OLYMPIC MOUNTAIN RESCUE

RESCUE RIGGING 4.2

Skills learned here are generally standard practices for Northwest MRA units; however, rescue units may have other standard practices or variations. **We need to be continually learning and assessing other methods.**

PERSONAL GEAR and SKILLS

I. KNOTS

(General Rules: a knot reduces the strength of the rope, webbing, or cord by approximately 30%.)

A. Knots vs bends vs hitches
   1. Knot - usually tied in the end of a line, or with both ends of the same line
   2. Bend - usually used to join two ropes
   3. Hitch - usually for tying a rope to a ring, rail, post or other object
   4. Direction of pull on knot
      a. Follows the lay of the knot
      b. Splays or stresses knot

B. FIGURE 8
   1. Figure 8 on a bight
   2. Figure 8 rewoven

C. BOWLINE
   1. Bowline with double overhand back up
   2. Bowline with long tail
      a. Interwoven long tail bowlines
         (1) Clip carabiner through both loops
         (2) tail appropriate to function

D. DOUBLE FISHERMAN'S BEND
   1. Joining two ropes
      a. High strength
      b. small diameter
      c. difficult to untie after loading

E. SHEET BEND
   1. Joining two rope of different sizes
      a. Double sheet bend
         (1) relatively easy to untie after loading

F. RESCUE PRUSIKS (soft camming device)
   1. Short Prusik (54" untied) Long Prusik (66" untied) of 8mm accessory cord
   2. Tie with double fisherman's bend, allow 1.5" for tail
   3. Three wraps
   4. Locate knot 1" to 2" away from bend in cord

G. RING BEND (Tape Knot)
   1. Joining webbing ends
   2. Can be untied relatively easily
   3. Can be adjusted easily

H. BUTTERFLY KNOT
   1. ★★ Demonstration ★★
      a. Isolate damaged rope
      b. Two way pull for middle tie on glacier

II. ROPE HANDLING

A. PACKING ROPE BAGS

Note: Rope may be used directly from rope bag

1. Leave both ends out about 10'
2. Hold bag with finger loop grip
3. Stuff and thump

B. COILING ROPE

Note: all styles of coiling require stacking the rope prior to use

1. Single Butterfly
2. Double butterfly
3. Figure 8 coil
4. Wrap and girth hitch for carry

C. STACKING THE ROPE
   1. Long tail of free end well clear of stack
   2. Stack as you take in
   3. Restack to change ends

III. PERSONAL PROTECTION FOR RIGGING

(Always visually and physically inspect partners harness set-ups and tie-ins. Become familiar with other harnesses. if the set-up doesn't look right ask for the wearer to explain their particular set-up.)

A. PERSONAL EQUIPMENT
   1. SEAT HARNESS
   2. CHEST HARNESS
      a. Commercially manufactured
      b. Belly loop connects sit and chest harneses
   3. TIE IN THOUGH BOTH CHEST AND SEAT HARNESS
      a. Rewoven figure eight
      b. Bowline with backup
   4. UIAA APPROVED CLIMBING HELMET
   5. LEATHER PALMED GLOVES
   6. EAR PROTECTION
   7. EYE PROTECTION
   8. SKIN PROTECTION (Long pant, long sleeve shirt, sunscreen)
   9. PURCELL PRUSSIKS

B. PERSONAL BELAY TECHNIQUES
(Personal belay techniques are optional for non-rescue load belaying, e.g., initially belaying the leader to review scene or a rigger near an edge.)

1. MUNTER HITCH BELAY
   a. **ONE** body weight only
   b. Belay only, not for lowering
   c. Making the hitch and hand movement
   d. Other uses
2. PURCELL PRUSIKS
   a. Tying Purcell Prusiks
      (1) See handout from Rigging Review
   b. Uses
      (1) Ascending and descending a fixed line
      (2) Primary attachment for litter attendant
      (3) Self belay
      (4) Pretensioned back tie
3. ★★ Prusik Practice ★★
   a. Ascend and descend with Munter Hitch belay
   b. Rappell with change over mid rope, to prusik ascent with Munter Hitch belay

ANCHORS, COMMAND & ORGANIZATION LOWERING AND BELAYING

I. ANCHORS

WARNING: Watch for conditions which will load an anchor in a direction other than intended. Example: A tied back anchor is tied back approx. 180 degrees from the direction of loading. On a raising system with a change of direction on a tied back anchor, the hauling team may induce forces on the anchor in a direction other than its intended loading.

A. Any anchor system shall normally consist of multiple independent attachment points .
B. Separate anchoring systems for each working line.
C. Anchor attachment points – *always checked by safety leader*
   1. Primarily natural features, i.e., trees, rocks
   2. Artificial devices
      a. Rock – cams, chocks, pitons, bolts, stoppers
      b. Snow – pickets, screws, deadman, bollards
D. Focal point of anchor system
   1. Point at which independent attachment points of an anchor system come together

2. Choice of focal point is a result of force direction and attachment point location with consideration for working space
3. Pretensioned backties – interweave webbing
   a. 2 methods: 3 strand or utilizing Purcell
   b. "a while later' factor

E. Webbing tie off on natural features; following condition must be met:
1. Minimum: wrap three, pull two.
2. Interior angle < 60 degrees
3. Ring bend tie off faces focal point
4. When using multiple webbing segments, segments shall be connected with ring bends — **NO** Girth Hitches

II. RESCUE WORKING LINES

A. Carries rescue load
B. 11.2 mm (7/16") low stretch rope
1. Standard for Mountain Rescue
2. Provides a adequate safety margin with standard methods and 2 person rescue load
3. 12.7mm (½") is also not uncommon for Mountain Rescue — 15:1 safety margin with standard methods and 2 person rescue load

C. Typical mountain load = One 200, and one 300' low stretch ropes
D. Longevity / Replacement Criteria
1. Outer sheath is ½ worn
2. Deformity or "exposure" of inner sheath
3. Arrested a "Rescue Load" fall
4. Report any rope damage immediately

E. Rope care and washing
1. Wash rope when very muddy or otherwise requires
2. Never store wet ropes and webbing
   a. It is imperative that all members of the rescue team assist in drying gear upon return to home base
3. Cool, dry, dark place
4. Do Not store with chemicals

III. LOWERING SYSTEM

A. Main Line
1. Lowering Device
   a. Commercial brake rack
      (1) setup
      (2) Lowering
      (3) tie-off & Locking

B. Belay line - Always incorporate load release hitch
1. Tandem 8mm rescue prusiks with load release hitch
2. Operation without prusik minding pulley
3. Operation with prusik minding pulley

C. RADIUM RELEASE HITCH
   1. Tying up - 8 mm perlon (30')
   2. Use on belay system
   3. Shock absorbers
   4. Releasing locked prusiks
D. Knot passing on main line
E. Demonstrate set up and operation
   1. Locked prusiks on belay line
   2. Knot pass on main line brake rack
F. WHEN TO USE TANDEM 8 MM RESCUE PRUSIKS
   1. Belay— *Always*
   2. Main line rachet with 3 person rescue load — *Always*
   3.

IV. SAFETY OF RESCUERS AT OR OVER THE EDGE

A. Tended belays using climbing rope
   1. Belay device
   2. Munter hitch
   3. Tandem 8 mm rescue prusiks
B. Tether with prusik self-belay using climbing or low stretch ropes
   1. Tether rope attached to anchor point
   2. Rescuer ties in to tether rope
   3. Rescuer self-belays with 3 wrap prusik

V. EDGE PROTECTION

A. Rollers
B. Carpet canvas
C. Plastic sheets
D. Improvised - ice axe, packs, branches, & etc.

VI. ORGANIZATION and COMMAND

Need to teach or review the entire routine of a mission from 1st contact and page to field work to completion of mission report. When talking about the actual field work stress the importance of communication within the team, the base OL, and the in-town contact.)

A. Field Organization
   1. Approaching site, centralize group gear, personal gear & comfort
   2. Leader surveys area and develops plan
   3. Leader reviews plan with entire team and asks for questions
   4. Leader assigns set-up tasks (after walk through) {Leader should remain untasked, if teampower allows}
   5. As assigned tasks complete, report back to Leader for additional assignment
   6. Leader or assigned safety checks entire set-up

7. Leader assigns working positions to team members (may assign Control to someone else and Leader may not have an assigned working position)

B. Positions
   1. Rescue Leader — overall responsibility, assigns jobs, & assumes or assigns Safety
   2. Control — directs operations, maintains communication, always has a radio
   3. Belayer — operates belay system
   4. Brake/Rachet Operator — operates brake rack on lower, tends ratchet on raise
   5. Edge Person — assist litter handling at edge and throughout operation, maintains edge protection, assists with communication
   6. Litter Attendant — attends litter and patient, always has a radio, directs Edge Person(s)
   7. Haul Team Captain — responsible for the raising system and haul team coordination and communication
   8. Haul Team — provides muscle for raising operations

C. Voice Signals
   1. *STOP* — may be called at any time by anyone who perceives a safety problem — all action ceases.
   2. Why Stop? — asked by Control
   3. *Down* — brake operator feeds rope through rack, belay operator pays out belay line.
   4. *Down, Down* — increase lowering speed
   5. *Up* — haul team pulls rope, belayer takes in belay lines.
   6. *Up, Up* — increase raising speed
   7. *Slow* — usually called by Litter Attendant
   8. *Set* — called by Haul Team Captain when the raising system needs to be reset "Set" means to ensure that the rescue prusik on the main line is set
   9. *Re-set* — commanded by Leader to Haul Team Captain to re-Set the location of the pulleys on the haul line. Haul Team Captain assigns this task within the Haul Team — should be rotated during a long or heavy raise. Hauling will continue immediately after reset complete until control directs otherwise.
   10. Quiet - Self explanatory
   11. Preparatory communications:
       a. Main line ready Yes or No
       b. Belay ready Yes or No
       c. Edge ready Yes or No
       d. Attendant ready Yes or No (Note: Attendant asked last)
       e. Advise when ready Issued if NO given above

D. Whistle and Arm Signals

(Whistle signals may be used when radios are not available. If the Control cannot visually see the entire operation, if possible there should be a Lookout positioned where the Control and Litter Attendant can both see them to relay both whistle and arms signals.)

1. STOP — one whistle blow, Lookout's arms straight out from side of body
2. UP — two whistle blows, Lookout's arms straight above head
3. DOWN — three whistle blows, Lookout's arms straight at 45 down

E. Procedure
   1. Safety and system check
      a. safety visual and touching inspection by rescue leader or designee
      b. leader turns command over to control
      c. control audibly checks status of all working positions
         (1) response is either "Yes" or "No"
         (2) litter attendant is always checked last
   2. Commence operations

VII. LOWERING PRACTICE

A. ★Flat ground run through★
B. ★Brake rack lower★

RAISING

I. SIMPLE PULLEY SYSTEMS

(Definition: all pulleys on the load side travel towards the anchor at the same rate of speed. Able to determine mechanical advantage by counting strands between the load and the hauler.)

A. Change of direction vs. mechanical advantage (last pulley at anchor)
B. Recognizing mechanical advantage
   1. Even advantage
      a. tied off at anchor
      b. example -2:1 (count strands supporting the load)

2. Odd advantage
   a. tied off at load
   b. example - 3:1 (count strands supporting the load)
3. Increasing advantage
   a. Add pulleys at load end
   b. Increasing advantage increases amount of rope pulled through system to move load
   c. Pulley added at anchor only change direction of pull — does not increase mechanical advantage
4. Efficiency of pulleys
   a. Larger the pulley = higher the efficiency
   b. Ball bearing pulleys more efficient
   c. Efficiency of pulleys and placement
5. Set up simple systems
   a. Single pulleys
   b. Double Sheave pulleys
6. Attach simple system to main line
   a. Single 8 mm Rescue Prusik
   b. Tended ratchet – single 8 mm Rescue Prusik for 2 person rescue load [tandem 8 mm for 3 person load]
7. Incorporating load line into pulley system
   a. Self tending ratchet – single 8 mm Rescue Prusik for 2 person rescue load [tandem 8mm for 3 person load]
   b. **Not recommended when knot passing anticipated**

II. COMPOUND PULLEY SYSTEMS

Definition: one simple pulley system acting on another simple pulley system.

A. Put one simple system on another
   1. 2:1 on 2:1
   2. 3:1 on 3:1
   3. Use "**Counting Ts**" technique to determine mechanical advantage
B. Convert a simple system to a compound system
   1. 5:l to a 9:1
   2. 3:l to a 9:1
   3. Compounds can be set on same anchors or separate anchors
   4. Higher advantage system on lower advantage = fewer resets
C. Advantages
   1. More efficient
   2. Less pulleys
   3. Less manpower to raise
   4. Disadvantages
      a. More resets

III. FIELD PRACTICE

A. Set up pulley system with belay (3:1, 5:1, 9:1)
B. Lower and raise individual body weights
C. Practice main line resets (emphasize haul team coordination)

PATIENT PACKAGING, LITTER RIGGING, EDGE RIGGING

I. PATIENT PACKAGING

A. Secure/Anchor litter prior to packaging
B. Loading patient into litter
C. Pad where necessary - foam pads, clothing, etc.
    1. Critical parts - under knees, head stabilization, insulation under patient

D. Tie in
    1. Tie in must be modified as necessary to not exacerbate patient injuries
    2. Attach shoulder webbing to litter and cross with ends outside the head of the litter.
    3. Attach foot webbing
    4. Place patient in litter using lifting method appropriate to patients injuries
    5. Tie off shoulder webbing
    6. Tie off foot webbing, being sure to cross tie just below the knee
    7. Secure litter installed straps

E. LITTER RIGGING
    1. Horizontal bridle (high angle)
        a. Four point attachment
        b. Attaching to litter - locking carabiners only with gates in
        c. Adjusting balance - level or slight head up aspect - use ice axe to check
    2. Head bridle
        a. Two carabiners attach to side posts at head of litter - webbing bridle tied off with over hand knot at focal point
    3. Long tailed interwoven bowlines
        a. Clip through with locking carabiner
    4. Attendant tie in - high angle
        a. One long tail to attendant (belay)
        b. One long tail to litter bridal rings (main line)
        c. Attendant attaches Purcell prusiks to yoke
    5. Attendant tie in - low angle
        a. One attendant
            (1) ties to one of long tails, long prusik to yoke, stands on either side of litter at shoulder level of patient

b. Three attendants
   (1) One attendant on each side, at patient shoulder- ties one long prusiks to yoke, stands on either side of litter
   (2) One long tail (Main Line) to litter head rail
   (3) one long tail (Belay Line) to foot attendant
      (a) foot attendant also ties very closely to foot rail
         i) litter carrying aids
            a) Short prusik to harness
            b) standard sling over shoulder

6. EDGE RIGGING

a. Belay line remains on the ground (lowest supported point)
b. Main line may make use of directionals to increase ease of use
c. Directionals:
   (1) Pulley in tree or trees
   (2) Pulley suspended between trees (allows lateral movement)
   (3) Gin pole
   (4) bipod

7. VECTORING METHODS

a. Uses:
   (1) Assist litter in transition (up or down) over the edge
   (2) Take up slack in brake system
b. Vertical vector
c. Lateral vector

8. CONVERTING BELAY LINE INTO A RAISE OR LOWER IF MAIN LINE FAILS

a. re-establishment of a main line possible
b. If not, convert belay line

9. Field Practice

a. ★★Low angle lower & raise★★
b. ★★High angle lower and raise★★