

## Search and Rescue Techniques

### Course Introduction:

The following class has been created to identify those skills and competence level needed in technical rescue and mountain skills. Certification of a student's proficiency is graded on a pass/fail basis, with a 100% successful execution of the training required. All students will be certified by a Mountain Cadre Instructor.

The *Search and Rescue Techniques (OES Type 1)* class is designed to insure that each student demonstrates the skills\* to setup both basic and advanced rigging systems with the physical ability to perform serious technical rescues and recoveries in any environment. This includes high and low angle litter rigging and tending, patient packaging, mechanical advantage systems (both raising and lowering), anchors and anchor systems, rappel based rescues, self-rescue techniques, the ability to move over technical ground, climbing as a second, belaying, a working knowledge of mountaineering practices and winter survival, the ability to act as a team member for technical rescue systems/operations, and the ability to move safely in an alpine winter environment.

\*As identified by FEMA Type 1, California OES Type 1, MRA (Mountain Rescue Association)

### PRACTICAL SKILLS REQUIREMENTS

#### A. KNOTS

**This module of instruction provides the basis for all mountaineering involving rope work and the making of systems.**

- a. Students will observe the instructor conduct a demonstration of the technique while listening to lecture content regarding the appropriate use for each knot.
- b. Students will then demonstrate proficiency through a return demonstration and verbalize an understanding of the use of each knot.
- c. Each student will be given a 12' ft length of 9.5mm rope and a 16' ft length of 6mm nylon rope. These are the ropes the students will use to practice on and to be later tested on.

#### i. **Knots used to tie the ends of two ropes together**

1. Figure eight follow through

2. Double sheet bend
3. Fisherman's knot
4. Square knot
5. Barrel knot (triple fisherman's knot)
6. Water knot (only knot used to tie webbing together)

ii. **End of the line knots**

1. Figure eight
2. Figure eight on a bight
3. Double loop figure eight
4. Figure eight follow through
5. Bowline
6. Double bowline (three legged)
7. Overhand

iii. **Middle of the line knots**

1. Figure eight on a bight
2. In-line figure eight loop
3. Butterfly bowline
4. Ballentine bowline
5. Bowline on a bight

iv. **Others**

1. Prussik knot
2. Half hitch
3. Girth hitch
4. *Munter hitch*
5. Clove hitch
6. Swiss seat
7. Chest harness
8. Autoblock

**B. ANCHORS**

**This module of instruction provides a base upon which the systems will be built.**

- a. Students will observe the instructor conduct a demonstration of the technique while listening to lecture content regarding the appropriate use for each anchor.
- b. Students will then demonstrate proficiency through a return demonstration and verbalize an understanding of the use for each anchor.

- c. Practical application throughout the course will be used to further solidify the student's knowledge and technique.
- d. The students will be taken to various training locations (Fire Dept training towers, mountain slopes or cliffs) for the purpose of using a grouping of trees, rocks or man-made objects to tie the below anchors. They will use their personal 150' nylon 7/16" static ropes (issued) and their carabiners (issued) to configure the various types of anchors, and secure their ropes to fixed anchor points.
- e. The students will be issued both Passive and Active rock pro along with a 60m "Dynamic" rope and a climbing harness for the purpose of learning Rock-climbing to access victims. (See Individual Skills section for more info regarding rock-climbing.)

- i. **Types of anchors**

- 1. Directional (static equalized)
    - 2. 2 point load sharing
    - 3. 3 point load sharing
    - 4. Multi-directional (Self-equalizing)

- ii. **Secure rope to a fixed anchor point**

- 1. Tensionless hitch
    - 2. Pre-tensioned tie-back
    - 3. Wrap 3 pull 2
    - 4. Vehicle

- iii. **Rock climbing Access to victim**

- 1. Passive rock pro
    - 2. Active rock pro

## **B. INDIVIDUAL ROPE SKILLS**

**This module provides the basic skills for a rescuer to safely reach and assist a victim to safety.**

- a. Students will observe the instructor conduct a demonstration of the technique while listening to lecture content regarding the appropriate use for each technique.
- b. Students will then demonstrate proficiency through a return demonstration and verbalize an understanding of the use for each technique.
- c. Student training will initially begin at a state approved fire tower for the purpose of doing rappel training. This will be done with an instructor at the top of the rope. Along with an instructor at the ground level providing a "safety belay" for the student. As the student progresses in competency, the class will be moved to a cliff to accommodate learning longer rappels and negotiating overhand lips. Some rappel techniques such as "tie offs, and passing a knot, ascending a rope,

along with the below listed “pick-offs” can be done at the fire tower training facility. Additionally, all techniques will be taught with an instructor rappelling on a separate rope adjacent to the student. This is done to help talk him/her through the techniques.

- d. The initial training will involve the student “belaying” an instructor climber as he/she (instructor) places both active and passive rock protection along a climbing route. While the student is learning belaying, another instructor will be standing along- side the student holding the rope as a safety backup. After the first instructor is secure at the top of the route, the student will then climb the same route with a safety belay from the instructor above.

- i. **Rappelling techniques**

- 1. Up to 300’ rappel
    - 2. Rappel and tie-off
    - 3. Rappel and pass knot
    - 4. Negotiate overhand lip to rappel

- ii. **Cliff rescue techniques**

- 1. Cooperative conscious patient pick-off (Rappel with victim or lower victim alone)
    - 2. Pick-off non-responsive pt
    - 3. Solo man 1 victim rescue

- iii. **Rock climbing techniques**

- 1. Belaying the lead climber
    - 2. Demonstrate climbing skills as lead or second
    - 3. Ascend with Prussick, ascenders

## **C. LITTER RIGGING/PT PACKAGING**

**This module will provide the rescuer necessary training in the use of litter techniques.**

- a. Students will observe the instructor conduct a demonstration of the technique while listening to lecture content regarding the appropriate use for each litter technique.
- b. Students will then demonstrate proficiency through a return demonstration and verbalize an understanding of the use for each litter technique.
- c. The student will be given both a Stokes & Sked litter, a mannequin, and with 150’ ft of nylon rope with 20 ft of webbing. The student will be shown how the mannequin is put in the litter and secured. The litter will then be rigged according to vertical or horizontal orientation that is most appropriate for the terrain. As with the Truck training and the Systems training below, the mannequin and the rescuers will learn positioning on the litter and the hillside to be effective litter/edge tenders.

- i. **Preparation of litter system**

1. Convert litter from horizontal to vertical or vice versa
2. Improvised victim harness with tubular webbing
3. Package a victim in litter, both Stokes and SKED
4. 2 rescuer litter rig set-up

ii. **Operation of litter system**

1. Vertical or horizontal, raise or lower the litter
2. Work as litter tender
  - a. Use of proper commands
3. Work as an edge tender
  - a. Use of proper commands

D. **SYSTEMS**

**This module will provide instruction on techniques necessary to enhance ease of movement of victims across various obstacles.**

- a. Students will observe the instructor conduct a demonstration of the technique while listening to lecture content regarding the appropriate use for each system.
- b. Students will then demonstrate proficiency through a return demonstration and verbalize an understanding of the use for each system and the difference between theoretical and actual mechanical advantage.
- c. Students will be given a 150'ft. Nylon rope, a 20ft. length of 7 mm nylon rope, six steel carabiners, 4 pulleys, and 2 prussick loops to arrange in the various configurations that make up the various below mechanical advantages. The students will then operate the pulley (raising and lowering) systems with tension on them as they raise and lower the litter with a mannequin inside and a fellow student and instructor riding the litter up and down a steep hill and/or cliff. The students will learn the value of having different mechanical advantages to choose from along with the pros and cons of each.
- d. The students will then set up a Tyrolean Traverse from one fixed anchor point to another fixed anchor point across a small gully. Next the student will set up a high line system from a high anchor point to another anchor point that is considerable lower. The students will attach a litter to each system and travel the length between the two anchor points. All systems constructed will be made with the 10% rule (safety margin) in effect.

i. **Changing pulley direction or adding mechanical advantage**

1. -Set up and explain a 1:1 hauling/lowering system
2. -Set up and explain a 2:1 mechanical advantage
3. -Set up and explain a 3:1 mechanical advantage
4. -Set up and explain a 4:1 mechanical advantage
5. -Set up and explain a "Joshua Tree 4:1", attached to main line

6. -Set up and explain 5:1 complex system
7. -Set up and explain 6:1, 9:1 mechanical advantage systems

ii. **Operations of pulley systems**

1. -Set up and demonstrate use of Load Release Hitch
2. -Set up and operate safety line
3. -Converting raising system to lowering/ vice versa
4. -Passing a knot in mechanical advantage system
5. -Use of brake bar device, as a belay, on safety line

iii. **Utilization of pulley systems as related to:**

1. -Set up and operate a Tyrolean Traverse
2. -Set up and operate tandem high lines

iv. **The 10% rule**

1. -Explain breaking strengths of 7/16", 1/2" ropes, 1" tubular webbing
2. -Explain breaking strengths of aluminum and steel carabiners
3. -Explain definition of a Kilo Newton

**E. FIELD SKILLS**

**This module will provide information necessary to travel and navigate safely in mountainous terrain for the purpose of rescue operations.**

- a. Students will observe the instructor conduct a demonstration of the technique while listening to lecture content regarding the appropriate use for each skill.
- b. Students will then demonstrate proficiency through a return demonstration and verbalize an understanding of the use for each skill as well as navigate an extended course day and night- using a map and compass, be self-sustaining for 72 hours, and travel safely in 3<sup>rd</sup> and 4<sup>th</sup> class terrain.
- c. Students will be given various different types of topographical maps with most training to be done with a USGS 1:24,000 scale map. Students will be given a protractor, ruler, Garmin "Rino" GPS and a compass with an inclinometer. The students will learn various map skills that they will take with them as they later put the skills to work in a land navigation course that they will complete.
- d. Summer survival skills will initially be taught via a power-point presentation, then progress to a hike in the mountains where the students will be shown the various edible plants along with ways to obtain water in the wilderness.
- e. Search techniques and man tracking will be taught in a classroom setting with follow up in a field

setting.

i. **Land navigational skill, ability to understand and demonstrate:**

1. Difference between true and magnetic North
2. Difference in scale in various maps
3. Use of Garmin GPS
4. Different datum's used by ESD, SAR teams, helicopters and maps
5. Use of latitude/longitude and UTM
6. Resection, modified resection, triangulation, and orient a map to present terrain
7. Azimuth and back azimuth
8. Use of inclinometer on a Silva Ranger compass

ii. **Summer survival skills**

1. Edible plants
2. Techniques for obtaining water
3. Emergency signaling

iii. **Search techniques**

1. Philosophy, tactics, operations, lost person behavior
2. Basic awareness of man tracking

**F. ALPINE SKILLS**

**This module will provide training and skills necessary to conduct search, rescue, and survival operations at high altitudes.**

- a. Students will observe the instructor conduct a demonstration of the technique while listening to lecture content regarding the appropriate use for each skill.
- b. Students will then demonstrate proficiency through a return demonstration and verbalize an understanding of the use for each skill.
- c. This portion will start with a classroom session on the below subjects. The training will move to locations in the snow and ice.
- d. The use of snow and ice equipment will be taught in conjunction with snow and ice travel techniques. Self belay and arrest will be done with the student climbing up a moderate angle snow slope with sufficient run-out (flat area below). The intent is of sliding downhill then catching their fall with the use of an ice ax. This is to be practiced to the point of instinct and from any bodily orientation the alpinist ends up in. Having sufficient run-out is a safety measure that provides the student a safe way to stop sliding if he is unable to self arrest.
- e. Rope team techniques will be done with the students "roped- in" (tied on to a nylon rope at 20-30'ft

intervals. As the team travels up and down steep terrain (snow or ice), the team of students will learn placement of snow pickets and ice screws. This will be a safe way to learn both fixed and running belays. Additionally as the team travels through snow country, Route selection and hazard recognition with regards to avalanches will be pointed out to them.

- f. Winter survival will start with the instructor reviewing the student's backpack and its contents. This is to confirm understanding of appropriate gear and attire that will go into the backcountry. Upon arriving at the predetermined campsite, the students will erect their personal tents and build a snow wall around the camp. Next task will consist of building an emergency snow cave which the student will ultimately use to spend the night in.
- g. Avalanche victim searching will consist of the instructor hiding an avalanche beacon (on transmit mode) in the snow and the students using their beacons (on receive mode) to find the victim or in this case just the avalanche beacon. The students will then use their issued avalanche probes to poke through the snow to find a previously hidden backpack.
- h. The snow and ice anchors class will be in conjunction with rope team travel portion of this block. On moderate slopes the students will make a snow or ice bollard to rappel from. For additional safety measures this will be done with a independent belay rope on the student in the off chance the snow or ice anchor fails.

- i. **Use of snow and ice equipment**

- 1. Bod Harness
- 2. Crampons
- 3. Ice Ax
- 4. Avalanche beacons
- 5. Snow shoes

- ii. **Winter survival**

- 1. Winter camping above and below timberline including use of snow caves
- 2. Proper attire
- 3. Hydration

- iii. **Avalanche**

- 1. Route selection and route finding
- 2. Hazard recognition
- 3. Survival during and after
- 4. Search organization
  - a. Probing
  - b. Beacon searching



iv. **Snow and ice travel techniques**

1. Self belay
2. Self arrest
3. Ascending techniques
4. Descending techniques
5. Rope team techniques
6. Running belays/fixed belays
7. Moderate slope climbing (40-50 degree)
8. Anchors
  - a. Pickets
  - b. Dead man
  - c. Improvised dead man
  - d. Bollards
  - e. Ice Screws

G. **HELICOPTER RESCUE SKILLS**

**This module is designed to provide an overview of the proven techniques for deploying and recovering rescuers.**

- a. Students will observe the instructor conduct a demonstration of the technique while listening to lecture content regarding the appropriate use for each skill. This will be done during a “Ground School” where the instructor is teaching from a parked helicopter (Air Rescue 5).
- b. Students will then demonstrate proficiency through a return demonstration and verbalize an understanding of the use for each skill.
- c. With the use of Air Rescue 5 as it hovers at approx 50 ft, all students will conduct rappel training, hoist training, and one wheel deployments and recoveries. This will be under the direction of the on-duty crew chief. As a safety measure, the students will be belayed from below. Victim packaging and litter tending will be under the supervision of an instructor who will be on the ground watching the student rig the litter for the pick off and for other students who will be working the tag line as the litter is guided into the helicopter.
  1. Up to 275’ rappel
  2. Hoist in and out with harness or horse collar
  3. One-wheel deployments and recoveries
  4. Victim packaging and litter tending
  5. Tag line operation
  6. Selection of LZ
  7. Call- in helicopter using clock method, lat/long/ mirror and other signaling devices
  8. Act as litter tender on hoist operation

## **H. TRUCK OPERATIONS**

**This module will provide the rescuer with skills necessary to affect a safe “over the side” rescue.**

- a. Students will observe the instructor conduct a demonstration of the technique while listening to lecture content regarding the appropriate use for each skill.
- b. Students will then demonstrate proficiency through a return demonstration and verbalize an understanding of the use for each skill.
- c. Given a standard LASD Rescue truck, the instructor will have the students appropriately park the truck, chock the wheels, set the truck up for a winching operation and ultimately conduct raising and lowering operations from the edge of the cliff. All students near the edge will be tied into a safety rope to prevent any accidental falls off the cliff.
  1. Rescue truck positioning, chock wheels
  2. Winch safety and boom set up
  3. Safety systems
  4. PTO use
  5. Capstan set up and use
  6. Communications
  7. Rigging of litter- vert/horiz
  8. Winch controller
  9. Tend safety line/capstan

## **A. FIELD TRAINING EXERCISE**

**This module will test the student’s ability to implement the previously learned skills in a simulated scenario.**

**The scenario entails two backcountry skiers reported missing by family members. One of the skiers was able to make a phone call stating that he was injured. Unfortunately the call was “dropped.” The only additional information obtained was a UTM for their location. The students will load in the helicopter and fly towards the UTM location. Because of a low cloud cover ceiling (part of the scenario), the helicopter will not be able to complete the trip and students will be required to rappel out of the helicopter with their packs and make their way to the victim’s location. Accompanied by an instructor, students will trek across snow and ice with third and fourth class alpine terrain as well as apply land navigation techniques to locate the patient. The patient is a “pre-placed” mannequin, which they will secure in a sked. Students will be required to move the patient down rough mountain terrain using anchors and systems, locate a nearby helicopter landing zone, and call in the helicopter and do a litter hoist with the mannequin.**

## **ESD TRAINING REFERENCE MATERIALS**

### **MOUNTAINEERING AND ROPE RESCUE**

**Mountaineering, the freedom of the hills**

**Extreme Alpinism**

**Climbing Anchors**

**More Climbing Anchors**

**The Morrow Guide to Knots**

**CMC Rope Rescue Manual**

**CMC Rope Rescue Manual Field Guide**

**Wilderness Medicine**

**Wilderness Medicine**

**Medicine for Mountaineering**

**Alpine Climbing: Techniques to Take You Higher**

**Complete Guide to Climbing and Mountaineering**

**Mountaineering Handbook**

**The Mountaineers**

**Twight**

**Long**

**Long**

**Bigon & Regazzoni**

**Frank**

**Frank**

**Forgey**

**Auerbach**

**Wilkerson**

**Houston & Cosley**

**Hill**

**Connally**

### **SEARCH AND RESCUE**

**Wilderness Search and Rescue**

**Search is an Emergency**

**Setnicka**

**California OES**

### **AVALANCHE**

**Avalanche Safety for Skiers and Climbers**

**Snow Sense**

**Backcountry Avalanche Awareness**

**Daffern**

**Fredston and Fesler**

**Jamieson**