  - b) Can only be used to move a weight in a straight line between the timbers.
  - c) Consist of two timbers with their butts on the ground and the tops lashed together with round lashing.
  - d) Minimum dimension lumber required for the A-frame is a 4" x 4" x 12' timber.

3. Demonstrate the steps required in round lashing.
  - a) Select two 4" x 4" x 12' timbers, even the butts and put 2" x 2" x 24" spacers between the poles near the top and bottom of the timbers, tie the timbers together near the base with a draw-hitch.
  - b) Start with a clove hitch approximately 24" to 36" down from the tip of the shortest timber and marry the ends. Be sure to chamfer, or notch the area where the lashing is to be secured.
  - c) Continue with six close round turns around both timbers traveling upward.
  - d) Make two frapping turns between the two timbers, draw tight, and finish with a clove hitch on the opposite timber from where you started at the bottom of the lashing.
  - e) The round turns should be counted on the outside timber, then return to the nearest timber where the first clove hitch was tied before starting the frapping turns on an A-frame.
  - f) To reduce the risk of the lashing from slipping when loaded, 2 wedges can be driven under the lashing from the bottom of each side, or 2" x 4" blocks can be nailed at the bottom of the lashing on each side.
  - g) Cross the timbers and spread them 1/3 the distance between the bottom of the lashing and the butt ends.
4. Point out that a 2" x 6' tubular nylon sling is passed over the crotch at the top so that it will rest across the timbers and not on the lashing. This is the anchor sling for the tackle system.
5. Discuss an alternate method of opening a 2" x 6' tubular nylon sling and passing it over both timbers at the top. Take a loop of the sling down through the timbers above the lashing, and pull a loop up through the timbers above the lashing. Take these two loops down and around the timbers below the lashing so that they pull the timbers together.
  - a) A mechanical advantage system is then secured at this sling to create a mechanical advantage.
7. Demonstrate the steps required in constructing an "A" frame utilizing 4" x 4" x 12' timbers.

- a) After lashing the two timbers together with round lashing, spread the butts of the timbers until their distance apart is approximately one-third of the distance from the butt to the lashing.
  - b) To prevent the timbers from spreading further, a board ledger can be used to lash the legs using square lashing.
  - c) An alternate method to prevent the timbers from spreading further is to use a 1/2" x 20' kernmantle rope ledger. Start with a clove hitch and safety knot on the first timber. Go to the second timber and tie a round turn and two half hitches.
  - d) A 2" x 6' tubular nylon sling is passed over the crotch so that it will rest across the timbers and not on the lashing.
  - e) Discuss an alternate method of opening a 2" x 6' tubular nylon sling and pass it over both timbers at the top. Take a loop of the sling down through the timbers above the lashing, and pull a loop up through the timbers above the lashing. Take these two loops down and around the timbers below the lashing so that they pull the timbers together.
  - f) A mechanical advantage system is then secured at this sling to create a mechanical advantage.
  - g) A change of direction sling is lashed near the ground of one pole. Attach the change of direction pulley with the fall line being hauled in the direction of the opposite timber.
8. Discuss how "A" frames are held upright by a fore and aft guy line, forming an inverted "V."
9. Demonstrate the steps required in setting up a fore and aft guy line.
- a) A-frames are held upright by a two guy lines, fore and aft, forming an inverted "V."
  - b) Tie a clove hitch in the center of the rope and place it over the top of one timber, as close to the lashing as possible. The rope should be long enough to provide a length of 1 1/2 to 2 times the height of the timbers for the guy lines and made of 1/2" kernmantle rope. The clove hitch should pull from the inside of the timber.
  - c) Form another clove hitch and place it on the other timber in the same manner. The guy lines must

be put on so that they draw the timbers together when the load is applied. Example: The forward guy line is fastened to the rear timber while the aft guy line is fastened to the front timber.

- d) The fore and aft guy lines are secured to a solid anchor or picket anchoring system with a round turn and two half hitches or other form of brake control after the desired luff has been obtained.
  - e) The anchor points for the guy lines should be one and one-half to two times the length of the A-frame, never less than the length. The anchor points or is placed in line with the object to be lifted.
8. Point out that the initial luff should not be over one-fifth the distance between the butt ends and the top lashing on the A-frame, while the maximum luff should not be over one-third the distance between the butt ends and the top lashing of the A-frame.
9. Demonstrate the steps required for setting up a change of direction pulley at the base of the A-frame.
- a) Point out that the fall line should be pulled in the same direction as the initial luff. This will cause the base of the timbers to “dig in” rather than slip.

## **APPLICATION**

Upon completing the A-frame (utilizing timbers) demonstrations, have the Technical Rescuer candidates break up into teams and repeat the evolutions several times. Rotate the team members through each position of the A-frame (utilizing timbers) evolution. Closely monitor the evolutions to insure safety.

## **PRESENTATION**

### **ENABLING OBJECTIVE #9**

The Technical Rescuer candidate, when given the appropriate equipment, shall correctly demonstrate the construction of a tripod, utilizing timbers.

- 1. Describe the application, operation, basic safety components, and limiting factors of a tripod, utilizing timbers.

2. Discuss the use of a tripod system.
  - a) A tripod is used to lift loads heavier than those that can be handled by a gin pole or A-frame.
  - b) Tripods have three legs and do not require the use of guy lines.
  - c) Tripods are designed to lift loads vertically.
  - d) The minimum dimensions for the timber are 4" x 4" x 12' long.
  
3. Demonstrate constructing a timber tripod.
  - a) Select three 4" x 4" x 12' timbers and align the butt ends. Place 2" x 4" x 24" spacers between the timbers near the top and bottom of the timbers.
  - b) Tie the timbers together near the base with a draw-hitch.
  - c) Start with a clove hitch approximately 24" to 36" down from the tip of the shortest timber and marry the ends, be sure to chamfer, (notch the area) where the lashing is to be secured.
  - d) Next take the rope over and under the three timbers in a figure-of-eight fashion. Make at least six turns, working upward.
  - e) Then make two frapping turns between the first and second timber, and two frapping turns between the second and third timber.
  - f) Finish off with a clove hitch on the outside timber below the lashing. The remainder of the rope can be coiled around the outside timber.
  - g) After the figure-of-eight lashing is complete, raise the center timber and cross the outer timbers until their butts are at a distance apart equal to approximately one-half the distance between the butt end and the top lashing on the timbers (from lashing to the base of the timbers).
  - h) The timbers are set to form an equilateral triangle.
  
4. Demonstrate the method for attaching the primary sling to the crotch of the tripod and the secondary change of direction pulley at the base of one leg of the tripod.
  - a) Using a 6' long webbing sling rated for 6000 pounds (carabiner should be large enough to accommodate the width of the web sling).

- b) Open the nylon sling and pass it over the outside timbers at the top.
  - c) Take a bight of the sling down through one side of the center timber above the lashing and pull a bight up through the other side of the center timber above the lashing.
  - d) Take these two bights down and around the timbers below the lashing so that they pull the timbers together.
  - e) Secure a selected hauling system to the sling.
  - f) Secure an appropriate anchor sling system to the bottom of one leg of the tripod so it does not slip up when loaded; creating a secondary change of direction point. A wedge or 2" x 4" block can be attached above the sling to prevent slippage.
  - g) The direction of pull through the secondary change of direction pulley shall be towards the opposite leg of the tripod.
  - h) A mechanical advantage system is then secured at this sling to create a mechanical advantage.
4. Demonstrate securing the base of the tripod.
- a) Secure the butt ends (to prevent kick-out) using a rope ledger by tying a clove hitch with safety knot or other suitable hitch near the bottom of one timber and round turns to the remaining two timbers then tie off back at the original timber or secure the butt ends by lashing them to pickets.
  - b) The base of the tri-pod may be set in shallow holes for added stability, it may also be necessary to set the base of the tripod on bearing plates.

## **APPLICATION**

Upon completing the tripod (utilizing timbers) demonstrations, have the Technical Rescuer candidates break up into teams and repeat the evolutions several times. Rotate the team members through each position of the tripod (utilizing timbers) evolution. Closely monitor the evolutions to insure safety.

## PRESENTATION

### ENABLING OBJECTIVE #10

The Technical Rescuer candidate, when given the appropriate equipment, shall correctly demonstrate the construction of a gin pole, utilizing timbers.

1. Describe the application, operation, basic safety components, and limiting factors of a gin pole, utilizing timbers.
2. Discuss the use of a gin pole system.
  - a) A gin pole allows the object being lifted to be moved to the left or right, in addition to the front and rear.
  - b) Gin poles consist of one timber or two timbers lashed together for strength with the top supported by the use of four guy lines.
  - c) Square lashing is used to hold two timbers together that cross at right angles.
3. Demonstrate the steps required in square lashing a gin pole.
  - a) Select one 4" x 4" x 12' timber, or a 6" x 6" x 12' timber.
  - b) Lay a 2" x 4" x 24" board or ledger at a right angle to the timber approximately 18" from the top.
  - c) Using a 1/2" x 50' kernmantle rope, start with a clove hitch around the timber below the ledger and marry the running end to the standing part. Then take the married ends up and around both the timber and ledger.
  - d) Repeat this circuit four times inside on the timber and outside on the ledger; drawing the rope as tight as possible.
  - e) Take four frapping turns around the whole lashing between the timber and the ledger. Draw tight and finish with a clove hitch on the ledger.
4. Demonstrate the steps required in constructing a gin pole utilizing a 4" x 4" x 12' timber.
  - a) After the square lashing is complete, a change of direction sling is lashed so the upper block will be suspended over the ledger.

- b) Place the base of the gin pole where it is to be erected.
  - c) Place the guy lines on the gin pole using 1/2" kernmantle rope. The rope should be long enough to provide a length of 1 1/2 to 2 times the height of the timbers for the guy lines.
  - d) The distance of the guy line between the top of the gin pole and the bottom of the ledger should be 1 1/2 to 2 times the distance between the butt end and the bottom of the ledger.
  - e) For the base of the gin pole, dig a hole 6" to 12" deep, depending on the soil, and the weight to be lifted. If the ground is soft, use boards to make a bearing plate for the gin pole.
  - f) A picket holdfast may be used to keep the base of the gin pole from slipping.
  - g) Set up the picket holdfast approximately three feet from the base of the gin pole, and tie a rope from the base of the gin pole to the picket.
  - h) This holdfast will keep the gin pole from skidding while being raised and it will hold it in place while lifting; or loosely lash a picket to the base of the pole and create a snatch block sling for the change of direction pulley.
5. Discuss how the initial luff should not be over one-fifth the height of the gin pole while the maximum luff should not be over one-third the height of the gin pole.
- a) The side guy lines and the fore and aft guy lines are secured to a holdfast or picket anchoring system with a round turn and two half hitches after the desired luff has been obtained.
6. Point out that a change of direction sling is lashed near the ground of the gin pole.
- a) Secure an appropriate anchor sling system to the bottom of the gin pole so it does not slip up when loaded, creating a secondary change of direction point, a wedge or 2" x 4" block can be attached above the sling to prevent slippage.
  - b) Attach the change of direction pulley with the fall line being hauled in the same direction as the initial luff, this will cause the base of the gin pole to dig in, rather than slip.

## **APPLICATION**

Upon completing the gin pole (utilizing timbers) demonstrations, have the Technical Rescuer candidates break up into teams and repeat the evolutions several times. Rotate the team members through each position of the gin pole (utilizing timbers) evolution. Closely monitor the evolutions to insure safety.

## **PRESENTATION**

### **ENABLING OBJECTIVE #11**

The Technical Rescuer candidate, when given the appropriate equipment, shall correctly demonstrate the construction of a jib arm, utilizing timbers.

1. Describe the application, operation, basic safety components, and limiting factors of a jib arm, utilizing timbers.
2. Discuss the use of a jib arm system.
  - a) One end is anchored down and the other end projects over a support no more than 12" to 18".
  - b) This system allows objects to be lowered or raised using a mechanical advantage system capable of controlling the load.
  - c) The actual method of supporting or arranging the jib arm depends on the condition under which it is erected. It may be projected over a windowsill, resting on a piece of timber to distribute the load, with the jib arm kept in position by pads, or blocks at either side.
  - d) The jib arm may be supported on an A-frame.
  - e) In all cases safety must be observed both in respect to the jib arm itself and the structure from which the rigging derives its support; especially where buildings have been damaged.
  - f) Sound windowsills do not necessarily mean that there is a sound wall beneath them. The tail of the jib should be lashed down with round lashing or square lashing, according to the facilities available.
  - g) If necessary, floorboards should be ripped up to allow the tail to be lashed. If it is not practical to lash down the jib arm, debris, or heavy objects

- can be placed on the tail to act as a counterbalance for the weight being lifted.
- h) It is important that the jib not be projected out over the wall any more than necessary. Each additional inch of projection increases the leverage on the tail counterbalance.
  - i) When possible, the jib arm should be erected above the floor from which you are working.
  - j) As an additional safety measure, a rope should pass through the pulley system and anchored to a secure point in the event that the jib arm should fail, the load does not go to the ground.
3. Demonstrate the steps required in constructing a jib arm using timbers.
- a) Select one 4" x 4" x 12' timber, or 6" x 6" x 12' timber. If one timber is not strong enough, lash two timbers together.
  - b) Use a 2" x 6' tubular nylon sling close to the end of the jib arm.
  - c) Attach the selected hauling system or change of direction in the sling.
  - d) Project the jib arm through the opening and secure the tail in one of the manners described above.

## **APPLICATION**

Upon completing the jib arm (utilizing timbers) demonstrations, have the Technical Rescuer candidates break up into teams and repeat the evolutions several times. Rotate the team members through each position of the jib arm (utilizing timbers) evolution. Closely monitor the evolutions to insure safety.

## **SUMMARY**

This lesson plan addresses using ground ladders and timbers to construct anchors and anchoring systems commonly used in high and low angle rescue operations. The construction of each of these systems should be reviewed. The Instructor should identify the critical points of each anchoring system. It is imperative the Technical rescuer identify suitable anchor points, determine the construction of anchor materials, and understand the stress loads applied to anchor systems. The Technical Rescuer

will be called upon to incorporate many or perhaps all of these anchoring systems into the various rescue operations they will encounter. They must become proficient in each one. After all, the entire rescue operation may well hang on the ability of the Technical Rescuer to select and rig a safe anchor or anchoring system.