BY ORDER OF THE SECRETARY OF THE AIR FORCE

AIR FORCE HANDBOOK 10-351

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Operations

PARARESCUE PROCEDURES

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This handbook is the fundamental reference document for Pararescuemen and ground recovery operators; deviations should be taken using sound judgment after careful consideration. The procedures in this publication are recognized best practices presenting a solid foundation for the prosecution of assigned missions. This publication applies to individuals at all levels with a 1Z1 (Pararescue (PJ)), and 19ZXC (Combat Rescue Officer (CRO)) Air Force Specialty Code (AFSC), including the Air Force Reserve and Air National Guard, except where noted otherwise. This publication does not apply to the United States Space Force. Operational experience, training evaluation, and equipment modernization may provide updated information that differs from this Handbook. Refer recommended changes and questions about this publication to the office of primary responsibility (OPR) using the Department of the Air Force (DAF) Form 847, *Recommendation for Change of Publication*; route DAF Form 847 from the field through the appropriate functional chain of command. The use of the name or mark of any specific manufacturer, commercial product, commodity, or service in this publication does not imply endorsement by the Air Force. See **Attachment 1** and **Attachment 2** for references and acronyms.

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Chapter 1

INTRODUCTION

1.1. Overview. This document provides the baseline procedures for Pararescue Operations.

1.2. Pararescuemen. Pararescuemen (PJ) are the only Department of Defense (DoD) specialty specifically trained and equipped to conduct conventional and unconventional Personnel Recovery (PR) operations and is the force of choice for assisted survivor recovery. PJs provide the essential surface-to-air link in PR and materiel recovery and provide rapid response capability, special operations mission execution, and application of airpower during day or night operations and across the full spectrum of military operations in all geographic and environmental conditions including permissive, hostile, denied, and politically and/or diplomatically sensitive locales. PJs may be employed alone or as part of an Air Force, joint, interagency, or coalition force in support of the Combatant Commander's objectives and operate under austere conditions for extended periods. PJs provide technical rescue, emergency medical care, and security while facilitating extraction of recovered personnel and materiel to safety or friendly control when recovery by aircraft is not possible.

1.3. Missions.

1.3.1. Primary Mission. The primary mission of a Pararescueman is to conduct Combat Rescue operations, under the umbrella of Personnel Recovery, across the range of military operations providing capabilities to support a Joint Forces Commander (JFC). In accordance with Joint Publication 3-50, the JFC is responsible for PR of all isolated DoD personnel and other persons of interests as determined by the President of the United States or the Secretary of Defense.

1.3.2. Collateral Missions. Collateral PJ missions have included casualty evacuation (CASEVAC), Defense Support to Civil Authorities (DSCA), humanitarian assistance/disaster relief (HA/DR), noncombatant evacuation operations (NEO), Human Space Flight Support (HSFS) operations, and support to the President.

Chapter 2

MISSION PLANNING

2.1. Planning Conditions. There are three common conditions that are inherent in planning for military operations: Contingency planning, Crisis planning and Deliberate planning.

2.1.1. **Contingency Planning (CP).** Is directed in the Guidance for Employment of the Force (GEF) and Joint Strategic Campaign Plan (JSCP) to prepare for specific contingencies. So simultaneously, Combatant Commanders (CCDR) direct their staffs to conduct planning to address these contingencies within their region or functional area. CCDRs may also identify additional contingencies the command should prepare for through an analysis of the Area of Responsibility (AOR) or functional area. As a part of contingency planning, CCDRs backward plan to ensure their campaign plans address issues of Operational Effectiveness (OE). Contingency planning encompasses the preparation of plans that occur in non-crisis situations and is normally conducted in anticipation of future events. It will normally result in plan development. Since contingency planning is based on hypothetical situations, it relies on assumptions to fill in gaps.

2.1.2. **Crisis Planning.** Is conducted when an emergent situation arises. The planning team will analyze approved contingency plans with like scenarios to determine if an existing plan applies. If a contingency plan is appropriate to the situation, it may be executed through an Operations Order (OPORD) or Fragmentary Order (FRAGORD). In a crisis, planning usually transitions rapidly to execution, so there is limited deviation between the plan and initial execution. TLs assist in the planning process through their planning expertise and knowledge gained of the OE during similar planning efforts. This is critical in crisis planning, time-constrained planning, and during execution. Crisis planning activities are similar to deliberate planning activities, however, CP is based on dynamic, real-world events and is based on circumstances that exist at the time planning occurs. Events may occur that are assessed as significant to national security or impact national response, these time-sensitive situations generate crisis planning. CP can use plans developed in deliberate planning for a similar contingency.

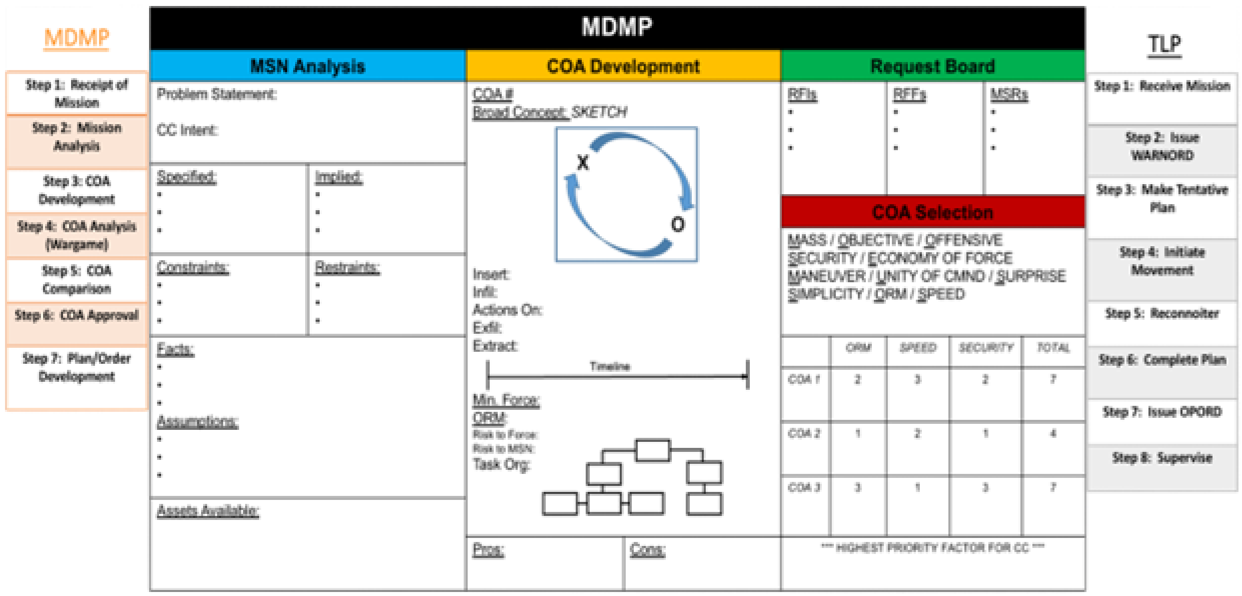
2.1.3. **Deliberate Planning.** During peacetime, commanders use the deliberate planning process to develop concept plans (CONPLAN) and detailed operations plans (OPLAN) for contingencies. From the supported commander's perspective, the deliberate planning process is never complete. Deliberate planning encompasses the preparation of plans that occur in non-crisis situations and is normally conducted in anticipation of future events. This type of planning will normally result in plan development.

2.2. Military Decision Making Process (MDMP). MDMP is an iterative planning methodology that ultimately leads to Operations Order (OPORD) development. It consists of seven steps and is generally geared towards higher level and staff leaders, providing these personnel with a construct to enable effective and deliberate planning. For the purpose of Pararescue operations, MDMP is solely used during contingency planning operations. While MDMP and Troop Leading Procedures (TLPs) can be used in a parallel construct, PJs typically do not execute planning in this manner. For more information on MDMP, reference AFTTP 3-3.Guardian Angel, Chapter 2.

2.2.1. **Guidelines for Using MDMP.** The following are iterative guidelines stipulating the most efficient and effective ways to use MDMP. See **Figure 2.1** As a general rule, follow the steps of MDPM in sequence, do not skip steps.

2.2.2.

Figure 2.1. MDMP Quick Reference Card.



2.2.3. **Commander's Intent.** Ensure clear commander's intent is given and/or generated. If clear intent is not given, it must be generated in order to sufficiently develop the problem statement. A clear intent is the cornerstone of MDMP and should be written in the format of "Purpose, Key Tasks, and End State". For an effective intent format see **Table 2.1**.

Table 2.1. Commanders Intent Form.

- Purpose: A restated mission statement with an emphasis of the purpose or an explanation of the issue that needs to be resolved with any amplifying explanations the CC (Commander) requires.
  - Example: Provide combat search and rescue (CSAR) alert standards to team for Horn of Africa tasking IOT recover/rescue US/coalition forces.
- Key Tasks: The minimum actions required to accomplish the mission or complete the task regardless of which COA is selected
  - Examples:
    - Adhere to +60 response time
    - Maintain sensitive item accountability
    - Develop plan to conduct risk assessment prior to step
    - Establish alert notification procedures/actions upon notification
    - Establish alert kits to fit AOR tasking and assets
    - Establish checklist/timeline to inventory and function check alert kits
    - Establish A/C contracts to fit mission set/AOR taskings
    - Establish training plan to ensure team is ready to meet AOR requirements
- End State: Describes friendly disposition after you've successfully accomplished the mission or solved the problem
  - Example: All coalition distressed/isolated personnel (IP) recovered and turned over to appropriate medical care, enemy personnel unable to impede the rescue, no sensitive items left on target for the enemy or media to exploit, rescue task force re-postured for alert.

2.2.4. **Problem Statement.** The problem statement is a description of the primary issues or issues that impede planners from achieving desired end states. A well-defined problem statement should be in clear contrast to the end state and must identify the source issue of the mission. If written appropriately, it should be referred to throughout the MDMP process to ensure the remainder of planning stays on target.

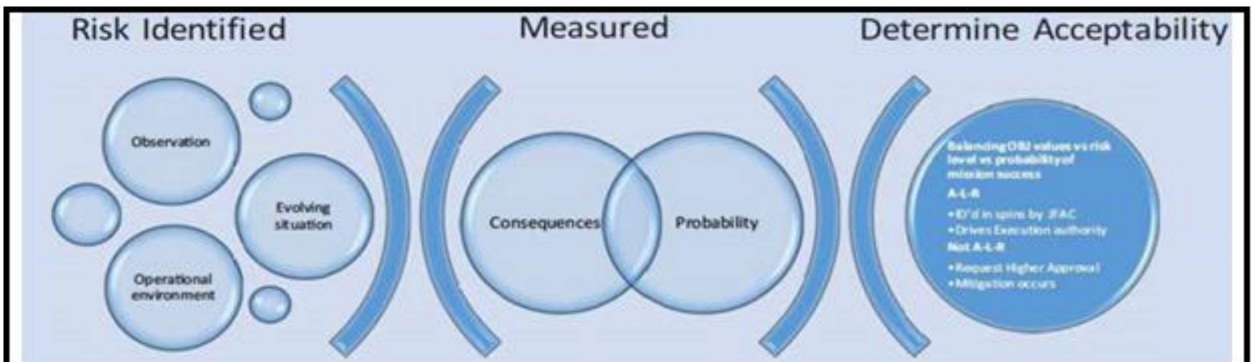
2.2.5. **Mission Analysis.** Planners must spend time in analysis to generate sufficient requests for information (RFI), request for forces (RFF), and mission support requests (MSR), see **Table 2.4** During the mission analysis phase, planners must clearly identify right and left limits (constraints/restraints), facts, assumptions, and assets available. Planners must also reinforce the commander's intent throughout this phase by identifying specified and implied tasks appropriately, ultimately shaping the COA development from this information. For additional information defining the above mission analysis criteria, reference AFTTP 3-3.Guardian Angel, Chapter 2.

2.2.6. **Course of Action (COA).** After completion of mission analysis, planners will begin COA Development, Analysis, and Comparison phase. COAs must be clearly defined and meet the following metrics: feasible, acceptable, suitable, complete, and distinguishable. It is important to effectively identify "pros" and "cons" for each COA. The COAs developed must allow for the most flexibility, limit the adversaries' freedom of maneuver, and provide the greatest probability of mission success. When evaluating developed COAs during the comparison phase, planners should not compare COAs against each other but instead evaluate them against the criteria established by higher level decision makers.

2.2.7. **COA Approval.** Following COA Comparison, planners and leaders must use both experience, intuition, and tangible selection criteria to choose the most appropriate COA for the mission. Following the approval of a specific COA, planners will then continue detailed planning on that specific COA. This, in effect, will initiate the usage of TLPs.

2.3. Risk. Throughout both the MDMP and TLP processes, risk is inherent to all levels of decision making. Proper risk analysis begins upon receipt of the mission and flows throughout all steps of each respective planning process. Deliberate risk management can be defined as the scientific process of analyzing and mitigating risk during the pre-mission phase of the operation. Real time risk management can be defined as the process of identifying, measuring, mitigating, and determining acceptability during mission execution See **Figure 2.2**, **Real Time Risk Acceptability**. For the purposes of planning, deliberate risk analysis, assessment, and mitigation is critical to developing acceptable COAs. Planners should become familiar with AFPAM 90-803, Risk Management Guidelines and Tools. To analyze combat risk, planners should understand and use the principles of Army FM 6-0, *Commander and Staff Organization and Operations*.

Figure 2.2. Real Time Risk Accessibility.



1. Identify risks in real time from an evolving situation.
2. Assess identified risks in terms of Consequences & Probability to determine level of risk.
3. Leaders balance the value of the objective, the risk level, and the probability of mission success to determine whether the mission meets or exceeds predetermined Acceptable Level of Risk (ALR), identified in theater Special Instructions (SPINS)/Air Operations Directive (AOD).
4. The team communicates its assessment of risk level to the execution authority.
5. Risk will be mitigated to an acceptable level or a higher ALR must be approved.
6. After ALR determination, continuous risk mitigation efforts should continue in an effort to lower the risk.

2.4. Troop Leading Procedures (TLP). TLPs are a dynamic eight-step process used by leaders to analyze a mission, develop a plan, and prepare for an operation. The goal of TLPs is to arrive at a suitable operation order that may or may not lead to execution. For more information on TLPs, reference the United States Army Ranger Handbook.

2.4.1. **TLPs 8-Step Process.** TLPs generate troop movement to develop and brief a complete plan. By design, TLPs are more fluid and less binding than MDMP. While the process delineates eight specific steps in order, the order by which planners follow is situational dependent.

2.4.2. The following are dynamic guidelines stipulating the most efficient and effective ways to use TLPs, see **Table 2.2**.

Table 2.2. TLP Quick Reference Guide.

1. Receive the mission.	5. Conduct reconnaissance.
2. Issue a warning order.	6. Complete the plan.
3. Make a tentative plan.	7. Issue the operations order.
4. Initiate movement.	8. Supervise and refine.

2.4.2.1. **Step-1:** Receive the Mission. The leader may receive the mission in an OPORD or a FRAGORD. The 1/3 - 2/3 rule only applies to the planning and preparation for an operation. Parallel planning occurs as the leader uses 1/3 of available planning and preparation time, and subordinates use the other 2/3. Emphasize conducting a hasty analysis with the primary focus on planning and preparation. Use of planning acronyms e.g., Mission, Enemy, Troops, Time, Terrain, Civilians (METT-TC), Size, Activity, Location, Uniform, Time, Equipment (SALUTE), and Obstacles, Cover and Concealment, Observation, Key Terrain, Avenues of Approach (OCOKA) to aid in developing a succinct situation.

2.4.2.2. **Step-2:** Issue a Warning Order. The leader provides initial instructions in a Warning Order (WARNORD) that contains enough information to begin preparation as soon as possible. The WARNORD mirrors the five-paragraph OPORD format, see **Table 2.3**, and may include: type of operation, general location of the operation, initial operational timeline, reconnaissance to initiate, movement to initiate, planning and preparation instructions (including planning timeline), information requirements, and Commander's critical information requirements (CCIR).

Table 2.3. Five-Paragraph WARNORD.

1. SITUATION. Find this in Higher Head Quarters (HHQ) OPORD
a. Area of interest: outline the area of interest on the map. • Orient relative to each point on the compass (north, south, east, and west). • Box in the entire area of operation (AO) with grid lines. **b. Area of operations:** outline the area of operation on the map. Point out the objective and current location of your unit. • Trace your zone using boundaries. • Familiarize by identifying natural (terrain) and man-made features in the zone your unit is operating. **c. Enemy forces:** include significant changes in enemy composition, dispositions, and courses of action. Information not available for inclusion in the initial WARNORD can be included in subsequent warning orders (WHO, WHAT, WHERE). **d. Friendly forces:** optional, address only if essential to the WARNORD. • Give higher commander's mission (WHO, WHAT, WHEN, WHERE, WHY). • State higher commander's intention. (HHQ [go to map board] OPORD, give task and purpose. • Point out friendly locations on the map board. **e. Attachments and detachments:** give initial task organization, only address major unit changes, and then go to the map board.
2. MISSION. Clear and concise, State mission twice, use 5 W's (who, what, when, where, why).
3. EXECUTION. Include the following information:
a. Concept of operations: provide as much information as available. The concept should describe the employment of maneuver elements. Give general direction, estimated distance, estimated time of travel, mode of travel, and major tasks to be conducted. Cover all movements and specify points where the ground tactical plan starts and stops. **b. Tasks to subordinate units:** provide specific tasks to subordinate units to aid in planning, preparing, and executing the mission. Planning guidance consists of tasks assigned to elements in the form of teams, special teams, and key individuals. **c. Coordinating instructions:** include any information available at that time, if known. At least cover the following items: • Uniform and equipment common to all. • Consider the factors of METT-TC and tailor the load for each member. • Timeline. (State when, what, where, who and all specified times. • Reverse plan. Use one-third to two-thirds rule). • Give specific priorities in order of completion. • Give information about coordination meetings.

• Rehearsals and inspections by priority. • Earliest movement time.
4. SUSTAINMENT. Include any known logistics preparation for the operation.
a. Logistics: include the following information: • **Maintenance:** include weapons and equipment direct exchange (DX) time and location. • **Transportation:** state method and mode of transportation for infiltration and exfiltration. Identify any coordination needed for external assets. Task subordinate leader (if needed) to generate load plan, number of lifts or serials, and bump plan. • **Supply:** only include classes of supply that require coordination or special instructions (such as rations, fuel, ammunition, or other items). **b. Medical Support:** identify any medical equipment, support, or preventative medicine that needs to be coordinated.
5. COMMAND & SIGNAL
a. Command: state the succession of command, if not covered in the unit's standard operating procedures (SOP). **b. Control:** include the following information: • **Command posts (CP):** describe the employment of CPs, including the location of each CP and its time of opening and closing, as appropriate. • **Reports:** list reports not covered in the SOP. **c. Signal:** describe the concept of signal support, including current signal operating instructions (SOI) edition or refer to the higher OPORD. Give subordinates guidance on tasks to complete for preparation of the OPORD and the mission. Give time, place, and uniform for the OPORD. Give a time hack and ask for questions.

2.4.2.3. **Step-3:** Make a Tentative Plan. The leader develops an estimate of the situation to use as the basis for the tentative plan. This is the leader's mission analysis. METT-TC is used when developing the tentative plan, see **Table 2.4**.

Table 2.4. Tentative Plan Development.

1. Conduct detailed mission analysis:

- **Mission, intent, and concept** of higher commanders' concepts and intents two levels up. This information is found in the OPORD.
- **Unit tasks** are tasks that are clearly stated in the order (specified tasks) or tasks that become apparent as the OPORD is analyzed (implied tasks).
- **Unit constraints.** The leader identifies any constraints placed on the unit. Constraints either prohibit or require an action. Leaders identify all constraints the OPORD places on their units' ability to execute their missions. The two types of constraints are proscriptive (required: mandates action) and prohibitive (not allowed: limits action).
- **Mission essential task(s).** After reviewing all the factors shown in previous paragraphs, the leader identifies the mission essential task(s). Failure to accomplish this task equals failure to accomplish the mission. The mission essential task should be in the maneuver paragraph.
- **Restate mission.** Clearly and concisely restate the mission (purpose to be achieved) and the mission essential task(s) required to achieve it. It identifies WHO, WHAT (the task), WHEN (the critical time), WHERE (usually a grid coordinate), and WHY (the purpose the unit is to achieve).

2. Analyze the situation and develop a course of action:

- **Suitable.** This accomplishes the mission and supports the commander's concept.
- **Acceptable.** The military advantage gained by executing the course of action must justify the cost in resources, especially casualties. This assessment is largely subjective.

3. With the restated mission from Step-1 to provide focus, the leader continues the estimate process using the remaining factors of METT-TC:

- What is known about the enemy? (SALUTE)
  - **S**ize
  - **A**ctivity
  - **L**ocation
  - **U**niform/Unit identification
  - **T**ime
  - **E**quipment
- How will terrain and weather affect the operations? Analyze terrain using observation and fields of fire, avenues of approach, key terrain, obstacles, and cover and concealment (OAKOC).
  - **Observation and fields of fire.** Determine locations that provide the best observation and fields of fire along the approaches, near the objective, or on key terrain. The analysis of fields of fire is mainly concerned with the ability to cover the terrain with direct fire.

- **Avenues of approach** are developed next and identified one level down. Aerial and subterranean avenues are also considered.
- **Key terrain** is any location or area that the seizure, retention, or control of that terrain affords a marked advantage to either combatant. Using the map and information already gathered, look for key terrain that dominates avenues of approach or the objective area. Next, look for decisive terrain that, if held or controlled, has an extraordinary impact on the mission.
- **Obstacles.** Identify the existing and reinforcing obstacles and hindering terrain that affects mobility.
- **Cover and concealment.** The analysis is often inseparable from the fields of fire and observation. Weapon positions need both to be effective and survivable. PJ units are capable of improving poor cover and concealment by digging in and camouflaging their positions. When moving, the terrain is used to provide cover and concealment.

2.4.2.4. **Step-4:** Initiate Movement: The unit may need to begin movement while the leader is still planning or forward reconnoitering. This step may occur anytime during the TLPs. This step can include pre/repositioning forces.

2.4.2.5. **Step-5:** Conduct Reconnaissance: If time allows, the leader makes a personal reconnaissance. When time does not allow, the leader makes a map reconnaissance. Sometimes, the leader relies on others means (such as Intelligence Surveillance and Reconnaissance (ISR)) to conduct the reconnaissance.

2.4.2.6. **Step-6:** Complete the Plan. The leader completes the plan based on the reconnaissance and any changes in the situation.

2.4.2.7. **Step-7:** Issue the Operations Order. Team Commanders (TC) and Team Leaders (TL) normally issue oral operation orders to aid subordinates in understanding the concept for the mission. If possible, leaders should issue the order with one or both of the following aids: within sight of the objective, on the defensive terrain, or on a terrain model or sketch. Leaders may require subordinates to repeat all or part of the order, or demonstrate on the model or sketch, their understanding of the operation. They should also quiz their PJs to ensure that all PJs understand the mission.

2.4.2.8. **Step-8:** Supervise and Refine (Step-8). The leader supervises the unit's preparation for combat by conducting rehearsals and inspections. Rehearsals include the practice of having Element Leaders (EL) brief their planned actions in execution sequence to the TL. The leader should conduct rehearsals on terrain that resembles the actual ground and in similar light conditions. Rehearsals are used to: 1) Practice essential task (improve performance), 2) Reveal weaknesses or problems in the plan, 3) Coordinate the actions of subordinate elements, and 3) Improve PJ understanding of the concept of the operation (foster confidence). See **Table 2.5**.

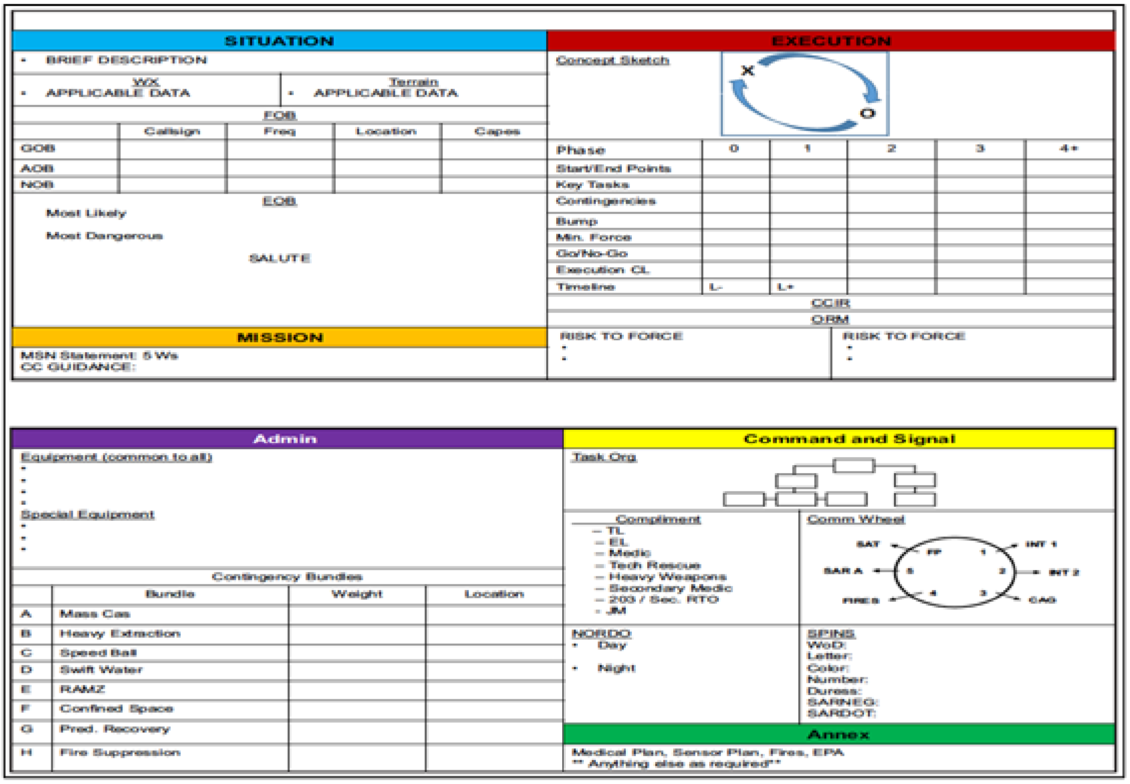
2.4.3. **Rehearsals.** Teams may begin rehearsals of battle drills and other SOP items before the receipt of the operation order. Once the order has been issued, the team can rehearse mission-specific tasks. See **Table 2.5**, for important tasks to rehearse.

2.4.4. **Inspections.** ELs should conduct initial inspections shortly after receipt of the WARNORD and spot checks throughout the unit's preparation for combat. The TC and TL make a final inspection. See **Table 2.5**, for important pre-combat inspections.

Table 2.5. Mission Rehearsals & Inspections.

Purpose
1. Practice essential tasks (improve performance) 2. Reveal weaknesses or problems in the plan 3. Coordinate the actions of subordinate elements
Mission Specific Rehearsals
1. Actions on the objective 2. Actions at the assault position 3. Obstacles (IED, mine and wire, etc.) 4. Using special weapons or demolitions 5. Immediate action drills / react to contact
Inspections
1. Weapons and ammunition 2. Uniforms and equipment 3. Mission essential equipment 4. PJs' understanding of the mission and individual responsibilities 5. Communications 6. Rations and water 7. Special equipment/Medical 8. Deficiencies noted during earlier inspections

Figure 2.3. OPORD Quick Reference Card.



SITUATION

- BRIEF DESCRIPTION

WX	Terrain
• APPLICABLE DATA	• APPLICABLE DATA

FOB

	Callsign	Freq	Location	Capes
GOB				
AOB				
NOB				

EOB

Most Likely

Most Dangerous

SALUTE

MISSION

MSN Statement: 5 Ws
CC GUIDANCE:

EXECUTION

Concept Sketch

Phase	0	1	2	3	4+
Start/End Points					
Key Tasks					
Contingencies					
Bump					
Min. Force					
Go/No-Go					
Execution CL					
Timeline	L-	L+			

CCIR

ORM

RISK TO FORCE	RISK TO FORCE
• •	• •

Admin

Equipment (common to all)
-
-
-
-

Special Equipment
-
-
-

Contingency Bundles

	Bundle	Weight	Location
A	Mass Cas		
B	Heavy Extraction		
C	Speed Ball		
D	Swift Water		
E	RAMZ		
F	Confined Space		
G	Pred. Recovery		
H	Fire Suppression		

Command and Signal

Task Org

Compliment
- TL
- EL
- Medic
- Tech Rescue
- Heavy Weapons
- Secondary Medic
- 203 / Sec. RTO
- JM

Comm Wheel

SAT, FP, 1, INT 1, SAR A, 5, 2, INT 2, FIRES, 4, 3, CAS

NORDO
- Day
- Night

SPINS
WoD:
Letter:
Color:
Number:
Duress:
SARNEG:
SARDOT:

Annex

Medical Plan, Sensor Plan, Fires, EPA
** Anything else as required**

Table 2.6. OPORD Template.

OPERATIONS ORDER

1. SITUATION. Include the following information:
a. Area of interest: describe the area of interest or areas outside of the area of operation that can influence your operation.
b. Area of operations: describe the area of operations. Refer to the appropriate map and use overlays, as needed.
• Terrain: using the OAKOC format, state how the terrain will affect friendly and enemy forces in the AO. Use the OAKOC from HHQ OPORD. Refine it based on your analysis of the terrain in the AO.
• Weather: describe the aspects of weather that impact operations. Consider the five military aspects of weather to drive your analysis: visibility, winds, temperature/humidity, cloud cover, and precipitation (V, W, T, C, and P). State how the weather will affect both friendly and enemy forces in the AO.
c. Enemy forces: the enemy situation in higher headquarters' OPORD forms the basis for this. Refine it by adding the detail your subordinates require.
• State the enemy's composition, disposition, and strength.
• Describe recent activities of the enemy.
• Describe their known or suspected locations and capabilities.
• Describe the enemy's most likely and most dangerous course of action.
  • Go to the map.
  • Point out on the map the location of recent known and suspected enemy activity.
d. Friendly forces: get this information from paragraphs 1d, 2, and 3 of the higher headquarters' OPORD.
• Higher headquarters mission, intent, and concept.
  • Higher headquarters two levels up.
    • Mission: state the mission of the higher unit (two levels up).
    • Intent: state intent two levels up.
• Higher headquarters one level up.
    • Mission: state the mission of the higher unit (one level up).
    • Intent: state intent one level up.
• **Mission of adjacent units:** state locations of units to the left, right, front, and rear. State those units' tasks and purposes and say how those units will influence yours, particularly adjacent units.
    • Show other unit's locations on map board.
    • Include statements about the influence each of the above units will have on your mission, if any.
    • Obtain this information from HHQs OPORD. It gives each leader an idea of what other units are doing and where they are going.
    • Also, include any information obtained when the leader conducts adjacent unit coordination.

a. Attachments and detachments: Avoid repeating information already listed in task organization. However, when not in the task organization, list units that are attached or detached to the headquarters that issues the order. State when attachment or detachment will be in effect if that differs from when the OPORD is in effect, such as on order or on commitment of the reserve. Use the term "remains attached" when units will be or have been attached for some time.

2. MISSION.

a. Who

b. What (task)

c. When

d. Where

e. Why (purpose) from HHQ maneuver paragraph

3. EXECUTION.

a. Commander's intent: state the intent, which is the clear, concise statement of what the force must do and the conditions the force must establish with respect to the friendly, enemy, terrain, and civil considerations that represent the commander's desired end state. This serves to allow subordinate and supporting commanders to achieve the commander's desired results without further orders, even when the operation does not unfold as planned.

b. Concept of operations: write a clear, concise concept statement. Describe how the unit will accomplish its mission from start to finish. Base the number of subparagraphs, if any, on what the leader considers appropriate, the level of leadership, and the complexity of the operation. Ensure that you state the purpose of the warfighting functions within the concept of the operation.

c. Scheme of movement and maneuver: describe the employment of maneuver units according to the concept of operations. Address subordinate units and attachments by name. State each one's mission as a task and purpose. Ensure the subordinate units' missions support that of the main effort. Focus on actions on the objective. Include a detailed plan and criteria for engagement and disengagement, an alternate plan in case of compromise or unplanned enemy force movement, and a withdrawal plan. The brief is to be sequential, going from start to finish, covering all aspects of the operation:

- Brief from the start of the operation to mission completion.
- Cover all primary and alternate routes, from insertion through to linkup, and include extraction until the mission is complete.
- Brief plan for crossing known danger areas.
- Brief plan for reacting to enemy contact.
- Brief any approved targets and Casualty Collection Points (CCP) as you brief the routes.

d. **Scheme of fires:** state scheme of fires to support the overall concept and state who (which maneuver unit) has priority of fire. You can use the purpose, location, observer, trigger, communication method, and resources (PLOT-CR) format to plan fires.

e. **Casualty evacuation:** provide a detailed CASEVAC plan during each phase of the operation. Include CCP locations, tentative extraction points, and methods of extraction.

f. **Tasks to subordinate units:** clearly state the missions or tasks for each subordinate unit that reports directly to the headquarters issuing the order. List the units in the task organization, including reserves. Use a separate subparagraph for each subordinate unit. State only the tasks needed for comprehension, clarity, and emphasis. Place tactical tasks that affect two or more units in coordinating instructions. Team leaders may task their subordinate units to provide any of the following special teams: reconnaissance and security, assault, support, aid and litter, Enemy Prisoner of War (EPW) and search, clearing, and demolitions. You may also include detailed instructions for the Element Leader, Joint Terminal Attach Controller (JTAC), Medic, etc.

g. **Coordinating instructions:** List only the instructions that apply to two or more units, and which are seldom covered in unit SOPs.

The information listed below is required:

- **Time schedule:** state time, place, uniform, priority of rehearsals, confirmation briefs, inspections, and movement.
- **Commander's critical information requirements**: include Priority, Intelligence, Requirement (PIR) and friendly force information requirements (FFIRs).
- **Priority intelligence requirements** includes all intelligence that the commander needs for planning and decision-making.
- **Friendly force information requirements:** include what the commander needs to know about friendly forces available for the operation. It can include personnel status, ammunition status, and leadership capabilities.
- **Essential elements of friendly information (EEFI):** these are critical aspects of friendly operations that, if known by the enemy, would compromise, lead to failure, or limit success of the operation.
- **Risk-reduction control measures:** these are unique to the operation. They supplement the unit SOP and can include mission-oriented protective posture, operational exposure guidance, vehicle recognition signals, and fratricide prevention measures.
- **Rules of engagement (ROE).**
- **Environmental considerations.**
- **Force protection.**

4. SUSTAINMENT. Describe the concept of sustainment to include logistics, personnel, and medical.

a. Logistics. Include the following information:

- **Sustainment overlay:** include current and proposed company supply train locations, CCPs (include marking method), equipment collection points, helicopter landing zones (HLZs), ambulance exchange points (AXPs), and any friendly sustainment locations such as forward operating bases (FOBs) common operational pictures (COPs), or other methods.

- **Maintenance:** include weapons and equipment, time, and location.
- **Transportation:** state method and mode of transportation for insertion and extraction, load plan, number of lifts and serials, bump plan, recovery assets, and recovery plan.
- **Supply:**
  - Class I—food, rations, and water.
  - Class III—petroleum, oils, and lubricants.
  - Class V—ammunition.
  - Class VII—major end items.
  - Class VIII—medical supplies, minimal amounts.
  - Class IX—repair parts.
  - Distribution methods.
- **Field services:** include any services provided or required.

b. **Personnel services support:** include the method of marking and handling EPWs.

c. **Medical System support:** include the following information:

- **Medical mission command**: include location of medics. Identify medical leadership, personnel controlling medics, and method of marking patients.
- **Medical treatment:** state how wounded or injured personnel will be treated
- **Medical evacuation:** describe how dead or wounded, friendly and enemy personnel will be evacuated. Identify aid and litter teams. Include special equipment needed for evacuation.

c. Preventive medicine: identify any preventive medicine team personnel may need for the mission (sun block, lip balm, insect repellant, in-country specific medicine, or other items).

5. COMMAND AND SIGNAL. State where mission command facilities and key leaders are located during the operation.

a. Command. Include the following information:

- **Location of commander or patrol leader:** state where the commander intends to be during the operation, by phase if the operation is phased.
- **Succession of command:** state the succession of command, if not covered in the unit SOP.

b. **Control.** Include the following information:

- **Command posts (CP):** describe the employment of CPs, including the location of each CP and its time of opening and closing, as appropriate. Typically, at team level the only reference to command posts is the company CP.
- **Reports:** list reports not covered in SOPs.

c. **Signal:** describe the concept of signal support, including current SOI edition or refer to the HHQ OPORD. • Identify the **SOI index that** is in effect. • Identify **methods of communication by priority**. • Describe **pyrotechnics and signals,** to include arm and hand signals (demonstrate). • Give **code words** such as OPSKEDs. • Give **challenge and password** (use behind friendly lines). • Give **number combination** (use forward of friendly lines). • Give **running password.** Give **recognition signals** (near—far and day—night).
Actions after issuance of OPORD: d. Issue annexes. e. Highlight next hard time. f. Give time hack. g. Ask for questions.

Chapter 3

INDIVIDUAL COMBAT SKILLS

3.1. Individual Combat Equipment.

3.1.1. **Durability and Functionality.** Equipment should be chosen for durability and functionality. Items should be camouflaged for tactical operations and not cause excessive noise. Carefully consider need versus weight and function.

3.1.2. **Individual Combat Equipment Levels.** Individual equipment and clothing can be broken down into three levels (METT-TC dependent): first, second, and third line.

3.1.2.1. **First Line.** First-line equipment and clothing are the necessities required for personal defense, survival, evasion, and escape. It is the operator's last line of defense in the event the operator must shed the second and third lines. Examples include mission uniform, personal survival kit, concealable Escape and Evasion kit, navigation tools, food, water-gathering materials, lightweight signaling devices (mirror/whistle).

3.1.2.2. **Second Line.** Second-line equipment consists of the combat load. Weapons and munitions, communication, signaling devices, individual first aid kits (IFAK) limited rations, and a knife are examples. The combat load must fit properly and be appropriately camouflaged and silenced.

3.1.2.3. **Third Line.** Third-line equipment supplements the combat load and provides the extended operational capability. Examples include rations, additional uniforms, batteries, sleeping gear, additional munitions, medical equipment, stoves, and special mission equipment. The load is designed to provide the minimum necessities for living in the field and is normally carried in the rucksack.

3.1.3. **Essential Elements.** It is critical that the TL scrutinize the mission requirements to ensure each person is adequately equipped and always plan on the worst-case scenario. Terrain and weather analysis will determine the type of camouflage and basic equipment. Pre-combat inspections (PCI) and pre-combat checks (PCC) must always be completed before the missions.

3.1.4. **Load-Bearing Equipment.** The tactical load bearing equipment (LBE) is used to hold the basic equipment (armor, and munitions, etc.) necessary to prosecute a mission. Contents should be standardized, and operators should be familiar with all team members equipment placement where deviations from standardization exist.

3.1.5. **Radio.** Should be placed where it is secure and easily accessible. The team radio should be carried where the operator can manipulate the radio unaided by teammates (e.g., changing volume or switching between frequencies) and will not interfere with the manipulation of the operator's weapon system.

3.1.6. **Signaling.** Multiple sources of both day and night signaling devices are carried per the CSAR special instructions (SPINS). Examples include: Chemlights, multiple colors including infrared (IR), VS-17 panel or equivalent, etc.

3.1.6.1. Night Lighting for signaling. Compact, powerful, night vision device (NVD)-friendly/headlamp flashlight/headlamp can be used as a sign/countersign method.

3.1.6.2. Pyrotechnics. Dual-end smoke/flares and/or the Gyro jet/pen-gun flare. Consider using Gyro jet/pen-gun where penetrating large trees or high terrain is necessary.

3.1.7. **Rucksack.** The mission will dictate the type and size of the pack (e.g., jumping, extended surface operations, or direct-action missions). It should be lightweight and durable, ideally, have quick releases, and not interfere with weapons engagement. Mission-essential equipment arrangement within the rucksack will be determined by the team or unit SOP. All operators should be familiar with their teammates' loadouts or deviations from the standard.

3.1.8. **Food and Water.** METT-TC considerations dictate sustenance requirements. Food should be nutritionally balanced for the individual and the operating environment. The ability to purify and purification requirements are based on military and biological threat impact to water requirements. Choose purification systems which do not require heat and remove the greatest amount of bacteria.

3.1.9. **Sleeping Gear.** Prevailing weather conditions are the key consideration of what type of sleep gear will be carried for the mission. Sleep gear may consist of a poncho and poncho liner, cold weather system to include sleeping pad, bivy sack, inner bag, outer bag, and vapor barrier. Compression sacks help reduce the size and keep items together for rapid access or storage. When conducting operations, consider taking extra gear for the survivor.

3.1.10. **Communications Equipment.** Communications during PR missions should be encrypted to the greatest extent possible based on mission requirements. Each recovery element should carry at least one man-packable multiband radio (e.g., PRC-167) and each team member will carry their personal radio. Packing extra Radio batteries, external battery packs and sufficient power must be identified during the planning phases.

3.1.11. **Night Vision Devices.** NVDs increase combat effectiveness during nighttime operations. The equipment should be ruggedized, carefully maintained, and should be carried on all missions. Operators must be intimately familiar with equipment operation and limitations by referencing the manufacturer's technical manuals.

3.2. Navigational Tools.

3.2.1. **Purpose.** Operators must be thoroughly familiar day/night navigation procedures, maps of mission areas, and navigation instruments such compasses and geographical positioning system (GPS) receivers. Techniques and procedures for navigation are found in Army FM 21-26, *Map Reading and Navigation.*

3.2.2. **Maps.** Careful consideration should be given to selecting the appropriate map for the mission. The most common map used for ground navigation is a 1:50,000 scale map. Other map and chart types can be created and used, to include gridded reference graphics (GRG), which are satellite imagery overlaid with a grid for mission-critical areas. Ensure map datum and a declination diagram is on the map for quick reference. All operators should be familiar with the map legend and symbols. The date of the map should be checked to ensure relevance during mission planning and execution.

3.2.3. **Digital Compasses.** Before use, confirm that the altimeter and digital compass are calibrated. This must often be done from known elevations during a mission. As these devices are battery dependent and relatively unreliable for navigating, consider only using these during emergency situations when no other compass is available.

3.2.4. **Lensatic Compass.** The lensatic compass is the standard issue military compass. Uses include orienting maps, determining distance and direction, traveling, determining azimuths, and triangulation. Ensure the luminous parts of the compass are functioning, and the dial is free floating. **NOTE:** Lensatic compasses come in two types, southern and northern hemisphere. Although they will work in both hemispheres, they will be 180 degrees out if used in the opposite hemisphere.

3.2.5. **Floating Needle Compass.** The floating needle compass (i.e., Silva) is used similarly to the Lensatic compass. The Silva compass has a unique feature that precludes the user from having to orient the map to north on the ground. The numerical graduations on the compass dial may not be tritium-based as in the Lensatic compass. There are luminous points on the compass which allow a heading to be followed after being set. Ensure model selected has a luminous dot on the direction of travel line. This feature allows better alignment between the 0-degree mark and the line-of-travel arrow.

3.2.6. **Wrist Compass.** Various small wrist compasses are available. Although very useful in maintaining general direction and situational awareness, they should not be used for precise point-to-point navigation. As with other navigation aids, this compass should be checked before missions against other navigation aids for accuracy.

3.2.7. **Altimeter Used as a Compass Aid.** The barometric altimeter is useful for weather forecasting and as a navigation aid. For navigational purposes, the altimeter is always used in conjunction with the map and compass to confirm location based on altitude.

3.2.8. **Pace Count.** Maintaining an accurate pace count is vital for accurate navigation. Operators should determine their pace count before each mission with the gear they will be carrying on a measured 100-meter distance. All team members should review effects of terrain on pace count as outlined in Army FM 21-26, *Map Reading and Navigation.*

3.2.9. **Six-Point Navigation Checklist.** A six-point checklist should be made during mission planning for each leg based on a detailed map study. By referring to it during navigation, the team can ensure it is staying on course and able to always determine its position, see **Table 3.1**. **NOTE:** GPS are electrical and may break or be electronically jammed. Although highly beneficial for determining exact location, operators should be proficient in land navigation using map and compass and terrain following procedures.

3.2.10.

Table 3.1. Six-point Navigation Checklist.

1. Heading in degrees to the next point
2. Distance to be traveled in meters
3. Pace count for the entire navigation leg
4. Terrain description of the terrain to be covered
5. Estimated time of travel to the next point
6. Description of what the final point should look like (surrounding terrain)
7. The “seventh” point on the Six-point checklist is determining a backstop

3.2.11. **Global Positioning System (GPS).** GPS navigation aids are battery-powered, man-portable systems that use satellites to determine present location/position. If the operator is not in an area visible to the sky (e.g., multiple canopy tree cover, drainages, or urban areas), signal strength/accuracy can be reduced. Operators should be intimately familiar with their GPS and the effects of weather and terrain on signal strength.

3.2.11.1. GPS Types. The two main types of GPS are military and civilian. Military GPS units (i.e., PLGR, PLGR II, and DAGR) have many of the same functions as civilian units but have the selective availability/anti-spoofing module (SAASM) that allows the filling of cryptographic data, increasing the accuracy of the unit if GPS satellites have spoofing capability activated. Civilian models do not have this feature.

3.2.11.2. GPS Properties. GPS is extremely accurate and highly portable. All operators will be trained to load/maintain/use the GPS. GPS should be used to reconfirm suspected location. Battery life is limited in GPS units, and they are affected by cold and prolonged use. Once a distance and direction are established, use the Silva or Lensatic compass for traveling. The GPS can show magnetic azimuth, continuous position fix, and vehicle speed to aid in navigation. A navigator only relies on the GPS to back up base navigational skills. Using map, compass, and odometer readings, along with terrain orientation or DR, the navigator uses the GPS to confirm or make corrections in route movement when needed. This method is the preferred method of use; the navigator cannot rely solely on the GPS. A problem with the GPS such as power outage, a broken antenna, or the loss of satellite reception could leave the team disoriented. The navigator should be able to successfully navigate to the objective using the techniques previously addressed in this chapter.

3.2.11.3. Waypoints. Waypoints are spots loaded in the GPS unit that can be referenced by the user once a GPS fix is acquired. These waypoints can be loaded via serial port prior to a mission (such as search and rescue dot (SARDOT) or rally points) or using the “Mark” option. Waypoints can also be manipulated and loaded without actually being in the location.

3.2.11.4. Storing Waypoints. A waypoint is the coordinate of a specific location in the route programmed into the GPS. Once there are two or more waypoints, the navigator can set the GPS to plot a route from a given point to another given point. When done, the GPS gives direction in degrees magnetic, distance to travel, and the time it will take at the vehicle's current speed to arrive at the desired location. The device also indicates when the vehicle is off course due to wheel slip and allows the navigator to correct. Before departing isolation, the navigator can pre-program the team's entire route into the GPS for navigational purposes. During movement, the team leader can designate a location as a rally point, water source, target reference point, or another point of interest. The navigator can store this particular location as a waypoint.

3.2.11.5. Polar Plot. The GPS provides the navigator the ability to rapidly obtain an accurate polar plot to a target from position.

3.2.11.6. Jamming. Any GPS is subject to jamming. It is possible for the enemy to produce false signals that will cause the GPS not to work or produce inaccurate information. This problem is easy to correct, but the navigator must be aware of the possibilities. If the navigator suspects they are a target for this kind of information warfare, the navigator digs a hole below ground level and places the GPS antenna into the hole to check position. This hole must be deep enough to block any line-of-sight, ground-based transmissions. The antenna will only receive signals from satellites overhead and will give a correct navigational reading. Military GPS's, such as the Defense Advanced GPS Receiver (DAGR), when keyed with the proper encryption, are less susceptible to jamming. They can also triangulate a jamming source.

3.2.11.7. Errors and Inaccuracies. Many inaccuracies may exist when comparing an actual GPS location with its identified map location. These inaccuracies are caused by errors in reading and plotting, using incorrect map datum, and GPS inaccuracies, as well as other factors. Most inaccuracies can be prevented by ensuring proper map datum and using approved navigation and coordinate plotting and reading procedures.

Chapter 4

COMBAT MARKSMANSHIP

4.1. Weapon Safety. A collection of rules and recommendations applied when handling firearms. Following these rules can eliminate or minimize risk of unintentional death, injury, or damage to equipment caused by improper or unsafe handling of firearms.

Table 4.1. Fundamental Four Rules of Safe Weapons Handling.

1. Treat all weapons as if they are loaded.
2. Never point your weapon at anything you are not willing to destroy.
3. Keep your finger off the trigger/trigger housing, and safety on until your sights are on target, and you're ready to fire.
4. Positively identify (PID) your target and know what is behind it.

4.1.1. **Muzzle Discipline.** Muzzle discipline is controlling the muzzle and keeping it pointed in a safe direction at all times regardless of the weapon is loaded or unloaded.

4.1.2. **Trigger Finger Discipline.** Trigger Finger Discipline refers to knowing when and when not to place the finger on the trigger.

4.1.3. **Trigger Finger Indexing.** To apply "trigger finger discipline", shooters must learn to "index" the trigger finger along the side of the receiver. The trigger finger is held straight and placed flat on the outside of the lower receiver or slide above the trigger opening and does not enter the trigger guard until the shooter has sights on target and is ready to fire. When firing is complete and threat is eliminated, the finger should return to the indexed position.

4.1.4. **Positive Identification (PID).** PID of a target and its surroundings refers to the potential of a fired round to enter and exit the intended target, and then continue to travel into an unintended target.

4.2. Combat Triad. The Combat Triad is a three-concept idea, which includes: 1) Combat mindset, 2) Weapons handling, and 3) Combat Marksmanship. Each of these concepts must be exercised and mastered to become an expert gunfighter and to survive a lethal confrontation. Of these, the Combat Mindset is the most important.

4.2.1. **Combat mindset.** The combat mindset is the mentality and understanding of what you must do in order to eliminate your target while maximizing your survivability. The Combat Mindset is essential to survivability and consists of three main elements, see **Table 4.2**.

Table 4.2. Combat Mindset.

1. **Aggression –** To succeed in combat, Operators must be supremely violent at the appropriate time. The operator must be aggressive and have a willingness to engage enemy threats in all regards.
2. **Decision Making –** In the dynamic combat environment, all operators must be able to make sound decisions quickly with an oftentimes overload of rapidly changing facts and assumptions. The difference between life and death at the individual and team level could depend on the operator's ability to not only 'think tactically' and make the right decision but make the right decision quickly.
3. **Competence –** The final pillar of the Combat Mindset is tactical competence. You can be the most aggressive and appropriate decision maker; however, if your basic competence is lacking you will be unable to see your plan through.

4.2.1.1. Developing a Combat Mindset. Involves using and understanding the tools of your craft to win against a determined enemy who has proven capable of using any and all means to inflict casualties. It is not just about being able to hit a target, you must also assert aggressiveness and exhibit a willingness to engage enemy threats.

4.2.1.2. Utilizing the 'tools' of your craft. The individual is the weapon; the tools simply aid the individual.

4.2.2. **Combat Marksmanship.** Shooting, Moving, and Communicating are the three basic elements of combat marksmanship beyond the fundamentals. Each may be performed individually but maximize an operator's lethality when used in unison.

Table 4.3. Basic Elements of Combat Marksmanship.

1. Move with balance and efficiency.
2. Communicate individual actions along with teammates' required actions.
3. Shoot while moving and communicating simultaneously.

4.2.3. **Suppressed Weapons.** Suppressed weapons offer advantages such as reduced signature from muzzle flash/sound and less impeded communications among the friendly forces due to lowered sound levels. Suppressors should be used on weapons in training and operationally when available. Suppressors change the ballistics of the round. Operators should zero their weapon in the configuration (suppressed or unsuppressed) in which they will employ the weapon.

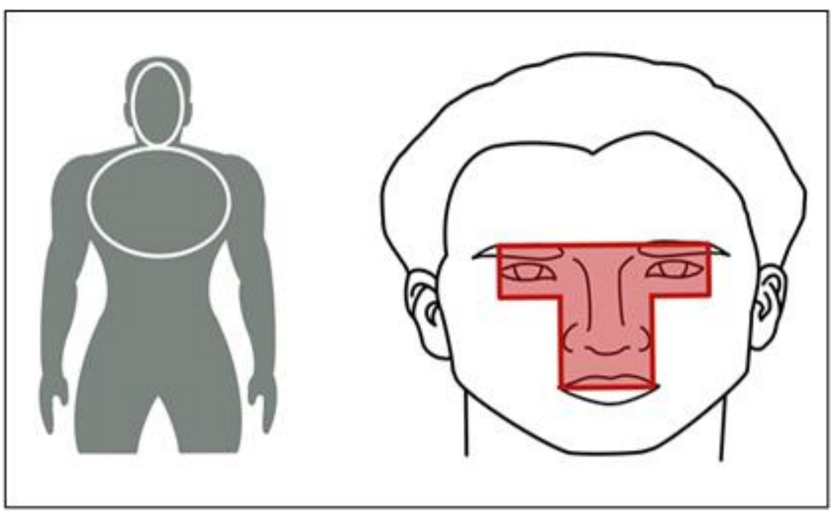
4.3. Target Zones (Lethal vs. Incapacitation).

4.3.1. **Lethal Shots.** Ideally, the point of aim is anywhere within a primary 'switch' (kill zone) area. This point will maximize the possibility of striking major organs and vessels, rendering a clean, one-shot kill. The lethal zone of the target is the head and thoracic cavity (chest). See **Figure 4.1, Lethal Shot Zones**. This is the area where vital organs such as the heart, lungs, major arteries, and portions of the central nervous system (spine) are located. Operators must be trained to shoot until the action stops and whatever action prompted the use of deadly force must be stopped! The enemy could still return fire and inflict bodily harm; therefore, operators should always be prepared to re-engage threats immediately. Never assume the fight is over!

4.3.2. **Hydraulic Shots.** Hydraulic shots or "timers," are impacts on a target where immediate incapacitation is NOT guaranteed. These types of ballistic trauma are termed "timers" as that after the strike of the bullet, the damage caused requires time for the threat to have sufficient blood loss to render it incapacitated. Hydraulic shots, although ultimately lethal, allow for the threat to function in a reduced capacity for a period of time. For hydraulic shots to eliminate a threat, they must cause a 40 percent loss of blood within the circulatory system. Shots in either the thoracic cavity or head maximize the chance of incapacitating a human target and stopping the threat. It is important to note that rounds impacting these areas are not guaranteed to instantly incapacitate or stop a threat.

4.3.3. **Incapacitating Shot Placement.** The best locations to engage a human target are the cranial vault (head) or base of the skull (medulla oblongata). The best shot placement to attain immediate and total incapacitation is one roughly centered in the face, below the middle of the forehead and the upper lip, and inside the outer limits of the eyes. Shots to the side of the head should be centered between the crown of the skull and the middle of the ear opening, from the center of the cheekbones to the middle of the back of the head. These shots increase the probability of bullets hitting the medulla oblongata and stopping all motor functions. This is the 'lights out' location and is displayed on targets as either a "T" box or triangle from eye to eye to the top lip, see **Figure 4.1** Shots to the head must be well aimed and accurately engaged.

Figure 4.1. Lethal Shot Zones & "T-Box".



4.3.4. **Circuitry Shots.** Circuitry shots, or "switches," are strikes to a target that deliver its immediate incapacitation. Immediate incapacitation is the sudden physical or mental inability to initiate or complete any physical task. To accomplish this, the central nervous system must be destroyed by hitting the brain or spinal column. All bodily functions and voluntary actions cease when the brain and spinal column is destroyed.

4.4. Basic Marksmanship Fundamentals. Accuracy is built on consistency; meaning shooters must know how to consistently apply proper shooting fundamentals. Certain fundamentals apply to all positions and once mastered will allow the shooter to accurately engage threats from any position.

4.4.1. **Stance/Position:** Position refers to establishing the most stable shooting platform possible. The subject of position includes Support (artificial, bone and Natural Point of Aim). Some universal rules that apply to all shooting positions: Always use artificial support if available. If unavailable, shooters should always use bone structure to support the weapon. The least preferred is muscular support alone. Natural point of aim occurs when the weapon's lay allows it to point naturally at the target without the shooter having to utilize muscles to move the weapon. When properly applied, the result is the weapon returns to target after firing and recoil. To establish natural point of aim, the shooter assumes a firing position, aims at the target, closes their eyes, simulates recoil of the weapon, and then opens their eyes. If natural point of aim has been achieved, the weapon sights will return to the target. Establishing natural point of aim increases accuracy and speed because the weapon returns to target faster. When shooters engage multiple targets requiring traverse of the weapon, the whole body must be realigned, and natural point of aim quickly re-established to maintain maximum accuracy. If not, the shooting platform breaks down decreasing accuracy.

4.4.2. **Grip.** Grip refers to holding the weapon to allow proper aiming. Grip relies on 4 points of contact: 1) Shooting Hand, 2) Support Hand, 3) Shoulder, and 4) Stock (Cheek) Weld. Properly applied, these four points of contact allow the shooter to mount the weapon consistently, manage recoil and maximize accuracy. Eye relief is the distance from the shooting eye to the rear sight. More importantly, inconsistent eye relief can cause a change in the point of impact (POI) of rounds on the target. Proper eye relief is obtained by obtaining a stock weld that consistently places the eye a set distance from the rear sight, every time the shooter shoulders the weapon. It must be the same in each shooting position. To accomplish this, shooters can touch the tip of their nose to the charging handle, or place two fingers from the shooting hand across the top of the stock behind and touching the charging handle. Stock weld is then established by touching the tip of the nose touching the closest finger. This technique will help inexperienced shooters practice consistent eye relief until they can do it by "feel" without the need to measure the distance to the charging handle.

4.4.3. **Aiming.** Aiming consists of two elements: 1) Sight Alignment and 2) Sight Picture.

4.4.3.1. Sight Alignment. Is aligning the barrel of the weapon with the line of sight of the shooting eye. Proper sight alignment varies to the type of advanced optical sight being used. Maintaining sight alignment is one of the most important fundamentals in shooting. It is more important than sight picture because this doesn't affect accuracy at practical combat distances. Improper sight alignment will greatly affect combat accuracy. To maintain proper sight alignment for individual optics, shooters must reference manufacturers manual and become proficient on its functionality and modifications prior to use. Note that front and rear iron sites should be used as a backup should optical sights fail.

4.4.3.2. Sight Picture. Sight picture is what the shooter sees when aiming the weapon at a target. It can be explained many ways but is essentially placing sight alignment over the target. The steps in sequence are: 1) Acquire target, 2) Align sights on target, 3) Shift focus to front sight (if using iron sights), and 4) Squeeze trigger.

4.4.3.2.1. A perfect sight picture is not as important to accuracy as sight alignment, but it is important as to aiming point on the target. Proper sight picture involves deciding what part of the target to aim at. For BZO and general qualification purposes (paper targets), the aim point should be center of mass (COM) on the silhouette. For combat purposes (carried out at greater distances) COM may be whatever part of the threat the shooter can see, even though training dictates to aim COM at the torso where vital organs are located.

4.4.4. **Trigger Control.** Trigger control is probably THE most important fundamental. Starting with the point of contact, the index finger must be placed on the trigger so that only the pad contacts the trigger. The area of the finger between the rifle grip to the pad touching the trigger must not touch the weapon. The trigger finger must be trained to move independently of the other fingers of the firing hand. As the trigger is pressed to the rear, the other firing fingers and thumb should not tighten as pressure is applied by the trigger finger.

4.4.4.1. The essence of controlling the trigger is moving the trigger straight to the rear without disturbing sight alignment. Rearward pressure applied to the trigger should be smooth and gradual not a sudden quick convulsive movement. Trigger control can be broken down into four parts: 1) Trigger prep (Take-up), 2) Surprise break (P-R-E-S-S), 3) Follow through, and 4) Reset.

4.4.4.2. The trigger on M4 series weapons has a certain amount of free movement followed by felt resistance. This free movement is called take-up or commonly referred to as 'trigger creep". "Trigger Prep" refers to taking the "slack" out until the resistance of the sear is felt. Shooters must be taught to press the trigger to the rear until they feel this resistance, at which point breathing stops; the eye is intensely focused on the red dot (optics), front sight (iron sights), and smooth gradual pressure is applied to the trigger.

4.4.4.3. Surprise Break (P-R-E-S-S) - A "Surprise Break" occurs when smooth steady pressure is applied to the trigger until it is released and the weapon fires. The shooter must think "P-R-E-S-S". The trigger is slowly pressed to the rear in one smooth motion. Concentration must be on maintaining perfect sight alignment without regard as to when the weapon will fire. Don't make it happen…let it happen! The purpose for understanding the "Surprise Break', is to ensure the shooter learns to apply smooth even pressure to the trigger and to prevent jerking the trigger or anticipating the recoil of the shot. Once mastered, the time frame to complete the “Surprise Break” can be decreased enabling a shooter to fire rapidly with a high degree of accuracy. Trigger control does not simply end with firing the shot, a shooter must learn to apply “Follow Through”.

4.4.5. **Follow Through.** Follow through is the continued application of marksmanship fundamentals after the shot is fired. Practicing proper follow through helps overcome the tendency to slap the trigger during rapid continuous firing. Consider what happens the instant the shot is fired; the weapon recoils to the rear and upward then falls back to the shooting position and natural point of aim. To complete proper “Follow Through”, the trigger is held to the rear until recoil recovery is complete and sight alignment on the target re-established. At this point rearward pressure on the trigger can be smoothly released to reset the trigger. ONLY after this is accomplished is the shot complete. Although “Trigger Reset” is part of “Follow Through”, it should be discussed separately.

4.4.5.1. Trigger Reset. After follow-through is complete, shooters must prepare to fire the next shot by resetting the trigger. The key to this is knowing that the trigger finger MUST NOT break contact with the trigger after the shot is fired. Proper “Trigger Reset” minimizes the time required for follow-up shots by eliminating the time spent replacing the trigger finger correctly on the trigger and performing “Trigger Prep” (take- up) after each shot. Shooters practice trigger reset during dry fire by holding the trigger after the shot while charging the weapon. Then release the trigger smoothly just to the point where they hear and feel the click of the reset. The shooter regains focus on sight and begins trigger press to the rear.

4.4.5.2. Main points to remember during the trigger reset are: 1) Maintain contact with the trigger after the shot and 2) Release the trigger smoothly only to the point of reset.

4.4.6. **Breathing Control.** Breathing control while firing a weapon will minimize movement of the weapon, thus increasing accuracy. There are three basic techniques to control breathing.

Table 4.4. Breathing Control Techniques.

1. For shots requiring maximum accuracy (BZO), distances beyond 300 yards/meters the shooter should take several deep breaths, let out half; then begin trigger squeeze. This method works best when zeroing or when time is not a factor.
2. The second technique is to utilize the natural pause between inhaling and exhaling. Used by more experienced shooters, this technique is accomplished by exhaling normally and “pausing” to squeeze the trigger before inhaling.
3. During qualification, when time limits are imposed, shooters should be taught to acquire a sight picture and stop breathing long enough to make the shot. This method also translates well into combat situations where targets may appear suddenly and are exposed only for a few seconds.

4.4.6.1. Regardless of which breathing method is applied, the breathing cycle should stop just prior to pressing the trigger.

4.4.6.2. Most shooters should be able to comfortably fire a few rounds during each pause, but in combat this may not be possible due to physical exertion prior to firing the weapon.

4.5. Designated Marksman. The designated marksman (DM) is an individual with additional training in the fundamentals of marksmanship and observation. In support of operations, the DM delivers precision fire on positively identified threats at ranges from 300 meters out to the max range specific to the weapon system carried, see **Table 4.5** A DM is an integrated member of the team and does not operate as a separate battlefield element with separate mission objectives.

Table 4.5. Weapons Effective Range.

Weapon	**Role**	**Effective Range**
M4 / M4A1	Primary	500 meters point target, 600 meters area target
Glock 19	Secondary	50 meters
M249 Automatic Rifle (LMG)	Support / Primary	600 meters point target, 800 meters area target
M240B Machine Gun (MMG)	Fixed / mounted support	800 meter point targets, 1,800 meter area targets
M110 SASS	Designated Marksman	800 meters point target, 1,000 meters area target
M203 / M320	Marking, support, crowd control, less than lethal	150 meters point target, 350 meters area target
Shotgun	Marking, breaching, crowd control, less than lethal	Ranges vary on types of ammunition used

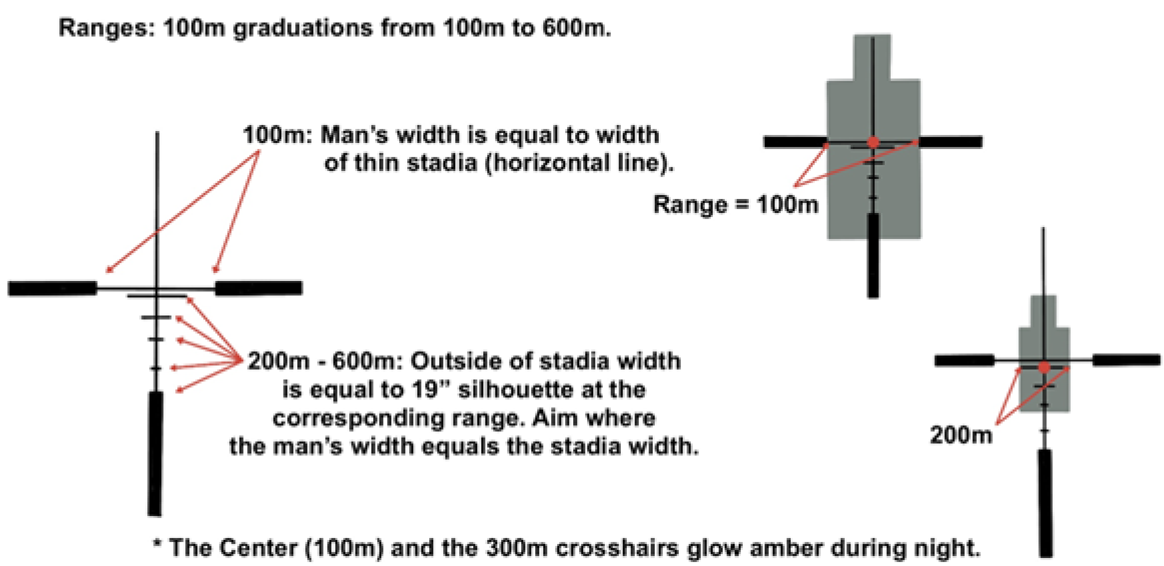
4.5.1. **Designated Marksman Training.** Prior to carrying a DM weapon, the DM should complete a comprehensive training course that emphasizes stress shooting, shot placement, angled firing, and night firing using various methods. A DM must possess a thorough understanding and demonstrated mastery of 1) Fundamentals of combat marksmanship, 2) Ballistics, 3) Corrective adjustments (elevation and windage), 4) Hold-off (adjusted point of aim), 5) Optic understanding and manipulation, and 6) Range estimation.

4.6. Sighting Systems.

4.6.1. **Day Optic Sight (DOS).** The Day Optic Sight, frequently referred to by its civilian name as the ACOG (Model # TAO1NSN) is a four power (4X) scope with 32 mm objective manufactured by Trijicon Inc. The DOS provides the capability to effectively engage point targets out to approximately 600m. The scope reticle contains a cross hair with graduated range stadia lines calibrated specifically for the trajectory of the M855 ball round when fired from the 14.5-inch barrel of the M4 carbine. The horizontal stadia are also used to determine range on a "man-size" target. See **Figure 4.2,** ACOG DOS with Classic Crosshair Reticle. The scope also has a Backup Iron Sight consisting of a rear aperture and post front sight attached to the top of the scope body. The DOS is mounted to the M1913 rail on top of the M4 upper receiver.

4.6.1.1. The ACOG has the advantage of being a magnified optic, which doubles the scope's usefulness by making it a tool one can observe and spot with. See **Figure 4.3**.

Figure 4.2. ACOG DOS with Classic Crosshair Reticle.

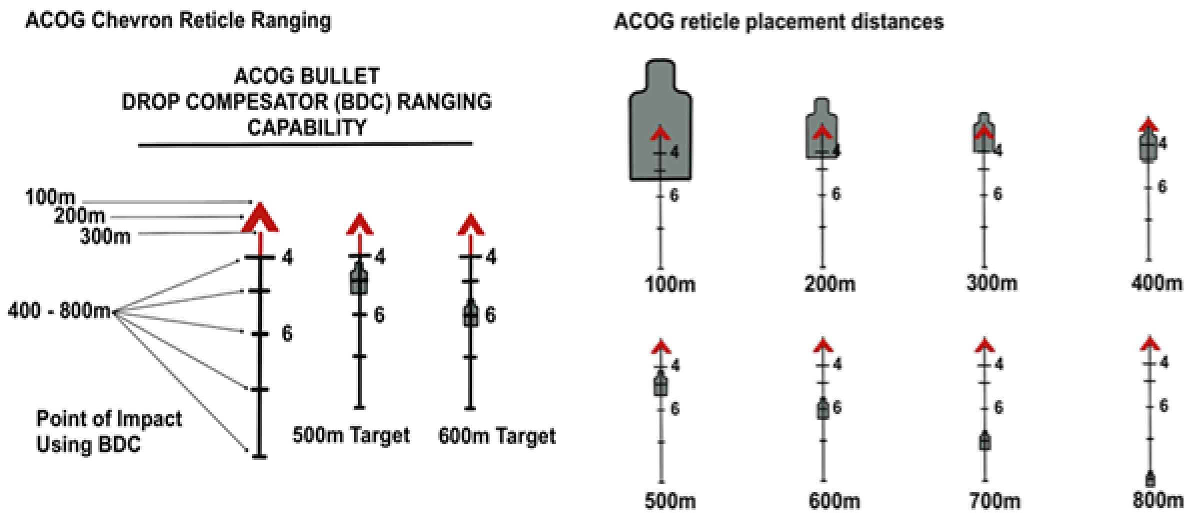


4.6.1.2. DOS Ranging and Aiming. The reticle pattern has been carefully designed to provide many features while retaining simplicity of operation. The operator does not need to make any manual adjustments between shots at different ranges. Ranging capability is built into the reticle pattern, which is parallax free along its vertical axis.

Table 4.6. DOS Ranging and Aiming.

1. Ranging. The shooter matches the width of the stadia line to the width of the man.
2. Aiming. After ranging, use the cross hair of the correct range stadia line to aim and fire.
3. Chevron Reticle. The Chevron reticle is the standard issue reticle for military use ACOG's, it looks like an upside-down V.

Figure 4.3. ACOG Chevron Reticle Ranging and Reticle Placement distances.



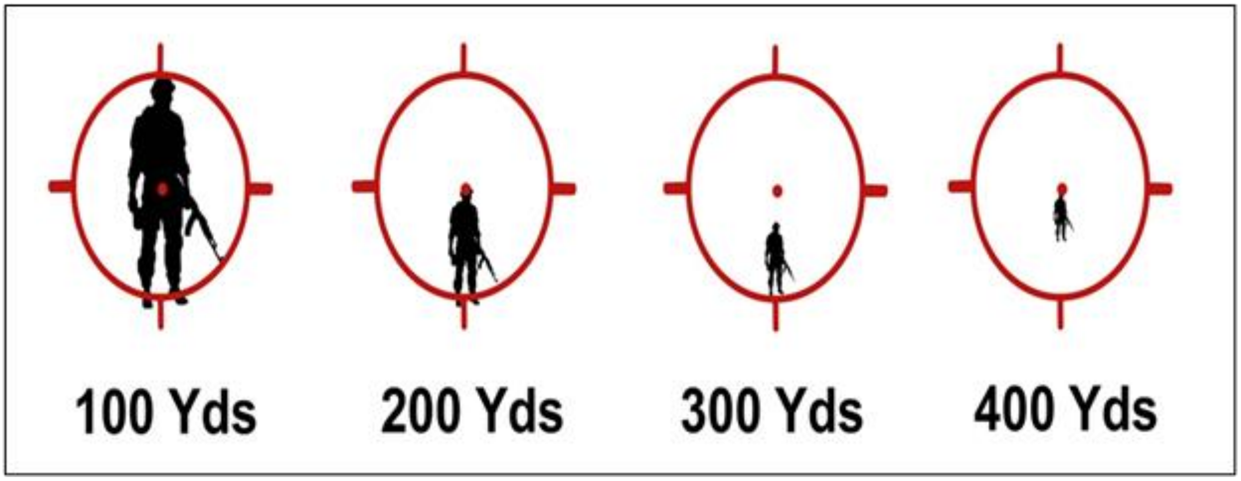
4.6.2. **M68 Close Combat Optic (CCO).** The M68 CCO is a reflex collimated red dot sight designed for the "two eyes open" method of firing. When zeroed, the red dot is bore-sighted with the barrel of the weapon. Regardless of the red dot's position within the optic, the bullet will impact where the dot is on the target at the zeroed range. Simply place the dot on the target and fire. The key is to properly sight-in the CCO during zero so that where the dot is, the bullet hits. Once mastered, the optic is fast and accurate within effective ranges of the M4. Additionally, an "anti-reflective device" (ARD) is included in the equipment package. When installed on the front of the optic, the ARD reduces the chance of light reflecting off the front lens of the optic, which helps avoid detection by the enemy. Shooters should adjust the intensity to the lowest setting possible that allows the dot to be clearly seen by the shooter. If set too high, the dot can "wash out" the target and may also be visible to the enemy from the front of the optic. There are currently two version of the M68 CCO for use on the M4.

4.6.3. **EOTech.** The EOTech (A65/1) reticle pattern is composed of three parts. First, the large outer ring has an outside diameter of 65 minutes of angle (MOA). This circle is about 10 inches in diameter at 15 yards. At this distance, the circle covers about 65% of the body of an average sized adult making this ideal for close quarter combat situations. The large circular reticle is very easy for the operator to see, and it can be locked onto the target very rapidly. It also provides a natural centering aid to the aiming dot. Second, the reticle design incorporates quadrant ticks extending off the outside diameter of the reticle circle. These 4 MOA ticks also assist in rapid target acquisition and provide additional leveling information to the operator. Third, the reticle consists of a precise aiming dot. This aiming dot is a true point source, so the actual size of the dot is beyond the resolution of the human eye. 1 MOA is the acuity limit of a human eye with 20/20 vision. The dot provides the highest level of accuracy possible with a 1X sight and can be very effective out to 200+m because the small targets are not covered or occluded.

4.6.3.1. Being a true point source, the dot does not magnify at the same rate as an environment or target. For example, using the EOTech with a 4X magnifier in tandem, will only produce a 1.6 MOA aiming dot at 600m, creating a highly lethal long-range optic.

4.6.3.2. Range Estimation. The reticle can be useful not only for quick target acquisition, but for range estimation as well. **Figure 4.4, Using an EOTech Reticle for determining range estimation**, illustrates how to determine estimated ranges out to 400 yards. The average adult male stands 5'9'' in height, about the size of the outer diameter of the 65MOA ring at 100 yards. Moving out to 200 yards, that same male adult will occupy half of this outer ring diameter. A third of the diameter represents this adult at 300 yards, and at a quarter of the ring at 400 yards.

Figure 4.4. Using an EOTech Reticle for determining range estimation.



4.7. Weapon Zeroing. The purpose of zeroing a rifle is to align the sight(s) with the rifle barrel. When this is done correctly the point of aim and the point of bullet impact are the same. There are three primary types of zero, the Battlesight Zero (BZO), Zero, and True Zero.

4.7.1. **Battlesight Zero (BZO).** A BZO is the elevation and windage settings required to place a single shot, or the center of a shot group, in the center of a target at 300 yards/meters, under ideal weather conditions (no wind). A BZO is the sight settings placed on your rifle for combat. In combat, your rifle's BZO setting will enable engagement of point targets from 0 – 300 yards/meters in a no wind condition.

4.7.2. **Zero.** A zero is the elevation and windage settings required to place a single shot, or the center of a shot group, in center of the target at a specific range, from a specific firing position, under specific weather conditions.

4.7.3. **True Zero.** A true zero is the same as a Zero except, under ideal weather conditions (i.e., no wind).

4.7.4. **Elements of Zeroing.** In order for a shooter to understand the zeroing process there are particular elements that must be accounted for.

4.7.4.1. Line of Sight (LOS). LOS is a straight line beginning at the center of the eye. It passes through the center of the rear sight aperture. Then, it continues across the tip of the front sight post to the exact point of aim on the target.

4.7.4.2. Aiming Point. The aiming point is the precise point where the tip of the front sight post is placed in relationship to the target.

4.7.4.3. Centerline of the Bore. Centerline of the bore is an imaginary straight line beginning at the chamber end of the barrel. It proceeds out of the muzzle and continues indefinitely.

4.7.4.4. Sight to Bore Offset. Often called 'Mechanical Offset', is the spatial difference between the sights (or optics) and the center bore of the barrel.

4.7.4.5. Mechanical offset varies from firearm to firearm; it is generally 1" to 3" for rifles and 5/8" to 3/4" for pistols.

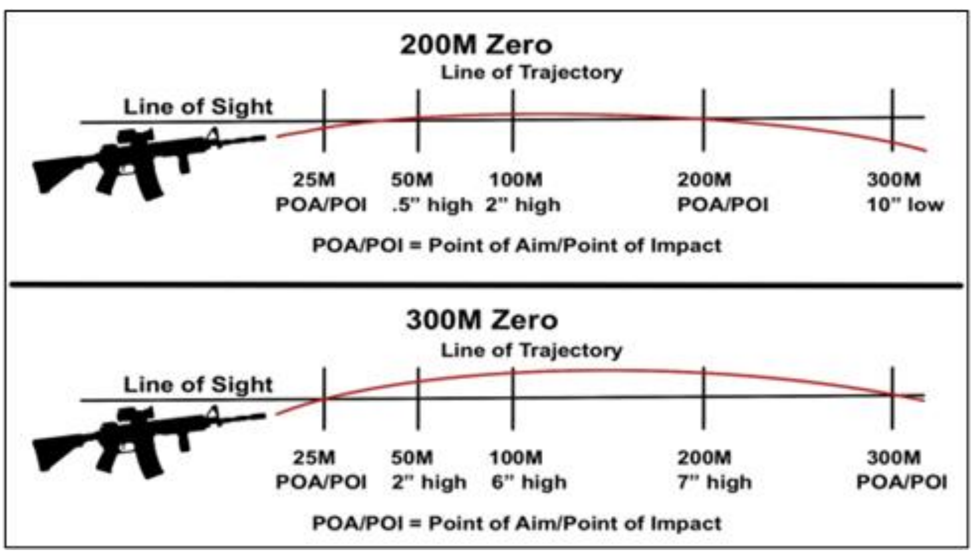
4.7.4.6. On M4 series weapons, the iron sights offset is approximately 2.5 inches above the bore line and with optics, the distance will vary according to the riser or scope rings/mount used. The Offset of a Glock 19 is 5/8 of an inch.

4.7.5. **Recommended Zero Distance.** Typical Zero distances are from 25 yards, 50 yards, and 100 yards. Using M855 Ball ammunition (62 grain) the following results will be obtained during zero.

4.7.5.1. 25/300 Yard Zero. For the M-4 series rifles, the recommended zero is performed at 25 yards. This zero also provides a 300 yard zero as well. The impact points of the bullet at 25 yards is the same at 300 yards, higher or lower in-between.

4.7.5.2. 50/200 yard Zero. Consider that the projectile will start out at 2.5 inches below the LOS. The bullet will continue to rise so that at 25 yards it will be 1.16 inches below the LOS, and at 50 yards it will cross the LOS. This is called the initial intersection. It will continue to rise for approximately 125-150 yards, at which it reaches its maximum height of about 2.0 inches above the LOS—the maximum ordinate. It will then drop down until it crosses the LOS again around 200-220 yards. See **Figure 4.5**.

Figure 4.5. Line of Trajectory 50/200yd/m and 25/300yd/m.



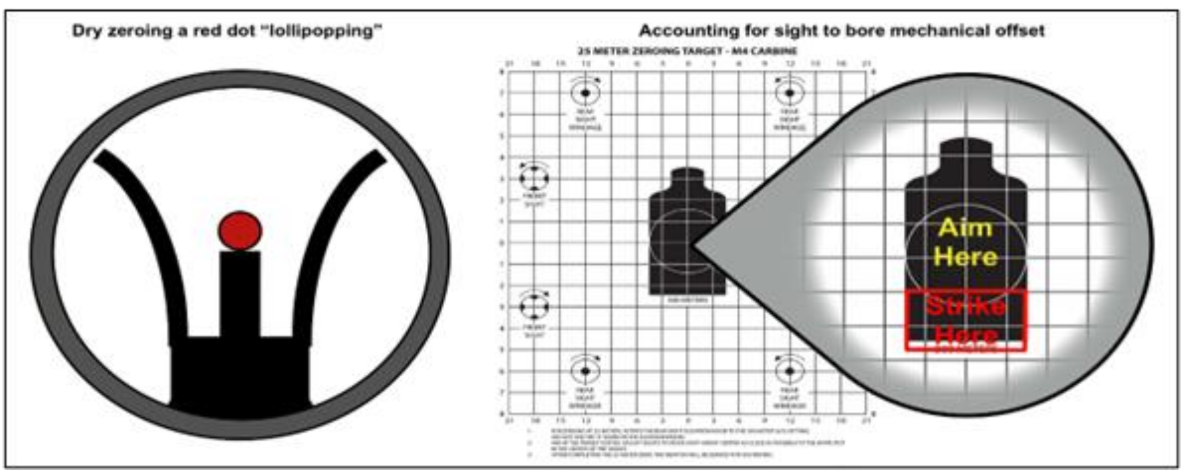
4.7.5.3. Units should standardize zero distances and targets used to coincide with a given weapons' optic or iron sight calibration, so each incremental sight adjustment made is true.

4.7.5.4. Conversion. One click = 1 centimeter at 25 meters for windage. Zeroing at 25 yards = 27.34 meters, one click now equates to 1.1cm. Yards=Meters/0.914 and Meters=Yards x 0.914.

4.7.6. **M68 CCO Zeroing Procedures.** M68 Dry (Non-firing) Zeroing Starting with a securely installed and live-fire zeroed BUIS. Mount the reflex sight to the front of the receiver rail. Raise the BUIS and align sights on target. While maintaining sight alignment, adjust windage and elevation on the CCO until the center of the aiming dot appears to rest on top of the front sight post "lollipopping" when viewed through the BUIS while assuming a normal firing position, see **Figure 4.6** Lower the BUIS and proceed to live-fire zero using the CCO. When complete the CCO will be co-witnessed with the BUIS. This procedure is commonly referred to as "lollipopping" as the red dot resembles a lollipop while it sits atop the front sight post.

4.7.6.1. 25/300-Meter Battlesight Zero Procedures. When zeroing the M68 CCO at 25 meters, a designated point of impact zone must be identified on the 25-meter zero target. Starting from center mass of the silhouette on the 25-meter zero target; count down 1½ squares or 1.5 centimeters. This is now the desired point of impact when zeroing the M68 CCO. The shooter will continue to aim center mass of the black silhouette and will adjust the M68 so that the rounds impact in the secondary 4x4 centimeter box (illustrated in red) 1½ squares (1.5 centimeters) down from the point of aim, see **Figure 4.6**.

Figure 4.6. Dry Zeroing a Red Dot & Accounting for Mechanical Offset.



4.7.7. **Machine Guns.** Tactical teams use machine guns as both an offensive and defensive weapon. Machine guns are nearly as accurate as a standard rifle but provide a greater volume of fire. This section discusses general techniques and employment principles for using these weapons. See **Table 4.7** for classes of fire.

Table 4.7. Classes of Fire.

Classes of fire
1. Grazing Fire – Center of the cone of fire does not rise above 1m above the ground. 2. Plunging Fire – Danger space is practically confined to the beaten zone. 3. Fixed Fire – Firing at a stationary target where the beaten zone covers the target. 4. Traversing Fire – Firing distributed in width by successive changes in direction. 5. Searching Fire – Firing distributed in depth by successive changes in elevation. 6. Traverse & Search – The amount of adjustment is determined by slope of terrain or angle of target. 7. Swinging Traverse – Fire delivered against rapid moving or wide targets. 8. Free Gun – Fire delivered against massive targets.
Classes of fire with respect to the target
1. Frontal Firing – Firing directly into the front of the target, the long axis of the beaten zone is at a right angle to the front of the target. 2. Flanking Fire – Firing directly against flank or the right angle of the target. 3. Oblique Fire – Firing at an angle other than a right angle to target. 4. Enfilade Fire – The long axis of the beaten zone coincides with long axis of the target.

4.7.8. Distribution, Concentration, and Rate of Fire. The size and nature of the target determine how the gunner applies fire. The gunner must manipulate the machine gun to move the beaten zone throughout the target area. The gunner must control the rate of fire to adequately cover the target, but at the same time to conserve ammunition and preserve the barrel. Understanding the formation or shape of your target will help determine the type of accurate fire to engage with. The Classes of fire are broken into three categories.

4.7.8.1. Distribution of Fire. Distribute fire in width and depth on large targets such as enemy formations.

4.7.8.2. Concentration of Fire. Concentrate fire on point targets such as automatic weapons or an enemy fighting position.

4.7.8.3. Rate of Fire. Use sustained, rapid, and cyclic rates of fire with the machine gun. These rates enable leaders to control and sustain fire and to avoid destroying the weapons barrel as well as conserving the limited supply of ammo you have. The threat of the target and ammunition supply dictates rate of fire, see **Table 4.6**.

Table 4.8. Rates of Fire.

Sustained Rate of Fire		
Application	This is the gunner's normal rate of fire.	
Rate	• M249	50 rounds per minute, in 3 to 5 round bursts.
	• M240B	100 rounds per minute, in 6- to 9-round bursts.
Maintenance	Gunner pauses for 4- to 5-seconds between bursts.	
Barrel	M249AR Gunner changes barrel after firing 200 rounds. M240B Gunner changes barrel every 10 minutes.	
Rapid Rate of Fire		
Application	This rate of fire works best when the gunner is trying to establish fire superiority.	
Rate	• M249	100 rounds per minute, in 6- to 8-round bursts.
	• M240B	200 rounds per minute in 10- to 12-round bursts.
Maintenance	Pause for 2 to 3 seconds between bursts.	
Barrel	M249AR Change after firing 200 rounds. M240B Barrel change every 2 minutes.	
Advantage	Exceptionally high volume of fire.	
Disadvantage	Feasible only for short periods of time. Requires frequent barrel changes.	
Cyclic Rate of Fire		
Application	This rate of fire should only be used in emergencies.	
Method	Hold trigger to the rear, rounds per minute are based on an endless belt of ammo.	
Normal Rate	• M249	850 rounds per minute.
	• M240B	650 to 950 rounds per minute. 300 rpm disparity is based on the gas regulator settings.
Advantage	Places the most possible rounds on the enemy in one minute.	
Disadvantage	Damaging to barrel and inability to control accurate fire placement.	
Barrel	M249AR/M240B Change after firing 1 minute at cyclic rate.	

Chapter 5

SMALL UNIT TACTICS

5.1. General. This chapter provides a baseline for Guardian Angel ground operations.

5.2. Formations. Combat formations are composed of two variables: lateral frontage, represented by the line formation; and depth, represented by the column formation.

5.2.1. **Terrain and Formations.** Formation of movement is generally dictated by terrain (OCOKA). Leaders combine the elements of lateral frontage and depth to determine the best formation for their situation based on METT-TC. The File, Column, Vee, Wedge, Diamond, Line, and Echelon formations combine these elements in varying degrees, see **Figures 5.1** through **Figure 5.7** Leaders position themselves in the formation where they can best maintain control and situational awareness. Leaders will designate an element as the base element and the others as maneuver elements when in recovery team size formations. Pictures below are depicted using an 8 man team.

Figure 5.1. Wedge Formations.

Wedge Formation: The interval between members in the Wedge formation is normally 10 meters. The Wedge expands and contracts depending on the TLs ability to communicate and coordinate. Recovery elements modify the Wedge when environmental factors make control of the Wedge difficult. The normal interval is reduced so that all team members can have line of sight to their leadership. The sides of the Wedge can contract to the point where the Wedge resembles a single file. Operators expand or resume their original spacing when moving in less rugged terrain where control is easier.

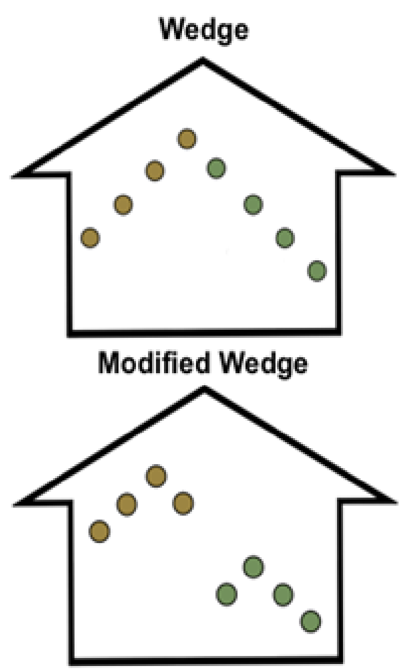


Figure 5.2. File Formation.

File Formation: Elements use the File formation when terrain makes the Wedge formation impractical. The File is also used when a high suspicion of IEDs exists.

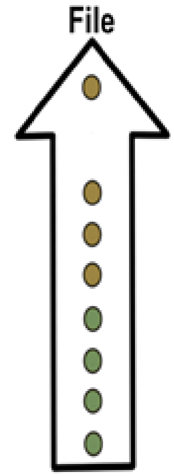


Figure 5.3. Column and Staggered Column Formations.

Column Formation: The column provides good dispersion and facilitates maneuver. The recovery team can quickly form up in Staggered Column or in Column Wedge (not shown).

Staggered Column: Spacing between team members is approximately 5 meters. Two lines are formed with team members staggered on left and right, creating 10 meters of distance between members on one side of the formation. For an area with open terrain on either side, sectors of fire face outboard. For an area of travel within an urban environment, sectors of fire may face inboard and up in order to cover high points on structures on the opposite side of the formation.

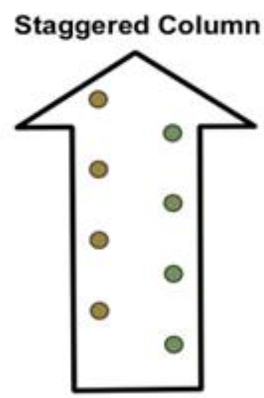


Figure 5.4. Line Formation.

Line Formation: The line provides maximum firepower to the front. This formation can be used to search the objective area for survivors and/or sensitive items.

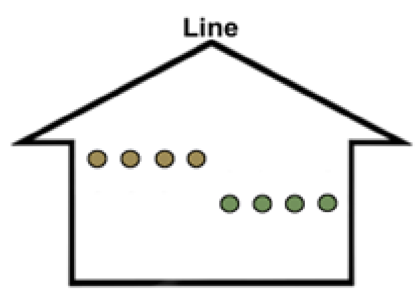


Figure 5.5. Vee Formation.

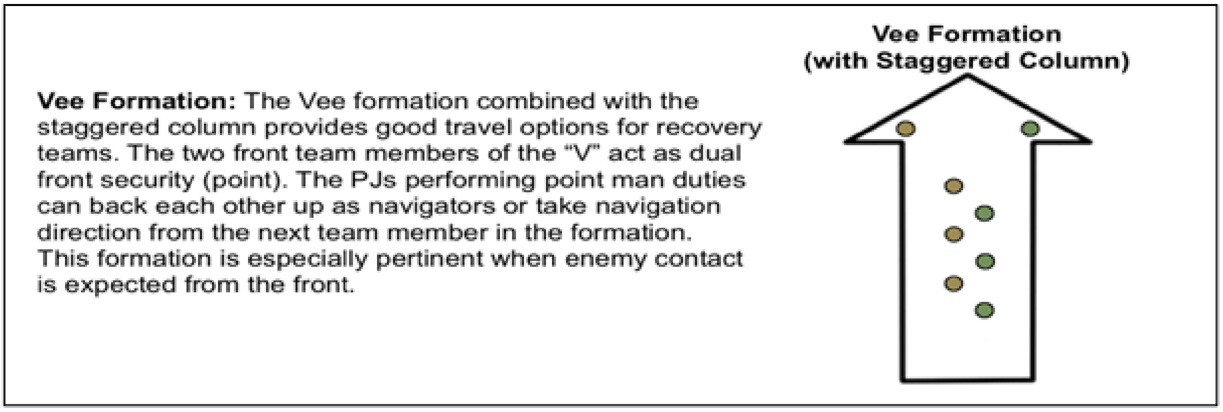


Figure 5.6. Echelon Formation.

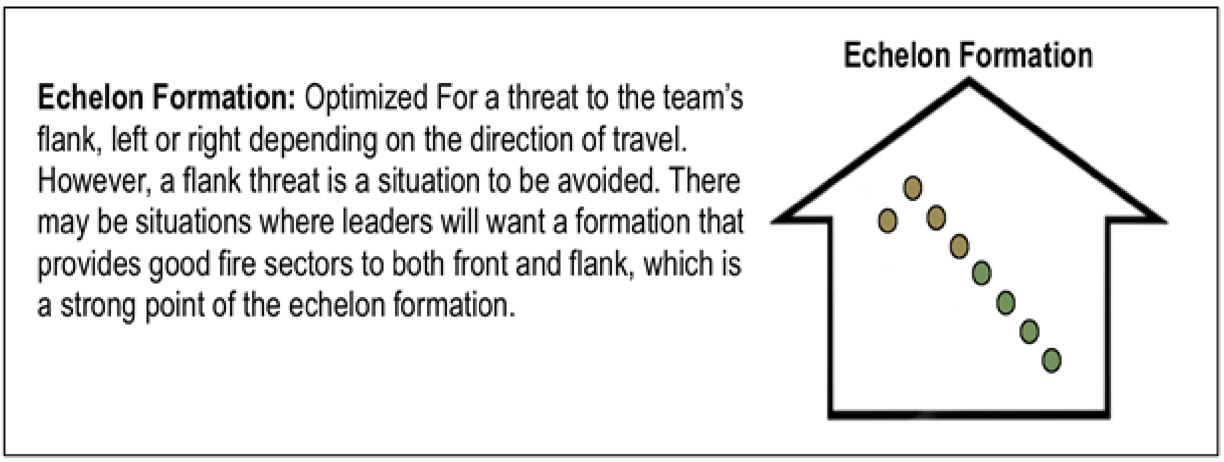
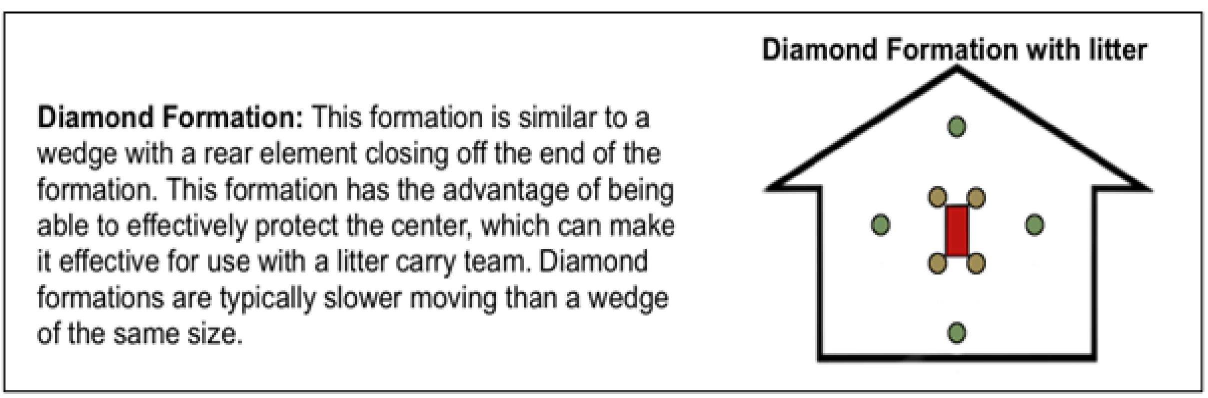


Figure 5.7. Diamond Formation.



5.3. Litter Carry Techniques.

5.3.1. **Four-man Litter Carry.** Is used to move with a non-ambulatory patient or transport heavy equipment. It is manpower and labor intensive. See **Figure 5.7**.

5.3.2. **Litter Calls.** The operator to the right of the patient's head makes all the calls (e.g., stop, up, down, move out, etc.) The primary medic should take this position when feasible. **NOTE:** When hoist equipped aircraft are available for exfil, overland movements should be accomplished with a hoistable litter, such as a SKEDCO.

5.3.3. **Two-Man Litter Drag.** If the team is carrying a litter (SKED, Foxtrot, or similar type) that is designed to be dragged, utilize the two-man Litter Drag technique.

5.3.4. **Movement Considerations.** Consider all movements to be tactical movements. Consider the use of difficult terrain in route planning. In mountainous terrain, plan to use the military crest of ridgelines for easy movement but avoid sky lining. Plan routes along easily recognizable key terrain features rather than along direct headings. When navigating to linear terrain features (e.g., rivers and mountain ranges), use a deliberate offset either to the left or right of the objective. Each degree offset will move 17 meters left/right for every 1 kilometer. Keep the element informed of their position from one key point to another. At night, avoid contour navigation. See **Table 5.1** for movement tips.

5.3.4.1. Movement Discipline. Careless movement may result in enemy contact. The goal of sound movement techniques is for the element to contact the enemy on the element's terms rather than the enemy's terms, see **Table 5.1**.

Table 5.1. Movement Tips & Discipline.

Movement Tips
• Avoid likely ambush sites and other danger areas (channeled terrain is especially dangerous). • Enforce camouflage, noise, and light discipline. • Take maximum advantage of weather conditions (precipitation and storms) which can mask team noise and cover tracks. • Leaders should consider stopping the formation 5 to 15 minutes after commencing a movement for a Stop, Look, Listen, and Smell (SLLS) halt. The purpose of this is to acclimate the team to its surroundings for the subsequent movement and/or detect enemy activity.
Movement Discipline
• Don’t bunch up – maintain proper team dispersion. • Don’t cross open areas without overwatch or the threat of fire. • Attempt to contact the smallest enemy element possible.

5.3.5. **Speed.** Speed may be dependent on detection avoidance. The element's rate of speed is controlled by other factors such as METT-TC, weather, temperature, altitude, personnel load, and route knowledge/experience.

5.3.6. **Traveling on Trails.** Avoid movements on trails, except when speed is essential and when there is low expectation of enemy contact. Whenever possible, hide signs of movement to prevent leaving a trail; this is important when crossing danger areas such as trails or beaches. Remember that standard issue boots leave a distinctive trail sign. Use operational deception (OPDEC) by avoiding use of the same trails or routes more than once.

5.3.7. **Security Halts.** Units conducting tactical movement frequently make temporary halts. For short halts, teams use a cigar-shaped perimeter intended to protect the force while maintaining the ability to continue movement. When the TL decides on prolonged tactical halt, he transitions the team to a perimeter defense. The perimeter defense is used for longer halts or lulls in combat.

5.3.7.1. Cigar-shaped Perimeter. When the unit halts, team members should move off the route and face out to cover the same sectors of fire they were assigned while moving, allowing passage through the center of the formation. This results in a cigar-shaped perimeter. Actions by subordinate leaders and their team members occur without an order from the leader. Team members are repositioned as necessary to take advantage of the best cover, concealment, and fields of fire.

5.3.7.2. Perimeter Defense. The team uses a perimeter defense during extended halts, resupply, issuing orders or lulls in combat. Teams in the perimeter defense involves more established security positions. The team members can run down their priorities of work while maintaining security during these extended halts.

5.3.7.3. Patrol Bases. Patrol bases are established during surface operations when the element intends to remain for up to 24 hours. Patrol bases are used for sleeping, messing, detailed planning, or reorganization. It is a place defendable for the time necessary to eliminate the threat, either by offensive measures or by breaking contact. It should have escape routes to a predesignated rally point. It should provide good concealment and allow the element early warning of approaching enemy personnel. There must be a thorough understanding of patrol base location, avenues of escape, rally points, critical times, and password authentication for identifying element members and immediate actions in the event of ambush or detection. All personal items and equipment should remain packed, unless actively being used. The patrol base site should be thoroughly sterilized prior to departure. For a comprehensive discussion of patrol bases, refer to ATP 3-21.8, *Infantry Rifle Platoon and Squad*.

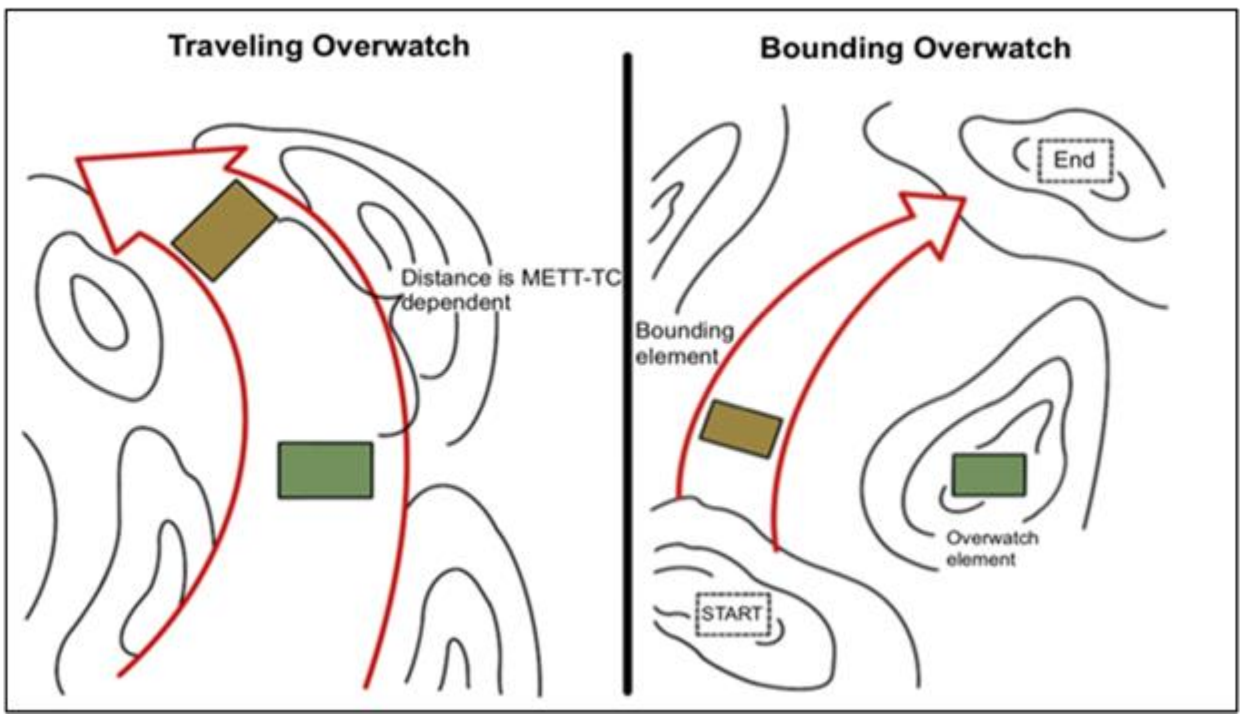
5.3.7.4. Defensive Firing Position. When contact with the enemy is imminent, there are two separate and distinct principles to consider: cover and concealment. Cover is physical protection from enemy fire. Concealment is protection from enemy detection. Cover and concealment are best provided by some type of fighting position. The type of position used is METT-TC dependent. For a comprehensive discussion of defensive firing positions, refer to ATP 3-21.8.

5.3.8. **Movement Techniques.** There are three movement techniques: traveling, traveling overwatch, and bounding overwatch. Factors to consider for each technique are control, dispersion, speed, and security. Movement techniques are neither fixed nor are they formations. Movement techniques are distinguished by a set of criteria such as distances between individual team members, elements, and recovery teams that vary based METT-TC. The selection of a movement technique is based on the likelihood of enemy contact and the need for speed. Leaders primarily control element movement with hand-and-arm signals, using voice and radio when required.

5.3.8.1. Traveling. Traveling is used when contact with the enemy is not likely and speed is needed. When using the traveling technique, all team elements move continuously. In continuous movement, all team members travel at a moderate rate of speed. During traveling, formations are essentially not altered except for effects of terrain. The increased speed and lessened dispersion of the formation results in the least amount of security of the movement techniques.

5.3.8.2. Traveling Overwatch. Traveling overwatch is an extended form of traveling in which the lead element moves continuously but trailing elements move at varying speeds, sometimes pausing to overwatch movement of the lead element. Traveling overwatch is used when enemy contact is possible but not expected. Caution is justified but speed is desirable. The trail element maintains dispersion based on its ability to provide immediate suppressive fires in support of the lead element. The intent is to maintain proper spacing, provide flexibility, and sustain movement in case the lead element is engaged. The trailing elements cue their movement to the terrain, over watching from a position where they can support the lead element. Trailing elements overwatch from positions and at distances that do not prevent them from firing or moving to support the lead element. The idea is to put enough distance between the lead and trail units so that if the lead unit comes into contact, the trail units will have the ability to maneuver on the enemy.

Figure 5.8. Traveling and Bounding Overwatch.

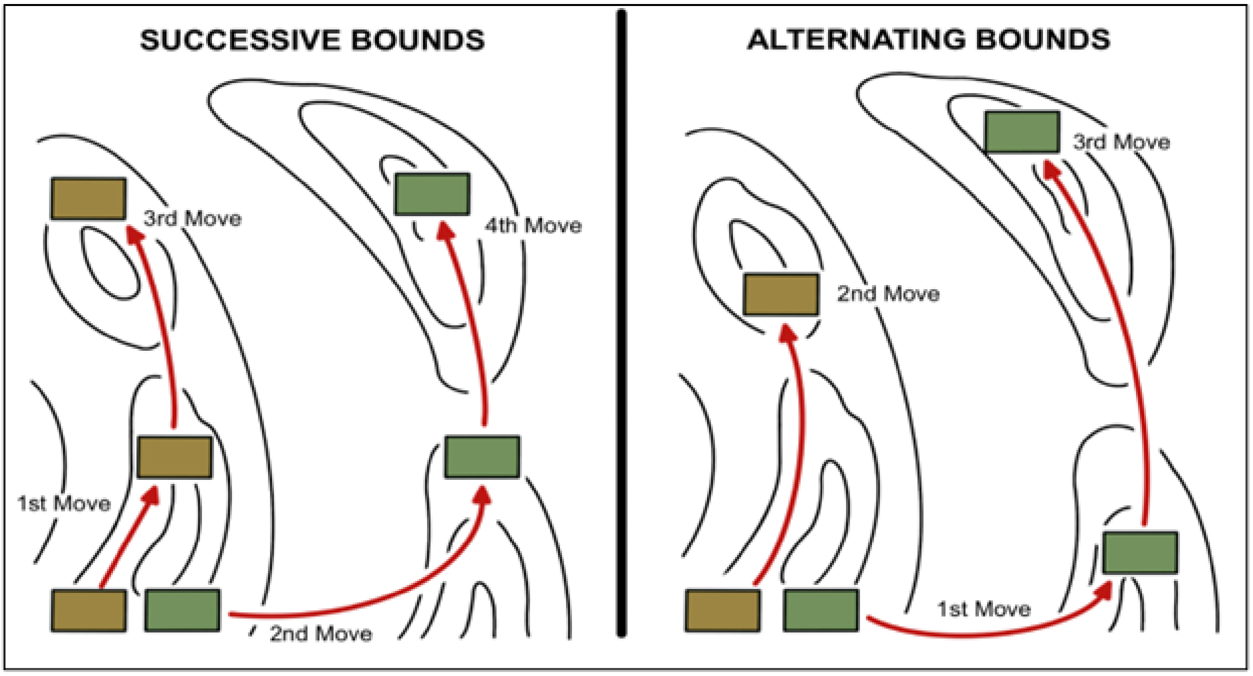


5.3.8.3. Bounding Overwatch. Bounding overwatch is similar to fire and movement in which one unit overwatches the movement of another. The difference is there is no actual enemy contact. Bounding overwatch is used when contact is expected, the leader feels the enemy is near or a large open danger area must be crossed. The base element overwatches the first. The key to this technique is the proper use of terrain. The formation is separated into two maneuver elements, Base and Maneuver, see **Figure 5.8**.

5.3.8.4. Successive Bounds. When one element moves to a position, and the overwatching element moves to a position generally online with the first element. See **Figure 5.9**.

5.3.8.5. Alternating bounds. When one element moves into a position, and then the overwatching element moves to a position in front of the first element. See **Figure 5.9**.

Figure 5.9. Successive and Alternate Bounds.



5.3.8.5.1. Base: Lead element halts in a position that offers observation of terrain in front of trail element and becomes the support element. The support element will attempt to occupy a position with cover, maximum fields of fire and concealment. The support element will cover the moving element with "effective fire" and be able to account for them at all times.

5.3.8.5.2. Maneuver: Once the support element is set, the maneuver element bounds forward, selecting their next position of cover in the general direction of movement and using terrain to their maximum advantage (drainages or defilade). The maneuver element must be aware of the other element location to not mask any supporting fire and communicate.

5.3.8.5.3. Once the maneuver element has successfully passed through terrain, they take up a position that offers best observation of terrain in front of them. This process is repeated until the element reaches its objective.

5.3.8.5.4. In the event of enemy contact: When under fire, the bounding overwatch must react quickly and violently. Team members receiving fire immediately return fire, seek cover, establish a support-by-fire position, and suppress the enemy position(s) through violent accuracy and fire superiority.

5.4. Battle Drills. Standard collective actions made in response to common battle occurrences. A drill is a collective action (or task) performed by the team without the application of a deliberate decision-making process. It is initiated on a cue, accomplished with minimal orders, and performed to standard throughout rescue squadrons (RQS), special tactics squadrons (STS) and sister service units. The following Battle Drills are some of the most common. See **Figures 5.10** through **Figure 5.15**.

Figure 5.10. React to Contact.

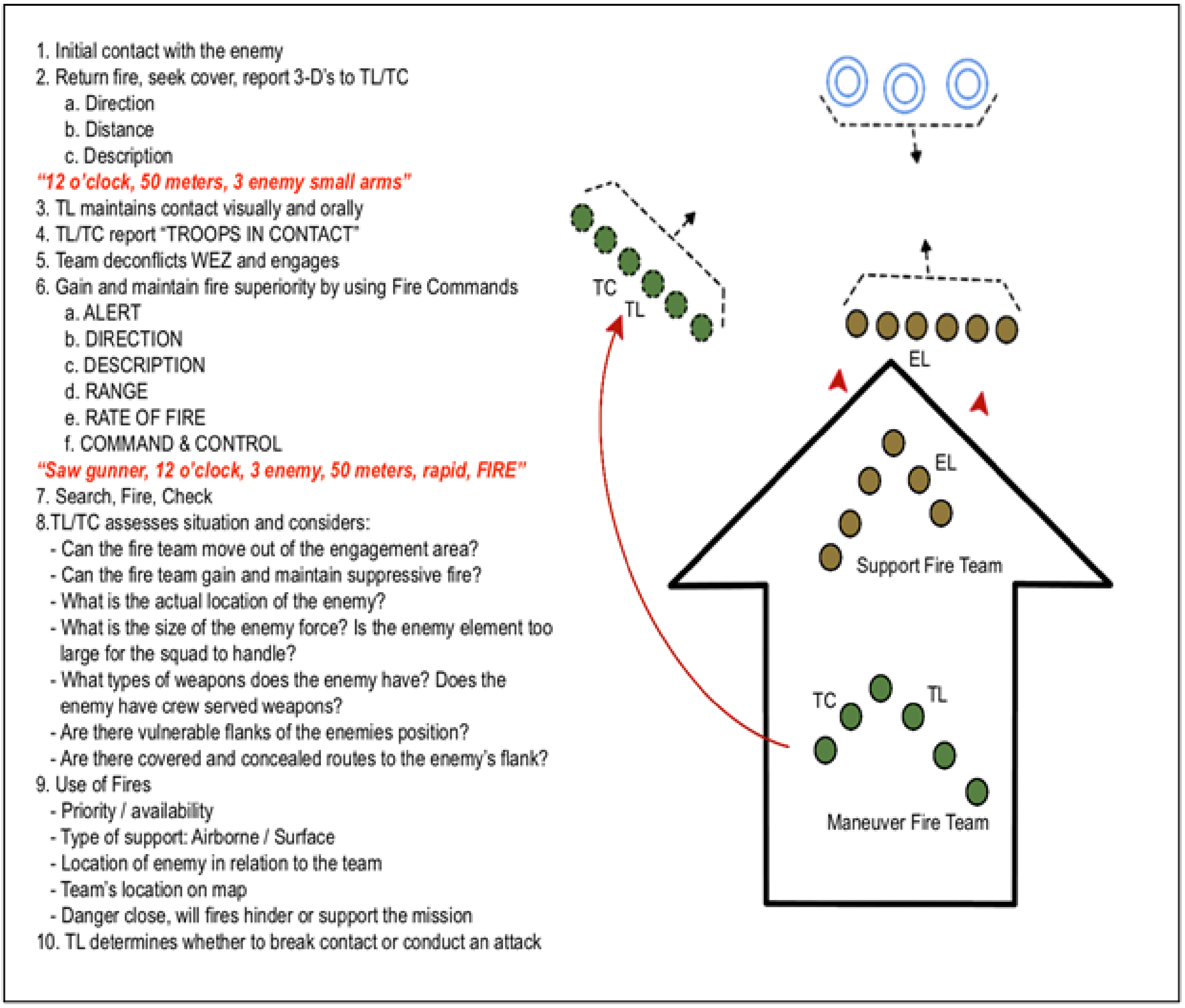


Figure 5.11. Team Attack.

1. Team reacted to contact, assessed the situation and considered the options outlined in RTC drill
2. TL/TC assess the enemy's vulnerabilities
3. TL/TC communicate intent
   - TL/TC ID support / maneuver elements
   - Confirm the signals for lift / shift fire
   - Direct heavy weapons employment
4. SITREP
5. Radio considerations
6. Team online, L/R limits, lane with identifiable features, avoid funneling
7. TC maintains optimal position during attack
8. TL/TC maintain battlefield SA
9. Shift / lift fire signals
10. Establish Limit of Advance (LOA)
11. Consolidate and Reorganize
    - 360 degree security, ACE, Key WPNS, ammo, SITREP
12. Special Team considerations
    - The size of the enemy element encountered
    - The overall size of the Objective area
    - How much time can team remain on the Objective before enemy reinforcements arrive
    - How many men can be pulled off the perimeter without letting security fail
13. Initial EPW search, Aid & Litter, EPW search, Demo
14. Withdrawal from OBJ / continuation of mission

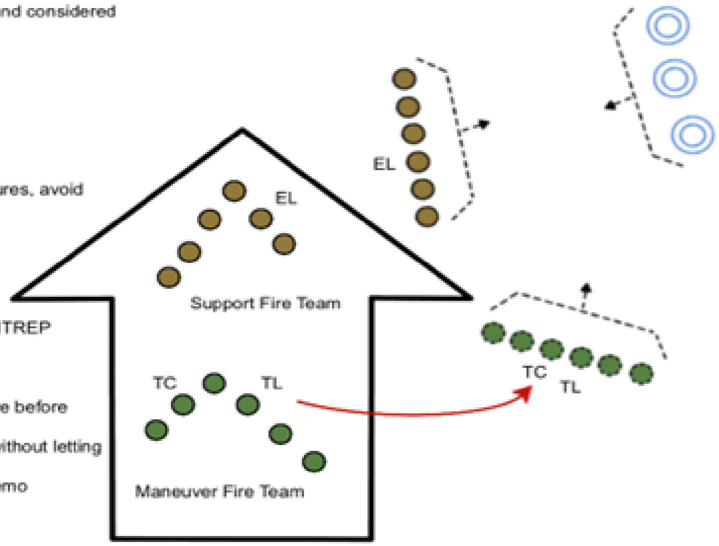


Figure 5.12. Break Contact.

1. Team reacted to contact, assessed the situation and considered the options outlined in RTC drill
2. Reasons why a squad may need to break contract include:
   - The Team is up against a sniper in an unknown location
   - The Team's mission calls for avoiding contact
   - The Team is outnumbered or in a vulnerable position
   - The enemy has overwhelming firepower, like a crew served weapon
3. Based on TL's assessment, TL communicates ***"Break contact"***
4. TL tells lead fire team (team in contact) -
   - That fire team is the initial base of fire
   - To gain fire superiority through volume of fire
   - TL considers placement of heavy weapons
5. TC tells TL -
   - That his team is the initial maneuver element
   - Direction, Distance, and Identifiable Feature to move to
   "6 o'clock, 100 meters, that big white oak tree/large boulder"
6. Secondary is positioned for effective use against enemy
7. Use smoke / hand grenades to disguise movement
8. Team online, L/R limits, lane with identifiable features, avoid funneling
9. Employ heavy weapons in the most advantageous position
10. Radio considerations
11. Continue to maneuver until -
    - No longer receiving effective fire from the enemy
    - Passes through a higher level of support-by-fire position
    - The Team reached it's assigned location for it's next mission
12. Team moves 300 meters or a major terrain feature away
13. Consolidate and Reorganize
    - 360 degree security, ACE, Key WPNS, Ammo, SITREP
14. Continue Mission (CM)

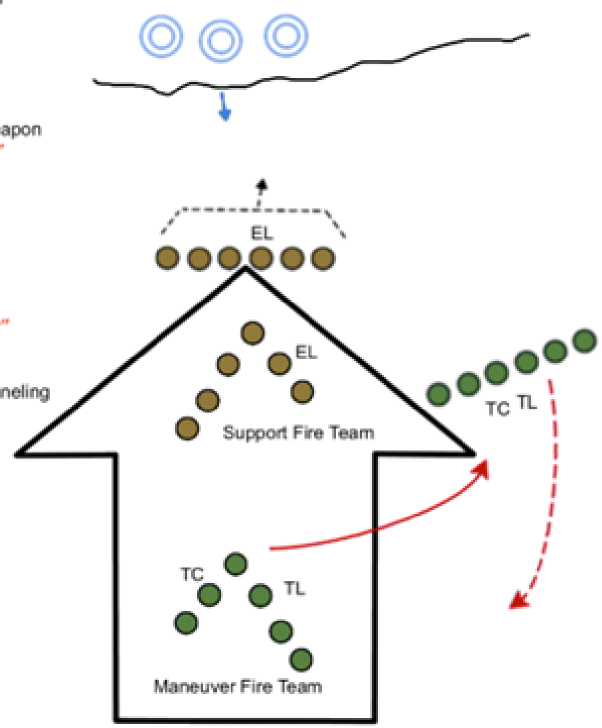
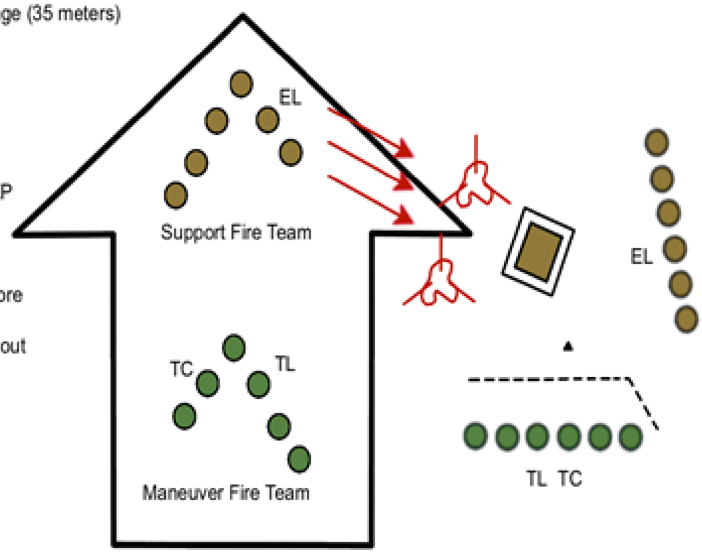


Figure 5.13. React to a Near/Far Ambush.

"An ambush is defined as a surprise attack by fire from a concealed position on a moving or temporarily halted target"

1. Plan to avoid possible ambush lines
2. Initial contact with the enemy, within hand grenade range (35 meters)
3. Immediately return fire and seek cover
4. Throw hand / smoke grenades, prevent fratricide
5. Continue to suppress / commence assault
6. Shift / lift fire signals
7. Establish Limit of Advance (LOA)
8. Consolidate and Reorganize
   - 360 degree security, ACE, Key WPNS, Ammo, SITREP
9. Special Team considerations
   - The size of the enemy element encountered
   - The overall size of the Objective area
   - How much time they can remain on the Objective before enemy reinforcements arrive
   - How many men can be pulled from the perimeter without letting security fail
10. Initial EPW search, Aid & Litter, EPW search, Demo
11. Withdrawal from Objective
12. Far ambush is contact from more than 35 meters
13. Continue Mission (CM)



EXECUTE TEAM ATTACK or BREAK CONTACT

Figure 5.14. React to Indirect Fire.

1. Team yells ***"INCOMING"*** when initial indirect fire is received.
2. Immediately get down and seek cover.
3. After rounds impact, TL/TC determines direction and distance for team to move.
4. TL/TC commands ***"Move 12 o'clock, 300 meters"***
5. Team echoes command and double times in that direction / distance
6. Get into buddy teams and assist all injured team members out of impact area.
7. TL maintains contact visually and orally
8. TL/TC determines direction and distance based on:
   - The direction of travel
   - The direction of incoming fire (if known)
   - Possible obstacles and terrain
   - The enemy's most probable course of action
9. Change direction due to possible forward observers
10. TL/TC maintain control and ensure use of proper movement techniques
11. Move a minimum of 300 meters
12. Establish security halt
13. Consolidate and reorganize
    - 360 degree security, ACE, Key WPNS, Ammo, SITREP
14. Continue Mission (CM)

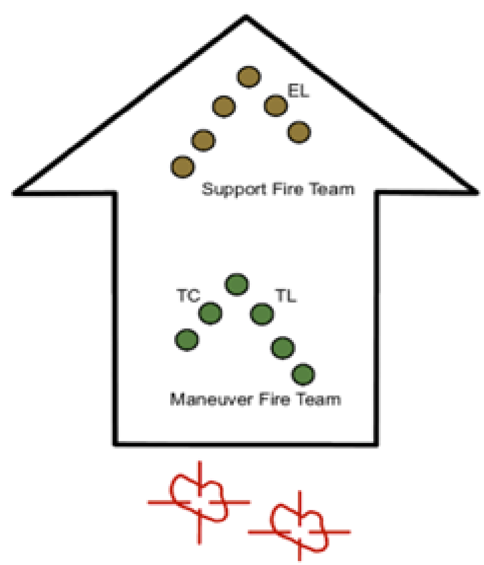
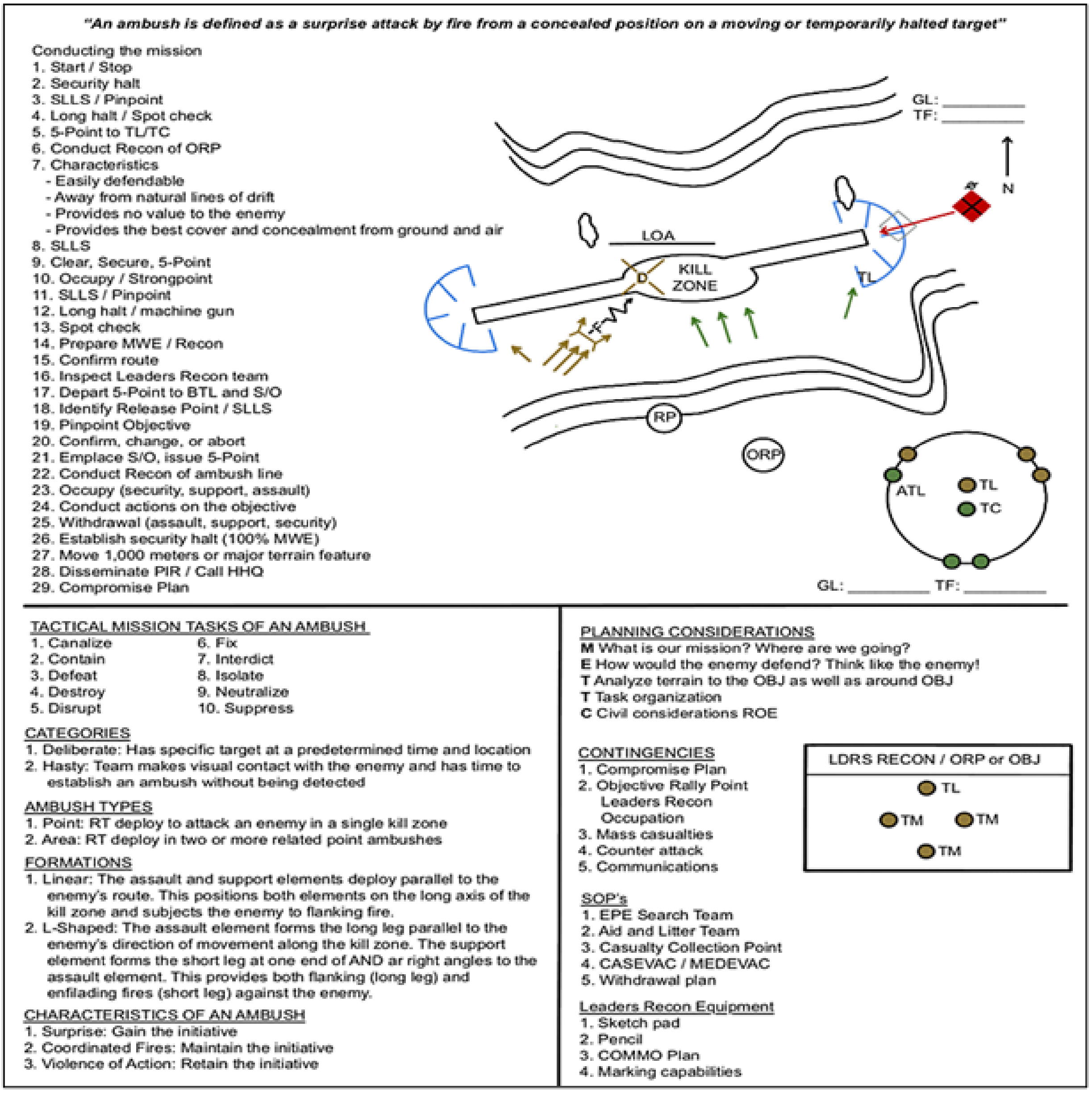


Figure 5.15. Recovery Team Offensive Ambush.



5.5. Team Casualty Procedures. Refer to TCCC guidelines and the Pararescue Medical Operations Handbook for appropriate medical treatment guidance. Use the following priorities to determine team/individual action when experiencing casualty under fire:

5.5.1. Assess the threat.

5.5.2. Engage and attempt to neutralize the threat.

5.5.3. Remove casualty from the danger area.

5.5.4. Treat life-threatening injuries.

5.5.5. Determine team's course of action.

5.6. Methods of Handling Deceased Personnel. During mission planning, leaders must consider the squad's actions should a teammate be killed in action. If the initial plan is to not to leave the deceased, the following procedures should be accomplished:

5.6.1. Bury remains at or near an easily identifiable site.

5.6.2. Wrap remains securely in a poncho, or other suitable covering

5.6.3. Bury remains deep enough (if burial is not possible, cover with large rocks/branches/logs and camouflage) to prevent exposure from erosion or animals.

5.6.4. Team leaders should make a mental note and mark the grave location on a map or GPS.

5.7. Sanitizing Deceased Personnel. The following items should be removed from the remains and retained by the team:

5.7.1. One dog tag

5.7.2. Identification card

5.7.3. Classified material(s)

5.7.4. Maps and compass

5.7.5. Communications equipment

5.7.6. Weapons and ammo (as needed)

5.7.7. Other equipment needed for mission accomplishment or survival.

5.7.8. All other equipment shall be buried with the remains.

5.7.9. Any weapons left behind will be rendered inoperative or destroyed.

5.8. Imminent Capture Actions. If capture is imminent, zeroizing radios and destroying weapons and munitions are priority. If weapon parts are removed and destroyed, ensure the same or like items of each system is destroyed. Use of M14 incendiary grenades may not be effective in the destruction of equipment. The use of accelerants, such as fuel and explosives, should be used to increase the effectiveness of the M14 grenade. Items, such as wallets, letters, and personal papers might reveal information if lost or captured and should not be carried. These general considerations may be different in each area of operations (AO), see detailed guidance from Intel and SERE for the specific AO.

5.9. Tactical Communication. The following paragraphs list forms of tactical communication teams may use while patrolling.

5.9.1. Whispering. Whispering carries farther than speaking in a low, normal voice and should be avoided while patrolling.

5.9.2. Hand-and-Arm Signals. Hand-and-arm signals are used to communicate quickly and clearly within a team without using voice commands.

5.9.3. Signals and Voice Commands. All signals and voice commands must be passed completely throughout the team and understood by all members. Ensure the entire signal has been received and return it to the sender to ensure understanding-do not steal a signal-use time afforded by not being compromised, see **Table 5.2**.

Table 5.2. Signals and Voice Commands.

Voice Command	Signal
ADVANCE/HALT	Open hand waves forward/open hand held up
FREEZE	Clenched fist
RALLYUP	Circular movement above the head with finger and arm
RALLYPOINT	Rally signal, followed by pointing to designated of point
ENEMY	“Gun” index/thumb extended, thumb down-point toward threat
HASTY	Pump arm as you back away in the intended direction of fire
TURN AHEAD	Point in direction of the turn making curving motion
BREAK TIME	Simulate breaking a stick followed by the number of minutes
DANGER AREA	Non-Firing hand slashing motion across the chest
HEAD COUNT	Pat top of head
I’M COVERING THIS SECTOR/SIDE	Point weapon in the direction you are covering while tapping the top of weapon. This is also the direction you will take 1 to 2 steps to open up the staggered column to perform a center peel
I SEE	Point at the eyes; then point in direction of object
SPEED UP	Pump arm up and down above head
SLOW DOWN	Pushing down with hand and arm
GET OFF TRAIL	Sweeping motion of arm, palm facing outward
GET DOWN	Palm down, sweep arm down
GET UP	Palm up, sweep arm up
SEND UP PACE COUNT	Pat side of foot

OPEN/CLOSE	Open or close arms
BOOBY TRAP	Cup hand, fingers up
MAN-MADE	Cup hand, fingers down (such as, house, hut, bunker)
FLANK R/L	Start with arm extended 45 degrees; slap thigh and then chop in the direction the flank should come from
CENTER PEEL	Elbow bent; fist clenched just below the eyes
PEEL RIGHT/LEFT	Start with hand at shoulder level at opposite direction you intend to peel, then move your hand down and to the direction you want
BREAK RIGHT/LEFT	Fists together then conduct a fist breaking motion followed by a chopping motion in the direction you want whole group to rush
SET SECURITY	Vertical edge of handheld to face, followed by point in the direction to set security
Movement Formation	
File	Weapon held vertical
Column	Hold both arms up overhead
Staggered Column	Weapon held over head, parallel to ground
Wedge	Form inverted "V" with both arms. If this is the only signal provided, Alpha and Bravo will move out in two traveling
Traveling Overwatch	Give wedge signal followed by arm extended to side of body elbow locked and move it up and down
Bounding Overwatch	Give wedge signal followed by tapping the top of your head then locking your elbow/arm out to the side; repeat two to three times
V Formation	Form "V" overhead with both arms
Line or On Line	Face extended direction to get online, sweep weapon horizontally right/left or in the case you're passing the hand and arm signal through the formation, extend your weak arm and sweep right/left like the weapon
Echelon Right/Left	Raise one arm up in a 45-degree angle and the opposite arm down in a 45-degree angle
Diamond	90-degree bend in elbow, hands come together overhead

5.10. Noise Discipline. Noise discipline is essential at all times. Strict noise discipline is necessary when there is little vegetation present to absorb sound. Ensure all equipment is noise-proofed by padding and taping. Know the location of members in both leading and following within the element(s). Take advantage of background noises. Weapons banging against equipment make the most common form of noise infractions. Use friction tape to secure rifle swivels, sling points, and other items that may rattle. Perform the bounce test with all equipment to detect noise. If there is a need to cough, open mouth and cough into hat or press into the hollow point of the throat with the fingers.

5.11. Light Discipline. Exercise firm light discipline. Use a poncho/Gortex to shield flashlights when a map study is required. Light discipline includes shadow discipline. Everyone should be aware of their shadows. Observation from overhead can easily detect shadows, which may not be visible from an observer on the ground. Flashlights should have red lens. If use of white light is necessary, use a poncho/Gortex as cover and use only one eye.

5.12. Night Operations. The ability to fight at night is an essential skill, and it is a combat multiplier. Ground forces use night skills to gain a tactical and psychological advantage. The absence of night vision devices (NVD) do not prevent commanders from planning and executing night operations. For GA, the ability to operate effectively at night with NVDs is a mission enhancement and mitigates additional risk inherent of night engagements. The following is an overview of night fighting techniques:

5.12.1. **Night Movement.** Operators maximize their ability to successfully operate at night with NVDs. Moving on trails and roads at night may provide better navigation; however, this may increase the chance of contact with the enemy. Visibility at night in open or lightly forested areas is normally sufficient to see other element members because of celestial illumination. When moving at night in reduced visibility, maintain visual contact between element members; hands-on contact if visual contact is not possible.

5.12.2. **Night Vision vs. Day Vision** . At night, the eye cannot differentiate color and is easily blinded when exposed to light. Light exposure creates a central blind spot which causes larger objects to be missed as distances increase.

5.12.3. **Protecting Night Vision.** Exposure to light directly affects night vision. Exposure to intense sunlight for 2 to 5 hours causes a definite decrease in visual sensitivity, which can persist for as long as 5 hours. This effect can be intensified by reflective surfaces such as sand and snow. At the same time, the rate of dark adaptation and the degree of night vision capability will be decreased. Since these effects are cumulative and may persist for several days, military neutral density (N-15) sunglasses or equivalent filter lenses should be used in bright sunlight when night operations are anticipated.

5.12.4. **Night Vision Scanning.** Dark adaptation or night vision is only the first step toward maximizing the ability to see at night. Night vision scanning enables operators to overcome many of the physiological limitations of their eyes and reduce the visual illusions that so often confuse them. The technique involves scanning from right to left or from left to right using a slow, regular scanning movement. Although both day and night searches use scanning movements, at night an operator must avoid looking directly at a faintly visible object when trying to confirm its presence.

5.12.5. **Off-Center Vision.** Viewing an object using central vision during daylight poses no limitation, but this technique is ineffective at night. This is due to the night-blind spot that exists during low illumination. To compensate for this limitation, use off-center vision. This technique requires looking 10 degrees above, below, or to either side of an object rather than directly at it. This allows the peripheral vision to remain in contact with an object.

5.12.6. **Dark Adaptation.** Dark adaptation is the process by which the eyes increase their sensitivity to low levels of light. Adaptation to the darkness occurs at varying degrees and rates. During the first 30 minutes in a dark environment, the eye sensitivity increases roughly 10,000 times but not much farther after that time.

5.12.7. **Exposure to Bright Lights.** Dark adaptation is affected by exposure to bright lights such as matches, flashlights, flares, and vehicle headlights. Full recovery from this exposure may take up to 45-minutes. Night vision goggles impede dark adaptation. If a team member adapts to the dark before donning the goggles, the team member gains full dark adaptation in about 2-minutes after removing them.

5.12.8. **Bleach-Out Effect.** Even when off-center viewing is practiced, the image of an object viewed longer than 2 to 3 seconds tends to bleach out and become one solid tone. As a result, the object is no longer visible and can produce a potentially unsafe operating condition. To overcome this condition, one must be aware of this phenomenon and avoid looking at an object longer than 2 to 3 seconds. By shifting one's eyes from one off-center point to another, one can continue to pick up the object in the peripheral field of vision.

5.12.9. **Shape or Silhouette.** Objects must be identified by their shape or silhouette. Familiarity with the architectural design of structures common to the area of operations determines one's success using this technique. E.g., the silhouette of a building with a high roof and a steeple can be recognized in the US as a church, even though churches in other parts of the world may have entirely different architecture.

5.13. Danger Areas. A danger area is any place on a route where the leaders indicates the team may be exposed to enemy observation or fire. Examples of danger areas are open areas, roads, trails, and obstacles such as minefields, streams, and wire obstacles. Avoid danger areas whenever possible. If they must be passed or crossed, use great caution. Long, narrow danger areas, such as roads, fences, streams and arroyos are often referred to as linear danger areas (LDA). See **Figure 5.16** and **Figure 5.17**. Danger Area Considerations: **NOTE:** Desired goal is to fluidly move away from LDA as quickly as possible. If far side of an LDA is a concern, execute a leader's recon of the area. If enemy contact is likely or if the team is attempting a dangerous crossing and separation is likely, the TL will brief a five-point contingency plan.

5.13.1. Avoid danger areas whenever possible.

5.13.2. Assessing the number/type of known danger areas is critical during route selection and mission planning.

5.13.3. Danger area actions should be planned the same as actions on the objective.

5.13.4. Training and rehearsals are critical for success.

5.13.5. If in doubt, perform a leader's recon prior to committing to a danger area.

5.13.6. Like movement techniques, LDA crossings have various types of security/speed considerations.

Figure 5.16. Large Open Danger Area.

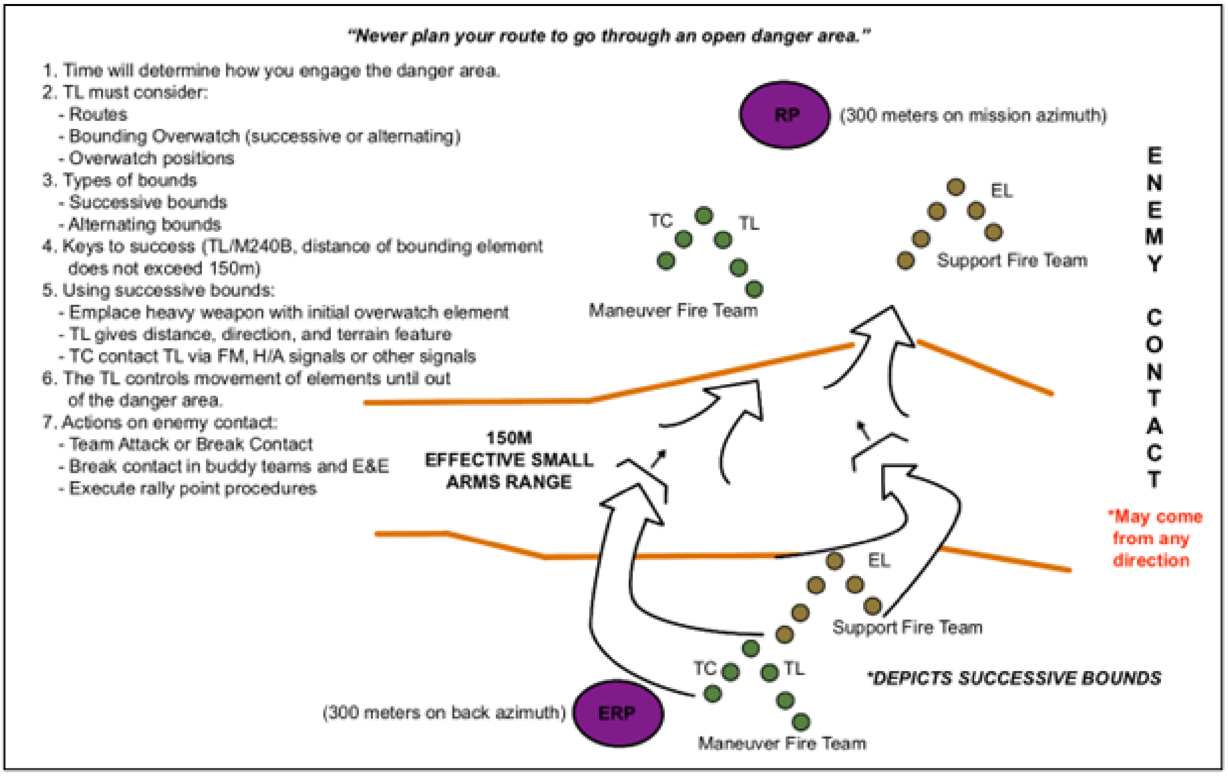
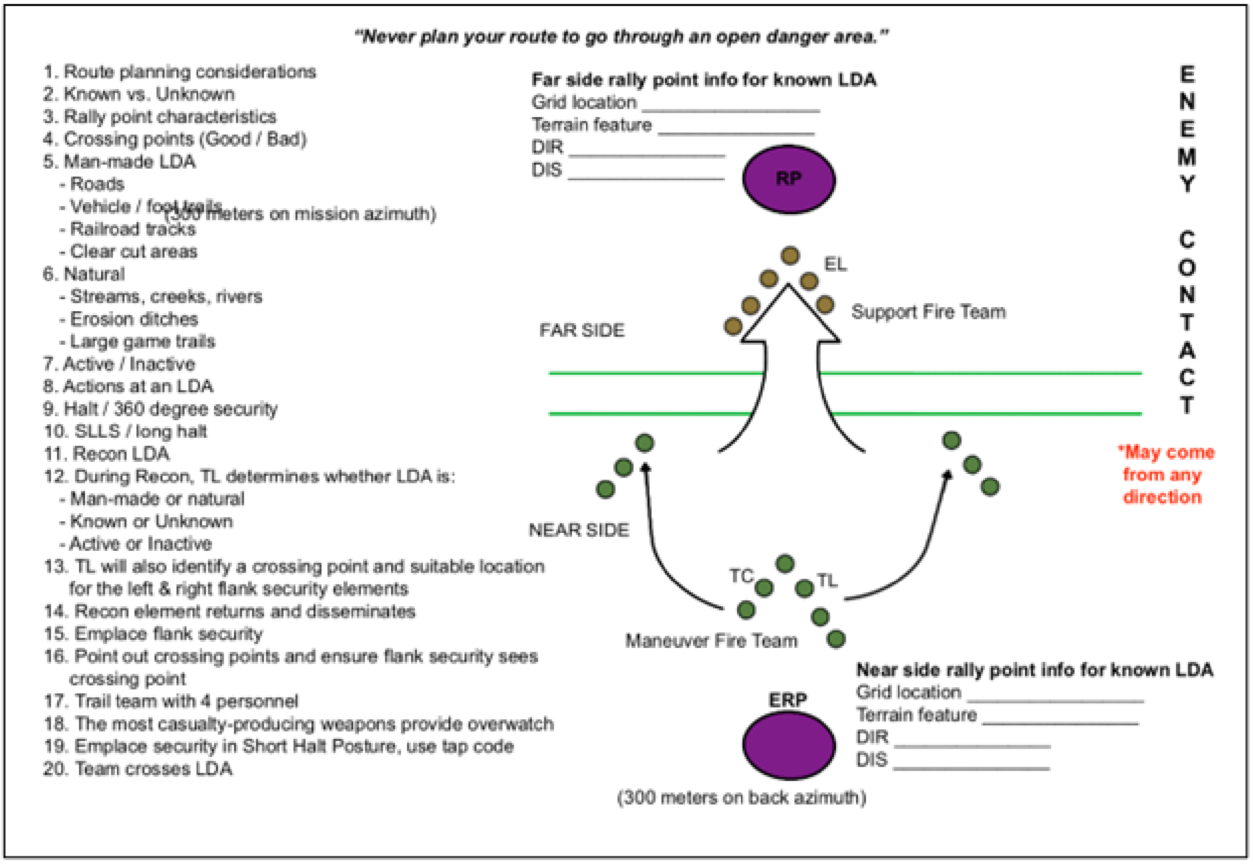


Figure 5.17. Linear Danger Area.



5.14. Rally Points. Rally points (RP) are a control and security measure. RPs are places where teams can reassemble, reorganize, and prepare, prior to actions at the objective. The TL should select RPs both in planning and during team movement. RPs consist of initial, en route, objective, and extraction rally points.

5.14.1. Initial Rally Point (IRP). Is used immediately after insertion to ensure the element is prepared for surface operations. It should be an easily recognized point or terrain feature within 100 meters of the insertion point. The team should maintain initial communication with the insertion platform should a need for an immediate extraction arise.

5.14.2. En route Rally Point (ERP). Is where an element rallies if dispersed or separated en route to or from its objective. If separated or dispersed before an ERP is established, team members go back to the IRP to regroup and re-organize. If the team must return to the IRP, be aware of personnel who may have been drawn to the sites/sounds of the insertion vehicle.

5.14.3. Objective Rally Point (ORP). Is where the team halts to prepare for actions at the objective, and where the team will return after its action at the objective are completed (as required).

5.14.4. Extraction Rally Point (XRP). Is used as the final staging point for re-grouping and re-organizing the team in preparation for extraction.

5.15. Safe Passage. If mission objectives require departing or re-entering friendly lines on the surface, leadership should coordinate directly with the stationary unit through which the element requires to pass. For a comprehensive discussion of safe passage, refer to ATP 3-21.8.

5.16. Shelters. Shelters should protect the team from the environment, be tactically concealed, and meet mission needs. For further information on shelters, refer to AFTTP(I) 3-2.26, *Multi-Service Procedures for Survival Evasion and Recovery*.

5.17. Resupply. Resupply may be necessary during extended operations. The responsibility for resupply planning and coordination lies with the Ground Force Commander (GFC) and Team Leader (TL) and should be incorporated during the mission planning phase. Some resupply methods for consideration are as follows.

5.17.1. Aerial Resupply. Occurs via various methods of airdrop.

5.17.2. On-Call Resupply. Planned before the insertion of a tactical team into the operations area but not executed until requested by the team.

5.17.3. Automatic Resupply. Planned before insertion of a tactical team into the operations area and occurs at a prearranged time and location, unless changed by the tactical team after insertion.

5.17.4. Emergency Resupply. Occurs based on a predetermined set of circumstances and time interval if radio contact is not established or, once established, is lost between a tactical team and its base.

5.17.5. Cache for Resupply. A relatively secure and defendable location, manned or unmanned (stored and hidden), where supplies are "cached" for use by a tactical team should the need arise.

Chapter 6

MOUNTED OPERATIONS

6.1. Mounted Movement. Mounted surface movement provides a relatively rapid and secure operational capability within the area of operations. Typical Operator surface movement within the area of operations can be expanded with the mobility of mounted teams. Mission planners should consider the advantages and disadvantages of conducting tactical vehicle operations.

Table 6.1. Mounted Movement Advantages & Disadvantages.

- Advantages
    - Mobility. Mounted elements can cover long distances rapidly.
    - Endurance. Mounted elements can remain in the field for extended periods without the need of being re-supplied.
    - Transportation. Mounted elements can ferry specialized equipment and personnel to and from AOs.
    - Firepower. Mounted elements can bring additional firepower to bear on threats that cannot be avoided.
- Disadvantages
    - Vehicle Maintenance. Personnel need to be skilled in maintenance and repair, including depot-level maintenance procedures. Additional tools and parts to sustain extended operations are required.
    - Training. Personnel will require additional training including mounted tactics, driving and navigational techniques, maintenance and repair, and vehicle camouflage.
    - Security. The amount of security offered declines with the size of the element. The number of vehicles involved in the mission, the tracks they leave, and noise and light discipline will increase the probability of detection.

6.2. Gun Trucks. Minimum Requirements and fields of fire:

6.2.1. **Priority of Employment.** The priority for employment of gun trucks is the rear (trail), front, then in the body of the column (center). The rear is the weakest point in a convoy, with most trucks having a large blind spot in this direction. Always keep a gun truck in the trail of the convoy.

6.2.1.1. **Gun Truck 1:** (Front) covers front and flanks at 270 degrees; scouts for IEDs; scans overpasses; anticipates and locates probable ambush sites.

6.2.1.2. **Gun Truck 2:** (Center) covers flanks. May act as roving security, constantly changing position in the convoy; acts as quick reaction force (QRF). There may be several gun trucks in the center position, depending on the size of the convoy.

6.2.1.3. **Gun Truck 3:** (Rear) covers rear and flanks at 270 degrees; may act as QRF.

6.3. Convoy Operations Principles. The principles of mounted movement for tactical convoys include:

6.3.1. **360-degree Security.** Combine maximum all-around visibility, for situational awareness, with interlocking sectors of fire and mutual support. Situational awareness should focus on approaching vehicles, potential IEDs and mines, suspicious wires and antennas, channeling terrain, and suspicious individuals or groups. Convoy personnel should be aware of what is above and below their position. An air guard will be assigned to observe for enemy fixed wing, rotary wing, and UAS systems and alert the convoy.

6.3.2. **Deterrence.** Present an intimidating, aggressive, and professional posture that demonstrates readiness and willingness to engage the enemy. An aggressive posture often deters the enemy from approaching or engaging the convoy. Passive air defense measures will be planned to ensure force protection while en route and at halts,

6.3.3. **Agility.** Adapt to conditions set by METT-TC analysis.

6.3.4. **Unpredictability.** Minimize the enemy's ability to predict time, route, composition, and purpose of the convoy.

6.4. Observation and Fire Techniques.

6.4.1. The sector of observation is comprised of the entire area visible to the crew member. Not all observable areas can be affected by direct fire. Observers should continuously scan in depth and width without focusing excessively on any object, activity, or person. If there is an enemy air threat, gunners perform additional duty as air guards throughout the convoy.

6.4.2. Sector of fire is the area that can be covered with direct fire by a specific individual or a crew-served weapon. Sectors of fire should interlock to ensure complete coverage. Sectors of fire from a vehicle depend on its armor and overall configuration. In an armored vehicle, it may be impossible to fire from any position except the gunner's turret. The gunner should be prepared and equipped to cover blind spots around the vehicle. Sectors of fire should be established in unit convoy SOPs. Drivers normally are not able to engage their weapon while operating the vehicle but should be assigned a sector of fire when not driving (i.e., halted or dismounted).

6.5. Site Security at Halts. See **Table 6.2**.

Table 6.2. Site Security at Halts.

- Stop the column at the prescribed time and location for scheduled halts.
- Do not establish a pattern, either in terms of time of the halt, time at the halt, or location of the halt.
- Post a traffic control point to stop or detour civilian traffic around the convoy.
- Report the halt to higher headquarters.
- Assume a defensive formation at the halt.
- Gunners stay mounted. Vehicles should be arranged to stagger the gunners' orientation within the convoy.
- Check weapons. Perform a PMCS/function check on all weapons at the halt.
- Do not check more than one crew-served weapon at a time.
- Trail elements maintain rear security.
- Keep civilians away from the vehicles.
- Position gun trucks to cover dead space and likely avenues of approach.
- If the halt is 2 hours or more in duration, perform vehicle PMCS.
- Vehicle crews conduct a scan and expanding visual inspection of the area around the vehicles starting from 5 meters and expanding to 25 meters in 5 meter increments.
- Scanning procedures are as follows:
  - Scan for things out of place or unnatural objects. (IEDs, mines, etc.)
  - Look for security ties, wires, or other foreign objects secured to or suspended from utility poles and lines, trees, signs, or buildings.
  - EVALUATE specific, likely sniper positions using available optics.
  - EXCHANGE information with other crew members to see things from different perspectives.
  - At night, use a spotlight to scan if not under blackout conditions.
  - Crew members will notify team leader once scans are complete.
- Notify the maintenance officer of any vehicles that require immediate repairs.
- Inspect vehicle loads for safety and security.
- Provide drivers with updated intelligence on threats and route conditions.
- Refuel and re-arm as needed.
- Recover security on order to move.
- Account for all personnel by name prior to departure. Leaders report personnel status to the convoy leadership. The convoy does not depart until all personnel are accounted for.
- For scheduled halts, conduct departure at the specified time in the movement order.
- Report resumption of the march to higher headquarters.

6.5.1. **Blocking Positions.** Blocking is a technique used to physically block the road with a vehicle to prevent traffic from feeder roads, traffic circles, and ramps from intermingling with the convoy. Blocking techniques require extensive rehearsals. Route reconnaissance and analysis is critical to determine ahead of time where these techniques will be used.

6.5.2. Blocking vehicles are designated during mission preparation.

6.5.3. Blocking vehicles should not be the front or rear security vehicles.

6.5.4. “Block left” or “block right” commands indicate the specific side of the road.

6.5.5. In large convoys, blocking vehicles can be relieved in place by subsequent blocking vehicles from within the convoy, to maintain order of march.

6.5.6. A designated vehicle, convoy, or security commander gives the blocking command for designated vehicles to bump up and block a location.

6.5.6.1. **On/Off Ramps and Road Intersections.**

6.5.6.1.1. The convoy reduces speed as it approaches an intersection.

6.5.6.1.2. It reduces the interval between vehicles but maintains sufficient room for maneuvering.

6.5.6.1.3. Blocking vehicles move up the side of the convoy to the place they are to set the block.

6.5.6.1.4. Blocking vehicles setup before the convoy enters the intersection.

6.5.6.1.5. Once the convoy passes, blocking vehicles move forward and resume their positions in order of march.

6.5.6.1.6. Multiple Intersections (**figure 20**). Each intersection is handled by a different blocking vehicle from the convoy.

6.5.7. **Traffic Circles.**

6.5.7.1. Blocking vehicles control the circle allowing the convoy to move through without interference from third-party traffic.

6.5.7.2. The convoy reduces speed as it approaches the circle.

6.5.7.3. It reduces the interval between vehicles but maintains sufficient room for maneuvering.

6.5.7.4. Blocking vehicles move up the side of the convoy to the place they are setting the block.

6.5.7.5. Blocking vehicles need to be in place before the convoy enters the circle.

6.5.7.6. Once the convoy passes, blocking vehicles move forward and resume their positions in the order of march.

6.5.8. **Friendly Positions.**

6.5.8.1. Reentering friendly lines includes actions conducted when arriving at the convoy RP.

6.5.8.2. Upon closing with friendly lines, the unit must unload and clear weapons in accordance with (IAW) SOPs. If the release point is an en route location, the convoy commander will provide guidance regarding link-up for return trips and where billeting, messing, and refueling are to take place. The Team Commander must have a vehicle manifest available IAW established or local SOPs.

6.5.9. **Formations.** Movement formations and techniques include preplanned battle drills recommended for crossing danger areas and reacting to enemy direct fire, mines, and IEDs. Convoy commanders should place themselves in the best location within the convoy to facilitate Command and Control (C2). The assistant convoy commander is positioned near the rear of the convoy and is not collocated with the convoy commander. The following techniques can be used, based on the experience of the convoy team, METT-TC, and the judgment of the convoy commander.

Table 6.3. Convoy Formations.

	Advantages	**Disadvantages**
Column Formation (best used with inexperienced and foreign drivers)	• Simplicity • Usable at night, but the interval has to be compressed • Minimizes IED blast effects (when driving on centerline of the road)	• Weak left flank security because the driver is not a primary shooter • Reduced field of view • Reduced headlight coverage at night
Staggered Formation (used only on multi-lane roads)	• Allows for all-around security • Provides greater flexibility • Permits ease of maneuver during contact • Limits third-party vehicle interference • Provides greater headlight coverage at night	• Requires more C2 and driver experience • Is more vulnerable to IED blast effects, including multi-vehicle hits and victim-initiated IEDs
Offset Formation (used to block third-party traffic and assists in changing lanes)	• Combines flexibility of stagger with the ease of file formation • Allows convoy commander to control third-party traffic	• Increases vulnerability of IED blast effects, including multiple attacks & victim-initiated IEDs • Is difficult for C2
Inverted "T" Formation (used on multi-lane roads and the convoy runs on the centerline of the lanes)	• Limits third-party vehicle infiltration	• Requires experienced drivers • Is difficult for C2 without sufficient communications • Offers weak left flank security • Increases vulnerability to IED blast effects, including multi-vehicle hits and victim-initiated IEDs
Diamond Formation (used on multi-lane roads)	• Limits third-party vehicle infiltration	• Requires experienced drivers • Is difficult for C2 without sufficient communications • Increases vulnerability of IED blast effects
Herringbone Formations (used for short halts, this is the traditional formation for use in daylight and indirect fire defense)	• Staggered formation with vehicles placed at 45 degree angles usually 50-100 meters apart • Gun trucks act as stationary or roving defense as the terrain and situation dictate • This formation leaves the road clear for traffic	

	• This formation is the best defense against air attack and indirect fire • Drivers remain in their vehicles with the engines running • Remaining crew members should dismount only if required by the mission to do so • For long halts, all vehicle crew members, with the exception of drivers and gunners, should dismount and assume perimeter security

6.6. Driving Considerations.

6.6.1. Be unpredictable: vary driving techniques, start point times, and convoy routes.

6.6.2. Configure the vehicle to maximize visibility.

6.6.3. Use available optics to facilitate scanning

6.6.4. Employ counter radio-controlled improvised explosive devise electronic warfare (CREW) systems.

6.6.5. Establish minimum and maximum speeds for the convoy.

6.6.6. Maintain the vehicle interval to avoid the accordion effect.

6.6.7. Follow the tracks of preceding vehicles on unpaved roads.

6.6.8. Stay on the pavement. Avoid driving on the shoulder of the road.

6.6.9. Travel in the lane that allows rapid travel.

6.6.10. If conditions permit, travel down the middle of the road to maximize the distance from the median and shoulder of the road

6.6.11. Change lanes often to avoid establishing a predictable pattern.

6.6.12. If the convoy must stop, conduct a 0–5–25–200-meter scan.

6.6.13. Do not dismount unless the mission requires it.

6.6.14. Use a “rolling stop” when halting.

6.6.15. Slow the vehicle and conduct a 0–5–25–200 meter scan before stopping. (See **Chapter 4** for 6.6. 0–5–25–200-meter scan information.)

6.6.16. Exercise caution at choke points.

6.6.17. Watch for vehicle breakdowns, bridges, one-way roads, traffic jams, and sharp turns.

6.7. Convoy Strip Map Standards. A strip map provides an easy-to-use navigational aid, route control and battle tracking information, operational and logistical support points, major terrain features, key built up areas, highway infrastructure, and danger areas. Although a strip map may be generated at a higher command level, units should improve these products with information obtained locally to maximize their effectiveness. The unit is responsible for coordinating with appropriate agencies and organizations to obtain current information and reproduce enough strip maps so one is issued to each vehicle in the convoy. The following are essential elements of a strip map:

6.7.1. Start point.

6.7.2. Release point.

6.7.3. Halts/rally points.

6.7.4. Check points with grid coordinates.

6.7.5. Distances between check points.

6.7.6. Friendly forces.

6.7.7. Arrival and departure times at start point, check points, and rally points.

6.8. Convoy routes and route data.

6.8.1. Include route numbers

6.8.2. Main supply route designator

6.8.3. Major intersections (controlled and uncontrolled).

6.8.4. Mileage between points

6.8.5. Number of lanes

6.8.6. Route material composition designation (hard or loose surface)

6.8.7. Obstacles (canalizing characteristics such as bridges, tunnels, cuts, fills, etc.), and complex features (off-/on-ramps, roundabouts/traffic circles, etc.).

6.8.8. Major cities and towns.

6.8.9. North orientation.

6.8.10. Duress frequency (911 or "sheriff" frequency).

6.8.11. Logistical support data (Location of logistical support facilities)

6.8.12. Danger areas and types of threats.

6.9. Gear Configuration.

6.9.1. Vehicle commanders must ensure that any externally stowed items are secured from theft and do not constitute a fire hazard if the vehicle is attacked by IED, rocket propelled grenade (RPG), or other flammable device. External stowage should be minimized or modified to lessen the threat of vehicle fire and not restrict the view or movement of gunners or passengers providing security. All loose items stored inside the vehicle must be secured to prevent theft or becoming secondary missiles in the event of a mine or IED strike or a roll over TCs should consider stowing flammable items that are mission essential inside the vehicle and behind armored portions of the vehicle and securing non-mission-essential and nonflammable items outside the vehicles.

6.9.2. Other considerations:

6.9.2.1. Remove windshields, which often restrict mobility and visibility and may also shatter when struck, creating secondary missiles or fragments (shrapnel).

6.9.2.2. Consider lashing pioneer tools and crew-served weapon tripods to the front hoods of vehicles. (Extend them fully before lashing them down; this eases employment.)

6.9.2.3. Use on-board ammunition storage containers such as 60-mm mortar ammunition cans. These hold several types of ammunition and saves time when switching between ammunition for crew-served weapons.

6.9.2.4. Carry functional spare wheel and tire assemblies.

6.9.2.5. Consider equipping vehicles with wheeled vehicle tow bars in case of a vehicle down situation.

6.9.2.6. Consider emplacing civilian or military fire extinguishers in fixed positions inside the vehicle.

6.9.2.7. Establish load plan SOPs for sensitive items. They should account for ammunition and additional special equipment such as breach kits, demolitions, and first aid equipment. They should also account for any additional weapons, such as rifles, in case no automatic or crew-served weapons are required after dismounting. WARNING: Never use a halon fire extinguisher inside an armored vehicle.

6.10. Danger Areas. When moving mounted, units normally travel on roads, trails, and in unrestrictive terrain. Mounted units are typically vulnerable in the type of terrain favored by small teams such as restrictive and close terrain. Bridges, road junctions, defiles, and curves (denying observation beyond the turn) are also considered danger areas.

6.10.1. When the TL identifies a danger area, they determine the appropriate movement technique to employ (traveling, traveling overwatch, or bounding overwatch). If time and terrain permit, teams should either bypass a danger area or dismount to reconnoiter and clear it. If time constraints prevent these options, the unit uses a combination of traveling overwatch and bounding overwatch to negotiate the danger area. As with dismounted actions at a danger area, the TL must be prepared to quickly transition to maneuver in case the unit contacts the enemy.

6.11. Immediate Action Drills.

6.11.1. React to Direct Fire Contact.

6.11.2. Maintain 360-degree security.

6.11.3. Limit stationary time and exposure.

6.11.4. Adopt an offensive response.

6.11.4.1. **Break Contact.**

6.11.4.1.1. Follow through (i.e., find, fix, finish, exploit, and analyze).

6.11.4.1.2. Once enemy contact is neutralized or upon order to break contact, unaffected vehicles depart the contact zone.

6.11.4.1.3. Vehicle crews will use hasty vehicle recovery techniques to recover and displace damaged vehicles.

6.11.4.1.4. If a maintenance team is left behind to recover a vehicle, at least one gun truck must accompany it.

6.11.4.1.5. No convoy elements move for any purpose without gun truck support.

6.11.4.1.6. Blow Through. The command given by the Convoy Commander, requiring the entire element to push through a threat or danger area. Usually applies to intersections, IED detonations or small arms fire.

6.11.4.1.7. Account for all personnel and equipment.

6.11.4.1.8. Send a report to HHQ (IAW unit SOP)

6.11.5. **Hasty Attack (Assault).**

6.11.5.1. The security element and assault force suppress the identified threat with accurate fire.

6.11.5.2. The security element maneuvers to a suitable position, under cover of suppression fires, and assaults through the enemy.

6.11.6. **Emergency Dismount Procedures (Bail-out or Disabled Vehicle).**

6.11.6.1. The vehicle commander or Driver makes the bail out call.

6.11.6.2. Personnel on side of vehicle not in contact dismount and return fire.

6.11.6.3. Dismounted personnel use buddy teams to overwatch each other.

6.11.6.4. Occupants return fire as capable and move to non-contact side to dismount

6.11.6.5. All personnel return fire and break contact with assistance of fire support from other vehicles

6.11.6.6. Vehicles moving forward can recover Bail Out crew and recover vehicle if capable.

6.12. Dismount and Remount Procedures. These procedures can be used to dismount when not in contact with, but in proximity to, persons who may pose a threat.

6.12.1. Dismount/Mount. The vehicle commander makes the dismount call.

6.12.2. Dismounted personnel do not get in between any vehicles but protect the space between vehicles

6.12.3. Dismounted personnel use buddy teams to overwatch each other

6.12.4. The rear security person is the only one behind a vehicle.

6.12.5. If necessary, dismounted personnel use hand motions and verbal commands to move civilians back

6.12.6. If more force is required, dismounted personnel ensure actions taken are consistent with the current ROE.

6.12.7. If fired upon, dismounted personnel move to cover, suppress with fire, or mount their vehicle.

6.12.8. Vehicles moving forward can signal the mount call.

6.13. Remain-Over-Day (ROD) / Remain-Over-Night (RON). A RON - ROD is a position set up when the patrol unit halts for an extended period. When the unit must halt for a long time in a place not protected by friendly troops, it takes active and passive security measures. The time the RON - ROD may be occupied depends on the need for secrecy. It should be occupied only as long as necessary, but not for more than 24 hours except in an emergency. The unit should not use the same RON – ROD location more than once.

6.13.1. **Box Formation for Long Halts (RON-ROD).** The box formation is a close formation which employs the principle of mass to consolidate command, control, and firepower. It allows the convoy to mass its firepower in the event of a small arms attack, using the vehicles as shields.

6.13.1.1. Distance between vehicles in the box formation varies IAW METT-T/METT-TC.

6.13.1.2. Do not park vehicles so close that the drivers cannot easily pull their trucks out of the formation.

6.13.1.3. All control vehicles (except gun trucks), maintenance vehicles, and aid and litter teams are located inside the box.

6.13.1.4. Gun trucks are positioned one on each end (6 and 12 o'clock), and stationary security elements are located at the center of the convoy (oriented at 3 and 9 o'clock). If only two gun trucks are available, place them in the formation at 6 and 12 o'clock. Additional gun trucks or escort vehicles may act as roving security.

6.13.1.5. Do not allow civilian traffic to infiltrate the box. Halt it or route it around the box.

6.13.1.6. Due to space limitations, it is often not practical in an urban environment.

6.13.2. **The Staggered Formation (RON-ROD).** The staggered formation is not complex as the box formation. It does not provide as much security but can be used in urban and rural environments. Staggered formation procedures are as follows:

6.13.2.1. Vehicles peel off to the side of the road in an alternating pattern when they halt.

6.13.2.2. The first vehicle goes right, the second left, the third to the right, and so on.

6.13.2.3. Distance between vehicles in this formation is METT-TC dependent, but typically one vehicle length.

6.13.2.4. Gun trucks assume stationary overwatch positions, or remain mobile, roving up and down the length of the convoy.

6.13.2.5. The staggered formation leaves the center of the road open to allow military traffic to transit the area.

6.13.2.6. Civilian traffic should be halted or routed around the formation.

6.14. Vehicle Drop Off. Mounted elements can infiltrate and operate in low-or mid-intensity conflicts over various type of topography terrain consisting of high deserts with rugged mountains to low deserts and with sand dunes and salt marshes. The capability of these elements to travel unassisted long distances in enemy territory areas gives the Joint Forces Air Component Commander (JFACC) a viable surface overland option of employment. In preparing for conflicts in a desert environment, planners assume that long distances from the insertion area to the objective area are too great for dismounted infiltration. When aircraft cannot insert the recovery team within its dismounted surface movement capability; having a mounted surface movement option allows the mission to proceed. **NOTE:** When planning mounted Vehicle Drop Off (VDO) as a form of insertion the team should plan for contingency operations and extraction.

6.14.1. To prepare for mounted operations the team should be prepared to do the following:

6.14.1.1. Operate and communicate over long distances.

6.14.1.2. Operate without air support.

6.14.1.3. Coordinate available and appropriate air support.

6.14.1.4. Navigate in rugged terrain both on and off road.

6.14.1.5. Make on-site repairs to equipment using organic personnel, tools, and parts.

6.15. Vehicle Pick Up (VPU). Should be considered, TCs and TLs should plan for far and near recognition signals and communication with the VPU unit to prevent a fratricide (Blue on Blue) situation. Signals and communication planning should include day/night, no radio (NORDO) signals, challenge, and passwords for authentication.

6.16. Travel Considerations & Limitations.

6.16.1. **Fuel Estimation.** It is imperative to the PR/RO operation that the element have adequate fuel to complete the mission. When determining fuel requirement, the TL should consider the range of the vehicles to be used, the distance expected to travel, the expected load to be carried, terrain, scale of the map being used for mission planning, and a 15 percent safety factor.

6.16.2. **Terrain considerations:**

6.16.2.1. Road conditions.

6.16.2.2. Off-road travel conditions.

6.16.2.3. River crossings.

6.16.2.4. Expected rainfall or snowfall.

6.16.2.5. Presence of civilian vehicles in area--are vehicles normally encountered in the AO?

6.16.2.6. Communications ranges.

6.16.3. **Navigational considerations.**

6.16.3.1. Movement times: Day or night?

6.16.3.2. White light or NVDs?

6.16.3.3. Road or cross-country?

6.16.3.4. Recovery (Can the unit self-recover?)

6.16.3.5. How will the unit deal with nonrecoverable or disabled vehicles?

6.16.3.6. Load plan for casualties or additional personnel in case vehicles are destroyed or disabled.

6.16.3.7. Fuel cans, 5 or 10 gallons, with long fuel lines to attach directly to engine intakes, to allow the vehicle to operate even if the fuel tank is punctured.

6.16.4. **Additional considerations.**

6.16.4.1. Mission range (mileage), duration, and expected vehicle fuel consumption.

6.16.4.2. Availability of resupply or support during operations.

6.16.4.3. Planned vehicle loads (personnel and equipment).

6.16.4.4. Expected enemy situation.

Chapter 7

MILITARY OPERATIONS IN URBAN TERRAIN (MOUT)

7.1. General. Maintaining situational awareness of both the inside and outside of structures during movement in urban terrain is critical. Since an operator can move from one area to another by stepping through an opening, he should be constantly aware of both areas when moving through an urban area. Movement in an urban area exposes an operator to all the dimensions of urban terrain. An enemy could be on the outside or the inside of any building or on any floor, to include below ground or the roof. Typical external sectors of fire orient on specific external open areas—a length of a street or a small section of a street—that is visible from either inside a nearby building or from down an adjoining side street. Typical internal sectors of fire orient on specific internal open areas—large open rooms, doorways, or hallways.

7.2. Navigation. Urban areas present different navigational challenges. Normal terrain features depicted on maps may not apply. Buildings become the major terrain features, and units become tied to streets. Navigational tools that may be available to leaders during MOUT include:

7.2.1. Maps. Maps of sewers, gas lines, and electrical lines along with other information about the city infrastructure can often be provided by city utility workers.

7.2.2. Global Positioning System. GPSs have difficulty determining locations when underground or within buildings due to line of sight challenges. They should be employed on the tops of buildings, in open areas, and down streets where obstacles do not affect line of sight readings.

7.2.3. Aerial Platforms. Aerial platforms can assist units in navigating through urban terrain, using a laser or an infrared searchlight to identify objectives, friendly locations, or areas of unknown activity.

7.2.4. Photographs. Photographs, especially current aerial photographs, are excellent supplements to military maps. Recent photographs show changes that have taken place since a map was made, which could include destroyed buildings, streets blocked by rubble, and even enemy defensive preparations. Whenever possible, use aerial photos or satellite imagery when the sun is directly overhead to minimize the amount of shadowing around structures.

7.3. Communication.

7.3.1. To ensure success and prevent fratricide, Operators must effectively communicate with other team members and other teams in their vicinity. However, using verbal commands may reveal the location and immediate intent of friendly forces to the enemy. Terms similar to those listed in **Table 7.1**, should be a part of each Operator's vocabulary and used per unit SOP.

7.3.2. Prior to breach of an entry point or room entry, the clearing team members should communicate using visual signals to reduce the chance that the room's occupants are alerted to the presence of the team or their likely entry point. After entry, the clearing team members should find a balance between verbal and visual communication that allows them to clear the room rapidly and safely without alerting other enemy forces as to their location or intent.

7.3.3. If at any point a team member experiences a weapon malfunction, he must make an immediate decision based on his location and the presence of any enemy. If near the doorway, he must clear the doorway. However, if an enemy combatant is present and presents an immediate threat, he must try to subdue or disable the enemy by any means possible. The immediate goal is to clear the other team members' fields of fire. Once the other team members have cleared their sectors of fire and eliminated any other enemy in the room, they can then assist the Operator with the malfunctioning weapon.

7.3.4. If the enemy is outside the immediate danger area of the Operator; he should clear the doorway and drop to one knee. Doing so indicates he has experienced a weapon malfunction and prevents fratricide by ensuring that the next Operator's fields of fire are clear. Once on a knee, the Operator should remain there until the TL directs him to stand up. If the kneeling Operator corrects his weapon malfunction, he can engage targets from his kneeling position. Announcing MALFUNCTION or GUN DOWN and GUN UP (when the gun is again operational) communicates with the other team members but can also alert the enemy, see **Table 7.1**.

Table 7.1. Example verbal commands.

TERM	Explanation
Clear	Given by an individual to report their AO is Clear
Up	Given by an individual to report they are ready to continue the mission
Room Clear	Given by the TL to report the room is clear and secure
Coming Out (In)	Given by an individual to inform another element that they are about to exit (enter) a space.
Come Out (In)	Given in response to a "coming out (in)" call to acknowledge it's safe to exit (enter) a space.
Coming Up (Down)	Given by an individual to inform another element that they are about to ascend (descend) stairs.
Come Up (Down)	Given in response to a "coming out (in)" call to acknowledge it's safe to ascend (descend) stairs.
Short Room	Given by Operator 1 or 2 to inform following team members that the space is small and Operators 3 & 4 shouldn't enter
Man Down	Given by an individual to inform other members that an operator is down (wounded or injured) and can't continue the mission
Grenade	Given by an individual to warn others that any enemy grenade has been thrown and to take immediate action. If possible, include the location of the grenade.
Go Long	Given by the TL to direct an operator to take up security farther into the room or farther down a hallway
Gun Down	Given by an individual to inform the team that their weapon has malfunctioned
Gun Up	Given by an individual to inform the team that their malfunction has been cleared and their weapon is operational
Checking	Given by an individual to inform the team that they are reloading their weapon. Follow with "Gun Up" when ready

7.4. Moving Outside Buildings. Movement in urban terrain is best conducted by fire teams. Individual movement techniques should be practiced until they become habitual, allowing for rapid engagement of any exposed enemy.

7.5. Individual movement techniques. See **TC 3-21.76, Ranger Handbook** for details on individual movement techniques in urban area.

7.5.1. **Crossing streets and open areas.** Open areas, such as streets, alleys, and parks, should be avoided. They are natural kill zones for enemy, crew-served weapons, or snipers. They can be crossed safely if the individual applies certain fundamentals, including using smoke from hand grenades or smoke pots to conceal movement. When employing smoke as an obscurant, keep in mind that thermal sighting systems can see through smoke. Also, when smoke has been thrown in an open area, the enemy may choose to engage with suppressive fires into the smoke cloud.

7.5.2. **Moving parallel to building.** Operators may not always be able to use the inside of buildings as routes of advance and must move on the outside of the buildings. Smoke, suppressive fires, and cover and concealment should be used as much as possible to hide movement. Operators should move parallel to the side of the building, maintaining at least 12 inches of separation between themselves and the wall, to avoid rabbit rounds (ricochets and rubbing or bumping the wall). Operators should stay in the shadows, present a low silhouette, and move rapidly to the next position. If an enemy gunner inside the building fires, he exposes himself to fire from other team members providing overwatch.

7.5.3. **Moving past windows.** Windows present another hazard to the operators. The most common mistakes are exposing the head in a first-floor window and not being aware of basement windows. When using the correct technique for passing a first-floor window, operators must stay below the window level and near the side of the building, ensuring they do not silhouette themselves in the window. An enemy gunner inside the building would have to expose himself to covering fires if he tries to engage. When passing basement level windows, operators should not walk or run past the window, as this will present a good target for an enemy gunner inside the building. Operators must ensure they stay close to the wall of the building and step or jump past the window without exposing their legs.

7.5.4. **Observing and moving around corners.** The area around a corner must be observed before the operator moves. The most common mistake made at a corner is allowing the weapon to extend beyond the corner, exposing the operator's position; this mistake is known as flagging your weapon. You should show your head below the height an enemy would expect to see it, which can be accomplished by lying flat on the ground or from a kneeling position being conscious not to flag your weapon by extending it beyond the corner of the building. Only expose your head enough to permit observation. You can also use a mirror, if available, to look around the corner. These techniques work well when speed isn't required. Another corner-clearing technique that is used when speed is required is the pie-ing method, see **Figure 7.1** This procedure is done by aiming the weapon beyond the corner into the direction of travel (without flagging) and side-stepping around the corner in a circular fashion with the muzzle as the pivot point.

Figure 7.1. Pie-ing the Corner.

7.5.5. **Crossing walls.** Operators must learn the correct method of crossing walls. After having reconnoitered the other side of the wall, quickly roll over the wall and keep a low silhouette. An operator's speed of movement and low silhouette denies the enemy a good target.

7.6. Entering Buildings. Once a leader decides to enter a building, the immediate goal is to secure a foothold. A foothold is the first room entered. From this room, units can launch operations throughout the rest of the building/compound. The most important considerations in securing a foothold in the building are the three potential threats: 1) Enemy outside the building, 2) Enemy inside the building, and 3) Inside enemy's ability to engage friendly forces on the outside. These three threats are key factors in selecting the building entry point and the operating conditions (surgical, precision, or high intensity). The selection of the entry point is heavily based on the mission variables, while the operating conditions influence how to breach an entry point. **NOTE:** Depending on the type of breach selected, a breach may be executed before or after moving to the entry point.

7.6.1. **Identify the Entry Point.** The "Entry Point" is a focal point for all enemy in the room. As such, it is known as the "fatal funnel." To minimize vulnerability, pass through it quickly and smoothly. Each additional Operator successfully through and away from the entry point increases the unit's control of the room. If an operator falls within or near the entry point, he should stay down until the last man clears the entry point.

7.6.2. **Breaching.** An entry point should be large enough for an operator to pass through. To obtain this size of an entry point a breach is often required. In high threat situations, avoid using ground-floor windows and doors except as a last resort. Consider using other means available to make breach holes for entry, to include entry from a higher floor, roof, or basement. If the threat situation warrants, the actual entry of Operators should be preceded by a hand grenade (fragmentation, concussion, or stun hand grenade) followed by immediate entry of the clearing team.

7.6.3. **Entering Through Doorways.** Doors can be easily booby trapped or blocked. Entering through a door that is not booby trapped or within the line of fire of enemy personnel is normally the best way to enter a room. If a door is suspected of being booby trapped or if enemy personnel may be in the room, avoid or explosively breach the door. Prior to entering or determining if a breach is necessary, Operators should trace the doorframe with their hand or barrel of their weapon while their eyes look for booby traps.

7.6.4. **Entering Through Windows.** Entering through most windows is limited to one Operator at a time and normally requires the use of at least one hand, leaving only one hand to hold a weapon. As such, an entering Operator is extremely vulnerable to fire from inside the room. To enter an enemy occupied room by going through a window, use some form of distraction, such as a hand grenade. The two levels of windows are described below.

7.6.4.1. Ground-Floor Windows.

7.6.4.1.1. Treat ground-floor windows that can be entered in an upright position as a doorway. Enter other ground-floor windows using the assistance of other Operators. This allows the entering Operator to enter by using one hand for balance and control while the other hand holds and manipulates his weapon. The two-man heel lift (**Figure 7.1**) or the two-man supported lift technique (**Figure 7.2**) can be used to enter a ground-floor window. After the first Operator enters, subsequent Operators are lifted into the room while the first Operator secures the room. From a secure room, additional Operators can be pulled into the room using the one-man lift (**Figure 7.3**) or the two-man pull technique (**Figure 7.4**).

Figure 7.2. Two-man heel lift.

Two men bend over, facing one another with their hands cupped together.

A third Soldier raises his feet into the cupped hands of the two others.

Once both feet are in the cupped hands, the two men push up on the third man's feet, lifting him upward.

Figure 7.3. Two-man Supported Lift.

THE TWO-MAN LIFT, SUPPORTED

Two men stand facing one another, holding a support (a board or bar).

Another Soldier steps onto the support.

Once both feet are on the support, the two men raise it, lifting the third man upward.

Figure 7.4. One-Man Lift.

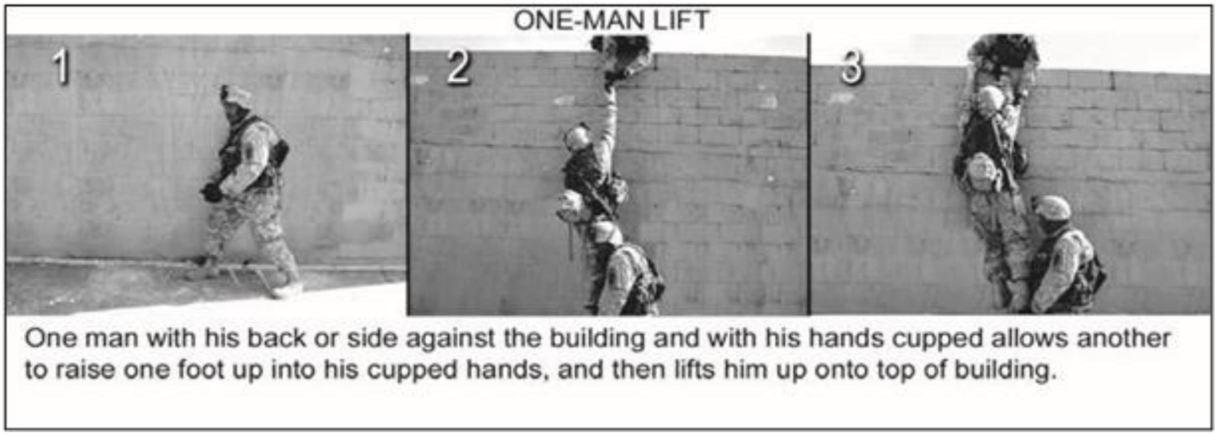
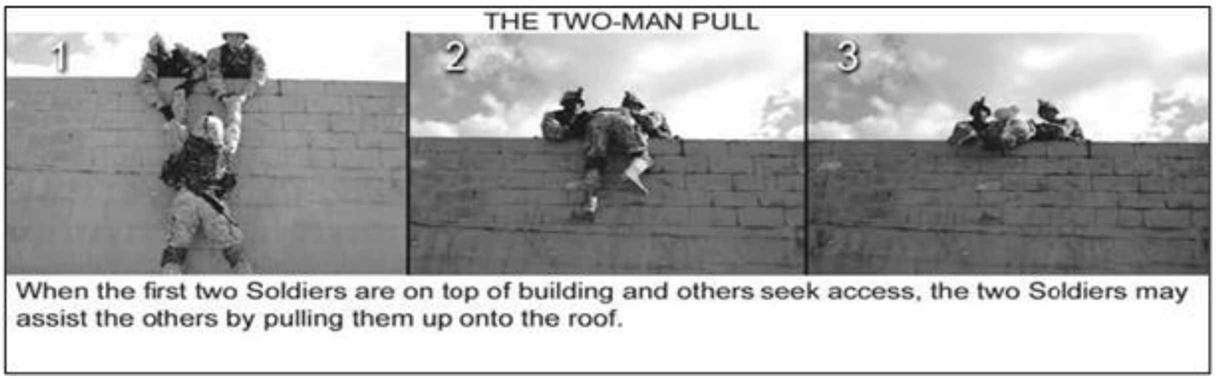


Figure 7.5. Two-man Pull Lift.



7.6.4.2. Upper-Floor Windows. An operator scaling or rappelling to access a window is vulnerable to enemy fire. He should avoid exposing himself to fire from other windows that are not cleared. An operator's individual weapon should be slung over his firing shoulder so it can be quickly brought into a firing position.

7.6.4.2.1. **Scaling.** Scaling using a grappling hook and rope to ascend into a building is not recommended. Scaling is extremely difficult, takes a significant amount of time and energy, and exposes the climber and nearby Operators to enemy fire.

7.6.4.2.2. **Rappelling.** Rappelling can be used to descend from the rooftop or higher-level floor into a lower window or to descend through a hole in the floor to a lower floor. (See TC 21-24 for details on rappelling.)

7.6.4.2.3. **Ladders.** Ladders are the preferred method of entry to upper-floor windows and offer the quickest method of access. Higher level floors may be accessible with longer ladders. Units should be equipped with lightweight, man-portable, collapsible ladders as referenced in the platoon UO kit. If portable ladders are not available, material to build ladders can be obtained through supply channels. Ladders can be built with resources available throughout the urban area. Ladders may be used to identify obstacles and threats and entry points for the assault element. Ladders may also be used to gain quiet entry into a building, provide overwatch security over a wall, and assist overwatch/snipers in gaining positions of dominance.

7.6.5. **Entering through roofs.** Many multistory buildings have a roof access that Operators can use to enter the building. These roof access points are typically stairs or permanently attached ladder. On buildings without roof access points, a hole can be made in the roof to gain entry. Basic hand tools can breach wood or shale-type roofs, while concrete or other durable material requires an explosive breach.

7.6.6. **Entering through ground-floor walls.** If doors and windows are inaccessible entry points, entry through a wall is an option. Using a door-size opening is preferred and enter using the same procedures as entering through a doorway.

7.7. Moving Inside Buildings. When moving inside a building, always be alert. Avoid presenting a silhouette in doors and windows, and always move with at least one other Operator for security. While the mission variables affect the particulars of moving, the basic element for moving inside buildings is the four-man fire team. A four-man fire team can move throughout a building as an individual entity. However, they can only secure where they are, not where they have been. The members of the four-man clearing team are assigned numbers 1 through 4. The assignments of these positions often rotate as the mission variables and the experience of the clearing team change. This does not mean that all four members must enter a room, nor does it mean that more than four men cannot enter. For a standard four-man fire team, a typical breakdown is as follows:

7.7.1. Rifleman is number 1. (Should not have an open bolt weapon.)

7.7.2. TL is number 2. (May be armed additionally with a shotgun.)

7.7.3. Grenadier is number 3.

7.7.4. Squad automatic weapon gunner is number 4.

7.7.5. **Moving Through Hallways.** When moving through hallways, stay 12 to 18 inches away from walls. Do not rub against walls as this may alert an enemy or, if engaged by an enemy, ricochet rounds tend to travel parallel to a wall. The two basic techniques for moving through hallways are described below.

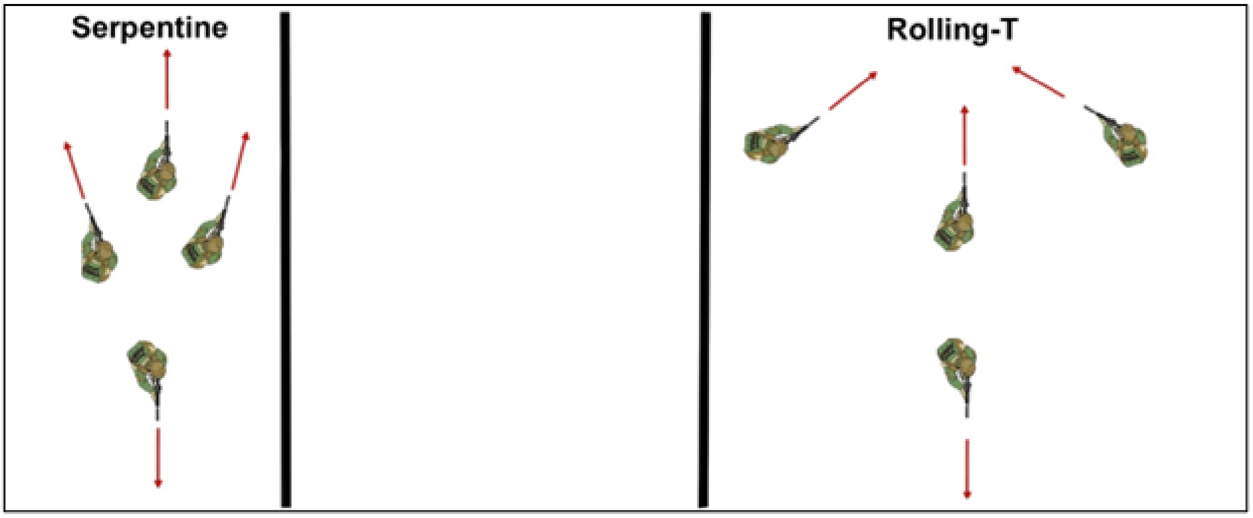
7.7.5.1. Serpentine. Use this technique in narrow hallways (**Figure 7.6**).

7.7.5.1.1. Operator 1 provides security to the front. His sector of fire includes any enemies who appear at the far end of the hall or from any doorways near the end.

7.7.5.1.2. Operator 2 and Operator 3 cover the left and right sides of Operator 1. Their sectors of fire include any enemies who appear suddenly from nearby doorways on either side of the hall.

7.7.5.1.3. Operator 4, normally carrying the M249 squad automatic weapon (SAW), provides rear security against any enemies suddenly appearing behind the clearing team.

Figure 7.6. Hallway Movement Techniques.



7.7.5.2. Rolling-T. Use this technique in wide hallways (**Figure 7.6**).

7.7.5.2.1. Operator 1 and Operator 2 move abreast, covering the opposite side of the hallway from the one on which they are walking.

7.7.5.2.2. Operator 3 covers the far end of the hallway from a position behind Operator 1 and Operator 2, firing between them.

7.7.5.2.3. Operator 4 provides rear security.

7.7.6. **Moving Through Intersections.** Hallway intersections are dangerous areas and should be approached cautiously. To minimize exposure when clearing around corners, left-hand corners should be cleared using the right-handed firing method and right-hand corners should be cleared using the left-handed method. Operators should be competent at smoothly transitioning and firing with both left and right-handed firing methods. Techniques to clear intersections differ slightly based on the type of hallway intersection. The three hallway intersections are described below.

7.7.6.1. Four-Way Intersection. The steps below depict a fire team's actions upon reaching a four-way intersection. See **Figure 7.7**.

7.7.6.1.1. Assume Start Position. Upon nearing the four-way intersection, the team configures into a 2-by-2 formation.

7.7.6.1.2. Operator 1 and Operator 2 move to the left side of the hallway.

7.7.6.1.3. Operator 3 and Operator 4 move to the right side of the hallway.

7.7.6.1.4. Operator 1 and Operator 3 move to the edge of their corners and assume a low crouch or kneeling position, while Operator 2 and Operator 4 remain standing.

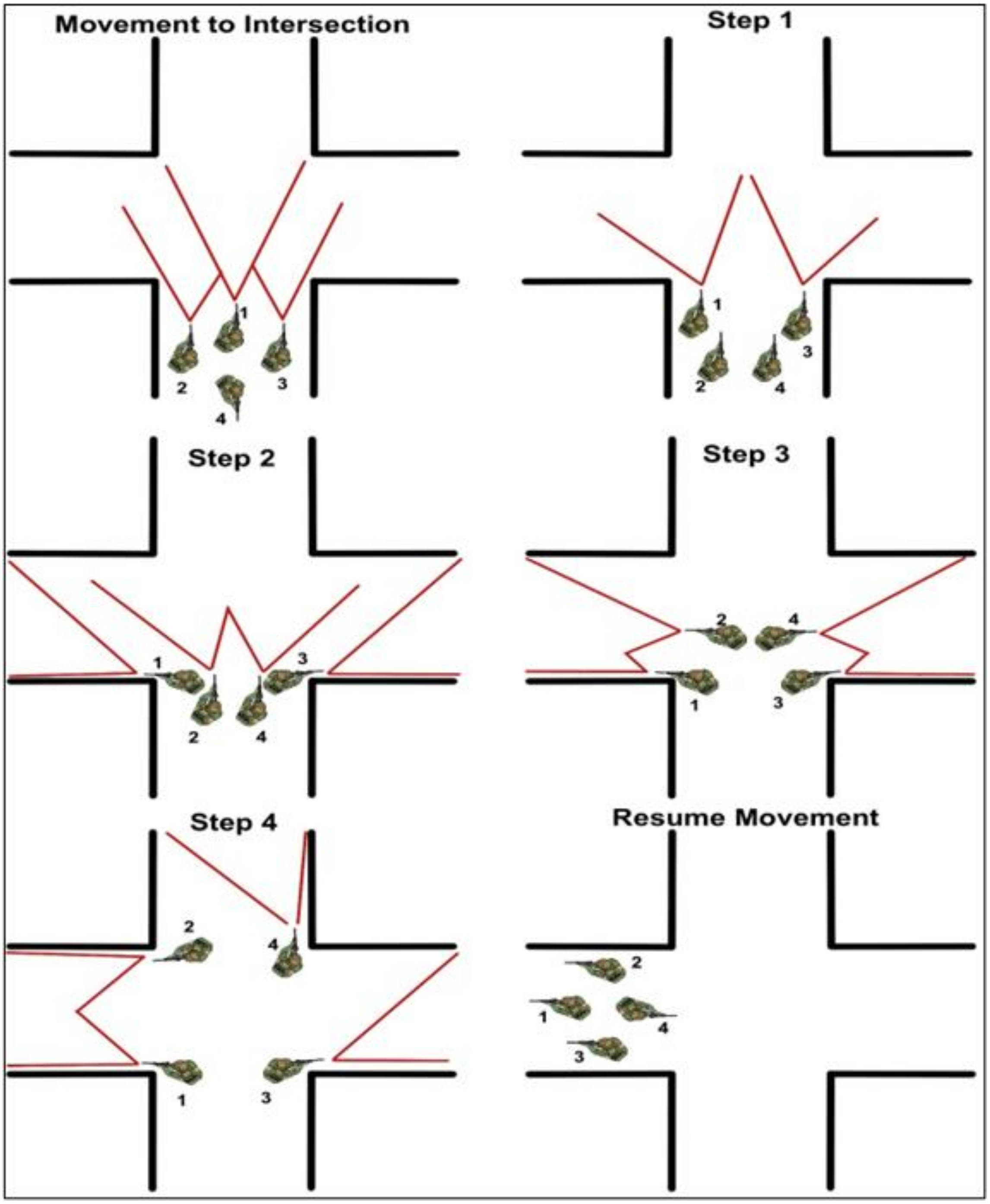
7.7.6.1.5. Clear around corners. Simultaneously execute movement on a prearranged signal. The sectors of fire for all Operators cover the full width of their hallway. The low and high positions prevent Operator 2 and Operator 4 from firing at Operator 1 or Operator 3, respectively.

7.7.6.1.6. Operator 1 and Operator 3 simultaneously turn left and right, respectively, and cover the hallway from their low position.

7.7.6.1.7. Operator 2 and Operator 4 step forward and turn left and right, respectively, maintaining their high position.

7.7.6.1.8. Resume movement. Once the left and right portions of the hallway are clear, Operator 4 turns and secures the hallway in the original direction of movement. The fire team then resumes their hallway movement formation.

Figure 7.7. Moving through 4-way Intersection.



7.7.6.2. **Upright T-Intersection.** The following depicts a fire team's actions upon reaching an upright T-intersection. In an upright T-intersection, the team approaches the "T" from the base hallway, see **Figure 7.8,** Moving through T-shaped hallway Intersection from base hallway.

7.7.6.2.1. Assume Start Position. Upon nearing the T-intersection, the team configures into a 2-by-2 formation.

7.7.6.2.2. Operator 1 and Operator 2 move to the left side of the hallway.

7.7.6.2.3. Operator 3 and Operator 4 move to the right side of the hallway and remain standing with their weapons in a high position.

7.7.6.2.4. Operator 1 and Operator 3 move to the edge of their corners and assume a low crouch or kneeling position.

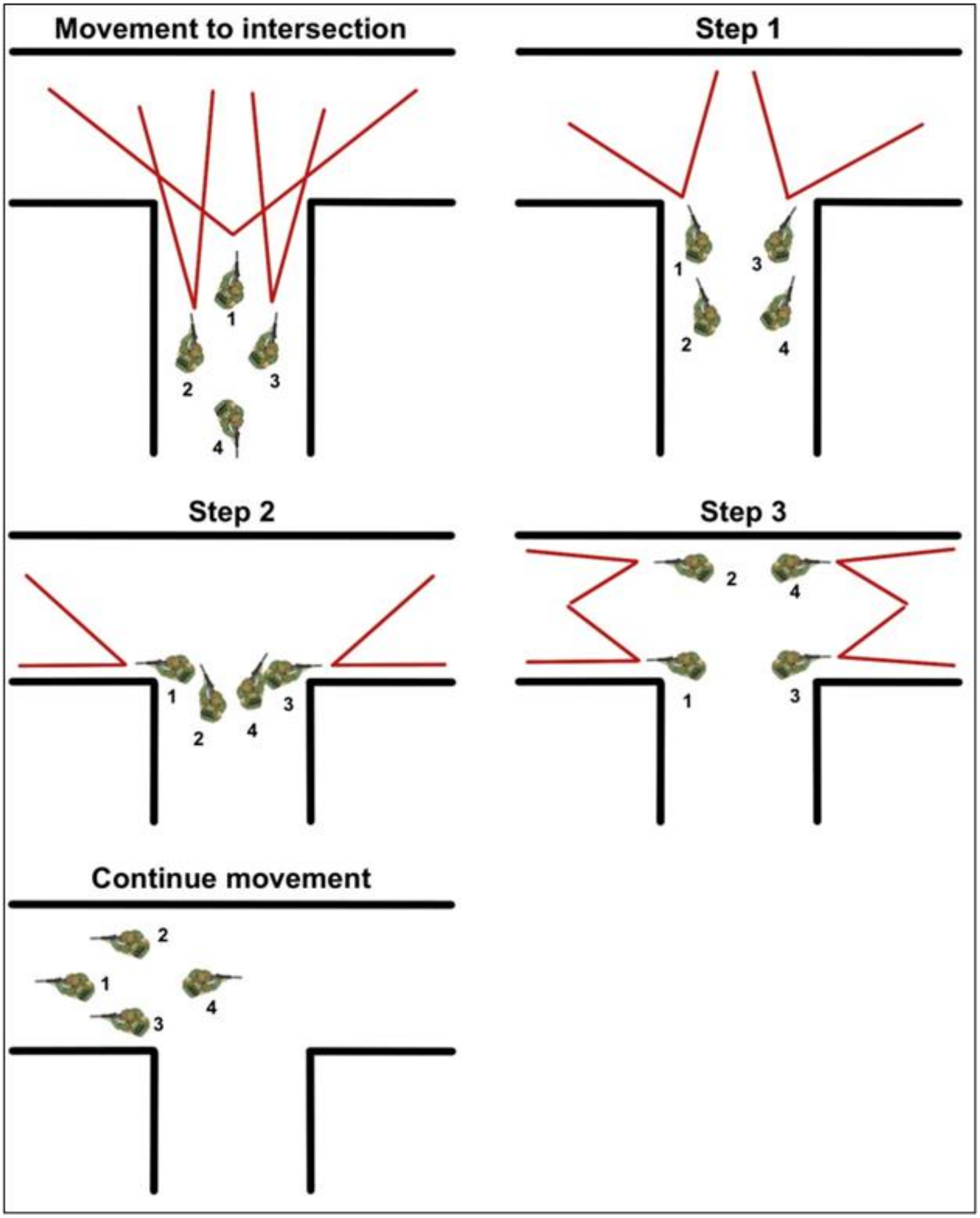
7.7.6.2.5. Clear Around Corners. Simultaneously execute movement on a prearranged signal. The sectors of fire for all Operators cover the full width of their hallway. The low and high positions prevent Operator 2 and Operator 4 from firing at Operator 1 or Operator 3, respectively.

7.7.6.2.6. Operators 1 and 3 simultaneously turn left and right, respectively, and cover the hallway from their low position.

7.7.6.2.7. Operators 2 and 4 step forward and turn left and right, respectively, maintaining their high position. Operators 2 and 4 then create enough space to allow for Operators 1 and 3 to move.

7.7.6.2.8. Resume movement. Once the left and right portions of the hallway are clear, the fire team resumes their hallway movement formation.

Figure 7.8. Moving through T-shaped hallway Intersection from base hallway.



7.7.7. **Branch T-Intersection.** The following depicts a fire team's actions upon reaching a branch T-intersection. In a branch T-intersection, the team approaches the "T" from the cross of the "T."

7.7.7.1. Assume Start Position. The team configures into a modified 2-by-2 formation, see **Figure 7.9**.

7.7.7.2. Operator 3 moves to the edge of the corner and assumes a low crouch or kneeling position.

7.7.7.3. Operator 1 moves abreast of Operator 3 and near the right side of the hall.

7.7.7.4. Operator 2 moves to the left side of the hall and orients to the front.

7.7.7.5. Operator 4 moves to the right of Operator 2 and maintains rear security.

7.7.7.6. Clear Around Corner. Simultaneously execute movement on a prearranged signal, keying in on the actions of Operator 3. The sectors of fire for all Operators cover the full width of their hallway. The low and high positions prevent Operator 2 and Operator 4 from firing at Operator 1 or Operator 3, respectively.

7.7.7.7. Operator 3 turns right around the corner keeping low.

7.7.7.8. Operator 1 steps forward while turning to the right and staying high.

7.7.7.9. Operator 2 and Operator 4 continue their movement in the direction of travel. Their movement is continuous.

7.7.7.10. Operator 2 and Operator 4 continue moving across the intersection and do not stop. Their movement keys the actions of Operator 1 and Operator 3.

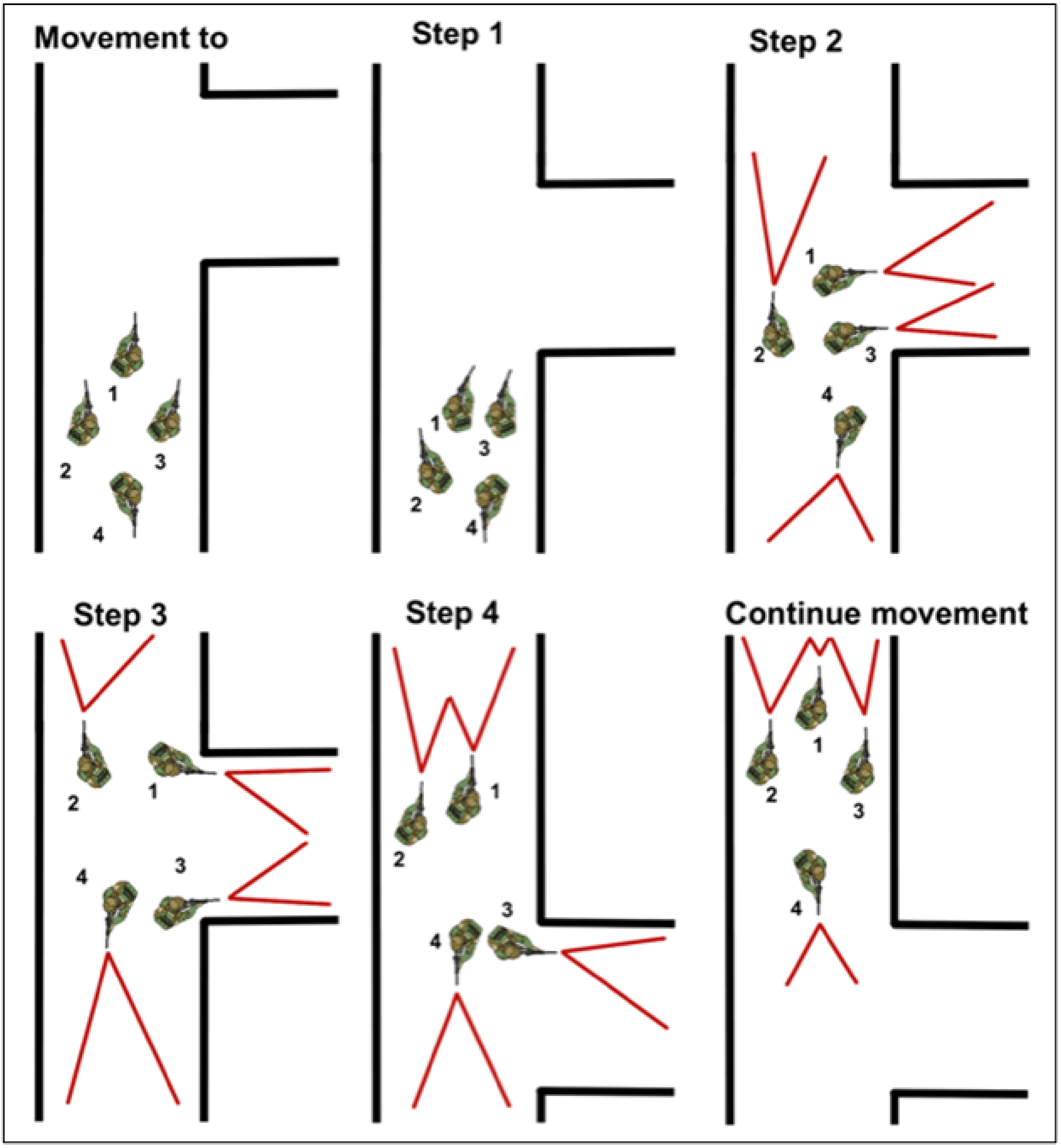
7.7.7.11. Operator 2 passes behind Operators 3. Operator 1 then continues moving down the hallway.

7.7.7.12. Operator 1, as Operator 2 passes behind, shifts laterally to his left until he reaches the far corner. Upon reaching the side of the hallway, Operator 1 turns into the direction of travel, resumes his position in the formation, and continues moving down the hallway.

7.7.7.13. Operator 4 passes behind Operator 3 and continues moving down the hallway.

7.7.7.14. Operator 3, as Operator 4 passes behind, shifts laterally to his left until he reaches the far corner. Upon reaching the side of the hallway, Operator 3 turns into the direction of travel, resumes his position in the formation, and continues moving down the hallway.

Figure 7.9. Moving through T-shaped hallway Intersection from cross hallway.



7.8. Narrow Hallways. When the available space in a hallway doesn't accommodate previous techniques, teams will often resort to single file or two abreast movement. Basic principles are the same and potential threat areas are covered. Regardless of the techniques used teams should consistently train to approved tactics, techniques, and procedures.

7.9. Exiting Buildings. Before exiting a building, inform nearby friendly elements to prevent fratricide and coordinate their overwatch. Unless the open area in front of the building's exit is secure, exit a building with the assumption that movement in the open exposes one to enemy fire. Before moving, identify the next covered position and then select and visually clear a route to that position. Once ready to move, the operator should rapidly exit the building, move along the selected route, and occupy the identified covered position. Depending on the threat level outside the building, additional measures, both before and during movement, may be required. These measures include other Operators providing overwatch or suppressive fires and the use of obscurants, such as smoke, to conceal the movement. If available, an armored vehicle may also be positioned to provide cover for part of the movement or as a final covered position. See **AFTTP 3-3.Guardian Angel** for additional information on MOUT.

Chapter 8

ROPED RESCUE

8.1. General. Competent technical skills in roped rescue operations require comprehensive training and ongoing proficiency to ensure prosecution of safe and successful missions. Operators can conduct roped rescue in support of recovery operations in varying terrain types and geographical locations. **NOTE:** All diagrams in this chapter are for instructional purposes only. They are not to be construed as endorsements of any equipment or specific system. Certain items such as progress capture Prusiks have intentionally been omitted for reasons of clarity.

8.1.1. **Roped Rescue.** This discipline centers on recovery of personnel or material from areas of great height or depth otherwise denied by a conventional approach. Rope rescue operations are frequently defined in terms of the type and steepness of the terrain on which they are to be performed. The steeper the ground, the more difficult and more technical the rescue becomes. Ropes and climbing hardware have to be relied upon to gain access to the objective and to support the team and the recovery at the objective site. Though precise definitions vary, for the purpose of this discussion, low-angle rescue is considered a slope angle from *15 to 35* degrees; steep-angle rescue is a slope angle from *35 to 60* degrees; high-angle rescue is a slope angle of *60* degrees and higher. High-angle rescue operations take considerable time to conduct and may require additional personnel and assets in the tactical environment.

8.1.2. **Tree Recovery.** Tree recoveries are performed primarily to recover personnel who inadvertently land in trees. Recovery complexity varies due to tree height, patient condition, equipment available and day or night operations. Rescue teams are equipped with specialized tree-climbing gear to expedite tree recoveries.

8.1.3. **Individual Responsibilities.** The TL is responsible for all phases of operations and accountability of all team members, patients, and equipment. The TL may be relieved of command in cases of federal agency (e.g., FEMA) assistance. TL responsibilities may include:

8.1.3.1. Site security and accountability.

8.1.3.2. Site analysis, operation area organization and fall line determination.

8.1.3.3. Conduct all applicable briefs.

8.1.3.4. Assigning team duties and responsibilities.

8.1.3.5. Inspecting all anchors, rope systems and operators prior to employment.

8.1.3.6. Ensures site safety.

8.2. Rope Rescue Operations. Technical rope rescue is based on applied physics. The goal is to work with these principles in the most efficient manner.

8.2.1. **Intended Scope.** This information is not intended to be an all-encompassing reference for every rope rescue operation. The primary purpose for the overview on physics and principles is so the technician can apply them to the situation at hand.

8.2.2. **Technical Merit.** The described techniques have been proven under field conditions. It should be noted many of the principles previously learned are now obsolete because they were either unsafe or unable to hold up to the unsubstantiated claims as to their strength and or safety.

8.2.3. **Safety.** Competent technical rescue skills involving ropes, anchoring and belaying systems, lowering and hauling systems, and litter work are mandatory for the safe performance of the rescue team.

8.2.3.1. Rescue Safety. Rescue personnel safety is paramount. Rescuers must constantly evaluate dynamic factors, including the consequences of catastrophic system failure, changing weather conditions, limitations of the team, or delayed evacuation.

8.2.3.2. Patient/IP Safety. Ensure that the IP is properly secured in the litter and has a safety knot attached to harness prior to any patient movement. All patients will be given proper PPE to prevent additional injuries.

8.2.3.3. Safety Factor (SF). The ratio of the breaking strength of the materials in reference to the force applied. Typically, for components whose failure could result in serious injury or death, anything that holds the full weight of the load, a safety factor of 10:1 is used. Non-critical components such as the components of the MA generally have a safety factor of 2:1.

8.2.4. **Communication.** Communication can be achieved through verbal commands, radio, whistle blasts, or through the edge person. Ensure that the desired form of communication is pre-briefed to best facilitate operations. All commands must be clear and concise.

8.3. Lowering Operations.

8.3.1. First Stage (Roll Call). Ensure everyone is physically and mentally ready. Ensure that all personnel are located at pre-briefed stations ready to begin movement.

8.3.2. Second Stage (Positioning the Load). Pre-position the attendant/victim, this may require additional help from the edge man, to allow for a smooth edge transition. To ease this movement, the attendant may ask for slack in the main line as required. Ensure that all personnel working in the vicinity of the edge must be tied off to mitigate an inadvertent fall.

8.3.3. Third Stage (Pre-tensioning). Take slack out of main and belay lines. Attendant will weigh the system and begin transitioning the load over the edge. Although there are several ways of pre-tensioning the system; the appropriate technique is dependent on the number of available rescuers, terrain and must be briefed by the TL prior to roll call.

8.3.4. Fourth Stage (Attendant Needs). Commands specific to the needs of the attendant, such as speed, belay, or edge protection requirements, and an indication of progress.

8.4. Raising Operations.

8.4.1. First Stage (Roll Call). Ensure everyone is physically and mentally ready. Ensure that all personnel are located at pre-briefed stations ready to begin movement.

8.4.2. Second Stage (Raising). Construct best mechanical advantage pulley system for number of available hauling personnel to reduce effort.

8.4.3. Third Stage (Edge Transition). Reset the haul system when the load is just below the edge to ensure the load can be cleanly and smoothly brought completely up over the edge without having to reset during the critical edge transition.

8.4.4. Communications Checklists. The following checklists in **Table 8.1** and **Table 8.2** are examples of those used by the control person when conducting raising or lowering operations. Individual teams should develop alternate signals in the event radio communications fail (e.g., whistle blasts).

Table 8.1. Command and Communication for Lowering Checklist.

Command and Communication for Lowering		
Control	**Response**	**Action**
First Stages (roll call)		
"BELAY READY?"	"READY!" "STANDBY!"	Belayer is physically and mentally ready: no slack. If not ready, give indication of time.
"ADVISE WHEN READY!" (If hearing "STANDBY") "MAIN LINE READY?"	"READY!" "READY!"	Device is unlocked and ready to feed.
"EDGE (1 and/or 2) READY?"	"READY!"	In position to move to load, edge clean and protected.
"ATTENDANT READY?"	"READY!"	Patient briefed; tie-ins properly adjusted.
Second Stage (position the load)		
"ATTENDANT, APPROACH THE EDGE!"		—
"ATTENDANT, STOP!"		—
"MAIN LINE, LOAD THE BRAKE!"		—
"EDGE, READY?"	"READY!"	Edge protection placed and ready to push out.
"ATTENDANT, READY?"	"READY!"	Patient briefed; hand on litter, ready for pre-tension.
Third Stage (pre-tensioning the system)		
A. Vectoring the main line		Used if a high directional exists.
-"VECTOR MAIN LINE!"		One or two people deflect the main line, no rope through the brake.
-"ATTENDANT, LEAN BACK!"		Pull litter away from obstructions.
-"EDGE, PUSH OUT!"		On main line only, not litter.
-"RELEASE VECTOR!"		Slowly at first, then gradually increase speed.
-"BRAKE DOWN SLOW!"		Gradually break static friction at end of vector to allow for feed.
B. No vector		Just exclude the vectoring commands above. High directional may not exist.
C. Jigger		Where there is no room to vector.
D. Edge lift		Used with overhead directional.

Table 8.2. Command and Communication for Raising Checklist.

Command and Communication for Raising		
Control	**Attendant**	**Main Line (haul team)**
First Stage (roll call; same as lowering)		
Second Stage (raising)		
"MAIN LINE READY?"		"READY!"
"ATTENDANT READY?"	"READY!"	
"MAIN LINE UP!"		"MAIN LINE UP!"
		"SET!"
"SET (to attendant), RESET!"	"READY!"	
"ATTENDANT READY?"		"READY!"
Third Stage (edge transition)		
"STOP. SET. RESET. LAST HAUL!"	"READY!"	"READY!"
"MAIN LINE UP!"		
"STOP. STOP. ALL STOP!"		
ADDITIONAL COMMANDS: "STOP!"—Given by anyone; this means freeze. "STOP. STOP. WHY STOP?"—If load has stopped for unknown reason. "DOWN! DOWN!"—Go down faster. "SLOW!"—Self-explanatory. "UP ROPE!"—Pull rope through device and ensure there is no slack. "SLACK!"—Too much tension, need more rope. **WHISTLE COMMANDS:** One Blast—Stop! Two Blasts—Up! Three Blasts—Down! Three Long Blasts—Help!		

8.4.4.1. **The physics behind the techniques.** All bodies take up space and therefore have a mass. A body of mass will fall toward the Earth at an increasing velocity (acceleration) because the force of gravity. Mass, force, and acceleration due to gravity are therefore related and must be clearly defined and understood.

8.4.4.2. Mass is the quantity of matter a body contains. The unit of mass in the SI system is the kilogram (kg).

8.4.4.3. Force may be defined as any action on a body which tends to change its size or shape, its state of rest, or its state of motion. The unit of mass in the SI system is the Newton (N).

8.4.4.4. Base Units. A unit of measure is used to describe the physical characteristics of something. Feet or meters for length, pounds or kilograms for mass, and seconds for time, see **Table 8.3**, Conversion Factors.

8.4.4.5. Derived Units. These are units of measure that are derived from two or more base units. For conversion factors from standard to SI units, see **Table 8.3**.

8.4.4.6. Speed is measured in meters per second.

8.4.4.7. Acceleration is measured in meters per second squared. The standard value for gravitational acceleration (G) is -9.806650 m/s2. (The actual value of G ranges between 9.77 and 9.83 m/s2 over the surface of the earth and even more widely above and below the surface. However, for the purpose of rope rescue physics, using 10 m/s2 provides a minuscule safety margin and vastly simplifies the math.

8.4.4.8. Force is the product of mass x acceleration and is measured in Newtons (N). 1 N=1kg x m/s2.

8.4.4.8.1. Example: 100 kg accelerated by gravity = (100 kg)(10 m/s2) = 1,000 kg m/s2 = 1,000 N or 1 kN.

8.4.4.9. Application: A 1 kN load is approximately equal to force applied to a system by one rescuer (100 kg) falling 1 m. A rescue load is roughly equal to a 2 kN load and is approximately equal to the force applied to a system by a rescuer and a patient (200 kg) falling 1 m.

8.4.4.10. Clarification: An “N” is not a measurement of weight but of the force required to accelerate 1 kg by 1 m/s2. NOTE: All tests of rope rescue systems are performed with a standard load of 2 kN. Hence, the need for a system strength of 20 kN, thereby giving a safety factor of 10:1.

Table 8.3. Conversion Factors.

For this Measurement:	Convert From:	Multiply By:	To Obtain:
Mass	Pound-mass	0.453	Kilogram (kg)
Length	Inch Foot	25.4 0.304	Millimeter (mm) Meter (m)
Speed (velocity)	Feet per second (ft/s)	0.304	Meter per second (m/s)
Acceleration	Feet per second squared	0.304	Meter per second squared (m/s2)
Force	Poundal Pound-force	0.138255 4.448222	Newton (N) Kg * m/s2
Stress	Pound-force per square inch (1 bf/in^2) (psi)	6.894757	Kilopascal (kPA) (kN/m2)

8.4.5. **Rope in Service.** The term rope in service refers to the amount of rope under load (or could be put under a load, i.e., the belay line, between the belay device and the attachment to the litter bridle) at a given point in a rescue operation.

8.4.6. **Fall Factor.** Fall factor is determined by dividing fall distance by the rope in service, or the length of the rope from faller to the fixed point, whether belayer or anchor. In the case of static rope, an acceptable fall factor would be 1 m drop/3 m rope = fall factor 1/2 or 0.33. The highest value a fall factor can have is 2. A fall factor of 2 can be catastrophic to the main line of a system. The most likely area for a fall factor of 2 to occur is during an edge transition.

8.4.7. **Rope Stretch and Rope Strength.** Contrary to popular belief, the terms “static” and “low stretch” are not universally interchangeable. According to the Cordage Institute rope standards, at 10 percent of a given rope’s minimum breaking strength a static kern mantle rope may have an elongation of up to 6 percent (2 to 3 percent ideally), while low stretch kern mantle ropes may range in elongation from 6 to 10 percent.

8.4.7.1. The static rope is ideally suited for technical rope rescue. Compliance with the previous specifications is based upon testing according to the Cordage Institute Standard Testing Methods for Fiber Rope and/or ASTM D-4268, Standard Methods of Testing Fiber Ropes.

8.4.7.2. Tensile strengths are approximate averages for new, unused ropes. To estimate the minimum tensile strength of a new rope, reduce the approximate average by 10 percent (Cordage Institute defines minimum tensile strength as two standard deviations below the average tensile strength of the rope).

8.4.7.3. The kern mantle construction used in these ropes features a double-twist cable core for low-static elongation and resistance to spinning while ascending or descending yet will elongate to absorb energy in the event of an accidental dynamic loading. It is important for a static rope to be able to absorb the energy of an accidental dynamic loading. This type of loading could possibly cause damage to the sheath and/or core of the rope, bodily injury, or anchor failure.

8.4.8. **Dynamic Force Calculations.**

8.4.8.1. The potential energy (PE) of an object is determined through multiplying mass x gravity x height (m·g·h). EXAMPLE: A 1 m fall with a 200 kg load (200 g x 9.81 m/s2 x 1m) = 1,962 kg or 19 kN. mass x gravity x (drop + stop) divided by stop [mg (drop + stop)/stop]. (200 kg) (9.81/s2) (0.5 m+1 m) = approximately 6,000 N or 6 kN 1m

8.4.8.2. The peak dynamic force (PDF) is approximately two times the ADF or as in the example above, 6,000 N x 2, or 12 kN. NOTE: 8 to 10 kN is the maximum sustainable fall the human body generally can withstand.

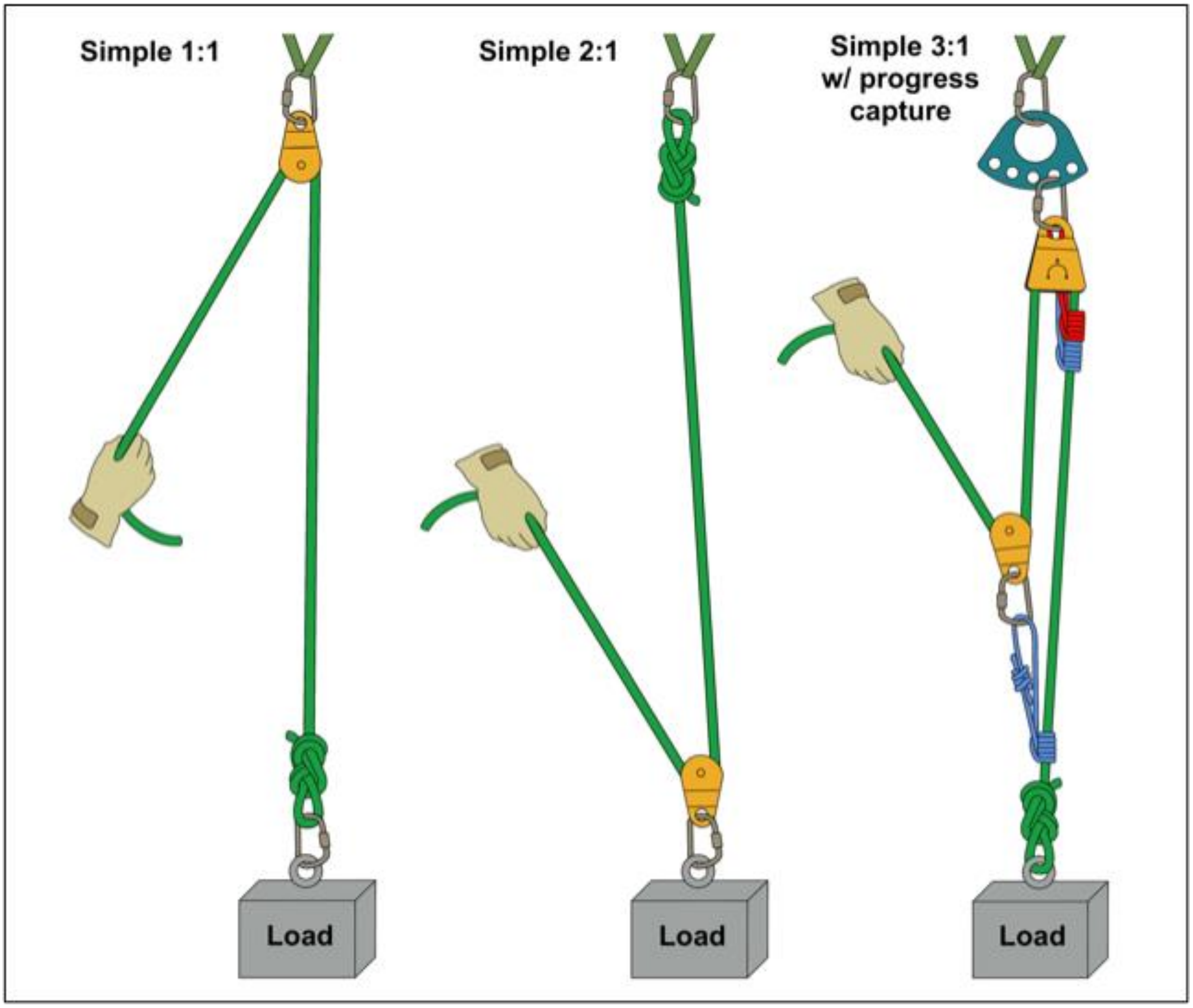
8.4.8.3. This becomes critical for the rescuer if a piece of equipment such as a daisy chain is subjected to a fall. An 80 kg load falling 1 meter will induce a shock load of 17.6 kN. The daisy chain will absolutely fail under this load.

8.5. Mechanical Advantage. Mechanical advantage is the ratio of output force divided by input force. Mechanical advantage in pulley systems is gained by increasing the number of times the initial 1 unit of tension is applied to the load. If the output force is bigger than the input force, a machine has a mechanical advantage greater than 1. This can be accomplished through several means.

8.5.1. A pulley is a chain, belt, or rope wrapped around a wheel. The mechanical advantage of a pulley system is approximately equal to the amount of supporting ropes or strands.

8.5.2. The simplest example of a pulley system is a Simple 1:1 shown in **Figure 8.1, Simple Pulley Systems.** Here the fixed pulley provides no MA, simply changing the direction of pull. The force required to lift the load is approximately the same as the load itself and the same amount of rope is brought in for the distance the load is raised.

Figure 8.1. Simple Pulley Systems.



8.5.3. If the same pulley is moved to a different location so it is now a traveling pulley, the MA changes. The pulley moves toward the anchor as the load is raised. The effort to haul the load is cut in half, but this requires hauling in twice as much rope to achieve the same distance raised. See the Simple 2:1 example in **Figure 8.1**.

8.5.4. If a second pulley is added so the direction of the pull is reversed, the pulley does not affect the Ideal Mechanical Advantage (IMA), though in some cases it may make it more practical for the haulers to pull. This is referred to as a system with an MA of 2, or a "2:1" system.

8.5.5. To be efficient, flexible, and effective, rescuers need to have the ability to quickly decide which system is most appropriate for the given working conditions such as the amount of tension the load places in the main line, the availability of equipment, working room, friction points, and the number of haulers.

8.6. Pulley Systems. Pulley systems can be divided into three categories: Simple, Compound, and Complex. Most pulley systems can be rigged either by using the main line or using a separate rope, often referred to as "acting on the main line," as shown below. While most pulley systems used in rope rescue will either be simple or compound, rescuers still need to be able to recognize and understand the advantages and disadvantages of all types of pulley systems.

8.6.1. There are some components that can be added to a pulley system to make its operation more practical during a rescue. The first is a "self-minding ratchet" also known as progress capture. This device enables the haulers to maintain lift distance gained without having to hold the rope at all times. One such device is the Prusik and a Prusik minding pulley (PMP), shown in the Simple 3:1 example in **Figure 8.1**.

8.6.2. Devices that act as ratchets also enable resets of the pulley system as they maintain tension in the main line while the pulley system is slackened and reset. This can also be accomplished by having a rescuer tend the device who can grab the rope when the pulley system needs a reset.

8.6.3. **Simple Pulley Systems.** These are characterized by having one continuous rope flowing back and forth alternately between the pulleys under load and the anchor (or the anchor and the load) and all pulleys at the load side (referred to as traveling pulleys) travel towards the anchor at the same speed. **Figure 8.1, Simple Pulley System**s, details this movement. Summary of Simple Pulley Systems Principles. **NOTE:** Simple pulley systems work out best most of the time due to altitude, cold, and team fatigue.

8.6.3.1. If the end of the rope is at the anchor, the IMA will be an even number (2:1, 4:1, 6:1, and so forth). If the end of the rope is toward the load, the IMA will be an odd number (1:1, 3:1, 5:1). A handy way to remember this is anchor even load odd, or A-E-L-O (or EAOL).

8.6.3.2. If the last pulley in the system (one closest to the haulers) is at the anchor (fixed), it does not add MA but just changes the direction of pull.

8.6.3.3. The IMA of a simple system is determined by counting the number of ropes under tension at the load side of the pulley.

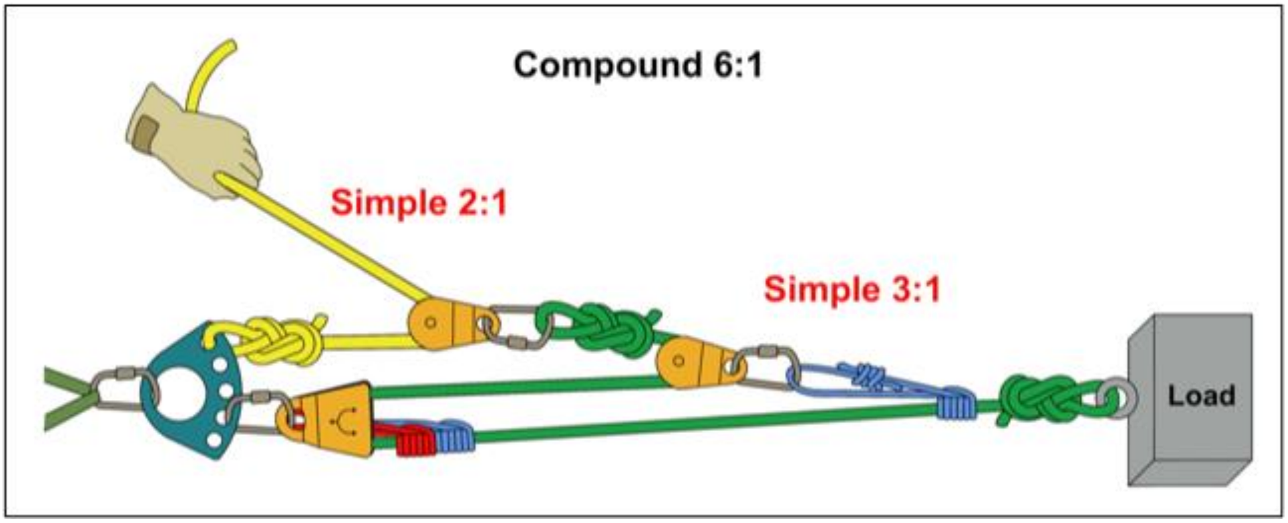
8.6.3.4. The number of pulleys required for a simple system (without change of direction) is always the IMA minus one.

8.6.3.5. To incorporate a "self-minding ratchet" located at the anchor, the IMA of the simple pulley system must be an odd number.

8.6.4. **Compound Pulley Systems.** These are characterized as one simple pulley system pulling on another simple pulley system; the traveling pulleys travel towards the anchor at different speeds. Compound pulley systems are useful because they can provide greater MA than simple systems for the same number of pulleys, thereby reducing overall friction loss for the same IMA. The following is a summary of compound pulley system principles.

8.6.4.1. The IMA of a compound pulley system is determined by multiplying the IMA of each simple pulley system together. For example, a simple 3:1 pulling on a simple 2:1 becomes a compound 6:1 as 3 x 2 = 6; also note a simple 2:1 pulling on a simple 3:1 is also a compound 6:1 as 2 x 3 = 6. If the goal is to get the load up with the least number of resets and the compound pulley system comprised of two dissimilar MA simple pulley systems, then rescuers should configure the higher MA system to pull on the lower MA system. In other words, have the 3:1 pull on the 2:1, resulting in a compound 6:1.

Figure 8.2. Compound Pulley System.



8.6.4.2. Longer throw distances per reset can be achieved by positioning the anchor pulleys of the last (closest to the hauler) simple pulley system, far enough back to allow each simple pulley system to collapse at the same time; the last 3:1 must have three times the reset distance of the first simple 3:1. This is due to the fact that three times more rope will be pulled through the last simple 3:1 than the first simple 3:1.

8.6.4.3. The highest MA with the least number of pulleys is achieved by repeatedly compounding a simple 2:1 on a simple 2:1. When constructing a compound pulley system, think of all the possible combinations when multiplied together will equal the desired MA; then consider the advantages and disadvantages of each and determine which will best meet the need given the available equipment and working constraints. See **Figure 8.2**.

8.6.5. **Complex Pulley Systems.** These are characterized by being neither simple nor compound. There is no one definition that characterizes all complex systems due to their great diversity.

8.6.5.1. With only four pulleys, more than 100 combinations of pulley systems can be made, with most of them being complex types.

8.6.5.2. With the exception of a few common complex pulley systems such as the "Spanish Burton," complex pulley systems are not often used in rescue work. Typically, similar objectives can be met using simple or compound pulley systems that are easier for rescuers to recognize and more flexible for modifications, as required.

8.6.6. **Theoretical mechanical advantage (TMA).** TMA is the estimated actual mechanical advantage (AMA) calculated after taking into consideration factors affecting IMA. These include several factors, the largest component of which is friction.

8.6.6.1. Calculating the TMA is covered later in this chapter, but it is important to note pulleys and Carabiners within the pulley system, the TMA, and AMA will always be less than the IMA.

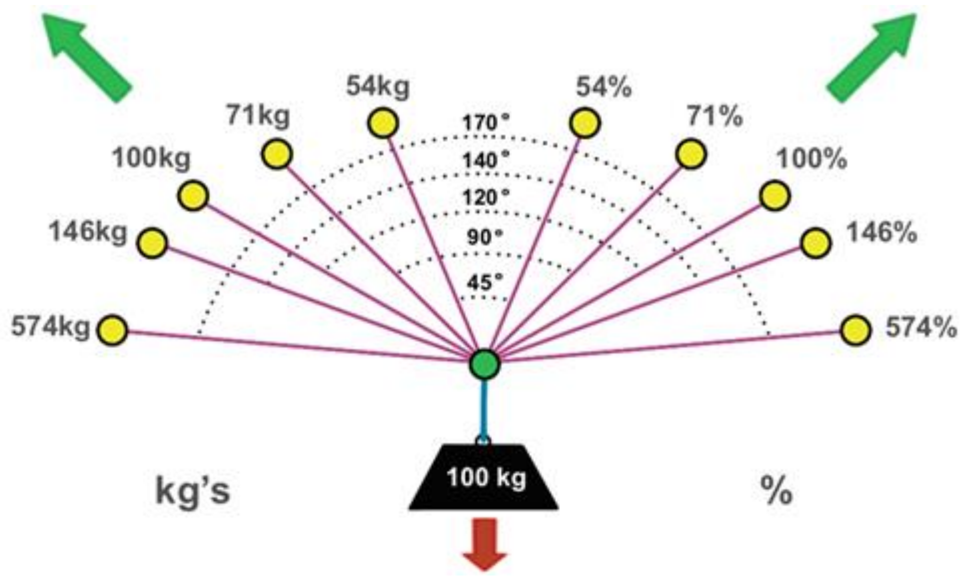
8.6.7. **Vector Angles.** One of several considerations when building a system is the effect that vector angles have on both mechanical advantage and anchors. See **Figure 8.3, Vector Angle and Resultant Loads**.

8.6.7.1. Of primary concern to the rescue technician is as the angle increases (widens), the greater the effect force applied to the middle has and the less effect force applied to the ends have.

8.6.7.2. Notice the decreased force applied to a pulley as the angle widens from 90 to 120 to 160 degrees.

8.6.7.3. Conversely, note the effect on anchors when force is applied to the central connection point. As demonstrated in **Figure 8.3**, when the vector angle between anchors reaches 120 degrees, a force equivalent to 100 percent of the load is transmitted to each anchor. Exceeding 120 degrees should be strictly avoided as the force created by the vector angles rapidly escalates (at 160 degrees the theoretical force applied to each anchor is three times the load).

Figure 8.3. Vector Angle and Resultant Loads.



8.6.8. **Tension-Method for Calculating Ideal Mechanical Advantage.** One method of calculating the IMA of any pulley system is referred to as the Tension method or T-method. A pulley system's ideal mechanical advantage (IMA), which does not factor in friction, is expressed as a ratio of the amount of output force to the amount of input force (e.g., 6:1 or “6 to1”). The input force is the tension applied to the system and is always expressed as “1.”

8.6.8.1. Some basic physics principles need to be understood and applied to knowing how tension is distributed through a pulley system. Mechanical advantage in pulley systems is gained by increasing the number of times the initial one unit of tension is applied to the load.

8.6.8.2. By assigning one unit of tension (called "T") to where one pulls on the pulley system, then following the path of the rope through the pulley system to the load itself, the IMA can be determined.

8.6.8.3. This is done by keeping track of how that initial unit of tension is distributed throughout the system. Simply compare the amount of tension the load receives to the initial input unit of tension.

8.6.8.4. The key to understanding the T-method is in recognizing what happens to the tension in the rope as it flows through the pulley system. Whenever there is a junction in the ropes of the pulley system, where either more than one rope acts on another rope, or one rope acts on more than one rope, then the tension on the side of the junction must be equal to the tension on the other side of the junction. Conversely, for each side of the junction, the tension must be distributed appropriately (not always equally) to each rope. For example, if a rope having one unit of tension makes a 180-degree change of direction through a pulley (a junction), then whatever that pulley is connected to receives two units of tension. In essence, two ropes each having a tension of one (for a total of two units of tension) are acting on (and being opposed by) what the pulley is connected to. Some examples of using the T-method to calculate the IMA of pulley systems are shown in **Figure 8.4** and **Figure 8.5**.

8.6.8.5. Steps for counting MA using the T-Method.

8.6.8.5.1. Assign one unit of tension to where one pulls on the pulley system.

8.6.8.5.2. Follow the rope through the pulley system and when encountering a junction, apply the principles of tension distribution. Keep track of all units of tension through to the load.

Figure 8.4. Calculating MA using T-Method.

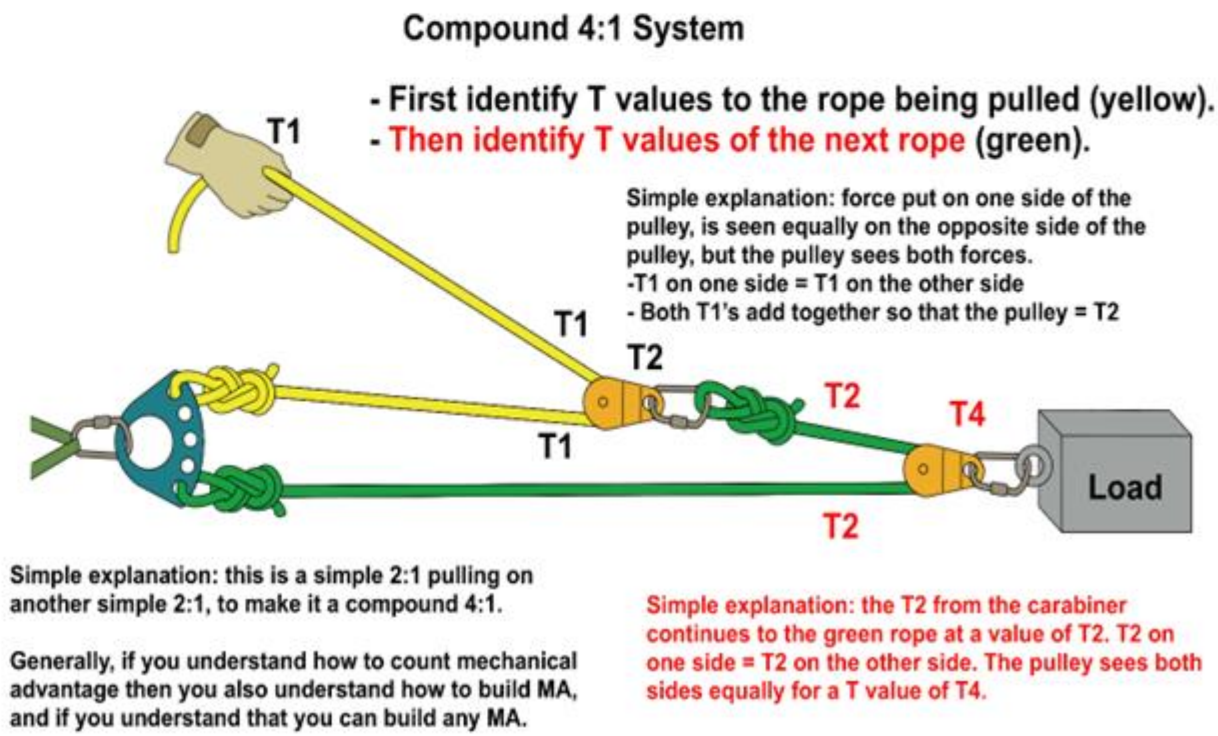
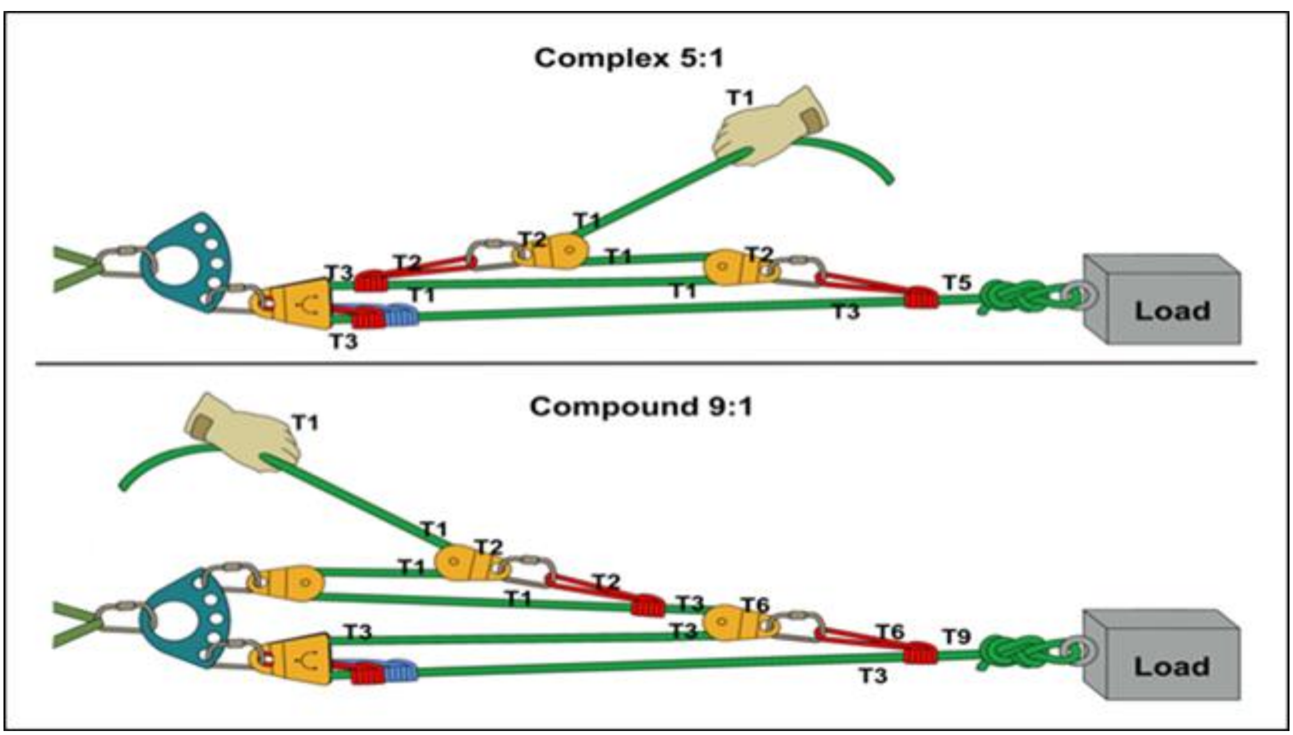


Figure 8.5. T-Method.

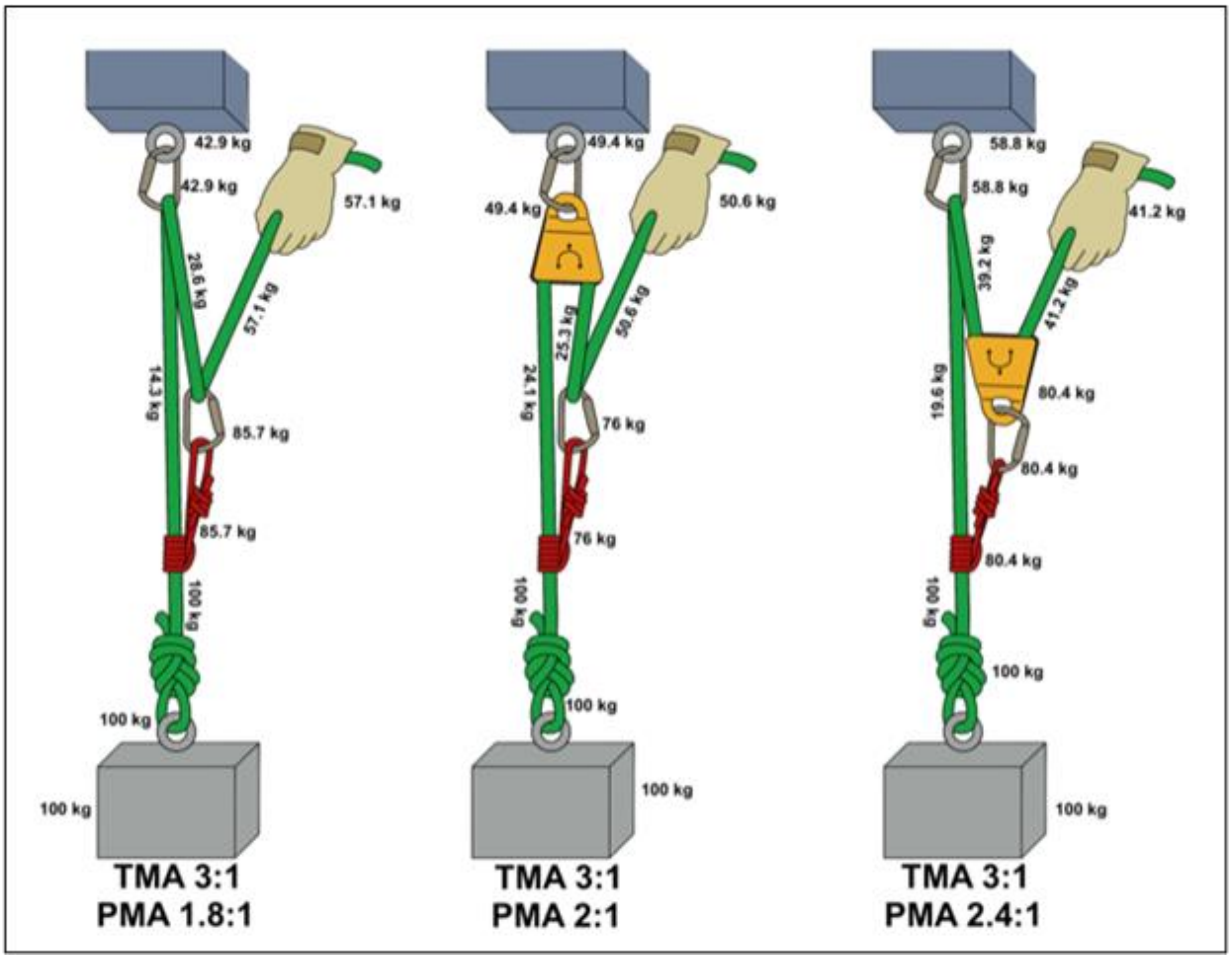


8.6.8.6. The theoretical mechanical advantage (TMA) is the estimated actual mechanical advantage (AMA) calculated after considering factors that affect IMA, the largest component of which is friction.

8.6.8.7. The greatest friction losses occur as the rope comes into contact with the pulleys. Sometimes carabiners are used in place of pulleys which results in an even greater amount of friction.

8.6.8.8. To calculate/measure the losses due to friction, one must know the efficiency of the pulleys or carabiners being used. Efficiency is the measure of friction loss calculated as the input force over the output force, expressed as a percent. For example, if 90 N is required on one side of a pulley to hold a 100 N load on the other side, the efficiency of the pulley is stated as 90 percent or 90/100. With efficiency information, the friction loss through the system can be calculated. **Figure 8.6** shows calculations for a pulley system with pulleys having an efficiency rating of 0.90.

Figure 8.6. Theoretical MA vs. Practical MA.



8.6.8.9. Assuming that the pullers pull at the pulley system with one unit of tension (1T), only 0.90 T will be transferred past the first pulley. When that 0.9 T reaches the second pulley, only 0.81 T will be transferred on (0.9 x 0.9 = 0.81) as the friction loss is now compounded over two pulleys. Follow this process all the way through the pulley system. When complete, use the T-method to determine the final TMA, which in this example is 2.71:1. If higher efficiency pulleys are used, the TMA is increased, bringing it closer to the IMA of 3:1. Also important to note is that if using pulleys of different efficiencies, fewer losses occur if the most efficient pulley is placed closest to the pullers. This is because the loss at the first pulley is compounded throughout the system.

8.6.9. **Friction.** Is a force that opposes motion. Friction acts in a direction opposite to the object's direction in motion. Without friction, the object would continue to move at a constant speed forever. There are different forms of friction-sliding, rolling, and fluid. The formula to calculate the normal force is FN = - MG.

8.6.9.1. FN is the normal force in Newton (N).

8.6.9.2. M is the mass in kg.

8.6.9.3. G is the gravitational acceleration in m/s2.

8.6.9.4. EXAMPLE: The normal force acting on a 70 kg person would be FN = - (70 kg) (-9.8 m/s2) = 686N. What this means in rope rescue is that friction incurred when lowering a victim and attendant can work to our advantage, whereas friction incurred while raising the same load makes for substantially more work. This sounds overly simple, but friction takes its toll on equipment and rescuers. For example, a 2,000 N load being raised over a pulley that changes direction 90 degrees will incur friction such that the haul team is only operating at 0.9 efficiency. In other words, they are only capable of hauling 1,800 N.

8.6.9.5. Friction Coefficient. Additional examples regarding friction coefficient are as follows:

8.6.9.6. Rock edge coefficient of 0.59. Therefore, a 2 kN load (2kN/0.59) would equal 3.38.

8.6.9.7. Metal edge coefficient of 0.83. Therefore, a 2 kN load would equal 2.40.

8.6.9.8. Munter Hitch coefficient of 0.15. Therefore, a 2 kN load would equal 13.33.

8.6.9.9. The challenge here is that the human hand can only hold 209 N for a short duration, therefore the friction coefficient generated is 0.32, or 209 N x 0.59 = 150.

8.7. Litter Raises and Lowers.

8.7.1. **Litter Transport.** Litter transport up or down steep embankments is an often-used rope technique for transporting patients involved in “over-the-side” vehicle accidents.

8.7.2. **Scree Evacuation.** In mountainous terrain, this technique may also be referred to as scree evacuation. Usually there are three or four litter bearers, and the main line is attached to the head end of the litter. While there are several different ways to rig the litter for a raise/lower on a slope, consideration must be given to the escalating tension that the main line is subjected to as the slope angle increases. If the objective is to operate at or above a static systems safety factor (SSSF) of 10:1, then there is a limit on how steep this technique can be used.

8.7.3. **Operating Guidelines.** Several operating guidelines need to be considered when determining maximum slope angle for a given rope type and number of litter bearers. While it is impractical to take a calculator or a set of force table to the rescue, some rules of thumb have been developed for understanding the relationship among mass, force, and slope angle.

8.7.4. **Use of Force Vectors.** The graphical use of force vectors provides both a reasonable level of force approximation and a better understanding of the forces produced within the system.

8.7.5. **Rule of Thumb.** Recognizing that many variables affect the resulting force or tension in the main line, some assumptions need to be made to simplify it toward the rule of thumb. These assumptions include the following:

8.7.5.1. The first two persons (rescuer and patient) have masses of 100 kilograms each, including equipment, and each additional person have masses of 80 kilograms each.

8.7.5.1.1. Each litter bearer walks with their body positioned perpendicular to the slope.

8.7.5.1.2. The rope angle is the same as the slope angle.

8.7.5.1.3. The path traveled by the litter bearer is that of the fall line.

8.7.5.1.4. Forces Acting on the System. There are basically three forces acting on the system, see **Figure 8.7**.

8.7.5.1.5. Mg: The mg-force (mass x gravity) due to gravity acting on the combined mass of the litter bearers, patient, and equipment.

8.7.5.1.6. R: The resisting force of the ground on which the litter bearers walk.

8.7.5.1.7. T: The tension in the rope.

8.7.6. **Force Vectors.** Statically, these forces are in equilibrium meaning they have resolved themselves. Each of these forces can be represented graphically as force vectors since they have both magnitude and direction. Knowledge of the total mass involved provides knowledge of the direction and magnitude of the mg force.

8.7.7. **Force Scale Selection.** By selecting a scale for force, such as 1 centimeter (cm) = 1 kilo Newton (kN), the force vectors can be drawn to scale, and determine the T in the rope by physically measuring that force vector.

8.7.7.1. Since the system is in equilibrium, the combined effect of the R and T force vectors result in an opposite and equal force to the mg vector, thereby countering its effect.

8.7.7.2. Procedures to draw the vectors:

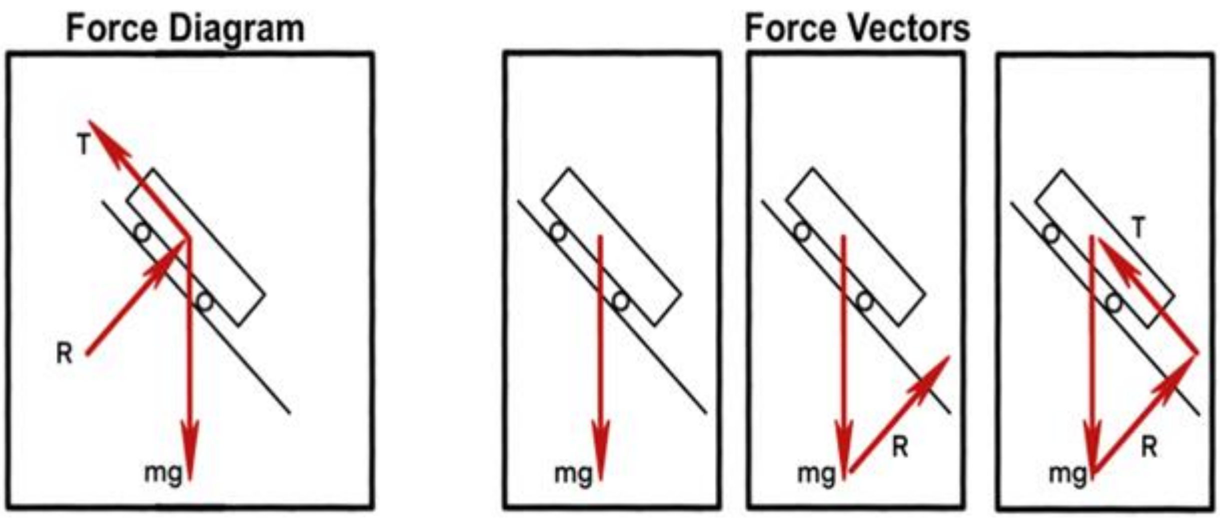
8.7.7.2.1. Start with the mg force vector, indicating both its magnitude and direction.

8.7.7.2.2. Next draw the vectors which counter the effect of mg

8.7.7.2.3. Draw the resistance R vector (**Figure 8.7**) in this case only know is direction—and have the tail of the R vector start at the tip of the mg vector.

8.7.7.2.4. Draw the T vector from the tip of the R vector and draw it parallel to the slope angle until it intersects the tail of the mg vector. The magnitude of the T vector—which is the tension in the rope—is determined by measuring its length and comparing it to the scale to which the mg vector was drawn. For example, if using the above scale and drew the mg vector 2 cm long representing 2 kN of force, the resultant T vector is 1.2 cm in length, then the corresponding force would be 1.2 kN.

Figure 8.7. Force Diagram and Force Vectors.



8.7.7.3. It becomes apparent that as the slope angle increases, the force vector T becomes larger to the point where T and mg are the same when the angle is 90 degrees (free-hang).

8.7.7.4. Conversely, the tension T becomes nil when the angle of the slope is 0 degrees (level).

8.7.7.5. Simple guidelines can now be developed for a 10:1 SSSF by comparing the knotted breaking strength of a rope to the resultant tension or T in main line for changing levels of mass and/or slope angle. **Table 8.4** shows the resultant force for given slope angles (in degrees) and different sized rescue loads (kg).

8.7.7.6. The green-shaded areas in the **Table 8.4** represent acceptable levels of main line tension (kN) for a 10:1 SSSF using an 11.1-mm or larger nylon kernmantle low-stretch rope, assuming a knotted breaking strength of at least 22 kN.

8.7.7.7. The yellow-shaded region shows acceptable combinations of mass and slope angle for a 12.7 mm main line, assuming a breaking strength of approximately 33kN. Force levels that exceed 10:1 SSSF for both 11.1mm and 12.7 mm main line ropes are shown in the red region. As an example, three litter bearers and a patient can maintain a 10:1 SSSF on slopes to just under 40 degrees using an 11.1 mm main line. If instead, they are using a 12.7 mm main line, then the maximum slope angle can be increased to 70 degrees.

8.7.7.8. It is important to note that the yellow and red areas of the **Table 8.4** do not represent "go" or "no-go" from an operational standpoint.

8.7.7.9. The different colors simply represent where a 10:1 SSSF does or does not exist given a certain slope angle, rope type, and rescue mass. Under certain conditions, a rescue team may choose to deviate from a 10:1 SSSF for specific reasons. This element should be factored into the ORM checklist. **NOTE:** All diagrams in this chapter are for instructional purposes only. They are not to be construed as endorsements of any particular type of equipment or specific system. Certain items such as progress capture Prusiks have intentionally been omitted for reasons of clarity.

8.7.7.10. Using the vector angles chart along with **Table 8.4**, the leg tension forces can be computed accordingly. The desired outcome is the determination as to whether or not it is safe to suspend a rescuer and victim on the line by maintaining a SSF of 10:1.

Table 8.4. Resultant Force (kN) for a Given Slope Angle and Mass.

Angle	Mass (kg)				
	200 Kg (Two people)	**280 Kg (Three people)**	**360 Kg (Four people)**	**440 Kg (Five people)**	**520 Kg (Six people)**
0	0.00	0.00	0.00	0.00	0.00
5	0.17	0.24	0.31	0.37	0.44
10	0.34	0.48	0.61	0.75	0.88
15	0.51	0.71	0.92	1.12	1.33
20	0.67	0.94	1.21	1.47	1.74
25	0.83	1.16	1.49	1.83	2.16
30	0.98	1.37	1.76	2.16	2.55
35	1.12	1.57	2.02	2.46	2.91
40	1.26	1.76	2.27	2.77	3.28
45	1.39	1.95	2.50	3.06	3.61
50	1.50	2.10	2.70	3.30	3.90
55	1.61	2.25	2.90	3.54	4.19
60	1.70	2.38	3.06	3.74	4.42
65	1.78	2.49	3.20	3.92	4.63
70	1.84	2.58	3.31	4.05	4.78
75	1.89	2.65	3.40	4.16	4.91
80	1.93	2.70	3.47	4.25	5.02
85	1.95	2.73	3.51	4.29	5.07
90	1.96	2.74	3.53	4.31	5.10

NOTE: Under certain conditions, a rescue team may choose to deviate from a 10:1 SSSF. This element should be factored into the ORM checklist.

Figure 8.8. Leg Tensions.

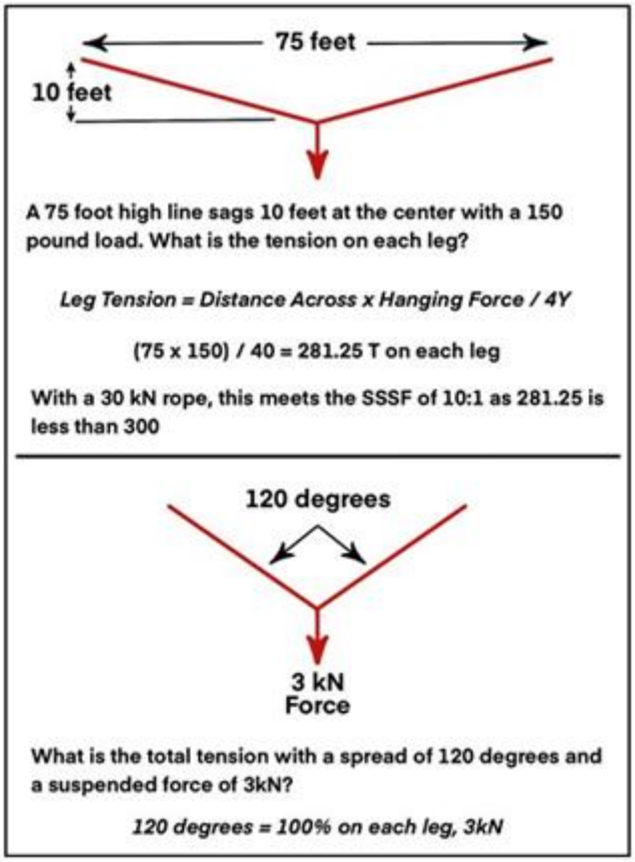


Table 8.5. Summary of Leg Tension Forces.

Angle Leg	Tension (percent)
90	70
120	100
150	200
170	575
NOTE: Leg tension = distance across span x hanging force / 4Y (vertical drop).	

8.8. Ropes for Rescue Work.

8.8.1. **Ropes Selection.** One of the most difficult concepts to grasp is the difference between static, low stretch and dynamic ropes. Static rope construction is ideal for rescue systems due to the low stretch characteristics. Static rope typically only stretch 2 to 3 percent and may not stretch more than 6% of total length per manufacturer's guidance. Low stretch rope stretches between 6% and 10% of its minimum breaking strength. Dynamic rope construction allows for a greater stretch with the rope making it ideal for lead climbing situations. **NOTE:** Dynamic ropes bear the UIAA symbol for single or double rope use. Ropes must be rated for single use to be utilized in a single rope system. Dynamic rope characteristics allow 8% - 10% stretch, reducing injuries in climbing falls. However, it is not the ideal rope in a rescue scenario. The least desired situation is a rescuer and patient to have to endure is rope elongation after a main anchor has failed.

8.8.2. **Rope Strength.** Rope strength is expressed as tensile strength at break. Tensile strength is the average strength of new rope under laboratory conditions. This is determined by wrapping the rope around two large diameter capstans and slowly tensioning the line until it breaks. The manufacturer's recommended working load is determined by taking the tensile strength and dividing it by a factor that more accurately reflects the maximum load that should be applied to a give rope to assure a comfortable safety margin and longevity of the line.

8.8.3. **Minimum Strength.** The minimum strength is the absolute "mandatory" consideration for handling of patients during roped rescue operations. Ropes are tested IAW Federal Standard 191A Method 6106. The NFPA also endorses the use of this standard. The testing of ropes is performed by an independent certified testing laboratory. Keep in mind that a laboratory test which is repeatable any time anywhere cannot accurately reflect the conditions in the field. The actual performance in the field may not measure up to laboratory standards.

8.8.4. **Determine Greatest Workload.** Before selecting a rope, first determine the greatest working load expected the rope to support in its lifetime i.e., single person rappel, lowering of personnel or equipment, high-line, traverse, etc. The current NFPA standard for one-man ropes is a safe working load of 300 pounds (136 kg), minimum tensile strength of 4,500 pounds (2,041 kg), minimum diameter of 3/8 inch (10 mm), and a maximum of 1/2 inch (12.5 mm). NFPA standards for two-man ropes are safe working load of 600 pounds (272 kg), minimum strength of 9,000 pounds (4,082 kg), minimum diameter of 1/2 inch (12.5 mm), and a maximum of 5/8 inch (16 mm). Further guidance regarding the selection of rescue ropes can be found in the attachments of this manual.

8.8.5. **Accessory Cord.** Accessory cords are scaled down kernmantle rope. Diameters less than 5/16 inch (8 mm) are accessory cords; all other sizes greater than (8mm) are considered ropes. A single accessory cord "should not" be used in a life-supporting situation. Do not use static accessory cord for climbing, rappelling, or rescue. Accepted uses for accessory cords include non-critical operations. Acceptable uses of accessory cord are ascending systems and hauling systems using knots. However, in these cases, the patient or precious cargo load must be supported by a redundancy in the system that will protect the load should a single accessory cord fail.

8.8.5.1. Inspection of ropes and cords. Be especially vigilant when inspecting ropes and accessory cords. Due to their compact design and small diameters, accessory cords tend to wear out much quicker than ropes.

8.8.5.2. Inspection of Friction Hitches. Friction hitches (i.e., Prusiks) under heavy loading can slip. The resulting frictional heating can glaze or melt the sheath. Keep a sharp eye for this type of damage.

8.9. Webbing.

8.9.1. **Flat Webbing.** Flat webbing is thicker, stronger, and more abrasion resistant than its tubular counterpart. The increased strength of flat webbing is often preferred in harsh and abrasive environments for use with technical rigging and in heavy rescue loads.

8.9.2. **Tubular Webbing.** Tubular webbing is easily identified because of the hollow center or tube-type construction. **CAUTION:** Products like SPECTRA cord have a low melting point and are extremely slippery; their use should be avoided.

8.9.3. **Load Rating.** All hardware should have a load rating stamped on it. If no rating stamp is present, do not use it.

8.9.4. **Static Systems Safety Factor Rating.** A SSSF of 10:1 which is equivalent to a rating of at least 20 kN is mandatory. Several pieces of rock climbing hardware do not meet this criteria such as daisy chains, Quickdraws, and some pulleys for haul systems.

8.9.5. **Lowering a Main Line.** Preferred equipment for lowering a main line is a scarab or dual ATC guides.

8.10. Pulleys. There are three main types of pulleys: ball bearing, needle bearing, and bushing. In general, pulleys with ball bearings deliver about 95% efficiency while pulleys with bushings deliver about 85% efficiency. Rope stiffness affects pulley efficiency.

8.11. Carabiners. Carabiners are manufactured in a multitude of sizes, shapes, and styles. They are of varying materials, strength, shape, gate type, gate opening, and reservoir space. The strength of a carabiner is of utmost importance and should be adhered to.

8.11.1. **Carabiner Limitations.** A Carabiner with an open gate generally loses approximately 50 percent of its strength, while tri-loading (three-way) usually results in 70 percent loss in strength. The shape and size of the carabiner determines how much material can be loaded onto the carabiner. Carabiners are often overloaded with material, making it difficult for the gate to be opened. Overloading a carabiner with material can cause side loading which significantly reduces the strength of the carabiner.

8.12. Descenders. Descenders (ATC, Gi-Gi, Gri-Gri, Reverso, etc.) are devices used to aid in belaying and rappelling. These devices create additional bends in the rope which increases friction, allowing for greater control and speed regulation during rappels and belays.

8.13. Belaying Devices. This device relies on a common principle of the rope generating a frictional force with the object upon which it is wrapped in proportion to the load. The load can be easily controlled as long as the number of wraps is sufficient to generate enough friction to counteract the force generated at the contracting surfaces. A very desirable further attribute of this principle is the ability of these systems to absorb large momentary increases in load forces. When the system is subjected to a sudden increase in force, the rope grips the object harder, creating a proportional increase in friction. The increase in friction effectively compensates for the sudden load increase and only a fraction of this force is transferred to the operator of the system, see **Figure 8.9**.

8.13.1. Stitch Plate Devices. Stitch plate devices, like ATC's, offer multiple friction windows which provide multiple levels of stopping power when used in lowering and rappelling. Dual ATC's may be used to belay a rescue load. Additionally, a single ATC with a locking carabiner redirect through the anchor with a Valdotain Tresse (VT) Prusik in the "Max/1" configuration (placed between the load and the ATC) connected to a load releasing hitch (LRH) secured to the anchor is also an acceptable technique for belaying rescue loads.

8.13.2. Scarab. Scarabs area small, simple device that could easily control heavy rescue loads. To increase friction on the device, add additional wraps to the horns. To decrease friction control on the device, remove wraps from the device. The strength of a Scarab frame and crossbar is greater than 40 kN.

8.14. Rigging Plates. Rigging or "stitch" plates are pieces of hardware designed for organizing the work position and to ease the creation of multiple anchor system expediently. It also serves to optimize the distribution of forces at the belay, see **Figure 8.9**.

Figure 8.9. Belay Device and Rigging Plates.

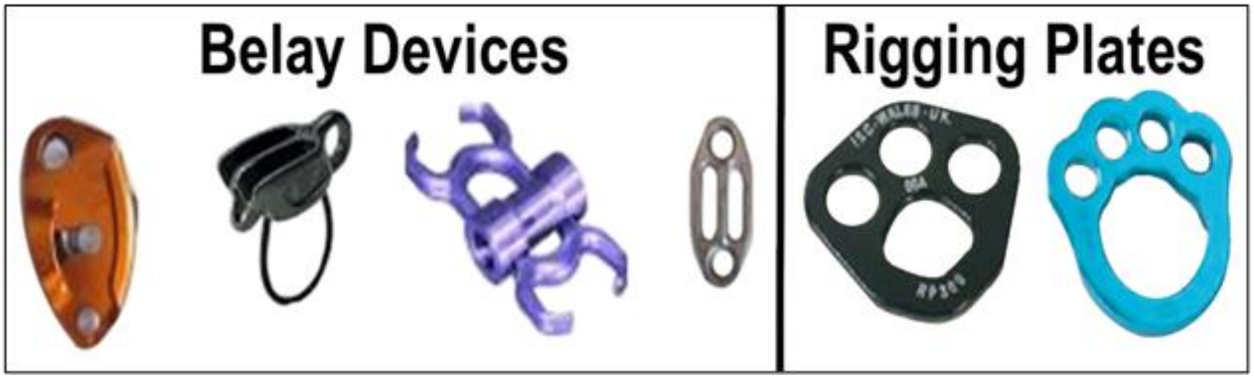


Table 8.6. Hardware Characteristics.

Device	Strength
Large diameter pulley	32 kN
Prusik minding pulley (PMP)	32 kN
SMC Mini Rigging Plate	36 kN
ATC	Not Officially Rated
Scarab	40 kN
Gri-gri	Not Officially Rated

Table 8.7. General Rope Characteristics.

Material	Strength
6 mm cord	8.7kN
7 mm cord	11kN
8 mm cord	16.3kN
10 mm rope	31.5kN
11 mm rope	36.4kN
1 inch webbing	17.7kN
Radium release hitch (RRH)	36 kN
Wrap 3/pull 2 anchor (W3P2)	35 kN
W2P1 anchor	24 to 26 kN
NOTE: The strength of rope or cord varies and is dependent on the type of material used in manufacturing. Users should be familiar with the type of material, construction, and strength rating prior to using mountaineering equipment.	

8.15. Knots, Bends, and Hitches. The following section is a compilation of the knots deemed most efficient for modern rope rescue work. It is not inclusive, but each of the knots depicted is reliable and easy to construct. **NOTE:** Rope rescue personnel should practice tying knots with the same size and type rope intended for use in the operation.

Table 8.8. Effects of Knots on Rope Strength.

Knot	Percent of Rope Strength Lost
Bends	
• Double fisherman’s knot	21
• Figure eight bend (Flemish bend)	19
• Water knot (actually a bend)	36
Loops	
• Figure eight loop (with bight)	20
• Figure eight loop (follow through)	19
• Double figure-eight loop	18
• In-line figure-eight loop	25
• Butterfly knot	25
• Bowline	33
• Overhand loop (with a bight)	15
• Overhand double loop	26
Rope With a Loop in It	
• Figure-eight loop	35
• In-line figure-eight loop	41
• Butterfly loop	31
Knots in Web	
• Overhand loop	35
• Figure-eight loop (with a bight)	30
• Figure-eight loop (follow through)	26

8.15.1. Rope Terms/Definitions:

8.15.1.1. Knot or Tie: Strand of material is tied to itself.

8.15.1.2. Bend: Connecting 2 ends of material together.

8.15.1.3. Hitch: A strand (or two strands) of material is tied around another object in such a manner that if the object were removed, the hitch would undo itself.

8.15.1.4. Running End / Working End: The end of the rope or material that is being worked with.

8.15.1.5. Standing End: The bulk of rope or material not being actively used.

8.15.1.6. Bight: 180-degree turn in the strand of rope material.

8.15.1.7. Loop: A 360-degree turn in the strand of rope or material. Basic and End-of-Rope Knot.

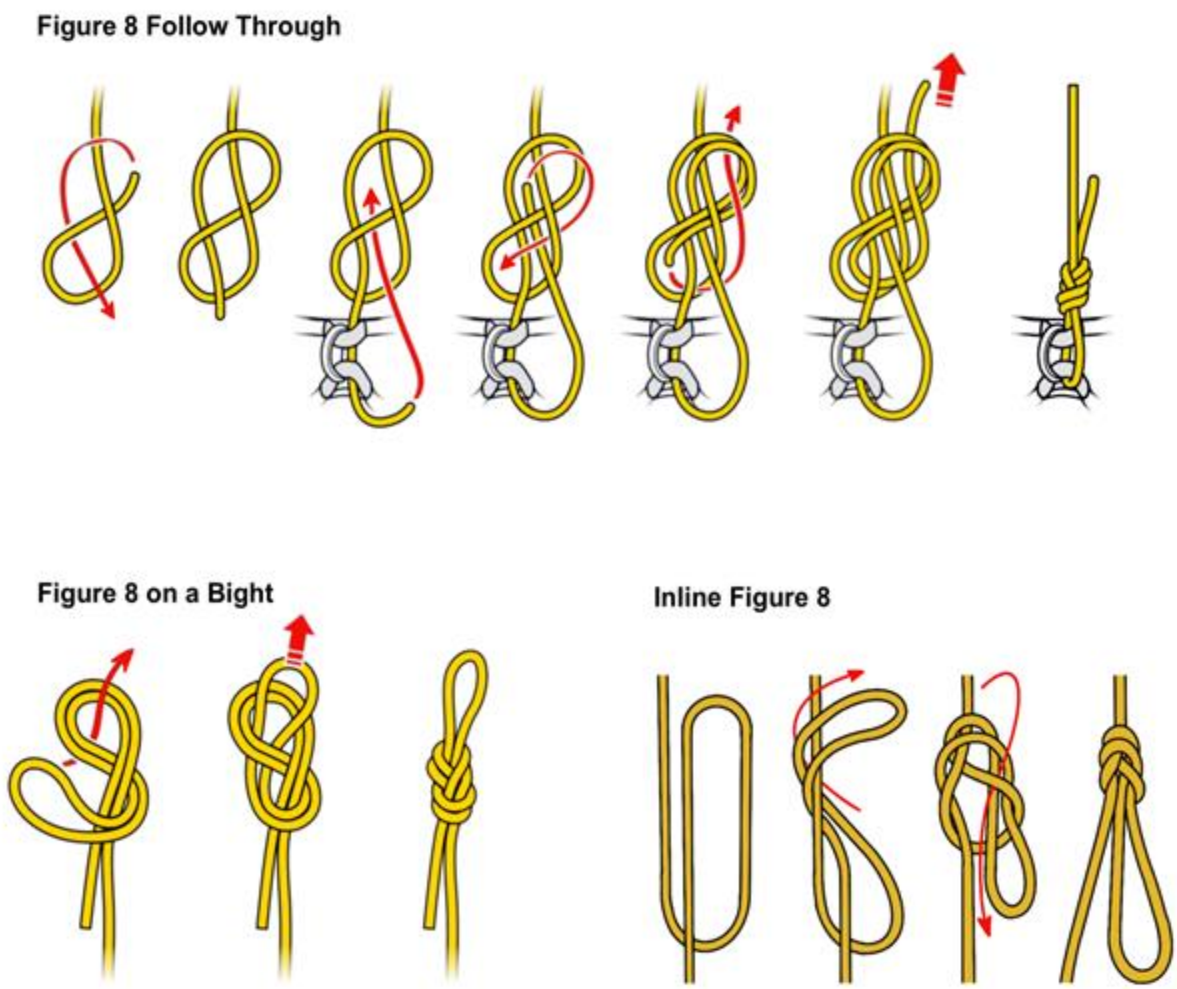
8.16. Types of Knots, Bends, and Hitches:

8.16.1. **Figure Eight Follow Through (Retraced Figure Eight).** The Figure Eight Follow Through is an anchor knot and produces the same result as a Figure Eight on a bight. However, by tying the knot in a retrace, it can be used to fasten the rope around objects where the loop cannot be used.

8.16.2. **Figure Eight on a Bight (Figure Eight Loop).** The Figure Eight on a Bight is used to form a fixed loop in a rope. It is a middle of the rope knot.

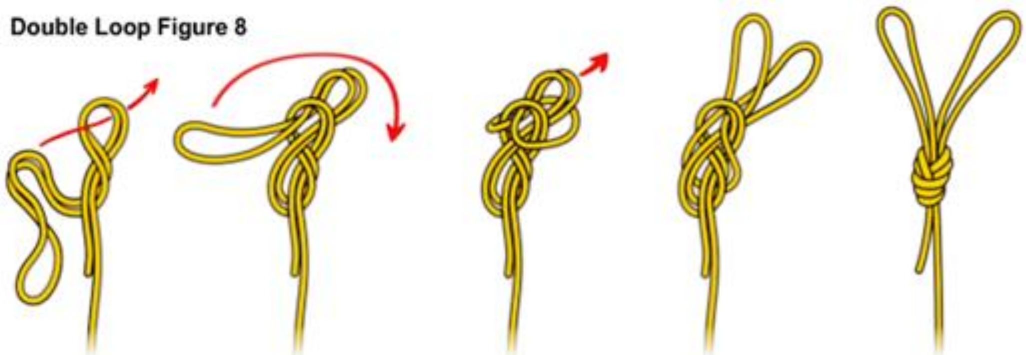
8.16.3. **Inline Figure Eight (Directional Figure Eight).** The inline figure-eight knot forms a single, fixed loop in the middle of the rope that lies back along the standing part of the rope. It is a middle rope knot.

Figure 8.10. Figure 8 Knots.



8.16.4. **Double-Loop Figure Eight.** The double-loop Figure Eight is a middle of the rope not and is used to form two fixed loops in the middle of a rope. It can also be used to equalize anchors when installing a fixed vertical or traverse line.

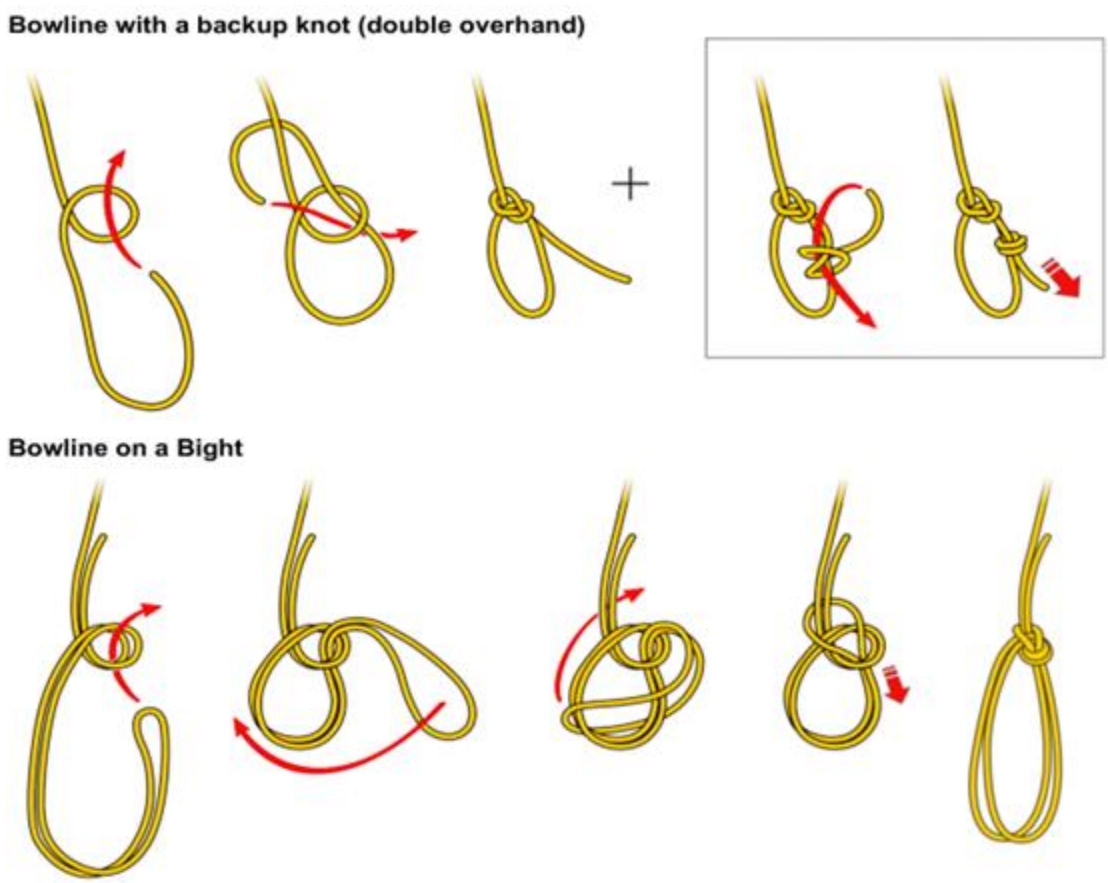
Figure 8.11. Double Loop Figure 8.



8.16.5. **Bowline.** The bowline is an anchor knot and is used to make a solid, fixed loop in the end of the line or around and anchor.

8.16.6. Bowline-on-a-Bight (Two-Loop Bowline). The bowline-on-a-bight is a middle of the rope knot and is used to form two fixed loops in the middle of a rope.

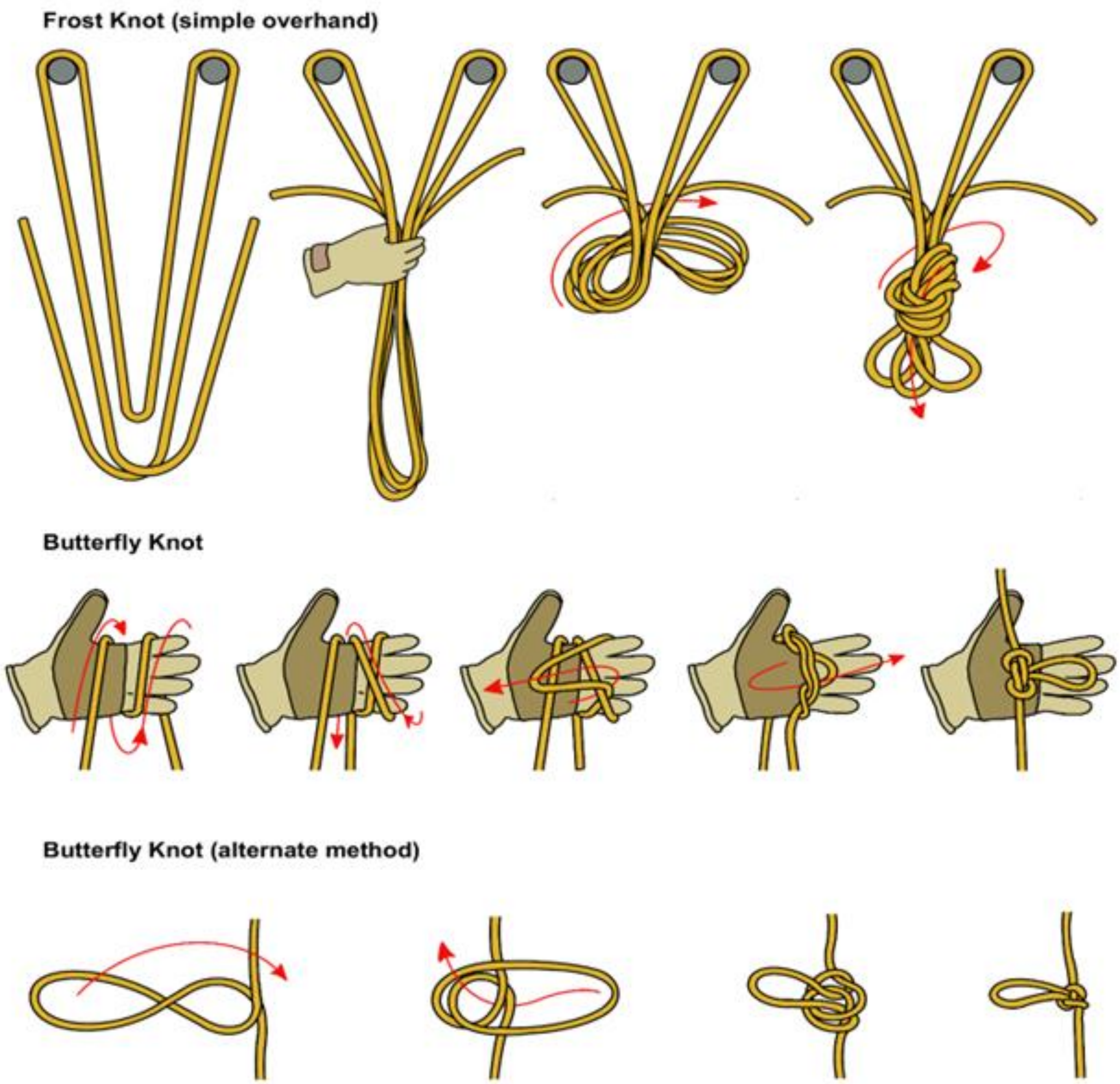
Figure 8.12. Bowline.



8.16.7. **Frost Knot.** The frost knot a generic term for any knot that uses more than two strands and is usually finished with a simple overhand know or figure-8 on a bight. It is tied with either webbing, cordellette, or rope and is used to create an equalized and redundant anchor. It can also be used to create the top loop of an etrier.

8.16.8. **Butterfly Knot.** The butterfly knot forms a single, fixed loop in the middle of the rope designed to pull in three directions. It is a middle rope knot. Also used to isolate a damaged section of rope.

Figure 8.13. Frost Knot & Butterfly Knot.

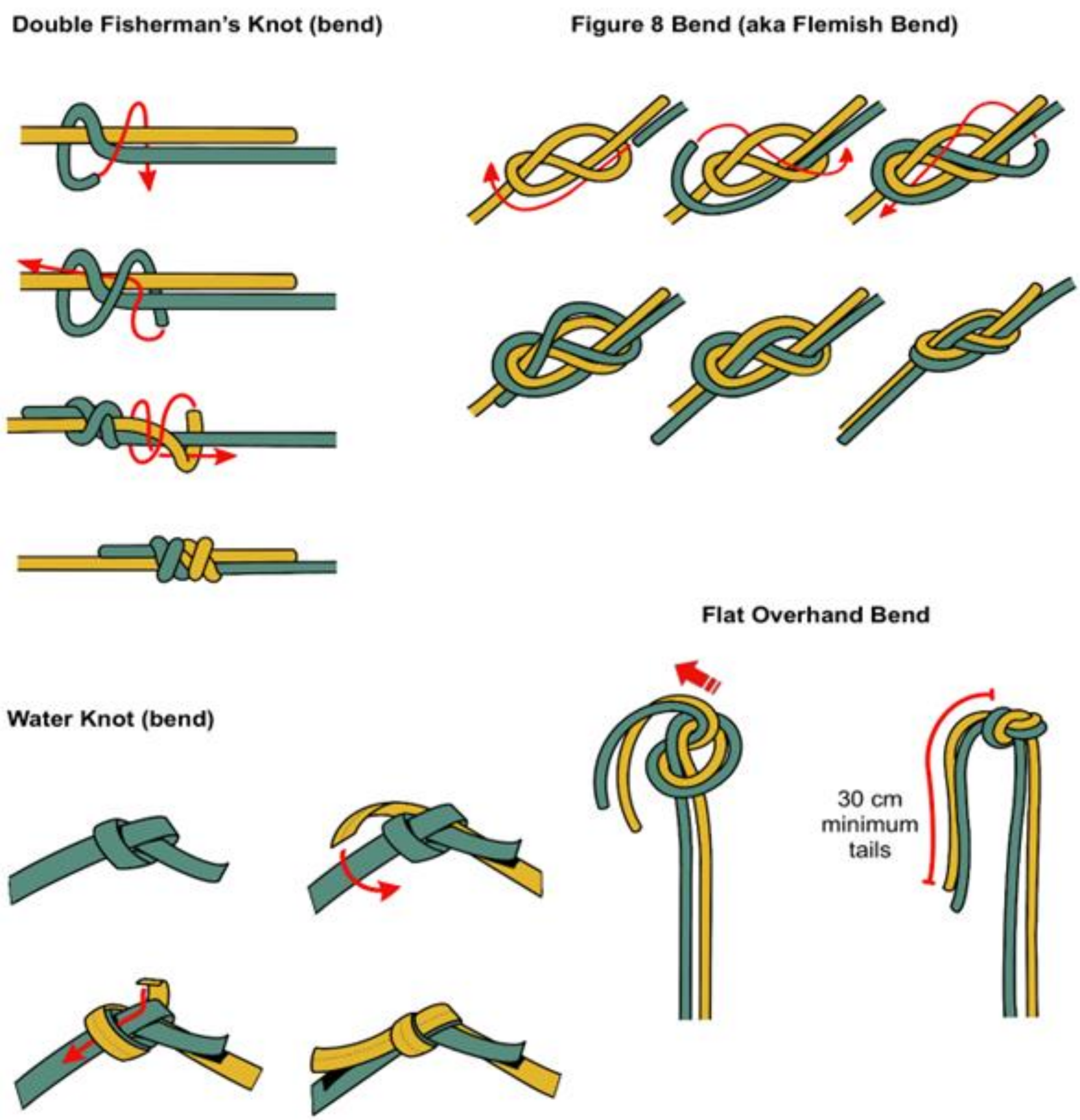


8.16.9. **Double Fisherman's Knot.** Also called double English or grapevine is used to tie two ropes of the same or approximately the same diameter, it is a joining knot.

8.16.10. **Figure Eight Bend.** Is used to join the ends of two ropes of equal or unequal diameter within 5 mm difference.

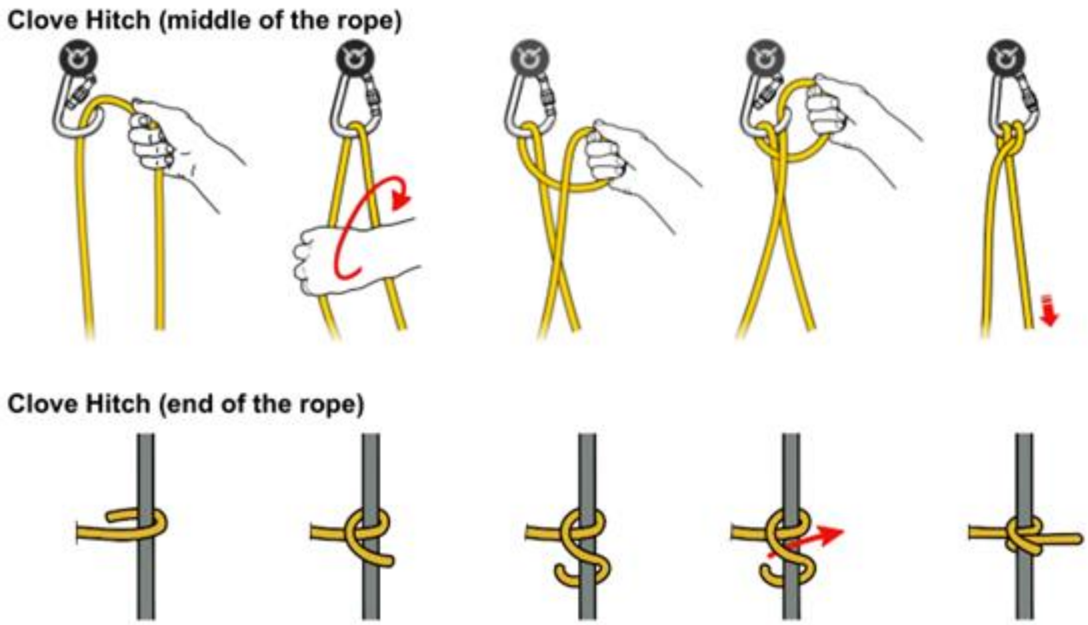
8.16.11. **Water Knot.** Is used to attach two webbing ends. It is also called a ring bend, overhand retrace, or tape knot. It is used in runners and harnesses and is a joining knot.

Figure 8.14. Bends.



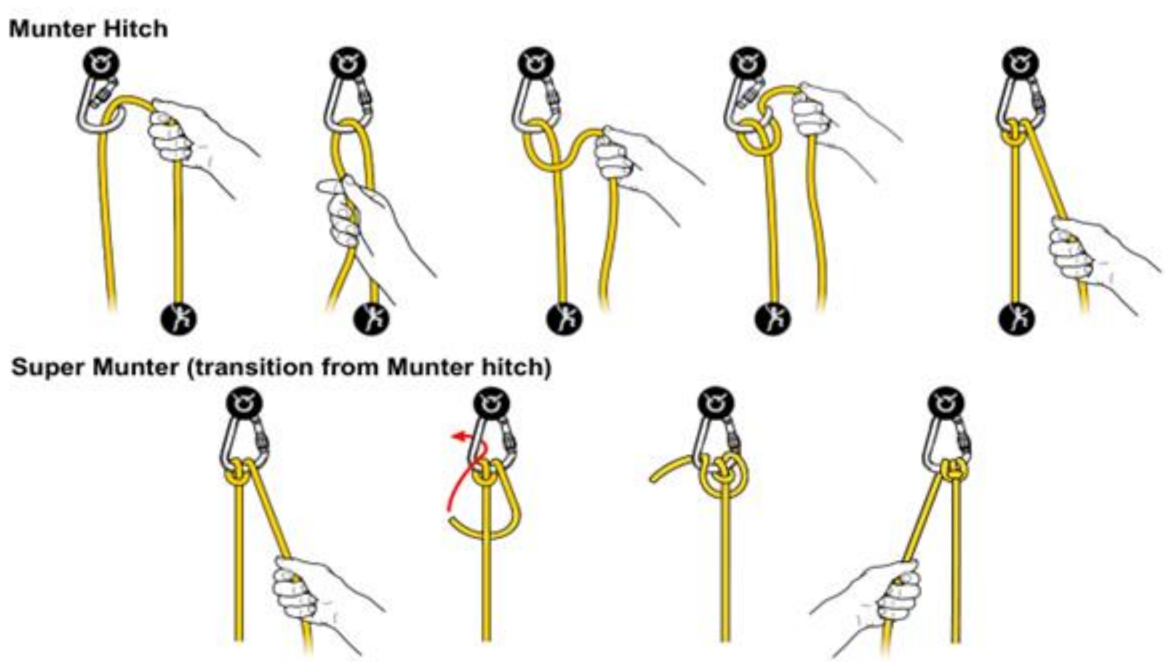
8.16.12. **Clove Hitch.** The Clove Hitch is a rapid-adjust anchoring knot and is particularly useful when the running end of the rope needs to be adjustable, since feeding in rope from either direction will loosen the knot to be tightened at a new position. The clove hitch is tied by creating two successive half-hitches around an object.

Figure 8.15. Clove Hitch.



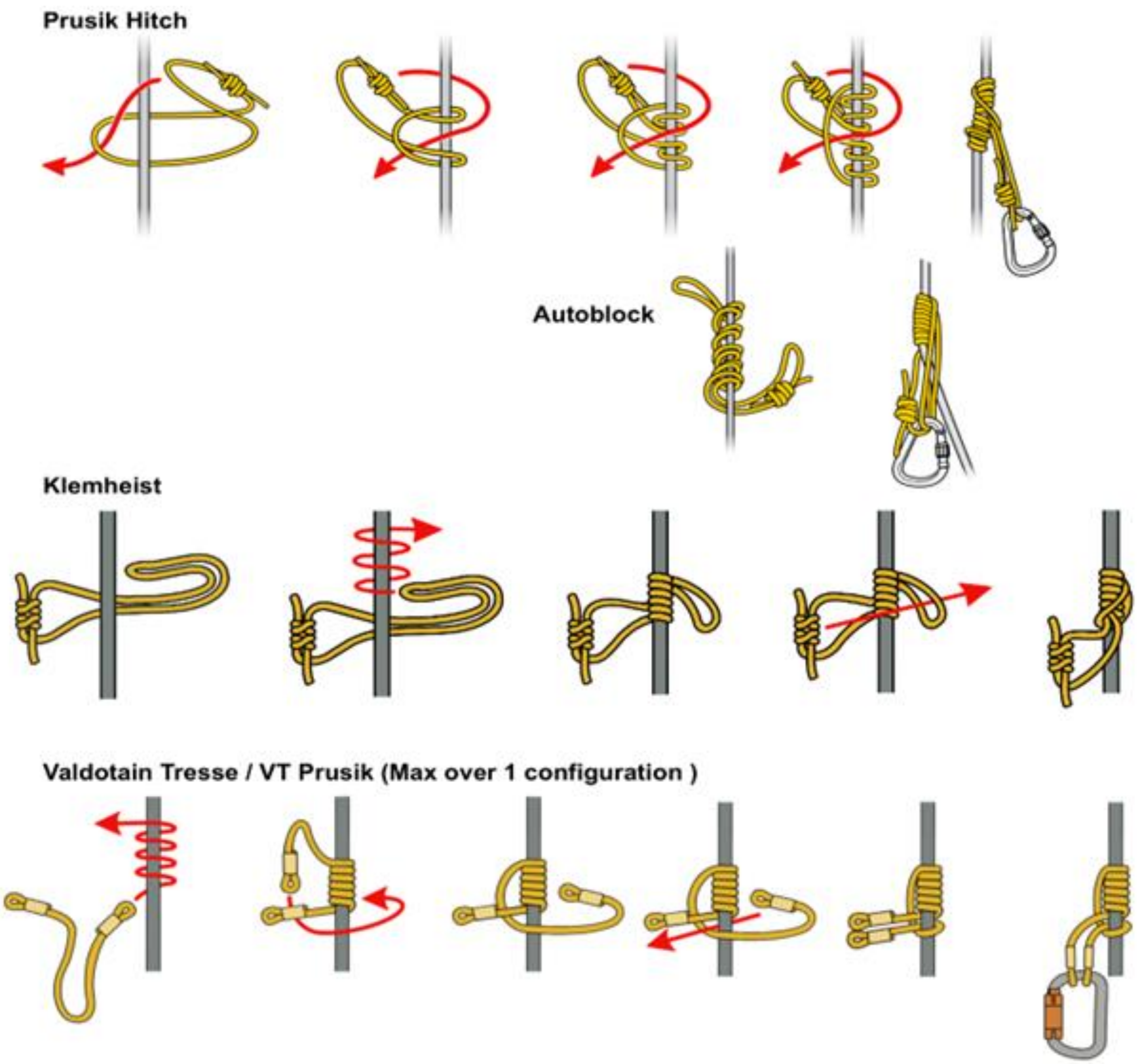
8.16.13. **Munter Hitch.** The Munter Hitch is simple adjustable knot used to control friction in a belay system. Addition friction can be added to create a Super Munter Hitch.

Figure 8.16. Munter Hitches.



8.16.14. **Prusik Hitch.** The Prusik hitch is used to put a moveable rope on a fixed rope such as a Prusik ascent, a tightening system, and the progress capture in a haul system. This hitch can be tied as a middle or end of the rope Prusik. Static accessory cord, braid on braid cord, or twisted cords may be used for Prusik hitches. Make absolutely sure that whichever type is used is strong enough for the intended load and that it is small enough in diameter (relative to the rope it's attached to) and will have enough friction to grab the rope effectively. As a general rule, the Prusik material diameter should be approximately 60 to 80 percent of the standing rope's diameter. If the diameter is too small, the hitch will over tighten, making it difficult to adjust. If the diameter is too large, the hitch will not tighten up enough to grip the standing rope. In life supporting applications such as rescue, two tandem triple wrapped Prusiks hitches will be used. **NOTE:** When using Prusiks, a minimum of a 4mm diameter differential is preferred for safe operations.

Figure 8.17. Prusik, Autoblock, Klemheist & VT Prusik Hitches.



8.17. Anchor Choices.

8.17.1. **Angle Calculations.** As the interior angle (A) increases, the force on the web (T1), and in example 2, the anchor points (T2) increases. Load L1 is a typical rescuer plus equipment of 220 pounds (100 kg). Load L2 is the NATRS consensus standard rescue test load of 440 pounds (200 kg), see **Table 8.9**.

Table 8.9. Angle Calculations.

Angle (A) Degrees	Multiplier	Force (T) for Load L1 (kN)	Force (T) for Load L2 (kN)
0	0.5	0.493	0.985
30	0.5	0.511	1.020
45	0.5	0.533	1.066
60	0.6	0.569	1.137
90	0.7	0.699	1.393
120	1.0	0.985	1.970
135	1.3	1.286	2.574
150	1.9	1.905	3.806
175	11.5	11.304	22.582
180	8.0	8.000	8.000

8.17.2. **Control Anchor Leg Angle.** It is important to control the angle of the anchor legs during construction. As the anchor leg angles increase, the anchor strength decreases. The closer the legs are the stronger the anchor will be. Using the ERNEST acronym while constructing anchors will ensure that it is a bomber anchor.

8.17.2.1. **E-Equalized:** Anchors should be constructed so that each component of the anchor carries an equal amount of the load.

8.17.2.2. **R-Redundant:** Anchors should consist of multiple components in case one or more components fail.

8.17.2.3. **NE-No Extension:** Anchors should be built so that if one or more of the components fail the remaining components won't be shock loaded.

8.17.2.4. **S-Strong (or Solid):** The stronger the better.

8.17.2.5. **T-Timely:** Anchors should be as simple and timely as possible without giving up any of the other ERNEST qualities.

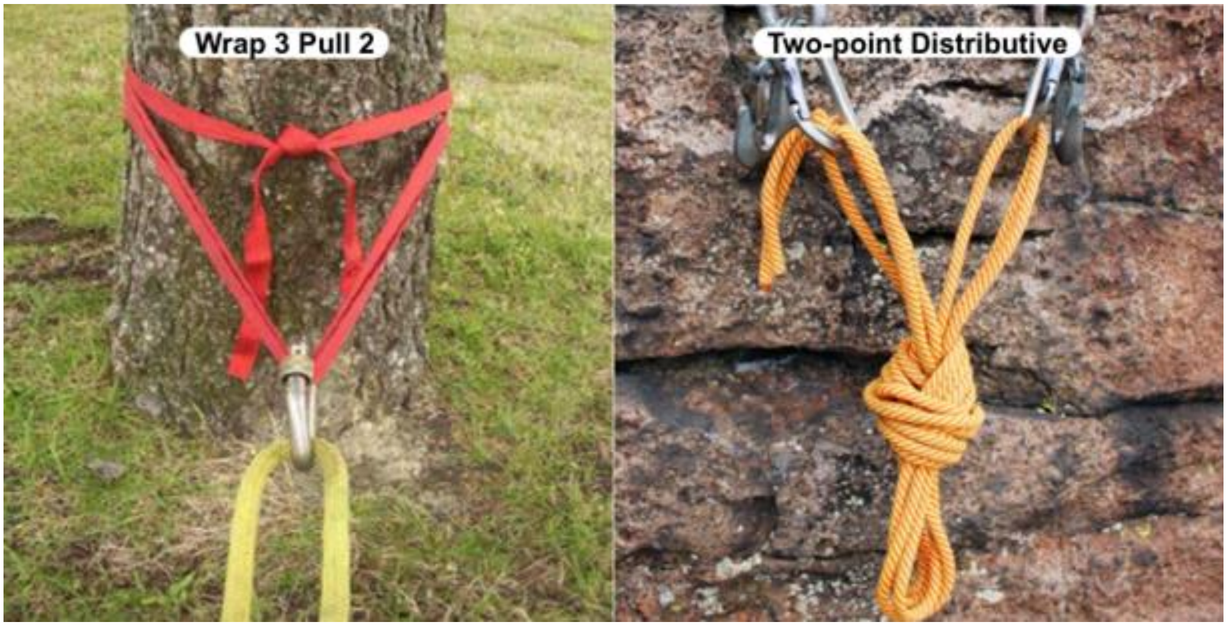
8.17.3. **Basic Anchors.**

8.17.3.1. A wrap three, pull two anchor is tied using 1-inch webbing completing three wraps around the anchor. A water knot is used to secure the ends and should be tied at the front of the anchor or facing the load. This puts the weakest link furthest away from the load and makes untying it significantly easier. See the wrap 3 pull 2 in **Figure 8.18**.

8.17.3.2. The wrap two, pull one anchor is the same as a wrap three pull two but with one less wrap.

8.17.3.3. The two-point distributive anchor system uses a figure eight knot to bring both legs from the anchor together. This is an excellent choice if two or three marginal anchors, especially rock, are being used. Also, it tends to stabilize the point of attachment.

Figure 8.18. Basic Anchor Examples.



8.17.3.4. A minimum of two wraps is sufficient for the high-strength tie-off hitch. The diameter of the tree should be at least 8 to 10 times that of the rope (e.g., 11.5 mm x 8 = 92 mm). It should also be mentioned that the overall stability of the tree should be determined before attaching a main line to it.

8.17.3.5. Be aware of the atmospheric conditions. For instance, is the tree significantly taller than surrounding trees, exposing it to prevailing winds? If so, it is most likely robust enough for your purpose. Conversely, if has been raining a lot lately and the ground is soggy, look closely to see if the tree is truly stable or likely to pull out when under load.

8.17.3.6. With the exception of rock gear, a minimum of two anchor leads should be concentrated into one anchor focal point. For rock gear, four anchor leads should be used due to the strength of the wire and likelihood that the rock itself might fail.

8.17.3.7. This concentration of the anchor points, defined as load sharing, is the center of all forces, and has leads of fixed lengths. The front of a rigging plate can also be tied into the anchors.

8.17.3.8. The concept of a load-distributing anchor inappropriately referred to as a "self-equalizing anchor" can be built using a variety of materials and techniques. Ensure anchor meets the ERNEST criteria.

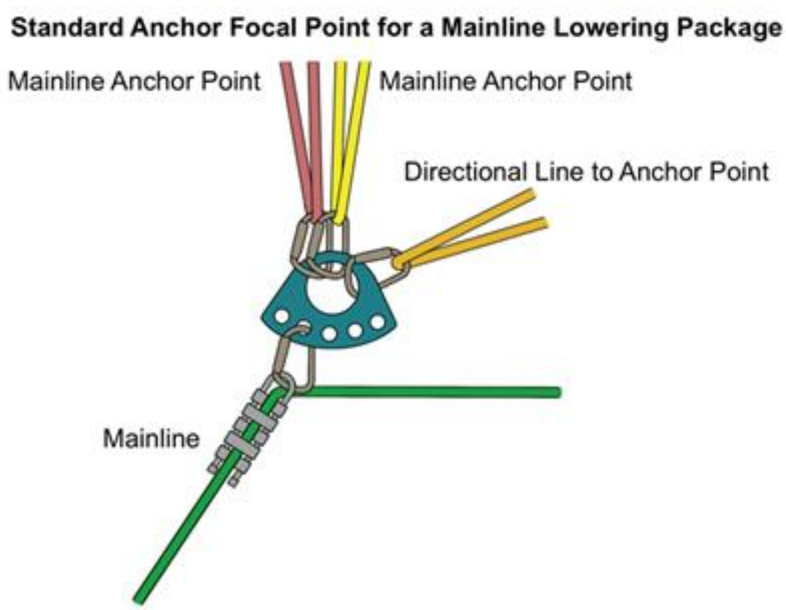
8.17.3.9. The same type of methodology needs to be used for the belay line as for the main line. Keep this in mind when inventorying equipment.

8.17.3.10. After the patient or load has been located, the rigging team should look for a location that is as flat as possible and free from tripping hazards. If directional pulleys are to be used, they should be pre-positioned.

8.17.3.11. In this section, typical anchor/mainline/belay line configuration will be discussed. Included in the calculations for the working area should be adequate space for anchor focal points. See **Figure 8.19**, for examples of focal points.

8.17.3.12. When using marginal anchors in an otherwise acceptable location, pre-tensioned back ties are a necessity, see **Figure 8.20** The underlying principle is that the back tie will add rigidity to the system, remove the slack, and reduce shock loading. The system is tensioned with a simple 3:1. This system is used when the anchors are a significant distance from the ideal focal point, thereby inducing the potential for significant slack in the system. This helps stabilize the focal point before tension is applied to the system.

Figure 8.19. Focal Point Examples.



8.17.4. **Edge Protection.** There are two primary reasons for protecting ropes against abrasion; to reduce friction and for safety, see **Figure 8.22** Rock edges can sever a rope under load if enough friction is incurred through the raising or lowering process. Edge protection can either be of the commercial variety which includes sewn tubes that are Velcro® and ride over the rope or homemade such as tubular insulation, rubber mats, or a rucksack and foam pad. Whichever is used, they should be secured with utility cord to ensure they remain in place during the operations.

8.17.4.1. Hard edge protection consists of metal devices with or without rollers for use with moving ropes.

8.17.4.1.1. Advantages include ultimate protection and substantial reduction in friction.

8.17.4.1.2. The disadvantages are that they are heavy and expensive.

8.17.4.2. Soft protection is most often used for stationary ropes such as with a rappel or safety lines.

8.17.4.2.1. Advantages include less expensive and weigh less than hard protection.

8.17.4.2.2. The disadvantages are that they do not provide enough protection and do not reduce friction.

Figure 8.20. Pre-tensioned Back Tie.

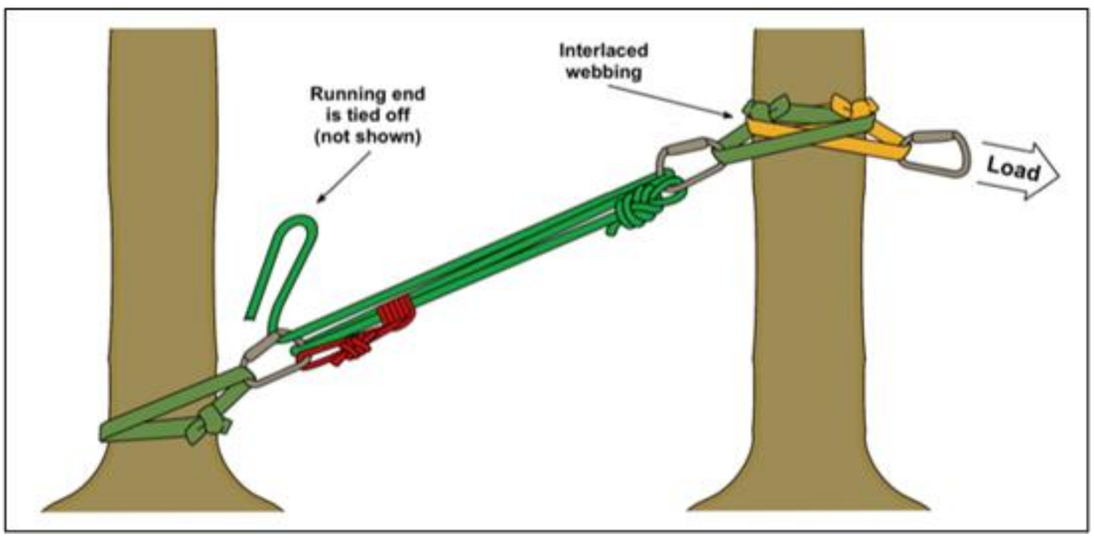


Figure 8.21. Pre-tensioned Front Tie.

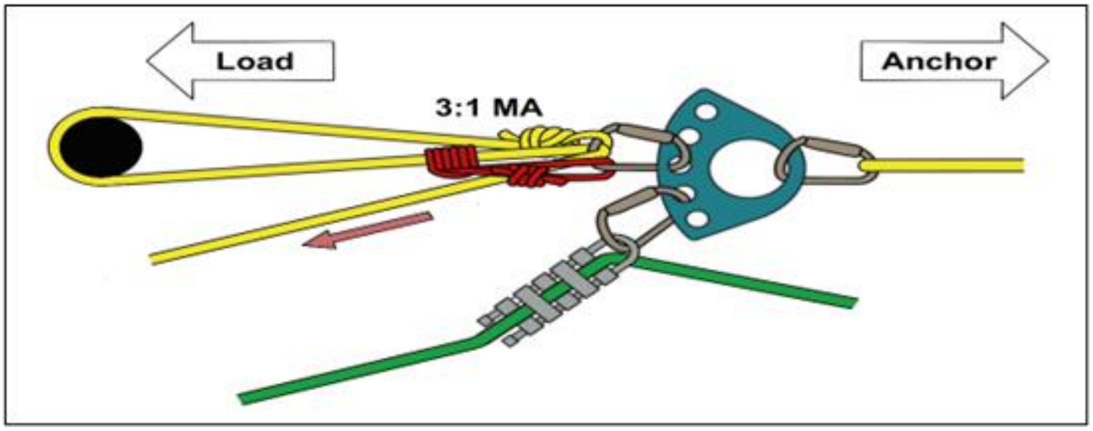
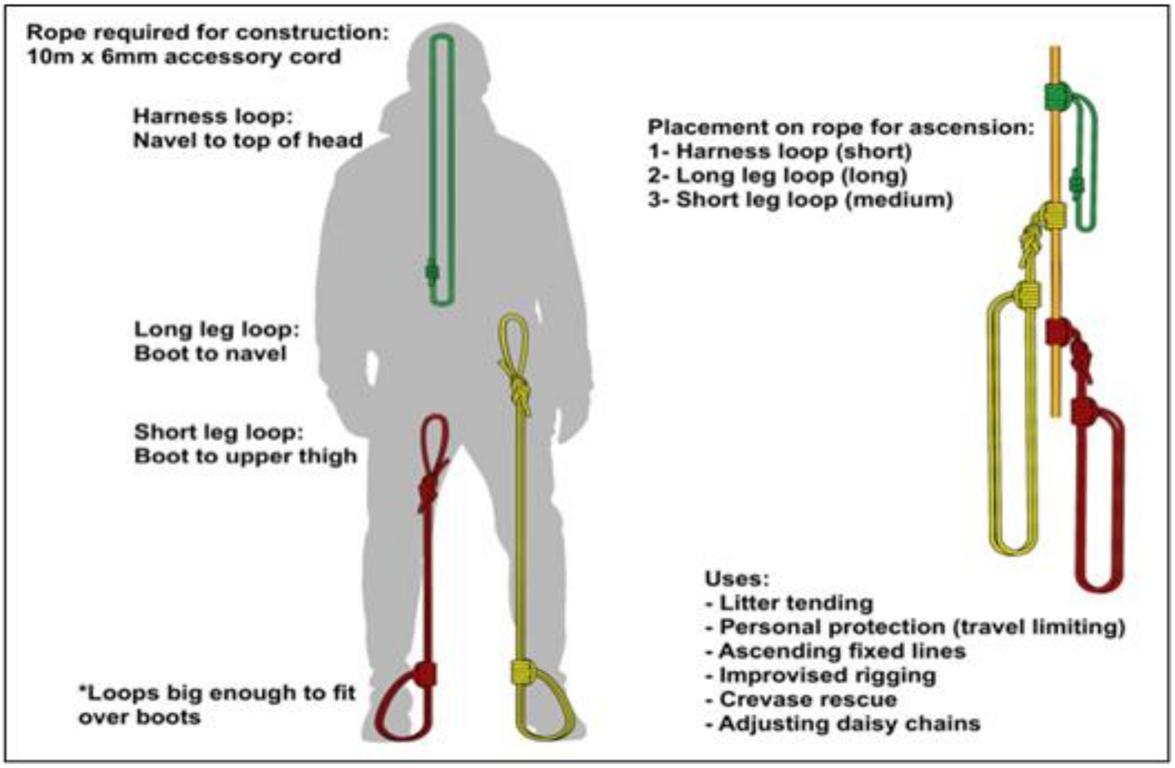


Figure 8.22. Edge Protection.

8.18. Ascending Systems. For self-reliance, safety, and flexibility, the rescuer should always have the ability to either descend or ascend a rope. Rescuers should always have their ascending system with them, readily available and should be competent in its use. A rescuer should have a separate, un-tensioned belay rope as a backup in case of emergency or system failure.

8.18.1. **Purcell Prusik Ascending System.** The Purcell Prusik system, see **Figure 8.23**, is an ascending system that combines equipment which allows rescuers to ascend in either a free-hang or sloping environment, tie-in to an anchor system or edge/safety line. It is a soft link in a multipurpose configuration and is a highly useful tool for rescuers. The system incorporates the use of three Prusiks: two leg loop Purcell Prusiks and one harness loop Prusik. The two Purcells allow for easier movement in non-free-hanging terrain. Also, if one Purcell is being used as an adjustable tie-in, then the other can be used to ascend a short distance. Additionally, Purcell Prusiks may be used to attach the rescuer to a stokes litter, as an attachment point to an aircraft, or for ascending a fixed line. A checklist format for sizing the system can be found in the *Technical Rescue Field Operations Guide* or the *Rigging for Rescue Technical Ropework Seminar Handbook.*

Figure 8.23. Purcell Prusik System.



8.19. Knot Bypass System.

8.19.1. **Knot Bypass for Mainline Lowering Package.** The knot bypass system for a main line lowering package consists of a five-step process.

8.19.1.1. Knot approaches to within 1 to 2 feet of the brake bar.

8.19.1.2. A load-releasing hitch (LRH) is attached to the main line with tandem Prusiks.

8.19.1.3. Tension is applied to the LRH until both Prusiks grab and assume the load.

8.19.1.4. The brake bar is slack, and the knot is passed around the brake bar.

8.19.1.5. The main line is tensioned and the LRH is slackened. Lowering continues.

8.19.2. **Knot Bypass for Mainline Raise Package.** The knot bypass system for a main line raise package also consists of a five-step process.

8.19.2.1. Knot approaches to within 1 to 2 feet of the MA.

8.19.2.2. Tension is placed on the second Prusik/pulley, slack on the first.

8.19.2.3. First Prusik/pulley is tensioned and assumes the load.

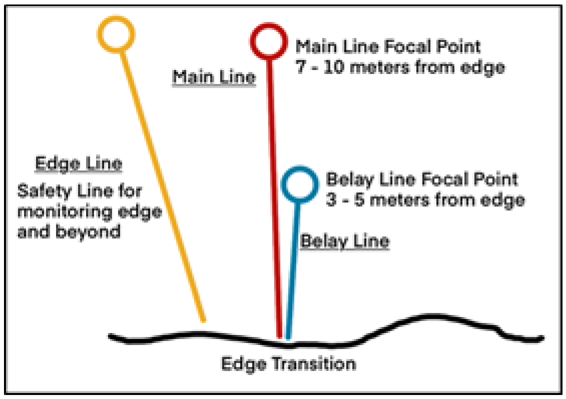
8.19.2.4. An additional Prusik/pulley at the main anchor is attached and tensioned.

8.19.2.5. Main line is reconfigured with secondary Prusik/pulley and bypasses.

8.20. Rescue Systems.

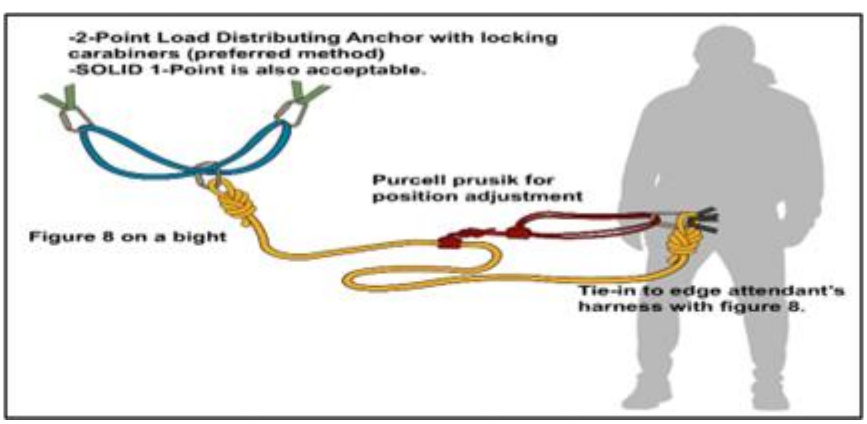
8.20.1. **Rescue System Elements.** High-angle rescue consists of elements such as rope, hardware, and anchors all working together as a system. Just as a chain is only as strong as its weakest link, the high-angle system is only as effective as its weakest link. For example, if the system uses a main line rope that has a test strength of 40 kN but is attached to an anchor that pulls out at 2.2 kN, the strength of the entire system is only 2.2 kN. Study the strengths of the component pieces of equipment carefully and learn how to best engineer them so as to maximize their strength in regard to the overall system.

Figure 8.24. Components of a Rescue System.



8.20.2. **Mainline Component.** The main line is the primary attachment for the patient and litter. The mainline focal point in a rescue system should be between 7 and 10 meters from the edge when terrain allows. This will allow adequate space for the belay sequence to occur yet not consume excess rope and anchor material. Control person should also be able to observe the main line crew. The belay line should be the strongest line in the system in the event it has to endure dynamic loading. The belay line focal point in a rescue system should be between 3 and 5 meters from the edge. This will allow adequate space for the attendant and edge transition team to prepare the litter and attendant for descent, as well as recover the litter during a raise. The edge line in a rescue system should be secured to a separate anchor from the main or belay line. Edge lines are solely for the edgemen to safely observe the litter attendant, assist with vectoring duties, or while initially laying ropes and anchors, see **Figure 8.24** and **Figure 8.25**.

Figure 8.25. Edge Attendant Tie-In.



8.20.3. **Belaying Techniques.** A belay is a method of protection against a fall by handling a tensionless rope. This technique allows slack to be taken in or out as another person climbs, rappels, ascends a fixed rope or is raised, lowered, or transported, yet be secure to hold this load in case of failure of the main support. The belay rope must never be used without backup when shifting the load during a working operation. **Table 8.10** outlines several types of belays.

Table 8.10. Types of Belays.

The Belay Is	A Totally Separate Tensionless Rope	A Rope Already Under Tension from Part or All of
Managed by others	Belay	Conditional Belay
Managed by the people in need	Self-Belay	Conditional Self Belay

8.20.4. **Tandem Prusiks Belay Method Procedures.**

8.20.4.1. two 8mm Prusiks, when the working rope in no less than 10mm (tied with a double Fisherman's knot) of different length (53 and 65 inches).

8.20.4.2. Three wraps are used around the belay rope.

8.20.4.3. Make sure the knots are tied neatly with the knot bridge on the same side.

8.20.4.4. Clip the two Prusiks and the Prusik minding pulley (PMP) into a pear-shaped locking carabiner in the following order: long Prusik first (closest to the carabiner's spine), then the shorter Prusik, and then the PMP.

8.20.4.5. This locking carabiner is then clipped into an LRH, which is clipped into the anchor.

8.20.4.6. When properly positioned, the Prusik knots will be about 4 inches (one hand-width) apart.

8.20.4.7. The belayer must be experienced in using the Prusik belay and must be very attentive to keep the knots taut but free running using the tips of the fingers with the thumbs pushing on the knots bridge.

8.20.4.8. The rope should be flaked so it will enter the tandem Prusik system smoothly from the side without twisting.

8.20.4.9. When belaying a load, the tandem Prusiks may be tended by the Prusik-minding pulley as the belay rope is pulled through it.

8.20.4.10. For passing a knot safely, two sets of tandem Prusiks must be available.

8.20.4.11. A load-releasing hitch is required in case the Prusiks lock up, for passing knots and when changing from lowering to raising or vice versa.

8.20.4.12. After using the load-releasing hitch always re-tie it to its original size, so it's ready for the next application.

8.20.4.13. The belayer should make every effort to avoid inducing too much slack as well as excessive tension during the belaying process. The belayer's primary responsibility is rope management, not arresting a dynamic fall. Again, the sequence of components is spine, long Prusik, short Prusik, and pulley.

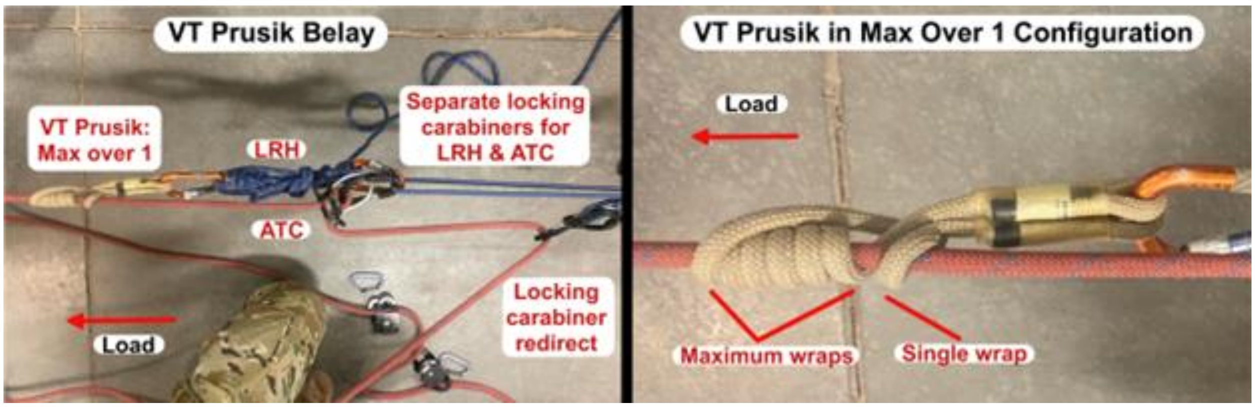
8.20.4.14. The only difference between the belay package raise and the belay package lower is the direction of rope travel. This provides ease of use, so no changeover takes place, and the belay person simply takes up slack using the same hand

8.20.5. **VT Prusik Belay Method Procedures.** See **Figure 8.26**.

8.20.5.1. Use one 8mm VT aramid fiber Prusik (example: Blue Water).

8.20.5.2. "Max over 1" configuration is used around the belay rope. Make sure the "Max" portion of the Prusik is oriented toward the load.

Figure 8.26. VT Prusik Belay Configuration.



8.20.5.3. To create the max over 1 configuration start with an offset girth hitch with the long end on the load side.

8.20.5.4. Wrap the long end through the bridge of the girth hitch around the host rope toward the anchor until there is just enough material to clip both loops together. There is small manufacture variation in the overall length of each Prusik. The number of loops will also depend on the size of the host rope, a smaller diameter rope will yield a greater number of loops (max) vs. a larger rope diameter will yield a smaller number.

8.20.5.5. Clip sewn eyelets to the locking carabiner from the LRH. A pulley is not attached to the rope while lowering a load. Verify the LRH is clipped to the full strength (20kN) anchor with a locked locking carabiner.

8.20.5.6. The rope should be flaked so it will enter the Prusik system smoothly from the side without twisting.

8.20.5.7. When belaying a load during a raise, the Prusik may be tended by the Prusik-minding pulley as the belay rope is pulled through it.

8.20.5.8. For passing a knot safely, a second set of VT Prusik and LRH must be available.

8.20.5.9. A load-releasing hitch is required in case the Prusik locks up, for passing knots, and when changing from lowering to raising or vice versa.

8.20.5.10. After using the load-releasing hitch always re-tie it to its original size, so it's ready for the next application.

8.20.6. **Litter Harness Configuration and Tending.**

8.20.6.1. Interlocking long-tail bowlines are used as the primary attachment point. The main line attaches to the victim’s harness with a retraced Figure Eight knot or a bowline.

8.20.6.2. The belay line attaches to the attendant’s harness with a retraced figure-eight or a bowline.

8.20.6.3. The attendant uses a Purcell Prusik between the harness and the interlocking long-tail bowlines in order to adjust position relative to the litter. See examples of litter rigging and interlocking bowlines in **Figure 8.27**.

8.20.6.4. Either Tri-locking carabiners, a tri-link, steel carabiner, or rigging plate is used to join the interlocking long-tail bowlines and the litter harness.

8.20.6.5. The attendant needs to wear a sit-harness and should also consider wearing a chest harness, one that fits comfortably as the attendant may have to endure long periods of suspension below a litter.

8.20.6.6. A loop connecting the sit harness to chest harness allows for flexion of the attendant's spine and hips allowing for greater ease in manipulating the litter.

8.20.6.7. Use high-directional anchors whenever possible.

8.20.6.8. Have a load-releasing hitch configured and ready to be attached in the event of a knot bypass or other obstruction.

8.20.6.9. Main line person should face the brake rack and be positioned at the rope end, not the anchor end.

8.20.6.10. Belay device should always be locked off before performing any other duties.

8.20.6.11. With double pulleys paired up, a 4:1 mechanical advantage system (personal jigger) can be easily constructed.

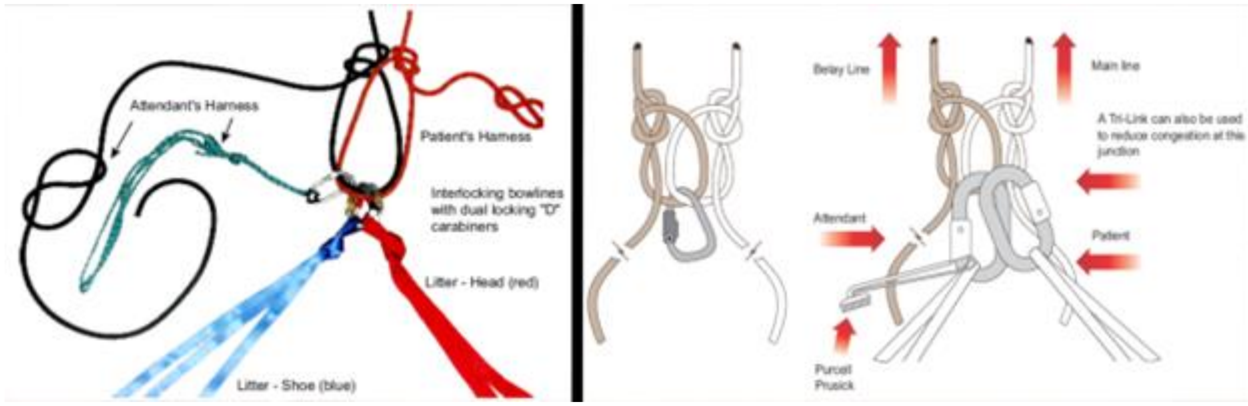
8.20.6.12. One or both of the two pulleys must have a connection becket below the sheave for connecting the end of the haul rope.

8.20.6.13. This is a system set up with a short length of rope that is used for making small movements to a load, which might be a stretcher, a fallen person awaiting rescue, or the rescuer.

8.20.6.14. It is becoming standard practice to use not one but two jiggers on a rescue stretcher.

8.20.6.15. One is attached to the head of the stretcher and controls the tilt, while the other forms the rescuer's attachment, to enable easy freedom of movement.

Figure 8.27. Litter Rigging with Interlocking Bowlines.



8.20.6.16. Tending a Vertical Litter. See **Figure 8.28**.

8.20.6.16.1. With this system, the attendant straddles the litter until the edge transition is complete.

8.20.6.16.2. The two edgemen will carry the litter package as close to the edge as possible.

8.20.6.16.3. The litter should be lowered to a point approximately 2 to 3 meters below the edge.

8.20.6.16.4. The attendant then slackens the jigger system and lowers to the foot of the litter.

8.20.6.16.5. Tending a horizontal litter. See **Figure 8.28**.

8.20.6.16.6. The attendant is attached to the interlocking long-tail bowlines by means of a Barrelman which allows flexibility to move up or down in relation to the litter.

8.20.6.16.7. The attendant can then also climb on top in the event of an overhang or to provide medical treatment, if required.

Figure 8.28. Vertical and Horizontal Litter Tending.

8.21. Raising Systems. Whenever a raising system is being designed, the number of available haulers is to be considered. The minimum number of members on the team is four: (1) main line, (2) belay, (3) attendant, and (4) edge (may have to double as control).

8.21.1. **Determining Optimum Mechanical Advantage (MA).** When calculating the MA needed for a haul system, you must first determine the number of haulers available. To determine the MA, take the number of haulers and multiple the desired MA. The optimal sum for a MA should range between 12 and 15. (Example: 3:1 MA, 4 Haulers available3 x 4 = 12. 3:1 MA would be an appropriate system for number of haulers available.) **WARNING:** Care should be taken to ensure number of haulers is appropriate to desired force application to the system. If the number of haulers is too great, forces in excess of the weakest point in the MA system could be applied causing an unsafe condition and potential for catastrophic failure.

8.21.2. **Optimal System.** The optimal system will be the one that requires the least amount of effort to safely raise the load with the minimum amount of equipment in the shortest time.

8.21.3. **Simple Pulley Systems.** Simple pulley systems are preferred especially when working at altitude or extreme cold. This will aid in preventing the rescuers from incorrectly building a system that may not fall within a 10:1 safety factor. Be sure to allow enough room for the haul team to safely and efficiently move while raising the load.

8.22. Lowering Systems.

8.22.1. Use a belay device/technique that provides sufficient control and ease of use (e.g., Super Munter, Scarab, dual stitch plate, etc.)

8.22.2. Build in a hands-free backup attached to a Load Releasing Hitch.

8.22.3. Consider building a raise capability into the system for faster transition in case required.

8.23. Lower/Raise Transitions.

8.23.1. **Lower to Raise:**

8.23.1.1. Main line is tied off to the lowering device.

8.23.1.2. Prusik is set in place to hold the main line.

8.23.1.3. Pre-rigged MA is now attached to main line.

8.23.1.4. Haul team is in place.

8.23.1.5. Prusik is released as haul team begins the raise.

8.23.1.6. Prusik is set as a progress capture while MA is reset.

8.23.2. **Raise to Lower:**

8.23.2.1. Progress capture Prusik is set.

8.23.2.2. Lowering device placed between anchor and Prusik, slack removed, and belay established.

8.23.2.3. Slowly release progress capture Prusik using its load-releasing hitch until the Prusik can be released, becoming the belay's hands-free backup.

8.24. Twin-Line Systems. Twin-line or Dual Main or Twin Tensioned systems are ideal for all types of technical rescue from low to steep and high angle. The system creates redundancy and safety when dealing with a rescue load. The system can be used for both belay and raise operations. With good coordination it's possible to haul a heavy load even with simple pulley system. The twin-line system also enables simple knot bypass and hot change overs because both lines are capable of supporting a rescue load while the other line is locked off. A disadvantage to this system is that load sharing between two ropes is never perfect; sometimes one rope holds the entire load; good coordination of team members is required.

8.25. Vertical Pickoffs. The primary reason for conducting a vertical pickoff is to access the patient and remove him from the environment quickly. This should not be done if it poses a risk to the rescuer's safety. Pickoff procedures:

8.25.1. Lower the attendant to the victim and attach the victim to the main line (using a Purcell, Pickoff strap, Prusik, or just a sling).

8.25.2. The attendant performs a controlled transfer of the victim's weight utilizing a block and tackle to the rescue system and signals for lower/raise.

8.25.3. Pickoff and changeover should take less than 2 minutes to perform.

8.26. High Lines and Traversing Systems.

8.26.1. **Kootenay Highline System.** The drooping high line used with the Kootenay carriage system uses only one track line, a low stretch rope. Additional low-stretch ropes are used as taglines and also function as belay lines. Its purpose is to send a load across an expanse in a safe and controlled manner. The maximum practical length of this high line is 300 feet.

8.26.1.1. Track Line Rigging.

8.26.1.1.1. The track line is tensioned with a 2:1 MA that is attached to the rope with tandem triple-wrapped Prusiks.

8.26.1.1.2. Use only one person to pull for tensioning without a load.

8.26.1.1.3. Failure to follow this rule could overstress the track line when a load is on the line.

8.26.1.1.4. With a rescue load hanging from the track line, up to a total of six persons may be used with a 2:1 MA to tension the track line.

8.26.1.1.5. The tension should be backed off when it is not needed any more too clear obstructions.

8.26.1.1.6. The tag lines are connected to the anchor with tandem triple-wrapped Prusiks and a brake bar on one side and a 2:1 MA on the other side.

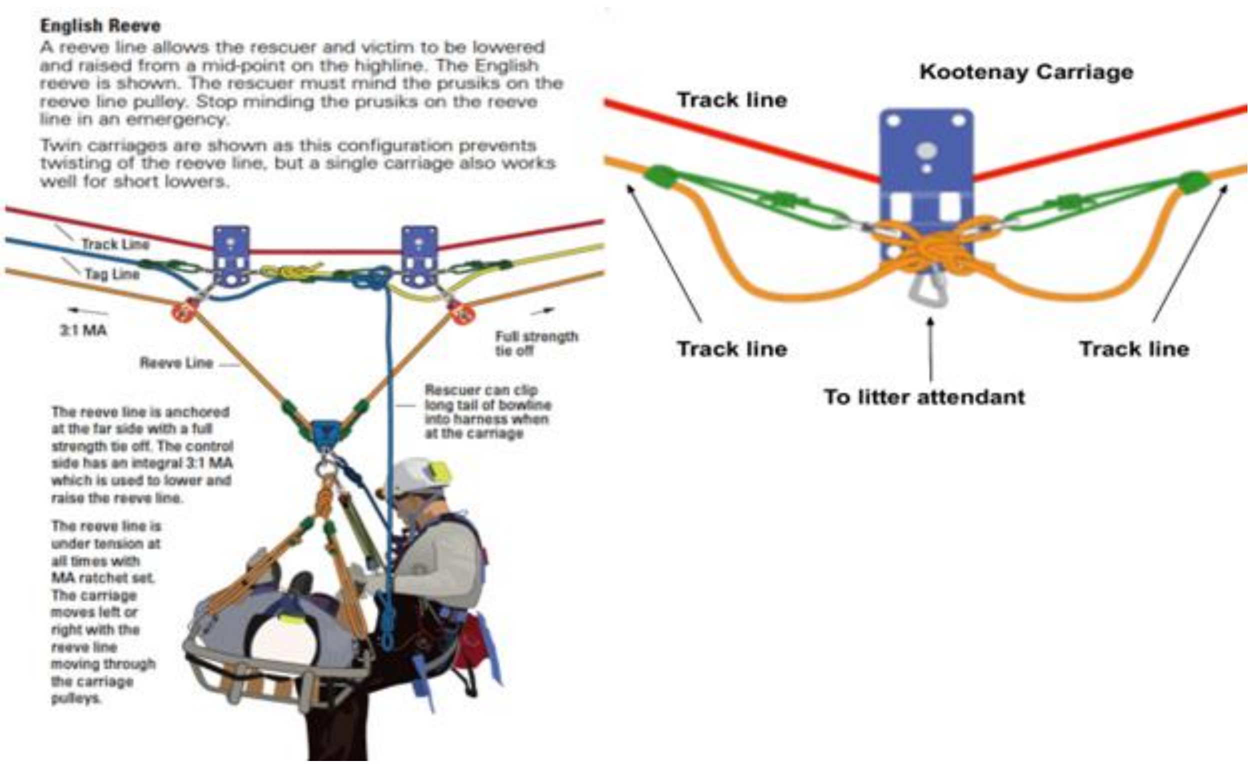
8.26.1.1.7. The two tag lines are attached to the pulley with triple-wrapped Prusiks and a figure-eight. See **Figure 8.29**.

8.26.1.1.8. The pulley should be a Kootenay pulley with three holes to attach the stretcher and the two tag lines or a 2-inch pulley with a rigging ring or plate clipped into the pulley with a locking carabiner.

8.26.1.1.9. Each tag line must be secured like a belay line.

8.26.1.1.10. A person on each end must operate the belay system in complete coordination with each other to make sure that there is never any slack in either tag line. WARNING: Failure to use and maintain coordinated tension to the tag lines from each side will result total system failure in the event of a main line failure.

Figure 8.29. English Reeve and Track Line Rigging.



8.26.2. **English Reeve System.** This system is used to either send an attendant across an expanse, with or without a litter, descend to the victim by way of the tag lines, and then recover to the main line. This is labor intensive effort requiring belayers on both sides of the expanse. The benefit of this system is that it allows the team to place the attendant on the victim with extreme precision. See **Figure 8.29**, **English Reeve**.

8.26.2.1. Through a coordinated effort, the belayers send the attendant and litter across the expanse to a point directly over the victim.

8.26.2.2. The belayers then lower the attendant and litter with the tag lines running through the Kootenay carriage.

8.26.2.3. Once the victim is secured in the litter, the belayers raise the litter with the tag lines up to the carriage.

8.26.2.4. The attendant then secures the litter to the carriage then is hauled across the expanse to either side.

8.26.2.5. Reliable communications is absolutely essential to ensure a coordinated effort among the belayers.

8.27. Tactical Considerations.

8.27.1. **Phase I: Arrive on Scene** . Take command; size up the situation.

8.27.1.1. The first senior PJ on scene should assume command.

8.27.1.2. Secure and interview any witnesses on scene as they will aid in identifying the problem and locating the victim.

8.27.1.3. Locate the Victim. In most cases, a recon element will need to determine the exact location of victim and nature of injuries. The recon element should have equipment to self-rescue as well as secure the patient and treat life-threats (consider aerial recon).

8.27.1.4. Assess the Need for Additional Resources. The recon element should provide enough information or recommend the need for additional resources. Information that will be helpful in determining the need for additional resources would include number of victims, location, condition of victims, estimated angle of terrain, distance to victim, and estimated time of extraction.

8.27.1.5. Assess the Hazards. Identify all potential hazards.

8.27.1.6. Decide on Rescue or Recovery. The recon element advises whether the operation will be conducted in the Rescue or Recovery mode. In the Rescue mode, recon personnel will begin treatment and patient packaging. In Recovery mode, consider leaving the victim and any related equipment in place for investigative purposes.

8.27.1.7. Decide on an Action Plan. With a recommendation from the recon element, decide on an action plan and ensure all players are briefed.

8.27.2. **Phase II: Pre-Rescue Operations** .

8.27.2.1. Make the General Area Safe. This may include securing the area and not allowing civilian personnel into the area.

8.27.2.2. Make the Rescue Area Safe. This may include removing all civilian personnel and all non-essential rescue personnel from the area. If securing hazards is not possible, they should be marked and identified to ensure all personnel operating in the area are made aware.

8.27.2.3. Pre-rescue/Recovery. Verify that all personnel are clear on the action plan and each member knows their assigned tasks. Establish a contingency plan should the primary plan fail and ensure all the alternate plan is communicated to all personnel.

8.27.3. **Phase III: Rescue Operations** .

8.27.3.1. Conduct rescue operations from low risk to high risk. Conduct rescues with the least amount of risk to rescuers necessary to rescue the victim. Low-risk operations are not always possible but should be considered first.

8.27.3.2. Order of rescue from low risk to high risk:

8.27.3.3. Self-rescue. If the victim is not exposed to a life-threatening situation, it may be possible to talk the victim into self-extrication.

8.27.3.4. Assisted Rescue. If the victim is exposed to a life-threatening situation, it may be best to advise the victim to stay in place until a rope rescue system can be set up.

8.27.3.5. For low-angle evacuation, the victim should assist with the extrication if able. If the victim is ambulatory, assistance may be rendered by the rescuers with the use of a belay/tag line. If appropriate, rescuers should set up an anchor system for the belay. A body belay may also be used by rescuers, if appropriate.

8.27.3.6. For a high-angle evacuation. The patient is packaged in a litter and prepared for the extrication. A separate raising/lowering line and belay line should be set up for raising or lowering during steep-angle evacuations.

8.27.3.7. In any case, an appropriate safety factor should be maintained, and a double-rope technique should be used if at all possible.

8.27.4. **Phase IV: Termination** .

8.27.4.1. Personnel accountability.

8.27.4.2. Equipment accountability.

8.27.4.3. Secure the scene.

8.27.4.4. Debriefing.

8.27.4.5. Return to service.

8.27.5. **Additional Considerations:**

8.27.5.1. Heat. Consider rotation of crews.

8.27.5.2. Cold. Consider effects of hypothermia on victim and rescuers.

8.27.5.3. Rain/snow. Consider the effects of rain on the hazard profile.

8.27.5.4. Time of day. Sufficient lighting for operations extending into the night?

8.28. Tree Recovery Procedures.

8.28.1. **Tree Climbing.**

8.28.1.1. Do not trust the last 10 feet of any treetop as this part of the tree is very weak and has no hardened core.

8.28.1.2. If the tree is between 60 and 80 feet in height, the weak section might be the last 15 or 20 feet of the treetop.

8.28.1.3. A climber, required to work near the top of a tree should be secured to a safety line.

8.28.1.4. Run the safety line once around the trunk about 10 to 15 feet below the working area, and then straight to and once around an adjacent tree trunk to the ground belayer.

8.28.1.5. The climber should also be safe tied to the tree trunk.

8.28.1.6. Leaning outward or swaying while working in the tree should be avoided; this increases the chance for a fall.

8.28.1.7. Dead trees should be approached with extreme caution. Dead trees may lack the support of a sound root system. If dead trees must be climbed during critical rescue operations, then a support/safety line should be used. In this case, the adjacent tree must be climbed first to install the safety rope. Hang the line over a sound limb of an adjacent tree while being belayed by a safety man on the ground. If this is not possible, then the climber must exercise great caution during the climb, rescue/recovery operation, and during descent.

8.28.2. **Using Tree-Climbing Equipment.** Tree climbing equipment consists of a pair of spiked “tree climbers” which are strapped to the lower legs and feet, a climbing safety belt with flip line(s), gloves, and a helmet.

8.28.2.1. Tree climbers are worn on the inside of each leg. They are securely strapped to the legs below the knees and to the feet on the outside of the ankles. Many models have thick leather bound pads to help relieve pressure on the ankle/leg. The spike of each tree climber protrudes downward and at a slight angle inward from the foot. Tree climbers typically have a slight curve to them which aids in the piecing of surface bark to set the spike into the subsurface wood. These spikes provide the necessary support for ascent and descent when jammed into the trunk of the tree. There are “pole climbers” which are designed for pole climbing/lineman duties, have a much straighter spike, and are not as highly recommended for tree ascents, but can be used.

8.28.2.2. The climbing safety belt comes in two parts, a belt worn around the waist, and an adjustable flip line. Each end of the flip line snap to the waist belt. The flip line keeps the climber from falling backwards and aids the climber when working to free equipment or personnel. The belt allows the climber to use both hands while working and in case of a fall, keeps the climber close to the trunk. When used in ascending or descending, the flip line should be kept between the head and waist. The length of the flip lines around the trunk must be adjusted to aid in comfortable climbing. The climber must ensure the knees never get too close to the trunk when using spiked climbing aids; the buttocks should be the farthest part of the body away from the trunk. The arms are either holding onto the trunk or branches or moving and holding the flip lines. **CAUTION:** If the spikes come free of the bark/wood causing a fall, arrest the fall by bringing the elbows together, forearms vertical to trap the flip line effectively pinching the tree trunk with the flip line. Do not try to reset the spikes into the tree until the fall has been arrested.

8.28.2.3. A second flip line should be carried to bypassing branches. When a branch is reached, the second flip line is attached past the branch then the first is released. A short rope or sling can be used if a second flip line is unavailable. Attach the rope or sling to a solid limb or trunk for security while moving the flip line past the limb.

8.28.2.4. Caution must be exercised when wearing and using tree climbers. Individuals may have to look down to observe the spot where the spike is being placed.

8.28.3. **Recovery of Personnel Suspended in Trees.**

8.28.3.1. Call to the patient to check for consciousness.

8.28.3.2. If the patient is conscious, inform them not to move or try to climb down.

8.28.3.3. Ask if they are injured and what type of injuries; then explain your intentions.

8.28.3.4. Evaluate the situation and coordinate with the team on a plan of action.

8.28.3.5. One Operator will climb the tree to the patient's location.

8.28.3.6. The climber will carry sufficient equipment to perform a tree letdown and medical supplies to treat life-threatening injuries.

8.28.3.7. The Operator should secure self to the tree while working on the survivor.

8.28.3.8. If the survivor has a secure hang-up, life-threatening injuries must be treated immediately

8.28.3.9. If the security of the hang-up is in doubt or the possibility of a fall exists, the first action should be to secure the patient to the tree to prevent additional injuries.

8.28.3.10. If tying into a parachute harness, the security of the harness should be checked to ensure the patient has not unfastened any of the harness straps.

8.28.3.11. After the patient has been secured, initial medical treatment may be administered.

8.28.3.12. Patient letdown is accomplished by a modified belay, see **Table 8.11**.

Table 8.11. Modified Belay & Lowering Procedures.

Modified Belay: • The end of the rope or letdown tape is passed through a carabiner secured to a large limb or tree trunk above the patient, and back to the patient. • If a rope is used, a two-loop knot is tied in the end of the rope. • A locking carabiner is attached to the main lift-web of the harness above the canopy release assembly on each shoulder. • One loop from the knot is clipped into each carabiner. • If the letdown tape is used, a figure-eight knot is tied approximately 6 feet from the snap fastener. • The snap fastener is routed under one shoulder of the survivor's harness, back up through the figure-eight knot, down to and around the other shoulder of the harness and connected back on itself. • While the climber is tending to the survivor, the remaining members will establish a belay system. • A rapid belay may be accomplished by passing the standing end of the rope around the base of a tree, or the team may use a standard belay used for adverse terrain operations. Lowering the survivor: • The belayer will take up as much slack as possible and place a brake on the system. • The climber will release the patient's harness which supports the least weight. • Ensure the patient, if conscious, is aware of the procedures used. • As the survivor “drops” free, keep the survivor from slamming into the trunk or large limbs. • A short fall will occur when the harness is released. • The Operator must have tension on the anchor sling for this action to avoid being pulled off the tree. • As the survivor is lowered by the belaying teammate, the Operator in the tree should descend with the survivor and guide the survivor between branches to avoid further injuries. • If the survivor is unconscious, have a litter in place directly below the lowering point. Lower the survivor directly into the litter. Initiate immediate medical care if needed. • Heavily branched or high trees might require two rescuers to climb the tree. • One Operator guides and holds the victim's feet and legs, while the other supports the upper body during descent procedures.

Chapter 9

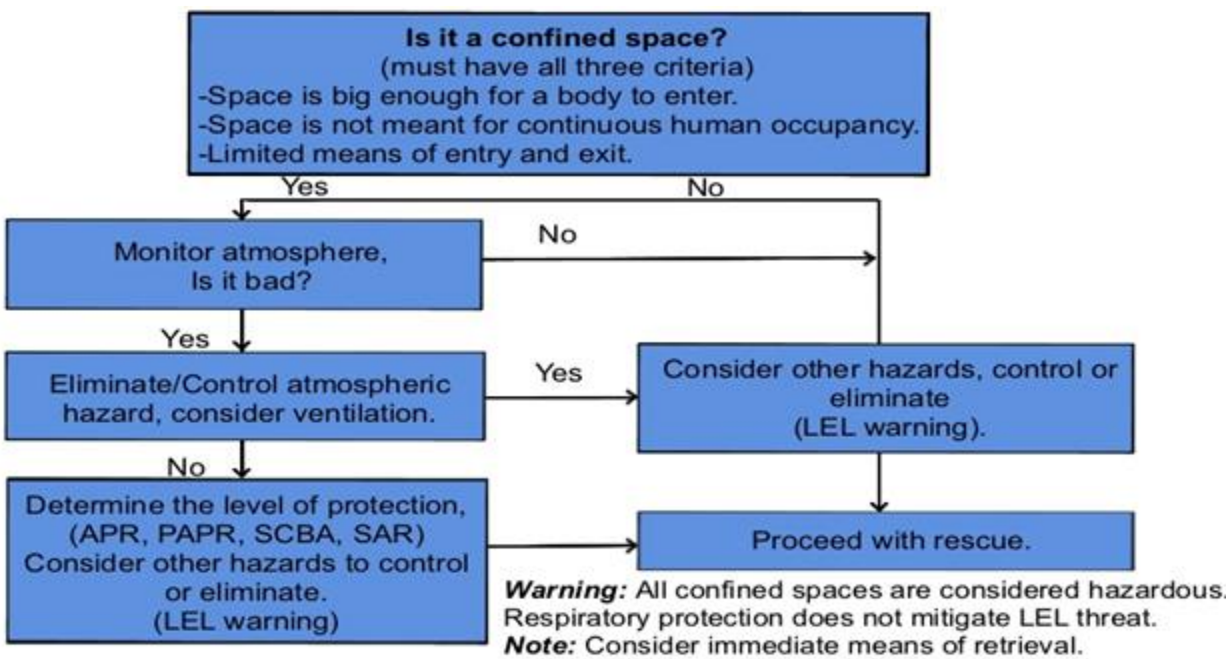
CONFINED SPACE/STRUCTURAL COLLAPSE AND NUCLEAR, BIOLOGICAL, CHAMICAL DECONTAMINATION

9.1. General. Confined space and structural collapse (CS/SC) missions typically take place in built-up urban environments. **WARNING:** Operators must receive thorough introductory training in the areas of confined space and structural collapse. This is an extremely dangerous type of rescue activity with many potentially fatal factors that fall outside the control of the rescuer. A thorough course of qualified instruction will greatly enhance the rescuer's ability to execute a recovery safely and successfully.

9.2. Confined Space. A Confined space defined must meet all the following three criteria: The space is big enough for a body to enter; it is not meant for continuous human occupancy; and it has limited means of entry and exit. See **Figure 9.1, Confined Space Flow Chart**.

9.3. Structural Collapse. Structural collapse is defined as any structure that has received damage to its infrastructure making it unsuitable for occupancy. Confined space and collapsed structure each have unique considerations, but the approach to both often can be combined because of the very common safety concerns they share. Collapsed structures nearly always result in confined spaces. These type operations are complex and time consuming.

Figure 9.1. Confined Space Flow Chart.



9.3.1. **Skill Cross-Applicability.** In the execution of a confined space or structural collapse scenario, many different rescue skills will be used, (e.g., climbing, rappelling, hauling, anchors, rope work, extrication tools, and patient treatment and packaging).

9.3.2. **Preparation.** As with any rescue, it is important to have rescue equipment kits prebuilt, tested, and ready for immediate selection and deployment. Once tasked for a mission, the team selects additional gear as required and has equipment shortfalls delivered to the site of operations if possible.

9.3.3. **Confined Space Rescue.** A confined space can exist by deliberate construction of a space or structure, or by the result of structural collapse or natural structure such as a cave.

9.3.4. **General Tactical Considerations.** In peacetime, this type of rescue is demanding without the considerations of a tactical, combat, or Nuclear, Biological, Chemical (NBC) environment. Teams must focus and be cautious, safe, and thorough when life is in the balance, the area is not completely secure, or in the case of terrorist activities. Teams must be cautious about dangerous residual materials or agents, UXOs, and secondary explosive devices. Having NBC specialists and explosive ordinance disposal (EOD) present on-site to provide expertise, detection, and mitigation equipment is desirable. In hostile environments, the rescue team will require a sizable security force with required support to secure the site. **WARNING:** No Operator will enter a confined space without a gas monitor.

Table 9.1. Equipment.

Equipment Minimum (ea.)	Optional Equipment	Entry Tools
• Gas detector • Avalanche/location beacon • High-decibel whistle • Head protection (Pro-Tec helmet, climbing/ mountaineering helmet) • Helmet light source (recommend halogen and LED combo light) • Secondary light source: helmet or handheld • Leather work gloves (recommend leather reinforced Nomex) • Eye protection • Climbing/body harness • Ropes, nylon, spectra, climbing hardware, as required • Dust mask, respirator, or self- contained breathing apparatus (SCBA) • Radio • Medical equipment as required • Extrication gear as required	• Elbow/knee/skin pads • Additional light sources: LEDs, lamps, chemical lights • Clamp meter • Patient protective equipment: eye, ear, breathing protection • Wired sound detection, microphone/communications systems • Remote camera systems • Ventilation fans and ducts	• Sledge hammers • Pick-axes • Chopping axes • Hooligan tools • Crash axes • Hammers • Hack saws • Kinetic energy tools • Gas powered tools such as (masonry) circular saws and chain saws • Battery-operated tools such as drills and blade saws
NOTE: Adequate amounts of water is necessary for operation of the masonry saw in order to keep the blade cool and the dust sludge wet. The chain saw requires additional oil to keep the chain well lubricated. Extra fuel and batteries will be required for extended or complex recovery operations.		

9.4. Hazard Identification. First, assess the scene and identify hazards. These can be comprised of physical, chemical, electrical, munitions, and atmospheric hazards.

9.4.1. **Atmospheric Conditions.** Prior to entering a confined space, the rescuer must evaluate the atmosphere to determine if the air safe to breathe and if there is sufficient oxygen content, see **Table 9.1**.

9.4.2. **Gas Monitors.** Every Operator that enters a confined space needs to be outfitted with a personal gas monitor. It is highly recommended that Gas monitors are set up at the entrance to a confined space.

9.4.2.1. Gas monitors come in various degrees of sensitivity, type of sensitivity, and complexity of construction and operation. For tactical use, the smaller handheld devices (size of small GPS) are adequate for team purposes. They can be placed in "Stealth" modes where they do not audible alarm or flash lights when limits are reached; and instead, they vibrate. These devices measure various types and levels of gases.

9.4.2.2. The lower explosive level (LEL) is a minimal level at which a concentration of combustible gas will readily explode or burn with a sufficient ignition source. This area encompasses all hydrocarbons. Typically, the default level on a gas monitor is set at 10 percent and will provide a safe conservative level of monitoring. This level can be changed but should only be done by a person qualified to evaluate the conditions of monitoring in a particular environment. Once a gas reaches the LEL of 100 percent, the probability of explosion with an ignition source is a given.

9.4.2.3. The oxygen (O2) level indicates two things: if there is an adequate supply of oxygen in the ambient air to support human occupancy and if there is an overabundance of oxygen in the air. Remember at sea level, O2 content is 21 percent (79 percent nitrogen and other gases), O2 is fuel for combustion, and it feeds fire. There is also the concern of oxygen toxicity in high O2 atmospheres for prolonged periods of exposure. A level of O2 at less than 19.5 percent is considered oxygen deficient; oxygen enriched is above 23.5 percent.

9.4.2.4. Sulfur dioxide (SO2) is by-product gas and is produced at heat and power facilities that use oil or coal containing sulfur. It is also produced through other types of combustion. Additionally, it is a product at sulfuric acid plants.

9.4.2.5. Hydrogen sulfide (H2S) is a poisonous, toxic gas in high concentrations. It is present in large quantities in geothermal reservoirs and coal mines. It has the smell of rotten eggs.

9.4.2.6. Carbon monoxide (CO) is a by-product of combustion. It usually occurs as a result of internal-combustion engine exhaust; however, it can occur in underground mines as a by-product of a methane gas explosion.

9.4.2.7. Sulfur compounds, though occurring naturally, are often deliberately added to industrial and domestically available combustible gases so that their presence can be detected by human smell (as well as electronic monitors) producing the well-known odor of "rotten eggs." This is a passive safety measure to alert humans to the presence of dangerous combustible gases.

9.4.3. **Self-Contained Breathing Apparatus (SCBA).** For teams that choose to deliberately train to respond to environments that may be contaminated, there are many options.

9.4.3.1. SCBA open-circuit systems are similar to the well-known Scott backpack bottle air supply system used by firefighters. Their usable time is limited by type of bottle, volume, and pressure and the workload of the rescuers. They are usually quite bulky and difficult to use in a confined space. Typical time is 15 to 30 minutes.

9.4.3.2. SCBA closed-circuit systems operate like a diving rebreather by scrubbing the carbon from exhaled breath. They are usually smaller and lighter than an open-circuit system and provide 30 minutes to several hours.

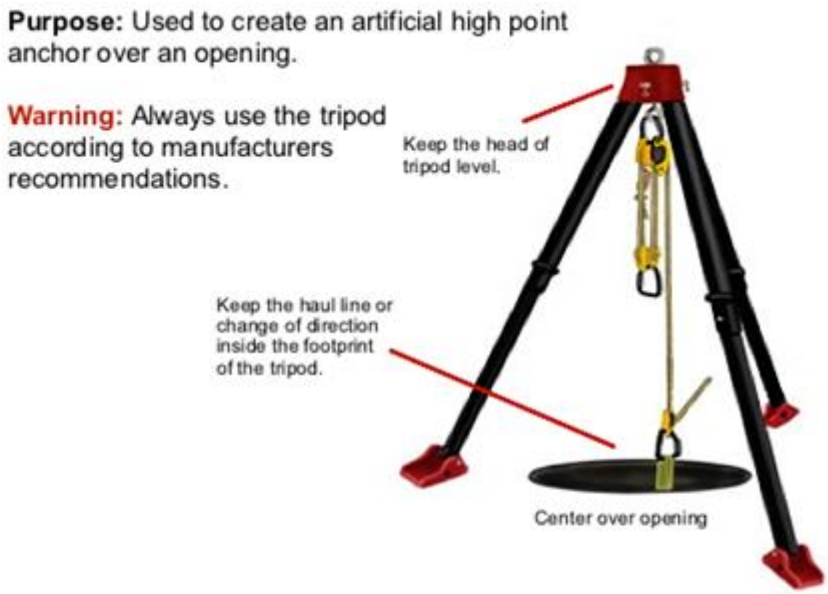
9.4.3.3. The supplied air-line respirators (surface) consist of an open-circuit face piece, regulator, and egress/walk-about cylinder. Some systems allow the user to detach from the low-pressure hose to move about more easily or deeper beyond the length of the hose which is usually limited to around 300 feet. Some systems allow hoses to be joined at their ends by a regulated high-pressure manifold to increase the overall distance.

9.4.4. **Communications.** Communications systems in confined spaces are essential. Direct line of sight is not always possible. Often the confined spaces diminish sound and voice projection or is absorbed by debris, materials, or the container. Confined spaces can magnify or reflect voice and sound so that it becomes unintelligible. The environment may be in a high noise area. The entrant/rescuer needs to have a radio on their person, and also consider of a secondary backup radio. This radio needs to be secured to the rescuer's body for positive control during the operation. Wireless radios can be affected by the surrounding debris, metals, magnetism, and electrical interference from generators and power lines. There are hardline communications systems, but they are limited by the length of their cable lines and lower versatility.

9.4.5. **Light Sources.** The rescuer should have more than one light source to include a primary and backup and the light sources should be bright enough to allow for safe operations and proper illumination of the working area. The light source should affix to the head or helmet of the rescuer so that the hands are free to work. The rescuer may want to consider bringing other light sources such as chemical lights to affix to the survivor, other patients, deceased, or illumination of the primary working area inside the confined space. **WARNING:** Open-flame lamps should not be used in confined spaces because of the possibility of explosive conditions and the close proximity of other rescuers, survivors, combustible materials, and loaded rope systems.

9.4.6. **Ropes and Associated Rope, Belay, Climbing Hardware.** Care, maintenance, and inspection of all applicable equipment remain the same as with regular climbing and mountaineering operations. Because a great number of confined spaces are accessed from a top entry, the importance of an overhead anchor is especially important when hauling litter patients and heavy objects. Since overhead anchors are typically rare, the team should have a heavy-duty tripod available. See **Figure 9.2, Anchor Tripod**.

Figure 9.2. Anchor Tripod.



9.4.7. **AC/DC Voltage Detector.** A handheld device that detects the presence of electrical voltage from a safe distance. They provide a warning to the user in the presence of dangerous voltages without the need to make physical contact with the source of voltage. This is useful when determining whether to cut a line or experiencing radio interference.

9.4.8. **Auditory Aids.** Microphone systems allow rescuers the ability to insert listening devices into small cracks and feed the devices into areas to listen for survivors before committing precious resources to uncovering an unknown area. Some devices are two-way broadband and allow the rescuers to communicate and listen to a remote survivor or rescue team. Some electronic listening devices have the capability of directional finding equipment by listening to acoustic and seismic signatures to locate survivor positions.

9.4.9. **Visual Aids.** There are small flexible camera systems that allow rescuers to peer into inaccessible areas to look for survivors or potential areas of entry prior to committing resources and time. These include fiberscope, borescopes, and flex scopes. They can provide black-and-white, color, and infrared/thermal imaging capability.

9.4.10. **Dogs.** In a continental United States (CONUS) peacetime environment, dogs may be present to assist in locating survivors. Their reliability varies based on training and conditioning of the animal. Secondary electronic means used in tandem with dogs provide a very good level of reliability.

9.4.11. **Kit Construction and Employment.** There are a variety of methods to package and employ confined space kits. Material required for this type of rescue is typically heavy and bulky. Ideally, rescue teams should position it as close to the objective as possible. Soft ballistic bags are available which can be dragged or carried by multiple personnel.

9.4.12. **Wheeled sleds.** Provide ease of transporting equipment and they can be loaded and stacked with gear and dragged over level terrain.

9.5. Procedures.

9.5.1. **Rescuer Recovery and Emergency Egress.** Active and passive rescuer recovery and emergency egress need to be rigged onto the rescuer prior to entry into a confined space. The rescuer needs to have the ability to actively egress the confined space immediately upon identifying a condition that could render the rescuer unconscious, incapacitated, injured, or trapped. The entry system should be set so that the monitor/belay team outside the confined space could raise, lower, or drag the rescuer out of the danger area.

9.5.2. **Patient Contact and Treatment.** The rescuer must consider the traumatic experience that may be affecting a conscious patient. The patient may be trapped, claustrophobic, feel suffocated or have any combination of traumatic injuries. The patient may have acute amnesia due to trauma-induced unconsciousness and may become extremely agitated and frightened once consciousness is regained. Talking to and touching the patient may ease a lot of the mental affects and will aid in calming. If unsuccessful, pharmaceutical aid may be required to calm the victim and to aid in expediting to recovery.

9.5.2.1. The situation or environment may dictate that the patient be removed from the space expediently. In these scenarios, there may not be enough time to package a patient or affix to a litter. A full-body harness can be placed on the patient to expedite recovery.

9.5.2.2. Many confined-space entry/exits are extremely tight. The patient may have to be packaged in a manner that provides the narrowest profile possible to clear the exit. Keeping an arm free prior to passing through the exit will allow the rescuers to position an arm overhead of the patient, with a possible shoulder tilt, thus reducing the shoulder profile of a wide patient to assist in passage.

9.5.3. **Hazard Reduction and Lock-Out Tag-Out.** Prior to commencement of operations in and around a structure, ensure that servicing utilities are shut off to minimize dangers to working personnel and victims and damage to the area.

9.5.3.1. Electrical. Secure energy at the source and along the circuit and provide visible marking such as “DO NOT ACTIVATE OR ENERGIZE”. Secure it with a lock on the switch to keep it from being inadvertently activation.

9.5.3.2. Other hazards to consider:

9.5.3.2.1. Hydraulic. Charged and pressurized lines.

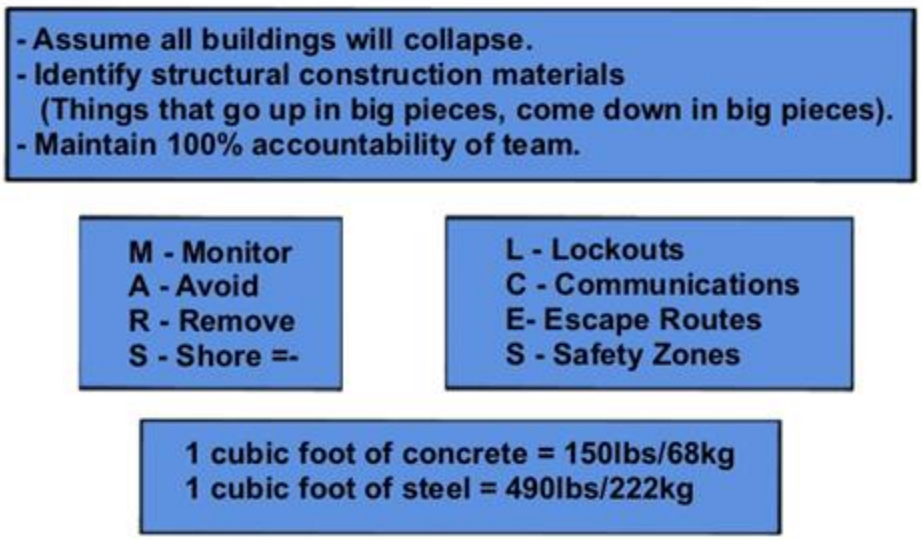
9.5.3.2.2. Mechanical. Blades, belts, gears, and flywheels.

9.5.3.2.3. Thermal. Liquefied gases at sub-temperatures, and thermal steam-operated systems and steam venting.

9.5.3.3. Forced Ventilation. Fans or blowers with flexible plastic ducts routed into the areas that to deliver ventilation can greatly reduce the presence of gas and extreme temperatures.

9.5.4. **Structural Collapse Rescue.** The study of this area includes the basic understanding of construction and laws of physics to the complexities of structural engineering. They should have a basic understanding of construction methods and materials. Prior to an event that causes damage or shift of a structure's foundation or load, a structural engineer can with great accuracy determine the load and weight dispersal of a structure. If an architectural engineer is not available, the rescue team can evaluate the circumstances, take the advice of all available experts, use previous experience and knowledge, and use rick mitigating safety equipment and procedures.

Figure 9.3. Structural Collapse Reminders.



9.5.4.1. Types of Structures. Structural collapse can include buildings, tunnels, and bridges.

9.5.4.1.1. Mega-structures

9.5.4.1.2. Ships

9.5.4.1.3. Ocean Oil Platforms

9.5.4.1.4. Complex Scaffolding

9.5.4.1.5. Caves

9.5.4.1.6. Man-Made Underground Complexes

9.5.4.2. General Considerations. Prior to entering a structural collapse, the rescue team should conduct a rapid site evaluation and consider some of the following:

9.5.4.2.1. How stable does the structure appear?

9.5.4.2.2. How old is the structure?

9.5.4.2.3. Was it in a state of disrepair prior to its collapse?

9.5.4.2.4. Is water, electricity, and gas still active in the building?

9.5.4.2.5. Are these utilities less of a concern but still pose a hazard concern?

9.5.4.2.6. Is any type of fuel stored within the structure or basement of the structure such as: Natural Gas, Propane, Heating Oil, Diesel, Fuels

9.5.4.2.7. What made the structure collapse or unstable: Natural Disaster, Poor Construction, Fire, Aerial Bombing, Terrorist Bombing, Utility Explosion.

9.5.4.3. Preparation. Before commencing operations around a collapsed or unstable structure, the following site evaluation criteria should be conducted.

9.5.4.3.1. A safety zone (or safety buffer) perimeter must be set up around the structure equal to one and a half times the distance of any remaining target standing structure.

9.5.4.3.2. Designate an entry/exit control point.

9.5.4.3.3. Closely monitor the number and names of personnel within the structure.

9.5.4.3.4. Clearly identify escape routes in the event of an emergency.

9.5.4.3.5. Maintain electronic communications with the entry personnel.

9.5.4.3.6. Consider tying a line to the entry teams.

9.5.4.3.7. Entry teams should be equipped with locator beacons.

9.5.4.3.8. Place safety observers/lookouts around a structure so that the team can be informed of shifting structures and significant activities.

9.5.4.3.9. dentify and label structural/infrastructural hazards.

9.5.4.3.10. Spray paint or use marking flags to mark hazardous areas.

9.5.4.3.11. The rescuer/entrant should have a safety line, whistle, locator beacon, radio and gas monitor secured on their person.

9.5.4.4. Structure Stabilization. Conducting shoring and cribbing will provide stabilization to a weakened route of entry in order to rapidly gain access and retrieve a survivor. **WARNING:** Conduct all crush injury protocols and medical treatment before attempting to move a heavy object off a survivor. See **Figure 9.4, Common Shoring Options**. Cribbing and shoring materials and equipment include:

9.5.4.4.1. Wood lumber and plywood: 6 x 6s, 4 x 4s, 2 x 4s

9.5.4.4.2. Plywood/gusset plates and nails to construct t-shores, vertical braced shores, laced post shores, horizontal shoes, and various raker shores.

9.5.4.4.3. Prefabricated metal mechanical pipe shores and trench jacks, pneumatic shoring posts, feet, brackets, sandbags, and extensions.

9.5.4.4.4. Mechanical Pipe Posts and Jacks. Used to shore overhead side bearing/trench loads. See **Figure 9.5**, Mechanical Jacks.

Figure 9.4. Common Shoring Options.

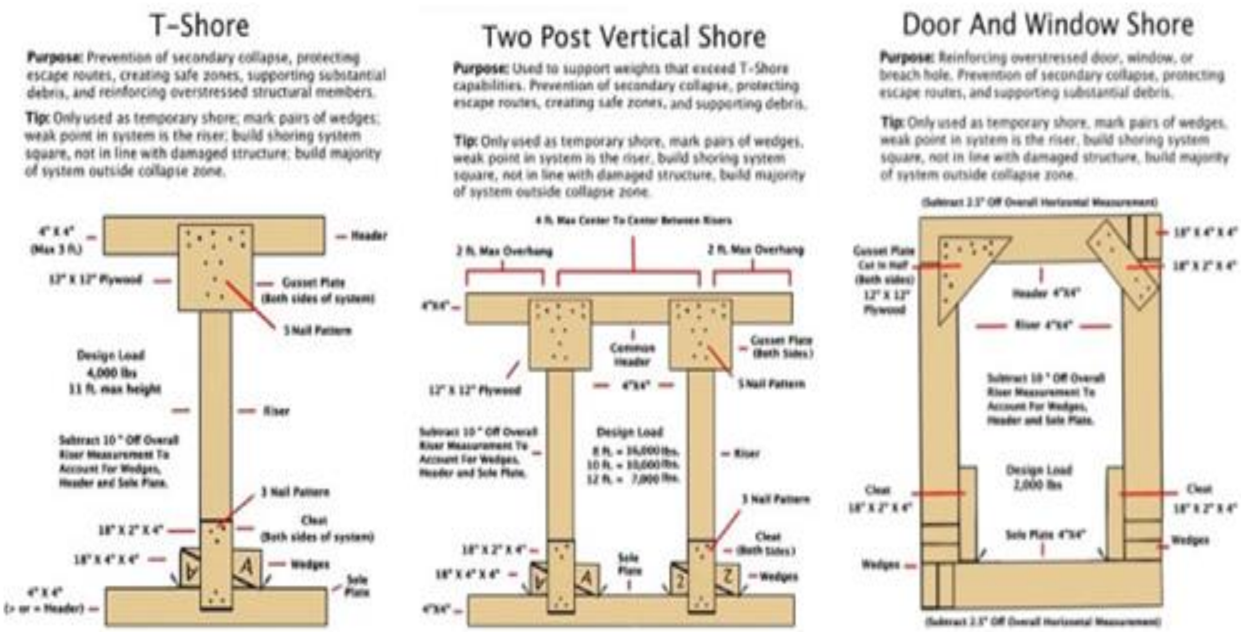


Figure 9.5. Mechanical Jacks.

9.5.4.5. Forced Entry. It may be necessary to break through a level of building material to get access to an adjacent area. The barrier may be a door or a slab of concrete, wall or floor. Attempt the simplest method first. The following figures display entry into a reinforced concrete slab. One access point was made using a Hooligan tool, sledgehammer, and saw with metal-cutting blade and the other access point was made using a masonry circular saw. Choice of tools is dependent on quality and thickness of the barrier material.

9.5.4.5.1. Concrete slabs. The use of the following techniques may be required to gain access through concrete.

9.5.4.5.2. Relief cuts. These cuts are made with saws to prevent the concrete from acting in compression. These relief cuts may be square, triangular, or "X" shaped. The gap created by the relief cut allows you to attack an inherent weakness of concrete, which is its poor structural stability when placed in shear or tension. See **Figure 9.6**, Concrete Entry Step Relief and Bevel Cut.

9.5.4.5.3. Bevel cuts. This is an angled cut which is made during a "lift out" operation. The bevel cut allows the rescue team to cut deep within the concrete while limiting the possibility that the cut section will slip through the hole. These types of cuts are critical when cutting over the top of a victim(s). See **Figure 9.6**, Concrete Entry Step Relief and Bevel Cut

9.5.4.5.4. Step cuts. This cut is used during a "lift out" operation when the slab is thicker and cannot be cut with one pass of the saw. Two cuts are made parallel to on another, the width of the saw blade guard. The concrete is then chipped out between the two cuts forming a trench. This allows the saw to complete the cut through the full depth of concrete. See **Figure 9.7**, Concrete Entry Step Cut.

Figure 9.6. Concrete Entry Step Relief and Bevel Cut.

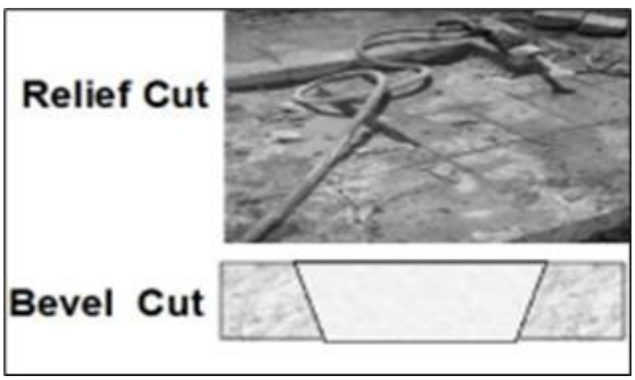


Figure 9.7. Concrete Entry Step Cut.

9.6. Confined Space Rescue Course Recommendations. It is highly recommended that teams attend extensive, highly focused courses of instruction that feature a tactical approach to confined space rescue. Courses should include real-life structures with realistic application in complex exercises. These courses should meet required standards and be certified by the National Fire Protection Association (NFPA), Occupational Safety and Health Administration (OSHA), Federal Emergency Management Agency (FEMA), or the American National Standards Institute (ANSI).

9.7. Nuclear, Biological, Chemical, and Explosives.

9.7.1. **General.** Contaminated environments are the most challenging due to environmental considerations, and rescue operations conducted in these environments are extremely dangerous. Not all rescues are feasible in these environments and serious risk management issues must be evaluated to execute recovery operations safely.

9.7.2. **Survivability.** The challenges of surviving in NBC environments should be adhered to before any other tactical considerations.

9.7.3. **Explosive Environments.**

9.7.3.1. Fertilizer plants

9.7.3.2. Munitions plants

9.7.3.3. Storage facilities

9.7.3.4. Chemical plants

9.7.3.5. Storage facilities

9.7.3.6. Fossil fuel power plants

9.7.3.7. Fuel depots

9.7.3.8. Oil and gas refineries

9.7.3.9. Combustible materials storage facilities

9.7.3.10. Facilities that transport dangerous explosive materials

9.7.3.11. Underground and above ground pipelines

9.7.3.12. Vehicles, trains, and aircraft.

9.7.4. **Operations in Explosive Environments.** The primary concern is being physically present at the site of the explosion. Other proximity injuries can be caused by heat, fire, and percussion. Some explosives residues can cause dermatological reactions and burns, and some materials can cause irritation when inhaled.

9.7.4.1. Reaction to Deliberate Attack. A reactionary situation occurs after the team is inserted and they are attacked with NBC weapons or are exposed by an indirect attack and don protective measures. METTC dependent, the team may continue with the mission if proper Personal Protective Equipment (PPE) is available.

9.7.4.2. Unplanned. The team is properly equipped and expects a high probability of NBC usage. PPE will be donned prior to entering the terminal and operational area.

9.7.4.3. Planned. The team receives notification prior to execution and may plan the recovery operations. PPE will be donned prior to entering the terminal and operational area.

9.7.4.4. Agent Type. The contaminating agent may be identified or classified prior to entering the area. This information is essential to protecting the rescue team.

9.7.4.5. Contaminant Exposure Prevention. All steps to prevent exposure will be taken. Rescue teams may not be equipped to operate efficiently in these environments. The primary consideration in these environments is safety and protection from exposure. Any team member becoming acutely symptomatic in an NBC environment will be removed from the rescue team.

9.7.4.6. Persistence of Contaminants. Survivability and persistence of these contaminants and agents in the field after induction can range from minutes, days, weeks and months. Persistence depends on weather conditions and how the contaminant/agent was engineered and dispersed.

9.7.4.7. Activities in Contaminated Environments. Enemy activity must be neutralized. If the area is contaminated, there should be limited enemy activity. Conducting effective defensive and offensive activities in these environments may be difficult. Committing additional security forces is a risk for increased casualties from exposure and hostile fire.

9.7.4.8. NBC Specialists. When able, seek aid from NBC specialists for rescue missions in NBC environments. Specialist can help prepare equipment or integrate with the team in certain cases. NBC specialists have specialized training and equipment to operate in these environments.

9.7.4.9. Prevention of Infectious Contaminates. A team working in a contaminated environment may be exposed to a contagious fatal biological agent. Infection of the team and survivors may preclude extraction to prevent the spread of a highly infectious contagion.

9.7.5. **Specific Nuclear, Biological, and Chemical and Explosive Considerations.**

9.7.5.1. Nuclear. Acute radiation injury results from high doses of radiation associated with a nuclear explosion, leak of radioactive material, or detonation of a radiation dispersal device made from highly radioactive material. Radiation can come from a variety of sources. It is most prevalent in nuclear reactors and weapons-grade nuclear materials. Contaminant radioactive material is a by-product of spent depleted uranium rounds. The number one consideration is avoidance. Distance and barriers provide the best protection. It is generally safe to treat victims of radiation exposure as long as they have not been exposed to radioactive materials. A Geiger counter is essential in a known incident area. A gas mask or respirator is important in an environment that may have radioactive dust present.

9.7.5.2. Biological. Biological agents are drawn from nature. Dozens of biological organisms and toxins are potential weapons of war and terrorism. They can range from simple exposures to mass quantities of a naturally occurring toxin or may be a genetically engineered and altered organism that can cause contagious, fast-acting, fatal diseases. Some examples are anthrax, botulism, pneumonic plague, smallpox, tularemia, and viral hemorrhagic fevers.

9.7.5.3. Chemical. Chemicals include blood, blister, nerve, and choking agents. Chemical exposure and release can occur from a chemical production plant or accidental release, attack and terrorist activity. As with other types of contaminants, symptom onset and severity depend on the following:

9.7.5.3.1. Is the agent a vapor, liquid, or powder?

9.7.5.3.2. Temperature, wind conditions, terrain, and humidity.

9.7.5.3.3. Route of absorption.

9.7.5.3.4. Specific agent, quantity, and duration of exposure.

9.7.5.3.5. Pre- and post-exposure treatment and protection.

Chapter 10

SNOW, ICE, & AVALANCHE

10.1. Introduction. Operations in these environments present unique challenges including rugged terrain, drastic elevation changes, erratic weather patterns, and extreme cold temperatures; requiring teams to be specially organized, trained, and equipped.

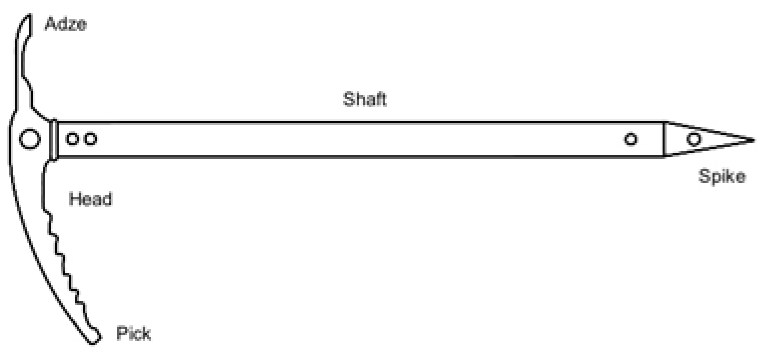
10.1.1. **High-Altitude Recovery Operations.** High-altitude operations are those conducted at altitudes over 10,000 mean sea level (MSL) and can exceed 18,000 feet MSL and higher. A physiological concern in a high-altitude environment is the decreased operational capabilities of human performance accompanied by altitude sicknesses.

10.1.2. **Snow and Ice Travel.** Snow and ice environments are dynamic and challenging. The principles of travel and rescue are similar to other environments but have some added considerations. Snow and Ice Tactics, Techniques and Procedures (TTP) are available in open-source mountaineering literature such as: *Mountaineering, The Freedom of the Hills*, *Glacier Mountaineering-An Illustrated Guide to Glacier Travel and Crevasse Rescue,* and *Staying Alive in Avalanche Terrain*.

10.2. Equipment. Terrain analysis, historical weather patterns, and current conditions will help to determine which personal and team equipment should be carried. See **paragraph 10.5.1** for specific avalanche equipment and **paragraph 10.8.2** for recommended glacier travel equipment.

10.2.1. **Ice Axe.** Used in snow and ice travel as a balance aid, to prevent a fall, and help arrest a fall. Its major components are the head, pick, adze, shaft, and spike. See **Figure 10.1**.

Figure 10.1. Parts of the Ice Axe.



10.2.1.1. Choosing the right size is determined by the intended purpose. A 60 to 70 cm axe is sufficient for general mountaineering use. Climbers use a leash to attach the axe to their wrist or harness; it prevents loss of the axe during a fall and allows the hands to be free if necessary. The leash should be long enough so that the axe can be attached to either hand.

10.2.2. **Crampons.** Crampons are metal spikes worn on the boots to attain traction in snow and ice. Usually made of alloy steel, they vary in point configuration, attachment system, and can be categorized into three types: Hinged, Semi-rigid, and Rigid. Hinged crampons are used for general mountaineering while the rigid crampons perform are used during technical ice climbing. When properly fitted, the crampons should remain attached to the boots without the use of straps.

10.2.3. **Wands.** Are used to mark the route and to retrace the path during bad weather, mark perimeters of probed areas and to mark hazards and danger areas. Wands can be constructed of bamboo stakes 30 to 48 inches long with a "flag" of fluorescent surveyor's tape on one end for identification. Wands are placed at regular intervals during travel, close enough to be seen in limited visibility, and varied terrain. They are retrieved by the team on descent. In inclement weather, the wands should be placed no further than the length of climbers' rope (this will enable members to retrace their route if needed).

10.2.4. **Ski or Trekking Poles.** Poles can assist in balance when the terrain does not require an axe (low-angle snow, tundra, or scree field). Adjustable poles can be set for the type and angle of terrain. Poles with removable baskets can be used to probe for crevasses during glacier travel.

10.2.5. **Snowshoes.** Compatible with almost any footwear, snowshoes attach to the boots and permit travel in soft snow. Snowshoes can be used to traverse varied terrain without requiring a high level of experience. Snowshoes are a great choice for team travel when traversing with members of low skilled skiing abilities. **NOTE**: Crevasse falls are more likely on snowshoes as they provide less surface area than snow skis.

10.2.6. **Skis.** Mountaineering skis attach to the boots with a binding system that allows for free heel movement for uphill travel and can lock down for descent. When used with fitted climbing skins, they provide an efficient travel method for basic snow and glacier movements. Skis have the advantage of requiring less energy for travel and displace the climber's weight over a larger surface area than snowshoes or crampons. Climbing skins are strips of synthetic material (once actual animal skins) that attach to the undersides of backcountry and metal-edged touring skis to provide traction for climbing by preventing the user from backsliding. Crossing icefalls, rocky terrain or heavily forested slopes with skis may pose some difficulty. Skis should be maintained by applying wax to the undersides. Wax protects skis from scratches in addition to giving them their glide. In warm weather, soft waxes based on petroleum wax repel slushy snow and keep skis gliding. On cold, hard snow, long-chain or branched alkanes protect the base of the ski, keeping it smooth and slick.

10.3. Travel Techniques.

10.3.1. **Ice Axe Use.** When traveling with an axe, the rescuer can carry it in either hand or attach it to their pack when not required. Axes are used to prevent falls using the self-belay technique and to arrest a fall by using the self-arrest procedures.

10.3.2. **Self-Belay.** Climbing using the self-belay provides the climber a handhold in the event of a slip. Self-belay procedures are as followed:

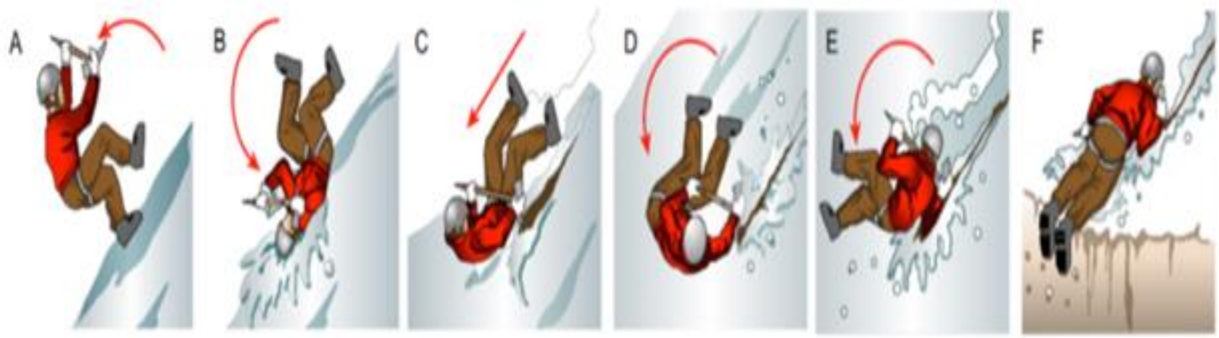
10.3.2.1. While holding the axe by the head with fingers around the pick, jam the spike down into the snow, and hold on with the uphill hand while moving forward.

10.3.2.2. Take a step or two and repeat, ensuring the placement is solid enough to hold your weight if a slip occurs.

10.3.2.3. If a slip occurs, keep one hand on the axe while the other grabs the shaft right at the snow surface.

10.3.3. **Self-Arrest.** The ability to arrest a fall initially before momentum builds is critical. **CAUTION:** During a fall with crampons, it is important to keep the feet off the ice (heels to your butt). If crampons catch on the ice, this may cause severe lower extremity injuries. Although there are various positions in which a climber can slide down the slope after a fall, the goal is to arrest the fall. Procedures for arresting a fall are 1) hold on firmly to the axe and place it across the chest, 2) drive the pick in the snow, and 3) shift and leverage all weight onto the axe to stop the slide.

Figure 10.2. Ice Axe Self-Arrest.



10.3.4. **Roped Travel.** Roped travel on snow or mixed terrain can provide security for less experienced teams. This method enables the entire team to arrest a fall if one occurs. If a team is not experienced in preventing falls utilizing this method, then running or stationary belays should be used.

10.3.5. **Belays.** Belays are used to protect a climber from falling. Depending on the environment, slope angle, prolonged exposure, climbing speed, and likeliness of a fall; the team should use quick anchored, or running belays, see **Table 10.1**.

Table 10.1. Belays.

Quick Belays. • A climber can use the axe to set up a quick belay such as the boot-axe belay or the Carabiner-axe belay.
Anchored Belays. • By placing pickets or other anchors, the climber can set up more traditional belays such as a hip belay or use a mechanical belay device. • Hip belays will generally place less dynamic load on the anchor than a mechanical belay device.
Running Belays. • Running belays can be used by the roped climbing team when stationary belays are not practical. Pickets are placed by the lead team member. • The rope is clipped in and “runs” through the anchor as the team moves by. • Each team member “clips through” the anchor while passing, ensuring to be always in the belay system. • The picket or pickets are pulled by the last person, and they are redistributed to the team at the next stop or rest site.

10.3.6. **Snow Anchors.** When using snow anchors, there are some considerations to keep in mind. Anchors need to be able to absorb the dynamic forces of a fall and there are variations in the consistency of the snowpack. Multiple anchors can help distribute the force and should be used when practical. The anticipated direction of pull is critical, and pieces should not "lever out" once loaded.

10.3.6.1. Pickets. Pickets are 18-36 inch aluminum stakes placed in snow as an anchor. Pickets work best in firm, hard snow, and placement should be a 30-45 degree angle from the direction of pull. There are holes drilled for attachment of runners and hardware.

10.3.6.2. Deadman. For softer snow, a buried anchor or "deadman" anchor works well. They can be constructed of pickets, ice axes, skis, packs, or other large objects that can be buried and have a runner attached. Some important points to remember when setting a deadman is to set the anchor and runner in the direction of pull and dig a slot for the runner so it is not levered out under tension.

10.3.6.3. Bollard. Bollards are large, carved-out mounds of snow that can be padded and wrapped with a runner and used as an anchor. Bollards are very strong in solid snow but take a lot of time to construct. **CAUTION:** When traveling on hard packed snow or ice with prolonged exposure, the team should always use running belays and protection. Arresting a fallen climber while roped together in these conditions is nearly impossible without running protection.

Table 10.2. Snow, Ice and Avalanche Terminology.

Term	Definition
Anchors	Trees, rocks, bushes that help to hold the snowpack in place.
Aspect	The direction the slope faces with respect to sun and wind. For instance, a slope may be north facing, or it may be a leeward slope.
Beacon	An electronic device used to locate buried avalanche victims. Also called transceivers or locators.
Bed surface	The snow surface on which an avalanche slides.
Collapsing	A snowpack collapsing onto a buried weak-layer, obvious sign of instability.
Continental climate	The snow climate found in mountains far from the influence of the ocean's weather. Characterized by thin snowpack, cold temperatures, and more persistently unstable snowpack.
Crown face	Distinct line where a slab avalanche separates from the snowpack on the uphill side.
Grid search	A rescue technique with traditional beacons in which the rescuer uses a series of perpendicular grids to find the transmitting beacon. Many newer beacons lead the rescuer directly to the victim, only requiring a grid search in the final pinpoint moments of the search.
Induction line search	A rescue technique with beacons in which the rescuer follows the curving electromagnetic lines that emanate from a transmitting beacon. Also called tangent search.
Intermountain climate	The snow climate commonly found in intermountain areas midway between maritime and continental climates. Characterized by intermediate snow depths and intermediate temperatures.
Leeward	The downwind side of an obstacle such as a ridge. Wind can deposit snow onto leeward terrain creating wind slabs or wind pillows, which are often dangerous.
Maritime climate	The snow climate near the oceans. Characterized by deep snow and warm temperatures.
Probe	A rod used to probe avalanche debris for buried victims.
Remote trigger	When a person triggers an avalanche some distance away. Sometimes called a sympathetic trigger.
Runout	The zone where an avalanche loses speed and deposits debris.
Runout angle	The angle, measured from horizontal, between the toe of the avalanche and the crown. Also called the "alpha" angle.

Settling, settlement	The slow deformation and densification of snow under the influence of gravity. Sometimes settling is incorrectly used to describe collapsing snow.
Slope cut	Moving rapidly across an avalanche starting zone, aiming at safe terrain on the side, so that if an avalanche breaks, your momentum will carry you off the moving slab onto safe terrain. Skiers call them ski cuts. Only to be performed by expert skiers.
Sympathetic trigger	One avalanche triggers another avalanche some distance away.
Terrain trap	Terrain pocket in the debris field that will catch more snow then other areas in the event of an avalanche. Common terrain traps include gullies, tree wells, abrupt terrain transitions, or an avalanche path that terminates in trees, crevasse field, or cliff.
Trigger	A disturbance that initiates fractures within the weak layer, allowing the slab to slide off the slope. In 90 percent of avalanche accidents, the victim or someone in the victim's party triggers the avalanche. Other triggers include new snow, cornice falls, wind, rapid warming, or percolated water. Avalanches are not triggered by noise.
Weak layer	A relatively less cohesive layer of snow underlying a relatively more cohesive layer of snow. In a slab avalanche, the weak layer fractures, allowing the overlying slab to slide of the slope.
Whumpf	Audible sound of snowpack collapsing on a buried weak layer; an obvious sign of instability.
Wind loading	Loading of weight on top of a snowpack when wind drifts snow onto lee terrain. Wind can deposit snow 10 times more rapidly than snow falling from clouds. Wind loading is a common denominator in most avalanche accidents.
Windward	The upwind slope of an obstacle such as a ridge. Usually, snow is eroded from the windward slopes making them relatively safer.

10.4. Avalanche Prone Terrain. The angle, aspect, and slope configuration are all key components that help answer the question, "Can the terrain produce an avalanche?"

10.4.1. **Angle.** Knowing the terrain angle is key since avalanches typically occur on slopes with starting zones between 60 to 25 degrees and prime slide angles at 35 to 45 degrees. Slopes that are steeper than 60 degrees will slough off snow constantly while slopes shallower than 25 degrees will not. Slope angles are difficult to estimate; using a clinometer is a reliable device to obtain this data. Rescue teams should evaluate both the slope currently working on and adjacent upper slopes.

10.4.2. **Aspect.** The aspect or direction the slope faces determines the amount of sun and wind the slope gets which increase slide potential. For the northern hemisphere, south-facing slopes receive more sun; therefore, the snow generally settles and consolidates faster than on north-facing slopes. This effect can make south-facing slopes safer in the winter months. The lack of sun on the north-facing slopes means consolidation generally takes longer; coupled with colder temperatures, this can contribute to instability. Wind has a great effect on avalanche potential as leeward slopes (those that face away from the wind) can receive a great deal of wind deposited snow or "wind loading."

10.4.3. **Configuration.** The slope surface itself can affect slide potential. Grass, brush, or tundra can provide a smooth surface for snow to move over. Trees and rocks can provide some "anchoring" for the snowpack, but it must be so thick or close together that travel through them is impractical.

10.4.4. **Slope Shape.** Slope shape is also a factor as convex slopes have zones of tension as the snowpack stretches over the curve of a hill. Fractures will often occur just below this area of tension.

10.4.5. **Weather.** Changes in the weather can impact the stability of the snowpack. Always evaluate the past, present and future weather conditions. The snowpack can slowly adapt to changes in snowfall, winds, and temperature over time. Rapid changes in any of these three areas will usually contribute to instability.

10.4.6. **Precipitation.** Snow, hail, or rain will all add stress on the snowpack. If a heavy load of new snow (less than 1 inch per hour or less than 12 inches per day) accumulates too quickly for the strength of the snowpack to absorb, a slide may result. Rain contributes stress to the snowpack by adding weight and percolating through the layers and weakening the bonds that hold them together. With any new precipitation, the team must evaluate how big of a new load it is and how well is it bonding to the existing snow.

10.4.7. **Wind.** Wind events can transport large amounts of snow from windward slopes, depositing it on leeward slopes "loading" them. In the transport of this snow, the snow crystals can also become broken which allows them to be packed tightly forming slabs. Recent changes in the duration, direction, or velocity of the wind should be considered in the stability evaluation.

10.4.8. **Temperature.** Temperatures inside the snowpack and external temperature changes affect the snowpack in different ways. Temperature differences within the snowpack can weaken the bonding among layers over time, allowing the creation of a sliding surface. Short-term warming can cause a new snow to settle and bond well while rapidly warming temps can weaken the bonds, affecting the stability of the snowpack. Rapid changes in temperature as well as recent trends are important factors in the weather evaluation.

10.4.9. **Snowpack.** Evaluate the snowpack and look for characteristics that contribute to an avalanche. A snowpack evaluation can provide good data on the general condition of the snow, the existence of a slab, weak layers and will help evaluate if the snow will fail. **NOTE:** Snowpack tests only show snow conditions in the exact spot they were taken. There are many methods to test the snowpack such as:

10.4.9.1. Extended Column Test (ECT)

10.4.9.2. Rutschblock test

10.4.9.3. Shovel shear tests

10.4.9.4. Ski pole tests.

10.4.10. **Slab Configuration.** The snowpack is made up of layers, each one characterized by relative strength, hardness, and thickness. A slab avalanche happens when a large area of cohesive snow begins to slide on a weak layer within the snowpack or over smooth ground. As you evaluate the snowpack, constantly search for slab formation, size, and depth.

10.4.11. **Bonding Ability.** Teams need to determine the strength of the bonded layers, the cohesiveness of the bonds within the pack, and if there are any weak layer's present.

10.4.12. **Sensitivity.** The snowpack exists in a balance between strength within it and stresses placed upon it. For an avalanche to occur, something must disturb the balance so that the stress exceeds the strength. Inherently, the snowpack can adjust to a limited amount of stress at a certain speed. As more stress is added such a recent heavy snowfall, or a rapid increase in temperature, the balance is tipped and an avalanche will occur, see **Table 10.3**.

10.4.13. **Human Factors.** Team strength, team member attitudes, and skill level contribute a subjective component of the hazard evaluation called human factors. Attitudes is when team members are committed to the mission or objective but with inconclusive agreeance by all members on the assumed level of risk. Sound judgment is critical in decision making and the ability to objectively evaluate information on the terrain, weather, and snowpack.

Table 10.3. Clues to Snowpack Stability.

Clue	Message
Recent avalanche activity	Best clue to instability. Slopes of similar elevation and aspect should be considered suspect.
Whumphing noises	Sounds caused by a sudden collapse of a weak subsurface layer; indicates extreme instability in the area. Pick routes across gentle slopes (slopes with angles of less than 25 degrees) and avoid runout zoned of steeper slopes.
Shooting cracks	A form of brittle failure caused by the sudden release of stored elastic energy (i.e., extreme instability is present).
Pluming and wind transport	Wind pluming (wind-generated snow clouds), which results from snow getting eroded from the windward slopes and new snow being rapidly deposited on leeward slopes. If wind loading persists, the period of instability is usually followed by repeated cycles of avalanche activity and reloading. Avoid these leeward slopes and terrain below them.
Storm activity	Tends to make conditions more unstable. These periods of instability are generally of shorter duration in warmer snow climates but persist for long periods of time in colder climates.

10.5. Travel Considerations for Avalanche Prone Terrain. Safe travel in the back country depends on making choices that attempt to limit the exposure to hazards. Some guidelines for use are as follows:

10.5.1. Terrain management. The most experienced person(s) should lead the team during the route finding phase.

10.5.2. Choose to travel the lowest angle slopes that will get you to the objective; be especially cautious of slopes in the 35-45 degree range.

10.5.3. Favor ridges and the edges of slopes where slides are less likely and safe terrain is closer to escape to if one occurs.

10.5.4. Favor windward slopes: avoid snow-loaded leeward slopes that can have wind-deposited slabs.

10.5.5. Avoid gullies and be aware of the run out zone beneath snow slopes, especially if there are cliffs below.

10.5.6. Cross danger areas one at a time, moving from one point of safety to the next point of safety.

10.5.7. Constantly evaluate the environment for potential avalanche danger and potential consequences.

10.5.8. **Required Equipment.** An avalanche beacon or transceiver, an avalanche probe, and a shovel are the minimum equipment requirements for travel in avalanche terrain.

10.5.8.1. Beacon or Transceiver. The transceiver or beacon is the principal tool for locating buried victims. Beacons can switch between the transmit mode for travel and receive mode for searching. Current beacons are now using a 475-kHz signal with digital processors that give both audible and visual signal cues in the Search mode. Beacons should be worn close to the body and under your jacket to prevent it from being lost during an avalanche. Personnel beacons should be checked before each day's travel for battery life and functionality both in the Send and Receive mode.

10.5.8.2. Probe. Commercial avalanche probes are constructed of lightweight metal sections that quickly assemble into a single unit (usually 3 meters) for locating buried objects under the snow. Some ski and trekking poles have removable baskets and can be joined together to function as a probe.

10.5.8.3. Shovel. Shovels provide the ability to displace snow quickly. Some of the better shovels have large metal scoops and "D" handles which provide more ability to chop through avalanche debris and hard pack snow. Shovels can also be used for constructing tents and snow shelters.

10.5.8.4. Air Bags. Air bags are typically built into specialized backpacks. When caught in an avalanche, personnel activate the airbag which inflates around the person's head. Airbag packs work through the principle of inverse segregation as bigger objects are more likely to stay higher in the avalanche debris. A deployed airbag simply makes a person bigger which helps personnel stay on the surface. Staying on the surface of an avalanche increases chances of survival.

10.6. Avalanche Survival Guidelines:

10.6.1. Always assume the slope you are on will slide.

10.6.2. Have an immediate escape route planned at each phase.

10.6.3. If caught in a slide, commit to fight for survival.

10.6.4. Activate air bags (if equipped).

10.6.5. Try to stay on the surface of the slide by “swimming.”

10.6.6. Look for and try to get to an escape route off to the side.

10.6.7. Try to get rid of skis and poles as they can drag you deeper into the slide.

10.6.8. Keep the pack on; it can protect the back from trauma.

10.6.9. As the slide slows down, cup one hand in front of the mouth and nose to form an air space and take a deep breath and try to shoot the other hand up to the top of the snow.

10.6.10. After the snow stops, it will be impossible to move.

10.6.11. Do not shout or struggle; relax, and conserve air.

10.6.12. You must now rely on the team to locate and dig you out.

10.7. Avalanche Rescue.

10.7.1. **Time.** The first minutes of an avalanche response are critical; people found within 15 minutes have a 90 percent chance of survival. Teams must rely on their ability for self-rescue.

10.7.2. **Surface Search Methods.** The last point seen is a critical point from where to begin the search. The next area to search is likely areas of deposition (terrain traps) downhill from the last point seen. Following the path of travel, perform a rough surface search looking for hats, gloves, or other clues that will lead you to the victim location.

10.7.3. **Transceiver (Beacon) Search Methods.** Ensure all searchers switch their beacons to Search mode and begin following the signal to the survivor's location. As one or two team members begin to pinpoint the signal, remaining team members should begin to prep shovels and probes. Refrain from probing until searchers have zeroed in to the closest distance with their avalanche beacon.

10.7.4. **Probing.** Formal probe searches are very time consuming whereas spot probing likely burial areas can be far more effective, especially the area identified during the beacon search.

10.7.5. **Recovery.** Once you have located the survivor through probing, leave probe in place and focus digging efforts far enough downslope of victim that you are digging in on a horizontal plane. Digging downslope of the victim serves two purposes:

10.7.5.1. It facilitates digging by scooping the snow back and downhill, rather than lifting it up and out of the hole.

10.7.5.2. It allows the victim to be pulled out and downslope rather than lifting victim up and out of hole, see **Figure 10.3**.

10.7.6. **Other Rescue Considerations.**

10.7.6.1. Evaluate and continually monitor scene safety; one avalanche has the potential to trigger other avalanches, turning rescuers into victims. See **Figure 10.4**, Avalanche Hazard Evaluation Checklist.

10.7.6.2. For multiple burials, as you recover each victim, ensure to turn off their beacons as to not confuse the search efforts.

10.7.6.3. While the primary diggers work, other team members should move the dislodged snow away from them to minimize their efforts. Primary diggers should swap out after very short intervals to prevent fatigue while maintaining a high rate of snow removal.

Figure 10.3. Dig Downslope to Recover Victim.

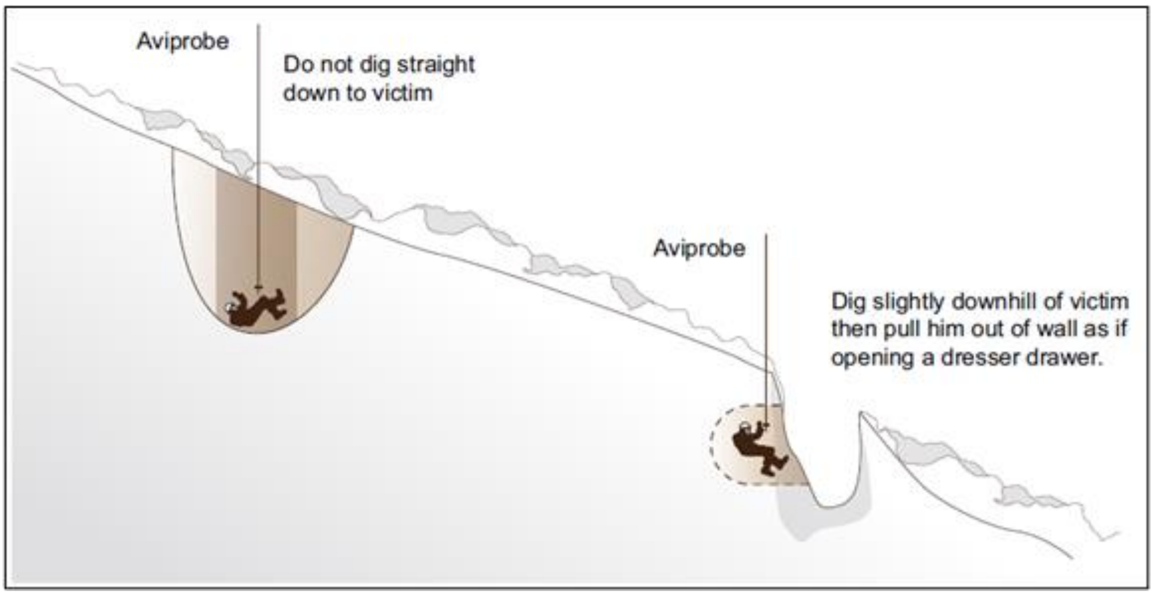
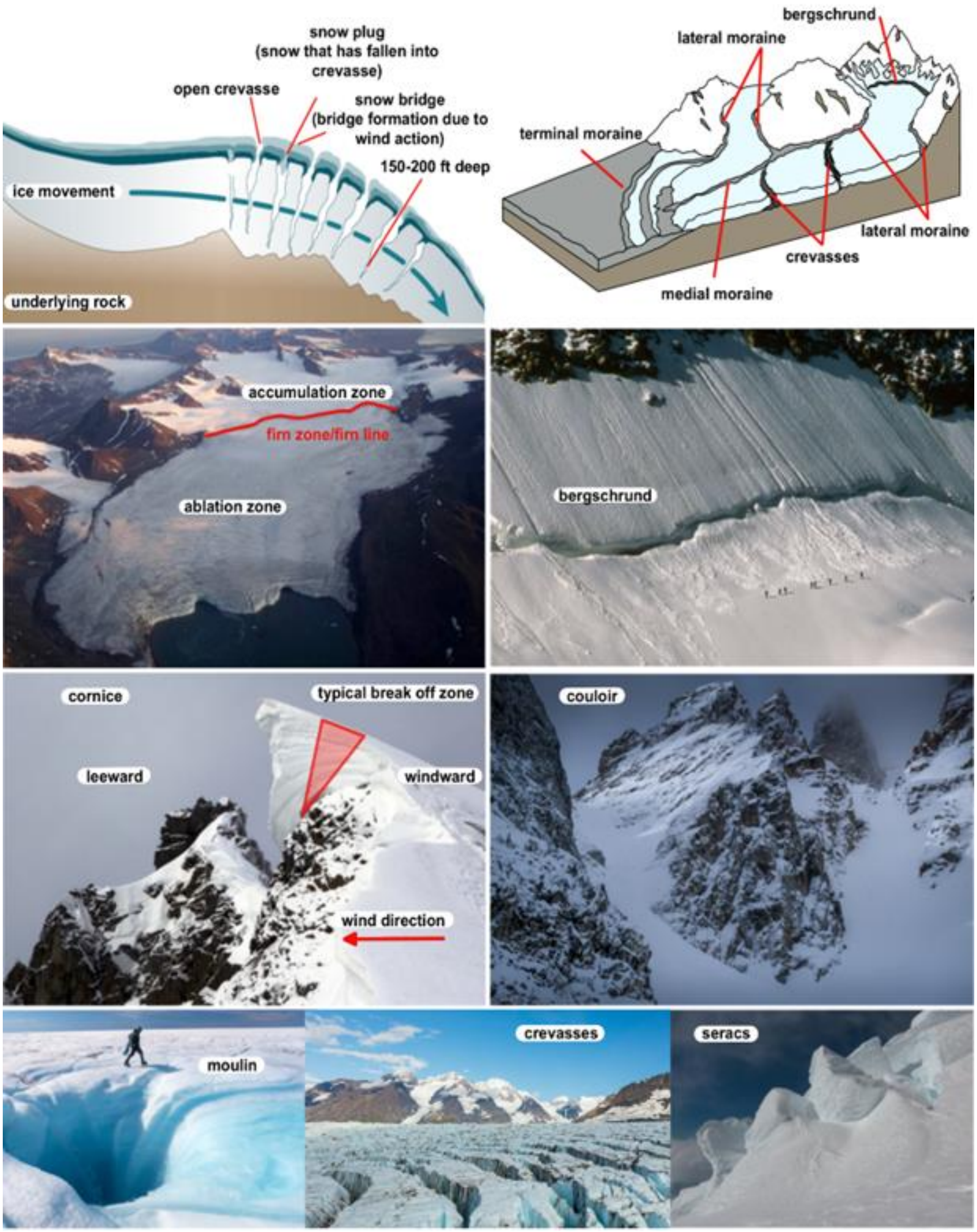


Figure 10.4. Avalanche Hazard Evaluation Checklist.

CRITICAL DATA	HAZARD LEVEL*			ACTION	
PARAMETERS: KEY INFORMATION	G	Y	R	*GO*	*NO GO*
TERRAIN: *Is the terrain capable of producting an anvalanche?*					
Slope angle (how steep, exposed?)					
Slope aspect (leeward, shadowed, or extremely sunny?)					
Slope configuration (smoothness, anchoring, and shape effect?					
Overall effect					
WEATHER: *Has the weather been contributing to instabilllity?*					
Precipitation (added weigth, stress?)					
Wind (significant snow transport and deposition?)					
Temperature (rapid/prolonged warming, weakening?)					
Overall effect					
HUMAN FACTORS: *Could you be a trigger or a victime, and are you prepared for the consequences?*					
Attitude (toward life, risk, goals, data?)					
Technical skill level (high / low, so what?)					
Physical and mental ability (tired, weak, strong?)					
Appropriate equipment (prepared for the worst?)					
Overall effect					
DECISION / ACTION: *Do better alternatives exist?*					
Go / No go: why? (What assumptions are you making?)					
*** Green = Go / OK Yellow = caution / potentially dangerous Red = stop / dangerous**					

10.8. Glacier Characteristics. Glaciers can be thought of as rivers of ice that are constantly moving and molding to the terrain they cross. Glaciers form as snow and ice buildup over time and can range in size from a football field to over 100 miles long. They can also be relatively thin and can range in thickness from 100 feet to thousands of feet thick. Crevasses or large, deep cracks form in the zones of tension as the glacier flows downhill. See **Figure 10.5**.

Figure 10.5. Anatomy of a Glacier.



10.8.1. Glacier: A body of permanent ice slowly flowing downhill under the pull of gravity. Not to be confused with a snowfield, which is a body of snow that does not move.

10.8.2. Accumulation Zone: Where more snow falls than snow melts.

10.8.3. Ablation Zone: Where more snow melts than snow falls.

10.8.4. Firn Zone: The firn zone or firn line is the boundary between the accumulation and ablation zones.

10.8.5. Crevasse: A crack in the glacier, sometimes hidden by snow cover. Can go as deep as 150 to 200 feet. Crevasses are formed in predictable areas on the glacier called zones of tension.

10.8.6. Snow Bridge: A formation of snow that spans a crevasse. Snow bridges are formed when snow falls on a glacier. The snow will accumulate on the edge of the crevasse; they will form much faster when temperatures are near freezing. Wind also plays a major role in the formation of snow bridges. The wind will create a cornice over the glacier until it reaches the other side.

10.8.7. Moraine: Rock and debris areas on the glacier; lateral, medial, and terminal moraines.

10.8.8. Bergschrund: Crack that develops at the base of steeper slopes, separating the moving ice from the stationary ice higher up. These do not follow the 200-foot rule of crevasses and will seem to drop infinitely.

10.8.9. Cornice: A buildup of snow on ridge crests, overhanging on the leeward side and created by the wind.

10.8.10. Couloir: A natural concave groove among steeper walls of rock; usually wider than a gully.

10.8.11. Moulin: A giant water drain hole in the crevasse.

10.8.12. Serac: A tower or block of ice that is separated from the mass. One of a mountaineer’s greatest hazards.

10.9. Equipment for Glacier Travel and Crevasse Rescue.

10.9.1. **Rope.** For glacier operations, a dynamic rope is recommended for the rope travel team, as it will help absorb some of the force in a crevasse fall.

10.9.2. **Sit Harness.** Proper fit of the sit harness is crucial for glacier travel. It is vital to pay attention to the sit harness since the climber will often be dangling in free space after a crevasse fall. Care should be taken when selecting a harness. The harness should have broad webbing or fabric, while its waistband cinches just above the climber's hipbones. This will support the climber with a high center of gravity. It is recommended that the operator try it on with a backpack to ensure a comfortable fit for traveling.

10.9.3. **Chest Harness.** The climber should wear a chest harness to better enable an upright position while climber is hanging in a crevasse. Chest harnesses can be purchased commercially, or they can be fabricated with tubular nylon or sewn slings. To fabricate and fit a chest harness using tubular nylon follow these steps:

10.9.3.1. Start by taking an 8-foot piece of 1-inch tubular nylon and tie it into a loop using a water knot. Then, loop it into a figure eight and put a shoulder through each loop, ensuring that the X is in the back. Finally, link the front two loops with a non-locking Carabiner

10.9.3.2. Once the chest harness is fitted to the climber, connect the front chest loops of the chest harness to the sit harness. When doing this it is important to note that the climber is able to bend forward. If traveling while roped up the rope can be used to connect the two harnesses.

10.9.3.3. disadvantage of the chest harness is that when the climber arrests a fall, the rope will squeeze the climber's chest towards the waist causing discomfort to the climber until an anchor is set and the weight transferred off the climber. CAUTION: Falling into a crevasse without a properly fitted chest harness can lead to serious injury to the climber's back.

10.9.3.4. The use of a full-body harness is an alternative to the chest and sit harness combo. This will alleviate the torso squeeze. It is more comfortable and effective in the rescue arena.

10.9.4. **Self-Rescue System/Ascent Capability.** Ascenders give the climber a way to ascend a line. They can be mechanical, such as Jumars, or hand-tied friction hitches, such as Purcell Prusiks.

10.9.5. **Crevasse Rescue Gear.** Below is a recommended gear list while traveling on a glacier. This list is for self-rescue of a team with two or more climbers traveling together. It can be used to affect a rescue in an emergency situation. Quantities of specific gear listed below may be adjusted based on team size and unit SOP. Additionally, anchoring equipment is dependent on the glaciers condition (i.e., a “wet” snow covered glacier or “dry” exposed ice glacier).

10.9.5.1. Helmet – if environment suggests it

10.9.5.2. Descent control device (belay device)

10.9.5.3. Non-locking carabiners x 4-6 ea.

10.9.5.4. Locking carabiners x 4-6 ea.

10.9.5.5. Prusik-minding pulley x 2 ea.

10.9.5.6. Tandem Prusiks x 1 pr.

10.9.5.7. Purcell Prusiks x 1 pr.

10.9.5.8. 7mm Cordelette x 10 meters

10.9.5.9. Sewn sling x 2 ea.

10.9.5.10. Ice screw x 1 ea. (22cm length recommended for building a v-thread)

10.9.5.11. V-thread tool

10.9.5.12. picket x 2 ea. (120cm sewn slings attached to each)

10.9.6. **Packs.** The pack is not normally tied into the system while traveling. Tie cordelette around the entire pack, ensuring that if a fall is taken, it will not release. Some packs are sewn well enough that a sewn sling may be girth-hitched around the carrying handle and shoulder strap. Once a sling is on the pack, attach a Carabiner to the end of the sling. After a fall, the climber can attach the pack to the rope using the sling. Attach the Carabiner to the rope between your tie-in and your ascension device. This will create a 2-to-1 mechanical advantage, resulting in the climber ascending with half the weight of the pack.

10.9.7. **Sleds.** There are many types of sleds available to the climber. Sleds range from those specifically manufactured for climbing to plastic kiddy sleds. Manufactured sleds are very sturdy but weigh a lot. Kiddy sleds are lightweight and work just as well as manufactured sleds.

10.9.7.1. Tying a sled into a system (Two Examples).

10.9.7.1.1. Tie the sled directly into the rope in between two climbers. This is done by attaching the sled to the rope via two Prusiks. One will be tied from the front of the sled to the rope and the other from the back to the rope. This allows the sled to be moved along the rope as needed. A disadvantage to this is that the sled may move on the rope due to the Prusik slipping when no tension is applied to it.

10.9.7.1.2. Attach the sled to the climber's pack with cordelette. Then run a rope through a Carabiner on top of the sled and tied by a clove hitch in the back.

10.9.8. **Skis.** Skis are the preferred travel method as they provide the most flotation and distribution of weight while moving over snow and snow bridges. Additionally, it's the least physically straining method for the personnel. Be advised that when descending steeper slopes on skis, it requires greater skills.

10.9.9. **Snowshoes.** Are the second best method for glacier travel and are easy to use regardless of skill level. Be aware that snowshoes do not provide as much flotation moving across snow and snow bridges.

10.9.10. **Crampons/boots.** Are the least preferred method for glacier travel because they present the potential for post holing, they are a slower method of traveling and are much slower and require higher levels of physical endurance. Crampons/boots have a higher potential for ice/snow build up and provide little to no surface flotation while traveling across snow and snow bridges.

10.10. Individual Configuration for Glacier Travel.

10.10.1. **Sit/Chest Harness.** One locking Carabiner is used to connect climbing rope knot to sit harness (if traveling with ice axe, clip ice axe leash Carabiner to this locking Carabiner). A properly fitted sit harness should be worn and should include a chest harness as an option. When outfitting for travel, use any means available to protect the climber's body in case of a crevasse fall. This can be rigged with the end of climbing rope and coiled around the climber, an actual chest harness, or a modified harness rigged with the backpack. In **Figure 10.6** Step 1, the sling is attached to the backpack and doubles as a chest harness—the Carabiner from the sling in self-rescue will need to be unclipped from the main rope and clipped back into the main rope below the pre-positioned friction hitches before ascending.

10.10.2. **Self-Rescue Ascent Capability.** Ideally, two ascension devices are attached. A light and easy method is the Purcell Prusik system, see **Figure 8.23**. Using the Purcell Prusik system, the short leg loop Purcell is attached to climbing rope and clipped with its own locking Carabiner to the climber's harness. Below this Purcell on the rope is the climber's long leg loop Purcell with the other end of the Purcell stowed in a pocket or clipped to gear loop on harness, see **Figure 10.6** Step 1 for pre-rigging and **Figure 10.6** Step 5 for ascension. This Purcell is also the device that the climber would use to transfer the weight to an anchor when building an anchor to rescue a fallen climber, see **Figure 10.6** Step 6. **NOTE:** Before any glacier operations, climbers should test individual configurations by hanging in their equipment and following self-rescue procedures.

10.10.3. **Ice Axe/Ski Poles.** Ice axe needs to be clipped into center of harness and can be clipped to one of the locking Carabiners in center of sit harness in case of crevasse fall. If traveling with ski poles, leashes should be wrapped around wrist in case of crevasse fall.

10.10.4. **Skis/Snowshoes.** Snowshoes and skis are not tied into the system while traveling. However, the climber must still have a way to attach them to the rope prior to self-rescue in the event of a crevasse fall. This is accomplished by fixing a small loop of cordage to the tips of the skis or snowshoes. Some skis come predrilled but other need to be drilled.

10.11. Team Configuration for Glacier Travel.

10.11.1. **Determining the Need for Roped Travel.** Rope configuration is determined by the type of terrain being traversed, the number climbers, and the team's level of experience.

10.11.1.1. On bare ice, steep slopes with hard packed snow and high consequence terrain below route of travel, roping up is dangerous because crevasse falls on this type of terrain are almost impossible to arrest and the likelihood for pulling the team into the direction of fall is high. On bare ice, crevasses are usually apparent and can be avoided. Consider using running protection/belays to minimize risk to individual and the entire rope team.

10.11.1.2. On snow-covered glaciers, roping up is strongly recommended because the crevasse hazards cannot always be seen and avoided.

10.11.2. **Coiled Ropes.** Only the end climbers will have extra rope. This rope can be coiled around the body or stowed in the backpack in case extra rope is needed to rescue a fallen climber. The preferred method is to stow on the top, inside of the backpack while traveling. Traveling with coils around the body makes it difficult to add and remove clothing during glacier travel.

10.11.3. **Rope Techniques.** When using rope, be cautious to not step on it while wearing crampons and keep it as dry as possible (a dry rope is recommended for glacier travel). Although rope is constantly being dragged through snow and ice while traveling, try to dry it at the end of the day or bag it up to prevent it from further saturation. If a team member falls, be sure to inspect the rope for any damage caused by the fall, ascension device, or hauling system.

10.11.3.1. Attach all ascenders to harness and rope, ready to ascend the rope if a fall is taken. This is easy for the climbers on the ends because there is only one side of the rope that they can possibly climb.

10.11.3.2. The climber in the middle will have either the front or back side of the rope to climb. In this case, it may be beneficial to attach friction hitches on both sides of the rope. This also allows for speed when belaying the climber's teammates in and out of areas while traveling. As previously stated, mechanical ascenders or friction hitches (i.e., Purcell Prusiks) may be used for ascension, see **Table 10.4** for advantages vs. disadvantages. **NOTE:** Before any glacier operations, climbers should test individual and team configurations by hanging in their equipment and following self-rescue procedures.

Table 10.4. Mechanical vs. Friction Hitch Ascension.

	Advantages	**Disadvantages**
Friction hitch ascension	• May leave on the rope while traveling • Light weight and can be used in a rescue system (multi-use) • Less potential for rope damage during load capture	• Not able to tie quickly • Not always easy to use when wearing heavy mittens
Mechanical ascenders	• Quick and easy to fasten to a rope • Easy to use with heavy mittens	• Not able to keep on the rope while traveling • Heavy • Single use • Potential for rope damage during load capture

10.11.4. **Determining the Size of the Rope Team.**

10.11.4.1. The two-person rope team is for those who are extremely experienced in glacier travel, and this method is best if the need for a rapid glacier crossing is present. The two climbers need to divide the rope into thirds, tie in at the one-third points, coil the two ends, and carry them on the pack or over the shoulder. To divide the rope into three equal parts, follow the steps in **Table 10.5**.

Table 10.5. Dividing Rope into Three Equal Parts.

Procedures
• Back-coil the rope finding both ends. • Climbers will stand facing one another, each with a separate end of the rope in hand. • One climber will reach across to the other climber’s rope, grasping the rope below the other climber’s hand. A carabiner can be used for this. • The climbers will now back away from one another while maintaining each end and letting the section they grabbed move through their hand or carabiner. • Once the rope is stretched, the climber will then tie into the rope and coil up the slack between the climber and the running end. • Once the climber is tied into the rope, the climber attaches the equipment into the system so as to not lose it in the event of a crevasse fall.

10.11.4.2. The three-person rope team is the standard configuration for glacier travel. The two rope team members at either end of the rope tie-in with an end-of-the-line figure-eight knot, and the middle climber uses a butterfly knot or midline figure-eight to tie in at the center of the rope. This configuration is beneficial because as one team member falls; the other two can arrest the fall and conduct the crevasse rescue.

10.11.4.3. The four-person rope team shares the same benefits of the three-person team, although it shortens the distance among climbers. To tie in, divide the rope into thirds. Two climbers tie in at the ends, the other two tie in at the one-third points.

10.11.4.4. The five-person team can be problematic, as the distance between climbers is shortened. This can be hazardous, as the minimal distance can put two climbers on the same snow bridge at the same time.

10.11.5. **Glacier Travel.** Glacier travel is demanding and dangerous. To make travel as safe and efficient as possible, teams should focus on the following:

10.11.5.1. Rope management while moving.

10.11.5.2. Route selection.

10.11.5.3. Properly crossing crevasses, see **paragraph 10.12**.

10.11.5.4. Time of day for travel.

10.11.5.5. of travel, see **paragraph 10.11.1**.

10.11.5.6. Sled towing.

10.11.5.6.1. Rope Management. Rope management is critical to safe and efficient travel. Managing the rope requires the climbers to remain diligent, communicate, and work together. To do this effectively it may require a teammate to speed up, slow down, stop, or back up depending on terrain. **WARNING:** Slack in a rope will add distance to a fall greatly increasing the chance of injury.

10.11.5.6.2. Route Selection. Personnel should use aids to select appropriate routes of travel such as: aerial photos, maps, and/or local guides. Keep in mind that glaciers change annually, so maps and photos may not have the most current data.

10.11.5.6.3. Time. Time of day is an important factor in deciding when to travel. Late night or early morning is a good time to travel on a glacier because it is colder during this time of day and the snow bridges have had time to reconsolidate, becoming stronger. Late afternoon to early evening is least preferred since the temperature usually rises and the bridges begin to melt, making them weaker. Consider “hang fire” from the snow slopes or ridges above the route of travel falling during the heat of the day.

10.11.5.6.4. Sled Towing. If traversing over relatively flat terrain, more weight in the sled is better than more weight on the climber's back. If climbing steep terrain, the climber should have the sled as light as possible. The sled must be packed properly to evenly distribute the weight and keep the center of gravity as low to the ground as possible. If possible, keep sleds to a minimum, take one sled and take turns pulling it. The sled should be attached to the first two climbers so that the weight of the sled can be managed by the climber behind it. If a team is descending a steep buttress and the first person on the rope has the sled, the second climber is maintaining space so that the sled does not slide up into the partner's legs causing the partner to trip or be pulled off balance. Once the climber is tied into the rope, the climber can tie equipment into the system.

10.12. Crossing Crevasses. Crossing a crevasse safely and efficiently requires effective team communication and proper rope management. There are four methods for crossing a crevasse and the method chosen is dependent on the conditions and the situation. **NOTE:** A friction hitch or mechanical ascender may be used to belay fellow climbers into a rest area or over snow bridges and may minimize the fall distance of a climber.

10.12.1. Keep the rope taught between members and the team continues to move over the bridge

10.12.2. Stop the team, probe crevasse and if able, continue across snow bridge while keeping the rope taut as members move across the bridge

10.12.3. Set a picket and belay the first climber across the bridge. When safely across, the climber will set another picket and belay the middle man across. When safely across, the middle man will belay the next or final climber across the bridge. Though time consuming, this is the safest method to cross.

10.12.4. If a crevasse is too big to cross or if a snow bridge is not sturdy, the climbing team may have to find the end run of the hole. This is done by probing along the edge until an area safe enough to cross is found.

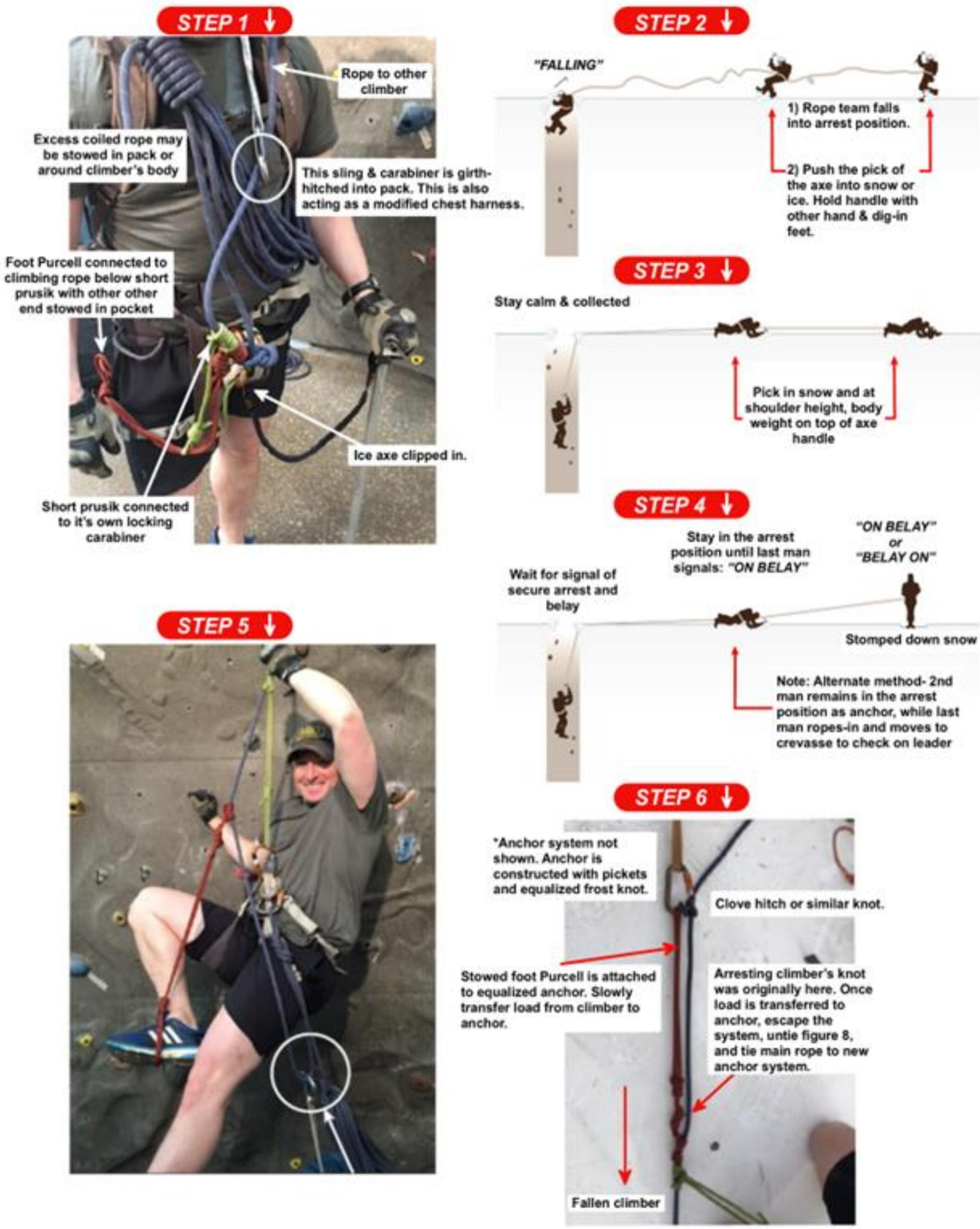
10.12.4.1. **Probing a Crevasse.** Get as close to the edge as safely possible, team keeps a taut rope while probing, using an avalanche probe allows much better accuracy detecting depth and strength of crevasse versus using an ice axe. Ideally, the snow bridge depth is greater than four feet and has a solid feeling floor. If the probe is easily pushed through snow while not feeling any bottom, look to cross somewhere else. Probing with an ice axe or ski pole is ineffective because they are typically not long enough and require the climber to be too close to the edge of the snow bridge to effectively probe its strength and depth.

10.12.4.2. **Belaying Climbers.** Friction hitches or mechanical ascenders may be used to belay fellow climbers into a rest area or over a snow bridge and may minimize the fall distance of a climber.

10.13. Crevasse Rescue. With proper rope management and traveling techniques, crevasse falls can be greatly mitigated. Roped teammates will arrest the climber's fall using an ice axe arrest. Often, just the weight of the arresting climbers is enough to arrest the fall, but the falling climber may pull the teammate to the ground. Figures **10.6** and **10.7** provide step-by-step illustrations of the crevasse rescue process. Once the fall is arrested, the team will need to communicate with the fallen climber to see if the climber can ascend without help or if assistance is needed. The top-side team may need to set an anchor. Once the anchor is in place, the team must communicate with the fallen climber. If able, the climber will begin to self-rescue. See **Figure 10.6** Step 5. Even if the climber can self-rescue, the top-side teammates must prepare the edge and may need to assist the climber over the lip/edge of crevasse (this is often the hardest part of any crevasse rescue). A drop loop 2:1 may be used to assist the climber over the edge, see **Figure 10.7** Step 8. **NOTE:** Prior to ascension, ensure top-side team has prepared the edge. If the climber starts ascending the rope prior, the rope may dig further into the snow/ice and may further complicate the rescue.

10.13.1. **Self-Rescue.** There are several ways the climber can ascend. Having two pre-positioned Purcell Prusiks connected to the rope expedites the time needed for self-rescue. Skis/snowshoes need to be removed and attached to the rope below the Prusiks. Attach climbing pack to the rope, attach foot loop around one boot and begin self-rescue. The fallen climber should consider tying in short to the climbing rope approximately every 10 to 15 feet of ascension. The climber must be prepared to cross the lip of the crevasse. This can difficult, due to the fact that the rope cuts into the snow. The team can help by protecting the edge with an ice axe or other pieces of gear. A simple drop loop 2:1 is often the easiest and quickest method if mechanical advantage is required to assist the climber over the lip of the crevasse, see **Figure 10.7** Step 8. If unable to self-rescue, the climber will require assistance from the team for extraction using pulley systems and mechanical advantages.

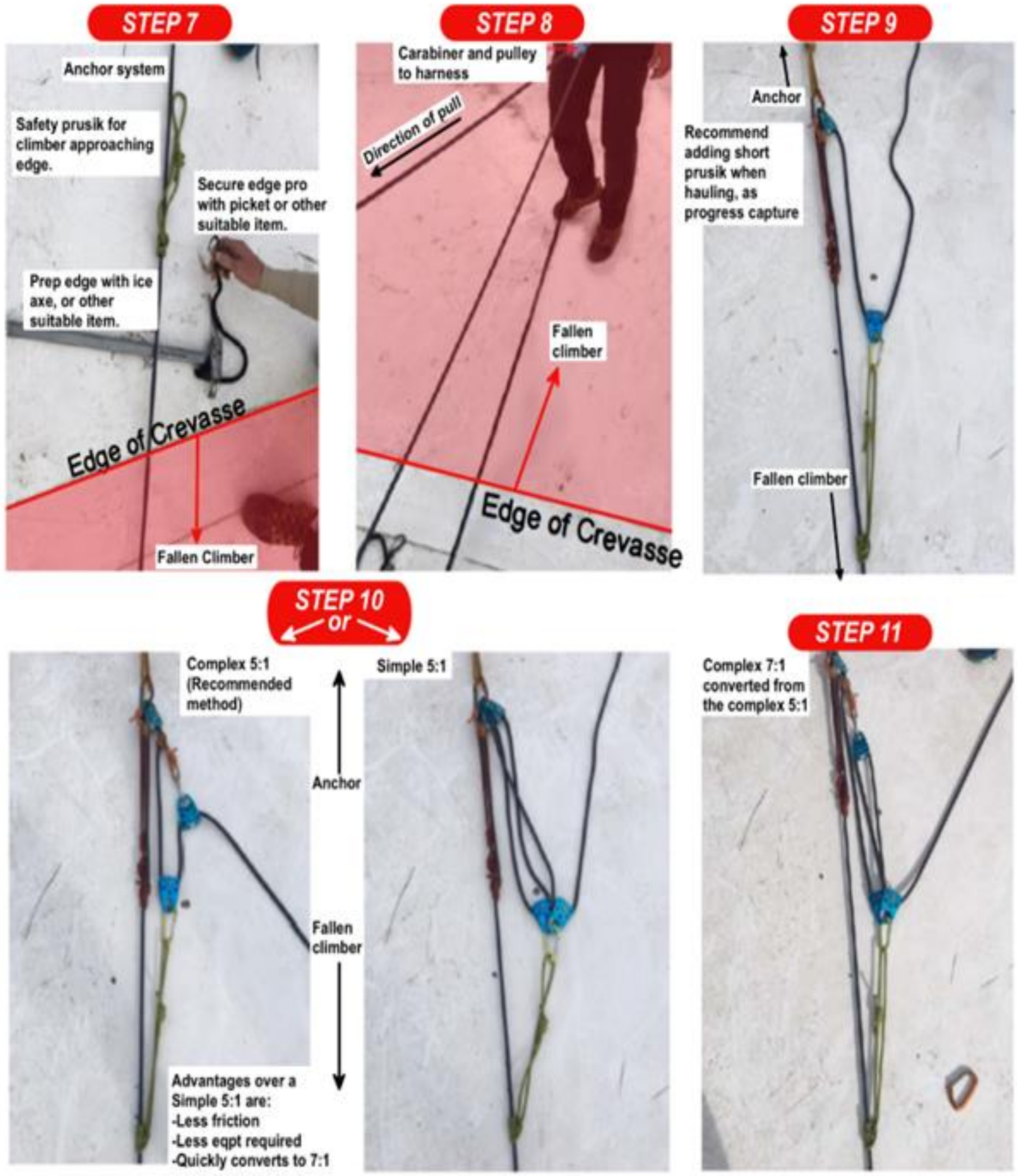
Figure 10.6. Crevasse Rescue: Steps 1-6.



10.13.2. **Rope Team Rescue.** Top-side teammates will need to build an anchor if the climber cannot self-rescue. After the anchor is built, transfer the fallen climber's weight to the anchor and escape the system. The top-side arresting teammate uses his stowed Purcell Prusik to SLOWLY transfer the weight of the fallen climber to the anchor, see **Figure 10.6** Step 6. Once free from the system, the top-side teammate approaches the edge, communicates with the fallen climber, prepares the edge, and builds the appropriate mechanical advantage system.

10.13.2.1. Mechanical Advantage. If the climber needs assistance, but can still assist the hauling team, a 2:1 drop loop can be used, see **Figure 10.7** Step 8. Attach a pulley and Carabiner to the working end of the rope and lower to the climber. The fallen climber attaches the pulley and Carabiner to their harness. It might take multiple raises to get the climber, pack, and sled out of crevasse. If just one teammate is available to haul, he should start with a complex 5:1 and move to a larger mechanical advantage system if required. See **Figure 10.7** Step 10, and **Figure 10.7** Step 11.

Figure 10.7. Crevasse Rescue Steps 7-11.



Chapter 11

MARITIME OPERATIONS

11.1. Maritime Infiltration.

11.1.1. **Phases of Maritime Combat Operations.** Reference **ATP 3-18.12 Special Forces Waterborne Operations** for detailed information and planning considerations of each mission phase.

11.1.1.1. Pre-infiltration preparation.

11.1.1.2. Movement to the debarkation point.

11.1.1.3. Movement to the launch point.

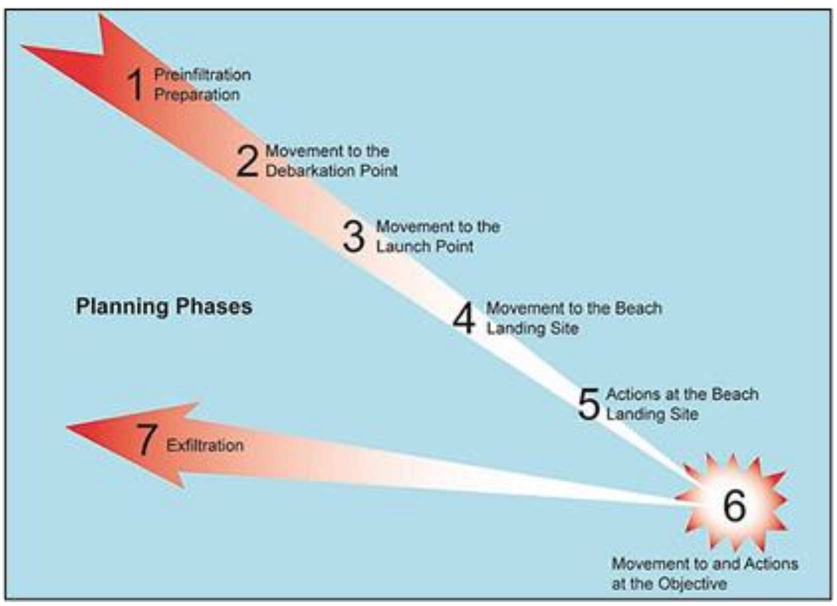
11.1.1.4. Movement to the beach landing site (BLS).

11.1.1.5. Actions at the BLS.

11.1.1.6. Movement to and actions on the objective.

11.1.1.7. Exfiltration.

Figure 11.1. Phases of Maritime Combat Operations.



11.1.2. **Infiltration Methods.** Teams can use different methods of maritime infiltration to reach an objective area. Methods include combat rubber raiding craft (CRRC), surface or subsurface tactical swimming, propulsion systems, Kayaks, assault boats, helicopter free-fall swimmer, submarine, and clandestine vessels.

11.1.3. **Maritime Exfiltration.** Generally, operators move from a coastal location to a secondary exfiltration method such as submarine, larger surface vessel, or vertical lift aircraft. During the infiltration and exfiltration planning and execution phases, planners should consider tidal data, navigation off-set, time, and distance.

11.1.3.1. Caching. The recovery team may utilize the same equipment for both infiltration and exfiltration. Teams' must approach this type of method undetected and ensure the area is sanitized with no indication of personnel or equipment cache area. Equipment can be cached either inland or subsurface. If equipment is cached inland, follow normal caching procedures. See **ATP 3-18.1, Special Forces Unconventional Warfare** for detailed information.

11.1.3.1.1. Equipment Considerations. Critical equipment and sensitive items to be buried should be in airtight waterproof containers. Equipment caches should be placed close to the shore and anchored to ensure they do not move from its GPS position.

11.1.3.1.2. The cache must be at a depth that can be reached by surface swimmers or divers. When considering planning for a cache, take into consideration tidal data as the rise and fall of the tide will impact the cache.

11.1.3.1.3. Weights. Weight(s) that are attached to equipment cache keeping it subsurface must be easy to jettison during recovery.

11.1.3.1.4. Cache Site Observation during Recovery. Observe the cache site for a period (METT-C dependent) prior to recovery to ensure the cache area is safe/secure.

11.1.3.2. Resupply.

11.1.3.2.1. Aerial Resupply (Water). Although very effective, can be difficult to execute in non-permissive locations or heavily defended coast lines that pose a threat to re-supply aircraft. However, if possible, one of the most effective is the delivery of a CRRC (i.e., Hard Duck and RAMB). The aircraft can fly parallel to and just off the coast and deploy the vessels. Joint Precision Aerial Delivery Systems (JPADS) is an advanced method of aerial delivery to be considered if available.

11.1.3.2.2. Aerial Resupply (Land). If the equipment is not dropped in the water, it must be dropped in the vicinity because of the difficulty in transporting equipment overland.

11.2. Team Swimming. To maintain recovery team integrity, surface and subsurface swims are conducted using a swim line or pole. An advantage of the swim line is that even if the environment adversely affects the team, the entire team and equipment will remain together.

11.2.1. **Formations.** There are generally two forms of a swim formation for combat infiltration swimming: an "on-line" variation and the "column" variation. The swim formation can use a swim line or long pole for team integrity.

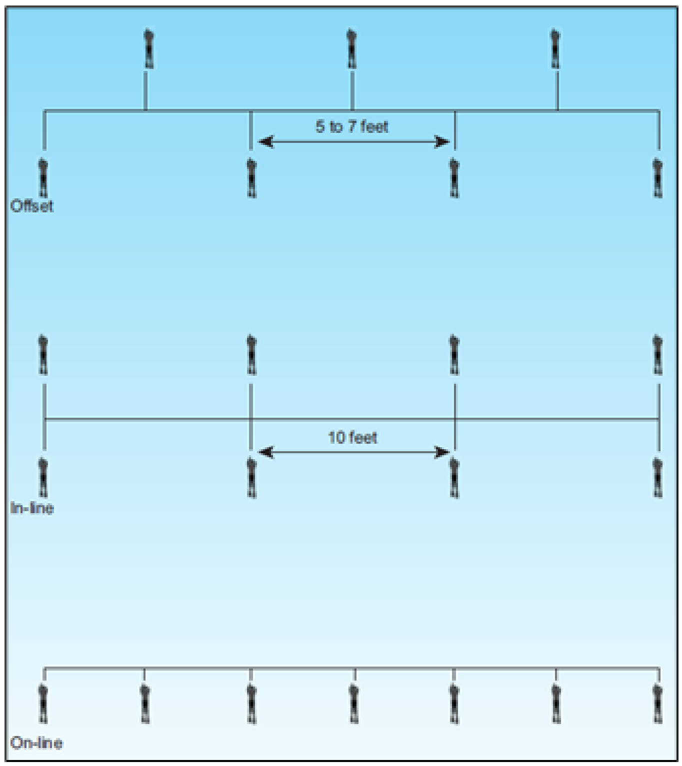
11.2.2. **On-Line.** The on-line swimming formation is the most frequently used formation for combat surface swimming. The team swims on-line toward its BLS. It can also be used for subsurface swims.

11.2.3. **Column (In-Line).** Use this line for combat surface or subsurface swimming. Each swim pair splits the line or pole. All swimmers follow the azimuth and pace of the lead swim team.

11.2.4. **Column (Offset).** Its major advantage is that the length of the line or pole can be reduced to half the normal size. It is primarily used for subsurface swims and greatly eases control of the team underwater. See **Figure 11.2, Team Swim Formations**.

11.2.5. **Underwater Control Measures.** A buddy line 6- to 10-feet long is used to connect the dive pair at night, in conditions of poor visibility, or when using UBA. The buddy line will either be "S"-folded in the respective diver's hand and attached to the diver's wrist with Velcro® or attached with a single-pull quick release so communications can be maintained. The line can be quickly released in the event of entanglement. Any line used for underwater operations should be strong and have neutral or slightly positive buoyancy. The diver uses pre-briefed silent control measures when swimming on a line or pole.

Figure 11.2. Team Swim Formations.



11.2.6. **Combat Surface Swimming.** Regardless of the movement formation used for swimming, certain concepts remain constant. The team members swim on their backs using the flutter kick. Team members wear enough weight to ensure their kicks remain subsurface while maintaining noise discipline. Equipment is either towed or pushed, attached to a line and connected to the team member with a quick release. The team member's LBE can be worn in the normal manner, and the individual weapon is slung across the chest with a sling. Very small equipment bags or rucksacks can be worn over the chest with the arms through the shoulder straps. Face masks are not normally worn while surface swimming due to sun/moon light being reflected from the lens. If the mask is worn, it is to be removed prior to surf zone and a safe distance from the BLS. If mask is worn, it should be oriented so it will not reflect light towards the BLS. Neoprene or latex hoods should also be removed outside the BLS, as they may interfere with hearing. Designated team members will be equipped with watches and compasses. If swimming on back towards the BLS, the team member will use a back azimuth.

11.2.7. **Combat Subsurface Swimming.** For subsurface operations, team members should remain close together to be able to readily aid a diver in trouble. Teams should use the column formation. When using a swim line or pole, to maintain the proper depth, pace, and azimuth of the lead team, at least one member of the buddy team must be attached to the line or pole. This enables the diver to alter the pace (speed up or slow down) by feeling the amount of slack or tautness in the centerline, in addition to maintaining direction and depth of the lead team. Consideration should be given to the carriage of backup equipment in the event of a loss or failure during the infiltration (i.e., extra mask, fin strap, compass board, and weight). To reduce the chance of entanglement, the use of a swim pole over a swim line is recommended for subsurface operations.

11.2.7.1. Procedures for subsurface swimming:

11.2.7.1.1. The compass navigator sets heading on compass and informs all divers of heading before entering the water.

11.2.7.1.2. The team enters the water, gives the “OK” signal to infiltration boat, and connects buddy lines.

11.2.7.1.3. The TL, usually paired up with the compass person at the front of the formation, initiates the descent signal. The TL usually designates descent by holding the oral inflation hose of the life jacket or buoyancy compensator device over the head.

11.2.7.1.4. The team descends and neutralizes at a pre-briefed depth. Each member checks their compass and orients in the direction of forward movement.

11.2.7.1.5. The TL checks in with compass navigator and gives two tugs/squeezes for the move out signal.

11.2.7.1.6. The team moves out in the briefed formation and swims to shore or for a duration as briefed. If a diver experiences a problem, to signal a halt, the diver gives one tug/squeeze.

11.2.7.1.7. The TL deploys the compass navigator to the surface to conduct a peek while still maintaining the buddy line.

11.2.7.1.8. When cleared to surface, the TL initiates the ascend signal.

11.2.7.1.9. The team will surface using a slow, controlled ascent as briefed.

11.2.7.1.10. The TL conducts a head count of personnel and continues the mission, using scout swimmers as required.

11.2.8. **Scout Swimmer Duties and Responsibilities.** The scout swimmers are employed to conduct reconnaissance and secure BLS prior to advancing the recovery team. Scout swimmers are normally deployed in pairs. Scout swimmers must also locate an assembly area, look for suitable cache sites, and select a location from which to signal the team. If scouts are used, the main body should hold well outside the surf area and the range of small-arms fire (at-least 500m).

11.2.9. **Beach Landing Site Signals.** Site Signals should be reviewed during mission planning phases and should be easily distinguishable from one another. Consider the use of submersible radios and/or submersible radio bags that allow the team members to maintain communication throughout the operation.

11.2.9.1. Safe Signal. This is the signal from the scout swimmers to the main element upon completing their reconnaissance and determining the BLS is clear.

11.2.9.2. Delay Signal. This is a signal from the scout swimmers to the main element to indicate that a temporary situation exists requiring the main body to delay its movement to the BLS. This can be given before or after the safe signal is given. This signal could be given due to unanticipated activity on the beach.

11.2.9.3. Abort Signal. This is a signal from the scout swimmers to the main element to indicate a dangerous situation exists that will compromise the mission if the main body attempts enter. The signal is relayed only if the scout swimmers can send it without compromising themselves.

11.2.9.4. Emergency Signal. This is a signal from the scout swimmers to the main element indicating that immediate extraction of the scout party is required

11.2.9.5. Absence of Signal. The absence of a signal indicates a condition exists on the beach that precludes safe landing and is a time-driven signal. When none of the above signals are received or within a certain period of time after the release of the swimmers, the rest of the team executes a contingency plan to link up with the swimmers at another location. The time required for scout swimmers to travel and properly reconnoiter and secure the BLS is extensive (60-90 min in some cases), and contingency plans must reflect this.

11.2.10. **Swimmer Navigation.** To keep their direction, the scout swimmers use a dive compass or guide on prominent terrain features or lights on the shoreline. Use of the side stroke permits 360-degree observation while approaching the surf zone or general vicinity of the BLS. The swimmers face each other and are responsible for observing the area beyond the other swimmer.

11.2.11. **Beach Landing Site Approach.** As the scout swimmers reach the surf zone, or when they get close to the BLS, they use the breaststroke so they can observe the beach. It is imperative that they use stealth and caution when approaching the beach. They must keep a low profile in the water for as long as possible. The use of a camouflage head net is ideally suited for concealing the scout swimmer’s outline in the water as the team approaches the beach. Team members should ensure that heavy surf or rolling waves do not silhouette them during their swim in.

11.3. The Beach. When the scout swimmers reach shallow water and when the situation is safe, they remove their fins without elevating their profile. Once in the BLS, team members may coat themselves with sand to better blend into the beach environment. The following are two methods used to move across the beach to initiate reconnaissance and secure the BLS.

11.3.1. **Wood Line in View.** If the wood line can be easily seen from the waterline, one team member remains in the water just at the waterline and provides security as the other team member moves quickly across the beach. Once the inland team member has moved to the edge of the wood line, the inland team member provides security while the other member moves across to the same position.

11.3.2. **Wood Line Not in View.** If the wood line cannot be observed from the waterline, the above method can be modified to include bounding over watch, or both team members can move across together. If both team members move at the same time, they should observe the beach area before initiating overland movement. Consider conducting far and near reconnaissance.

11.3.3. **Beach Landing Site Reconnaissance and Signal.** Once both team members have moved inland, they employ a modified Box pattern to reconnoiter and secure the beach. The team members agree on a suitable assembly and cache site when they finish their reconnaissance. One team member then positions at the edge of the tree line (or back shore if suitable cover and concealment are available) to provide security for the rest of the team. The other team member must ensure that the covert signal (i.e., IR chemlight, IR strobe, and directional overt light) is not masked by the surf and can be seen by the team off shore. If the team member is signaling with a directional device, ensure that the team member points it 45 degrees left and right of the team's suspected position off shore to account for drift of the team. As the team member observes the main body, the team member moves to the waterline to receive them.

11.3.4. **Assembly/Cache Considerations.** Teams should not use an assembly area as a cache site. Enemy can easily detect the assembly/cache area by following from the beach to the assembly area. Additionally, the cached equipment may be needed to support exfiltration at another location.

11.4. Tactical Small Boats. Due to various techniques involved with small boats, this text will only cover tactical landings and withdrawals using small boats such as the CRRC. Teams should conduct tactical exercises during training for proficiency of boat operations under operational conditions. For detailed information tactical small boat operations and procedures, see **ATP 3-**

11.5. Special Forces Waterborne Operations.

11.5.1. **Tactical Small Boat Landings.** As the boat approaches the surf zone, the TL orders the coxswain to lie to the outside of the surf zone and maintain positive position relative to the beach. The TL then orders the coxswain to deploy the scout swimmers. Scout swimmers should avoid splitting a breaker line or foam line as it silhouettes them against a white foam background. The scout swimmers determine the presence or absence of enemy in the landing area. They usually move out singly about 50 meters in opposite directions once they reach the beach. When scout swimmers determine the BLS is free of enemy activity, they signal the rest of the team with a pre-briefed covert signal. The scout swimmers signal from the point they have selected most suitable for landing. After signaling the boat, the scout swimmers move in opposite directions from the landing point to listening in observation positions. When the boat team receives the scout swimmers signal, the TL orders the coxswain to beach the boat at the point at which the signal originated. Once boat is beached, the TL orders it hidden and camouflaged as detailed during mission planning.

11.5.2. **Tactical Small Boat Withdrawals.** The TL will order two team members—usually designated scout swimmers—forward to determine if the withdrawal area is clear of enemy. The team members reconnoiter the cache to see if it has been disturbed and observe the beach for the presence of enemy. After the team members report the area is clear, the TL orders the coxswain to prepare the boat for withdrawal. When the boat is prepared for withdrawal, the coxswain informs the TL who then orders the coxswain to launch the boat. As the boat enters the water, the TL calls the security to the boat where they take their designated boat team positions. The coxswain then assumes control of all hands for the launching.

11.5.3. **Tactical Small Boat Search, Rescue, and Recovery Considerations.** Team may have to execute a clandestine search, rescue, and recovery operation in a coastal area within sight of the coastline. It is essential that light discipline be maintained during the conduct of these operations. Team members employ NVDs to operate and search from small boats locating the IP using IR signaling devices.

11.6. Equipment Preparation. Individual combat loads should be light and include only mission-essential equipment, weapons, and munitions. Equipment bundles should be small in order to reduce water drag, allow ease of handling, and to maintain a low profile in the water. The weight and size of equipment depends on mission requirements, swim distance, method of transport and delivery. Weapons, communications, and other mission-essential equipment must be packaged as ready operating units. The weapons or radio will be useless if component parts (i.e., ammunition and batteries) are packed separately and are lost or temporarily separated.

11.6.1. **Weapons Employment.** Weapons for water operations should be lightweight, automatic, easy to assemble/disassemble, suppressed, and waterproofed. Weapons should be waterproofed to allow quick employment at the BLS. Weapons may be placed in waterproof containers for subsurface infiltration. At minimum, water must be kept out of the barrel, sand and grit must be kept out of the receiver and magazines. Once on land, rinse with fresh water and apply oil/lubricants to weapons as soon as possible. At minimum, lubricate moving parts and work bolt action and selector lever to prevent corrosion. Specialized submersible "shoot-through" weapon bags exist that have an internal latex glove for the team member to operate the weapon while in the bag in emergency situations. The barrel end of the bag has a latex cap that can be easily repaired in the event of a contact.

11.6.2. **Camouflage and Concealment.** All metallic or reflective equipment should be spray painted or taped to be non-reflective and subdued.

11.6.3. **Waterproofing.** All equipment selected for swimming operations must be waterproofed. Radios, cameras, binoculars, infrared signaling and detection devices, and other sensitive equipment are particularly susceptible to water damage. Recovery teams should maximize use of submersible bags and procure vacuum sealers, zip lock bags, heavy lubricants, sealants, silicone-type lubricants, and other material for waterproofing prior to water operations. Do not waterproof anything that does not require it. Disassemble equipment into component parts when the tactical situation permits; it is easier to waterproof the smaller items. Identify each with tags or tape to enable quick assembly. Waterproof each item with more than one layer of protection.

11.6.4. **Swimming with Equipment.** Generally, rucksacks with frames are easier to work with during water operations. On a surface swim, the team member tows the bundle on the surface behind or pushes it in front. Use a 10-foot tether attached to the frame of the pack to pull the ruck and to maintain control. For subsurface swimming with UBA, the diver pushes the ruck in front just below the body. With the UBA, the bundle may be pushed or worn on the diver's back. **WARNING:** If equipment is tethered to the swimmer, a quick release must be provided to allow release if equipment becomes negatively buoyant and sinks.

11.6.5. **Individual Equipment Considerations.** Each team member must check the buoyancy of mission equipment before operational use. Personnel must be neutrally buoyant and be able to swim with only head above water. Neutral buoyancy can be accomplished by wearing inflatable Underwater Demolition Team- (UDT) style vest or hard flotation (closed-cell foam) built into or placed in the load-bearing equipment. Fins are carried by placing hands through fin straps and onto the wrists.

11.7. Uncooperative Survivor. Uncooperative survivors can be categorized into two distinct types: panicked and combative.

11.7.1. Panicked survivors. These survivors normally desire to be rescued but are in an uncomfortable environment. These survivors are usually frightened of drowning that they pose a danger to the recovery team and themselves. Calming a panicked survivor can be accomplished simply by providing them with some source of flotation. Once the survivor is calmed, use standard rescue procedures.

11.7.2. **Combative survivors.** These survivors initially desire to be rescued and may actively resist assistance from the rescuer. The combative survivor may intentionally try to harm the rescuer or themselves when approached. The following are procedures for handling a combative survivor in the water:

11.7.2.1. Approach survivor and establish verbal communication.

11.7.2.2. Attempt to calm the survivor with verbal reassurance and commands.

11.7.2.3. If survivor is actively combative, do not attempt to immediately gain physical control of the survivor.

11.7.2.4. Remain a safe distance (6 to 8 feet) from the survivor and assess the situation while allowing the survivor to tire.

11.7.2.5. If survivor does not have operable flotation, attempt to provide a flotation device to the survivor while still maintaining a safe distance.

11.7.2.6. Assume physical control of the survivor only when deemed safe.

11.7.2.7. Do not attempt to rescue an actively combative survivor unless the survivor requests assistance or becomes unconscious/incapacitated.

11.7.2.8. Ensure the survivor has no weapons.

11.7.2.9. Once physical control is established, remain vigilant for survivor to become actively combative or for the presence of any weapons.

11.7.2.10. Recover survivor using the appropriate device.

11.8. In-Water Survivor Approaches, Carries, and Releases. The recommended swimming approach to a survivor on the surface is the rescue stroke. The rescue stroke is a modified front crawl with the head up to keep the team member's eyes on the survivor. This also allows him to observe if the survivor submerges or makes a lunge towards him. Approach procedures are as follows:

11.8.1. Stop short of the survivor and observe the behavior of the survivor before making contact.

11.8.2. Attempt to establish communication with the survivor.

11.8.3. Be aware of the added buoyancy of the wet/dry suit and avoid premature surfacing.

11.8.4. If the survivor appears calm and under control, instruct the victim to roll over face up and to take several deep, calming breaths.

11.8.4.1. **The Defensive Position.** The legs are the preferred primary defensive tactic when dealing with a panicked survivor on the surface. By reclining backward away from a lunging survivor, the rescuer helps ensure the legs and fins will be ready to block any attack made by the survivor. Keep the legs extended toward the survivor, and keep moving horizontally, ready to react. Maintaining this position will prevent the survivor from grabbing rescuers' equipment, face, head, and neck.

11.8.4.2. **Rear Surface Approach.** The following are procedures for performing a rear surface approach.

11.8.4.2.1. Approach the survivor with head out of the water and eyes on the survivor.

11.8.4.2.2. With forward momentum, grab survivor under the armpits and rotate toward the rescuer.

11.8.4.2.3. Secure survivor with a cross-chest, collar tow, or equipment carry.

11.8.4.2.4. Avoid placing the survivor in a choke hold around the neck as this may induce panic.

11.8.5. **Underwater Approach.** The following are procedures for performing an underwater approach. **WARNING:** Do not use an underwater approach when a raft, lines, debris, or a parachute is attached to or in the immediate vicinity of the survivor. See **Figure 11.3**.

11.8.5.1. Approach the survivor with head out of the water and eyes on the survivor.

11.8.5.2. Upon reaching 6 to 8 feet from the survivor, execute a surface dive and swim under the survivor.

11.8.5.3. Execute a half-turn (survivor's back should be toward the rescuer) and surface.

11.8.5.4. While surfacing, place the survivor in a cross-chest carry.

11.8.6. **Front Surface Approach.** The following are procedures for performing a front surface approach. See **Figure 11.3**.

11.8.6.1. Approach the survivor with head out of the water and eyes on the survivor.

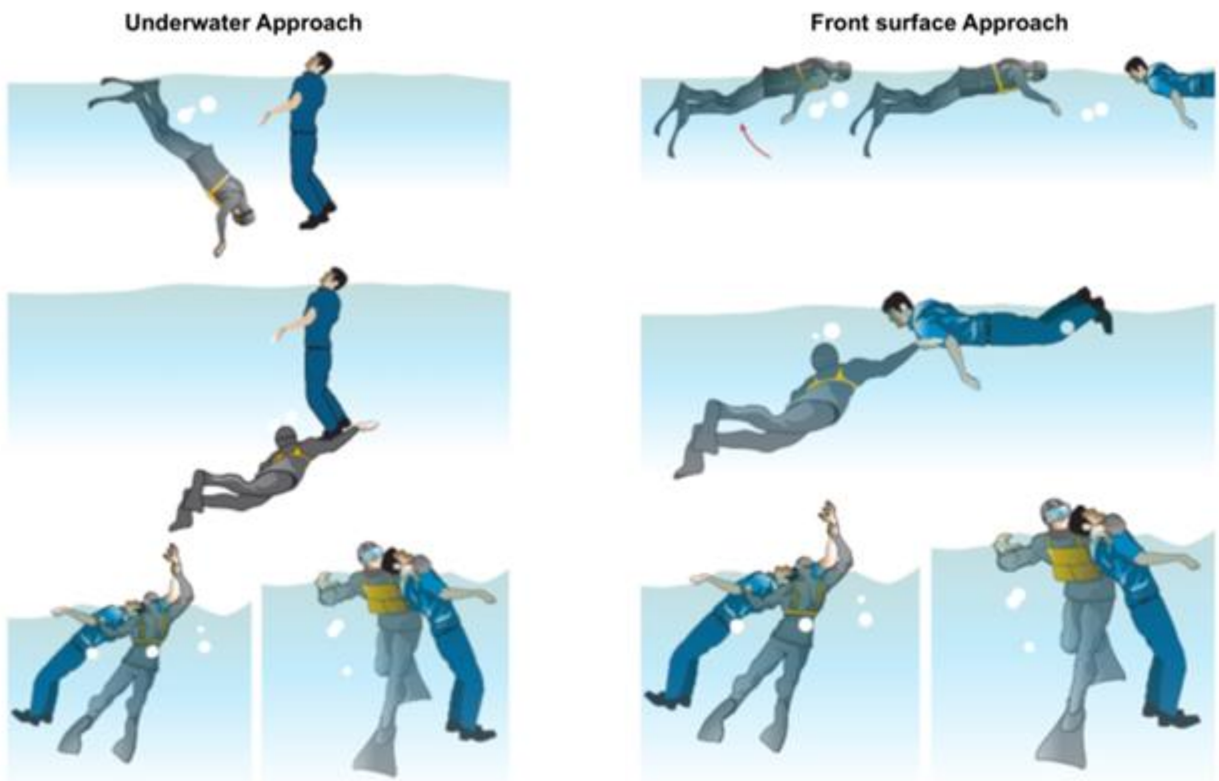
11.8.6.2. Upon reaching an arm's-length distance from the survivor, execute a quick reverse.

11.8.6.3. Timing the movement, the rescuer should quickly cross his arm over the survivor's arm and firmly grasp the back of the survivor's wrist, right hand on right wrist or left hand on left wrist.

11.8.6.4. Lean back and pull the survivor's arm across and in front of the rescuer's body, turning the survivor around.

11.8.6.5. When the survivor's back is fully turned, place the survivor in a cross-chest, collar tow or equipment carry.

Figure 11.3. Approaches.



11.8.7. **Cross-Chest Carry.** This procedure may be difficult to perform on military aircrew members because of their flotation and survival equipment. The equipment carry is appropriate in this situation. The following are procedures for the cross-chest carry. See **Figure 11.4**.

11.8.7.1. Positioned behind the survivor's shoulder or under the survivor's arm, reach across the chest and pull the survivor from under the armpit with the back of the hand.

11.8.7.2. The survivor's shoulder is then tucked securely into the rescuer's armpit and the arm firmly clamped against the survivor's chest.

11.8.7.3. Turn to the side with the hip directly against the small of the survivor's back, stroke vigorously with the legs, using a flutter kick to provide propulsion.

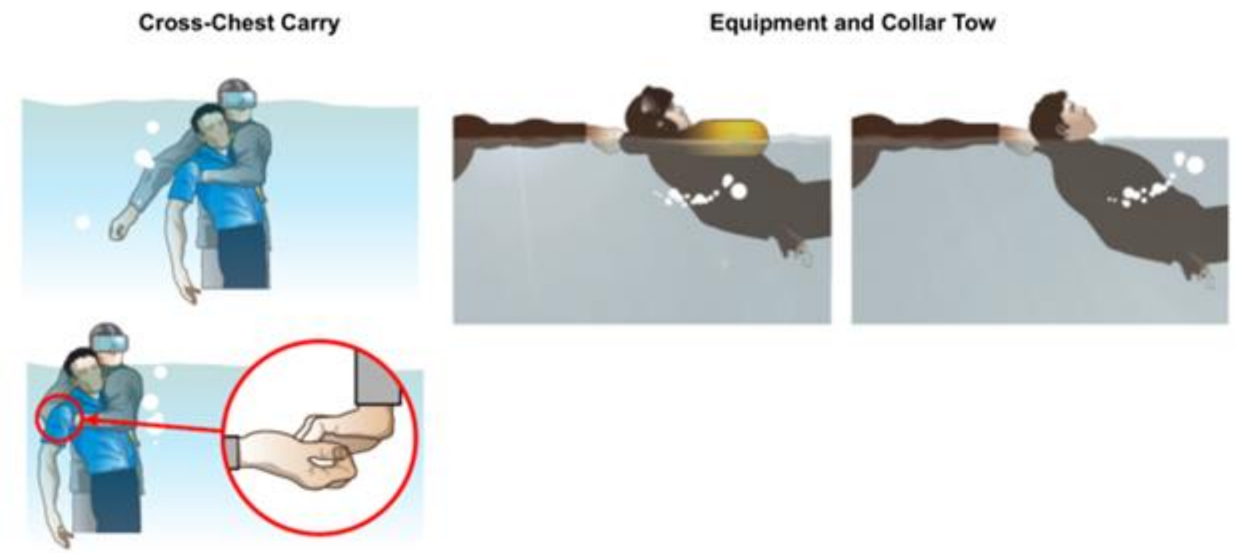
11.8.7.4. Should the survivor be aggressive, lock the free hand under the survivor's armpit.

11.8.8. **Collar Tow or Equipment Tow.** Do not grasp the survivor in a manner which may result in restricted breathing or circulation. The following are procedures for executing the collar tow or equipment tow, see **Figure 11.4**.

11.8.8.1. Grasp the survivor's shirt collar or flight equipment from behind and between the shoulder blades.

11.8.8.2. Assume the side-stroke position and stroke vigorously with the legs, using a flutter kick.

Figure 11.4. Cross-Chest Carry & Equipment and Collar Tow.



11.8.9. **Front Head-Hold Release.** The following are procedures for performing a front head-hold release. See **Figure 11.5**.

11.8.9.1. As soon as the survivor's arms are felt encircling the head, tuck the chin down and to the side while taking a quick breath of air.

11.8.9.2. Submerge taking the survivor underwater.

11.8.9.3. If the survivor's head is on the right of the rescuer's head, bring the right arm up and over the encircling arm and places a hand securely against the survivor's right cheek, the little finger against the side of the survivor's nose, and the thumb hooked under the jaw.

11.8.9.4. Should the survivor's head be on the rescuer's left side, the method is reversed.

11.8.9.5. The remaining hand is brought up beneath the survivor's other arm, seizing it in a grip with the thumb just above the elbow.

11.8.9.6. In one continuous motion, the survivor's head is pressed out and around with the right hand over the rescuer's head and sweeping it across the far side.

11.8.9.7. This is a continuous movement until the survivor's back is to the rescuer.

11.8.9.8. The left hand continues to hold the arm until it can be moved into a cross-chest carry, then the right arm is shifted from the survivor's face to the chest to lock in the controlled cross-chest carry.

11.8.9.9. Should the survivor's head be on the left side of the rescuer, the method is reversed. If the survivor places a scissor lock on the rescuer with their legs, the scissors rarely is held after the head hold is released.

11.8.9.10. If scissor lock is not released, use one hand between the ankles to unlock the crossed feet.

11.8.10. **Rear Head-Hold Escape.** The following are procedures for performing a rear head-hold escape. See **Figure 11.5**.

11.8.10.1. As soon as the survivor's arms are felt encircling the head, tuck the chin down and to the side while taking a quick breath of air.

11.8.10.2. Then submerge, taking the survivor underwater.

11.8.10.3. Bring the hands up to the underside of each of the survivor's elbows.

11.8.10.4. While keeping the chin tucked in and hunching the shoulders, push forcefully upward freeing his/her head.

11.8.10.5. The survivor is then pushed back.

11.8.10.6. Turn to face the survivor, prepared to prevent any subsequent grasps.

11.8.10.7. Swim well out of the reach of the survivor, surface, and decide what rescue procedure to use.

Figure 11.5. Front and Rear Head-Hold Releases.

11.9. In-Water Rescues.

11.9.1. **Rescue Breathing.** A non-breathing survivor or team member in the water is an immediate emergency. Rapid and skillful rescue breathing may be the survivor's best chance for survival and a critical lifesaving skill. Breaths must be free of water with full exhalations.

11.9.2. **Turning the Survivor Face Up.** It is easier to turn a face-down survivor by crossing his/her arms prior to turning him/her over. In crossing the arms, the strongest one is placed on top. Then pull with the strongest arm and push with the weaker one. This technique positions the survivor face up.

11.9.3. **Do-Si-Do Technique.** The do-si-do technique for in-water rescue breathing gives good control and close monitoring of the survivor, especially under the rotor wash of an aircraft. This is important in the event the survivor vomits during the tow or resuscitation effort. If this happens, roll the survivor to keep the airway clear and ensure there are no more particles left in mouth. The following are procedures for performing the do-si-do rescue breathing technique in the water. This technique can be performed from either the left or right side of the survivor.

11.9.3.1. Make the survivor buoyant if possible.

11.9.3.2. Position the survivor on the back in the water.

11.9.3.3. From the survivor's left side, slide left hand and arm between the survivors' left arm and the survivor's body.

11.9.3.4. Reach under the survivor with left hand to grasp the survivor's collar, equipment, clothing, or tank valve.

11.9.3.5. The rescuer rests the right hand on the survivor's forehead to extend the neck and keep the airway open.

11.9.3.6. Use your left hand and arm to roll the survivor toward the rescuer sufficiently to begin rescue breathing.

11.9.3.7. Use the right hand to pinch the survivor's nose closed as the rescuer exhales into the survivor.

11.9.3.8. It is recommended the rescuer stop swimming when delivering breaths to the victim.

11.9.3.9. Position so as to rise slightly in the water bringing fins back under the rescuer as this will provide better control.

11.9.3.10. If surface conditions are poor, use the right hand to cover the survivor's nose and mouth to prevent aspiration of water.

11.9.4. **Chin-Carry Technique.** The chin-carry technique is an expedient method that enables the rescuer to swim and deliver effective rescue breaths. The team member swims on his back allowing a very powerful fin stroke with the survivor in alignment. The following are procedures for performing the chin-carry technique for rescue breathing in the water:

11.9.4.1. Make the survivor buoyant if possible.

11.9.4.2. Position yourself at the victim's head and use the left hand, placed between the shoulder blades or center of the back, to provide enough lift to keep the survivor clear of the water.

11.9.4.3. Grasping the survivor's chin with the right hand, cradle the survivor's head with the right shoulder.

11.9.4.4. Be careful with the hand placement so it does not put pressure on the airway or carotid arteries.

11.9.4.5. To start rescue breathing, slide the right hand up to the forehead to pinch the survivor's nose closed during the breaths.

11.9.4.6. The left hand must stay where it is to maintain sufficient lift.

11.9.4.7. When swimming, position the body under and in front of the survivor, this permits rapid swimming and protects the survivor from waves.

11.9.4.8. The right hand can be used to seal the nose and mouth to keep water off the survivor's face.

11.9.5. **In-Water Cervical and Spinal Stabilization.** When the situation allows and the survivor's injuries indicate a potential for spinal damage, cervical-spine precautions are mandatory. Conventional cervical stabilization, a hand on each side of the head, will not work in the water. Any water movement could compromise the integrity of the survivor's spine. Any stabilization technique used must maintain the head and body in line as a complete unit.

11.9.6. **Deep Water Roll.** If the team member responds to an incident site with a non-moving survivor face down in the water, assume spine injury unless clearly informed otherwise or the conditions or threat dictate speed is of the essence. This roll involves placing the arms against the survivor's upper back and chest, then dipping under the victim. Do not twist the survivor over by solely turning their head. **CAUTION:** Rolling the survivor by solely turning the head could cause permanent paralysis. The following are procedures for performing the deep water roll:

11.9.6.1. Place the survivor's arms directly down alongside the survivor's body.

11.9.6.2. Splint the survivor with your (rescuer's) arms by placing one elbow in the middle of the survivor's back, with your hand on the rear of the survivor's head.

11.9.6.3. Place your other elbow in the middle of the survivor's chest, with your hand cradling the survivor's chin.

11.9.6.4. Take a breath, firmly holding the survivor in the splinted position, then swim under the survivor, using the legs to kick as the survivor rotates onto the survivor's back.

11.9.6.5. Emphasize using your (rescuer's) elbows to lever the survivor over.

11.9.7. **Shallow-Water Roll.** This is another alternative to rolling over an unconscious survivor found face down in the water. This procedure is normally used in shallow water. The following are procedures for performing the shallow-water roll.

11.9.7.1. Stand alongside the survivor with your (rescuer's) side perpendicular to the survivor, facing the survivors near arm.

11.9.7.2. Reach across the survivor's back with the closest hand and grasp the survivor's arm between the elbow and shoulder and gently pin the survivor's upper arm on the far side against the far ear.

11.9.7.3. Pin the survivors near upper arm against the near ear.

11.9.7.4. Push down on the survivors near arm while pulling up with the other hand.

11.9.7.5. Keep the survivor's arms pinned to their head as this is executed.

11.9.7.6. The survivor should roll over with the upper back cradled in your (rescuer's) arm.

11.9.7.7. Then squeeze the survivor against the chest to maintain the splint as the nearest hand is removed.

11.9.8. **Spine Boarding in the Water.** Securing a survivor to a spine board in the water will require more than one rescuer. The spine board should be able to float and be secured within a Stokes basket equipped with hard flotation and counterweights to keep the survivor's face out of the water. The following are procedures for performing spine boarding in the water.

11.9.8.1. One rescuer maintains cervical stabilization while another one applies a cervical collar.

11.9.8.2. The cervical collar is applied and maintained by one rescuer as the spine board is brought in from the survivor's side.

11.9.8.3. The board is pushed completely underwater and aligned below the survivor.

11.9.8.4. The board is then gently raised up until the survivor is on it.

11.9.8.5. If the survivor is incorrectly positioned, the board should be raised and repositioned.

11.9.8.6. As the board is raised, the rescuer maintaining cervical stabilization removes his hands as best as possible, without sacrificing control of the survivor's neck, to not interfere with placement.

11.9.8.7. Straps are then secured to the survivor starting at the chest and downward toward the feet.

11.9.8.8. Once the survivor's torso is secure, the head is secured using foam blocks.

11.9.8.9. Straps can be "S" folded and secured with retainer bands or masking tape to streamline and facilitate quick attachment.

11.10. Wet Rock Rescue. Survivors may be forced upon wet rocks in breaking waves requiring the team to use TTP specific to that environment.

11.10.1. **Tethered Swimmer Option.** A team member conducting a boat-based approach to wet rocks can be tethered and tended by another team member in a CRRC. It may be necessary for the team member to be removed from the rocks expeditiously due to changing sea state or weather conditions and the tether will facilitate this. Once the team member has landed on the rocks, the tether can be used to bring a litter with medical and additional rescue equipment to the rock for treatment and packaging of the survivor.

11.10.2. **Wet Rock Approach.** Approach the rocks and stop a safe distance away to continue scene assessment. Hazards may include debris, fuel, lines, submerged rocks, and kelp entanglement. Determine the best place to attempt landing. If the rescuer is able to land on the wet rock, take careful measure of the surf beat. The rescuer must remain vigilant of number of waves in each set, the period between them, the height relative to the emerged rocks, and the length of the lull. If the rescuer can reach firm footing with good hand holds at low water in the lull, the rescuer should exit the rocks at this time. If the rescuer requires assistance to mount the rock, await for returning waves to assist.

11.10.3. **Following Waves.** The use of following waves as assistance may present a hazard. It is extremely dangerous to be caught between breaking waves and emerged rock. The swim must be timed to the rocks to follow on the back of the wave arriving with the high water. Typically, there will only be about 1 or 2 seconds for establishing good hand-holds and footing before the water retreats. If failing to establish good holds that allow climbing quickly out of the way of the next wave, then the rescuer must immediately abandon that attempt and swim away with the withdrawing water. Once on the rocks, evaluate the survivor’s condition and begin the extrication. If working on jetties or areas with boulders, consider use of small, short fins to facilitate movement without the need to remove fins.

11.11. Surf Rescue. In addition to the rescue of survivors in the surf, team members must be prepared to rescue other team members in distress during the conduct of maritime infiltration and exfiltration techniques.

11.11.1. **Surf Entry.** Entries into the surf from shore are readily accomplished in calm conditions. In these conditions, enter the water with no fins worn to expedite entry. Once in waist-deep water, stop to don fins and swim towards the survivor. In rough conditions, all gear should be worn before attempting to enter the water. Walk backward or sideways while wearing fins and edge closer to the breaking waves. If time permits, study the wave intervals to determine the lull periods. If waves are not big but too small to dive under, turn sideways to the wave and brace for impact. When deep enough to swim, dive under the next approaching wave and surface beyond the breaker zone.

11.11.2. **Surf Extraction.** Moving an impaired survivor from the water and onto the beach may be the most difficult part of a water rescue. As a last resort, the rescuer could simply grasp the survivor under the arms and walk backward, dragging the survivor behind. In environments such as a flat sloping beach and breaking surf, this may be the only option. Learn to use the waves as an aid to get in and out of the surf. Plant feet firmly as the wave approaches and brace for impact. Movement should be timed so the water is not being fought. **CAUTION**: In circumstances where the waves are dangerously high, rescuers should wait for a lull among the breakers before attempting the lift.

11.12. Combat Rubber Raiding Craft (CRRC) Operations. Equipment Configuration. Equipment will be used IAW applicable service and command regulations, instructions, and appropriate technical manuals. This document provides “only” minimum recommended equipment lists. **NOTE:** The Wing P Series boat utilizes a two piece fuel hose assembly. Directly attaching the fuel bladder to the engine is possible but not recommended. Teams should ensure that the second stage hose with the bulb pump is included with the fuel bladders. **NOTE:** Review local navigational light methods when operating in waters outside of the US.

11.12.1. Foot Pumps. Two sets of foot pumps with hoses should be stowed in the forward pockets on the buoyancy tubes.

11.12.2. Water and Food. TLs determine requirements for food and water based on a mission analysis on duration of water environment and exposure. Desalination pumps can be used to minimize the amount of water the team employs with.

11.12.3. Fuel. The team should compute and employ with fuel requirements for operational transit. If employing from aircraft, bundles can be configured for dropping additional fuel to the team.

11.12.4. Personal Flotation Device (PFD). A PFD must be worn by all personnel in the CRRC and must have sufficient lift to support the individual and his combat load. When wearing combat equipment, each team member should conduct a float test to ensure there is adequate flotation.

11.12.5. Radio. Complete waterproofed radio sets with spare batteries will be carried in each CRRC.

11.12.6. Navigation Equipment. Passive electronic methods of navigation such as GPS are recommended. As a minimum, the following navigation equipment is recommended: Marine binoculars, Marine compass with speed measuring device, and Navigation charts for the AO.

11.12.7. Signaling Devices. These devices include smoke, flares, chemlights, sea dye markers, and submersible strobe lights.

11.12.8. Paddles. Enough paddles should be transported to provide propulsion and steering for the CRRC in case of outboard motor (OBM) failure.

11.12.9. Repair Kit. This kit should contain provisions for the CRRC and OBM. See **Table 11.1**, for Outboard Motor and Combat Rubber Raiding Craft Repair Kit Contents. All components should be kept in a watertight container, secured to the CRRC, and treated to resist saltwater corrosion. Consult your local boat master for current date requirements for the repair kit.

11.12.10. Sidelights. Colored lights are used as follows: red on port side and green on starboard. Consider using battery-powered light sticks as opposed to chemlights as battery-powered light sticks can be easily turned off.

11.12.11. Lines. Bow and stern lines should be at least 15 feet long and boat riding lines should also be configured.

11.12.12. Protective Clothing. Protective clothing will be worn at the discretion of the TL and as dictated by the environment and mission. TLs may consider the desires of the individual crew. Planners should take into consideration hypothermia during prolonged exposure to sea spray and wind even in relative mild air temperatures.

Table 11.1. Outboard Motor and Combat Rubber Raiding Craft Repair Kit Contents.

Tools	Extra Parts
• 3/8-inch socket or breaker bar. • 13/16-inch spark plug wrench. • 8-inch pliers. • Number 2 Phillips head screwdriver. • 3/8-inch-wide regular screwdriver. • 1/4-inch-wide regular screwdriver. • 8-inch adjustable wrench.	• One extra coil. • One extra power pack (for older engines). • Two extra spark plugs. • Emery cloth. • Extra tie ties. • Emergency patches; one large patch, two small patches. • 4 feet of .5 inch tubular nylon webbing (starting cord replacement)

11.12.12.1. **Equipment Loading.** Place all organizational equipment not worn by the team (e.g., medical gear, rescue equipment, and radios) in waterproof bags (as required) within rucksacks or submersible bags. Pad sharp corners and projections on equipment to prevent damage to the boat. Stow the bags or rucksacks securely in the boat before deploying.

11.12.12.2. Alternate equipment tie-down procedures (Fixed “D” ring).

11.12.12.3. Rig a single equipment line from the lifting ring on the transom, forward to a “D” ring on the opposite bow.

11.12.12.4. Tie a loop near the bow end of the line and Carabiner an equipment container to act as a stopper into the loop.

11.12.12.5. Secure the remainder of the equipment into the equipment line between the stopper and the transom.

11.12.12.6. The equipment should be free to slide the length of the equipment line and to be retained on the line by the stopper.

11.12.12.7. If the CRRC capsizes, a team member can release the bow end of the line, and this allows the cargo to float free (secured at the transom) while the CRRC is righted.

11.12.12.8. This method removes a significant portion of the weight from the CRRC and makes it much easier to right the boat.

11.12.12.9. The team can then recover the equipment over the stern, or it can be towed, if the situation requires.

11.12.12.10. Weight and Balance. Weight placed in the front of the boat can help to keep the bow down and improve controllability, especially when using the 55-HP multi-fuel engine (MFE). Keep as much ballast in the front of the boat as needed to bring the nose down and increase stability.

11.12.13. **Raider outboard engine starting procedures.**

11.12.13.1. Check fuel, oil levels, and make sure the fuel selector switch is in the appropriate position.

11.12.13.2. Move the tilt/run lever to the RUN position.

11.12.13.3. Ensure water intake screens are below the water level.

11.12.13.4. Hook up the fuel container.

11.12.13.5. Make sure the hose connector is all the way on the motor.

11.12.13.6. Open the fuel vent valve if equipped on the fuel container and squeeze the priming bulb until it is hard.

11.12.13.7. Connect emergency lanyard (kill switch)

11.12.13.8. Move shift lever to NEUTRAL.

11.12.13.9. Twist throttle grip to the slowest idle position.

11.12.13.10. Engage starter or pull starter handle slow until resistance is felt and then pull forcibly. Pull as needed until the OBM starts. Do not over extend pull strokes as this may damage the starter.

11.12.13.11. Do not move the throttle from the slowest idle position prior to engine start. Advancing the idle will cause starting/running problems and the engine may not accelerate above idle.

11.12.13.12. After engine start, ensure the water pump is functioning properly. A steady stream of water indicates proper function.

11.12.14. **Shifting.** To shift the OBM while underway, use the following procedures.

11.12.14.1. After the engine is running smoothly, turn the throttle control to the shift position.

11.12.14.2. Move the shift forward with a quick motion.

11.12.14.3. (Reverse). Decrease the speed, turn throttle control clockwise to the shift position, and move the shift lever to reverse.

11.12.15. **Underway Throttle Control.** Good throttle control and a gentle increase of the throttle lowers the possibility of cavitation. If cavitation occurs, the operator should decrease throttle and then slowly increase the throttle to return to the desired speed. While underway, maneuver at a speed that gives the coxswain time to identify problems and adjust control inputs.

11.12.15.1. **Stopping the OBM.** To stop the OBM while underway or when stationary, perform the following.

11.12.15.2. Slow the OBM to idle speed.

11.12.15.2.1. Move the shift lever to neutral.

11.12.15.2.2. Press the stop button which is located on the end of the steering handle or in the front of the motor by the primer. **CAUTION:** For the 55-HP MFE, accomplish the self-winterization procedures found in the operators guide after each use or when placing an engine into storage. Failure to winterize after each use can cause severe damage to engine components.

11.12.16. **Tilt Use.** To adjust the tilt of the OBM perform the following.

11.12.16.1. Move the tilt lever up.

11.12.16.2. The OBM will be able to come to the up position.

11.12.16.3. Move the tilt lever and use the tilt on the engine cover to raise the motor to the full tilt position.

11.12.16.4. Tilt support will automatically engage.

11.12.16.5. Make sure the propeller is always underwater.

11.12.16.6. Do not operate the OBM in reverse when the tilt is up as motor will tilt up causing loss of control.

11.12.16.7. Always run the OBM at slow speeds and be sure to check the water pump indicator often.

11.12.17. **Broken Starting Cord.** In the event the team has a broken starting cord, do the following.

11.12.17.1. Remove the cover.

11.12.17.2. Remove the three bolts from the recoil assembly using a wrench.

11.12.17.3. Make a pull cord, by using about four feet of 0.5-inch tubular nylon.

11.12.17.4. Tie a knot in one end of the cord.

11.12.17.5. Place knot in the notch of the flywheel and wrap clockwise.

11.12.17.6. Pull sharply.

11.12.17.7. Do not wrap the line around the hand or wrist.

11.12.17.8. If unable to shift into neutral, remove the neutral starting switch cable by using a standard screwdriver.

11.12.17.9. The engine will start in gear with neutral starting switch cable removed.

11.12.18. **General Maintenance.**

11.12.18.1. Flush the OBM in fresh water using a dip tank or engine rinsing ears.

11.12.18.2. Do not put the engine in gear when using the engine rinsing ears.

11.12.18.3. The engine is flushed for 5 minutes to remove any salt water and marine life.

11.12.18.4. The cover is removed, and the motor head sprayed with fresh water.

11.12.18.5. Disconnect the fuel line and run the engine until it stops.

11.12.18.6. As the engine begins to sputter, pump the primer to remove all residual fuel.

11.13. CRRC Contingency Considerations.

11.13.1. **Outboard Motor Breakdown.** Team members should be familiar with basic troubleshooting and maintenance for the OBM. If possible, the team should bring a trained technician and spare parts for the employed OBM.

11.13.2. **Low Fuel.** Teams should run trials with a fully loaded CRRC in various sea states to calculate fuel consumption rates. The CRRC takes enough fuel for a worst-case scenario.

11.13.3. **CRRC Puncture.** Teams should carry and be familiar with the use of expedient plugs.

11.13.4. **Tow Operations.** All CRRCs must be rigged and equipped for both tow and towing operations. When a CRRC fails, team members should do the following:

11.13.4.1. Immediately prepare the craft for towing.

11.13.4.2. Towlines should be long enough to sag under their own weight.

11.13.4.3. Taut towlines result in accidents.

11.13.4.4. Cross-deck a trained technician to repair the OBM.

11.13.4.5. If towing is required, cross-deck team members to an alternate craft to lighten the load.

11.13.4.6. Tow the inoperable CRRC with only the coxswain and OBM technician onboard.

11.13.4.7. Tow at a slower speed than the CRRCs normally travel.

11.13.4.8. Do not make quick turns.

11.13.4.9. Assign a lookout in the towing craft to observe the towed CRRC.

11.13.4.10. Do not make sudden stops.

11.13.4.11. Maintain steering control of the towed CRRC.

11.13.4.12. If the towing craft stops suddenly, the towed CRRC must be able to steer clear without ramming the towing boat.

11.13.4.13. Raise the engine on the towed craft.

11.13.5. **Capsized CRRC.** If a CRRC begins to capsize, the coxswain should warn the craft's occupants and attempt to stop the engine. When the team members are in the water, they should protect their heads with their arms. Actions taken after capsizing include the following:

11.13.5.1. The TL conducts a head count.

11.13.5.2. All team members swim to the seaward side of the craft to keep it from being pushed by swells over the top of them.

11.13.5.3. They should remain in a group.

11.13.5.4. Team members attempt to right the craft.

11.13.5.5. If unable to do so, they stay with the CRRC.

11.13.5.6. If capsized in the surf zone, the CRRC will be pushed ashore.

11.13.5.7. If in the near-shore area but outside the surf zone, personnel try to swim the CRRC to shore.

11.13.5.8. If at sea, it is easier for search assets to spot a capsized CRRC than individual swimmers.

11.13.6. **Loss of Contact.** If contact is lost between crafts when conducting operations involving multiple CRRCs, the usual procedure is for the lead craft to wait a preplanned period of time for the missing CRRC to catch up. Make every attempt to re-establish contact as soon as possible. Factors to consider include the following:

11.13.6.1. CRRCs are most likely to lose contact at night and in reduced visibility (fog, rain, and heavy seas). To reduce the likelihood of lost contact, formations should be kept tight, and the coxswains maintain visual contact with the other craft

11.13.6.2. If a CRRC falls behind the formation or stops, the other craft will stop to render assistance. In the event a CRRC cannot maintain the formation speed, the CRRCs will travel at the slow craft's best possible speed.

11.13.6.3. If contact is lost, the lead CRRC should stop and wait for the lost craft to catch up. If after a short period, the lost craft does not catch up, the lead CRRC follows a reciprocal bearing until contact is made.

11.13.7. **Contingency plans.**

11.13.7.1. If contact is not made along the track, the lead CRRC will proceed to a predesignated rally point and wait until the lost craft arrives.

11.13.7.2. The coxswain of the lost craft attempts to re-establish contact. If contact is not swiftly made, the coxswain moves to the predesignated rally point to await the rest of the force.

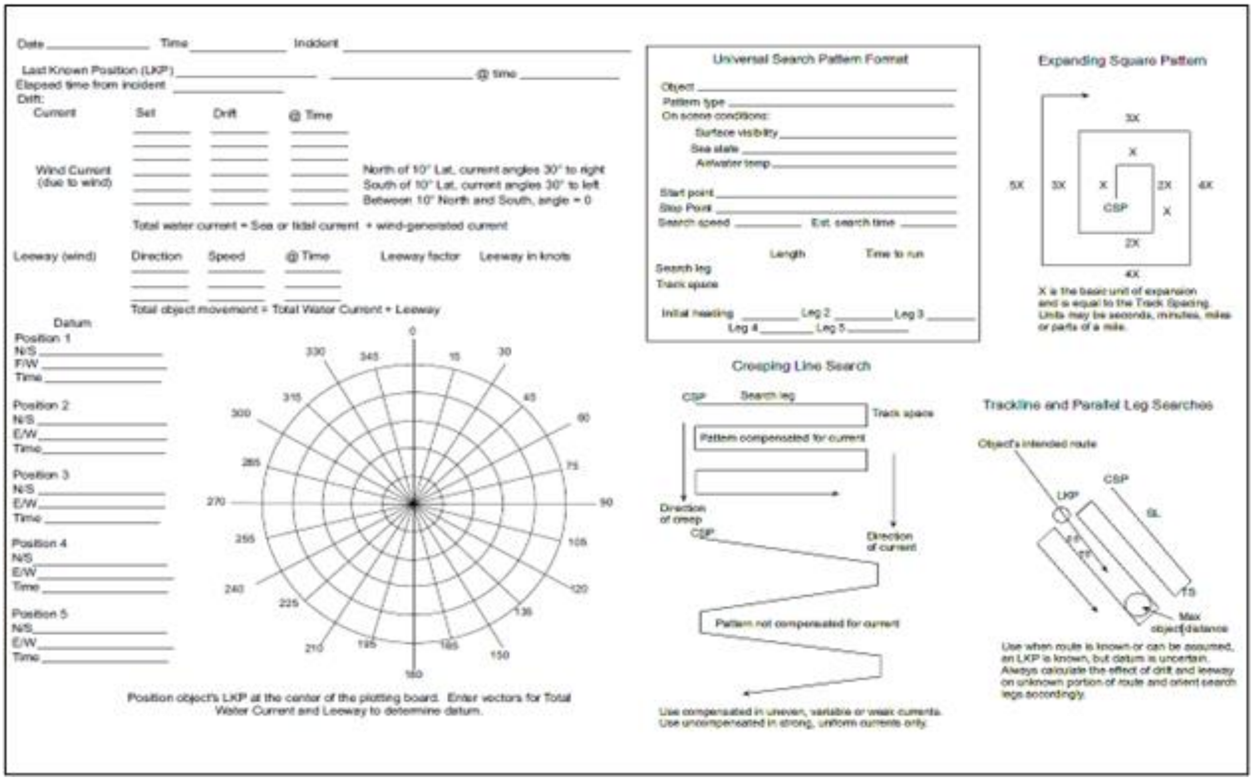
11.13.7.3. The TL decides if the mission or the lost craft takes precedence, considering the time available for the mission and the preplanned abort criteria.

11.13.8. **Man Overboard.** If a team member falls overboard, the coxswain will alert the TL and other craft in the area using voice, radio, or visual signals. To facilitate recovery, each team member will have a pre-briefed signaling device (these may be IR depending on the tactical situation) attached to a personal flotation device (PFD). It will be activated upon falling overboard. Depending on the tactical situation, the team member overboard in the surf zone can return to the beach where a designated boat will recover the team member, or the team member will swim through the surf zone and be recovered. The CRRC from which the team member is assigned will be primary in the recovery. If unable, the coxswain will request assistance from another craft and direct it to the vicinity of the team member. **WARNING:** Unless the CRRC is in a dangerous area where stopping would endanger the team, the coxswain will immediately maneuver CRRC away from the team member and will place the engine in neutral to prevent the person from being struck by the propeller. The team will maintain visual control of man overboard.

11.14. Boat-Based Search Operations. Teams conducting CRRC operations should be prepared to conduct search operations to affect the rescue of survivors. Overhead assets may be used to aid in the search if available to vector the recovery team to the survivor's location.

11.14.1. **Basic Search Planning.** Detailed planning is required to accurately determine the area where the survivors are located upon arrival at the scene. Planning the search involves calculating datum and outlining the boundaries of the search area. See **Figure 11.6** for a search planning work slate.

Figure 11.6. Search Planning Work Slate.

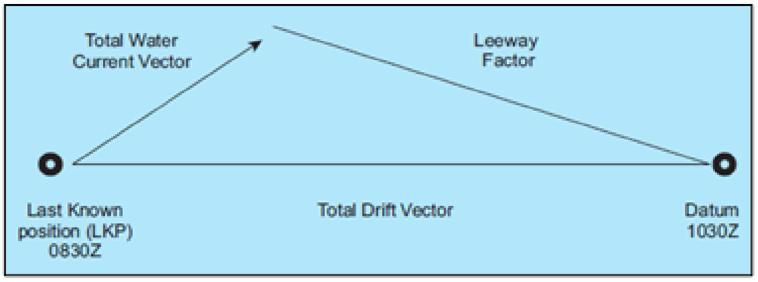


11.14.2. **Datum.** The term datum refers to the most probable location of the search object corrected for drift over a given period of time. Depending on the information available and its accuracy, datum may be a point, line, or area. As the incident develops, datum must be corrected to account for wind and current. A point is established at the center of the area where it is estimated the search object is most likely located. The probability of detection (POD) is maximal at that point and decreases going away from that point.

11.14.3. **Datum Area.** When the team cannot determine the exact position of the survivor or object, a datum area is developed based on many factors, but includes as a minimum: fuel endurance of the vessel in distress, wind and currents which affect the search object, the survivor's preplanned intentions/plan.

11.14.4. **Forces Affecting Datum.** As time progresses, datum must be corrected to compensate for the effects of wind and current. Some of the many natural forces which affect objects in the maritime environment are listed below. See **Figure 11.7** for an example of an objects drift.

Figure 11.7. Search Object Drift.



11.14.4.1. Leeway. Leeway is the movement of an object through the water. Leeway is caused by winds blowing against the exposed surface of the object.

11.14.4.2. Wind-Driven Current. Wind blowing over the water's surface will push the water along in the same direction the wind is blowing. This wind current affects the movement of objects in open waters. Wind-driven current may not be a factor when searching in coastal waters, small lakes, rivers, or harbors because nearby land masses may block or reduce the effect of wind.

11.14.4.3. Sea Currents. Sea current refers to the movements of water in the open sea.

11.14.4.4. Tidal Currents. Tidal current is caused by the rising and falling of tides.

11.14.4.5. River Currents. The flow of water in a river is called river current. These currents can quickly move objects over long distances.

11.14.5. **Sources for Datum on an Object Adrift.** In addition to intel reports, Coast Guard stations can provide datum and search areas for an object in the water. US Navy SIPR Portal and the National Geospatial Intelligence Agency (NGA) provide high fidelity datum for objects adrift in areas beyond coastal waters. Consult the AOR's respective Personnel Recovery Coordination Cell (PRCC) and/or Joint Personnel Recovery Center (JPRC) for accurate DATUM calculation and/or access to these systems. Additionally, the U.S. Coast Guard (USCG) sponsored SAROPs software provides in-depth maritime SAR planning and datum analysis; acquisition and training is provided by the USCG Maritime Search Planning Course at the Yorktown, VA National Search and Rescue School.

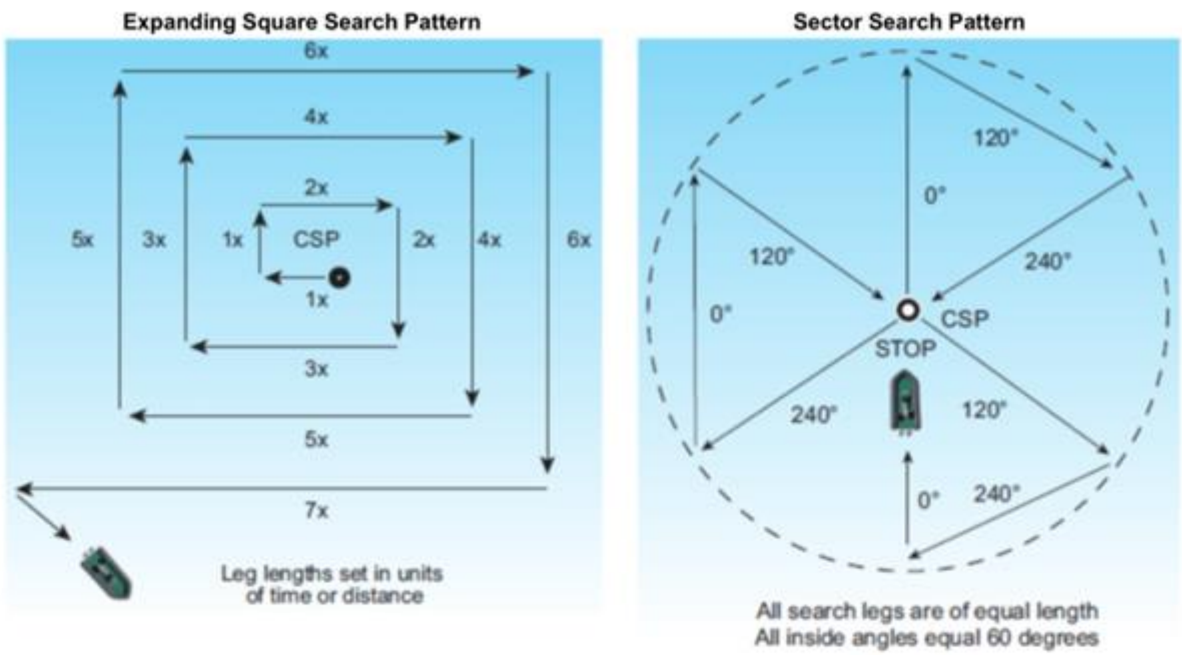
11.14.6. **Search Patterns.** Once a search area has been determined, the team determines the best search pattern to use.

11.14.6.1. Pattern Considerations. Consider the following when determining which pattern to use weather conditions, size of the search area, size of the lost object, number of search platforms available, search area location, and time limitations.

11.14.6.2. Expanding Square Search Pattern. The Expanding Square Search pattern is used when the last known position (LKP) of a search object has a high degree of accuracy, the search area is small, and a concentrated search is desirable. See **Figure 11.8** for Search Patterns.

11.14.6.3. Sector Search Pattern. A Sector Search pattern is used when datum is established with a high degree of confidence, but the search object is difficult to detect. The team navigates through datum several times, each time increasing the chances of finding the search object. Datum should be marked by the team with a buoy or other floating object. By marking the center of the search pattern, the coxswain has a navigation check each time the boat comes near the center of the search area. This pattern consists of nine legs. All legs and crosslegs of this pattern are of equal length. After running the first leg, the team's first turn will be 120 degrees to starboard to begin the first cross leg. All subsequent turns will be 120 degrees to starboard to a course determined by adding 120 degrees to their previous course. Notice after completing the first leg and crossleg, the second and third legs of the pattern are completed in sequence without turning in between. This pattern can be simplified by starting on a heading of 0 degrees, the second leg being 120 degrees and legs three and four being 240 degrees. All remaining search legs will alternate through these three headings. See **Figure 11.12** for Search Patterns.

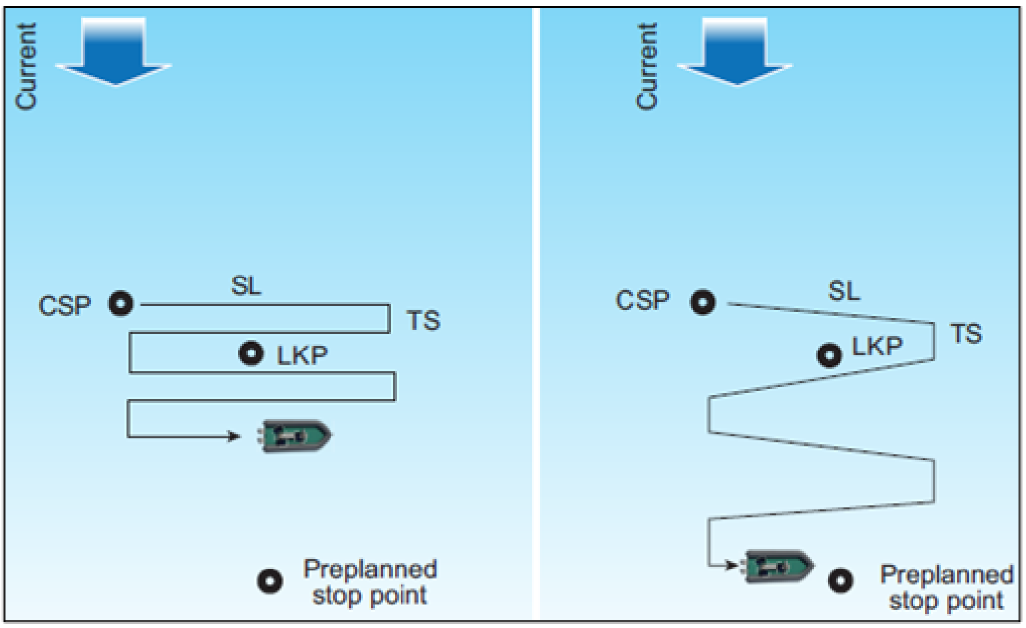
Figure 11.8. Search Patterns.



11.14.6.4. Parallel and Trackline Search Patterns. The parallel and trackline search patterns are used to search when the only information available is the intended or probable track of the lost item. It is used when the approximate location of the search object is known, and uniform coverage is desired. Parallel track patterns are the simplest of the search patterns. The team steers straight courses on all legs. Each leg is one track spacing from the other. The legs are parallel to the long side or major axis of the search area.

11.14.6.5. The Creeping Line Search Pattern. The Creeping Line Search is used when the probable location of the search object has been determined to be more likely at one end of the search area than at the other end. This is best used to cover large areas where datum is vague, and the search object is easy to spot. In areas of relatively static water, the creeping line search will track relatively true over the ground giving very complete coverage. Searches in areas of strong current should not attempt to compensate for drift but follow a compass heading and allow the current to drift the search craft downstream. This is to ensure the search craft will eventually overtake the drifting object. See **Figure 11.9**, for examples of search patterns.

Figure 11.9. Parallel and Creeping Line Search Patterns.



11.14.6.6. Barrier Pattern. The Barrier pattern is used in areas with strong current such as a river. The search lies along the path of the current. The boat moves back and forth over the same track. This can be done by steering on an object on each side of the river bank. The boat moves from one side of the search area to the other while the current carries the water and objects past the search barrier. Since river currents can vary across the width of a river, a more effective barrier might be established by forming a line abreast. This is done by placing observers on each bank and having a boat in the area of swiftest current hold station between the observers on shore. Additional boats, if available, could be added to the line abreast to reduce the effective track spacing and increase the effective coverage. This technique produces a more effective, and predictable, barrier.

11.14.6.7. Shoreline Search. CRRCs can perform a shoreline search since their draft allows them to get close enough to the shoreline to permit careful inspection. Search craft engaged in shoreline searches must be aware of navigational constraints and any limitations imposed by sea conditions. TLs consider the possibility of survivors clinging to navigational aids such as buoys, or to rocks offshore. Survivors may make their way to any dry land they drift close enough to see. Survivors may also anchor their boat or raft or tie it to an offshore navigational aid if they drift into shallow water but still cannot see land or believe they cannot make it to shore unaided.

11.14.7. **Search Area Determination Procedure.**

11.14.7.1. Draw a circle with a 6- Nautical Mile (NM) radius centered at the LKP.

11.14.7.2. If drift is considered significant, the team should estimate the drift based on local knowledge/on scene conditions and center the 6-NM circle on the drifted LKP.

11.14.7.3. Remember the time of datum must take into consideration the underway transit times for the search craft.

11.14.7.4. Next, draw the search pattern within the tangent of the circle.

11.14.7.5. Datum for the search is the commence search point (CSP).

11.14.7.6. Orient the search area in the same direction of drift, that is, in the same direction as the total drift vector.

11.14.7.7. If the reported position of a distressed craft is in shallow water, it could be at anchor, and a search down the drift line may be appropriate.

11.14.7.8. Commence Search Point.

11.14.7.9. The CSP is a point identified by datum in which a search craft begins its search pattern.

11.14.7.10. Track Spacing. Track spacing (TS) is the distance between adjacent parallel legs within a search area and is a function of visibility and size of the target being searched for. These tracks may be conducted simultaneously by multiple units separated by fixed intervals, or they may be the result of successive sweeps conducted by a single search craft. Most of the search patterns described in this chapter consist of equally spaced, parallel search legs (tracks). See **Table 11.2** to determine track spacing.

11.14.7.11. Locating Distressed Aircraft. Except for seaplanes, aircraft usually sink rapidly after ditching, and only pieces of buoyant debris, oil, fuel, etc. will remain.

11.14.7.12. Locating a Person in the Water (PIW). In an open ocean environment, this can be a difficult task due to sea state, weather conditions, time of day, and absence of a PFD. If the survivor is not wearing a PFD, only the head will be visible. Survivors may use debris for flotation.

Table 11.2. Track Spacing.

Search Object	**Good Conditions:** Wind Less Than 14 Knots, Seas Less Than 3 Feet	**Poor Conditions:** Wind Greater Than 15 Knots, Seas Greater Than 3 Feet
Person in water	0.1 NM	0.1 NM
Object less than 15 feet long	0.5 NM	0.2 NM
Object greater than 15 feet long	1.0 NM	1.0 NM

11.15. Boat Rescue Operations. CRRCs may be used as a recovery platform in maritime incidents.

11.15.1. **PIW Recovery.** All required rescue and medical equipment should be prepared in advance. The method for approaching a person in the water should briefed to all team members. A team member will act as a pointer and must always keep the PIW in sight. The pointer will be in visual and verbal contact with the coxswain and direct the coxswain to the PIW until the survivor is alongside the buoyancy tube of the CRRC. The coxswain will reduce speed, shut the engine off or put it in quick reverse to prevent injuring the survivor. The team takes direction from the coxswain regarding the pick-up side and gets in position to aid the survivor out of the water. See **Figure 11.10** for an example of a recovering a person from the water with the CRRC. Take the following into consideration when conducting PIW recoveries.

11.15.1.1. Approach the survivor facing into the current or wind, whichever is the stronger of the two.

11.15.1.2. Steer into the elements, the coxswain will maintain steerage even at slow speed and can use the elements to slow and stop the CRRC.

11.15.1.3. Survivors immersed in cold water will rapidly lose muscle strength and coordination and may not be able to help themselves.

11.15.1.4. Survivors may need assistance every step of the way to recovery.

11.15.1.5. Suspected hypothermia victims should always be recovered gently and horizontally to reduce the chance of drop in blood pressure.

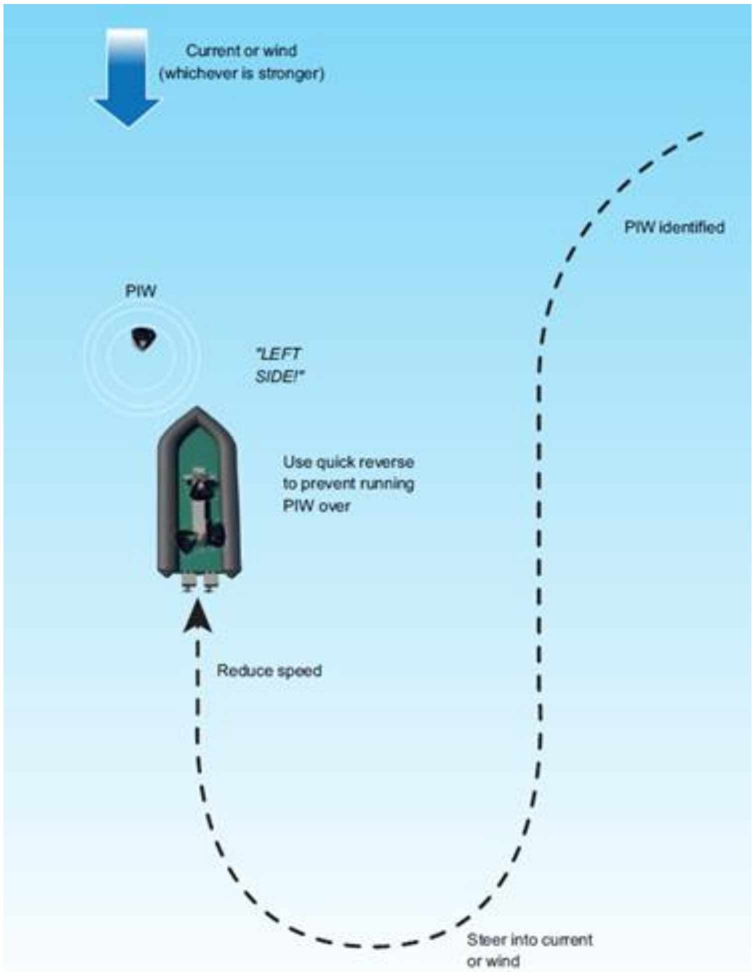
11.15.1.6. Treat all immersed survivors for hypothermia.

11.15.1.7. Recover survivors who are without flotation aid before those with flotation.

11.15.1.8. Recover survivors without hypothermia protection before others.

11.15.1.9. Interview all survivors at the earliest opportunity to determine whether others are in the water and for last known location.

Figure 11.10. Person in the Water Recovery by Combat Rubber Raiding Craft.



11.15.1.10. In cases of locating multiple PIW, provide temporary flotation during recovery operations. Employ aircraft life rafts to act as a floating collection point for triage and recovery staging.

11.15.1.11. If the RV is acting as an overhead search platform, it can vector the team to the PIW's location by marking the position where the PIW is between the team and the RV. The team in the CRRC steers towards the RV which will eventually lead them to the PIW.

11.15.1.12. Do not leave the scene until all survivors have been recovered and the component rescue coordination cell (RCC) concurs.

11.15.2. **Methods of Recovery.** Two broad categories of recovery methods exist. Direct methods involve direct contact between the team and the survivors, while indirect methods involve the use of various devices to assist the recovery. Indirect rescue methods should be used first. When all indirect methods have failed, use direct methods to execute the recovery. Recovery teams conducting boat-based rescues generally involve the use of throw lines.

11.15.3. **Survivor Removal from the Water.** Removing a helpless or unconscious survivor from the water and onto a CRRC is difficult. The CRRC poses a challenge; though low in the water, the buoyancy tube is much wider than a rail in a standard boat, causing the team member to have to reach far out to pull the survivor on board. If there is an indicating mechanism of injury, every attempt will be made to recover unconscious survivors with a floatable spine board. The following techniques should be considered for removing an unconscious survivor from the water.

11.15.3.1. Position the survivor as close as possible to the side of the boat to limit how far the rescuer must reach.

11.15.3.2. To keep from falling overboard, the rescuer keeps a center of gravity well within the boat.

11.15.3.3. Keeping low, position the survivor facing away from the boat.

11.15.3.4. Reach under the survivor's arms so the rescuer's arms are between the survivor and the boat.

11.15.3.5. The rescuer should grasp the survivor tightly, lift with the legs, and may consider wiggling the survivor side-to-side slightly, thereby lifting each side in increments.

11.15.3.6. When it is possible for the rescuer to brace elbows on the top of the boat's side, use the legs to lift the survivor until their waist is at the rail.

11.15.3.7. Gently lower the survivor to the deck or take a step back into the boat pulling the survivor further inside the boat.

11.15.3.8. If more than one team member is available to lift, it will help to use a short length of webbing to give them something to lift with.

11.15.3.9. Starting again with the survivor's back to the boat, pass the webbing under one arm, around the chest, and under the other arm.

11.15.3.10. Cross the ends of the webbing behind the survivor.

11.15.3.11. Each team member will haul up on the end of the webbing until the survivor is in the boat.

11.15.3.12. Bounce Lift. It may be possible to use the survivor's buoyancy to get them on board the boat.

11.15.3.13. Upon reaching the boat, secure the survivor to the boat and climb aboard.

11.15.3.14. The survivor can be secured by keeping one hand constantly pinning the survivor up against the boat.

11.15.3.15. The survivor is then freed and turned to face the boat.

11.15.3.16. Push the survivor low in the water, about chin level, and then aggressively pull up on the victim.

11.15.3.17. This will often bring the survivor's torso over the edge of the boat.

11.15.4. **Hoisting from CRRC.** Once a survivor is recovered, they should not be placed back into the water to facilitate hoisting. Rotor wash from RVs will push a stationary CRRC around necessitating the survivor to be hoisted out while underway. The RV may have to deploy a stokes basket to the team prior to conducting the hoist. To assist the hoisting process, do the following.

11.15.4.1. Change the CRRC's course to the wind on the bow, preferably on the port bow.

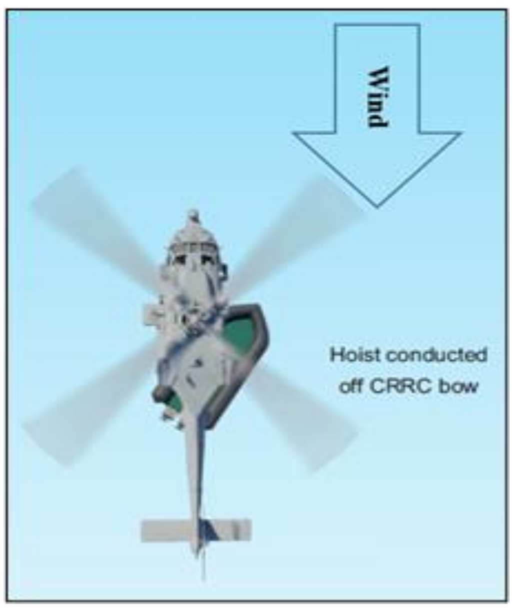
11.15.4.2. The RV aircraft commander sits in the starboard side of the vertical lift aircraft which helps to give the pilot the best view of the CRRC. See **Figure 11.11** for a depiction of hoisting from a CRRC while underway.

11.15.4.3. Reduce speed to ease the CRRC's motion but continue to remain underway.

11.15.4.4. Conduct the hoist operation on the bow of the CRRC in conjunction with a tag line.

11.15.4.5. If floating collection points are used for multiple survivors, the team will have to make multiple trips to and from the collection points.

Figure 11.11. Hoisting From Combat Rubber Raiding Craft Underway.



11.16. Dive Equipment for Adverse Environments.

11.16.1. **Full Face Masks.** Traditional face masks are unacceptable for contaminated water conditions but suitable for clean warm water operations. Divers should keep the mask on until they are out of the water and place the mask strap under the hood to prevent loss in the event the mask becomes dislodged while underwater. Cleaning the face plate regularly with a mask cleaner or any soft abrasive cleanser will prevent fogging. A fogged-up mask will not affect a diver in no-visibility conditions but may increase the chance of the diver wanting to remove his mask upon surfacing. **NOTE:** Divers should avoid breathing off the regulator while on the surface. Breathing off the regulator on the surface could result in the manifold freezing. Divers should use the environmental valve to breathe on the surface and ensure they close the valve before leaving the surface. **NOTE:** Divers should ensure the proper nose block is installed in their full-face mask in order to Valsalva their ears.

11.16.2. **Protective Helmets.** If diving in an overhead environment or moving water, head protection should be worn. If the mission requires the vertical lift aircraft free-fall employment of scuba-equipped team members, wear a protective helmet to prevent hitting the head on the tank manifold/regulator first stage when making impact with the water. Use a lightweight plastic helmet. Because of the buoyant characteristics of the helmet padding, consider taking out the padding and wearing the helmet over a hood or wear a neutrally buoyant helmet. Protective helmets also give versatility by their ability to mount submersible lights or cameras

11.16.3. **Gauges.** All divers should be equipped with a depth gauge and submersible pressure gauge. Most recovery team dive operations will occur in limited-visibility conditions; it is recommended phosphorescent analog gauges be used to facilitate visibility of the gauge. Low visibility may hamper being able to visualize the numbers on the gauge. If only the needle can be seen, divers can remember the clock position of the needle on the gauge when at the minimum return to surface pressure reading. i.e., 1,000 psi is at the 2 o'clock position on the gauge, the diver has to remember to return to the surface at "2 o'clock." For no-visibility conditions, the diver can fill a zip-lock bag with clear water and tape it to the top of the gauge. To view the gauge; the diver can press the bag against his mask in conjunction with a small light.

11.16.4. **Contingency Cylinders.** In addition to the safety offered by the standby diver, there should be a contingency tank within easy access of the surface team. A contingency tank is a designated emergency scuba tank configured to be taken to a diver trapped underwater. The contingency cylinder should have a regulator attached, a carrying handle, a least one extra cutting tool, a Carabiner, and a light marker. It should be full, and the dive supervisor should check its status before the primary diver enters the water. Take into consideration that if the team is using a single aluminum 80/100 ft^3 scuba tank, it will become buoyant once some of its air is used. To prevent possible loss of the tank by the entrapped diver, weigh it with a 2-pound weight about 8 inches above the bottom.

11.16.5. **Emergency Gas Supply Bottles (EGS).** Small additional tanks allow divers to self-rescue when their primary air source has been depleted. Small 19- to 40-cubic-foot pony bottles with an independent regulator give the standby diver an EGS that can be transferred to another diver allowing the standby diver to leave and return with more backup air. The EGS is mounted to the main tank with a quick-release mechanism that allows easy access by both diver and standby diver in an emergency. Mount the EGS on the right side of the tank so the regulator second stage on the cylinder is properly configured for the entrapped diver to use. **CAUTION:** If a diver must use a contingency or emergency air source in contaminated water, be aware that the regulator mouthpiece will be contaminated when it enters the diver's mouth. A diver wearing a full-face mask (FFM) will be required to move his mask to make the transition, exposing his mouth, nose, eyes, and skin to the same hazard. Upon surfacing treat and monitor appropriately.

11.16.6. **Swim Fins.** Due to entanglement hazards diving in limited visibility waters, consider taping the outside strap of each fin or route straps back through the buckles so the running end pull tab is on the inside of the fin strap. Keeping the inside strap free for adjustment makes it easier for divers to reach. Highly buoyant fins and booties may provide a hindrance for search and recovery operations in shallow water, decreasing effectiveness of the search pattern. Having buoyant feet can be a hazard to dry suit-equipped divers increasing the risk of inadvertent feet first ascents. A pair of ankle weights will assist in prevention.

11.16.7. **Wet Suits.** Wet suits are not recommended when conducting search, rescue, and recovery operations in a contaminated water environment. Wet suits allow water to come in contact with a diver's skin and they offer no protection against hazardous materials.

11.16.8. **Gloves.** Gloves must always be worn by divers conducting search, rescue, and recovery operations. Some environments are very hazardous that divers may be required to wear thick leather gloves over thin neoprene or dry suit gloves for additional protection. Kevlar glove liners or reinforcing neoprene gloves with duct tape can protect a diver from sharp objects. As neoprene tends to absorb body fluids and tissue from handling decomposing victims, all gloves used in this capacity should be destroyed after use.

11.16.9. **Diving Harness.** A diving harness allows a tethered diver to operate hands free during the execution of a search dive. Properly configured, a harness will allow a diver to maintain a taut line without any discomfort or effort and feel line-pull signals out to 150 feet. Keeping the attachment point in a constant location, a diver can monitor his ascent rate by the change in the angle of the line across his chest. The angle of the line also indicates the tether became snagged on an underwater obstacle. The harness should sit across the solar plexus so it will not interfere with the diver's breathing. Any harness on the Approved for Use List (AFUL) may be used. The diver is tethered by securing a line to a "D" ring on the front of the harness with a figure-eight knot with a snap shackle. The "D" ring tether point should sit off-center so when the diver is in the proper search position the line will not run between the diver's legs. **NOTE:** Seat harnesses and loops tied around the diver's waist should be avoided as it will put the diver in a vertical position under the water. Loops tied around the diver's waist may also rotate around the body causing difficulty in locating it to clear an entanglement or signal the line tender.

11.16.10. **Weight Systems.** To search more effectively when conducting search operations along the bottom, divers should be over weighted by a maximum of 2 pounds. The following weight systems can be used.

11.16.10.1. Weight Belts. If a weight belt is being used. Consult with Navy Dive Manual for configuration and use Weight Harnesses and Weight-Integrated BCs. If employing weight harnesses or weight integrated BCs, it is imperative all team members be familiar on how to jettison the diver's weight.

11.16.10.2. Ankle Weights. Weights worn on the diver's ankles distribute the weight requirements; however, they require more effort and exertion to swim. Ankle weights add versatility by being a simple fix to add weight to a buoyant diver. If the divers require the weight before descending, another diver can clip the weight around the tank valve where it will be out of the way. Another technique is to clip the ankle weight around the tether line and slide it down with a push. The diver can then clip it around the BC strap.

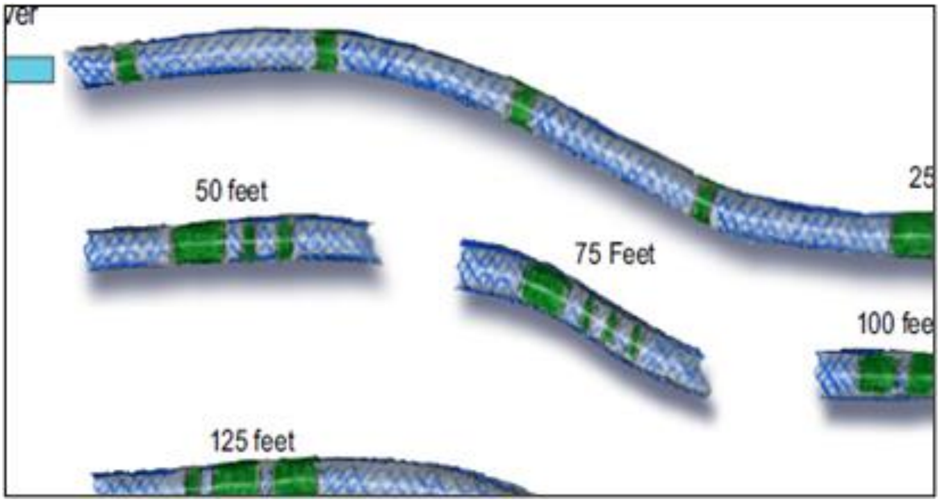
11.16.11. **Cutting Tools.** Use bandage shears underwater to handle entanglement problems due to the fact they do not pose the accidental cutting hazard associated with knifes. Shears can cut through fishhooks, fishing line, and wire with the use of only one hand. Divers operating in a Search, Rescue, or Recovery mode carry at least two sets of shears, a small blunt-tipped dive tool, and any other cutting tools the mission may require (e.g., wire cutters, seat-belt cutters, or window punches). In an entanglement, the tool can be dropped; therefore, redundancy is a must. Mount two on the diver's harness and one on another location. Two mounted to the harness allow the diver to have the tools on themselves in the event they ditch their other equipment. Do not mount cutting tools on the legs where they can be difficult to reach and become an entanglement hazard. Tools can be mounted in the "golden triangle," the area from the mouth down to the bottom of the rib cage on both sides of the diver. Any equipment within this area will be easily accessible by both hands, increasing the chances for self-extrication and facilitating the rescue of another diver.

11.16.12. **Dive Lights.** Invaluable for night searches in clear water, dive lights are worn on the back of the hand or mounted as headlights because they leave both hands free for conducting searches by feel. If diving in no-visibility conditions, dive lights have no use other than for illuminating gauges.

11.16.13. **Tender Lines.** Tender lines 3/8-inch in diameter with a tensile strength of 1,200 to 1,500 pounds offer the best compromise between strength and drag. Braided polypropylene rope is recommended because of its dynamic and floating characteristics. Ideal qualities include tender lines being pliable, easy to knot and pack. Ideal lines allow a submerged diver to feel line-pull signals up to 150 feet. Mesh rope bags protect the rope and facilitate transport and tender use. **NOTE:** An unnecessarily long tending line dampers the pulls from the diver and tender. Keep lines shorter to improve communication and reduce the amount of force required to pull.

11.16.13.1. Line Markings. Mark the lines for distance to manage a searching diver's progress and what area has been searched. No standard marking system exists, but one popular with the public safety diving community is shown in **Figure 11.12**, using narrow and wide wraps of duct tape with various colors for each 25-foot increment. Previous guidance has suggested marking distance searched with knots or loops in the tender line. This technique is no longer recommended because it can lead to line entanglement and increases the drag of the line.

Figure 11.12. Line Markings.



11.16.14. **Contingency Strap.** A standby diver responding to an emergency needs to be able to descend swiftly through limited-visibility water on the primary diver's tending line. A contingency strap is used by connecting it to the standby diver's harness and snapped into the primary diver's tether line. The recommended setup is to use a 1-inch plastic side-release buckle in the middle, a Carabiner at one end to snap onto the primary diver's tether, and a brass ring at the other end that affixes to the standby diver's harness attachment point. Divers should not attach themselves to someone else without a quick-release. A contingency strap offers the advantage of having the standby diver descend the primary diver's tether without pulling on it hand over hand, which may worsen an entanglement or worsen an injury. Descending hands free enables the standby diver to equalize pressure, adjust buoyancy and descend with equipment.

11.16.15. **Variable Volume Dry Suits (VVDS).** Dry suits provide superior thermal protection to the diver both on the surface and sub-surface. They are constructed so the entry zipper seals, wrist and neck seals are waterproof that keep the diver dry. They can be inflated orally or from a low-pressure air source via an inlet valve. Air can be exhausted from the suit via a second valve, allowing buoyancy control. The level of thermal protection can be varied through careful selection of type and thickness of wool or synthetic long underwear. Divers should be aware that too much underwear is bulky and can cause overheating, sweating and subsequent chilling of the standby diver. Dry suits are essential equipment in cold, contaminated, and adverse environments which offer advanced levels of protection to the diver.

11.16.15.1. Dry suits limitations and risks:

11.16.15.1.1. Horizontal swims may be fatiguing due to suit bulk.

11.16.15.1.2. Extra weight is required to achieve neutral buoyancy.

11.16.15.1.3. Dry suits may cause overheating during dives in exceptionally warm contaminated water (>75 degrees Fahrenheit).

11.16.15.1.4. Blowup. Is the sudden loss of buoyancy control caused by the rapid expansion of air trapped inside a dry suit? It is commonly caused by an inadvertent ascent without venting the suit, a stuck (often frozen) low-pressure inflator, or a closed or jammed exhaust valve.

11.16.15.1.5. If the diver is horizontal or head down, air can migrate into the foot area and become trapped causing the diver to lose attitudinal control. Because there are no exhaust valves in the legs, the diver may find himself ascending feet first and out of control. The expanding air in the legs can cause a blowup.

11.16.15.1.6. Inlet and exhaust valves. Can malfunction causing a loss of buoyancy control.

11.16.15.1.7. Seams/Zippers. A collapsing or parting seam or zipper or a rip in the suit can result in a flood out. While the diver may experience thermal shock caused by the sudden exposure to the very cold water, the result of catastrophic buoyancy loss has been greatly exaggerated within the diving community.

11.16.15.1.8. Neck seals. A tight neck seal can cause carotid sinus reflex, or the slowing of heart rate caused by too much pressure on the neck at the level of the cricoid cartilage. This can result in unconsciousness or death.

11.16.15.1.9. Ambient temperatures. Do not subject the dry suit to an ambient outside temperature below 32 degrees F before a dive. Such exposure can cause icing of the inlet and exhaust valves on immersion. If it is necessary to expose the suit to extreme temperatures before diving, the diver should lubricate the valves with silicone. Attempt to rewarm the valves before entering the water.

11.16.16. Dry Suit Hoods. The primary function of the hood is to prevent heat loss through the head. In water less than 70 degrees F, hoods should be a minimum of 3mm thick to decrease heat loss and help prevent vertigo induced by cold water flooding the ears. Dry suits are available with built-in latex hoods. An insulated skull cap or a wet suit hood should be worn under the hood to provide advanced thermal protection. The dry suit will offer the best protection if equipped with an attached hood that seals around the diver’s face and under an FFM. Latex hoods are great for sealing with a FFM, but they are susceptible to puncture. If a wet suit hood is worn, it should have vents to prevent the build-up of air under the hood. Two vents should be at the top for when the diver is vertical and one at the back of the head for when the diver is horizontal.

11.16.16.1. **Dry Suit Gloves.** Gloves protect the divers’ hands and provide thermal protection. They are highly recommended for contaminated water. Dry gloves are permanently attached to the suit but are considered an accessory which can be removed when necessary. Some dry gloves attach to the dry suit by use of inner and outer cuff rings. Consult the owner’s manual of your dry suit for proper installation of dry gloves.

11.17. Dry Suit Diving Techniques. Dry suit diving is an acquired skill which requires specialized training, practice under controlled conditions, and adequate exposure time for the diver to adapt to the open water diving in a dry suit system.

11.17.1. **Entering the Water.** Prior to entering the water, exhaust all excess air in the dry suit. Partially inflate the BC and enter the water. When entering the water feet first, excess air in the suit will be forced to the upper parts of the dry suit. The exhaust valve should be fully opened with a one-quarter to one-half turn backward to prevent sudden loss of air in the suit which can lead to suit squeeze, heat loss, and restricted movement.

11.17.2. **Achieving Neutral Buoyancy at the Surface.** Do not dive in a dry suit until the weights have been adjusted so they are neutrally buoyant at the surface with an empty tank. To achieve proper buoyancy, accomplish the following:

11.17.2.1. Vent all the air from the BC.

11.17.2.2. Vent all the air from the dry suit.

11.17.2.3. Air can be vented by assuming a vertical position in the water and opening the dry suit exhaust valve completely by turning it counterclockwise until it stops.

11.17.2.4. Raise the left elbow and allow the suit to vent.

11.17.2.5. Water pressure will force air from the lower point of the suit up through the torso and out the exhaust valve.

11.17.2.6. Fill the lungs with air and then float at eye level.

11.17.2.7. When all the air is completely exhaled, slowly begin to sink.

11.17.2.8. If both conditions are met, the diver is neutrally buoyant.

11.17.2.9. As more air in the tank is consumed, the diver will become more buoyant.

11.17.2.10. After achieving neutral buoyancy at the surface with a full tank of air, add an amount of weight equal to the weight of the air in the tank.

11.17.2.11. Before adding the weight, inflate the BC.

11.17.2.12. Add just enough weight to offset the change in buoyancy of the tank being used.

11.17.2.12.1. Once in a vertical posture with head out of the water, the diver will notice there is more pressure on the legs than the chest. This is normal anytime they are in the water and the head is higher than the feet. The dry suit should feel as though it is squeezing the diver gently, but firmly, all over the body. **WARNING:** Weighting will be checked by a dive supervisor who is knowledgeable on dry suit diving prior to entering the water. **NOTE:** Different tank sizes and tank materials will require different amounts of weight to compensate for the change in buoyancy from a full tank to an empty tank. **WARNING:** Do not fully close the dry suit exhaust while underwater. The valve is designed to vent automatically when at its highest point of the body. Closing the valve increases the amount of air trapped in the suit that may lead to catastrophic loss of control or rapid ascent.

11.17.3. **Dive Start.**

11.17.3.1. Ensure the exhaust valve is turned counterclockwise all the way, until it stops, and back it off one-quarter to one-half turn.

11.17.3.2. Lift the left elbow to raise the valve to the highest point of your body.

11.17.3.3. Keep the wrist lower than the elbow.

11.17.3.4. With the mask on, the diver may not be able to see the valve but should be able to hear air exiting the valve.

11.17.3.5. Descend by venting all the air from the BC.

11.17.3.6. Descent.

11.17.3.7. Once descended past 10 feet, descent will be faster.

11.17.3.8. Add air to the suit in short bursts, the short bursts will control the volume of air going into the suit and will help keep the valve from freezing open when air or water temperatures are below 40 degrees F.

11.17.3.9. Add adequate air to eliminate any uncomfortable squeeze.

11.17.3.10. To equalize a foot squeeze, the diver must get air into the boots. Air can only enter the boots if the diver is parallel to the surface or in a slight feet-up attitude.

11.17.4. **Attaining Neutral Buoyancy at Depth.**

11.17.4.1. When the desired depth is reached, add just enough air to the BC to become neutrally buoyant.

11.17.4.2. Dive with only with the minimum volume of air in the dry suit and ensure proper weighting.

11.17.4.3. Use the BC to adjust buoyancy.

11.17.4.4. If additional weight is recovered during the dive, use a lift bag to raise the additional weight to the surface.

11.17.4.5. If the lift bag becomes too buoyant and the diver is unable to control it, release it.

11.17.4.6. Do not use the dry suit or BC as a lift bag.

11.17.4.7. Vent air from the BC dump valve to adjust to this buoyancy change.

11.17.5. **Trim.** When swimming underwater, the diver should be neither foot down nor head down, but in level trim.

11.17.6. **Ascent Procedures. NOTE:** New divers should ascend next to an anchored line for their first few dry suit ascents; it can be used to gain control if necessary.

11.17.6.1. Prior to ascent, ensure the exhaust valve is fully open and backed off one-quarter to one-half turn.

11.17.6.2. The ascent must be slow and controlled.

11.17.6.3. As the diver starts towards the surface, they will become positively buoyant as the air inside the suit expands.

11.17.6.4. Vent air from the dry suit/BC exhaust valves as needed to maintain neutral buoyancy.

11.17.6.5. Neutral buoyancy will allow for maintaining the proper ascent rate of no faster than 1 foot per 2 seconds.

11.17.6.6. Monitor the ascent rate using a dive timer and depth gauge and stay within ascent rate limits.

11.17.6.7. If the diver ascends too fast, dump more air from BC.

11.17.6.8. If BC is empty, raise the bent left arm to allow the dry suit to vent more air.

11.17.6.9. If raising the left arm does not slow the ascent, push in on the exhaust valve to activate the manual override.

11.17.6.10. If negatively buoyant and having difficulty ascending, inflate the BC.

11.17.6.11. Be prepared to stop the ascent at any time.

11.17.7. **Surface Swimming.** Inflating the BC will allow the diver to swim comfortably on the surface without inflating the dry suit. Inflation of the dry suit on the surface will place pressure on the swimmer’s neck. Consider fully closing the exhaust valve during surface swimming to prevent water from leaking into the suit through the valve. Ensure to open the valve counterclockwise until it stops and back it off one-quarter to one-half turn before submerging again. **WARNING:** The following emergency procedures should be practiced in a controlled environment under the supervision of a dive supervisor experienced in dry suit diving before the dry suit is used in open water.

11.17.8. **Dry Suit Diving Emergencies.**

11.17.8.1. Diver Inversion. If positively buoyant and the diver turns upside down, they will find they are drifting toward the surface feet first. Regain control immediately because the air is not able to be vented in this position.

11.17.8.1.1. If upside down when close to the bottom:

11.17.8.1.1.1. Swim hard toward the bottom.

11.17.8.1.1.2. Push off the bottom with both hands.

11.17.8.1.1.3. Roll to an upright position.

11.17.8.1.1.4. Immediately vent the dry suit through the exhaust valve.

11.17.8.1.2. If upside down in mid-water.

11.17.8.1.2.1. Kick hard toward the bottom.

11.17.8.1.2.2. Bend forward at the waist.

11.17.8.1.2.3. Roll to an upright position.

11.17.8.1.2.4. Immediately vent the dry suit through the exhaust valve.

11.17.8.1.2.5. If unable to recover and experiencing an uncontrolled ascent, flare your body to reduce the speed of ascent.

11.17.8.1.2.6. Spread the arms and legs away from the body and maintain the fins parallel to the surface to create drag while continuously exhaling.

11.17.8.1.3. Inflator Valve Stuck Open.

11.17.8.1.3.1. Immediately disconnect the low-pressure inflator hose from the suit and vent any excess air through the exhaust valve.

11.17.8.1.3.2. If the diver forgets which direction to turn the exhaust valve to open it, manually vent through the automatic valve by pushing in on it.

11.17.8.1.3.3. If unable to vent enough air through the exhaust valve, open the neck or wrist seals (this may prove very difficult to perform this with thick gloves on) to allow air to escape. This will allow water to enter the dry suit.

11.17.8.1.3.4. If sufficient air still cannot be vented and the diver is still experiencing an uncontrolled ascent, flare the body to reduce the speed of ascent.

11.17.8.1.4. Inflator Valve Stuck Closed.

11.17.8.1.4.1. If inflator valve is stuck in the closed position, stop the descent and terminate the dive immediately.

11.17.8.1.4.2. Use the BC as needed to control buoyancy.

11.17.8.1.4.3. Return to the surface while venting the expanding air in the suit.

11.17.8.1.5. Leaking Exhaust Valve.

11.17.8.1.5.1. If the exhaust valve is leaking, the dry suit will not hold air properly.

11.17.8.1.5.2. Terminate the dive immediately.

11.17.8.1.5.3. Use the BC as needed to control buoyancy and return to the surface.

11.17.8.1.6. Exhaust Valve Stuck Open.

11.17.8.1.6.1. If the exhaust valve is stuck open, the dry suit will not hold air properly.

11.17.8.1.6.2. Water will likely leak into the dry suit through the open valve.

11.17.8.1.6.3. Terminate the dive and use the BC as needed to control buoyancy and return to the surface.

11.17.8.1.7. Exhaust Valve Stuck Closed.

11.17.8.1.7.1. If the exhaust valve is stuck in the closed position, air cannot be properly vented from the dry suit.

11.17.8.1.7.2. This may result in an uncontrolled ascent.

11.17.8.1.7.3. If ascending uncontrollably, immediately open the neck seal or wrist seal to release air.

11.17.8.1.7.4. If sufficient air still cannot be vented and the diver is experiencing an uncontrolled ascent, flare the body to reduce the speed of ascent.

11.17.8.1.8. Slow Air Leak in Inflator Valve.

11.17.8.1.8.1. If experiencing a slow leak in the inflator valve, disconnect the low-pressure inflator hose and terminate the dive immediately.

11.17.8.1.8.2. Ascend while venting the expanding air in the dry suit through the exhaust valve as normal.

11.17.8.1.9. Flooded Suit. In the event of a zipper failure or other catastrophic dry suit failure, the dry suit will flood.

11.17.8.1.9.1. Inflate the BC as required to establish neutral buoyancy.

11.17.8.1.9.2. Position the leak as low as possible to minimize air loss.

11.17.8.1.9.3. Perform a controlled ascent.

11.17.8.1.9.4. Terminate the dive. **WARNING:** If the diver is unable to establish neutral buoyancy by inflation of the BC, the diver should consider dropping the weight belt or jettison the weight pouches of integrated diving BCs. The diver needs to ensure every effort is made to ascend using only the BC before ditching the weight belt. Such buoyancy is difficult to control and may result in a rapid and uncontrolled ascent.

11.17.8.1.10. Dropped/Lost Weight.

11.17.8.1.10.1. Attempt to recover the weights.

11.17.8.1.10.2. Grab ahold of anything and vent the suit.

11.17.8.1.10.3. If unable to control the ascent, assume the flare position.

11.17.8.1.10.4. Continue to exhale while ascending.

11.18. Communication and Line Signals. Divers conducting tethered underwater search, rescue, and recovery operations have three means of communicating which are dependent on availability of equipment, dive environment, and visibility. Divers can use voice communications, line-pull signals, and hand signals.

11.18.1. **Voice Communications.** The dive team makes every attempt to communicate with each other by using standard phrases. The terminology in **Table 11.3**, is considered standard terminology. All personnel using the intercom system should lower the pitch of their voices and speak slowly and distinctly. The conversation should be kept brief and simple, using standard diving terminology. Divers should repeat all commands received from topside tenders to confirm acknowledgement.

11.18.2. **Line Signals.** A line-pull signal consists of one pull or a series of sharp, distinct pulls on the tether strong enough to be felt by the diver. All slack must be taken out of the tether before the signal is given. Standard signals are applicable to all diving operations; special signals may be arranged between the divers and diving supervisor to meet particular mission requirements. Line signals are to be acknowledged as soon as they are received. When using standard line pull signals, it is the tender's responsibility to keep slack out of the tending line and it is the diver's responsibility to keep tension on tending line. The diver should stop, face the line and be oriented towards the starting point every time line signals are received and must acknowledge by repeating the line-pulls for that same signal. If a signal is not properly returned by the diver, the surface signal is sent again. **CAUTION:** If communications are lost, the dive supervisor must be notified immediately and initiate emergency procedures. A continued absence of confirmation is assumed to mean one of three things:

11.18.2.1. The line has become fouled.

11.18.2.2. There is too much slack in the line.

11.18.2.3. The diver is in trouble.

Table 11.3. Diver-to-Tender Voice Communications.

Voice Communication	Meaning
"DIVER LEAVING THE SURFACE"	The diver alerts the dive supervisor to start timing the dive.
"ROGER"	Used by either the diver or surface team to signify they have understood the other team member's message.
"DIVER ON THE BOTTOM"	Message from the diver to the surface team to notify them the diver is on the bottom.
"ON THE SURFACE"	Message from the diver to tender upon reaching the surface.

11.18.3. **Underwater Emergency Signals.** The primary diver and standby diver must establish underwater communication methods. This ensures the standby diver can communicate with the primary diver in case of an emergency, see **Table 11.4** After signaling for the standby diver, the primary diver should stop and put one hand on the harness carabiner, relax, concentrate, and slow breathing. The primary diver will be able to feel the standby diver coming down the tether. Once standby diver reaches the bottom, he will locate the primary diver's hand on the carabiner. The two divers then clasp hands so the primary can signal to the standby diver the nature of the emergency. The divers use one or more of the following hand signals to communicate their needs.

Table 11.4. Reduce Visibility Hand Signals.

Signal	Meaning / Actions Taken
Out of air: Tapping on the standby diver's second stage.	• "**I AM ALREADY ON MY EGS AND I NEED MORE AIR**." • If the primary diver's main tank is exhausted, the signal is given immediately. • Once the standby diver receives the signal, the standby diver places the primary diver's hand on the first stage of the new pony bottle. • The primary diver removes the EGS bottle from the standby diver and inserts the mouthpiece.
Leaving and Returning: Standby diver placing the primary diver's hand on the carabiner and giving three squeezes.	• "**I AM LEAVING, BUT I AM COMING RIGHT BACK**." • This signal should immediately follow the standby diver giving the primary diver the standby diver's pony bottle. • Air is still the immediate concern, and the standby diver will need to retrieve the contingency bottle and EGS bottle. • Upon returning, the standby diver should connect the contingency tank to the tether line so it will not become lost and handle the weight of the tank during descent.
Entanglement: Primary diver making a large circular motion with the standby diver's hand and then placing that hand on where the entanglement is.	• "**THIS IS WHERE MY ENTANGLEMENT IS**." • Locating it for the standby diver prevents the primary diver getting further entangled in the hazard.
Injured or hurt: Tapping the standby diver's hand on the primary diver's chest is used in the event the primary diver is injured	• "**I AM HURT/INJURED**." • After tapping the chest, the primary diver guides the standby diver's hand to the injured area. • The standby diver must move slowly and gently to prevent further injury.

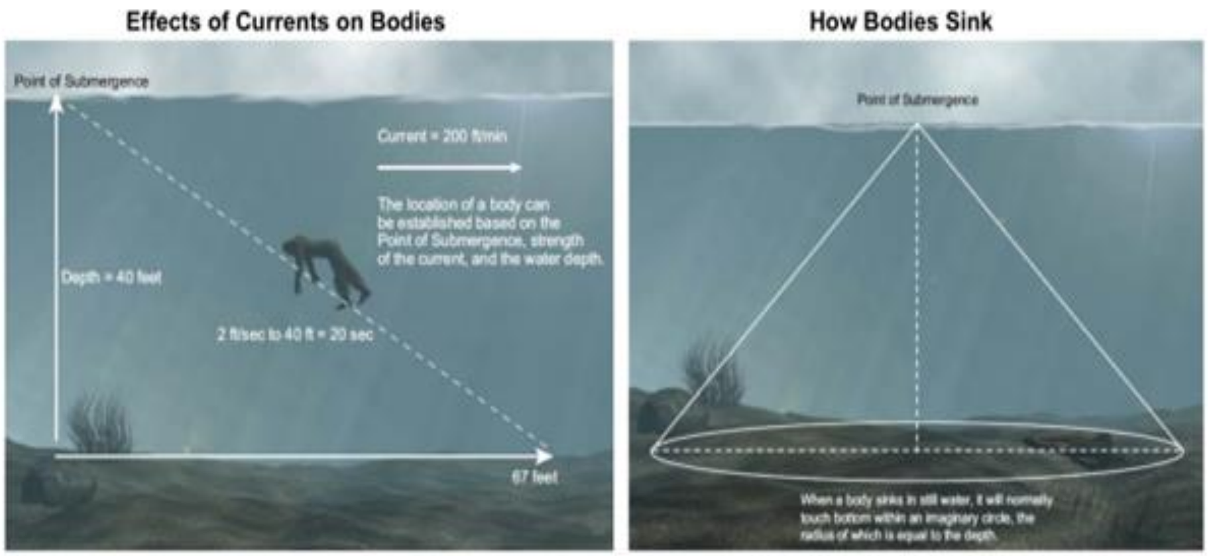
11.19. Underwater Search Operations. When conducting underwater search operations, recovery teams should conduct detailed planning for various types of operations they are expected to perform.

11.19.1. **Establishing the Last-Seen Point.** When interviewing witnesses to identify last-seen point (LSP), teams must identify the exact spot the witness was positioned during the time of the incident. The team can establish the LSP with a reference object by the following.

11.19.2. **Search Area Determination.**

11.19.2.1. Sink Rates. A human body will sink at a rate of about 1 to 1.5 feet per second in salt water and 1.5 to 2 feet per second in freshwater. Variations will result because of muscle-to-fat ratios, body composition, and clothing. Because of these variables, subject matter experts (SME) estimate bodies will sink at a rate of 2 feet per second in any environment. With the exception of shallow water and fast currents, once a body lands on the bottom it will not move until it has putrefied enough to gain buoyancy from the gases produced within. Once the body has enough buoyancy, it may only float partially and it may drift and scrape along the bottom for some time before finally rising to the surface, see **Figure 11.13** for a technique to estimate body drift from submergence to bottom. If a body sinks in water with little or no current, it will settle on the bottom within an imaginary circle of the radius of which is equal to the depth, see **Figure 11.13**.

Figure 11.13. Currents Effects on Bodies.



11.19.2.2. Grids. The first step in narrowing a search area is to eliminate areas of impossibility or lesser likelihood. On a large-scale map, divide the body of water into a grid. Based on information collected, observed currents designate areas upstream of the submergence point and those that are too far or too near. Once the team has outlined the overall search zone on the map, place outer perimeter buoys in the water according to the grid. Place the buoys 50 to 75 feet apart to designate the box. Divers will search in patterns within this boundary using these buoys as guidelines. When divers complete the search in that area, additional buoys are dropped within the box to section off each area. Emplacing the buoys after the search is conducted prevents divers from becoming snagged during the search.

11.19.3. **Tether Length Factors.** When conducting tethered diver searches, the primary diver should make every effort to work toward shore during the conduct of the search. The primary diver is sent out along the surface until reaching the descent point. The dive supervisor needs to consider the arc involved with diving tether lines. The deeper the water, the farther the primary diver needs to travel before descent. E.g., a primary diver who is tasked to begin the search 50 feet out and 20 feet deep will require 54 feet of line. If distances greater than 150 feet from shore are required, the dive supervisor should switch to a boat-based operation, see **Table 11.5** **NOTE:** It is important for tenders to remain pivoted in place when conducting tending duties to allow for tethered length distance accuracy and search pattern boundaries.

Table 11.5. Tether Length Tables.

Depth in Feet	**Surface Distance in Feet**														
	10	**20**	**30**	**40**	**50**	**60**	**70**	**80**	**90**	**100**	**110**	**120**	**130**	**140**	**150**
10	14	22	32	41	51	61	71	81	91	100	111	121	131	141	
20	22	28	36	45	54	63	73	82	92	102	112	122	132	142	
30	32	36	42	50	58	67	76	85	95	104	114	124	133	143	
40	41	45	50	57	64	72	81	89	98	108	117	127	136	146	
50	51	54	58	64	71	78	86	94	103	112	121	130	139		
60	61	63	67	72	78	85	92	100	108	117	125	134	143		
70	71	73	76	81	86	92	99	106	114	122	130	140	143		
80	81	82	85	89	94	100	106	113	120	123	136	144			
NOTE: If the tender is standing on a platform, then the height of the platform needs to be added to the depth.															

11.19.4. **Descent.** Divers should descend feet first to protect their head from hidden obstacles, prevent sinus squeeze, and facilitate the Valsalva maneuver.

11.19.5. **Bottom Search.** The tethered diver positions his body at a 45-degree angle to the tether, with head away from the tender. This position enables a taut line and provides ease to the tether for signal response. Search periods should be limited to a 20-minute bottom time (extendable to 30) because of the mental fatigue and hypothermia.

11.19.5.1. No-Visibility Search. This type of search can lead to fixation of the diver attempting to see anything. This may result in diver missing or misidentifying the object of the search. Divers should close their eyes and concentrate on feel (Divers should feel and touch an object identical to the one they will be searching for to familiarize themselves with the sensations of the object.) A diver searching in no-visibility conditions must use the entire body to conduct a search, visualizing what is felt with the fingertips, arms, torso, legs, and swim fins. The diver’s hands should not grope randomly. Divers should have their own individual search pattern to be used for the dive. Divers start with their hands in front of them palms down, sweep them out to each side and bring them together again. They then move them forward an appropriate distance for the size of the object being looked for and repeat the sweep. This technique ensures every area in the pattern is searched.

11.19.5.2. Clearwater Search. In clear water, the primary diver should not crawl along the bottom but use buoyancy skills to swim over, observing the bottom, scanning visually side-to-side, and looking for the search objective.

11.19.5.3. Sunken Structure Search. If divers are searching a large sunken vessel or structure, they should begin searching at the lowest point and begin working their way up. This allows divers to off-gas as they search and dedicate more bottom time with their residual nitrogen time for follow on dives.

11.19.5.4. Obstacles. If a diver encounters a large obstacle in the search path (e.g., car, submerged trees, or rocks), the diver must go up and over the object while paying attention not to get entangled with lines. The area should then be divided so the diver can search all areas of the object. If line entanglements is a risk, the team may want to consider a boat-based operation, allowing an increase in the angle of the tending line.

11.19.6. **Discovery.** When the objective of the search is found, the diver confirms they have found the target before giving the "FOUND OBJECT" line signal or employing a small marker buoy if conducting the search untethered. If the object of the search is a victim, the tender will discreetly notify the dive supervisor of the find. This gives the TL the opportunity to remove family members, spectators, and the media from the general area. Once the incident site is secure, the tender gives the "ASCEND SLOWLY" signal to the diver, giving clearance to surface with the victim. If the diver needs assistance, the diver signals "OKAY, BUT I NEED HELP FROM THE STANDBY DIVER" after the "FOUND OBJECT" signal is acknowledged. If the object is a piece of evidence and needs to be documented, it should be marked with a buoy, noted on the profile map, and left in place. For body recoveries, the victim will be bagged underwater and brought to surface utilizing lift bags. **WARNING:** When using lift bags to raise an object, divers will maintain positive control of the dump valve on the bag to prevent an uncontrolled ascent. At no time will a diver connect to the object or lift bag nor make any attempt to aid it by swimming it to the surface. If the lift bag has an uncontrolled ascent, the divers will move away free and clear, and make no attempt to stop it.

11.19.7. **Re-searches.** Divers should signal tenders to make note of objects on the bottom, such as weeds, trees, vehicles, debris, or anything else that may mandate searching the area again. If the diver is not maintaining an adequate search pattern, the diver should be recalled and re-accomplish the search in its entirety. Divers can expand the area of operations within the first approach and move in increments of 20 feet farther than the initial search; this is dependent on the diver's level of confidence that expanding the area will not reduce the effectiveness of the search pattern. An area should be researched if any of the following conditions apply.

11.19.7.1. A diver shows frequent slack in the tether line.

11.19.7.2. A diver's breathing rate was too high, indicating the diver may have been distracted or stressed, and therefore not focused on the search.

11.19.7.3. Divers missed test items that were placed in the search area. These items should be of equal or lesser size than the search object, thus indicating whether the divers are searching thoroughly.

11.19.7.4. The angle of the tether line shows a diver has come off the bottom during a low- or no-visibility search.

11.19.7.5. A diver has covered too many linear feet. If moving too quickly, the diver may not only be searching too fast but may have also totally missed an area along the way.

11.19.7.6. A tender is unable to follow correct tending procedures, allowing the diver to take out line, bringing the diver in too quickly, or not using the correct turn-around points.

11.19.8. **Rule of Thirds.** In limited to no visibility, divers use the “rule of thirds,” meaning they are halfway through their dive when their tank reaches two-thirds of their starting pressure. Using this technique gives the diver a reserve of air in the event the diver becomes entangled when attempting to surface or finding the object on the last search sector.

11.19.9. **Ascent.** Tethered divers should ascend prior to being pulled in by their tenders, this allows the diver to control the ascent. If the diver needs to be pulled by the tender at depth, the tender should not pull faster than 1-foot every 2 seconds. The diver should hold the BC power inflator in the left hand, hold it straight out, and place a finger or thumb over the dump button, not the inflator button. The diver’s buoyancy should be neutral or slightly negative and the diver should slightly kick toward the surface. During the ascent, the diver raises a hand overhead to protect against any obstacles. The diver should occasionally feel the angle of the tether line as the change in angle will give some idea of the ascent rate. The diver will vent air from the BC and dry suit as required to prevent a buoyant ascent.

11.19.10. **Search Patterns.** Search patterns can be conducted from shore with a tethered diver, a dive pair, tow sleds, or with the use of compasses. The simplest search method is the most effective. An effective search pattern must have the following attributes:

11.19.10.1. Starts at a known point, covers a known area, and ends at a known point.

11.19.10.2. Ensure clear communication between the diver and surface through line-pull signals or underwater communications for direction and assistance.

11.19.10.3. Is adaptable to various environments.

11.19.10.4. Should not require sophisticated, heavy, or expensive equipment.

11.19.10.5. Provides the ability to mark the location of located objects.

11.19.10.6. Can be adapted to finding objects of various sizes.

11.19.10.7. Is simple enough that the dynamics of the pattern can be explained to the least-experienced team member.

11.19.10.8. Does not require great amounts of manpower.

11.19.10.9. Can be conducted from shore or vessel.

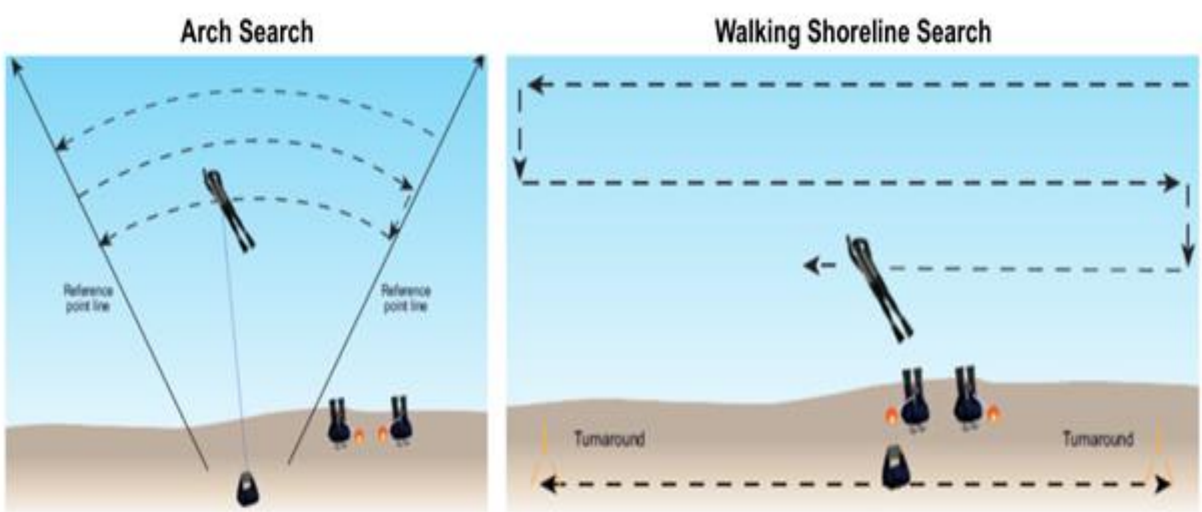
11.19.11. **Shore-Based Patterns.** The most practical arrangement of search patterns involves a relationship between the tender and a single tethered diver. The following searches are shore based and simple to execute.

11.19.11.1. Arc Search. The most frequently used patterns is the arc search. The tender remains in one spot as the diver sweeps back and forth at the end of a taut tether, gradually toward the shore. At the end of each pass, the tether pulls in an appropriate amount of line, from 2 to 5 feet, depending on the parameters of the search. To ensure the diver stays within the boundaries of the search area, the tender should pick a landmark on each side of the pattern. Arc searches allow for a rapid search of the bottom and works well in various environments. This technique can be challenging in areas with copious amounts of weeds due and obstacles and the probability of lines getting snagged. See **Figure 11.14** for examples of shore-based search patterns.

11.19.11.2. Windshield Wiper Search. For a fast search of a wide area, two arc searches can be combined to create a Windshield Wiper pattern. This method enables two primary divers that conduct searches in overlapping areas by moving back and forth in unison. Tenders should position themselves in exact distance of their primary divers. E.g., if the diver employs 50 feet out, they should stand 50 feet apart. A steep bottom or other restrictions might narrow the search arcs and cause the tenders to close their distance. Keeping the primary divers at the same search pace is the responsibility of the tenders. If one diver is ahead of the other, the signal can be sent from the tender to diver for him to stop until the other diver catches up. It is recommended when diving multiple primary divers, each have their own standby diver. In the event of an emergency, the other divers are stopped and slowly brought to shore as required.

11.19.11.3. Walking Shoreline Search. This search requires a long, straight shore, dock, pier, or other area for tenders to walk along. This is one of the most efficient and thorough patterns and enables a simple rectangular pattern that is easy to follow and profile. The tender moves along with the primary diver, creating parallel and straight-line passes along the bottom. When executed properly, the tender paces the diver as closely as possible, ensuring the diver always remains perpendicular to the shore. See **Figure 11.14** for examples of shore-based search patterns.

Figure 11.14. Shore Based Search Patterns.



11.19.11.4. Double Walking Shoreline Search. Shoreline searches can be set up with two divers who search at a distance from each other. It is recommended one diver work twice as far out as the near-shore diver to prevent their lines from tangling. The tenders walk separate, parallel paths and one ducks under the other's line as they pass. The divers do not need to work in unison.

11.19.11.5. Snag Method. When in clear water and searching for large objects in large areas (i.e., vehicle), the snag method may be used. This allows a substantial distance to be covered with each pass. When the object is snagged by the line, the diver simply swims to it and marks it with a buoy.

11.19.11.6. Frame Search. This method is utilized when searching for small objects. Construct a square frame of plastic to use as a small template for a concentrated search. Ensure it is weighted so it remains on the bottom. The primary diver places the frame down at the beginning of the first sweep then searches within its confines, under the frame and within a hand's width around the outer edge. If the search needs to be meticulous, use a sieve in combination with the frame. When the primary diver is finished with that area, the primary diver lifts up the closest side, leaving the opposite side on the bottom; flip the frame over so it covers a new area adjacent to the area just finished searching. At the end of a sweep, flip the frame laterally. This search works best in conjunction with a shoreline-walk pattern as they both cover a rectangular area. When the primary diver's bottom time has been reached and the search passed to another diver, the primary diver leaves the frame in place on the bottom. Both divers are tethered to make it easy for replacement divers to relieve divers and resume the search.

11.19.11.7. Free Search. This search is not recommended for low-visibility water due to search deficiencies and diver contingencies. These searches are effective in a restricted area choked by trees and debris where the diver would be hindered by having a tether and in fast water. In fast currents, the divers should wear witness floats to mark their location.

11.19.11.8. Walking Search. When searching clear and shallow, the team may opt to conduct a walking search in lieu of scuba operations. The team walks in search patterns in an attempt to stumble over the search objective. This method is not suitable when searching for small items but is effective when searching for body-sized objects.

11.19.12. **Boat-Based Patterns.** Searching an area on the bottom from a small boat requires precise positioning and movement allowing the team to cover areas that overlap. If the boat moves even a few feet, there will be a gap in the search pattern. In minimal wind and current conditions, a boat can still move. If a boat is moored by one anchor line, it will swing by the movement of the diver. If the boat swings back and forth, the anchor will pivot resulting in the boat possibly drifting.

11.19.12.1. Hurricane Anchoring System. This 3 point technique uses two anchors secured to the bow and one on the side of the stern. This type of anchoring system prevents the boat from moving during currents or wind. See **Figure 11.15** for an example of the Hurricane Anchoring System. To configure hurricane anchors, perform the following:

11.19.12.1.1. Maneuver the boat past the first point where searching is to begin and deploy a buoy at that point. The buoy only marks the position where the boat will be. It will be recovered once the boat has been properly anchored.

11.19.12.1.2. Position the boat so the wind or the current, whichever is stronger, is at a 45-degree angle to the bow and re-approaching the buoy from the downwind or down current side.

11.19.12.1.3. Before passing the buoy, drop the stern anchor, placing it on the same side of the boat as the buoy.

11.19.12.1.4. To avoid tangling the lines, anchors must be slowly lowered and not dropped.

11.19.12.1.5. Continue moving past the buoy, paying out stern anchor line as the boat goes.

11.19.12.1.6. Once past the buoy, lower a bow anchor on the same side as the stern anchor so it is directly into the wind or current.

11.19.12.1.7. Move the boat laterally away from the stern anchor to deploy the second bow anchor.

11.19.12.1.8. Taking in and paying out line as necessary, set the boat at the focus of these anchors.

11.19.12.1.9. There should be an anchor 45 to 90 degrees off both sides of the bow and one off the stern.

11.19.12.1.10. The engine should not be turned off until the boat is anchored securely.

11.19.12.1.11. To ensure an anchor is secure, the anchor line played out should be seven times the depth of the water.

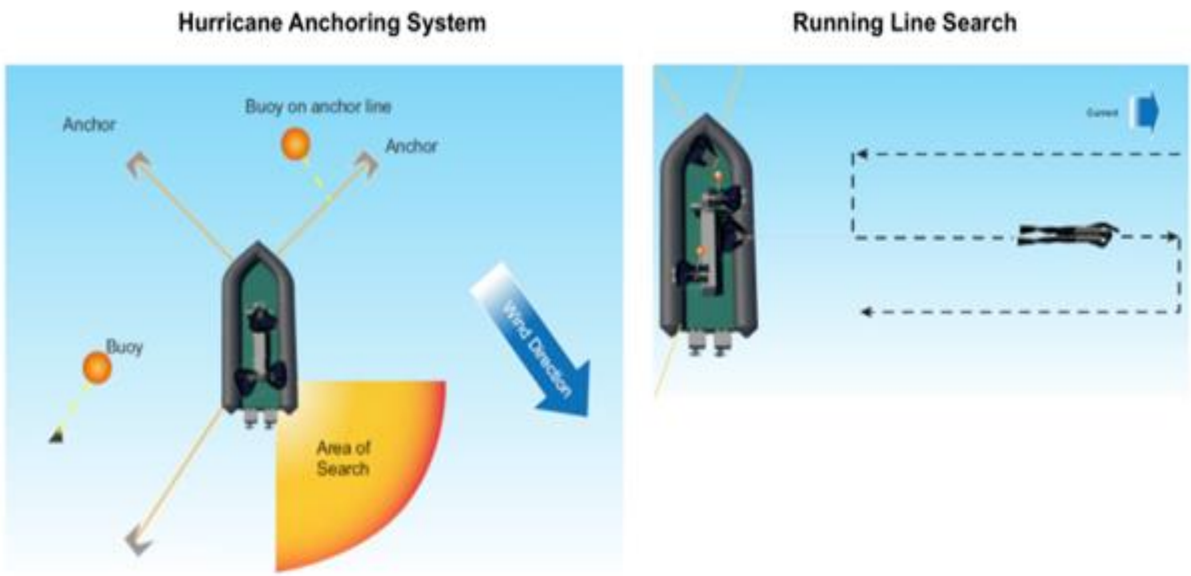
11.19.12.1.12. When the team has completed their area search, change position by hauling in and giving out line as necessary.

11.19.12.1.13. When the team has exhausted the search range of these buoys, another boat should deploy a fourth anchor and bring the end of the line.

11.19.12.1.14. This anchor will replace one of the original three.

11.19.12.1.15. The remaining anchors are reset, and the team continues the process of taking in and giving out line to move around the new, adjoining search area.

Figure 11.15. Hurricane Anchoring and Running Line Search.



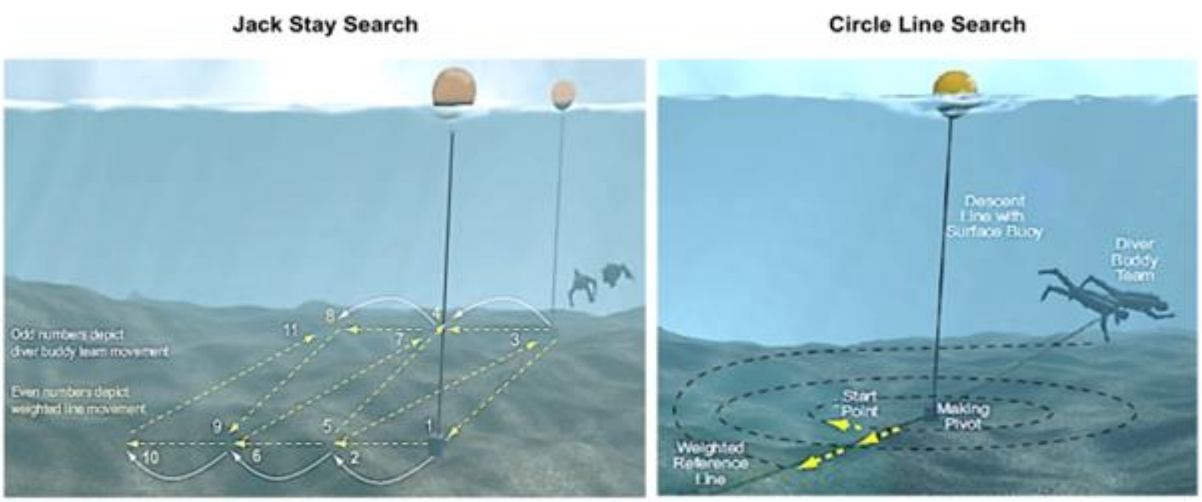
11.19.12.2. Running Line Search. This tethered search is useful in areas of heavy grass, debris, or strong currents. The diver searches straight out from shore or from a boat to the extent of the determined search area. If the water is moving, the diver deploys with the current. Once the diver reaches the end of the first sweep, the diver surfaces and moves with the tender 2 to 5 feet to one side, depending on the parameters of the search. The diver then searches toward the tender and the process repeats itself. This technique affords a reasonable degree of control while reducing line snags, see **Figure 11.15** for an example of the Running Line Search.

11.19.12.3. Direct Overhead Search. This tethered search is used in areas of heavy weeds or debris. The diver descends straight below the tender, who is on a platform, and searches the immediate area. The diver is then raised above the weeds and lowered again 1 or 2 feet to one side. Tenders should ensure they do not pull the divers up too quickly. The repetitive up and down motion greatly increases the risk of barotraumas and pulmonary overexpansion injuries.

11.19.12.4. Jack Stay Search. This search is used flat bottoms and when searching for small items. This technique can be accomplished with a single tethered diver, or with two divers and no tether. Configure one running line on the bottom weighted with 15 to 25 pounds at each end and no more than 125 feet in length. A vertical line to the surface, carrying a float of at least 10 pounds buoyancy is attached at each weight. The diver or dive pair descends to one end of the weighted running line. On reaching the other end, after searching in detail along its length, the diver moves the weight 2.5 to 3 feet, or as visibility and the size of the object in question dictate. When operating in a current, the line should be moved upstream. This allows silt to pass and not settle on the search area. See the Jack Stay Search in **Figure 11.16**.

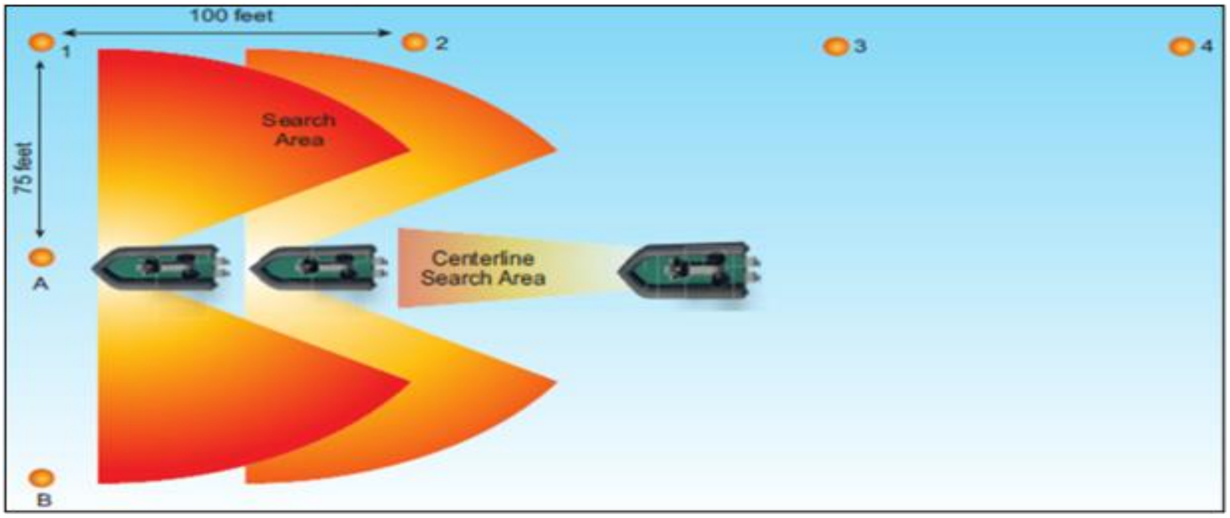
11.19.12.5. Circle Search. The primary diver following this technique executes a circular pattern over the bottom while tethered to a central point. A second diver can sit at the hub to let out line as required, or the tether can be rigged through a weighted swivel, with the line run up to a tender aboard a boat. Another method is to use a MacKin pivot, which is a weighted unit with a free-moving spool, allowing a diver to make unimpeded circles around it. In this case, the diver lets out his own tether line from a spool attached to his harness. Whenever a MacKin pivot is used, it should have a buoy line to the surface, indicating the center of the search pattern and also to act as a signal line. If a diver is controlling their own search, a marker must be placed on the bottom so that each time around, it will be apparent to the diver when to extend the search. If there is no tether line back to the surface, an additional diver needs to be in the water. The buddy should remain at the hub to monitor and send line signals. Circle searches have their disadvantages to include entanglement risk and not being tender directed. Conducting multiple searches using this pattern may leave large areas unsearched unless the circles are well overlapped. See **Figure 11.16** for dive search patterns.

Figure 11.16. Dive Search Patterns.



11.19.13. **Large-Area Searches.** A large area is searched by dividing the area into blocks. Each block should be a football-field-sized rectangle 300 feet long and 150 feet wide and marked with buoys. On the long side of the block, place four buoys 100 feet apart, numbered 1 through 4. Along the shorter side, where the team will start, place two buoys 75 feet apart and designate these as A and B. Start the boat at the buoyed end of the grid, along the centering. If adequate personnel are available, divers can work on both sides of the boat simultaneously. Deploy the divers just beyond the edges of the block; ensuring overlap with the adjoining block and have them work inward toward the boat. Once the divers have covered these sections, move the boat 25 to 35 feet farther down the centerline of the block and have them repeat the procedure until the boat is even with buoy 2. A diver should then deploy to search the area underneath the boat from previous search patterns. The tender should work the diver from the bow, sweeping the diver in a narrow path along the centerline from buoy A to the boat's present position. Repeat this procedure until the entire block has been covered. See **Figure 11.17** for an example.

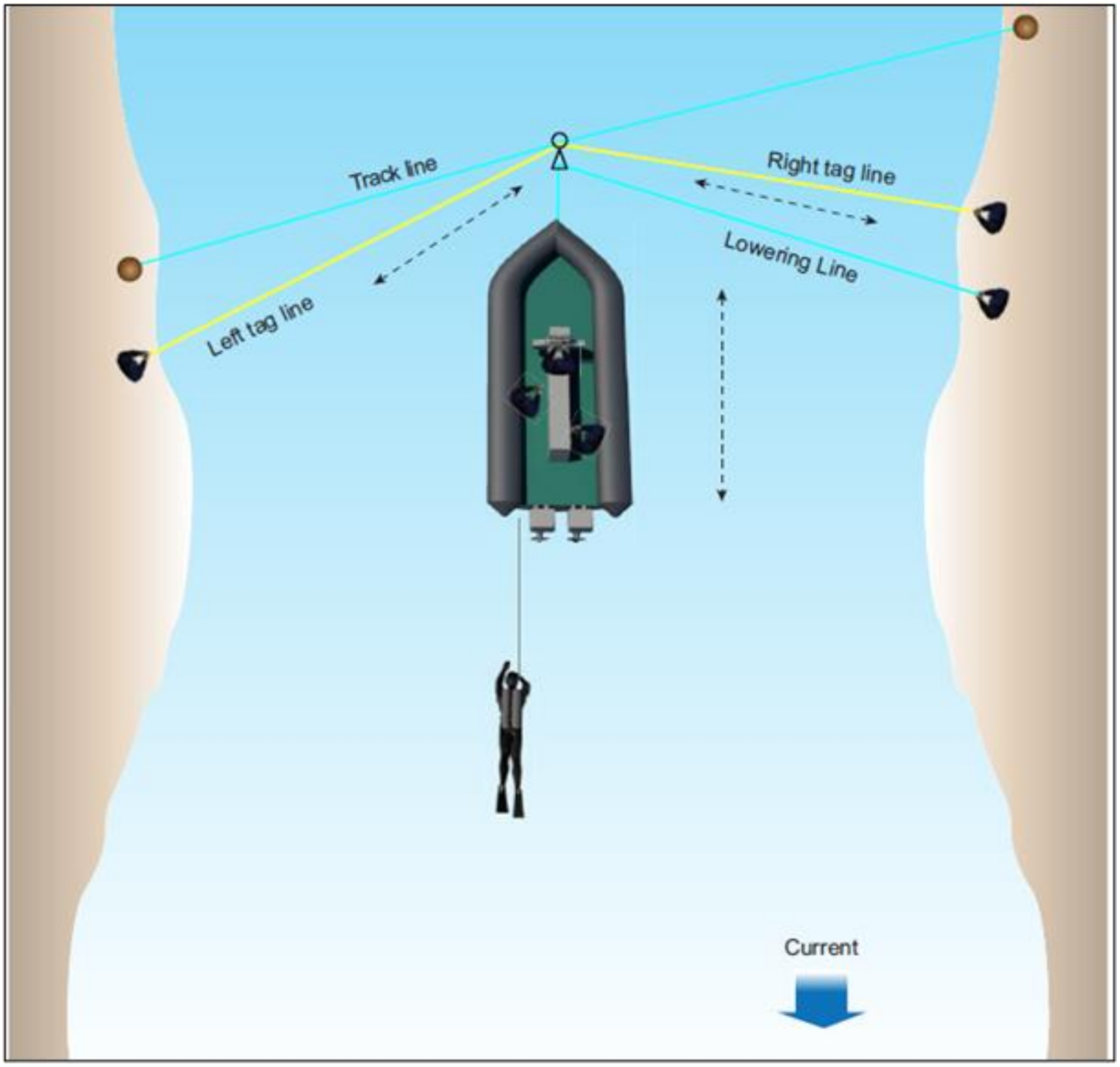
Figure 11.17. Large-Area Search.



11.19.14. **Moving Water Searches.** As the speed of water increases, the problems and complexities of the search also increase. A current greater than 1.5 knots could pin a diver against an obstacle and make an entanglement more difficult to manage. A 2.5-knot current can easily tear a diver's mask off and depress the purge button on the regulator second stage. Moving water will also affect tenders since they may be unable to fight the drag of any current greater than 1.5 knots. A tender may not be able to bring a diver back toward the platform or may even be pulled overboard. TLs need to be aware of these problems and make an intelligent risk management decision if the current is too fast to warrant a dive. In rivers and canals, downstream safety control measures will need to be in place before divers are committed to the water. Victims can get hung up on submerged stumps, roots, branches, lines, rock crevices, and weeds. The team may choose to dive some of the more obvious features before conducting a bottom search.

11.19.14.1. Static Line Platform Search. Team members construct a Telfer Lower in which a line is anchored from one shore to the other and rigged so the platform can be maneuvered upstream, downstream, left, and right of the search area. If only one shore is accessible or if the distance between shores is more than 200 feet, anchor the platform with the hurricane anchoring system. Once the platform has been established, the divers let out enough tether line so they will not be pulled up from the bottom by the current. Generally, the shallower the water, the farther out the diver must be to avoid being ripped off the bottom. Divers will have to add 4 to 5 pounds of weight to their weight belts to help them stay submerged in a strong current. Once they are on the bottom and have searched the immediate area, the tender signals the diver and the entire platform is pulled right or left. The diver searches the immediate area again. Once the span of the search area has been covered, the platform is lowered 2 to 3 feet downstream, and the process repeated. Advantages of this system are the diver is always at a fixed distance from the platform and does not have to fight the current. A problem with this technique is the bottom must be free of debris since the shallow angle of the tether line will increase the chance for entanglement. If the standby diver is deployed down the tether, the standby may be pushed into the primary diver. See **Figure 11.18** for an example of a static line platform search.

Figure 11.18. Static Line Platform Search.



11.19.14.2. Straight-Line Pattern. This pattern is used to search small inlets or channels where the distance covered is commensurate with the length of the search line. For effective use of this pattern, there can be no noticeable current or the line must be laid to run the same direction as the current. There are two methods for this the pattern: 1) Attach an anchor point on either shore, keeping the line taut. Using one diver one arch side of the line, they search the width of the channel. Move the shoreline points down the number of feet commensurate with the visibility and repeat the process. 2) Attach the search line at the shore on one end and the other end at the bottom, allowing it to run with the current if necessary, and work the pattern as above. To keep the pattern intact, small weights are sometimes necessary to be placed along the search line. This is especially true when working on an irregular bottom.

11.19.15. **Surf Considerations.** One of the most physically strenuous environments in which a recovery team may have to conduct underwater search, rescue, and recovery operations is when the victim or object to be recovered is in the surf zone.

11.19.15.1. Scuba Equipment Surf Considerations. In general, equipment for a surf zone dive should be modified to allow for minimal amount of gear while maintaining appropriate safety. The diver should be slightly negative buoyant so he can get under the waves and have more stability in the strong bottom surge.

11.19.15.2. Surf Diving Techniques. The diver must be knowledgeable with surf technique and water conditions by using those conditions to advantage for exit and entry. Observe surf conditions for at least 10 to 15 minutes prior to attempting an entry. The diver should watch for the set waves, noting the number of waves in the set and the period between sets. The diver must observe the development of rip currents. Rip currents are continuous and develop following the set waves. Note their relation to shore markers as the diver will be observing the shore from outside the surf line. If the diver intends on entering and exiting through the surf, the dive should begin in the least neutral negative. The diver should enter and exit with a snorkel with head above water to observe the waves approaching.

11.19.15.3. Searching in the Surf Zone. In some cases, there may be a need to conduct searches directly in the surf zone which can pose difficulty to divers. An effective search technique is to follow the currents as one would expect the victim's body to be moved. Rip currents will lead to easy entries on scuba past the surf line. Return can be made on the bottom by compass heading. Each diver must have an individual compass since as buddy separation can occur. Any return on the bottom should be delayed until the last set wave has passed the divers. After last wave passes, divers should immediately descend and begin on their compass heading. These searches are not thorough and require multiple passes for any chance of success. **CAUTION:** TLs and safety personnel should be cautious of diver exertion and fatigue in the surf zone.

11.19.15.4. Recovering Victims in the Surf. Secure a line and floatation to a victim found in large surf, moving to shallow water or past the drop zone— whichever is closer—and as quickly as possible. In large surf, a diver may lose grip of a victim when the wave impact. Whenever feasible, victims should be removed from the water by boat outside the surf line to avoid additional trauma to the body and to ensure privacy.

11.19.16. **Night Operations.** Whenever possible, underwater search and recovery operations should be conducted during daylight.

11.19.16.1. Night Search Hazards. Conducting operations during darkness carries the potential of hazards not normally encountered during daylight:

11.19.16.1.1. Increased confusion.

11.19.16.1.2. Monitoring the progress of untethered divers.

11.19.16.1.3. Potential for equipment loss.

11.19.16.1.4. Difficulty in controlling surface boat traffic.

11.19.16.1.5. Increased psychological stress.

11.19.16.1.6. Possibility of missing the search object because of the lack of available light.

11.19.16.2. Night Equipment Considerations. Night diving operations require additional equipment for both divers and support personnel.

11.19.16.2.1. Each diver should have a primary and backup light with sufficient intensity and battery life for the duration of the underwater search.

11.19.16.2.2. Adequate chemlights to mark divers, underwater equipment, search area, surface buoys, and underwater objects.

11.19.16.2.3. A buddy line is strongly recommended between buddy pairs.

11.19.16.2.4. If the tactical situation permits, topside illumination for dive support team members and diver entry and exit points.

11.20. Diver Contingencies. During tethered diver operations, the designated standby diver should be prepared to deal with emergencies involving the primary diver.

11.20.1. **Entangled Diver.** Divers usually find themselves entangled by their tank valves, fin buckles, or hoses and gauges. Most divers will snag themselves and continue to swim not realizing they are entangled. When divers realize they are entangled they often react with impatience resulting in further entanglement.

11.20.2. **Self-Rescue in Entanglements.**

11.20.2.1. Divers who realize they are entangled should stop, keep themselves in control, and consider their options before acting.

11.20.2.2. In no-visibility situations, the diver should conduct a thorough head-to-fin assessment of the predicament and use personal cutting tools to get free from the situation.

11.20.2.3. If unable to get free, the standby diver should be signaled using underwater communications or line-pull signals.

11.20.3. **Standby Diver Assistance to Entangled Diver.**

11.20.3.1. The standby diver will descend and use underwater contingency signals to determine the entangled diver’s problem.

11.20.3.2. In no-visibility conditions when the primary diver is unaware of where the entanglement is, the standby diver conducts a head-to-fin assessment and uses cutting tools to free the primary diver.

11.20.4. **Entangled Tending Line.**

11.20.4.1. If the primary diver’s line is entangled, the standby diver will descend, clear the line, and free the diver.

11.20.4.2. In the event the tending line is too entangled to clear, the standby diver will clip into the diver’s harness with a contingency strap, cut the tender line, and take the diver to the surface.

11.20.5. **Unconscious Diver.** An unconscious/unresponsive diver underwater immediately needs to be brought to the surface.

11.20.5.1. The diver checks the unconscious diver for responsiveness.

11.20.5.2. The diver checks the unconscious diver's mask.

11.20.5.3. If the mask is full of water, the diver removes it.

11.20.5.4. If the mask is not full of water, the diver will leave it on.

11.20.5.5. The diver will check the diver's regulator mouthpiece and if out, the diver attempts to reinsert the regulator IAW U.S. Navy dive manual paragraph 6-10.9..

11.20.5.6. If the diver's regulator mouthpiece is in, the diver holds it in during ascent.

11.20.5.7. The diver taps the BC low-pressure inflator to determine if there is air left in the unconscious diver's tank.

11.20.5.8. If air is present in the tank, it may be used to inflate the unconscious diver's BC to aid in bringing the diver to the surface.

11.20.5.9. It will be necessary to release the expanding air from the unconscious diver's BC while ascending.

11.20.5.10. The diver should be prepared to control it throughout the ascent.

11.20.5.11. Once the diver has positive control of the injured diver, the diver drops the unconscious diver's weight belt or other integrated ballast.

11.20.5.12. The diver is not concerned with ankle weights.

11.20.5.13. The diver raises the unconscious diver to the surface as quickly as possible without risking decompression sickness.

11.20.5.14. The diver should place pressure beneath the injured diver's diaphragm on ascent to help release any air in the lungs as it expands.

11.20.5.15. Once on the surface, the diver removes the patients' regulator and signals for help.

11.21. Submerged Vehicle. A rapid scene evaluation must be made to direct the divers to a good last-seen point. In addition to information from eyewitnesses, the team should look for tire tracks and possible debris from the wreckage on shore leading to the water. Damage to natural and man-made structures, such as trees, guardrails, and skid marks, are often helpful clues to a vehicle's location. Air bubbles shortly after the accident or a gas or oil slick on the surface often are good markings of a vehicle's location. An evaluation of the accident scene and vehicle condition can be an indication of the driver's condition. If the vehicle is submerged in a ditch or canal, the initial search may be done by surface personnel probing with pike poles. Recommend positioning personnel downstream to watch for floating victims, debris, or other evidence of the vehicle.

11.21.1. **Submerged Vehicle Hazards.**

11.21.1.1. Most vehicles will float momentarily prior to sinking. A vehicle floating and then sinking into water deeper than the vehicle's length will often flip upside down.

11.21.1.2. Badly damaged vehicles present a hazard to divers in the form of jagged and sharp edges. This is a particular hazard in water where a current is present, and the diver is against the vehicle. Always approach a submerged vehicle on the downstream side. The current will eddy on the downstream side and dig a hole in a soft bottom the vehicle may eventually fall into.

11.21.1.3. Large vehicles will seem very cramped for the diver and the roof and portals limit access to the surface and access to a responding standby diver. Vehicles should be moved but never to where it limits the ability for the tether to be snagged. Divers should start low and work their way up when searching a vehicle underwater. Be aware of items such as a bottle and spare tires that can be dangerous underwater as they are jarred loose and float toward the surface.

11.21.1.4. Contamination from petroleum products is another hazard from submerged vehicles. On contact with the skin, it may cause burning and irritation. Petroleum products will float to the surface and divers can avoid this slick by using dish washing liquid to disperse the slick momentarily enough for the diver to enter the water.

11.21.2. **Equipment Considerations.** When dealing with a vehicle underwater, bungee cords are necessary items. Any opened entrance should be immediately secured with a bungee cord. Wedges can also be carried by the divers and placed in the door hinges in the event the bungee cords are unavailable. If wedges are used, divers need to ensure the door is fully opened to prevent it from falling out. A window punch can be used to shatter automobile glass, but the diver may have to loosen the spring about a half turn to improve the operation of the tool underwater. When using lift bags, divers should use underwater communications which allow the divers to communicate freely.

11.21.2.1. Extrication Tools. Use of hydraulic extrication tools underwater can pose many hazards. Extrication tools are not recommended for Pararescue underwater operations without prior and detailed rehearsal.

11.21.3. **Extrication of Victims.** Cut the seat belt to ensure it is clear. Divers must search the entire vehicle, including the rear deck and under the dashboard when searching for victims.

11.22. Capsized Vessel. A vessel is capsized when it is knocked over, so it lies on its side in the water or turned over. This is a frequent occurrence among small sailboats that are sensitive to sudden changes in winds. Most small boats will remain in that position, unless able to be righted, and may float for prolonged periods to support any crewmembers. Survivors may be trapped inside the capsized hull, requiring a search and eventual rescue. Sea state may present a hazard as the vessel rises, falls, or crashes with large swells and waves. Sails, deck lines, fuel, and masts may present entanglement hazards. Divers should not enter underneath the vessel without a protective helmet, harness, and EGS. In limited-visibility water, two divers should be employed, one as an underwater tender on the edge of the vessel tending the diver conducting the search and to aid any survivors to the surface. **WARNING:** Divers should never approach underneath a vessel from the downwind or down current side. If the vessel loses buoyancy and a diver is downstream, he may be trapped by the sinking vessel.

11.23. Body Recovery. Divers may have to testify about the condition of a recovery victim in the event an investigation is launched. Whenever possible, the body should be bagged underwater. Body bags designed especially for this purpose are available with screen mesh panels for water drainage. Conventional body bags are not practical for this purpose and should not be used.

Figure 11.19. Body Recovery System and Open Bottom Lift Bags.

11.24. Lift Bags. Lift bags are used when buoyancy is required to lift an object to the surface. Lift bags are attached to the object then inflated underwater by a stand-alone scuba tank with an inflation yoke or by a search diver with their back up regulator. Open bottom lift bags are the most common bags used by recovery teams due to their ease of use and portability. These bags usually range in lift capacity from 25 to 500 pounds and may be equipped with a dump valve. See **Figure 11.19** for an example of open bottom lift bags.

11.24.1. Dangers of Lift Bag Operations. Due to the effects of Boyles Law, the gas within a lift bag inflated at depth will expand as it ascends leading to the possibility of an out-of-control ascent possibly endangering divers in the water.

11.24.1.1. Out-of-Control Ascent. A diver should actuate the dump valve as required during the lift to prevent uncontrolled ascents.

11.24.1.2. Too-Large Lift Capacity. Overfilling a lift device can result in an out-of-control lift bag ascent that could break the surface, rise completely out of the water, dump air, and cause the object to rapidly descend and strike or trap a diver. **WARNING:** When using lift bags to raise an object, divers will maintain positive control of the dump valve on the bag to prevent an uncontrolled ascent. At no time will a diver connect to the object or lift bag nor make any attempt to aid it by swimming it to the surface. If the lift bag has an uncontrolled ascent, the divers will move away free and clear, and make no attempt to stop it.

11.25. Submerged Aircraft. The primary objectives when responding to a water-related aircraft incident is to locate the wreckage and recover the victims.

11.25.1. Locating Submerged Aircraft. Immediately after the aircraft submerges a large quantity of fuel will rise to the surface above the wreckage. These slicks are difficult to locate and observe from the shore but easily identified from the air. Depending on the degree of structural damage to the aircraft, fuel may escape for up to 2 days. In the event the fuel slick is circular, it should be marked in the center with a large surface buoy and heavy anchoring weight. If water currents are present, the marker should be set at the prominent upstream point of the surface slick. A boat-based snag-line search with a weighted line towed between two small CRRC can provide a simple method for searching large areas. This method is only practical in bodies of water where the bottom is free of other snag hazards (e.g., logs, stumps, kelp, or rocks).

11.25.2. **Submerged Aircraft Hazards.** Before any operation is executed, team members should evaluate the type of aircraft and cargo. The cargo description will have a direct impact on precautions the recovery team will take.

11.25.2.1. Control Cables. Small cables constructed of relatively thin stainless steel wire may be exposed between pieces of wreckage and present an entanglement hazard. Further complications may arise when lift bags are used to raise large main sections of the wreckage which may be connected by these cables.

11.25.2.2. Tires. Large commercial aircraft employ high-pressure pneumatic tires which if ruptured could easily injure or kill a diver nearby.

11.25.2.3. Hydraulic Lines and Systems. On larger aircraft, hydraulic lines and systems pose hazards to divers as they contain high pressures and the potential of explosion along with hydraulic fluid.

11.25.2.4. Munitions and Ejection Seats. There are two major hazards when dealing with military aircraft—munitions and ejection seats. Divers removing a victim from an aircraft should be familiar with emergency egress locations and cockpit ejection handles of the aircraft.

11.26. Overhead Environments. An overhead environment is a dive in which a diver does not have a clear, unobstructed path to the surface. This situation may be present under ice, wrecks, large crashed aircraft, caves, pipelines, sewers, or even large vessels. In the event of an emergency, the diver will not be able to make a controlled or emergency ascent.

Chapter 12

SWIFTWATER RESCUE

12.1. General. Swiftwater is defined by any body of water that is moving, to include Class I through Class IV rapids, floods, and mudslides. This type of recovery is very dangerous, a team-dependent operation, and requires specific planning and advanced equipment. Due to the prolonged duration of swift-water rescue techniques, they are not commonly executed in a tactical environment. If conducted in a tactical environment, adequate security should be provided and under friendly control. Techniques and procedures can be found in Swiftwater Rescue Technical Unit 1TM Manual, Rescue 3 International, Inc.

12.2. Planning. Initial planning considerations should include a quick study of the water hydrology, basic river dynamics, and establishment of zones.

12.2.1. **Zones.** Establish zones for the safety of all personnel working in or around the rescue incident. Zones are used to define the areas for each level of personnel, for family, and for bystanders.

12.2.1.1. **Hot Zone** —defined as the water, entrance to this area is for feet-wet rescuers only.

12.2.1.2. **Warm Zone** —defined as within 10 feet of the water or inside a rescue craft (Zodiac); this zone is for feet-dry rescuers only.

12.2.1.3. **Cold Zone** —defined as any area outside the hot and warm zones; this is where all other non-rescuer bystanders must be located.

12.3. Tactical Considerations. Swiftwater techniques are usually executed as a reactionary response to a team or force who is inadvertently swept away in a swift-water environment. Rescue members must focus on safely attempting to recover the victim(s), while being vigilant to avoid becoming a casualty themselves. Remaining members must be alert to enemy activity to protect the recovery effort.

12.4. Hydrology and River Dynamics.

12.4.1. **Eddy.** A river feature that forms just downstream of an obstruction. An eddy can form on the side of a river or immediately after a boulder in a river. The water in an eddy is flowing in the opposite direction from the rest of the river and can at times be swirling and violent.

12.4.2. **Eddy Wall/Line.** The obvious line in the river where current moves in opposite directions at each side. This current differential between an eddy and the downstream current ranges from a gentle surface line to a wall of water dropping around the obstacle and recirculating horizontally.

12.4.3. **Hole, Stopper, Keeper (Hydraulic).** A swirling vortex of water where the river pours over an obstacle and drops toward the river bottom, leaving a pocket behind the obstacle into which an upstream recirculating surface current flow.

12.4.4. **Hydraulic Effect.** A change in currents that causes surface features that can deflect, slow, or speed up a raft's descent (e.g., holes, waves, and eddies). Haystack, Standing Wave. Rhythmic series of waves caused by the convergence of currents as the result of rising river water or underwater obstacles and ledges.

12.4.5. **Frowning Hole.** Also known as a keeper hole. A natural hydraulic whose outer edges curve upstream. A large hole or reversal that can keep and hold a boat or swimmer for a long period of time.

12.4.6. **Smiling Hole.** Also known as a friendly hole. A natural hydraulic whose outer edges curve downward. Much less retentive than a frowning hole.

12.4.7. **Downstream "V".** Hydraulic effect in the form of "V" pointing downstream caused by the convergence of downstream water flow into the channels of least resistance.

12.4.8. **Upstream "V".** Hydraulic effect in the form of "V" pointing upstream caused by the convergence of downstream water flow around an obstacle.

12.4.9. **Strainer.** An obstacle, such as a tree, that lets water flow freely through it but catches and entraps swimmers, rafts, and debris.

12.4.10. **Cushion, Stacked Water Cushion.** Buildup of downstream water in steep runs or large midstream obstacles at the area of greatest impact.

12.4.11. **Confluence.** A coming or flowing together, as of streams.

12.5. Shallow Water Crossing.

12.5.1. **General Principles for shallow water crossings:**

12.5.1.1. Factor in-depth, speed, and channel bottom.

12.5.1.2. Can be performed as a team using each other for stability.

12.5.1.3. Keep multiple points of contact with the bottom.

12.5.1.4. Move one point of contact at a time.

12.5.1.5. Swim if you fall. Do not put your feet back down until you have safely eddied out.

12.5.1.6. Always have throw bags or safety line downstream.

12.5.2. **Line Crossing.** Methods for line crossing include the following

12.5.2.1. Walking a rope across a bridge.

12.5.2.2. Throwing a line.

12.5.2.3. Line gun.

12.5.2.4. Boat.

12.5.2.5. Swimming.

12.5.2.6. Helicopter.

12.5.2.7. Slack for boat or swimmer methods

12.5.3. **Tensioned Diagonal.** See **Figure 12.1**.

12.5.3.1. 45degrees to the current.

12.5.3.2. To move rescuers across shallow water.

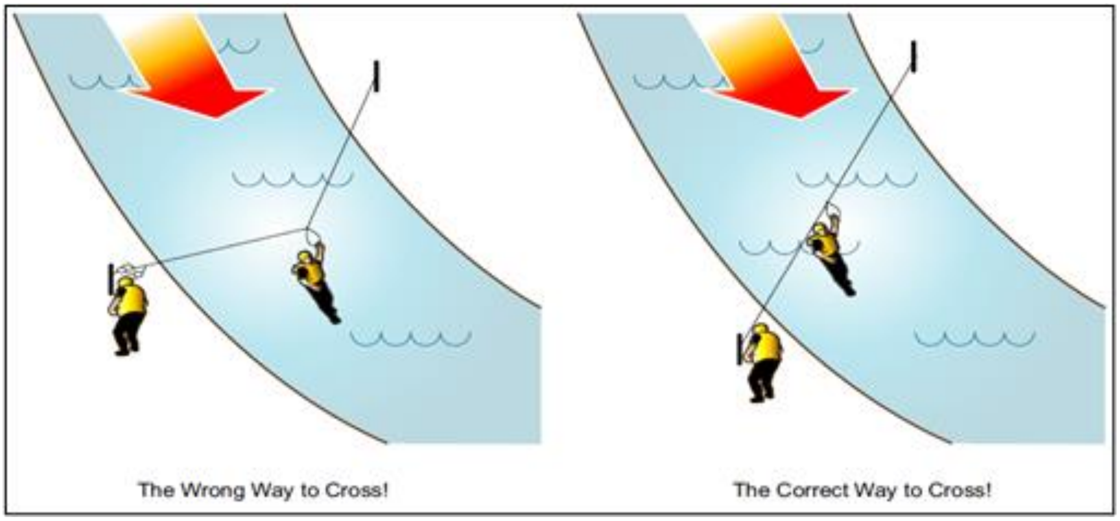
12.5.3.3. To rescue boaters trapped on midstream rocks.

12.5.3.4. As a downstream backup or safety line.

12.5.3.5. In water too deep to cross on foot.

12.5.3.6. Changing the angle to send back.

Figure 12.1. The Tensioned Diagonal.



12.6. Basic Rules of Swiftwater Rescue. The basic rules of Swiftwater Rescue are as follows.

12.6.1. Always wear an appropriately fitting personal flotation device (PFD). This includes anyone in the immediate vicinity of the water.

12.6.2. Always deploy spotters upstream of the rescue operation, ideally both sides of the river. Since rivers and major floods carry large amounts of debris, spotters with whistles or radios can warn personnel at the rescue site of the imminent arrival of dangerous objects.

12.6.3. Priorities at the scene are self-rescue first, rescue, and security of teammates second, and the victims last.

12.6.4. Always have backup COAs and be prepared to enact them at an instant should the primary COA fail to meet the requirement.

12.6.5. Always have multiple downstream backup plans/techniques ready (i.e., throw baggers on both banks with a boat on standby). Always have a plan in case your rescuer gets washed away so that you may retrieve the rescuer.

12.6.6. Keep plan and technique simple.

12.6.7. Use the right equipment.

12.6.8. Never count on the victim to help in own-self rescue. Victims and bystanders at rescues undergo a distinct psychological process. While few victims exhibit true panic, they are often numbed by the events, reacting sluggishly.

12.6.9. Never tie a rope around a rescuer. There are several rope-belayed rescue methods available for rescuers in a current. They all depend on the rescuer's ability to get free of the line if the water pressure becomes too great.

12.6.10. When tensioning a line across the river to be used in water safety or walking stream crossings, never tension it at a right angle to the current.

12.6.11. Once the victim is contacted, never lose the victim.

12.6.12. Always be proactive.

12.7. Hand Signals. See **Figure 12.2**.

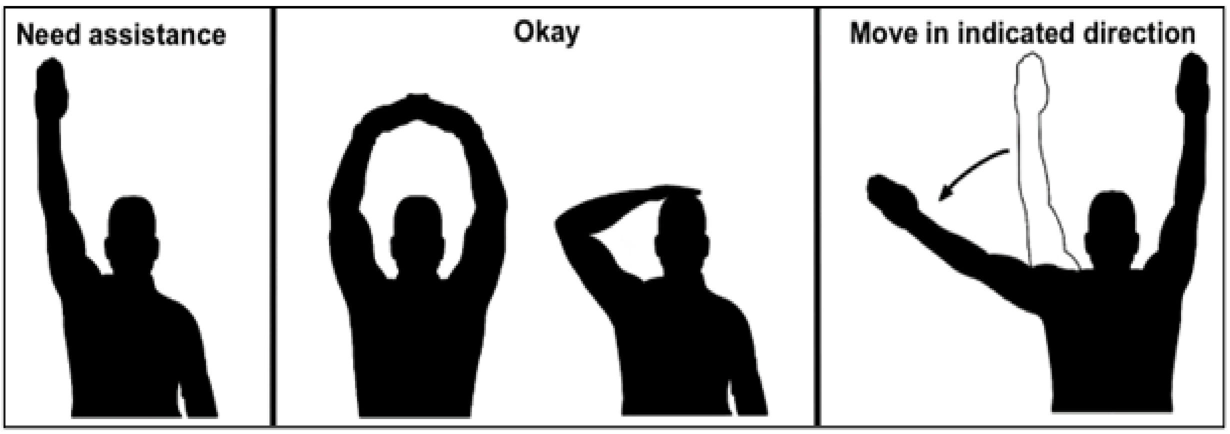
12.7.1. Need assistance: One hand extended overhead.

12.7.2. Okay: Two hands forming an "O" or one hand on head.

12.7.3. Move in direction indicated: Two hands extended overhead, then point left/right.

12.7.4. Standard PJ water rescue hand signals

Figure 12.2. Hand Signals.



12.8. Self-Rescue and Personal Safety, Swimming, and Obstacles.

12.8.1. **Basic or Defensive Swimming.** In current, the swimmer should roll onto their back and get both feet downstream, see **Figure 12.3** If wearing fins, it helps to flatten out to allow the blades to the surface when not kicking. If you do not have fins, the heels should be kept slightly lower than the butt. When in contact with rocks or debris, swimmers can either flatten out or use their feet to fend themselves off. They can use their hands to turn them back into the correct downstream position.

Figure 12.3. Self-Rescue and Personal Safety.

12.8.2. **Offensive or Aggressive Swimming.** In some situations, the defensive swimming position may simply not be adequate to propel the swimmer where the swimmer wishes to go in the river. The swimmer rolls to the belly and swims hard using the crawl stroke while kicking hard with the feet. Situations in which offensive swimming may be used are facing downstream for more speed, to enter or leave an eddy, while approaching a strainer, or when swimming a line across a river.

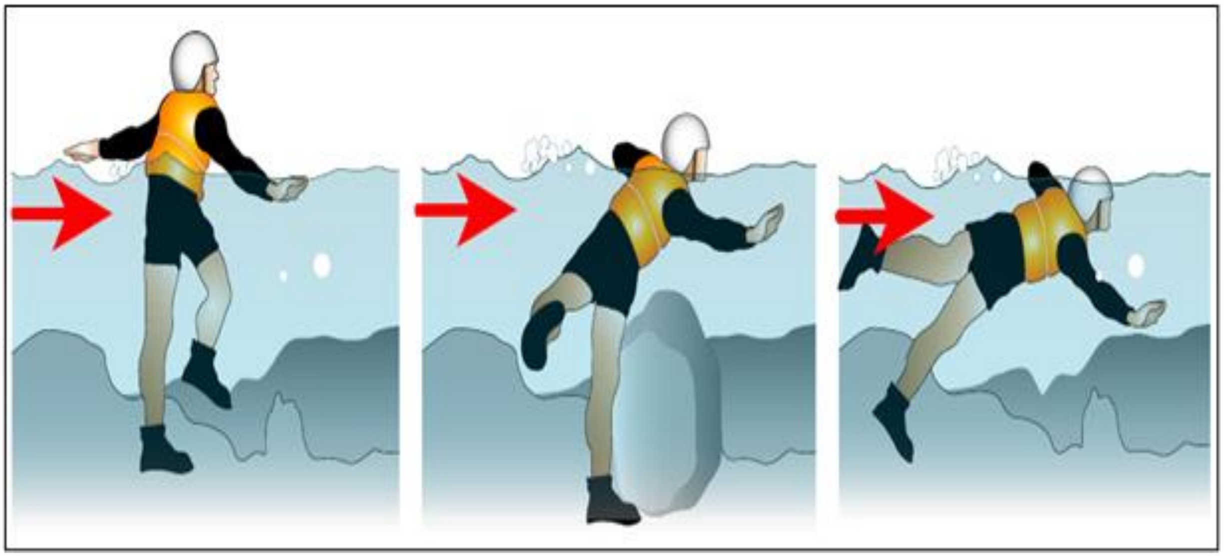
12.8.3. **Ferry Angle.** Used when the swimmer is trying to reach a spot in the river or the opposite shore. The swimmer is on their belly swimming hard upstream at a 45-degree angle to the current. This allows the force of the current on the upstream side to help push the swimmer towards the bank when ferrying personnel to the shore on a river rescue board. See **Figure 12.3** for an example of the ferry angle.

12.8.4. **Entrapments.** Caused by the victim or rescuer putting their feet down. The feet become wedged in between rocks or debris and the force of the water pushes the victim over downstream. Only the most fortunate victims are able to keep their heads above water until help arrives. See **Figure 12.4** for avoiding entrapments.

12.8.5. **Strainer.** Described as any river obstacle that allows water, but not solid objects such as a victim, to pass through it. Trees, brush, or debris piles are examples of strainers. The best defense is to swim to avoid, of course, but if it is inevitable, turn and swim into the strainer (up and over).

12.8.6. **Undercuts.** An undercut is a rock or ledge that the current cuts away from the surface. The best defense is to swim to avoid and if not able to avoid attempt to climb over the undercut. **WARNING:** Never put your feet down and attempt to stand up in the river if swept away and swimming.

Figure 12.4. Entrapments.



12.9. Water Rescue Skills and Techniques.

12.9.1. **Priorities of Rescue Methods.**

12.9.1.1. Reach. Simply trying to reach the victim from the shore by extending a pole, ladder, or similar object.

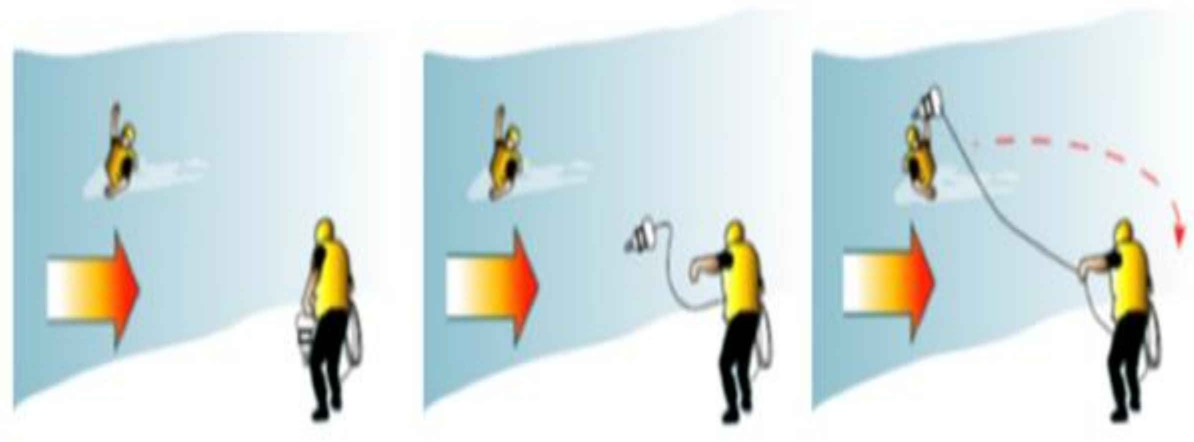
12.9.1.2. Throw. Throwing a flotation device to a swimmer. In the river, this usually refers to the throw bag.

12.9.1.3. Row. If a rescuer must leave the shore, use a suitable watercraft, if available.

12.9.1.4. Go and Tow. Since a significant number of people drown each year trying to rescue others, it follows that making such rescues in current is a risky option and should only be attempted after all lower risk options have been exhausted. If you must enter the water to contact the victim, keep control of the victim while towing the victim to safety.

12.9.2. **Throw Bag Rescue.** The throw bag is a piece of equipment all swiftwater rescuers should have. The bag should be held in one hand, and the rope in the other. The bag should be thrown underhand. Overhand throws with a throw bag often are ineffective. Ideal target placement is across the victim's chest; however, this is hard to accomplish. Rescuers should aim to throw the line across the water slightly downstream of the victim so that the victim will drift into the line. See **Figure 12.5** for an example of throw bag rescue. After the bag is thrown and the victim has positive control of if, rescuers should brace themselves to avoid being pulled off balance or out of position. Other rescuers should be positioned downstream to either retrieve the victim or repeat the throw. If throw bag misses victim, rapidly pull in slack rope while running down the riverbank alongside victim. Quickly gather lengths of throw rope in hand and do follow-on throws with coiled rope. Do not attempt to back-coil rope into the throw bag before rethrows. This will take too long, and victim will be washed too far downstream.

Figure 12.5. Throw Bag Rescue.



12.9.3. **Live Bait Rescues.** This is the intentional deployment of a swimmer to the victim. A line is attached so that the swimmer can quickly release it in the event of an emergency. The line should never be tied around the swimmer. The swimmer should enter head first and keep head their up. Rescuers on the bank should move downstream to avoid forcing the swimmer and victim from being pulled under water by the water pressure and the rope.

Chapter 13

AIRMANSHIP

13.1. General. This chapter addresses procedures for Operators employing from or recovering to any DoD or foreign service aircraft. It covers basic aircrew duties common to vertical-lift (VL) and fixed-wing (FW) aircraft across platforms, transload procedures, aircraft security, and isolated personnel treatment considerations.

13.2. Communication.

13.2.1. **Aircraft Communications.** Operators should refer to the specific Mission Design Series (MDS) TOs for instructions on proper use of the internal communications system (ICS). In aircraft with limited ICS connection ports and to facilitate the passage of critical information, recommend that operators come up as required on their inter team radios or monitor constantly during flight.

13.2.2. **Internal Communication.** Internal Communications System discussions are prioritized by "AVIATE (fly the plane), NAVIGATE (in the right direction), and then COMMUNICATE (talking to other airplanes or agencies)." For immediate threats to the aircraft, "directive" over "descriptive" is the most effective means of communication. For example, a pilot talking about navigation waypoints (navigate) should be interrupted to say, "BREAK LEFT, SMALL ARMS, 3 O'CLOCK" (aviate, directive over descriptive).

13.2.3. **Effective Communication.** Effective communication happens when the receiver responds with desired information and/or action. Situational awareness depends on good communications. Good communication techniques are as follows:

13.2.3.1. Be short, clear, and concise; words should express thoughts clearly.

13.2.3.2. Keep unnecessary conversation to a minimum.

13.2.3.3. When speaking, talk in short bursts and half sentences This allows breaks in which other radios may be heard or necessary interruptions can be added

13.2.3.4. Prior to keying, ensure critical radio traffic is not in progress.

13.2.3.5. If ICS connections are limited, utilize inter-team radios as required

13.2.3.6. Avoid pressing the "PUSH-TO-TALK" button until ready to speak.

13.2.3.7. Ensure the receiver is listening.

13.2.3.8. Avoid times of distractions or remove distraction.

13.2.3.9. Be aware of prejudices, biases, and attitudes.

13.2.3.10. Avoid emotion.

13.2.3.11. Avoid overloading the receiver.

13.2.3.12. Avoid overly technical terminology and excessive complexity.

13.2.3.13. Listen to the message, not what you think the message will be.

13.2.3.14. Do not process the message until you have heard it all.

13.2.4. **Common Terminology.** To avoid confusion and enhance crew coordination, use words or phrases that are understood by all participants. Use clear, concise terms that can be easily understood and complied with in an environment full of distractions. Avoid terms with multiple meanings. See **Table 13.1** for a list of commonly used terminology.

13.2.4.1. Operators acting as scanners can direct the pilot flying (PF) over the IP or hover point using standard terminology. Instructions should be clear, concise, and directive (versus descriptive) for approach and hover operations. The scanners can aid the PF with airspeed control during the approach by describing the reduction of distance in a numerical sequence from a given point to the IP. The frequency of numerical calls made should indicate the speed of the helicopter recovery vehicle (RV) toward the IP or the closure rate. A closure rate is not necessarily given in a preset distance of feet, yards, or meters.

13.2.4.1.1. Example: “IP AT TWELVE FOR 100, 75, 50, 40.” The faster the call, the more rapid the closure (e.g., “5, 4, 3, 2, 1, STOP”). If the approach is too fast and the RV cannot be safely slowed down in time, call “GO-AROUND, GO-AROUND, GO-AROUND.” While this call should only be used for safety of flight, it can be called by anyone in a primary crew position.

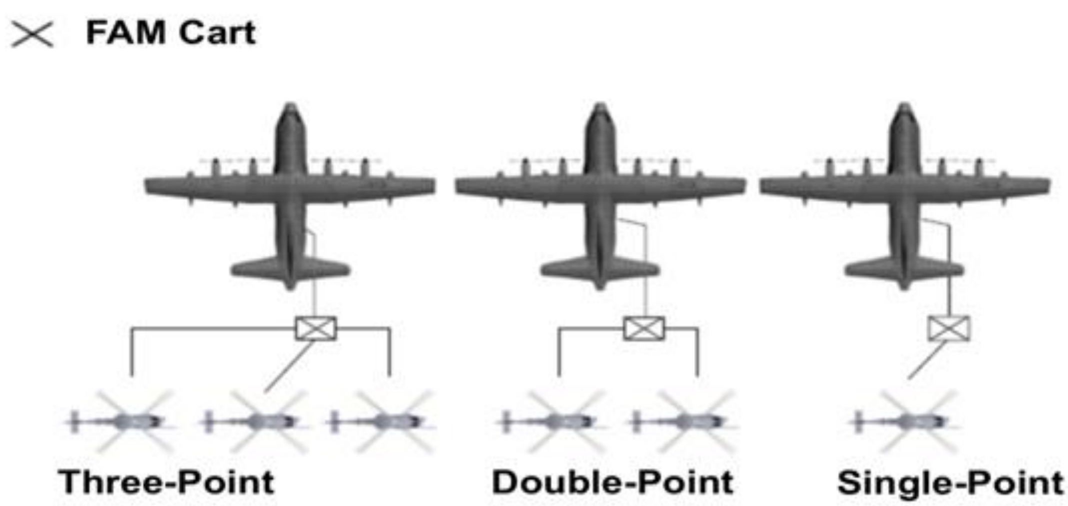
Table 13.1. Common Terminology.

Informative Terms	Meaning
CLEAR FORWARD / BACK/ LEFT / RIGHT / UP / DOWN	The aircraft is clear in the direction indicated.
“LEFT/RIGHT TURN”	The PF intends to turn the aircraft in the direction indicated.
“ON THE APPROACH”	The PF is commencing the approach.
“ON THE GO”	The PF is commencing takeoff.
“ROPES DEPLOYED/ RELEASED”	Alternate insertion and extraction (AIE) devices are deployed/released.
“SLIDING FORWARD / BACK / LEFT /RIGHT”	The PF is commencing aircraft movement in the direction indicated.
“FORWARD / BACK / LEFT/ RIGHT /UP/ DOWN X (units)”	Move the aircraft “X” units in the direction indicated; this call is usually followed by a countdown (e.g., “LEFT 5, 4, 3, 2, 1”).
“GO-AROUND, GO-AROUND, GO-AROUND”	Initiate a go-around (re-accomplish aircraft approach).
“HOLD”	Maintain present position, heading, and altitude.
“PILOT/COPILOT CABLE DOWN/UP”	Pilot/copilot use cyclic hoist switch to move the hoist cable up/down.
“ROLL OUT/STOP TURN”	Roll wings level.
“ROPES, ROPES, ROPES”	The aircraft is in a stabilized hover and PF is signifying it is clear to deploy the briefed AIE devices.
“STOP FORWARD / BACK / LEFT / RIGHT / UP / DOWN”	Stop aircraft movement in the direction indicated.
“SWIMMERS, SWIMMERS, SWIMMERS”	The aircraft is in pre-briefed parameters and team is cleared to deploy into the water.
“TURN LEFT/RIGHT”	Turn in the direction indicated; this call may be followed by a desired heading, a clock position, or “X degrees.”
“TERMINATE”	That phase of operations is complete, prepare for next phase.
“KNOCK IT OFF”	Cease operations, reset to blocks, debrief, RTB if indicated.
NOTES: • Directive terms indicate that immediate action is required because of the possibility of contact with obstacles, injury to deploying/recovering personnel, or mission requirements. • Terms may be combined (e.g., “CLEAR LEFT 5, 4, 3, 2, 1, STOP LEFT”). • Use pitch, tone, inflection, and reception, as necessary, to indicate the urgency of the directive terms.	

13.3. Scanning Duties. When Operators are not engaged in other mission duties, they should assist in scanning for threats to the aircraft. Personnel scanning should be positioned close to the manual flare dispense switch and fly with their free hand on the ICS push-to-talk (PTT) to quickly react to threats and call out corrective procedures. Suspected threats are called out to the aircrew in accordance with MDS-specific AFTTP 3-1. They should scan the ground and air for the presence of other factor aircraft and ground-to-air threats such as tracer fire, smoke plumes from RPGs or surface-to-air missiles (SAM).

13.4. Forward Arming and Refueling Point (FARP). FARPs are tactical ground refueling and possible rearming locations and may be used to extend the combat radius of receiver aircraft. Operators may be tasked to marshal aircraft during FARP operations. FARP required equipment and personnel lists are contained in AFI 11-235, Forward Arming and Refueling Point Operations. See **Figure 13.1** for an example of FARP layout. **NOTE:** Be aware of aircraft separation, turning radius, and rotor distances when marshaling aircraft around a FARP site.

Figure 13.1. FARP Layout.



13.5. Aircraft and Airfield Security. Operators provide security for themselves, the IP, and aircraft on the ground. During fixed-wing assault landing operations, an element may be tasked to provide aircraft security. Minimum equipment for security personnel disembarking the aircraft will include items necessary for survival and evasion should the aircraft be disabled or committed to an expedient departure. Primary crew members have specific responsibilities on the aircraft and should not be considered as part of the security element during planning phases.

13.5.1. **Embarked Security.** The team may provide aircraft security while remaining on-board the aircraft or in close proximity and ICS.

13.5.1.1. Forward security is provided from the forward escape hatch on equipped aircraft, or from the crew entrance door.

13.5.1.2. Side and rear security is provided from the paratroop (or equivalent) doors or ramp and door on equipped aircraft.

13.5.1.3. Small aircraft security can be provided by one position at the nose on ICS and a second at the tail on ICS or interteam radio.

13.5.2. **Disembarked Security Procedures.** When committed to air land in non-permissive environments, Operators must disembark the aircraft rapidly. Any delay could expose the aircraft and personnel to potential threats.

13.5.2.1. Off-load will be accomplished after the appropriate signal is received from a designated crew member.

13.5.2.2. Operators should charge and safe weapons prior to off-loading of the aircraft to provide immediate defense of the aircraft when required.

13.5.2.3. The TL should be the last team member off ICS and the last to disembark in order to facilitate an immediate element recall if necessary. At a minimum, the TL should have radio contact with the aircraft.

13.5.2.4. Any exit may be used during assault landing operations, provided it can accommodate the personnel and equipment to be loaded in or out. The ramp is usually the safest and most expeditious exit and entrance route.

13.5.2.5. The TL may implement a recall at the airfield if resistance is encountered or if he believes the operation has been compromised. Compromise might result from an unexpected visual or physical contact with a nearby enemy force.

13.5.2.6. Operators will move to a predetermined assembly point to orient themselves or to predesignate security positions and observe for enemy activity. If a reception party is anticipated, contact will be made according to the contact plan outlined in the operational plan.

Chapter 14

VERTICAL LIFT

14.1. Airland Operations. Airland operations are the fastest and safest method for inserting or extracting Operators and is preferred. Some vertical lift aircraft are capable of supporting surface vehicle employment providing greater mobility for quicker execution of mission objectives. Contingency planning should include recall procedures, communication and signaling, and team actions on and around the aircraft. **NOTE:** The following procedures are based on HH-60 guidance; refer to the specific MDS TO for additional guidance when employing from other aircraft.

14.2. Alternate Insertions and Extractions. Performing an AIE requires additional power, demands greater crew coordination, and increases exposure time. The TL should determine if the increased difficulty of performing an AIE is justified when compared with the risks or benefits of an offset air land insertion. Consider team training and competence on the intended AIE prior to execution. AIE methods discussed in this chapter are considered acceptable means of insertion and extraction for most situations.

14.2.1. **General Setup and Preparation.** Cabin configuration is the key to safe and effective AIE operations. To ensure safety, keep intercom cords and gunner belts clear of deployment and recovery pathways and AIE devices. Ensure gunner belts are clear of personnel and paths of travel. A V-blade knife or other similar tool should be readily available if the ropes need to be cut during emergencies. During night operations, configure devices with Chemlights or other lighting device to enhance aircrew and team situational awareness.

14.2.2. **Time Warnings.** For detailed descriptions, refer to the Team AIE Brief in AFMAN 10-3511, Guardian Angel Briefing Guide, and USSOCOM 350-6.

14.3. Caving Ladder. The caving ladder is a very lightweight device that requires minimal space in the aircraft. It may be used in lieu of the standard rope ladder using the same limitations and guidelines. Caving ladders are typically rigged on smaller RV with side doors. When rigging a caving ladder, attach the end of the caving ladder to the FRIES-bar or overhead rings with two locking carabiners. Overhead rigging makes it easier for personnel to enter the RV. If an overhead ring or FRIES-bar is not available, attach the ladder to a deck ring. Attach a separate safety strap from the ladder to a deck ring. The safety strap can be made of one inch tubular nylon and attached using Carabiners. Multiple ladders may be joined together to increase the usable length.

14.4. Rope Ladder. The rope ladder provides a quick method for recovering team personnel from the surface when a VL recovery vehicle (RV) cannot land. The decision to use a rope ladder should be weighed against time constraints and difficulty for personnel climbing the ladder. The rope ladder is not a suitable method of recovering injured. The rope ladder can be used simultaneously with hoist operations. **WARNING:** Contingencies and Emergency Procedure. If the aircraft comes under fire while performing a rope ladder, the team should attach themselves to the ladder by any means available. The aircraft will accomplish slow, forward flight to a safe area. Airspeed should not exceed 40 KIAS.

14.5. Rappel. Deploying personnel are responsible for all aircraft rigging and preparation. Rappelling allows the team to insert into uncertain terrain and around obstacles but requires more time for configuration and execution. **WARNING:** Figure Eight devices, Munter or Italian hitch rappel configurations may cause twists in the rappel rope. These twists may form knots that can cause the loss of brake hand control. **NOTE:** Stitch plate style descenders (ATC/Reverso/Gi-Gi) are recommended to minimize rope twists.

14.5.1. **Setup and Configuration.** Pad or tape any sharp edges that could damage ropes. Ensure a V-blade or sharp knife is available in the event of rope emergency.

14.5.2. **Installation.** Ropes may be anchored to any attachment point capable of holding the weight of the team. The primary anchor point for the HH-60G is the fast rope insertions and extraction system (FRIES)-bar. The secondary anchor point is the forward/upper cargo net ring. Secondary anchor point should be positioned to mitigate shock load.

14.5.2.1. Attach rope to anchor points by tying butterfly knot at primary anchor point and figure eight knot at secondary anchor point.

14.5.2.2. Check to ensure there is limited slack between the two anchor points.

14.5.2.3. All ropes should be either tied directly to anchor points or connected using life-rated locking Carabiners.

14.5.3. **Deployment Bag.** Back coil the rappel rope into the deployment bag until 2 to 3 feet are left. Close the deployment bag in a manner that contains the rope but allows to feed out freely. The 2 to 3 feet of rope are attached to the anchor point in the aircraft. As the bag is deployed, the rope will feed out until it reaches the ground. This method keeps positive control of the rope in the aircraft, during deployment, and on the ground.

14.5.3.1. Leg Bag. A leg bag may be used to maintain positive control of rappel rope and facilitate rappelling through and around obstacles (e.g., trees and ship masts). Leg bags are attached to the lower portion of the leg on the rappeller. When employing with a leg bag, the hover height should be limited to 50 feet lower than the length of rope available, and the end of the rope should have a knot tied to prevent rappelling off the rope.

14.5.3.2. Rope Bag. The bag should be weighted when not attached to leg. Weighting the bag assists in deployment and prevents the bag from being blown around by rotor wash. The weight should be tied to the bag with a weak link. Do not tie the weight directly to the rope.

14.5.4. **Deployment Preparation.** Rappellers should be ready for deployment prior to the 5-minute time call. The AIE master ensures ground contact is maintained. Safety personnel relay communications and monitor the deployed ropes to ensure ground contact is maintained and will recover or release ropes when iteration(s) are complete. **WARNING:** If rappelling with a barrelman or extension, ensure it does not contact the rope as it may burn through the extension causing catastrophic failure.

14.5.5. **Rappeller Disconnect and Rope Release.** After the rappeller reaches the ground, he must pull enough slack through the descender in case of hover height distribution. The scanners should direct the Pilot Flying (PF) to descend approximately 5 to 10 feet to provide enough slack in the rope to allow the rappeller to disconnect from the system. The Special Mission Aviator (SMA) or safety should release the ropes after the last iteration(s).

14.5.6. **Advantages.**

14.5.6.1. Rappelling equipment is light and small.

14.5.6.2. The team's descent is easy to control.

14.5.6.3. Deploying personnel stay secured to the device while deploying.

14.5.6.4. Personnel can deploy with more equipment.

14.5.7. **Disadvantages.**

14.5.7.1. Rappelling requires more time than fast roping.

14.5.7.2. Rappellers may have difficulty connecting to the rope in the aircraft and/or disconnecting from the rope once on the ground. **CAUTION:** During training, to prevent equipment damage, carabiners should not be dropped with the rope.

14.6. Hoist General Procedures. On VL aircraft when airland is not an option, the primary method for extraction is the rescue hoist. The Operator must know the maximum working loads, general control, function, and emergency procedures. A trained Operator may be designated to operate the hoist when mission dictates. Operators can connect themselves to the hoist prior to reaching the objective, remove slack and position themselves outside the door once the aircraft is on short final.

14.6.1. **Cable Slack.** The hoist operator and Operator must keep slack to a minimum when performing hoist recovery. Excessive slack is dangerous and more so during water recovery when personnel in the water are unable to see the cable. If the Operator loses situational awareness of hoist cable or is unable to manage excess slack, he should disconnect from the hoist, move away, reset and safely re-attempt.

14.6.2. **Static Electricity.** The hoist should be grounded prior to touching/connecting to it to discharge static electricity. In dry desert environments, static electricity can significantly charge in as little as 5-seconds if not grounded.

14.6.3. **Hoisting Through Trees.** When hoisting through trees, the rate of retrieval must be slow enough to allow the hoist riders to fend off branches and prevent cable entanglement. **WARNING:** Static electricity from a hoist grounded near fuel spills could cause it to ignite. **NOTE:** Exercise caution to keep from snagging or anchoring the hoist hook and cable around an immovable object.

14.6.4. **Oscillation/Pendulum.** Severe oscillation and/or pendulums may be induced when the hoist cable is raised and lowered. The hoist rider may be lowered back down, or the aircraft may transition to a forward flight to correct.

14.6.5. **Water Hoist Operations.** Because of heavy rotor wash, the aircrew should deliver the device to the swimmers opposed to having swimmers swim to the device. Place the swimmers under the aircraft door where there is less rotor-wash (sweet spot). Minimizing rotor-wash can also be accomplished by delivering the device from a hover height of 70 feet, which allows the Operator to connect to the device before the aircraft descends to perform the hoist.

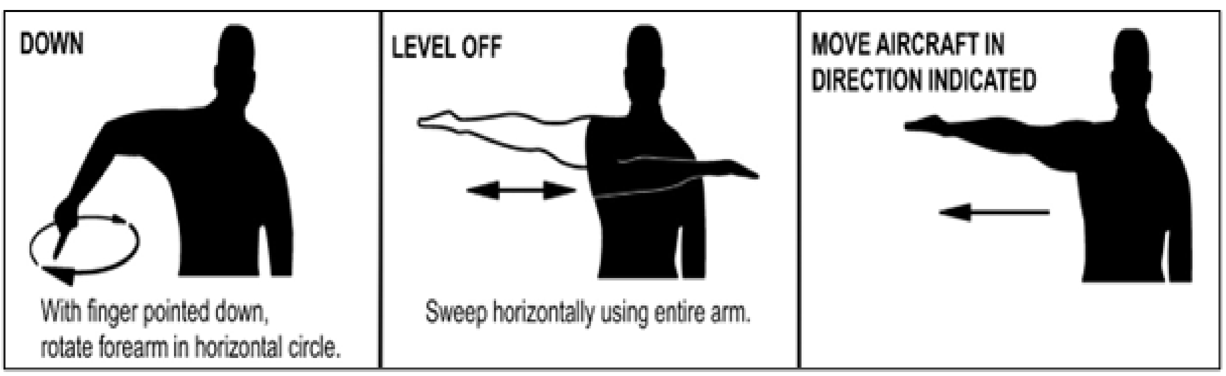
14.6.5.1. Day Water Hoist. While in the water, prepare a signaling device to assist the aircraft in locating the rescue position and don face mask/snorkel to shield eyes from rotor wash.

14.6.5.2. Night Water Hoist. The aircraft may deploy chemlights to mark survivor location and provide an approach pattern with hover references. This will ensure the rescue position can be reacquired if visual position is lost. The Operator should mark their position with a strobe, chemlights, or a flashlight. Night water operations are inherently more difficult because of reduced light, lack of hover references, and reduced field of vision. Operators must maintain situational awareness of the hoist devices and cable around personnel or objects in the water to prevent entanglement or injury.

14.6.5.3. Signals from Swimmer to VL Aircraft. Swimmer to VL aircraft signals that indicate ready for pick-up and or immediate emergency extraction need to be briefed prior to mission execution. It is recommended to have a waterproof radio ranger corded to your personal kit in the event of being stranded at sea due to unforeseen emergencies or circumstances. NORDO signals will depend on threat and equipment available. When in a low threat environment, operators should secure a steady green light or chemlight on each swimmer's helmet. An IR, overt strobe light or buzz saw may serve as a far recognition signal and indicate swimmers are ready for pick up. See AFMAN 10-3511 for detailed signals and guidance. **NOTE:** It is important to turn off strobe prior to reaching cabin door to prevent visual distortion to the hoist operator.

14.6.6. **Hoist Hand and Arm Signals.** The following hand and arm signals provide visual communication techniques for Operators to communicate while suspended from the hoist. These hand and arm signals are derived from the Coast Guard Helicopter Rescue Swimmer Manual COMDTINST M3710.4D. See **Figure 14.1**.

Figure 14.1. Hoist Hand and Arm Signals.



14.6.6.1. **Down.** Upper arm is held out parallel to the ground; elbow is bent 90 degrees so that forearm is pointing to the ground with index finger extended. The entire forearm is rotated in a horizontal circle.

14.6.6.2. **Level off/Stop.** Arm is held straight out parallel to the ground and swept along the horizon, moving from the shoulder. Level off/Stop.

14.6.6.3. **Move aircraft in direction indicated.** Arm is held out in the same manner as level off/stop. However, the arm stays stationary pointing in the desired direction of movement.

14.6.6.4. **Up.** The standard pumping thumbs-up is the preferred method to indicate that the hoist rider is ready to ascend.

14.7. Hoist Rescue Devices. The following is a non-inclusive list of various devices used in conjunction with the hoist.

14.7.1. **Barrelman Technique.** This method is for trained personnel to attach directly to the hoist hook using a climbing harness and barrelman strap. A chest harness may be used to counter a pack or equipment that makes the operator "top-heavy." The chest harness functions primarily as a balance point as most of the load is on the sit harness. A Carabiner through the front of load bearing equipment or pack straps can be used an alternative to a chest harness.

14.7.1.1. Barrelman Strap/Tie-ins. A commercially produced device specifically designed for either aircraft or mountaineering use that is life rated. Locally produced devices must use material rated to a minimum of 2,000 pounds, be tied using approved mountaineering knots, and meet unit approval. See AFMAN10-3511 Pararescue Operations and Procedures for more information. Select materials that have elastic properties such as nylon in order to mitigate the risk of shock loading. **NOTE:** Aircraft tie-ins must have a quick release at the harness connection point.

14.7.1.2. Barrelman Options. **WARNING:** Purcell Prusiks are not approved for water operations due to loss of friction and compromising functionality when wet.

14.7.1.2.1. Chain Reactor. The chain reactor is a daisy chain made with loops and is a safer alternative to the Daisy Chain and has a higher breaking strength.

14.7.1.2.2. Purcell Prusik. A Purcell Prusik is an adjustable strap, tied with Prusik cord and has a 2,000-pound breaking strength requirement. Commercial websites and mountaineering literature provide instructions on how to fabricate them. Purcell Prusiks are attached to the sit harness using a locking Carabiner but can also be girth hitched.

14.7.1.2.3. Barrelman Length. For hoist operations, the strap is adjusted to place the hook at a height equal to the operator's face. For litter hoist operations, place the operator's "belly button" against the side of the litter. If the strap is too long, the Operator may be below the level of the cabin floor when at aircraft door. If the strap is too short, the Operator's legs will be unable to reach the floor underneath a litter. **NOTE:** For successful hoist operations, Barrelman Length should adequately be adjusted when operating on variances of domestic and foreign vertical lift aircraft.

14.7.1.3. Procedures. Place the strap/Carabiner through the rescue hoist hook. Ensure the pin is secured in the hook and Carabiner gates are locked.

14.7.1.3.1. One-Man Pick-Up. Hoisting one person using the barrelman technique is the simplest and fastest method for hoist retrieval. The operator's arms and legs can be used to counter spinning, fend off obstacles, and prepare for a controlled landing. The operator does not require any assistance to enter the aircraft unless injured, bringing up a survivor or other objects.

14.7.1.3.2. When entering the cabin, grab the ceiling strap, H-bar, FRIES bar, or airframe as necessary to facilitate entry into the aircraft.

14.7.1.3.3. Do not grab any cables, wires, or the Hoist Operator.

14.7.1.3.4. Be cautious of taking hold of the forward edge of the door as this may inadvertently move/depress controls on the hoist cabin control panel.

14.7.1.3.5. Two-Man Pick-Up. The two-man pick-up is similar to the one-man. It is easier to enter the cabin if the hoist riders are level with each other. When picking up a survivor using the rescue strop, ensure the rescuer is at a comfortable height to control the survivor.

14.7.1.3.6. Ensure the survivor does not remove the device or attempt to grab cables, wires, or the hoist operator.

14.7.1.3.7. When approaching the aircraft, position the survivor to the inside, this will facilitate the hoist operator/team's ability to pull the survivor in as well as using the rescuer to block the exit.

14.7.2. **Forest Penetrator.** The forest penetrator is used for single or multiple recoveries from land or water. The forest penetrator has three seats, each approximately 12 inches long. A retaining latch under each seat secures it in the extended position.

14.7.2.1. To release the seat from the extended position, push down on the seat and pull down on the latch.

14.7.2.2. The seat will then snap back into the retracted position.

14.7.2.3. Three webbing safety straps are provided to secure survivors.

14.7.2.4. Yellow webbing tabs marked "Pull Out," are sewn to the safety straps and extend from one of three stowage openings.

14.7.2.5. Pull these tabs to unstow the strap, route it around the IP and under their arms.

14.7.2.6. The straps terminate with a yellow fabric marked "Tighten," pull this to secure the IP.

14.7.2.7. Forest Penetrator Preparation.

14.7.2.7.1. Fold the seat paddles up and stow safety straps before lowering the penetrator through trees or dense foliage.

14.7.2.7.2. For water recoveries, install the flotation collar before lowering the penetrator, and place at least one seat paddle in the down position with one safety strap removed from the stowed position.

14.7.2.7.3. Do not unhook the safety strap fastener from the penetrator. **WARNING:** The aircraft may depart the area with the hoist rider still suspended on the cable. When conducting hoist operations using the forest penetrator, keep arms down, elbows locked against the body and never attempt to grab the cable or weighted snap link above the device. **NOTE:** If the safety strap is not used (will not fit around bulky equipment), use an alternate means of securing (e.g., chest strap or alternate load belt).

14.7.3. **Stokes Litter.** The Stokes litter is constructed of mesh and lightweight tubing that holds a survivor immobile in a supine position. The sides of the litter protect the survivor from bumping against obstructions or the side of the VL aircraft during retrieval. The Stokes litter should be configured with sling, flotation devices (as required), and three restraining belts.

14.7.3.1. Lowering. The team can either deploy with the Stokes or it can be delivered via hoist. When snag hazards are present, configure the stokes litter for vertical lift/lower by connecting the hook to the head of the litter so it hangs vertically.

14.7.3.2. On the surface. The hoist operator should provide enough slack in the hoist cable to allow it to be disconnected from the Stokes. If able, the RV should move away/depart the working area so the team can complete medical treatment and secure the patient without unnecessary noise and rotor-wash.

14.7.3.3. Securing patients. Smaller patients can be secured by routing straps directly across the patient, for large patients the straps can be routed outside and over the top bar. **CAUTION:** If operating on hoist equipped aircraft without a safety pin, do not use a Carabiner between the cable rings on the Stokes and the hook. A large Carabiner can rotate out of the hook. Instead, place the rings directly into the rescue hook.

14.7.3.4. Outside Barrelman. The normal position for the barrelman is “outside” and is the only method allowable for aircraft with skids.

14.7.3.4.1. Barrelman with short legs may have to adjust their barrelman strap to position the litter higher than the normal “belly button” position.

14.7.3.4.2. When nearing the aircraft, place the litter towards the inside so that the barrelman is facing the cabin.

14.7.3.4.3. If aircraft has skids installed, use the forward foot to maneuver the Stokes litter outside the skids.

14.7.3.4.4. Place a foot on the skid or tire to clear the aircraft (ensure pilots are briefed to have brakes set so the wheels do not spin).

14.7.3.4.5. As the hoist operator raises the cable, maneuver the head of the litter inside the aircraft (overhead straps will allow the barrelman to assist during cabin entry).

14.7.3.4.6. After the barrelman signals, the hoist operator will begin to lower the hoist while the barrelman pulls/pushes the litter inside.

14.7.3.4.7. If done correctly, the hoist operator should not have to assist the barrelman in pulling the litter inside the aircraft.

14.7.3.5. Inside Barrelman. This may be necessary during a hoist pickup overwater when the barrelman has not been able to remove fins.

14.7.3.5.1. When nearing the aircraft, the barrelman maneuvers the litter towards the outside, the barrelman enters the aircraft first and then maneuvers the litter inside.

14.7.3.5.2. The SMA or safety may assist by turning both the Stokes litter and the barrelman sideways in order to maneuver them into aircraft. CAUTION: Installation of a snow shield increases the chance of uncontrollable spinning.

14.7.4. **Sked Rescue System.** The Sked is made of plastic and is equipped with nylon webbing and steel buckles to secure a patient. If possible, Skeds should be hoisted inside a Stokes litter for added security and protection. If a Stokes litter is not available, the Sked may be hoisted independently using the manufacturer provided horizontal lift slings and configured IAW manufacturer's instructions. **WARNING:** A tag line or anti-rotational device is mandatory for all Sked hoist operations. The Sked's construction and asymmetry will cause violent spins during hoisting if not carefully controlled. **CAUTION:** Keep the Sked and all components away from chemicals that may damage the material (gasoline, corrosives, etc.). Store the litter and components in a cool, dry location away from direct UV sunlight.

14.7.5. **Rescue Basket.** The rescue basket is standard equipment aboard US Coast Guard rescue VL aircraft and is used by other branches and foreign governments. The rescue basket accommodates one survivor, weighs 39 pounds and folds for compact stowage.

14.7.6. **Rescue Strop (Horse Collar).** The rescue strop is designed to hoist uninjured personnel. METT-TC may dictate its use to hoist injured personnel for speed or obstructions. The rescue strop is designed to be unaffected by repeated use in a marine environment.

14.7.7. **Quick Strop.** The quick strop is similar to the rescue strop but is smaller and lighter. The use of the rescue/quick strops is similar to the penetrator. Up to three slings may be lifted at once, not to exceed hoist weight limitations. A weight may be attached to strop for stability during deployment. The strop can be used in various environments. It is not recommended for use in forest or jungle environments where there is a risk of snag hazards. **WARNING:** When conducting hoist operations using a rescue strop or quick strop, keep arms down, elbows locked against the body, and make not attempt to grab the cable or weighted snap link above the device.

14.8. Tag Line. The tag line is a rope of varied construction and used by surface personnel to prevent oscillation and spinning of hoist rescue devices. It can be used to guide the rescue device or survivor through confined areas, such as ships, trees, or canyon walls. When connecting a tag line to any portion of the aircraft, it must incorporate a "weak link." This link will be made from a double loop of 1/4-inch cotton webbing (80-pound test) or a single loop of gutted 550-cord. **CAUTION:** When deploying or recovering a tag line from a VL aircraft, a weight should be attached to the tended end of the line to prevent entanglements and provide control while working in confined or restricted spaces. **NOTE:** Tag line tenders should wear abrasion resistant gloves. **CAUTION:** Team Leaders should evaluate the use of a tag line if entanglement with obstacles is greater than anticipated benefits.

14.8.1. **Tag Line Deployment. WARNING:** Tag line tenders must be positioned to keep tag line clear of rotors or other snag hazards that may produce catastrophic emergencies.

14.8.1.1. The tag line can be either lowered or dropped if using a weighted and back-coiled line over the intended delivery point.

14.8.1.2. Once the tag line is on the ground, the pilot may reposition the aircraft to regain visual contact with the team.

14.8.1.3. Hoist operators must ensure the tag line is attached via a weak link to the rescue device before lowering.

14.8.1.4. Tenders use the tag line to prevent oscillation and guide the rescue device to the desired location.

14.8.2. **Retrieval Operations.** The Operator or IP will indicate they are ready for hoist by pre-briefed signal. The Tag line tender must ensure sufficient offset angle from hoist point to prevent oscillation or spins. Optimal tender positioning is approximately 120 degree angle from the hoist side of the RV.

14.8.3. **Repositioning of Aircraft.** This technique is useful when the tender's movement is restricted e.g., hoisting from small vessels, confined spaces, or in the water. As the rescue device is hoisted off the surface and clear of obstructions, the pilot repositions the aircraft away from the tender creating an offset. The crew maintains this position until the device is in the cabin and tag line is retrieved or discarded.

14.8.4. **Repositioning the Tender.** When there is unrestricted mobility, position the tender at the desired offset prior to hoist initiation.

14.8.5. **Alternate tag lines/uses.** After a rappel insertion, the rappel rope can be used as a tag line by rigging with a Carabiner and weak-link attached to foot or head end of the Stokes litter. A tag line may also be used in lieu of the hoist to lower small items. The item to be lowered will be attached via Carabiner and appropriately weighted. If the tag line is attached to the aircraft, a weak link must be included in the connection.

14.9. Dynamic Hoisting. The concept of dynamic hoisting is to eliminate load instability and rotation, reducing workload for the hoist operator and eliminating the need for a tagline. It is now becoming the industry standard for civilian SAR units and is increasingly being implemented by military units. While it is not the answer for every situation where hoisting is necessary, it is an extremely effective technique when used properly. The technique achieves this by using near constant motion and higher hoist altitudes. This simultaneously stabilizes the load with airflow, while also minimizing the effect of rotor wash through both altitude and forward motion with the load drifting aft. While dynamic hoisting is effective with any load, it is particularly effective when hoisting inherently unstable loads, prone to rotation, like a rescue basket, or stokes litter. This technique has been used to stabilize an empty stokes litter, with no tag line, PJ, or weight in the basket. For more information see **AFTTP 3-3.HH-60G**.

14.10. Free-Fall Swimmer Deployment. Free-fall swimmer deployments, also known as low and slows, provide an effective method of delivering a team or equipment in the water.

14.10.1. **Pre-deployment Considerations.**

14.10.1.1. The aircraft should not fly directly over the survivor until the hoist pick-up phase.

14.10.1.2. Determine the wind direction prior to delivery.

14.10.1.3. Set up for a delivery downwind and down drift of the survivor, allowing the survivor to drift into position.

14.10.1.4. When mission dictates, the team may be delivered upwind or off-wind. The team should be prepared to swim hard to reach the objective.

14.10.1.5. In heavy winds/seas or low-light conditions, delivery away from the survivor may complicate procedures, team separation and loss of contact with the survivor.

14.10.2. **Aircraft Procedures.** Deployment procedures vary depending on type of aircraft, personnel, and special equipment. HH-60 and similar platforms allow the deploying team members to sit in the door. Because the aircraft is in forward flight, the team deployment order starts at the rear of the aircraft. This limits team members deploying on top of each another. When deploying from a ramp equipped airframe, the team is positioned in a single file (column) formation and follows the first person out. Spacing should be 1-second between team members. Last-minute corrections of the flight path are made by the TL to the SMA using pre-briefed signals. During high seas, the aircraft flies 10-feet above the wave crests. Swimmer's time their exit to land on or near the wave crest. When deploying swimmers in high seas, deploy no more than two swimmers per wave crest to avoid additional distance in the trough of the wave. During high sea states, consider using the fast rope or the "Alaska Slide" for deployment. (Alaska Slide: hoist down using a strop and when at the height of the wave crest, they can slide out of the strop and slip into the water).

14.10.3. **Deployment Procedures.** Deploying at night with non-NVD-equipped crew members may require an overt chemlight attached to each individual deploying. Personnel exit the aircraft in a manner that reduces possibility of entanglement and expedites delivery of personnel and equipment. The exit maneuver should not be forceful. Exit by stepping off or pushing away from the aircraft. After exiting, bring legs together with the fins pointed upward so the heels contact the water first. It is recommended that swimmers wear a face mask with a snorkel for water operations. When wearing a face mask during deployment, use one or both hands to prevent the mask from coming off. Once in the water, swimmers will relay a "thumbs-up" signal to the aircraft indicating they are "okay" and uninjured.

14.10.3.1. If deploying with SCUBA tanks, grab the tanks support strap just behind the hip and hold it firmly down and against the back. This technique prevents the tank manifold striking the back of the head.

14.10.3.2. When deploying to an injured survivor, consider deploying with a Stokes litter. To ensure control of the Stokes litter, deploy the litter between the first and second swimmer, ensuring the first swimmer is clear before deploying the stokes.

14.11. Equipment Delivery. Equipment delivery uses the traditional mountaineering skill of belaying in a nontraditional environment.

14.11.1. **Deployment System.** The deployment system consists of a belay and the container or harness. Equipment is added to the package as required. E.g., a Stokes litter, medical equipment or extrication gear may be integrated and deployed with the kit.

14.11.2. **Sked Litter.** The Sked may be attached as a transport medium. It offers a hard plastic smooth surface (skid plate) that enables equipment to be dragged in tow. The Sked may be full sized or modified to fit the equipment container.

14.11.3. **Padding.** Pad as necessary to protect equipment. Consider adding crush board on the bottom to cushion impact on deployment.

14.11.4. **Harness.** The harness should be designed to contain the equipment and allow a connecting point for belay or airdrop. It may be commercially manufactured or built from A7A straps (see **TO 13C7-1-11**, Airdrop of Supplies and Equipment: Rigging Containers, for various methods of rigging).

14.11.5. **Attachment point.** The equipment package should have a snap shackle ("pelican hook"); and can be substituted with a locking Carabiner for a lowering point to ensure a quick release once on the surface.

14.11.6. **Lighting.** During night operations, consider marking the kit on all sides with chemlights.

14.12. Tethered Duck Operations (T-duck). T-duck is the deployment method for a deflated and rolled combat rubber raiding craft (CRRC). T-Duck operations consist of deploying a deflated CRRC rigged with an air tank, fuel bladders and engine from the cabin of a VL aircraft.

14.12.1. **Setup and Preparation.** Before conducting live operations, the aircrew and team should perform a detailed walk-through of the operation, with the T-Duck loaded and configured on the aircraft. A harness holds the boat in its deflated and rolled configuration and is equipped with a single-point attachment for the belay rope to lower the boat. The boat is loaded so that the motor faces the door/outboard and will be the first part to exit the aircraft. The T-Duck is traditionally positioned at the right door of the HH-60 with the engine protruding over the edge of the door. For ramp-equipped aircraft, the T-Duck is positioned IAW CG requirements. The fast rope should be coiled and secured out of the way. Secure and activate the chemlight at the inflation handle prior to take-off in case the team cannot reach it during the time warnings sequence.

14.12.1.1. Ensure anchor points are capable of suspending the weights of personnel/equipment and do not interfere with deployment procedures. A cargo strap should be used to secure the CRRC during flight and removed during the time warnings sequence.

14.12.2. **FRIES Bar Lowering Configuration.** The FRIES bar is configured with a pulley and/or Carabiner to act as a high directional point. The rope is then routed from the T-Duck harness up and through the pulley/Carabiner and down to a floor ring where a belay device controls the lowering of the package. Attach a snap shackle to the belay device to allow the belayer to release the friction device from the floor ring.

14.12.3. **Equipment Release. NOTE:** If the CRRC is placed in the right door, the fast rope can be recovered and coiled in the left door without affecting hoist/penetrator operations. **CAUTION:** When selecting fast rope length, consider intended T-Duck deployment hover height. Excess fast rope in the water may become entangled with the deployed T-Duck. **CAUTION:** A knife should be readily available to the belayer in case of a rope snag or inability to disconnect the rope from the belaying device.

14.12.3.1. Let the lowering line run through the belay device and pulley ensuring it does not foul the tail rotor by throwing it into the water.

14.12.3.2. Once the first team member reaches the package in the water, release the pulley/carabiner, and then allow the hardware and rope excess to be thrown in the water. This technique is only recommended for use when the loss of equipment is not an issue.

14.12.4. **Aircraft Configuration.**

14.12.4.1. CRRC Secured (In Door/On Ramp).

14.12.4.2. Install Restraint "Teeter" Strap.

14.12.4.3. Connect quick release end to package and Carabiner end to floor, then adjust length so that it will allow the package to lean out the door, but not fall out of the aircraft.

14.12.4.4. Install motor and A-3 bag with fuel bladders and secure package with at least one CGU-1B cargo strap.

14.12.4.5. Attach belay to a center floor ring with a high-point directional at an overhead cargo ring or the FRIES bar.

14.12.4.6. An overhead cargo ring or the FRIES bar may be used as the attachment point if a floor ring is not an option.

14.12.4.7. Install rope in belay device and through high-point FRIES bar or cargo ring (T-Duck may bend the older H-bar.

14.12.4.8. If the aircraft has the H-bar, attach the belay device to a red cargo ring).

14.12.4.9. Secure all locking Carabiners.

14.12.4.10. Attach rope to FRIES bar, Coil and secure out of the way.

14.12.4.11. Extend FRIES bars or arrange with crew to extend bars by the 5-minute warning.

14.12.4.12. Activate chemlight at inflation handle (prior to takeoff in case the team cannot reach it during the time warnings sequence).

14.12.4.13. Ensure there is unrestricted access to the inflation handle.

14.12.5. **Time Warnings.** Standard time warnings are used to ensure both the deploying team and the crew are ready. Standard time warnings of 20, 10, 5, and 1 minute (30 seconds for CV-22) are announced by the aircrew based upon their calculated arrival (TOT). The rope master may require more than the minimum time calls and should be on intercom until at least the 5-minute call. The 20-minute and 10-minute time warnings are designed to inform of the approaching TOT; usually no actions are required other than mental preparation.

14.12.5.1. 5-minute call:

14.12.5.1.1. Extend the FRIES bar and ready it for deployment.

14.12.5.1.2. members will don fast rope and water PPE

14.12.5.1.3. Activate chemlights as required

14.12.5.1.4. Remove the cargo tie-down strap (after ensuring belay is set)

14.12.5.1.5. Slowly inflate the cones of the CRRC

14.12.5.2. 1-minute call.

14.12.5.2.1. Verify belay is set and holding full brake

14.12.5.2.2. Slide the T-Duck out the door until the teeter strap is taut.

14.12.6. **Deployment Procedures.** Use standard fast rope procedures for personnel deployment. The recommended minimum hover altitude is 30 feet above water level (AWL) and airspeed less than 5 KIAS, hover preferable. Chemlight colors and their specific use should be properly briefed to all deploying personnel to avoid confusion among types of equipment, emergency exits, and their corresponding colors. When the aircraft is established in a hover over the intended deployment site the pilot gives the command for deployment. **WARNING:** Ensure belay rope is slack prior to releasing from the deployed T-Duck to avoid the rope snapping back up into the aircraft fuselage/rotors.

14.12.6.1. Ensure CRRC deployment rope is manned, and all slack is taken out (to not overload belay system)

14.12.6.2. Team members in the cabin release the teeter strap

14.12.6.3. Slide the CRRC out the cabin door in a controlled manner (belay person and one team member deploy the CRRC).

14.12.6.4. The belay person lowers the CRRC to the water slowly.

14.12.6.5. One or more persons then deploy via fast rope to secure the package.

14.12.6.6. Aircraft departs as soon as team deploys, and the fast rope is recovered/released.

14.12.6.7. Fast rope insertion is considered the insertion method of choice during T-Duck operations.

14.12.6.8. Ramp-equipped VL aircraft can get the ramp low enough to the water for free-fall deployment of the T-Duck and low and slow of personnel. This method is only possible with calms seas and if the ramp is within 5 feet or less of the water.

14.12.7. **Procedures in the Water. NOTE:** Do not release quick releases until inflation has begun.

14.12.7.1. First swimmer to the T-Duck stabilizes it and places one hand on the inflation handle.

14.12.7.2. The second swimmer to the T-Duck assists in stabilization and confirms someone has the inflation handle in hand prepared to inflate.

14.12.7.3. Working in synchronization, swimmer two releases one side of the harness; repositions to release the second side of the harness, calls for inflation, and releases the second side of the harness once the inflation begins.

14.12.8. **Emergency Procedures.** Brief all personnel involved in the deployment the actions required of them in case of an emergency. The AIE master should be on intercom during equipment deployment. The rope master must understand the pre-briefed hand signals and emergency procedures. A V-blade knife will be available in the cabin area during equipment deployments.

Table 14.1. Suspended Weight Limits.

Suspended Weight Limits	
H-Bar	600 lbs.
FRIES bar in intermediate position	1,800 lbs.
FRIES bar in full extension	1,300 lbs.

14.12.9. **Considerations.** The belayer will maintain control of belay rope until the first swimmer has control of the T-Duck. In high seas, the belayer should maintain control of the T-Duck until de-rigging has begun.

14.13. Vertical Lift Aircraft Free-Fall Equipment Delivery. Equipment should be packaged to withstand the forces of being dropped.

14.13.1. Seven-or Twenty-Man Life Raft. Teams should not use any aircraft emergency equipment intended for use by the crew for the rescue of others except in emergencies.

14.13.2. **Preparing Raft for Drop.**

14.13.2.1. Remove the raft inflation “D” ring from its pocket and leave the pocket unsnapped.

14.13.2.2. Securely tie a 14-inch piece of web tape through the “D” ring to form an approximate 5-inch loop.

14.13.2.3. Secure the raft near the appropriate exit.

14.13.2.4. Attach a 10-foot lanyard to the tie-down ring that is located by the forward-most part of the side cargo door.

14.13.2.5. Attach the other end to the 5-inch loop of web tape.

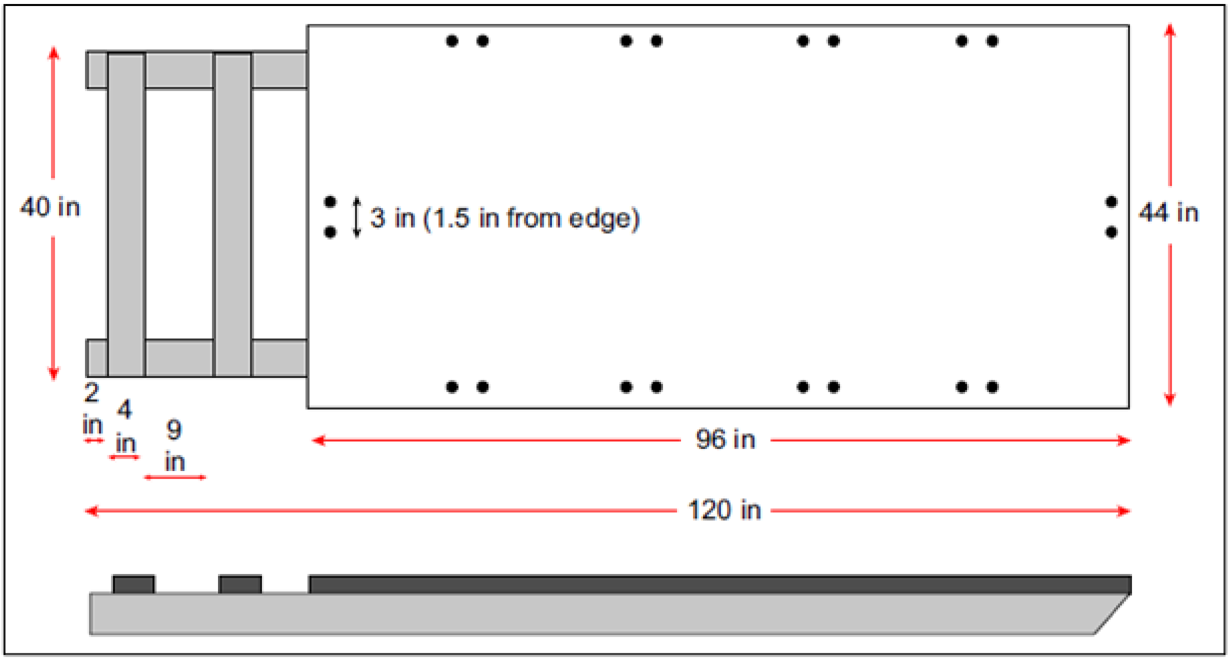
14.13.2.6. Snap the carrying handles together beneath the raft.

14.13.2.7. Attach chemlights to the raft at night prior to deployment.

14.14. SOF Duck. The SOF duck insertion method involves attaching an inflated CRRC preloaded with equipment to a wooden platform. Two CRRCs can be stacked opposite each other on the same platform. The OBM can be attached to the transom during insertion for quick derigging. Because of the size of the SOF duck, a VL aircraft with a ramp (e.g., CH-46, -47, -53) is required for insertion. Smaller aircraft, such as the CH-46, requires the CRRC to be under-inflated during the cast. The aircraft proceeds to insert point and deploys the SOF duck followed by the personnel from a 10-foot-at-10-knot flight profile. This method allows more equipment to be inserted with the CRRC as compared to the other cast-insertion methods.

14.14.1. **Construction of the SOF Duck and Platform.** The platform can be made of any type of smooth material that provides protection to the CRRC underside and allows the SOF duck to easily move on the aircraft roller rails. Figure14.2, SOF Duck Platform, shows the platform for an SOF duck. The recommended construction of the platform and SOF duck is as follows:

Figure 14.2. SOF Duck Platform.



14.14.1.1. Cut a sheet of 0.75-inch, 4-foot x 8-foot plywood to 44 inches x 96 inches. (leave 48 inches x 96 inches for H-47 and -53 rigging).

14.14.1.2. Drill four pairs of holes equally spaced on each long side of the plywood. Drill one pair of holes centered in each short side. The holes that make up a pair are three inches apart and 1.5 inches from the edge.

14.14.1.3. For the H-46, runners can be built to match the internal rollers using the following techniques. For an expedient platform, skip to **paragraph 14.16.1.9**.

14.14.1.4. Place a 45-degree beveled cut on the end of two 120-inch, 4-inch x 4-inch pieces of wood. Place the 4-inch x 4-inch rails on the ground parallel to each other and spaced 40 inches apart (measured from the outside edge) with the beveled edge facing down.

14.14.1.5. Place the 44-inch x 96-inch sheet of plywood on the 4-foot x 4-foot rails aligning the long side of the plywood with the rails. The leading edge of the plywood is even with beveled end. Secure the plywood with screws or nails.

14.14.1.6. Cut two plywood 4-inch x 40-inch braces from the scrap wood remaining. Attach the braces perpendicular to the rails at the open end of the rails. The braces are spaced 9 inches apart with the first brace starting 2 inches from the end of the rail. Secure using screws or nails. The brace is used to secure the lower unit of the OBM.

14.14.1.7. Girth hitch a 14-foot length of 0.5-inch tubular nylon through each pair of side holes and a 20-foot length through each pair of end holes.

14.14.1.8. Mount the OBM to the transom temporarily locked in tilt position. Place two layers of cut honeycomb on the platform braces to cushion the lower OBM unit. Unlock from the tilt position and secure the lower unit to the honeycomb and platform using 0.5-inch tubular nylon.

14.14.1.9. On expedient platform with a fully inflated CRRC (H-47/53 employment) without runners and the engine platform, tie a 15 foot length of type VIII "gate" nylon to a rear towing D-ring.

14.14.1.10. While maintaining max possible tension, route the nylon under the engine's drive shaft housing, then wrap around the drive shaft housing and continue to the opposite rear towing D-Ring. Secure the nylon using a trucker's hitch to induce max tension.

14.14.1.11. Once complete the system will support the engine in the "unlocked" position without letting the prop sag below the level of the platform. **NOTE:** Ensure the OBM is free floating (unlocked) when mounted to the transom to prevent damage to the transom. See **Figure 14.3** for the expedient SOF Duck engine mount.

Figure 14.3. Expedient SOF Duck Engine Mount.

14.14.1.12. The equipment in the CRRC is secured in a similar fashion as the hard duck (see Army FM 10-542) using 0.5-inch tubular nylon.

14.14.1.13. Partially deflate the CRRC prior to securing it to the platform. Bring the 14-foot side and 20-foot end tie-downs up to meet and tie off in the center using a donut ring as outlined in the Hard Duck Manual (Army FM 10-542). Keep the sides square when securing the tie-downs by pulling equally from all sides. The limiting factor of the SOF duck is that it can be no wider than 60 inches for H-46. (Deflation is not required for H-47 and -53 aircraft.)

14.14.1.14. For stacked SOF duck procedures, refer to Naval Special Warfare Air Operations Manual, COMNAVSPECWARCOMINST 3000.3A.

14.14.1.15. Sandbags may be placed on the platform to sink the platform and minimize floating debris after the CRRC is derigged. **NOTE:** Load equipment and fuel in the CRRC toward the front, ensuring a slightly nose heavy configuration, this will aid in preventing the CRRC from flipping during deployment.

14.14.2. **Loading the SOF Duck in the Aircraft.** The boat may be loaded bow or stern first; two boats may be loaded if loaded bow first in the H-47. Secure the boats with at least two cargo tie-down straps per boat, with a short bow or stern line attached with quick-release to the aircraft. The load is positioned partially on the ramp. The 4-inch by 4-inch runners on the platform will sit on top of the aircraft's internal roller rail system. If rollers are not available in the VL aircraft, portable roller rails or a field expedient roller assembly can be rigged in the aircraft. A field expedient roller assembly can be rigged using lengths of PVC cut to 2.5 feet and placed under the CRRC.

14.14.3. **Deployment Procedures.**

14.14.3.1. "5-MINUTES" call: Team members who will deploy from the front, if this method is used, will move to the front of the cabin area. The team members who will deliver the boat will prepare for exit in the aft. **NOTE:** The H-53 must have the tail skid retracted prior to drop.

14.14.3.2. "1-MINUTE" call: Team members and crew members will prepare the boat for drop by removing tie-down straps, except bow or stern line. The pilot will approach a 10-foot wheel height above the waves while slowing to 10 knots ground speed.

14.14.3.3. "BOATS, BOATS, BOATS" call: The pilots gives this final call when cleared to drop. When cleared, the designated crew member or team member will release the bow or stern line from the aircraft and push the boat out. The delivery TL will remain on intercom until the "1-MINUTE" call. A pre-briefed crew member on intercom will relay the clear-to-drop signal to the team. **NOTE:** The team may exit the aircraft from either the door, ramp, or both. If both are used, execute the ramp delivery first.

14.14.4. **Derigging the SOF Duck.** A hook knife or trauma shears works best for cutting lines and preventing damage to the CRRC. Once all lines securing the boat to the platform are cut, pull the CRRC off the platform, lower the motor into the underway position, ensure the prop is free of entanglements and begin engine start procedures. If the engine has been submerged, use RAMZ dewatering techniques.

14.15. Special Patrol Insertion/Extraction System (SPIES). The SPIES was developed to rapidly insert or extract team members from an area where landing is not possible. It is relatively slow and impractical compared to fast rope and rappelling techniques. SPIE has gained applicability for extracting personnel from water. This system can recover up to ten personnel at a time. The rope and personnel are treated as an external load, so airspeeds, altitudes, and oscillations must be closely monitored.

14.15.1. **Standard equipment:**

14.15.1.1. SPIES rope.

14.15.1.2. SPIES harness (commercial/improvised) with safety sling.

14.15.1.3. Two 9-foot Type 13 cargo suspension slings. (NSN:1670-00-856-0266)

14.15.1.4. Type IV links.

14.15.1.5. Leather work gloves.

14.15.1.6. Eye protection.

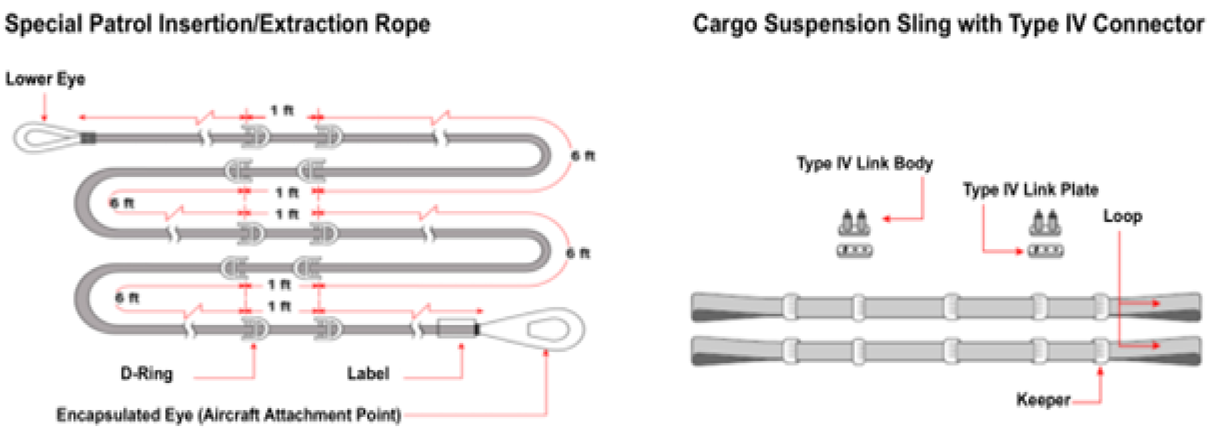
14.15.1.7. Helmet (as required).

14.15.2. **Setup and Preparation.** The SPIE system consists of the SPIE rope, a harness, and a safety line. The SPIE rope assembly (NSN: 1670-01-065-0851) is approximately 120 feet long with doubled tapered eye splices at each end. The top eye is encapsulated in polyurethane to protect it from abrasions. The rope is one inch in diameter and coated with a nylon solution for protection. Ten "D" rings are located in pairs on opposite sides of each other, spaced 1 foot apart and 7 feet from center of one set to center of the succeeding set. Four additional "D" rings can be added to provide a capacity of 14 personnel. The assembly has a tensile strength (dry) of 24,000 pounds and a recommended maximum load of 5,000 pounds. The SPIE harness is a parachute-type harness. A 20-inch looped strap is connected to the crossover portion of the back straps; a locking Carabiner is used to connect this to the SPIE rope. The safety sling consists of a 12- to 15-foot rope that serves as the secondary anchor device and is worn underneath the harness.

14.15.3. **Installation.**

14.15.3.1. Two 9-foot Type 13 nylon cargo suspension slings are routed through the top tapered eye of the rope assembly and secured to the four rappel rings with Type IV links.

Figure 14.4. SPIE Setup.



14.15.3.1.1. Pad the entire left edge of the cargo hook well with appropriate material (e.g., two thicknesses of 0.5-inch felt pads, carpet, and fire hose) to prevent damaging the SPIE rope. If the cargo hook is installed, the rope assembly should be routed through the hook during deployment.

14.15.3.1.2. For night operations, attach chemlights to the SPIE rope assembly. Using three chemlights, tape two chemlights at the bottom of the rope and one chemlight 3 feet above the first set of "D" ring attachment points.

14.15.3.1.3. For water operations, tie three flotation devices to the SPIE rope to provide buoyancy for the rope while in the water. Tie one flotation device at each end of the "D" ring attachment point areas and one flotation device in the middle of the attachment point area, just above the middle two sets of "D" rings. **WARNING:** The tensile strength of the SPIE rope is reduced when wet.

14.15.4. **Employment Procedures.**

14.15.4.1. Once established over the landing zone (LZ), aircrew will deploy the rope.

14.15.4.2. Once on the ground, the team members hook into the "D" rings.

14.15.4.3. When all members are secure and ready, the TL will give the aircrew "thumbs-up" (at night, prearranged light signals may be used).

14.15.4.4. If possible, the radio person will hook up close to the bottom of the rope and maintain radio contact with the aircraft in order to provide a verbal backup for the extract, clearing of obstacles, and descent into the LZ.

14.15.4.5. Upon receiving the "thumbs-up" from the team, the aircraft will ascend once the SPIE rope is clear of all obstacles and slowly accelerate to 40 to 60 knots to a secure area.

14.15.4.6. A minimum 100-foot clearance should be maintained between the bottom of the SPIE assembly and ground obstacles, tactical situation permitting.

14.15.4.7. During the flight, the aircrew should advise the pilot of team status and check rigging frequently. **WARNING:** Aircraft must not exceed 70 knots in warm weather or 50 knots in cold weather to prevent environmental injury to suspended personnel.

Chapter 15

AERIAL DELIVERY & RESUPPLY

15.1. Types of Airdrops. Container loads are delivered by Low-velocity airdrops and free-fall airdrops.

15.1.1. **Low-Velocity Airdrop.** A low-velocity airdrop is the delivery of supplies from an aircraft using cargo parachutes. The loads are prepared for airdrop either by packing the item in air droppable containers or by lashing them to air droppable platforms.

15.1.2. **High-Velocity Drop.** A high-velocity drop is the delivery of items or supply that are specially packed and rigged in containers having layers of energy-dissipating material attached to the underside. The stabilizing device, such as a ring-slot parachute, is designed to minimize oscillation of the load and to create enough drag to keep the load upright during descent.

15.1.3. **High-Speed/Low-Level Aerial Delivery System.** The high-speed/low-level aerial delivery system was developed for airdrop resupply from the Combat Talon flying at 250 KIAS and as low as 76 meters (250 feet) above ground level (AGL). This system employs a modified container using A-21 covers and a modified 22-foot or 28-foot extraction parachute. This system can deliver up to four cargo containers weighing a minimum of 250 pounds each but not exceeding a total of 2,200 pounds at delivery altitudes ranging from 76 to 229 meters (250 to 750 feet) AGL. A "slingshot" ejection system ejects the cargo load over the designated area.

15.1.4. **Free-Fall Airdrops.** Free-fall airdrop is the delivery of non-fragile items of equipment or supply from a slow-flying aircraft at low altitudes, without the use of parachutes or deceleration devices. This technique is most effective when the drop can be made into a river, stream, or other body of water to soften the impact on landing.

15.2. Methods of Airdrops.

15.2.1. **Door Loads.** Door loads are pushed or rolled out of the paratroop doors or ramp. This method is suitable for free-fall airdrops, low-velocity airdrops, and high-velocity airdrops. This method is commonly used for re-supply door bundles.

15.2.2. **Wing Loads.** Wing loads are rigged in containers attached to the shackles on the underside of the aircraft wings. The aircraft load capacity, the container's size, and the container's asymmetrical flight characteristics limit the size, weight, and shape of the load.

15.2.3. **Gravity-Release Loads.** Gravity-release loads function by cutting the load-restraining ties and allowing the load to roll out of the cargo compartment by gravity alone. The aircraft flies at a pre-determined drop altitude in a nose up attitude. An example of this method is the rigged alternate method-boat (RAMB).

15.2.4. **Extraction Loads.** Extraction loads use a drogue parachute to extract a platform from the aircraft cargo compartment.

15.2.5. **External Transport Loads.** External transport works by hanging a load from a hook clevis on a helicopter. The load is flown to the delivery site and released using the free-fall, low-velocity, or high-velocity airdrop method. An example of this method is the K-Duck.

15.3. Cargo Parachutes.

15.3.1. **Inspection and Maintenance.** The inspection, repacking and maintenance of cargo parachute assemblies will be performed by certified AFE personnel. Teams should become familiar with the inspection and repack dates. Refer to the appropriate TO for complete inspection, packing instructions, and storage.

15.3.2. **Routine Inspection.** PJs should be familiar with performing routine inspections of assigned cargo parachutes.

15.3.2.1. Check the external condition of the parachute packs, risers, and static lines for visible defects, weak spots, broken threads, cuts, frays, or other damage.

15.3.2.2. Check all hardware for rust, corrosion, and smoothness of operation.

15.3.2.3. Inspect pack closing and static line break cords for defects in material, incorrect cord, improper routing, or improperly tied knot.

15.3.2.4. Inspect condition of parachute pack and ensure parachute canopy material is not showing.

15.3.2.5. Check parachute pack for tears, loose stitches, stains caused by oil or grease, and weakened areas.

15.3.2.6. Parachutes will be stored IAW applicable technical orders.

15.3.2.7. Parachutes will not be stored wet or damp.

15.3.2.8. If the routine inspection reveals conditions indicating a need for repairs, the parachute will be turned over to the parachute repacking facility, regardless of the date of last repack.

15.3.3. **Cargo Parachute Types and ballistics.**

Table 15.1. Cargo Parachute Data.

Parachute	Diameter (feet)	Weight (pounds)	Capacity (pounds)
G-8 / M390	8	11	100
T-7A	28	16	100 to 500
G-13	24.25	45	200 to 500
G-14	34	37	200 to 500
T-10 C/D	35	20	90 to 350
G-12	64	128	501 to 2,200

15.4. Aerial Delivery Containers. Except for fuel containers, types and sizes of containers are not specified. Regardless of content or container, personnel using the equipment should be familiar with the content and placement of equipment.

15.5. Cushioning Materials for Aerial Delivery Loads. Equipment may require padding or cushioning materials. Items can be separated with Styrofoam, cellulose wadding, felt sheets, or any energy-dissipating material pads (honeycomb) suitable to protect them from damage. Exercise care when packing components of assemblies to ensure all items necessary for operation of the assembly are packed in the same airdrop container.

15.6. Aerial Delivery Equipment. This section contains information on the use of cargo slings, bags, and airdrop containers. See **Table 15.2** for aerial delivery systems details.

Table 15.2. Aerial Delivery Systems.

Delivery System	Type	Weight (pounds)	Capacity (pounds)
A-7A	Sling	6.0	500
A-10	Net	7.0	300
A-13	Rigid	7.0	100
A-16	Rigid	45	200
A-21	Bag	31	500
A-22	Bag	58	625 to 2,200
AKIO	Sled	38	200

15.6.1. **A-7A Cargo Sling.** The A-7A cargo sling consists of four identical 188-inch sling straps. Each sling strap has a stationary parachute quick-fit friction adapter and a floating "D" ring. Use a combination of two, three, or four sling straps for rigging per load depending upon its size, weight, and shape. It is used to drop non-fragile supplies. Its maximum load capacity is 500 pounds. The minimum load is dependent on the type of parachute used and the method of airdrop (low- versus high-velocity). Two A-7A sling straps have a maximum weight limit of 300 pounds, three straps, 400 pounds, and four straps, 500 pounds.

15.6.2. **A-21 Cargo Bag Assembly.** The A-21 cargo bag assembly is an adjustable container consisting of a sling assembly with scuff pad, a quick-release assembly, two ring straps, and a 97- by 115-inch canvas cover. The A-21 cargo bag weighs approximately 31 pounds. Use it to drop both fragile and non-fragile supplies. The maximum load capacity is 500 pounds. The minimum load capacity is dependent on the type of parachute used and the method of airdrop.

15.6.3. **A-22 Cargo Bag Assembly.** The A-22 cargo bag assembly is an adjustable, cotton duck cloth and webbing container consisting of a cotton or nylon webbing sling assembly, a cover, and four cotton or nylon suspension webs. The modified A-22 cargo cover is the only part of the system used when rigging the deflated CRRC. The A-22 cargo bag has a maximum load capacity of 2,200 pounds. The maximum allowable dimensions for a rigged load are 48 inches wide and 55.5 inches long. The maximum height is normally 83 inches but may extend to 100 inches with HHQ Air Force approval. For a low-velocity airdrop, a standard cargo bag skid (48 X 53.5 inches) serves as a base for the container load. For a high-velocity airdrop, the standard cargo bag skid or an appropriate size piece of plywood for the base of the container load is used. The A-22 assembly weighs approximately 58 pounds. Only ammunition listed in FM 10-553 may be airdropped.

15.6.4. **A-10 Cargo Net.** The cargo net is the most versatile aerial cargo delivery system (CDS). The net weighs 7 pounds and has a 300-pound capacity

15.6.4.1. Rigging. Lay intended cargo in center of the net with the heaviest items in the center and low in the net, fold sides up with excess facing in (double fold if needed). Use multiple carabiners to take the slack out of the net with an emphasis on keeping the net as stream lined as possible and the excess net folded to the inside of the bundle. Any excess in the bundle poses a serious snag hazard during deployment. The intended parachute should be placed on the top of the bundle over the center of gravity. Attach the parachute with locking carabiners/clevises to as many strands of the net as possible. The size limit of the bundle is driven by the maximum size of the opening through which the bundle will be deployed.

15.6.4.2. T-10/11 parachute Options. The T-10/11 is the most commonly used parachute on cargo nets. The T-10/11 can be used in either the cargo or chest reserve configuration (MIRPS).

15.6.4.3. Procedures: The cargo parachute S/L can be attached directly to the anchor line cable on the aircraft. When using MIRPS, attach a 15-foot lanyard of 550 cord or girth hitch a 15 foot static line to the reserve handle when using 550 cord, attach the other end to a cargo ring on the aircraft floor. Attach the cord to a cargo ring that will not hamper the deployment efforts or pose a safety issue. Cargo net riser extensions can be used to attach the parachute to the bundle in preparation of a parachute landing in a tree or other obstruction. Recommended material to make the riser extensions is a static rope or 1 inch tubular webbing. Adjust the length to the common obstructions in your intended deployment area. Make sure the "S" fold or "birds' nest" of the riser extensions is secured to the bundle with retaining bands so as to not inhibit deployment. **CAUTION:** When using MIRPS with 15-foot static line girth hitched to handle, ensure the handle is padded with Styrofoam or similar material. This will prevent damage to the aircraft should the handle make contact with the aircraft exterior after parachute has deployed.

15.7. Aerial Delivery Procedures.

15.7.1. **Airdrop Patterns.** The cargo airdrop patterns flown by the aircraft are similar to personnel deployment patterns. The minimum altitude for day equipment bundle paradrop is 300 feet and 150 feet for day free-fall equipment drops (reference MDS specific TOs, AFIs, and guidance).

15.7.2. **Water Equipment Delivery.** Items dropped to personnel in the water are dropped with retrieval lines. For drops to surface vessels, the MA-1/2 kit may be used as a delivery vehicle and the equipment to be delivered substituted for the number 2, 3, or 4 bundles. If rafts are not required, a delivery kit can be constructed by replacing the life rafts with MK 6 Mod 3 flare smokes. When a parabundle is dropped using the above procedure, a parachute must be attached to the MK 6 Mod 3.

15.7.3. **Tree Let-Down Sling.** TLs should consider using the tree let-down sling when delivering equipment into areas of rough terrain or dense forest. Using this procedure allows equipment to penetrate obstacle (e.g., tall trees) and fall to the ground prior to the parachutes being hung up.

15.7.4. **Procedures are as follows. WARNING:** Jumpers exiting the aircraft after bundles must exit when the parachutes are free from the D-bag. Parachutists may become fatally entangled in the tree let-down sling if exiting immediately after the bundle. **CAUTION:** Double-wrapped stows must be used on the tree let-down sling. Using single-wrap stows may cause line dump that may induce terminal results for the equipment bundle.

15.7.4.1. Take a suitable length of rope (dependent on height of obstacle to be penetrated) and double that length plus rope for knots.

15.7.4.2. Tie a double figure eight on a bight at the working end of the rope and attach it to the load using two locking carabiners (one on each bite of the figure eight), usually to the two attachment points on an A-7 sling.

15.7.4.3. "S" fold the remaining length of rope, bottom to top, onto the load using double-wrap rubber-band stows.

15.7.4.4. Take the running end of the rope and tie a double figure eight on a bight, attach it to the cargo parachute risers using a clevis.

15.8. Airdropping Fuel. Units operating in or subject to operate in cold climate areas must use special fuel (Coleman/white gas, butane/propane). Lanterns, stoves, and heaters carried, stored, or deployed from aircraft will be empty and void of fuel or fumes. Fuel carried aboard aircraft will be in approved fuel containers and be padded to prevent accidental rupture. The following examples are the preferred methods of carrying fuel on aircraft.

15.8.1. **One-Gallon Cans.** Place one to three 1-gallon cans of factory sealed Coleman fuel into a metal 1,500-round ammunition component box. Use absorbent, non-flammable packing material such as vermiculite around the fuel cans to prevent shifting and contact with other cans. Ensure rubber gasket is intact prior to placing the lid on the ammunition box to provide a good seal on the ammunition box.

15.8.2. **Small Cans.** Aluminum fuel bottles (pint or quart, no pour spout) must have an unvented screw-on cap and gasket. They can be carried as described above or in a field pack. When carried in a field pack, aluminum fuel bottles will be centrally located where they are protected on all sides and not in contact with hard objects. **NOTE:** Recommend fuel bottles be filled at temperatures of 75 to 80 degrees Fahrenheit.

15.8.3. **Shipping Requirements.** Butane/propane cylinders should be carried in a containers provided by the manufacturer. Or in metal ammunition boxes with sufficient packing material to prevent shifting and contact with other cylinders.

15.8.4. **Labeling.** When fuel containers are carried on aircraft with floor heating systems, containers will be insulated from the floor. Ammunition component boxes or other similar containers used as storage/delivery containers will be marked by the word "FLAMMABLE" stenciled in 1-inch letters on two sides. Under the word "FLAMMABLE", stencil with 1-inch letters the type of fuel. Fuels such as white gas and butane will not be stored in the same container. Field packs containing fuel will have tags affixed to it and be stenciled in 1-inch letters as stated above. All containers must meet packing requirements for hazardous cargo.

15.9. Special Tactics Rucksack Lowering Line System (STRLLS). Use of the STRLLS in conjunction with the All-Purpose Lightweight Individual Carrying Equipment (ALICE) pack system eliminates disassembly of the pack as components remain attached to the rucksack. **NOTE:** Refer to Major Command specific guidance for construction, inspection, and maintenance of the STRLLS.

15.9.1. **Fabrications Procedures are as follows:**

15.9.1.1. Static Line (S/L) and Military Freefall (MFF) front mounted release assembly materials:

15.9.1.1.1. 2ea. - 30” x 1” tubular nylon

15.9.1.1.2. 2ea. - 16” x 1” 23/32” type 8 nylon

15.9.1.1.3. 1ea. - 10” x 1” hook Velcro®

15.9.1.1.4. 1ea. - 10” x 1” pile Velcro®

15.9.1.1.5. 2ea. - HR Snap Shackles (stainless steel) P/N 2375 (functional load 3525 lbs.)

15.9.1.2. S/L and MFF front mounted release assembly fabrication:

15.9.1.2.1. Run one end of the type 8 nylon through the bail of the snap shackle (the bail is the closed ring that swivels).

15.9.1.2.2. Sew the type 8 nylon closed with a ¾” box stitch making a ¾” loop around the bail. See **Figure 15.1**.

15.9.1.2.3. Sew one, 10” length of hook Velcro® onto first piece of 1” tubular nylon, 1 1/4” from one end.

15.9.1.2.4. Sew one, 10” length of pile Velcro® onto the second piece of 1” tubular nylon, 1 1/4” from one end.

15.9.1.2.5. Run the other end of the 1” tubular nylon through the release ring and overlap the tubular nylon over itself up to the edge of the hook/pile tape on the outside. See **Figure 15.1**.

Figure 15.1. Snap Shackle Box Stich & Hook/Pile Configuration.

15.9.1.3. MFF rear mounted release assembly materials:

15.9.1.3.1. 2ea. – 30” x 1” tubular nylon

15.9.1.3.2. 2ea. – 36” x 1 23/32” type 8 nylon

15.9.1.3.3. 2ea. – reversible adapter (friction adapter P/N 5340-01-073-5304) MS70101-2 stamped on buckle

15.9.1.3.4. 2ea. – 5 ¾” x 1 23/32” type 8 nylon

15.9.1.3.5. 1ea. – 10” x 1” hook Velcro®

15.9.1.3.6. 1ea. – 10” x 1” pile Velcro®

15.9.1.3.7. 2ea. – HR Snap Shackles (stainless steel) P/N 2375 (functional load 3525 lbs.).

15.9.1.4. MFF rear mounted release assembly fabrication:

15.9.1.4.1. Connect bail of snap hook to friction adapter using 5 ¾” type 8 nylon.

15.9.1.4.2. Sew type 8 nylon closed with a ¾” box stitch or double bar tack making a ¾” loop around the bail and through the friction adapter. See **Figure 15.3**.

15.9.1.4.3. On one end of 36” type, 8 nylon, sew a 1” triple fold with a ¾” box stitch or double bar tack.

15.9.1.4.4. Route opposite end of 36” type 8 nylon through adapter. Sew 3 ½” fixed loop on end with ¾” box stitch or double bar tack ensuring a 2 ¾” opening. See **Figure 15.2** MFF Rear Mounted Release Assembly.

Figure 15.2. MFF Rear Mounted Release Assembly.

15.9.2. **Harness assembly materials:**

15.9.2.1. 1ea. - 15” x 1 23/32” type 8 nylon.

15.9.2.2. 3ea. - 85” x 1 23/32” type 8 nylon.

15.9.2.3. 3ea. - milspec 70101 or 70101-1 friction adapters.

15.9.2.4. Size E nylon thread (8310-00-616-0079).

15.9.3. **Harness assembly fabrication:**

15.9.3.1. Cut and heat sear three, 85” long lengths and one 15” long length of type 8 nylon webbing. The horizontal strap can be constructed with type 4 or 8 nylon.

15.9.3.2. Assemble the horizontal strap by running one end of the 85”, type 8 nylon webbing through the bottom portion of the friction adapter and overlap the running end of the nylon webbing 17 ½” back onto itself creating a 17 ½” flap.

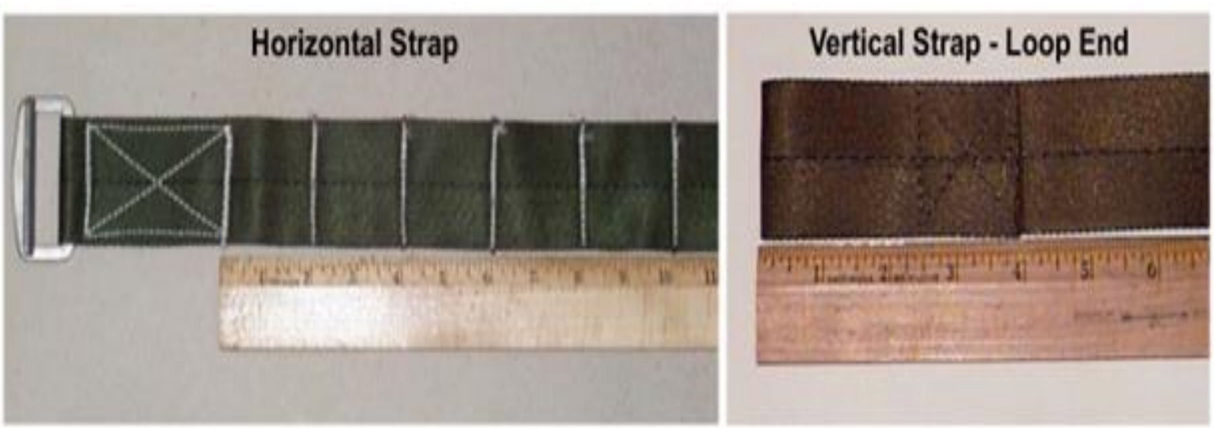
15.9.3.3. Place the 15” piece of type 8 nylon webbing under the 17 ½” flap created in 4.2.1.1. so that it is sandwiched between the running and standing ends of the 85” piece of type 8 nylon.

15.9.3.4. Sew a 3” box “X” to secure the friction adapter. There will be approximately 14” of flap left.

15.9.3.5. Measure and mark in 2” increments down the remaining 14” of flap.

15.9.3.6. Ensuring the edges are flush, sew across all layers of type 8 nylon at each mark. Forward and back stitch three times for reinforcement. See the horizontal strap in **Figure 15.3**.

Figure 15.3. Horizontal and Vertical Straps.



15.9.3.7. Assemble each of the vertical straps by taking an 85” length of type 8 nylon webbing and measure and mark the webbing 4” from one end. Fold the webbing at the mark creating a 4” flap of material. Measure 2” from the end of fold. Mark 2” measurement and sew a ½” “box X”. See the vertical strap in **Figure 15.3**.

15.9.3.8. Place two marks; one 11 ½” from the folded edge, the second 17 ½” from the folded edge (**Figure 15.4**). Fold the webbing at the 17 ½” mark making a bite approximately 3” long which lines up at the 11 ½” mark (This will create a “Z” shaped threefold). Place the posterior section of friction adapter on threefold so it’s located on the bite of webbing created between the 11 ½” mark and the 17 ½” mark. Lay flat, align edges, and sew a 2 inch “box X” through all three layers of webbing. See **Figure 15.4**. Vertical Strap Friction Adapter.

15.9.3.9. Repeat the previous steps for the second vertical strap.

Figure 15.4. Vertical Strap Friction Adapter.

15.9.4. **Installing the STRILLS on the ALICE Pack:**

15.9.4.1. **Step-1:** Route the free end (end without friction adapter) of horizontal strap through the right-side keeper from rear of rucksack toward the rucksack frame (ensure the sewn-on portion of the horizontal strap faces toward rucksack frame). Route strap under right side of rucksack frame over middle crossbar of pack frame and back under the left side of rucksack frame. Continue routing through the left side keeper. See **Figure 15.5**.

15.9.4.2. **Step-2:** Take vertical straps, keeping the friction adapters to outside (away from rucksack) and route the looped ends behind the large equipment side pockets. See **Figure 15.5**.

Figure 15.5. STRILLS Rigging: Steps 1-2.

15.9.4.3. **Step-3:** Route free end of horizontal strap through the loops of the vertical straps and under the rucksack closing straps. Secure to the horizontal strap friction adapter, then tighten and stow excess webbing with 80lb or speed tape. See **Figure 15.6**, for Steps 3-8.

15.9.4.4. **Step-4:** Route the free ends of the vertical straps under the rucksack lower back crossbar.

15.9.4.5. **Step-5:** Continue up, over horizontal crossbar and through an appropriate vertical strap keeper (strap should come up through the section closest to rucksack frame and back down through the same section of keeper.

15.9.4.6. **Step-6:** Continue routing over the horizontal crossbar and back under the rucksack lower lumbar crossbar.

15.9.4.7. **Step-7:** Continue routing through the appropriate vertical strap friction adapter to tighten, and then secure excess webbing.

15.9.4.8. **Step-8:** The lowering line is then attached to the horizontal strap by girth hitching the looped end of the lowering line around the horizontal strap or around a locking carabiner clipped to the horizontal strap. The rucksack may remain rigged at all times; however, the lowering line should be removed during non-airborne operations.

Figure 15.6. STRILLS Rigging: Steps 3-8.

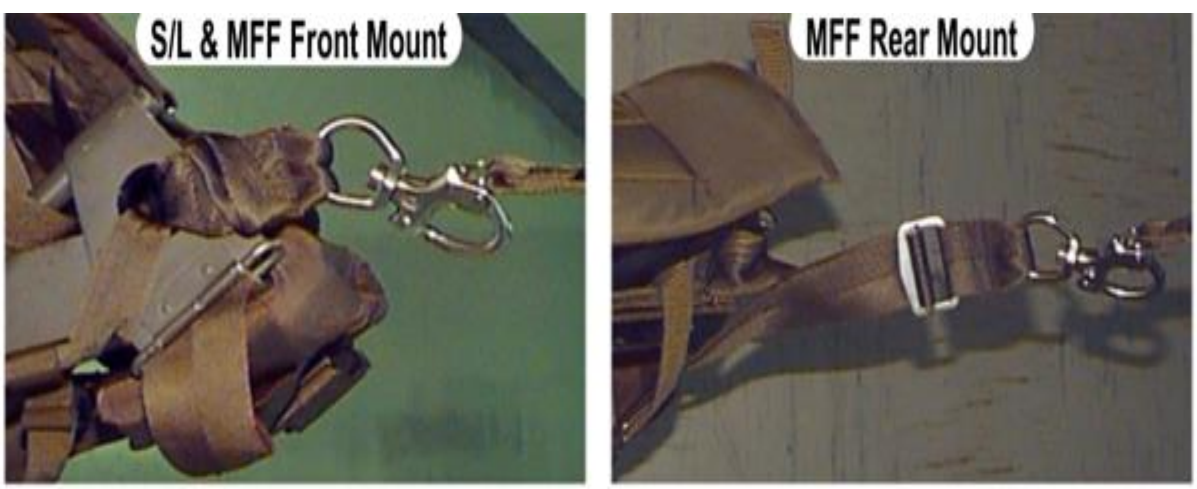
15.9.5. **Installation of Quick Release Assembly for S/L and MFF Front Mounting:**

15.9.5.1. Run the looped ends of the release straps through the round holes on the lower sides of the frame, then run each shackle through its respective loop. Pull up on the shackle to tighten as much as possible. **NOTE:** When additional length is required to attach rucksack to parachute harness, attach a locking carabiner to the hole in the bottom side of the frame and through the loop of the quick release strap. This will provide a small extension when wearing a front mounted compass board for High Altitude High Opening operations.

15.9.6. **Installation of the Quick Release Assembly for MFF Rear Mounting:**

15.9.6.1. Run the looped ends of the release straps through the round holes on the bottom of the frame, then run each shackle through its respective loop. Pull up on the shackle to tighten as much as possible. See **Figure 15.7**.

Figure 15.7. S/L & MFF Mounting.



15.9.7. **STRILLS Jumpmaster Personnel Inspection:**

15.9.7.1. Inspect the equipment attaching strap fittings to ensure that they are fully seated, the release handles have been connected with hook/pile tape, and are routed over, not under the reserve parachute (for static-line operations).

15.9.7.2. Inspect the equipment attaching straps to ensure that they are secured to the round reinforced rings on the ALICE frame. Inspect the straps, which secure the bottom portion of the ALICE pack, for torn stitching.

15.9.7.3. Inspect the horizontal harness strap to ensure that it is routed through the keepers on either side of the ALICE pack and the looped ends of the vertical harness straps. Make sure that the free end of the horizontal harness strap is secured with tape or ¼-inch cotton webbing.

15.9.7.4. Inspect the vertical harness straps to ensure that they are routed behind the outside cargo pockets on the ALICE pack.

15.9.7.5. Lift the ALICE pack.

15.9.7.6. Inspect the vertical harness straps to ensure that they are routed through the keepers on the horizontal harness straps from top to bottom.

15.9.7.7. Inspect the free ends of the vertical harness straps to ensure that the straps are properly routed through the friction adapters and secured with tape or ¼-inch cotton webbing.

15.9.7.8. Inspect the hook pile tape lowering line to ensure that it is secured through the center keeper on the horizontal harness strap. Ensure the hook pile lowering line is secured to the rucksack frame with two retainer bands. Ensure the lowering line is attached to the quick fit V-ring (right side for MFF, left side for S/L) on the parachute harness lowering line adapter web. Ensure routing of the hook pile tape lowering line between the V-ring and center keeper on the horizontal harness strap is free of the ALICE pack shoulder straps.

15.9.7.9. If a locking carabiner is used, ensure that it is secured through the center keeper on the horizontal harness strap. Secure the looped end of the hook pile lowering line to the locking carabiner. Ensure the hook pile lowering line is secured to the rucksack frame with two retainer bands. Ensure the lowering line is attached to the quick fit V-ring (right side for MFF, left side for S/L) on the parachute harness lowering line adapter web. Ensure routing of the hook pile tape lowering line between the V-ring and center keeper on the horizontal harness strap is free of the ALICE pack shoulder straps.

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Attachment 1

GLOSSARY OF REFERENCES AND SUPPORTING INFORMATION

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Prescribed Forms

None

Adopted Forms

DAF Form 847, *Recommendation for Change of Publication*

Abbreviations and Acronyms

AFI—Air Force Instruction

AFMAN—Air Force Manual

AFPD—Air Force Policy Directive

AFTTP—Air Force Tactics, Techniques and Procedures

AGL—Above Ground Level

AIE—Alternate Insertion and Extraction

ALICE—All-purpose Lightweight Individual Carrying Equipment System

AO—Area of Operation

AOR—Area of Responsibility

ATO—Air Tasking Order

ATP—Army Tactical Publication

AWL—Above Water Level

BLS—Beach Landing Site

C2—Command and Control

CASEVAC—Casualty Evacuation

CC—Commander

CCDR—Combatant Commander

CCIR—Commander's Critical Information Requirements

CCP—Casualty Collection Point

CDS—Container Delivery System / Cargo Delivery System

COA—Course of Action

CONPLAN—Concept Plan

CONUS—Continental United States

COP—Common Operating Picture

CP—Contingency Planning / Command Post

CRO—Combat Rescue Officer

CRRC—Combat Rubber Raiding Craft

CS/SC—Confined Space/Structural Collapse

CSAR—Combat Search and Rescue

DA—Direct Action

DAGR—Defense Advanced GPS Receiver

DM—Designated Marksman

DOD—Department of Defense

DODI—DOD Instruction

DOS—Day Optic Sight

DZ—Drop Zone

EGS—Emergency Gas Supply

EL—Element Leader

EOD—Explosive Ordnance Disposal

EPA—Emergency Plan of Action

EPW—Enemy Prisoner of War

FARP—Forward Arming and Refueling Point

FFM—Full Face Mask

FM—Field Manual / Frequency Modulation

FRAGORD—Fragmentation Order

FW—Fixed-Wing

GA—Guardian Angel

GFC—Ground Force Commander

GPS—Geographical Positioning System

HA/DR—Humanitarian Aid and Disaster Relief

HHQ—Higher Headquarters

HLZ—Helicopter Landing Zone

HSFS—Human Space Flight Support

IAW—In Accordance With

ICS—Internal Communications System

IP—Isolated Personnel / Impact Point

IR—Infrared

ISR—Intelligence, Surveillance, and Reconnaissance

JFC—Joint Force Commander

JPADS—Joint Precision Airdrop Delivery System

JPRC—Joint Personnel Recovery Center

JTAC—Joint Terminal Attack Controller

JTF—Joint Task Force

KIA—Killed in Action

LBE—Load-Bearing Equipment

lbs—Pounds

LOS—Line of Sight

LRH—Load-Releasing Hitch

LZ—Landing Zone

MDMP—Military Decision Making Process

MDS—Mission Design Series

METT-TC—Mission, Enemy, Terrain and Weather, Troops and Support Available - Time Available and Civilian Considerations

MFE—Multi-Fuel Engine

MFF—Military Free Fall

MOA—Minute of Angle

MOUT—Military Operations Urbanized Terrain

MSR—Mission Support Request

NBC—Nuclear, Biological, Chemical

NEO—Noncombatant Evacuation Operations

NGA—National Geospatial Intelligence Agency

NM—Nautical Mile

NORDO—No Radio

NVD—Night Vision Device

O2—Oxygen

OBM—Outboard Motor

OCOKA—Obstacles, Cover/Concealment, Observation Points, Key Terrain, and Avenues of Approach

OPLAN—Operations Plan

OPORD—Operations Order

PID—Positive Identification

PIR—Priority, Intelligence, Requirement

PJ—Pararescueman

POI—Point of Impact

PR—Personnel Recovery

PRCC—Personnel Recovery Coordination Cell

PTT—Push-To-Talk

PVC—Polyvinyl Chloride

RAMB—Rigging Alternate Method Boat

RCC—Rescue Coordination Center

RFF—Request for Forces

RFI—Request for Information

RM—Risk Management

ROE—Rules of Engagement

RPG—Rocket Propelled Grenades

RPM—Revolutions Per Minute

RQS—Rescue Squadron

RV—Recovery Vehicle

SAASM—Selective Availability Anti-Spoofing Module

SALUTE—Size, Activity, Location, Unit Identification, Time, and Equipment

SAM—Surface-to-Air Missile

SARDOT—Search and Rescue Dot

SAW—Squad Automatic Weapon

SERE—Survival, Evasion, Resistance, and Escape

SME—Subject Matter Expert

SOI—Signal Operating Instructions

SOP—Standard Operating Procedure

SPINS—Special Instructions

TC—Team Commander

TL—Team Leader

TLP—Troop Leading Procedures

TO—Technical Order

USCG—US Coast Guard

USSOCOM—United States Southern Command

VDO—Vehicle Drop Off

WARNORD—Warning Order

Attachment 2

CHEAT SHEETS

Table A2.1. Cheat Sheets.

Troop Leading Procedures (TLPs)	Mission Analysis	Salute Report
Receive the mission Issue WARNORD Make a tentative plan Start movement Reconnoiter Complete the plan Issue OPORD Supervise-Rehearse-Inspect	**M**-Mission **E**-Enemy **T**-Troops **T**-Terrain **T**-Time **C**-Civilians	**S**-Size **A**-Activity **L**-Location **U**-Unit **T**-Time **E**-Equipment
Operation Order (OPORD)	**Recovery Analysis (CARVER)**	**Initiative in the Offense or Defense**
S-Situation **M**-Mission **E**-Execution **A**-Admin and Logistics **C**-Command and Signal	**C**-Critical **A**-Accessible **R**-Recoverable **V**-Vulnerability **E**-Effect **R**-Recognizable	Plan and prep area Find the enemy Avoid detection Fix the enemy Find or create weakness Maneuver-exploit weakness Consolidate and reorganize
OCOKA	**5-Point Contingency Plan**	**SLLS**
O-Observation & fields of fire **C**-Cover and concealment **O**-Obstacles **K**-Key terrain **A**-Avenues of approach	**G**-Going where **O**-Others going with you **T**-Time expected to return **W**-What to do if I don't return **A**-Actions on contact	**S**-Stop **L**-Look **L**-Listen **S**-Smell
Individual Brief Back	**EPW Handling (5S's)**	**Movement Techniques**
Name Ops initials Duty position or order of march Equipment Special equipment Actions at the objective EPA-Emergency Plan of Action	Search Silence Segregate Safe guard Speed to the rear	Traveling Traveling overwatch Bounding overwatch Successive bounds Alternating bounds
Immediate Action Shelters (BLISS)	**Uniform (COLDER)**	**MWE Check**
B-Blend with surroundings **L**-Low silhouette **I**-Irregular shape **S**-Small **S**-Secluded location	**C**-Keep Clean **O**-Avoid Overheating **L**-Wear Loose/Layers **D**-Keep clothing Dry **E**-Examine-Wear/Tear **R**- Repair	Men Weapons Equipment
Mission Planning Acronyms	**Classes of Supply**	**Patrolling Acronyms**
GAF- Ground Assault Force HAF- Helo Assault Force NAI-Numbered/Named Area of Interest	I-Food and water II-Individual equipment clothing III-POL (petroleum, oil, lubricants) IV-Barrier materials	AA-Assembly area CCP-Casualty Collection Point DZ-Drop Zone FSRP-Far Side Rally Point

ACM-Airspace Control Measure JTF-Joint Task Force JFACC-Joint Force Air Component Command JFLCC-Joint Force Land Component Command JFMCC-Joint Force Maritime Component Command ATO-Air Tasking Order SPINS-Special Instructions WARNO-Warning Order FRAGO-Fragmentation Order TOS-Time arriving on station TOT-Time on Target	V-Ammunition, explosives VI-Personal use items VII-Major end items VIII-Medical supplies IX-Repair items, spare parts X-Civil affairs items **PIR** P-Priority I-Intelligence R-Requirements	IRP-Initial Rally Point ERP-En route Rally Point FFI-Friendly Force ID EKIA-Enemy Killed in Action EPW-Enemy Prisoner of War KIA-Killed in Action LOA-Limit of Advance LDA-Linear Danger Area LURP-Link-Up Rally Point LZ-Landing Zone NSRP-Near Side Rally Point OBJ-Objective ORP-Objective Rally Point

Figure A2.1. Symbol Key.