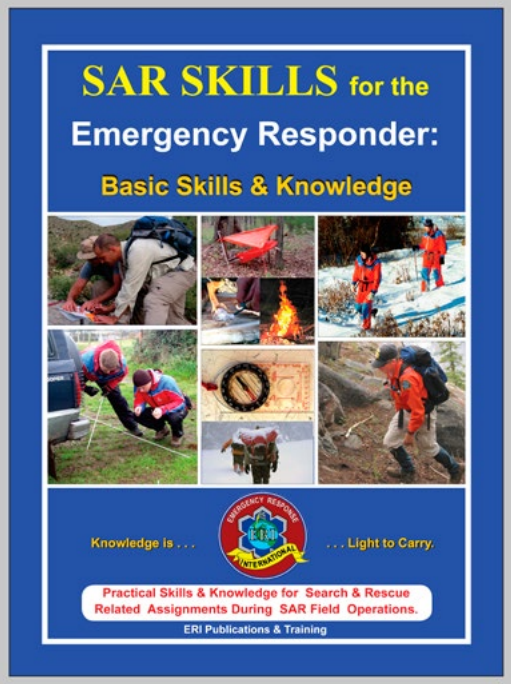
NEW!

SAR Skills for the Emergency Responder

from

Emergency Response International

A New Standard for Training SAR Personnel!



- **Comprehensive**
- **Fully Illustrated step by step guides and instructions**
- **Current Information**
- **Presented at an Introductory level**

Overview

This textbook was designed to fulfill a critical need for a comprehensive SAR training program at the local level in any jurisdiction. The information contained within this textbook allows trainers to take an individual, with no experience or understanding of basic search and rescue, and give them the skills and knowledge to contribute to a SAR response effectively.

SAR Skills for the Emergency Responder merges several disciplines and arenas from the SAR world in a comprehensive work never published together or presented in such detail before.

The book starts with a broad based overview of the national and international search and rescue system to explain how a SAR team member fits into the big picture. Next we cover the prescribed organizational structure for any type of response along with all the facets of a SAR mission from start to finish. We describe the basics of liability and ways organizations protect themselves from lawsuits, followed by a focus on the physical skills and equipment needed for self sufficiency in a wilderness or rural setting. Then, the text delves into the basics of SAR theory and lost person behavior, to give responders an idea of why different assignments come from their respective SAR management teams. The book lays out the basics of how to effectively search an area and how searchers may aid an investigation by providing and protecting the right information. Finally, we end with working with aircraft, an overview of common SAR equipment and good communications techniques.

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Why do you need This Book?

Every jurisdiction needs a reliable program to ensure the baseline knowledge of the people who work in Search and Rescue Operations. *SAR Skills for the Emergency Responder* gives you a resource to provide required skills and knowledge for every SAR responder. Use it to help create competent emergency responders in your jurisdiction.

Try, Learn and Practice SAR Skills

Gain Knowledge of the U.S. and International Search and Rescue Systems - Discover the results of search theory, lost person behavior, good search technique, and the basics of SAR organizations. Sharpen Your Practical Skills - Learn about the physiology of human survival, ropes and knots, emergency shelters, clothing systems, navigation, signals, equipment use, and searching.

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A New Standard for Training SAR Personnel!

Chapter 1

The SAR System: International, Federal, State, Local - Air and Ground

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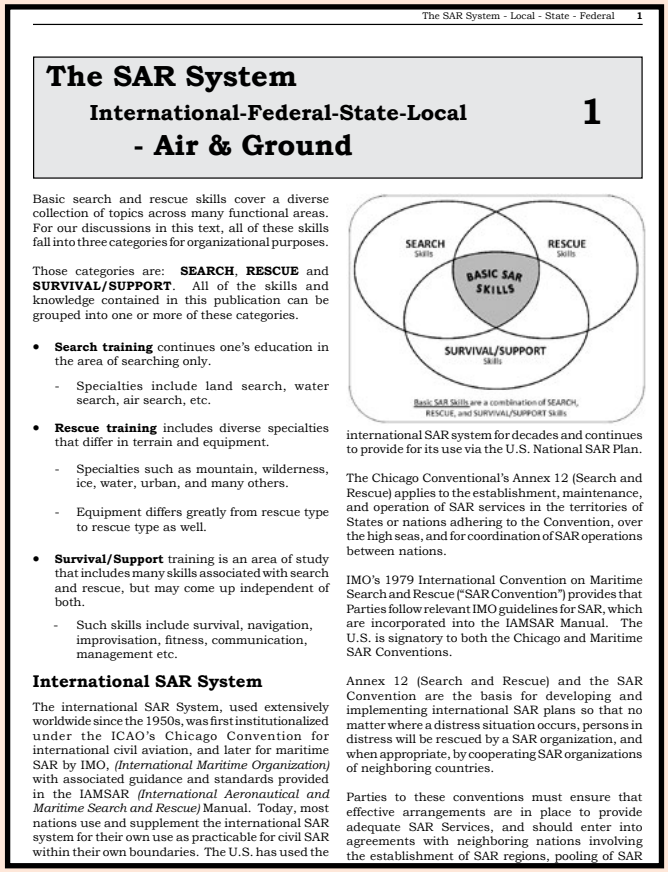
The first chapter in the book sets the stage for a basic understanding of how SAR operates at the international, federal, state and local, levels. We describe functions, responsibilities and response capabilities, as well as attributes and shortfalls of the technology used in emergency beacon systems. Specifically the chapter outlines who responds and with what, at each level in detail.

In summary, the first chapter provides a detailed explanation of how the SAR system works to locate a lost, injured or deceased person in the outdoors or after natural/man-made disasters. The chapter also discusses the unique issues surrounding searches for downed or missing aircraft.



The SAR System - Local - State - Federal 1

The SAR System
International-Federal-State-Local - Air & Ground **1**

Basic search and rescue skills cover a diverse collection of topics across many functional areas. For our discussions in this text, all of these skills fall into three categories for organizational purposes.

Those categories are: **SEARCH**, **RESCUE** and **SURVIVAL/SUPPORT**. All of the skills and knowledge contained in this publication can be grouped into one or more of these categories.

- **Search training** continues one's education in the area of searching only.
  - Specialties include land search, water search, air search, etc.
- **Rescue training** includes diverse specialties that differ in terrain and equipment.
  - Specialties such as mountain, wilderness, ice, water, urban, and many others.
  - Equipment differs greatly from rescue type to rescue type as well.
- **Survival/Support** training is an area of study that includes many skills associated with search and rescue, but may come up independent of both.
  - Such skills include survival, navigation, improvisation, fitness, communication, management etc.

International SAR System

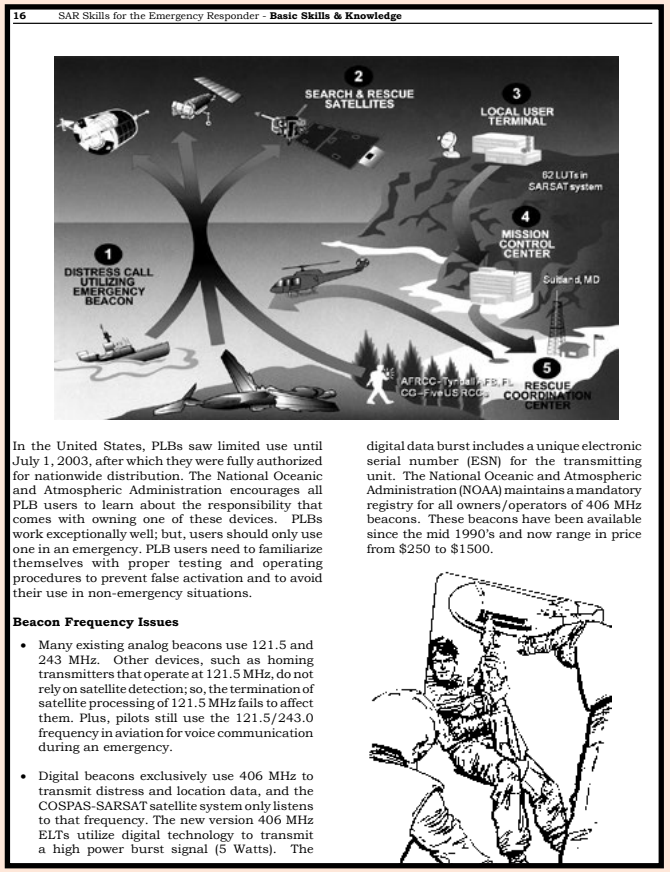
The international SAR System, used extensively worldwide since the 1950s, was first institutionalized under the ICAO's Chicago Convention for international civil aviation, and later for maritime SAR by IMO, *(International Maritime Organization)* with associated guidance and standards provided in the IAMSAR *(International Aeronautical and Maritime Search and Rescue)* Manual. Today, most nations use and supplement the international SAR system for their own use as practicable for civil SAR within their own boundaries. The U.S. has used the international SAR system for decades and continues to provide for its use via the U.S. National SAR Plan.

The Chicago Conventional's Annex 12 (Search and Rescue) applies to the establishment, maintenance, and operation of SAR services in the territories of States or nations adhering to the Convention, over the high seas, and for coordination of SAR operations between nations.

IMO's 1979 International Convention on Maritime Search and Rescue ("SAR Convention") provides that Parties follow relevant IMO guidelines for SAR, which are incorporated into the IAMSAR Manual. The U.S. is signatory to both the Chicago and Maritime SAR Conventions.

Annex 12 (Search and Rescue) and the SAR Convention are the basis for developing and implementing international SAR plans so that no matter where a distress situation occurs, persons in distress will be rescued by a SAR organization, and when appropriate, by cooperating SAR organizations of neighboring countries.

Parties to these conventions must ensure that effective arrangements are in place to provide adequate SAR Services, and should enter into agreements with neighboring nations involving the establishment of SAR regions, pooling of SAR



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In the United States, PLBs saw limited use until July 1, 2003, after which they were fully authorized for nationwide distribution. The National Oceanic and Atmospheric Administration encourages all PLB users to learn about the responsibility that comes with owning one of these devices. PLBs work exceptionally well; but, users should only use one in an emergency. PLB users need to familiarize themselves with proper testing and operating procedures to prevent false activation and to avoid their use in non-emergency situations.

Beacon Frequency Issues

- Many existing analog beacons use 121.5 and 243 MHz. Other devices, such as homing transmitters that operate at 121.5 MHz, do not rely on satellite detection; so, the termination of satellite processing of 121.5 MHz fails to affect them. Plus, pilots still use the 121.5/243.0 frequency in aviation for voice communication during an emergency.
- Digital beacons exclusively use 406 MHz to transmit distress and location data, and the COSPAS-SARSAT satellite system only listens to that frequency. The new version 406 MHz ELTs utilize digital technology to transmit a high power burst signal (5 Watts). The digital data burst includes a unique electronic serial number (ESN) for the transmitting unit. The National Oceanic and Atmospheric Administration (NOAA) maintains a mandatory registry for all owners/operators of 406 MHz beacons. These beacons have been available since the mid 1990's and now range in price from $250 to $1500.

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Chapter 2
ICS in SAR: The Organizational Structure

A New Standard for Training SAR Personnel!

The second chapter describes the Incident Command System (ICS) under (NIMS) National Incident Management System as a consistent on-scene management structure. Further, we discuss how the emergency responder fits into that scheme. The chapter describes how good organizational structure enhances coordination, cooperation and functional positions during SAR Operations. We point out problems and pitfalls using case studies and research along with the most sensible approach to managing an incident with minimal manpower while still using ICS. In particular, current direction with regard to Intelligence / Investigation options and the flexibility with which those functions can be integrated are described. Our recommendations focus on functional management and practical utility.

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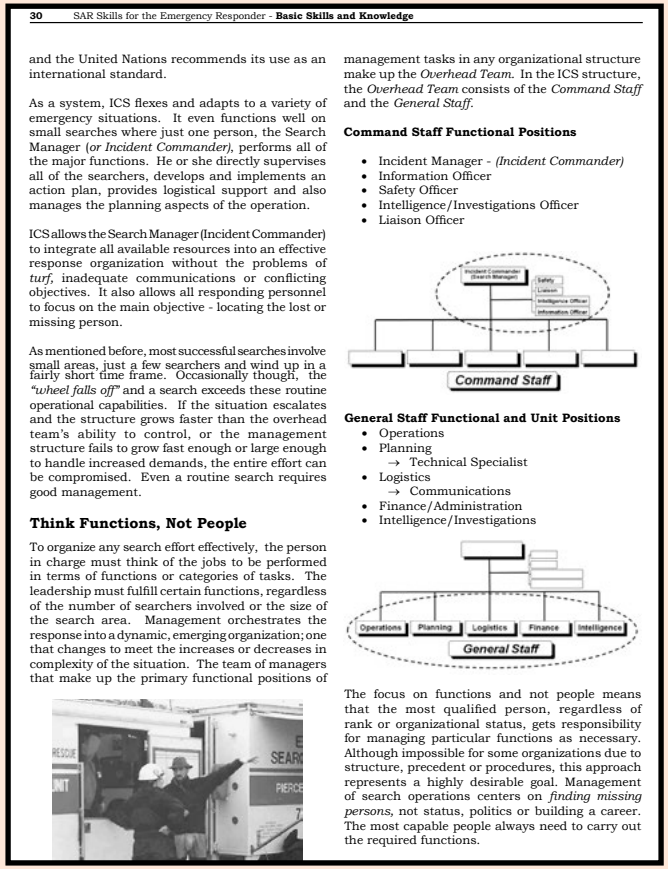

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and the United Nations recommends its use as an international standard.

As a system, ICS flexes and adapts to a variety of emergency situations. It even functions well on small searches where just one person, the Search Manager (*or Incident Commander),* performs all of the major functions. He or she directly supervises all of the searchers, develops and implements an action plan, provides logistical support and also manages the planning aspects of the operation.

ICS allows the Search Manager (Incident Commander) to integrate all available resources into an effective response organization without the problems of *turf,* inadequate communications or conflicting objectives. It also allows all responding personnel to focus on the main objective - locating the lost or missing person.

As mentioned before, most successful searches involve small areas, just a few searchers and wind up in a fairly short time frame. Occasionally though, the *"wheel falls off"* and a search exceeds these routine operational capabilities. If the situation escalates and the structure grows faster than the overhead team's ability to control, or the management structure fails to grow fast enough or large enough to handle increased demands, the entire effort can be compromised. Even a routine search requires good management.

Think Functions, Not People

To organize any search effort effectively, the person in charge must think of the jobs to be performed in terms of functions or categories of tasks. The leadership must fulfill certain functions, regardless of the number of searchers involved or the size of the search area. Management orchestrates the response into a dynamic, emerging organization; one that changes to meet the increases or decreases in complexity of the situation. The team of managers that make up the primary functional positions of management tasks in any organizational structure make up the *Overhead Team.* In the ICS structure, the *Overhead Team* consists of the *Command Staff* and the *General Staff.*

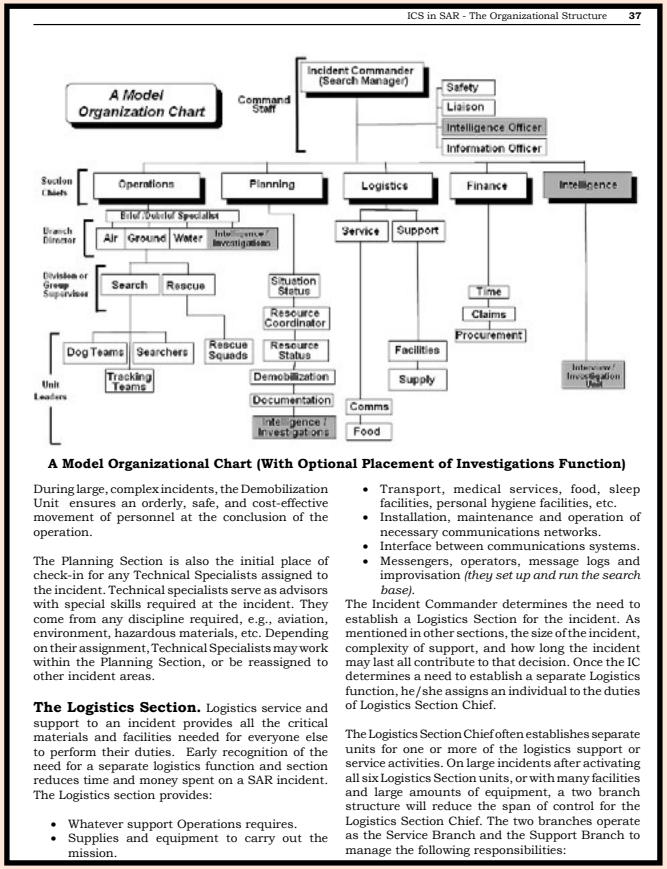
Command Staff Functional Positions

- Incident Manager - *(Incident Commander)*
- Information Officer
- Safety Officer
- Intelligence/Investigations Officer
- Liaison Officer

General Staff Functional and Unit Positions

- Operations
- Planning
  - → Technical Specialist
- Logistics
  - → Communications
- Finance/Administration
- Intelligence/Investigations

The focus on functions and not people means that the most qualified person, regardless of rank or organizational status, gets responsibility for managing particular functions as necessary. Although impossible for some organizations due to structure, precedent or procedures, this approach represents a highly desirable goal. Management of search operations centers on *finding missing persons,* not status, politics or building a career. The most capable people always need to carry out the required functions.



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A Model Organizational Chart (With Optional Placement of Investigations Function)

During large, complex incidents, the Demobilization Unit ensures an orderly, safe, and cost-effective movement of personnel at the conclusion of the operation.

The Planning Section is also the initial place of check-in for any Technical Specialists assigned to the incident. Technical specialists serve as advisors with special skills required at the incident. They come from any discipline required, e.g., aviation, environment, hazardous materials, etc. Depending on their assignment, Technical Specialists may work within the Planning Section, or be reassigned to other incident areas.

The Logistics Section. Logistics service and support to an incident provides all the critical materials and facilities needed for everyone else to perform their duties. Early recognition of the need for a separate logistics function and section reduces time and money spent on a SAR incident. The Logistics section provides:

- Whatever support Operations requires.
- Supplies and equipment to carry out the mission.
- Transport, medical services, food, sleep facilities, personal hygiene facilities, etc.
- Installation, maintenance and operation of necessary communications networks.
- Interface between communications systems.
- Messengers, operators, message logs and improvisation *(they set up and run the search base).*

The Incident Commander determines the need to establish a Logistics Section for the incident. As mentioned in other sections, the size of the incident, complexity of support, and how long the incident may last all contribute to that decision. Once the IC determines a need to establish a separate Logistics function, he/she assigns an individual to the duties of Logistics Section Chief.

The Logistics Section Chief often establishes separate units for one or more of the logistics support or service activities. On large incidents after activating all six Logistics Section units, or with many facilities and large amounts of equipment, a two branch structure will reduce the span of control for the Logistics Section Chief. The two branches operate as the Service Branch and the Support Branch to manage the following responsibilities:

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Chapter 3
Anatomy of a SAR Incident

The third chapter describes all the component parts of a SAR incident. This section of the book takes students through a step by step look at how a SAR incident will most likely unfold, plus how an individual emergency responder fits into both the management structure and the on-scene effort. Initial information gathering starts the process for planning and assembling searching data. Detailed descriptions then move through call out, check-in, reflex tasking, briefing, task assignment, debriefing, checkout and return to service. We discuss all the steps in the process in detail for maximum retention and understanding. Initial action strategies and searching modes are also reviewed to emphasize likely SAR team assignments.

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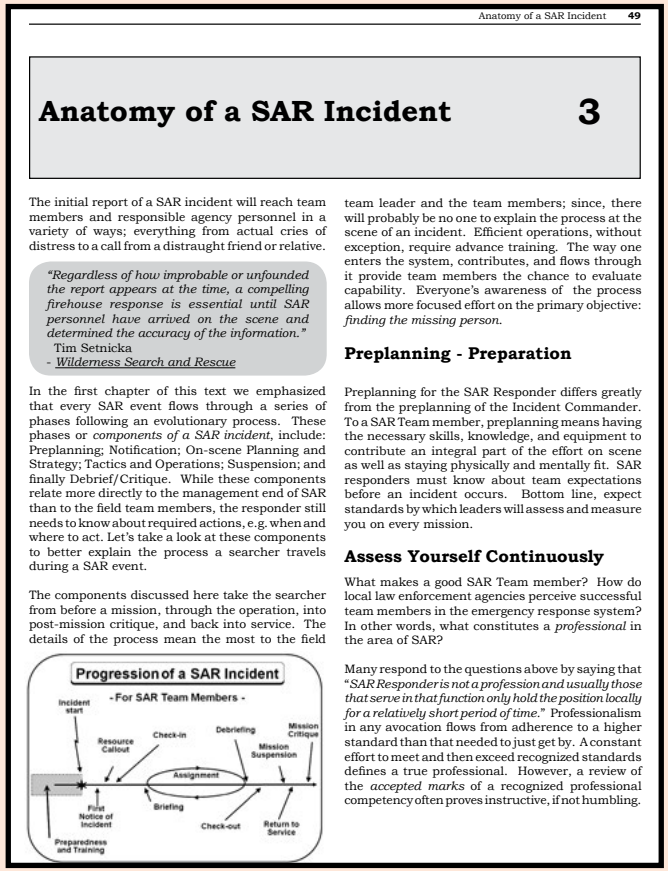

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Anatomy of a SAR Incident 3

The initial report of a SAR incident will reach team members and responsible agency personnel in a variety of ways; everything from actual cries of distress to a call from a distraught friend or relative.

"Regardless of how improbable or unfounded the report appears at the time, a compelling firehouse response is essential until SAR personnel have arrived on the scene and determined the accuracy of the information."
Tim Setnicka
- *Wilderness Search and Rescue*

In the first chapter of this text we emphasized that every SAR event flows through a series of phases following an evolutionary process. These phases or *components of a SAR incident*, include: Preplanning; Notification; On-scene Planning and Strategy; Tactics and Operations; Suspension; and finally Debrief/Critique. While these components relate more directly to the management end of SAR than to the field team members, the responder still needs to know about required actions, e.g. when and where to act. Let's take a look at these components to better explain the process a searcher travels during a SAR event.

The components discussed here take the searcher from before a mission, through the operation, into post-mission critique, and back into service. The details of the process mean the most to the field team leader and the team members; since, there will probably be no one to explain the process at the scene of an incident. Efficient operations, without exception, require advance training. The way one enters the system, contributes, and flows through it provide team members the chance to evaluate capability. Everyone's awareness of the process allows more focused effort on the primary objective: *finding the missing person.*

Preplanning - Preparation

Preplanning for the SAR Responder differs greatly from the preplanning of the Incident Commander. To a SAR Team member, preplanning means having the necessary skills, knowledge, and equipment to contribute an integral part of the effort on scene as well as staying physically and mentally fit. SAR responders must know about team expectations before an incident occurs. Bottom line, expect standards by which leaders will assess and measure you on every mission.

Assess Yourself Continuously

What makes a good SAR Team member? How do local law enforcement agencies perceive successful team members in the emergency response system? In other words, what constitutes a *professional* in the area of SAR?

Many respond to the questions above by saying that "*SAR Responder is not a profession and usually those that serve in that function only hold the position locally for a relatively short period of time.*" Professionalism in any avocation flows from adherence to a higher standard than that needed to just get by. A constant effort to meet and then exceed recognized standards defines a true professional. However, a review of the *accepted marks* of a recognized professional competency often proves instructive, if not humbling.

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Assignment

Individual Responsibilities

While deployed on a SAR incident and assigned in the field, individual SAR responders maintain certain responsibilities with direct implications to effectiveness and safety. SAR teams vary in size, but normally fall within the ICS doctrine for span of control. ICS parameters dictate the five to one *rule of thumb* for unit size and supervision. Certain obligations exist for team members and each individual needs to ensure they get carried out.

1. All members of the team need their own personal gear, without dependence on anyone else for equipment. Criteria for good SAR equipment follows:
   - Versatility
   - Functional but not elaborate
   - Tough and able to stand up under hard use
   - Quality without extra expense
   - Lightweight but compact
2. SAR missions require self sufficiency and solid equipment. That means primary, supplemental and backup clothing for all environments as well.
3. SAR demands a lot, mentally and physically! Team members regularly perform difficult and arduous operations. Easy missions come hand-in-hand with tough missions.
4. If you find skill limitations or shortfalls in your personal training, make sure you give the team leader a heads up. Assume nothing!

What Does the IC Expect from Individual SAR Responders?

- Discipline to accomplish assignments and debriefs accordingly.
- High performance standards directly related to high training standards.
- Proper clothing and equipment for virtually any local climatic conditions.
- Individual self-sufficiency for at least 72 hours.
- To perform pinpoint navigation and record it on a map.

Team Responsibilities

Before deployment into the field, every SAR team needs to assign at least one member to the following responsibilities: Navigator, Tally or Distance Keeper, Time Keeper, and Team Leader.

Team leaders require very specific qualifications and will probably accept the role before the establishment of the rest of a field unit. Normally unit members and qualifications stem from rosters at call-out.

Every member of a team needs a constant awareness of their location. All levels involved in the incident, from the public to the command staff, expect this of operationally trained responders in SAR. This translates to knowing relative position in the search area at any given time. One member always acts as team navigator to check accuracy with GPS, compass readings or way points on the map.

The tally or distance measurer keeps track of distance traveled within a search segment for each assignment. The overhead team at Base uses this essential information to calculate *Area Effectively Swept* within POD calculations (Downloadable GPS tracks work well, but keeping count of stride works too). Some teams calculate the average speed of search through certain kinds of terrain and vegetation. This becomes a *SAR team benchmark* used to calculate how far the team searches in a set time. In that case, they simply multiply the benchmark speed by time spent for a *total trackline length* (More on this later).

The Time Keeper maintains a chronology, in writing, of what goes on, with specific time hacks, during the assignment period. This documentation plays an essential role in the debrief process. One person who writes down important events or comments while on the move through a segment makes other members memory or recall much more complete during debrief.

The Team Leader orchestrates the entire move through the field assignment. His or her job ensures to the extent possible, the satisfactory completion of the entire assignment. Not only that, but he/she keeps mental (if not physical) notes to accomplish an effective debrief at the end of the Op period. The Team Leader also ensures the efficiency of his/her team mates. Reminders about the *Searcher Cube* and due diligence about technique, snapshot visual scanning, looking through vegetation and ground cover, all form an effective team leader's skill-set.

What Does the IC Expect from SAR Responder Teams?

- Organization and functional position structure suggested by ICS.
- Reliability.

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Chapter 4
Legal Issues and Public Expectations

The fourth chapter discusses the basic issues of liability in SAR operations response. Elements used to prove liability are described as well as some of the more common causes of lawsuits against emergency responders. The focus in the chapter is placed on understanding the law and the basis for liability. With regard to trespass on private property, common safeguards and guidelines are provided. The legal process is outlined and what must be proven for litigation to be successful. Volunteer status, Necessity and the Good Samaritan laws are also reviewed along with strategies to avoid lawsuits against both individuals and SAR organizations. The final section in the chapter deals with handling evidence or clues on-scene, crash scene management, and handling the deceased.

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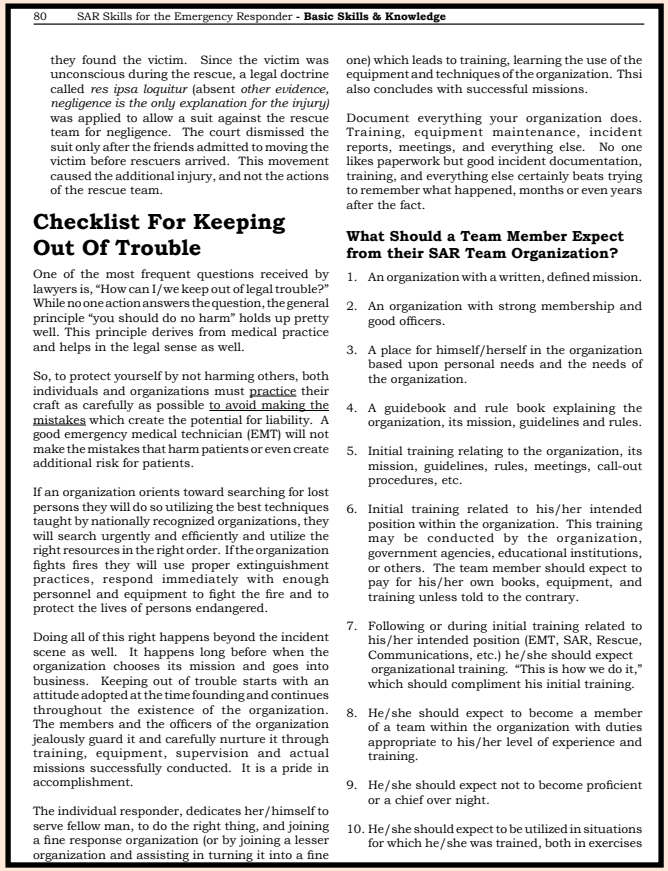

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they found the victim. Since the victim was unconscious during the rescue, a legal doctrine called *res ipsa loquitur* (absent *other evidence, negligence is the only explanation for the injury)* was applied to allow a suit against the rescue team for negligence. The court dismissed the suit only after the friends admitted to moving the victim before rescuers arrived. This movement caused the additional injury, and not the actions of the rescue team.

Checklist For Keeping Out Of Trouble

One of the most frequent questions received by lawyers is, "How can I/we keep out of legal trouble?" While no one action answers the question, the general principle "you should do no harm" holds up pretty well. This principle derives from medical practice and helps in the legal sense as well.

So, to protect yourself by not harming others, both individuals and organizations must practice their craft as carefully as possible to avoid making the mistakes which create the potential for liability. A good emergency medical technician (EMT) will not make the mistakes that harm patients or even create additional risk for patients.

If an organization orients toward searching for lost persons they will do so utilizing the best techniques taught by nationally recognized organizations, they will search urgently and efficiently and utilize the right resources in the right order. If the organization fights fires they will use proper extinguishment practices, respond immediately with enough personnel and equipment to fight the fire and to protect the lives of persons endangered.

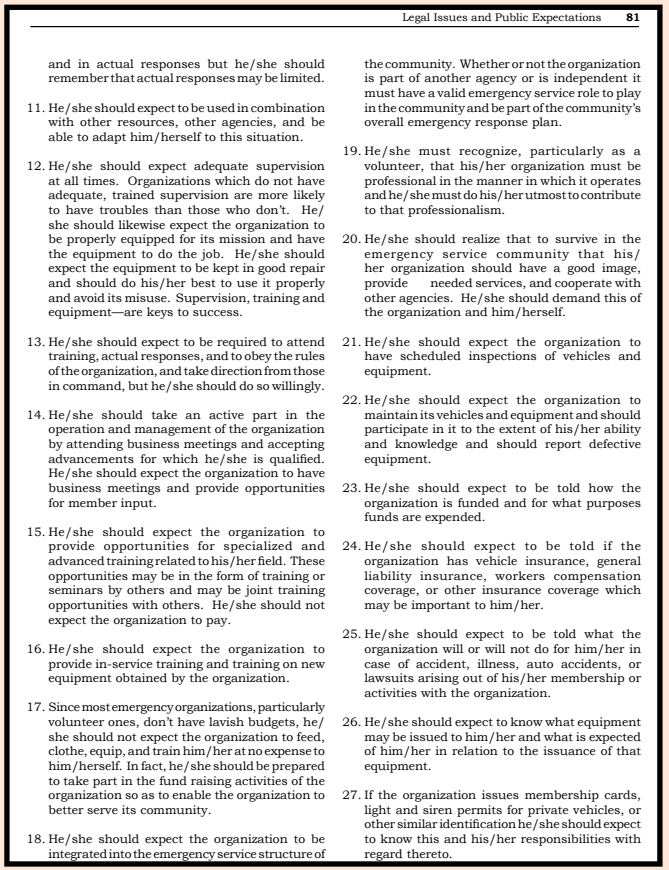
Doing all of this right happens beyond the incident scene as well. It happens long before when the organization chooses its mission and goes into business. Keeping out of trouble starts with an attitude adopted at the time founding and continues throughout the existence of the organization. The members and the officers of the organization jealously guard it and carefully nurture it through training, equipment, supervision and actual missions successfully conducted. It is a pride in accomplishment.

The individual responder, dedicates her/himself to serve fellow man, to do the right thing, and joining a fine response organization (or by joining a lesser organization and assisting in turning it into a fine one) which leads to training, learning the use of the equipment and techniques of the organization. Thsi also concludes with successful missions.

Document everything your organization does. Training, equipment maintenance, incident reports, meetings, and everything else. No one likes paperwork but good incident documentation, training, and everything else certainly beats trying to remember what happened, months or even years after the fact.

What Should a Team Member Expect from their SAR Team Organization?

1. An organization with a written, defined mission.
2. An organization with strong membership and good officers.
3. A place for himself/herself in the organization based upon personal needs and the needs of the organization.
4. A guidebook and rule book explaining the organization, its mission, guidelines and rules.
5. Initial training relating to the organization, its mission, guidelines, rules, meetings, call-out procedures, etc.
6. Initial training related to his/her intended position within the organization. This training may be conducted by the organization, government agencies, educational institutions, or others. The team member should expect to pay for his/her own books, equipment, and training unless told to the contrary.
7. Following or during initial training related to his/her intended position (EMT, SAR, Rescue, Communications, etc.) he/she should expect organizational training. "This is how we do it," which should compliment his initial training.
8. He/she should expect to become a member of a team within the organization with duties appropriate to his/her level of experience and training.
9. He/she should expect not to become proficient or a chief over night.
10. He/she should expect to be utilized in situations for which he/she was trained, both in exercises and in actual responses but he/she should remember that actual responses may be limited.
11. He/she should expect to be used in combination with other resources, other agencies, and be able to adapt him/herself to this situation.
12. He/she should expect adequate supervision at all times. Organizations which do not have adequate, trained supervision are more likely to have troubles than those who don't. He/she should likewise expect the organization to be properly equipped for its mission and have the equipment to do the job. He/she should expect the equipment to be kept in good repair and should do his/her best to use it properly and avoid its misuse. Supervision, training and equipment—are keys to success.
13. He/she should expect to be required to attend training, actual responses, and to obey the rules of the organization, and take direction from those in command, but he/she should do so willingly.
14. He/she should take an active part in the operation and management of the organization by attending business meetings and accepting advancements for which he/she is qualified. He/she should expect the organization to have business meetings and provide opportunities for member input.
15. He/she should expect the organization to provide opportunities for specialized and advanced training related to his/her field. These opportunities may be in the form of training or seminars by others and may be joint training opportunities with others. He/she should not expect the organization to pay.
16. He/she should expect the organization to provide in-service training and training on new equipment obtained by the organization.
17. Since most emergency organizations, particularly volunteer ones, don't have lavish budgets, he/she should not expect the organization to feed, clothe, equip, and train him/her at no expense to him/herself. In fact, he/she should be prepared to take part in the fund raising activities of the organization so as to enable the organization to better serve its community.
18. He/she should expect the organization to be integrated into the emergency service structure of the community. Whether or not the organization is part of another agency or is independent it must have a valid emergency service role to play in the community and be part of the community's overall emergency response plan.
19. He/she must recognize, particularly as a volunteer, that his/her organization must be professional in the manner in which it operates and he/she must do his/her utmost to contribute to that professionalism.
20. He/she should realize that to survive in the emergency service community that his/her organization should have a good image, provide needed services, and cooperate with other agencies. He/she should demand this of the organization and him/herself.
21. He/she should expect the organization to have scheduled inspections of vehicles and equipment.
22. He/she should expect the organization to maintain its vehicles and equipment and should participate in it to the extent of his/her ability and knowledge and should report defective equipment.
23. He/she should expect to be told how the organization is funded and for what purposes funds are expended.
24. He/she should expect to be told if the organization has vehicle insurance, general liability insurance, workers compensation coverage, or other insurance coverage which may be important to him/her.
25. He/she should expect to be told what the organization will or will not do for him/her in case of accident, illness, auto accidents, or lawsuits arising out of his/her membership or activities with the organization.
26. He/she should expect to know what equipment may be issued to him/her and what is expected of him/her in relation to the issuance of that equipment.
27. If the organization issues membership cards, light and siren permits for private vehicles, or other similar identification he/she should expect to know this and his/her responsibilities with regard thereto.



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Chapter 5
Rope and Line Related Skills

This unique section of the book includes descriptions and an illustrated compendium of useful knots and rope related skills for the SAR responder. The descriptions, pictures and illustrations provide specific instructions for tying reliable, as well as practical, knots and lashes with cordage, rope, or webbing, and attaching these to equipment, branches, poles, and other objects. These skills greatly enhance the SAR responder's arsenal of tools related to safety, utility and especially improvising. These skills also improve a whole host of other outdoor related activities such as rescue, survival, climbing, backpacking, camping and packing with horses or all-terrain vehicles.

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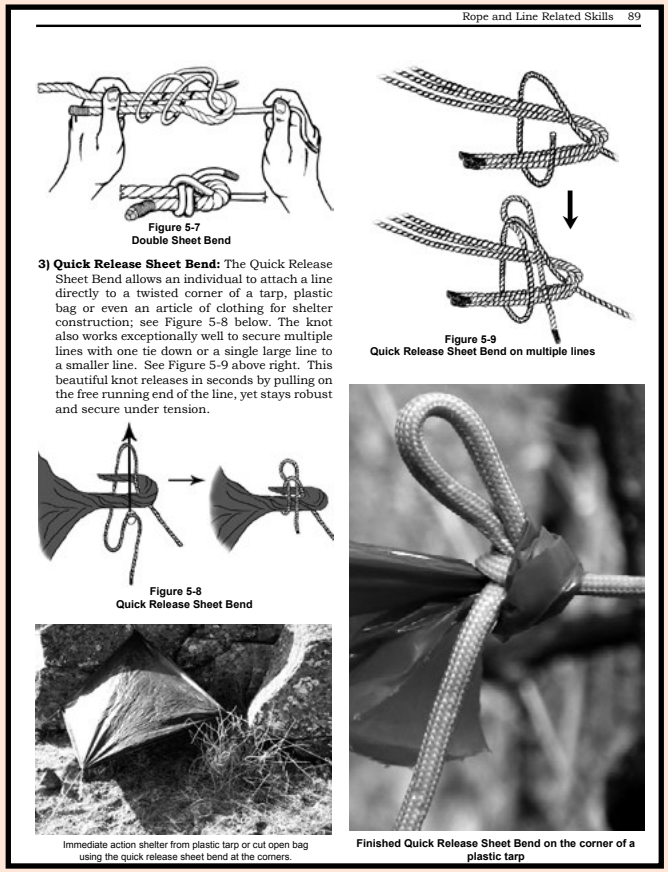

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Figure 5-7
Double Sheet Bend

Figure 5-9
Quick Release Sheet Bend on multiple lines

3) **Quick Release Sheet Bend:** The Quick Release Sheet Bend allows an individual to attach a line directly to a twisted corner of a tarp, plastic bag or even an article of clothing for shelter construction; see Figure 5-8 below. The knot also works exceptionally well to secure multiple lines with one tie down or a single large line to a smaller line. See Figure 5-9 above right. This beautiful knot releases in seconds by pulling on the free running end of the line, yet stays robust and secure under tension.

Figure 5-8
Quick Release Sheet Bend

Immediate action shelter from plastic tarp or cut open bag using the quick release sheet bend at the corners.

Finished Quick Release Sheet Bend on the corner of a plastic tarp

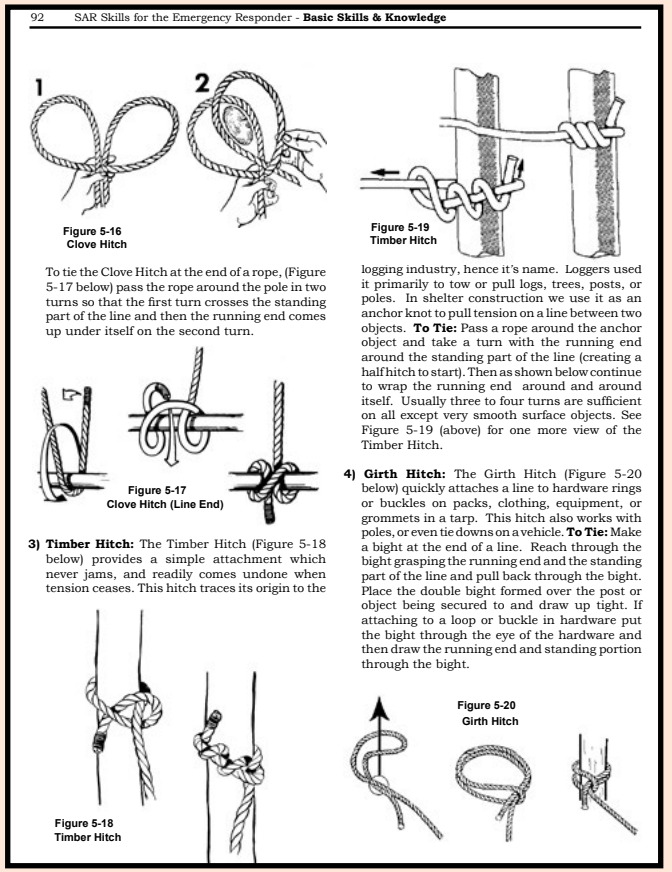

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Figure 5-16
Clove Hitch

To tie the Clove Hitch at the end of a rope, (Figure 5-17 below) pass the rope around the pole in two turns so that the first turn crosses the standing part of the line and then the running end comes up under itself on the second turn.

Figure 5-17
Clove Hitch (Line End)

3) **Timber Hitch:** The Timber Hitch (Figure 5-18 below) provides a simple attachment which never jams, and readily comes undone when tension ceases. This hitch traces its origin to the logging industry, hence it's name. Loggers used it primarily to tow or pull logs, trees, posts, or poles. In shelter construction we use it as an anchor knot to pull tension on a line between two objects. **To Tie:** Pass a rope around the anchor object and take a turn with the running end around the standing part of the line (creating a half hitch to start). Then as shown below continue to wrap the running end around and around itself. Usually three to four turns are sufficient on all except very smooth surface objects. See Figure 5-19 (above) for one more view of the Timber Hitch.

Figure 5-18
Timber Hitch

Figure 5-19
Timber Hitch

4) **Girth Hitch:** The Girth Hitch (Figure 5-20 below) quickly attaches a line to hardware rings or buckles on packs, clothing, equipment, or grommets in a tarp. This hitch also works with poles, or even tie downs on a vehicle. **To Tie:** Make a bight at the end of a line. Reach through the bight grasping the running end and the standing part of the line and pull back through the bight. Place the double bight formed over the post or object being secured to and draw up tight. If attaching to a loop or buckle in hardware put the bight through the eye of the hardware and then draw the running end and standing portion through the bight.

Figure 5-20
Girth Hitch

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Chapter 6
Survival Basics for the SAR Responder

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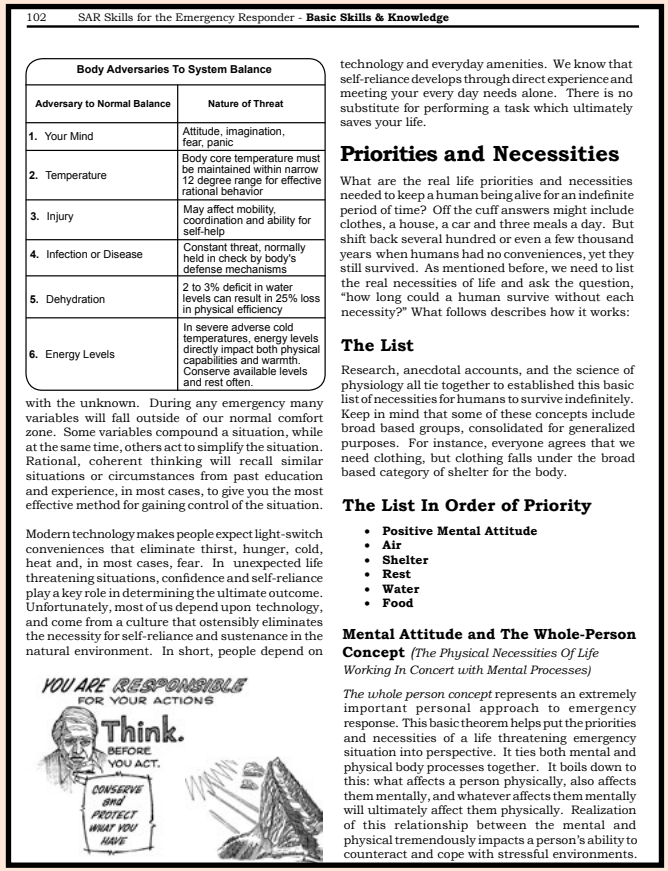
In this chapter we introduce a broad overview of important skills and knowledge about survival for first on-scene SAR Responders. Long term survival situations involving responders rarely occur during lost or missing person incidents because of the proximity to others with training and experience. However, situations don't need to be long term or remote to be serious or even life threatening. Hazardous weather, medical situations, tragic accidents, and injuries all or singly combine with other factors to rapidly complicate incidents. We set the stage for practical skills in the field. It provides a quick overview of survival training, emphasizing the importance of both psychological and physiological survival requirements. The chapter stresses the importance of keeping the mind positively engaged at all times, recognizing problems, finding resources, and using those resources to solve problems. We cover: Priorities and Necessities of Life; Body Management; the importance of PMA (Positive Mental Attitude); serious medical emergencies; Hypothermia; Hyperthermia; and Dehydration. Additional subjects covered include recommendations for immediate action shelter (personal protection for the individual responder and for an injured victim), Fail proof fire-craft for extreme environments, rope, knot and lash applications, navigation tools, improvised signaling basics and safe handling of pyrotechnic signaling devices.



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Body Adversaries To System Balance	
Adversary to Normal Balance	**Nature of Threat**
1. Your Mind	Attitude, imagination, fear, panic
2. Temperature	Body core temperature must be maintained within narrow 12 degree range for effective rational behavior
3. Injury	May affect mobility, coordination and ability for self-help
4. Infection or Disease	Constant threat, normally held in check by body's defense mechanisms
5. Dehydration	2 to 3% deficit in water levels can result in 25% loss in physical efficiency
6. Energy Levels	In severe adverse cold temperatures, energy levels directly impact both physical capabilities and warmth. Conserve available levels and rest often.

with the unknown. During any emergency many variables will fall outside of our normal comfort zone. Some variables compound a situation, while at the same time, others act to simplify the situation. Rational, coherent thinking will recall similar situations or circumstances from past education and experience, in most cases, to give you the most effective method for gaining control of the situation.

Modern technology makes people expect light-switch conveniences that eliminate thirst, hunger, cold, heat and, in most cases, fear. In unexpected life threatening situations, confidence and self-reliance play a key role in determining the ultimate outcome. Unfortunately, most of us depend upon technology, and come from a culture that ostensibly eliminates the necessity for self-reliance and sustenance in the natural environment. In short, people depend on technology and everyday amenities. We know that self-reliance develops through direct experience and meeting your every day needs alone. There is no substitute for performing a task which ultimately saves your life.

Priorities and Necessities

What are the real life priorities and necessities needed to keep a human being alive for an indefinite period of time? Off the cuff answers might include clothes, a house, a car and three meals a day. But shift back several hundred or even a few thousand years when humans had no conveniences, yet they still survived. As mentioned before, we need to list the real necessities of life and ask the question, "how long could a human survive without each necessity?" What follows describes how it works:

The List

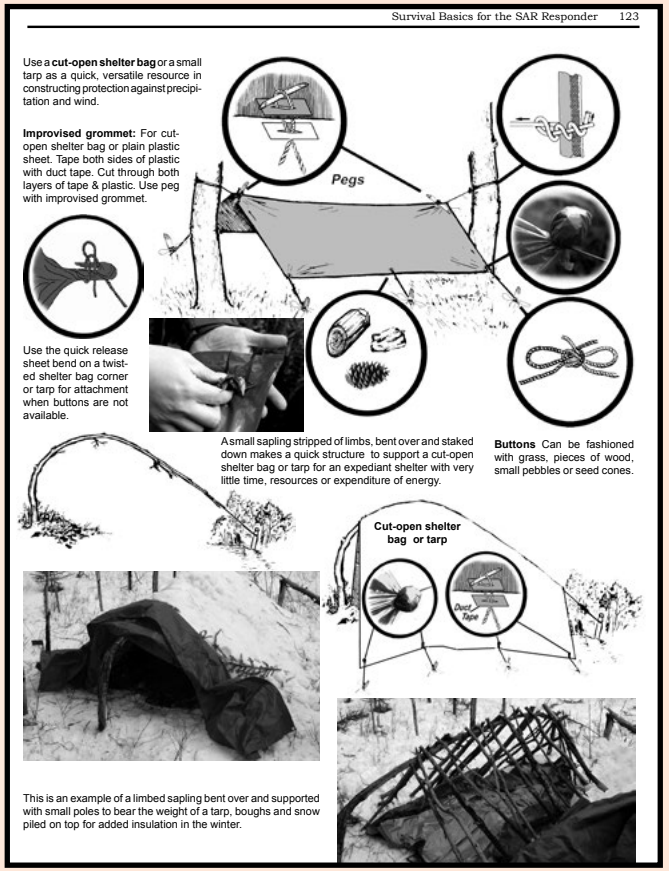
Research, anecdotal accounts, and the science of physiology all tie together to established this basic list of necessities for humans to survive indefinitely. Keep in mind that some of these concepts include broad based groups, consolidated for generalized purposes. For instance, everyone agrees that we need clothing, but clothing falls under the broad based category of shelter for the body.

The List In Order of Priority

- **Positive Mental Attitude**
- **Air**
- **Shelter**
- **Rest**
- **Water**
- **Food**

Mental Attitude and The Whole-Person Concept *(The Physical Necessities Of Life Working In Concert with Mental Processes)*

The whole person concept represents an extremely important personal approach to emergency response. This basic theorem helps put the priorities and necessities of a life threatening emergency situation into perspective. It ties both mental and physical body processes together. It boils down to this: what affects a person physically, also affects them mentally, and whatever affects them mentally will ultimately affect them physically. Realization of this relationship between the mental and physical tremendously impacts a person's ability to counteract and cope with stressful environments.



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Use a **cut-open shelter bag** or a small tarp as a quick, versatile resource in constructing protection against precipitation and wind.

Improvised grommet: For cut-open shelter bag or plain plastic sheet. Tape both sides of plastic with duct tape. Cut through both layers of tape & plastic. Use peg with improvised grommet.

Pegs

Use the quick release sheet bend on a twisted shelter bag corner or tarp for attachment when buttons are not available.

A small sapling stripped of limbs, bent over and staked down makes a quick structure to support a cut-open shelter bag or tarp for an expediant shelter with very little time, resources or expenditure of energy.

Buttons Can be fashioned with grass, pieces of wood, small pebbles or seed cones.

Cut-open shelter bag or tarp

This is an example of a limbed sapling bent over and supported with small poles to bear the weight of a tarp, boughs and snow piled on top for added insulation in the winter.

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Chapter 7
Dressing and Eating to Respond

This chapter begins with a comprehensive description of the clothing technology required for SAR responders to meet the flexible demands of harsh operating conditions and weather extremes. We outline three lines of defense for responders against the rigors of weather and temperature. The most important and expedient defense is the clothing worn by each person. We define clothing system tips, jargon and nomenclature for outdoor garments for personal protection. The second part of the chapter discusses the nutritional requirements of emergency response and other heavy exertion during prolonged SAR operations. We reference the U.S. Navy Seal nutrition guide and use it to plan balanced meals for outdoor activities. These two sections focus on how to maximize response capability by insuring proper body protection in adverse climatic conditions and consuming the right calories to meet the demand of a tough or long SAR mission.

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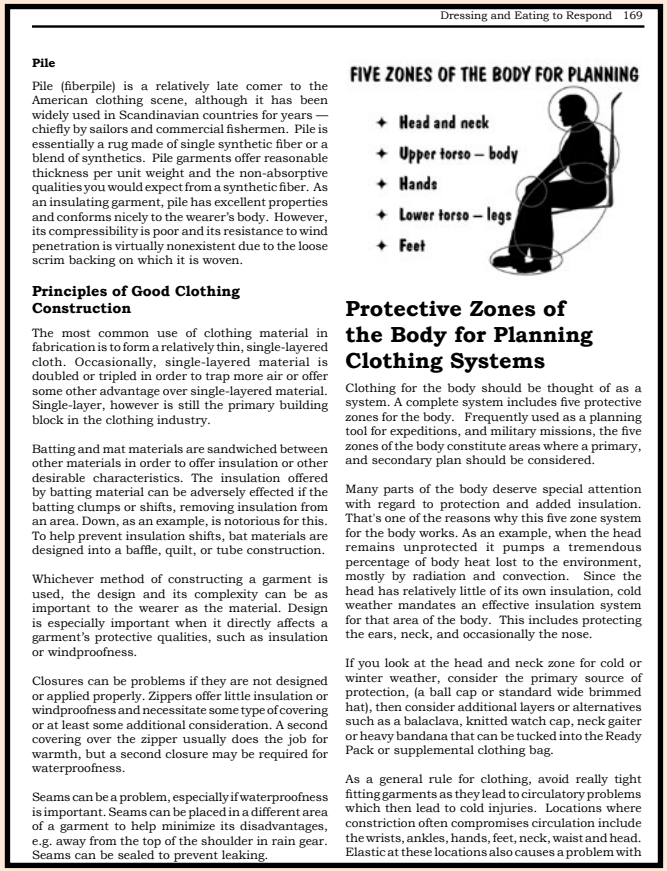

Pile

Pile (fiberpile) is a relatively late comer to the American clothing scene, although it has been widely used in Scandinavian countries for years — chiefly by sailors and commercial fishermen. Pile is essentially a rug made of single synthetic fiber or a blend of synthetics. Pile garments offer reasonable thickness per unit weight and the non-absorptive qualities you would expect from a synthetic fiber. As an insulating garment, pile has excellent properties and conforms nicely to the wearer's body. However, its compressibility is poor and its resistance to wind penetration is virtually nonexistent due to the loose scrim backing on which it is woven.

Principles of Good Clothing Construction

The most common use of clothing material in fabrication is to form a relatively thin, single-layered cloth. Occasionally, single-layered material is doubled or tripled in order to trap more air or offer some other advantage over single-layered material. Single-layer, however is still the primary building block in the clothing industry.

Batting and mat materials are sandwiched between other materials in order to offer insulation or other desirable characteristics. The insulation offered by batting material can be adversely effected if the batting clumps or shifts, removing insulation from an area. Down, as an example, is notorious for this. To help prevent insulation shifts, bat materials are designed into a baffle, quilt, or tube construction.

Whichever method of constructing a garment is used, the design and its complexity can be as important to the wearer as the material. Design is especially important when it directly affects a garment's protective qualities, such as insulation or windproofness.

Closures can be problems if they are not designed or applied properly. Zippers offer little insulation or windproofness and necessitate some type of covering or at least some additional consideration. A second covering over the zipper usually does the job for warmth, but a second closure may be required for waterproofness.

Seams can be a problem, especially if waterproofness is important. Seams can be placed in a different area of a garment to help minimize its disadvantages, e.g. away from the top of the shoulder in rain gear. Seams can be sealed to prevent leaking.

FIVE ZONES OF THE BODY FOR PLANNING

- Head and neck
- Upper torso – body
- Hands
- Lower torso – legs
- Feet

Protective Zones of the Body for Planning Clothing Systems

Clothing for the body should be thought of as a system. A complete system includes five protective zones for the body. Frequently used as a planning tool for expeditions, and military missions, the five zones of the body constitute areas where a primary, and secondary plan should be considered.

Many parts of the body deserve special attention with regard to protection and added insulation. That's one of the reasons why this five zone system for the body works. As an example, when the head remains unprotected it pumps a tremendous percentage of body heat lost to the environment, mostly by radiation and convection. Since the head has relatively little of its own insulation, cold weather mandates an effective insulation system for that area of the body. This includes protecting the ears, neck, and occasionally the nose.

If you look at the head and neck zone for cold or winter weather, consider the primary source of protection, (a ball cap or standard wide brimmed hat), then consider additional layers or alternatives such as a balaclava, knitted watch cap, neck gaiter or heavy bandana that can be tucked into the Ready Pack or supplemental clothing bag.

As a general rule for clothing, avoid really tight fitting garments as they lead to circulatory problems which then lead to cold injuries. Locations where constriction often compromises circulation include the wrists, ankles, hands, feet, neck, waist and head. Elastic at these locations also causes a problem with

exercises in the cold for several weeks. This emphasizes the fact that energy intake must increase to meet the increased energy demands.

Both fats and carbohydrates are used as fuel when exposed to the extremes of cold environments. However, a high CHO diet is preferred as it will replenish glycogen stores that are rapidly being used to maintain core temperature. A high fat diet is discouraged as it would require a prolonged period of adaptation and may result in gastrointestinal problems. Ideally 60% of your energy should come from CHO, 30% from fat and around 10% from protein. This of course should be supplemented with high carbohydrate snacks eaten in between meals. (See below) Protein supplements or high protein diets are not recommended as they would increase water losses.

Calculating Energy Requirements for Cold Weather Example

A SAR Responder requires 4000 cals./day
A 25% increase in energy would be:
4000 X 0.25 = 1000 calories/day
Goal: Eat 5000 calories / day.

Eat frequent snacks during the day and a large snack before going to bed.

Snacks for SAR Operations in the Cold

When working in cold weather, snack on foods that are high in carbohydrates. CHO (*carbohydrate*) foods produce more heat when digested than either fat or protein. To go along with the food snacks, beverages like cocoa or soup serve very well.

Trail Mix

3 cups seedless raisins
1 cup dried apricots
1 cup dried apples
1 cup almonds
1 cup dry roasted peanuts
1 cup dried pineapple
1 cup dried dates
1/2 cup sunflower seeds.

Mix all ingredients together in a large bowl or bag. This recipe makes 10 - 1 cup servings.

Nutrition Information per 1 cup serving:
560 Calories Total
62% Carbohydrate - 7% Protein - 30% Fat

- Granola / Sports bars
- Fig Newtons
- Fruit bars
- Trail mix
- Crackers / Bread with jam
- Chicken noodle soup
- Hot chocolate
- Hot apple cider

24 hour sustained operations may require nutritional intervention

SAR Ops Sustained (24 + hrs)

Sustained Operations are work periods that last longer than 24 hours because of extenuating circumstances. (This could be as a result of an extended search, where the subject is found and a long extrication ensues with existing resources. Or a protracted operations due to lack of resources because of logistical problems. What this frequently results in is extreme fatigue, sleep loss as well as both physical and mental stress. Nutritional interventions can partially offset the effects of fatigue and sleep deprivation on physical and mental performance. The most effective nutritional interventions include:

- Carbohydrate intake
- Hydration status
- Caffeine intake

Carbohydrate Intake

A high carbohydrate (CHO) diet is needed for replacing muscle glycogen stores that are used up during prolonged activity and for maintaining a sufficient blood glucose level. Thus, your diet during sustained operations should provide 60 to 65 % of energy from carbohydrates, 10% from protein and the remaining calories from fat.

High CHO snacks or carbohydrate containing fluid replacement beverages providing 15 to 30 grams of CHO/hour will also help to maintain blood glucose and delay fatigue during strenuous prolonged

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Chapter 8
The SAR Ready Pack and Personal Equipment

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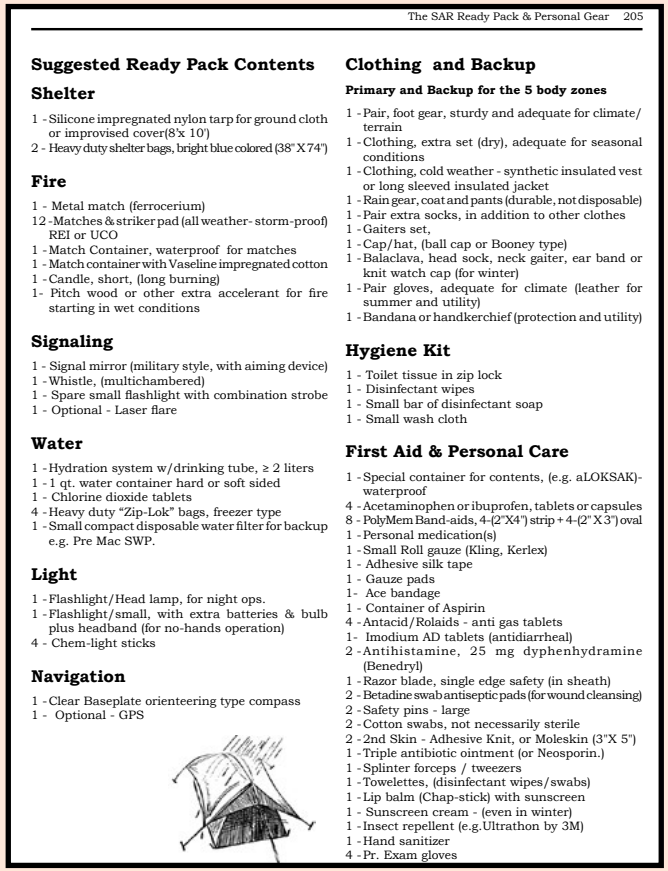
This chapter outlines many personal decisions for SAR responders. Much of what SAR personnel carry when responding to the field boils down to personal choice. The caveat to that is a number of essential items needed by any responder when responding. We evaluate these essential items from a personal perspective but also consider essentials for rendering assistance to an individual in distress. Personal clothing, shelter, water, food, tools, team gear, first aid and safety considerations are all discussed to give maximum options. The chapter outlines the questions: What might be needed?; What should be the criteria?; and, What are the options? Suggestions for minimum self-sufficiency, personal items and rendering assistance starts at 24 hours.



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Suggested Ready Pack Contents

Shelter

1 - Silicone impregnated nylon tarp for ground cloth or improvised cover(8'x 10')
2 - Heavy duty shelter bags, bright blue colored (38" X 74")

Fire

1 - Metal match (ferrocerium)
12 - Matches & striker pad (all weather- storm-proof) REI or UCO
1 - Match Container, waterproof for matches
1 - Match container with Vaseline impregnated cotton
1 - Candle, short, (long burning)
1- Pitch wood or other extra accelerant for fire starting in wet conditions

Signaling

1 - Signal mirror (military style, with aiming device)
1 - Whistle, (multichambered)
1 - Spare small flashlight with combination strobe
1 - Optional - Laser flare

Water

1 - Hydration system w/drinking tube, ≥ 2 liters
1 - 1 qt. water container hard or soft sided
1 - Chlorine dioxide tablets
4 - Heavy duty "Zip-Lok" bags, freezer type
1 - Small compact disposable water filter for backup e.g. Pre Mac SWP.

Light

1 - Flashlight/Head lamp, for night ops.
1 - Flashlight/small, with extra batteries & bulb plus headband (for no-hands operation)
4 - Chem-light sticks

Navigation

1 - Clear Baseplate orienteering type compass
1 - Optional - GPS

Clothing and Backup

Primary and Backup for the 5 body zones

1 - Pair, foot gear, sturdy and adequate for climate/terrain
1 - Clothing, extra set (dry), adequate for seasonal conditions
1 - Clothing, cold weather - synthetic insulated vest or long sleeved insulated jacket
1 - Rain gear, coat and pants (durable, not disposable)
1 - Pair extra socks, in addition to other clothes
1 - Gaiters set,
1 - Cap/hat, (ball cap or Booney type)
1 - Balaclava, head sock, neck gaiter, ear band or knit watch cap (for winter)
1 - Pair gloves, adequate for climate (leather for summer and utility)
1 - Bandana or handkerchief (protection and utility)

Hygiene Kit

1 - Toilet tissue in zip lock
1 - Disinfectant wipes
1 - Small bar of disinfectant soap
1 - Small wash cloth

First Aid & Personal Care

1 - Special container for contents, (e.g. aLOKSAK)-waterproof
4 - Acetaminophen or ibuprofen, tablets or capsules
8 - PolyMem Band-aids, 4-(2"X4") strip + 4-(2" X 3") oval
1 - Personal medication(s)
1 - Small Roll gauze (Kling, Kerlex)
1 - Adhesive silk tape
1 - Gauze pads
1- Ace bandage
1 - Container of Aspirin
4 - Antacid/Rolaids - anti gas tablets
1- Imodium AD tablets (antidiarrheal)
2 - Antihistamine, 25 mg dyphenhydramine (Benedryl)
1 - Razor blade, single edge safety (in sheath)
2 - Betadine swab antiseptic pads (for wound cleansing)
2 - Safety pins - large
2 - Cotton swabs, not necessarily sterile
2 - 2nd Skin - Adhesive Knit, or Moleskin (3"X 5")
1 - Triple antibiotic ointment (or Neosporin.)
1 - Splinter forceps / tweezers
1 - Towelettes, (disinfectant wipes/swabs)
1 - Lip balm (Chap-stick) with sunscreen
1 - Sunscreen cream - (even in winter)
1 - Insect repellent (e.g.Ultrathon by 3M)
1 - Hand sanitizer
4 - Pr. Exam gloves

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Sleeping System

1 - Sleeping pad, (*closed cell foam or ThermaRest are both good*)
1 - Closed cell foam pad for sitting & kneeling
1 - Seasonal sleeping bag with Bivy sack

Utility

1 - Knife, single shank blade, (utility and splitting wood)
1 - Knife sharpening tool
1 - Mil-spec para-cord at least 150 ft.(colored for visibility?)
1 - Goggles, light-weight and comfortable eye protection
1 - Multipurpose utility tool (e.g. Leatherman)
1 - Folding saw - (e.g. Buck, light weight, cuts both ways)
1 - Scissors, heavy duty, (i.e. clavicle shears)
1 - Aluminum foil roll (Without internal tube) (4' length)
1 - Duct tape, 8 feet (wrapped around match containers)
1 - Sunglasses, sturdy (> 97% UV protection)
1 - Metal cup or pot, for cooking & drinking
1 - Wire lengths, 2'-3', heavy gauge, for improvised repair
1 - Spare batteries and bulbs

Food & Snacks

- Base food and snacks choices on SAR operations in hot or cold environments, 24 hour sustained operations, or even elevations consistently above normal. (See Chapter 7 – Dressing and Eating to Respond) **Example:** High protein intake causes water loss which then leads to dehydration in hot environments. **Another Example:** Military experience and research shows that extreme cold causes weight loss without substantially increased calories during cold conditions.

- Choose nonperishable snacks

Personal Support Gear for SAR

1 - Pack, sturdy internal frame adequate for a diverse array of contents

Outside Pouches of Pack (for easy access)

1 - Extra eyeglasses or contacts (as necessary)
1 - Rain cover or liner for pack
1 - Water resistant note pad and pencil
1 - Personal identification and SAR Log
1 - Roll flagging tape (high visibility) or surveyors tape
1 - Tracking combination walking stick, > 42"
1 - Digital camera - (small, compact)

SAR Ready Pack - Considerations and Reminders

Because SAR Responders always carry their ready pack, consider weight when compiling a list of what to put in it. Don't fall into a false sense of security using the following attitude: "*All I need is a few basic tools and I can improvise the rest.*" While the ability to improvise helps tremendously, it is not an excuse for lack of preparation. Carry what you need and get the knowledge to properly use those resources.

Keep in mind that many pieces of gear or equipment fall into the convenient category, but are they essential? Weight and bulk also factor in. Sometimes extra weight and bulk trade-off in terms of utility and sometimes not. Responders will just have difficulty improvising some things. As an example, a compact and efficient saw cannot be improvised. Nor can a person improvise a good utility knife or multi-tool. SAR responders need to have the ability to meet any challenge in the field.

The following tips come from experienced outdoorsmen and SAR instructors and relate directly to carrying gear/equipment in the field:

Always Keep the Pack and Contents Close at Hand

No matter what a person puts in their ready pack and transports to the SAR operational site, it will all be for naught if it's unavailable when needed. Often, no warning precedes the need for tools, resources, and equipment during an operation. The ready pack needs to stay with *the SAR responder* at all times. Never put it down to go do something else, just keep it with you. Never respond to a SAR incident without a ready pack (*whether working in the field or not*). Make it a habit.

Also leaving a part of the pack, or part of the gear behind, at camp for instance, to lighten the load, or for any other reason, never works well. Attempting an assignment without the right tools places you and your team at risk, not to mention the lack of efficiency. Regularly not needing a specific piece of gear means it probably shouldn't have been included in the first place. An experienced SAR responder knows what the job requires and then carries it all the time.

Don't Share With Others

When committed into the field, or located at the operational Command Post site, the ready pack represents the responder's home away from home. A

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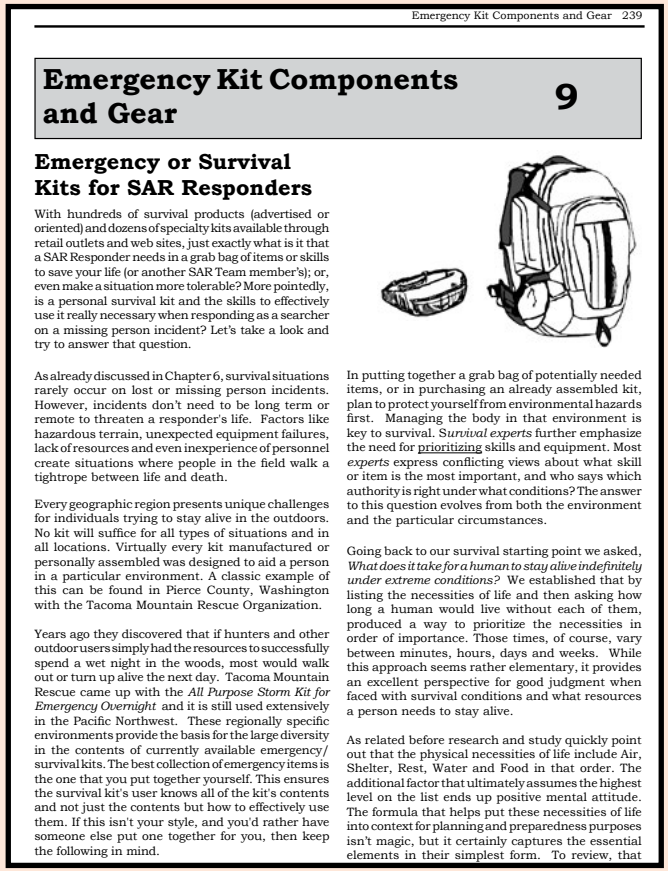
Chapter 9
Emergency Kit Components and Gear

(Click an image for a full page sample)

This chapter helps determine exactly what a SAR Responder needs to save their own life (or another SAR Team member's); or, to help make a difficult situation more tolerable. We try to impart a systematic approach to building and carrying personal emergency/survival kits and the skills to effectively use them. This chapter lays out the considerations, the essential groups of emergency kit components and important skills to practice as well.



Emergency Kit Components and Gear 239

Emergency Kit Components and Gear **9**

Emergency or Survival Kits for SAR Responders

With hundreds of survival products (advertised or oriented) and dozens of specialty kits available through retail outlets and web sites, just exactly what is it that a SAR Responder needs in a grab bag of items or skills to save your life (or another SAR Team member's); or, even make a situation more tolerable? More pointedly, is a personal survival kit and the skills to effectively use it really necessary when responding as a searcher on a missing person incident? Let's take a look and try to answer that question.

As already discussed in Chapter 6, survival situations rarely occur on lost or missing person incidents. However, incidents don't need to be long term or remote to threaten a responder's life. Factors like hazardous terrain, unexpected equipment failures, lack of resources and even inexperience of personnel create situations where people in the field walk a tightrope between life and death.

Every geographic region presents unique challenges for individuals trying to stay alive in the outdoors. No kit will suffice for all types of situations and in all locations. Virtually every kit manufactured or personally assembled was designed to aid a person in a particular environment. A classic example of this can be found in Pierce County, Washington with the Tacoma Mountain Rescue Organization.

Years ago they discovered that if hunters and other outdoor users simply had the resources to successfully spend a wet night in the woods, most would walk out or turn up alive the next day. Tacoma Mountain Rescue came up with the *All Purpose Storm Kit for Emergency Overnight* and it is still used extensively in the Pacific Northwest. These regionally specific environments provide the basis for the large diversity in the contents of currently available emergency/survival kits. The best collection of emergency items is the one that you put together yourself. This ensures the survival kit's user knows all of the kit's contents and not just the contents but how to effectively use them. If this isn't your style, and you'd rather have someone else put one together for you, then keep the following in mind.

In putting together a grab bag of potentially needed items, or in purchasing an already assembled kit, plan to protect yourself from environmental hazards first. Managing the body in that environment is key to survival. S*urvival experts* further emphasize the need for prioritizing skills and equipment. Most *experts* express conflicting views about what skill or item is the most important, and who says which authority is right under what conditions? The answer to this question evolves from both the environment and the particular circumstances.

Going back to our survival starting point we asked, *What does it take for a human to stay alive indefinitely under extreme conditions?* We established that by listing the necessities of life and then asking how long a human would live without each of them, produced a way to prioritize the necessities in order of importance. Those times, of course, vary between minutes, hours, days and weeks. While this approach seems rather elementary, it provides an excellent perspective for good judgment when faced with survival conditions and what resources a person needs to stay alive.

As related before research and study quickly point out that the physical necessities of life include Air, Shelter, Rest, Water and Food in that order. The additional factor that ultimately assumes the highest level on the list ends up positive mental attitude. The formula that helps put these necessities of life into context for planning and preparedness purposes isn't magic, but it certainly captures the essential elements in their simplest form. To review, that

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formula is **PMA + 98.6°F = BCS**. This equates to **P**ositive **M**ental **A**ttitude plus 98.6°F (**normal body temperature**) gives the Best Chance for Survival. Let's break that down just a little more. If we can maintain a positive mental attitude, use all of our skills and abilities to maintain a 98.6 body temperature, then we will have the **Best Chance of Survival**. Not a guarantee, but the best chance. Skills, abilities and attitude then keep the body in balance if we maintain our problem solving ability and have the right resources.

A survivor always protects their problem solving ability by providing the body with adequate protection (*shelter*). Hypothermia and other physiological body upsets directly affect our ability to think and reason. Combine these factors with search and rescue data concerning length of missions and a 24 to 72 hour time frame for response and the real survival priorities begin to show through.

Preconceived ideas about survival generate incorrect priorities and actions that can lead inexorably to a fatal end. Survival means adapting, and that adaptation means a change. The change (*what we do and how we react*) gets driven by an accurate reading of the environment and the hazards it poses. In other words, "*What's going to kill me first?*" Every incident presents different challenges just as every individual brings different skills and tools to the situation. But the necessities and priorities of life do not change, and a look at that list outlines a general course of action and the needed equipment. Environmental hazards pose threats so constantly assess the current (highest priority) threat to determine immediacy of actions and priorities.

Let's run down the list. Positive Mental Attitude based on knowledge, training or experience when faced with a survival ordeal gives the capability to render aid to yourself and anyone with you. Shelter rises as the next most important concern in the majority of cases. Protect the body's balance of resources and problem solving ability at all costs by maintaining normal temperatures and creating protective defenses. Conservation of existing energy stores, heat and water are also paramount to survival. Only do what is necessary. Keep the body's systems in balance. Signal distress and solve problems from the resources at hand and stay alive until rescue.

Three Lines of Defense

The first line of protective defenses in a survival kit and against any hazardous environment includes the clothing worn by that person. If they get hurt, knocked unconscious, or incapacitated in any way, the layers of clothing become the only defense against cold, heat or moisture. The second line of defense centers on what else you brought with you to the environment. That includes extra clothing, preparedness items (your survival kit), a vehicle and any improvised protection that comes from the parts and pieces of those resources. The third line of defense lies in the natural environment such as snow blocks, grass, boughs, leaves or other natural insulation material.

Essential Groups of Kit Components and Skills:

- **Shelter** - Heavy duty plastic shelter bags (for immediate action), plastic tube tents, rubber or plastic quick-don suits, nylon reinforced plastic bags, and bivy sacks all serve. Silicone impregnated nylon tarps allow for greater construction options and help shelter multiple people. Include 50 feet of nylon mil-spec para-cord. Also consider eight to ten feet of duct tape. This component group immediately protects the radiated layer of warmth around our bodies and reduces the possibility of hypothermia by keeping clothing and the body dry and protected from the wind.

  After listing some of the components satisfying the first category (shelter), consider the skills necessary to really use these resources in a challenging environment. Knots, techniques and innovative options should come to mind as naturally and freely as in any other activity in SAR. Training, orientation and practice represent familiar concepts for the SAR Responder.

  Every environment presents different protection requirements addressed by utilizing basic concepts. For instance, in wet, swampy or water laden areas a survivor needs to get off of the wet ground. A heavy mil DOT bag not only protects the body when you put it on correctly, it easily works as a chair, a stretcher, an overhead roof, a water catchment for drinking water, plus a myriad of other functions. It's not only very useful, it only takes up about as much space as a small wallet when vacuum packed (i.e. with a Food Saver unit). Minimizing a kit means using items to fill multiple needs.

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Chapter 10
Map, Compass and Navigation

(Click an image for a full page sample)

Chapter 10 defines and explains the most common grid systems used in land navigation, and map reading. Clear descriptions, illustrations and pictures instruct on correct orientation of a topographical map using a base plate compass, practical use of the Universal Transverse Mercator (UTM) grids and using the United States National Grid (USNG) system for the coordinates at a specific point. We provide guidance for taking a bearing to a location and transferring it correctly to a map. Conversely, we also provide for how to obtain a bearing on a map and transfer that directly to field navigation. True north, grid north, magnetic north, contour lines, contour index lines, magnetic declination, isogonic lines, longitude and latitude designations are all explained in detail using pictures, illustrations and example maps. Several methods to keep track of distance in the field are also covered.

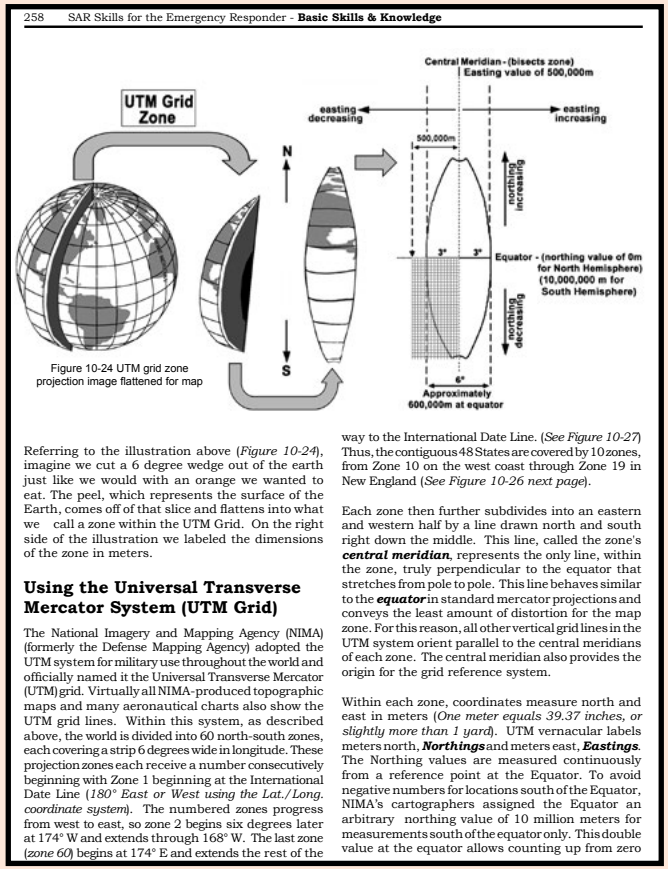

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Figure 10-24 UTM grid zone projection image flattened for map

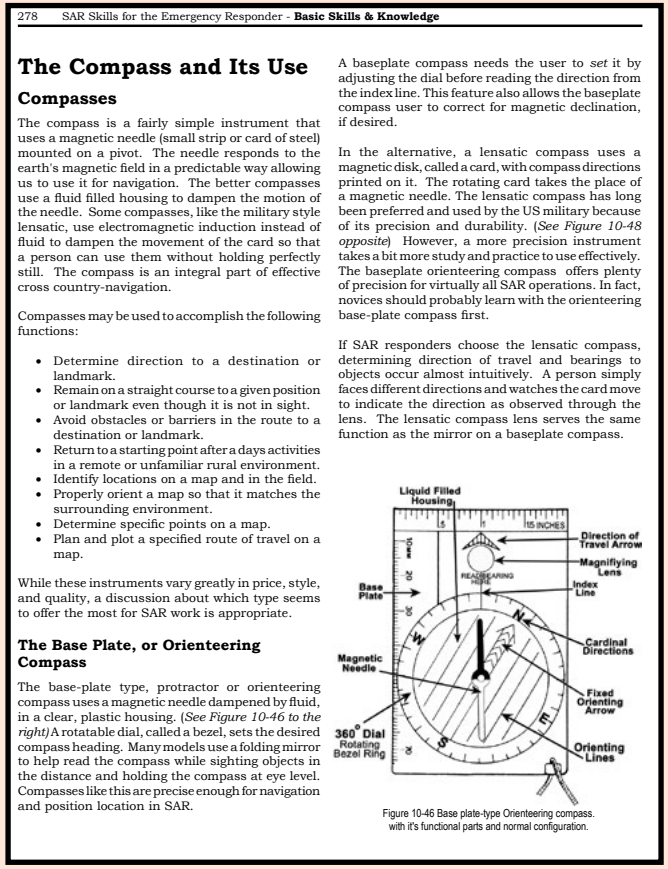
Referring to the illustration above (*Figure 10-24*), imagine we cut a 6 degree wedge out of the earth just like we would with an orange we wanted to eat. The peel, which represents the surface of the Earth, comes off of that slice and flattens into what we call a zone within the UTM Grid. On the right side of the illustration we labeled the dimensions of the zone in meters.

Using the Universal Transverse Mercator System (UTM Grid)

The National Imagery and Mapping Agency (NIMA) (formerly the Defense Mapping Agency) adopted the UTM system for military use throughout the world and officially named it the Universal Transverse Mercator (UTM) grid. Virtually all NIMA-produced topographic maps and many aeronautical charts also show the UTM grid lines. Within this system, as described above, the world is divided into 60 north-south zones, each covering a strip 6 degrees wide in longitude. These projection zones each receive a number consecutively beginning with Zone 1 beginning at the International Date Line (*180° East or West using the Lat./Long. coordinate system*). The numbered zones progress from west to east, so zone 2 begins six degrees later at 174° W and extends through 168° W. The last zone (*zone 60*) begins at 174° E and extends the rest of the way to the International Date Line. (*See Figure 10-27*) Thus, the contiguous 48 States are covered by 10 zones, from Zone 10 on the west coast through Zone 19 in New England (*See Figure 10-26 next page*).

Each zone then further subdivides into an eastern and western half by a line drawn north and south right down the middle. This line, called the zone's ***central meridian***, represents the only line, within the zone, truly perpendicular to the equator that stretches from pole to pole. This line behaves similar to the ***equator*** in standard mercator projections and conveys the least amount of distortion for the map zone. For this reason, all other vertical grid lines in the UTM system orient parallel to the central meridians of each zone. The central meridian also provides the origin for the grid reference system.

Within each zone, coordinates measure north and east in meters (*One meter equals 39.37 inches, or slightly more than 1 yard*). UTM vernacular labels meters north, ***Northings*** and meters east, ***Eastings***. The Northing values are measured continuously from a reference point at the Equator. To avoid negative numbers for locations south of the Equator, NIMA's cartographers assigned the Equator an arbitrary northing value of 10 million meters for measurements south of the equator only. This double value at the equator allows counting up from zero



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The Compass and Its Use

Compasses

The compass is a fairly simple instrument that uses a magnetic needle (small strip or card of steel) mounted on a pivot. The needle responds to the earth's magnetic field in a predictable way allowing us to use it for navigation. The better compasses use a fluid filled housing to dampen the motion of the needle. Some compasses, like the military style lensatic, use electromagnetic induction instead of fluid to dampen the movement of the card so that a person can use them without holding perfectly still. The compass is an integral part of effective cross country-navigation.

Compasses may be used to accomplish the following functions:

- Determine direction to a destination or landmark.
- Remain on a straight course to a given position or landmark even though it is not in sight.
- Avoid obstacles or barriers in the route to a destination or landmark.
- Return to a starting point after a days activities in a remote or unfamiliar rural environment.
- Identify locations on a map and in the field.
- Properly orient a map so that it matches the surrounding environment.
- Determine specific points on a map.
- Plan and plot a specified route of travel on a map.

While these instruments vary greatly in price, style, and quality, a discussion about which type seems to offer the most for SAR work is appropriate.

The Base Plate, or Orienteering Compass

The base-plate type, protractor or orienteering compass uses a magnetic needle dampened by fluid, in a clear, plastic housing. (*See Figure 10-46 to the right*) A rotatable dial, called a bezel, sets the desired compass heading. Many models use a folding mirror to help read the compass while sighting objects in the distance and holding the compass at eye level. Compasses like this are precise enough for navigation and position location in SAR.

A baseplate compass needs the user to *set* it by adjusting the dial before reading the direction from the index line. This feature also allows the baseplate compass user to correct for magnetic declination, if desired.

In the alternative, a lensatic compass uses a magnetic disk, called a card, with compass directions printed on it. The rotating card takes the place of a magnetic needle. The lensatic compass has long been preferred and used by the US military because of its precision and durability. (*See Figure 10-48 opposite*) However, a more precision instrument takes a bit more study and practice to use effectively. The baseplate orienteering compass offers plenty of precision for virtually all SAR operations. In fact, novices should probably learn with the orienteering base-plate compass first.

If SAR responders choose the lensatic compass, determining direction of travel and bearings to objects occur almost intuitively. A person simply faces different directions and watches the card move to indicate the direction as observed through the lens. The lensatic compass lens serves the same function as the mirror on a baseplate compass.

Figure 10-46 Base plate-type Orienteering compass. with it's functional parts and normal configuration.

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Chapter 11
Introduction to the Science of Search

Chapter 11 provides a clear explanation of the history and development of scientifically based search for everything from people to objects. The history and derivation of search theory dating back to WWW II and Operations Research. We link these established branches of science to finding lost or missing people. We review research and field experiments which give clear rationales for SAR responder tasks, procedures and strategies during SAR incidents. We outline current approaches to management and the planning of searches with all of their shortfalls. This analysis relates directly to the need for quantification and applying regular mathematical units to the process. We also explain very simple field procedures for SAR responders that provide significantly more accurate assessments of search effectiveness.

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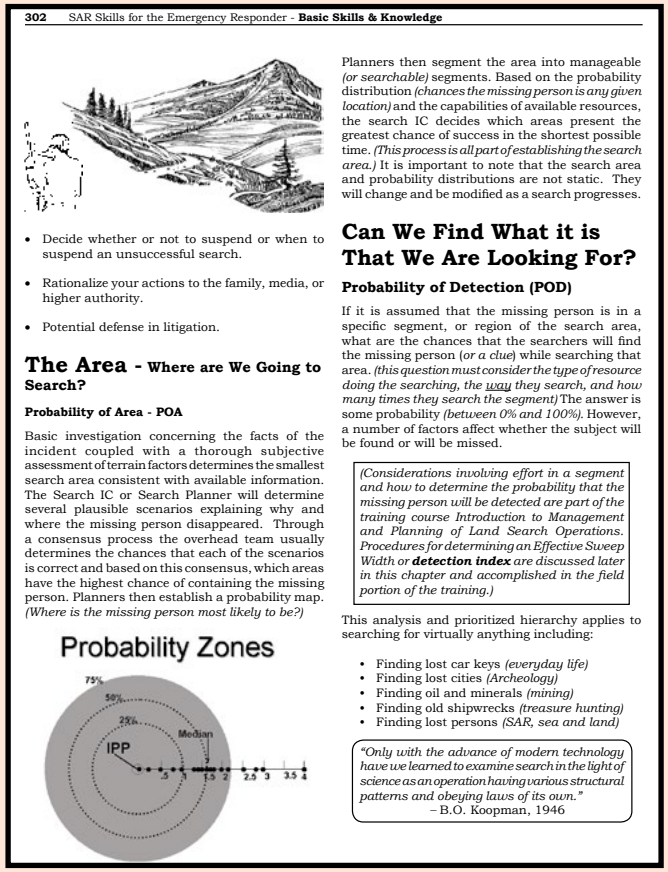

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- Decide whether or not to suspend or when to suspend an unsuccessful search.
- Rationalize your actions to the family, media, or higher authority.
- Potential defense in litigation.

The Area - Where are We Going to Search?

Probability of Area - POA

Basic investigation concerning the facts of the incident coupled with a thorough subjective assessment of terrain factors determines the smallest search area consistent with available information. The Search IC or Search Planner will determine several plausible scenarios explaining why and where the missing person disappeared. Through a consensus process the overhead team usually determines the chances that each of the scenarios is correct and based on this consensus, which areas have the highest chance of containing the missing person. Planners then establish a probability map. *(Where is the missing person most likely to be?)*

Probability Zones

Planners then segment the area into manageable *(or searchable)* segments. Based on the probability distribution *(chances the missing person is any given location)* and the capabilities of available resources, the search IC decides which areas present the greatest chance of success in the shortest possible time. *(This process is all part of establishing the search area.)* It is important to note that the search area and probability distributions are not static. They will change and be modified as a search progresses.

Can We Find What it is That We Are Looking For?

Probability of Detection (POD)

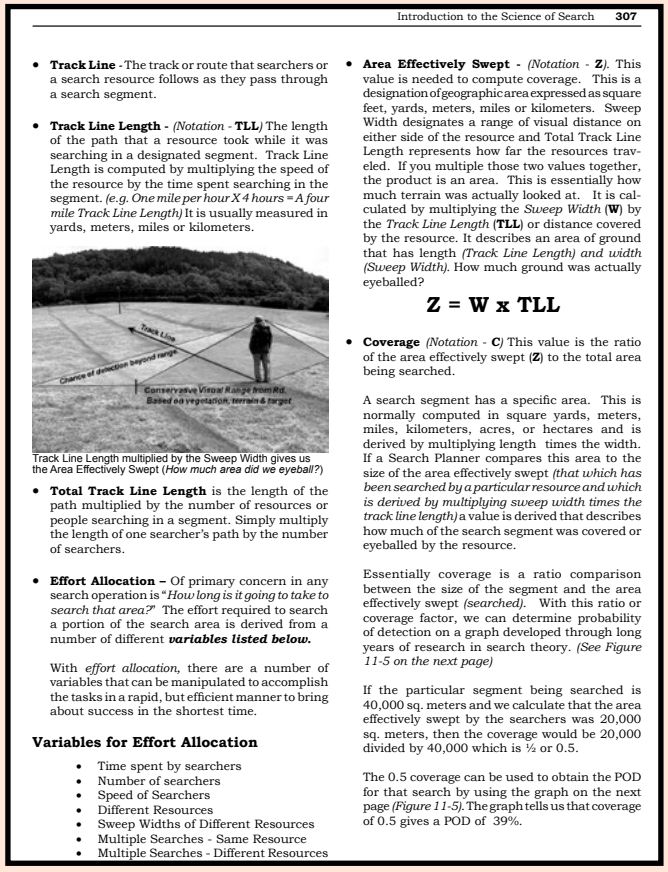
If it is assumed that the missing person is in a specific segment, or region of the search area, what are the chances that the searchers will find the missing person (*or a clue*) while searching that area. *(this question must consider the type of resource doing the searching, the way they search, and how many times they search the segment)* The answer is some probability *(between 0% and 100%)*. However, a number of factors affect whether the subject will be found or will be missed.

(Considerations involving effort in a segment and how to determine the probability that the missing person will be detected are part of the training course Introduction to Management and Planning of Land Search Operations. Procedures for determining an Effective Sweep Width or ***detection index*** *are discussed later in this chapter and accomplished in the field portion of the training.)*

This analysis and prioritized hierarchy applies to searching for virtually anything including:

- Finding lost car keys *(everyday life)*
- Finding lost cities *(Archeology)*
- Finding oil and minerals *(mining)*
- Finding old shipwrecks *(treasure hunting)*
- Finding lost persons *(SAR, sea and land)*

"Only with the advance of modern technology have we learned to examine search in the light of science as an operation having various structural patterns and obeying laws of its own."
– B.O. Koopman, 1946



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- **Track Line** - The track or route that searchers or a search resource follows as they pass through a search segment.
- **Track Line Length** - *(Notation* - **TLL***)* The length of the path that a resource took while it was searching in a designated segment. Track Line Length is computed by multiplying the speed of the resource by the time spent searching in the segment. *(e.g. One mile per hour X 4 hours = A four mile Track Line Length)* It is usually measured in yards, meters, miles or kilometers.

Track Line Length multiplied by the Sweep Width gives us the Area Effectively Swept (*How much area did we eyeball?*)

- **Total Track Line Length** is the length of the path multiplied by the number of resources or people searching in a segment. Simply multiply the length of one searcher's path by the number of searchers.
- **Effort Allocation –** Of primary concern in any search operation is "*How long is it going to take to search that area?*" The effort required to search a portion of the search area is derived from a number of different ***variables listed below.***

  With *effort allocation*, there are a number of variables that can be manipulated to accomplish the tasks in a rapid, but efficient manner to bring about success in the shortest time.

Variables for Effort Allocation

- Time spent by searchers
- Number of searchers
- Speed of Searchers
- Different Resources
- Sweep Widths of Different Resources
- Multiple Searches - Same Resource
- Multiple Searches - Different Resources

- **Area Effectively Swept** - *(Notation* - **Z***)*. This value is needed to compute coverage. This is a designation of geographic area expressed as square feet, yards, meters, miles or kilometers. Sweep Width designates a range of visual distance on either side of the resource and Total Track Line Length represents how far the resources traveled. If you multiple those two values together, the product is an area. This is essentially how much terrain was actually looked at. It is calculated by multiplying the *Sweep Width* (**W**) by the *Track Line Length* (**TLL**) or distance covered by the resource. It describes an area of ground that has length *(Track Line Length) and width (Sweep Width)*. How much ground was actually eyeballed?

  Z = W x TLL

- **Coverage** *(Notation* - **C***)* This value is the ratio of the area effectively swept (**Z**) to the total area being searched.

  A search segment has a specific area. This is normally computed in square yards, meters, miles, kilometers, acres, or hectares and is derived by multiplying length times the width. If a Search Planner compares this area to the size of the area effectively swept *(that which has been searched by a particular resource and which is derived by multiplying sweep width times the track line length)* a value is derived that describes how much of the search segment was covered or eyeballed by the resource.

  Essentially coverage is a ratio comparison between the size of the segment and the area effectively swept *(searched)*. With this ratio or coverage factor, we can determine probability of detection on a graph developed through long years of research in search theory. *(See Figure 11-5 on the next page)*

  If the particular segment being searched is 40,000 sq. meters and we calculate that the area effectively swept by the searchers was 20,000 sq. meters, then the coverage would be 20,000 divided by 40,000 which is ½ or 0.5.

  The 0.5 coverage can be used to obtain the POD for that search by using the graph on the next page *(Figure 11-5)*. The graph tells us that coverage of 0.5 gives a POD of 39%.

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Chapter 12
Lost and Missing Person Behavior

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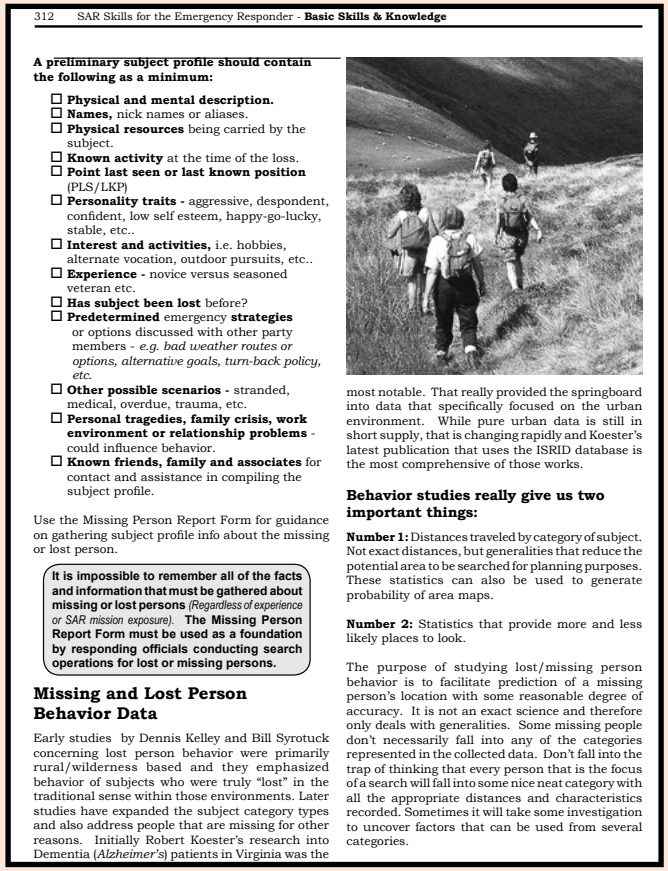
Lost Person Behavior and resource data from ISRID (the International Search and Rescue Incident Database) may significantly increase effectiveness on missing person searches. We show why researchers combine national and international search data through the concept of ECO-Regions. The chapter outlines the use of the ISRID database and reflex tasks through statistical data for one subject category, Dementia. We discuss how to determine subject category, and where to go to find the statistical data for other subject categories. The importance of standard procedures in the initial response phase of a search is also emphasized.

A useful "Bike Wheel Model" for on-scene initial response provides an analogy of a bike wheel and specific functions are described for each component of the wheel. The logical sequence for planning a search effort is given along with guidelines for developing attainable, verifiable operational period objectives which may be easily evaluated later. First arriving resource (SAR responders) will now have an idea, based on the subject category, what needs to be accomplished on almost every SAR incident.



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A preliminary subject profile should contain the following as a minimum:

- ☐ **Physical and mental description.**
- ☐ **Names,** nick names or aliases.
- ☐ **Physical resources** being carried by the subject.
- ☐ **Known activity** at the time of the loss.
- ☐ **Point last seen or last known position** (PLS/LKP)
- ☐ **Personality traits** - aggressive, despondent, confident, low self esteem, happy-go-lucky, stable, etc..
- ☐ **Interest and activities,** i.e. hobbies, alternate vocation, outdoor pursuits, etc..
- ☐ **Experience** - novice versus seasoned veteran etc.
- ☐ **Has subject been lost** before?
- ☐ **Predetermined** emergency **strategies** or options discussed with other party members - *e.g. bad weather routes or options, alternative goals, turn-back policy, etc.*
- ☐ **Other possible scenarios** - stranded, medical, overdue, trauma, etc.
- ☐ **Personal tragedies, family crisis, work environment or relationship problems** - could influence behavior.
- ☐ **Known friends, family and associates** for contact and assistance in compiling the subject profile.

Use the Missing Person Report Form for guidance on gathering subject profile info about the missing or lost person.

It is impossible to remember all of the facts and information that must be gathered about missing or lost persons *(Regardless of experience or SAR mission exposure).* **The Missing Person Report Form must be used as a foundation by responding officials conducting search operations for lost or missing persons.**

Missing and Lost Person Behavior Data

Early studies by Dennis Kelley and Bill Syrotuck concerning lost person behavior were primarily rural/wilderness based and they emphasized behavior of subjects who were truly "lost" in the traditional sense within those environments. Later studies have expanded the subject category types and also address people that are missing for other reasons. Initially Robert Koester's research into Dementia (*Alzheimer*'s) patients in Virginia was the most notable. That really provided the springboard into data that specifically focused on the urban environment. While pure urban data is still in short supply, that is changing rapidly and Koester's latest publication that uses the ISRID database is the most comprehensive of those works.

Behavior studies really give us two important things:

Number 1: Distances traveled by category of subject. Not exact distances, but generalities that reduce the potential area to be searched for planning purposes. These statistics can also be used to generate probability of area maps.

Number 2: Statistics that provide more and less likely places to look.

The purpose of studying lost/missing person behavior is to facilitate prediction of a missing person's location with some reasonable degree of accuracy. It is not an exact science and therefore only deals with generalities. Some missing people don't necessarily fall into any of the categories represented in the collected data. Don't fall into the trap of thinking that every person that is the focus of a search will fall into some nice neat category with all the appropriate distances and characteristics recorded. Sometimes it will take some investigation to uncover factors that can be used from several categories.

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in the field. This is comforting for family, media, peers or companions at the scene. Reflex Tasking shows an immediate purpose and solidly gives the impression that someone is doing something based on facts. Overall impression is that someone knows what they are doing.

Functional Groups for Reflex Tasking

Koester has established six (6) functional groups of tasks for each of the subject categories. These functional groups of tasks remain constant throughout each category of subject. The functional groups of tasks are as follows:

- Investigation
- Initial Planning Point
- Containment
- Hub/Immediate Area
- Travel Corridors
- High Probability Tasks

While the functional groups remain constant throughout all categories, specific tasks in those functional groups will depend on the subject category. As an example under the subject category of **Dementia** *(Alzheimer's)* under functional group Travel Corridors, Reflex Tasks for this group would be as follows:

- **Travel Corridors**
  - ☐ Hasty search of trails, roads, drainages, and other routes leading away from the IPP, patrol roads.
  - ☐ Look for decision points and cut for sign at turn off points.
  - ☐ Dogs into drainages.
  - ☐ Corridor search parallel to roads and routes.

By comparison look at the same functional task group *(Travel Corridors)* and the Reflex Tasks for **Children 7-9:**

- **Travel Corridors**
  - — Hasty search of trails, roads, drainages, and other routes leading away from the IPP.
  - — Cut for sign along routes and at shortcuts.
  - — Look for various routes to familiar places.

Going back to the example database for Dementia (*Alzheimer*'s) in Koester's manual it is instructive to fill in the other Reflex Tasks under the other five functional groups.

- **Investigation**
  - → Determine planning data
  - → Determine searching data
  - → Start MPQ (Missing Person Questionnaire/ Lost Person Questionnaire) Ask specific questions.
  - → Previous wandering?
  - → Potential destinations.
  - → Severity of dementia.
  - → Check taxis, mass transit *(all shifts)*, hospitals, EMS, jails, shelters, etc.
  - → Alert municipal workers.
  - → Issue ***Silver*** alert.
- **Initial Planning Point**
  - → Preserve IPP.
  - → Locale search.
  - → Highly systematic grounds and structure search.
  - → Repeat search of grounds and structure.
  - → Task sign cutters/trackers.
  - → Tracking/Trailing dogs; ideal if they have practiced with persons with dementia.
- **Containment**
  - → Establish containment.
  - → Use statistical max zone or theoretical zone.
  - → Containment provided by road patrols/air.
  - → In urban environment, use road, bike, air patrols. Contain entrances to gated developments.
- **Hub/Immediate Area**
  - → Canvass campground.
  - → Canvass neighborhood.
  - → Thorough search of 25% zone. Sweep/area dogs.
  - → Notify community by media, flyer, door to door, and/or telephone system.
- **High Probability Tasks**
  - → Check historical finds.
  - → Previous lost locations.
  - → High hazard areas.
  - → Previous homes.
  - → Ensure heavy brush is searched.

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Chapter 13
The Basics of Searching

Target Orientation, Human Vision and the Detection Process

The first section in the chapter deals with how and why searchers see clues or even the missing subjects in the environment. Simple explanations do not fit as this is a complex process of sensation (vision) and decision making. Vision, perception and detection versus recognition are described and illustrated with practical examples. Feature integration, form, organization and grouping along with vision basics are all explained and related to searching in the field. Canonical perspective is also explained along with visual briefings and how they relate to POD when searchers go to the field. Many believe in a direct correlation between a briefing, how SAR responders train and their eventual POD in the field.

Searching the Searcher Cube – An analysis of searcher scanning technique

Virtually all training related to Basic Search and Rescue Skills refers to what we call the Searcher Cube as they pass through the environment on a search. This section defines that searcher cube and identifies a training shortfall in the SAR community concerning ways to search in consistent, reliable ways. To understand and improve what really happens in the field on a search, this chapter then discusses the research and the experiments conducted through the National Search and Rescue Committee for determining effective sweep width (a detection index). Common searcher errors were recorded in detail during those experiments. Our discussion then suggests the use of various visual routines very similar to instrument pilots, military/police patrols and aerial observers to provide guidance for scanning complicated visual environments.

Track and Clue Awareness

The last section covers a relatively new skill in the SAR arena. The concept of Track and Clue Awareness (TCA) as a skill is used to detect the path (direction and movement) of someone or something, but it also helps discover what activities occurred at a specific site (point of departure, crime scene, trail junction, campsite, etc.) That means processing or examining a site. We present Track and Clue Awareness as a process of interpretation for everything left behind by our target. The skill is both an investigative (strategic) and an operational (tactical) search tool.

(Click an image for a full page sample)

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Searching the *Cube* – an analysis of basic searcher scanning techniques and training

Virtually all training related to Basic Search and Rescue Skills refers to or references searching what we call the ***Searcher Cube***. This section defines the often referenced *searcher cube* and identifies a training shortfall in the SAR community concerning ways to effectively search that *hypothetical visual zone*. To thoroughly understand the implications of this, readers must also understand the results of the *Sweep Width Estimation for Ground Search and Rescue* study funded and conducted through the National Search and Rescue Committee published in late 2004. We suggest a simple visual routine to insure efficient and thorough coverage of the searcher cube to directly influence (*and increase*) both coverage and probability of detection during any search.

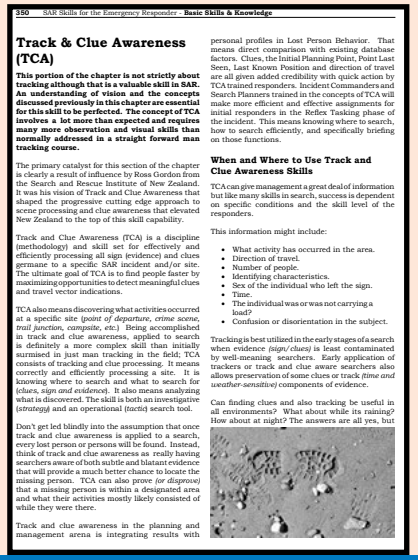
Imagine the searcher cube as a six sided transparent cube surrounding a searcher as he or she walks through an assigned search segment. Each side or plane of that cube (top, bottom, sides, front and back) must be scanned constantly and effectively as a searcher's movement takes them through the segment. It sounds simple, but successful searching takes a fairly complicated and coordinated effort to get the job done. For instance, how does a searcher check the six o'clock position (*effectively look back*) while proceeding through an area of mixed vegetation or very dangerous and tenuous footing? The dimensions of the searcher cube form the basis of how the searcher covers the environment with his or her attention. Each of the six faces of the cube should be one full sweep width (*2 x the lateral range curve*) in height and width with the searcher at the center. The sweep width is estimated by the Average Range of Detection procedure in the field at the beginning of the operational period (see The Textbook for Managing Land Search Operations, *Page 338-339*). This dimension provides an accurate foundation for the searcher's coverage calculation and ultimately his or her probability of detection (*POD*). This means that the probability of detecting an object outside the cube is equal to the probability of missing an object inside the cube (see The Textbook for Managing Land Search Operations, *Page 353*).

To understand and improve what really happens in the field on a search: we will look at both the research and the experiments conducted so far; the searcher errors recorded in those experiments; and finally, we will suggest the use of a visual routine very similar to that used by instrument pilots as well as military and police patrols to keep track of very busy and complicated visual environments.

During the Sweep Width Estimation Studies, a valuable secondary benefit of the experiments centered on how searchers detected or missed search targets *(randomly placed objects)* while data loggers observed them. Searchers seldom have an opportunity to get feedback on why they missed a search object and hence they don't get an opportunity to improve their skills.

Members of the experiment staff who placed the targets made relevant observations of the searchers in action. Because the experiment staff placed the targets, they knew the location of each object and they closely observed searcher technique while they looked for the targets. After the first experiment, the staff recorded additional details concerning the search targets. This information included the location along the track where the search target first became visible (detection opportunities), the maximum range at which it remained visible, what percentage of the time while in the visible range it could be detected, a qualitative term describing its visibility, and any features that might complicate its detectability. Unfortunately, since this facet of search was not the ultimate goal of the experiment no standardized form was made to collect this data. However, based upon the observations of the experiment data loggers (*observers*) the following were the most common errors in technique leading to missed visible targets.

- **Not looking behind or back.** (*Checking the 6 o-clock position*) Many targets in the experiments were only visible if the searcher looked back. Often over the entire course the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Track & Clue Awareness (TCA)

This portion of the chapter is not strictly about tracking although that is a valuable skill in SAR. An understanding of vision and the concepts discussed previously in this chapter are essential for this skill to be perfected. The concept of TCA involves a lot more than expected and requires many more observation and visual skills than normally addressed in a straight forward man tracking course.

The primary catalyst for this section of the chapter is clearly a result of influence by Ross Gordon from the Search and Rescue Institute of New Zealand. It was his vision of Track and Clue Awareness that shaped the progressive cutting edge approach to scene processing and clue awareness that elevated New Zealand to the top of this skill capability.

Track and Clue Awareness (TCA) is a discipline (methodology) and skill set for effectively and efficiently processing all sign (evidence) and clues germane to a specific SAR incident and/or site. The ultimate goal of TCA is to find people faster by maximizing opportunities to detect meaningful clues and travel vector indications.

TCA also means discovering what activities occurred at a specific site (*point of departure, crime scene, trail junction, campsite, etc.*) Being accomplished in track and clue awareness, applied to search is definitely a more complex skill than initially surmised in just man tracking in the field; TCA consists of tracking and clue processing. It means correctly and efficiently processing a site. It is knowing where to search and what to search for (*clues, sign and evidence*). It also means analyzing what is discovered. The skill is both an investigative (*strategy*) and an operational (*tactic*) search tool.

Don't get led blindly into the assumption that once track and clue awareness is applied to a search, every lost person or persons will be found. Instead, think of track and clue awareness as really having searchers aware of both subtle and blatant evidence that will provide a much better chance to locate the missing person. TCA can also prove *(or disprove)* that a missing person is within a designated area and what their activities mostly likely consisted of while they were there.

Track and clue awareness in the planning and management arena is integrating results with personal profiles in Lost Person Behavior. That means direct comparison with existing database factors. Clues, the Initial Planning Point, Point Last Seen, Last Known Position and direction of travel are all given added credibility with quick action by TCA trained responders. Incident Commanders and Search Planners trained in the concepts of TCA will make more efficient and effective assignments for initial responders in the Reflex Tasking phase of the incident. This means knowing where to search, how to search efficiently, and specifically briefing on those functions.

When and Where to Use Track and Clue Awareness Skills

TCA can give management a great deal of information but like many skills in search, success is dependent on specific conditions and the skill level of the responders.

This information might include:

- What activity has occurred in the area.
- Direction of travel.
- Number of people.
- Identifying characteristics.
- Sex of the individual who left the sign.
- Time.
- The individual was or was not carrying a load?
- Confusion or disorientation in the subject.

Tracking is best utilized in the early stages of a search when evidence *(sign/clues)* is least contaminated by well-meaning searchers. Early application of trackers or track and clue aware searchers also allows preservation of some clues or track *(time and weather-sensitive)* components of evidence.

Can finding clues and also tracking be useful in all environments? What about while its raining? How about at night? The answers are all yes, but

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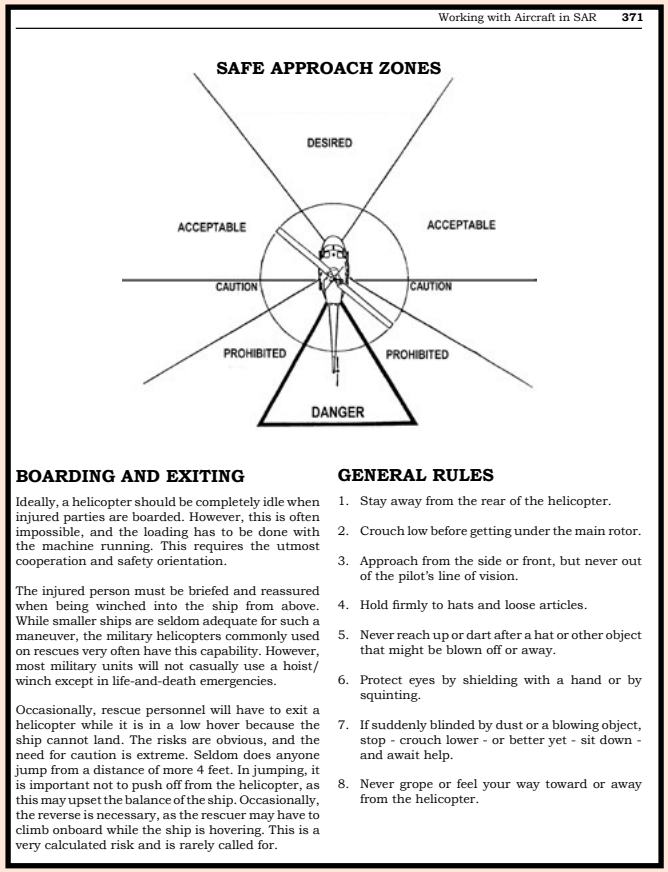
Chapter 14
Working with Aircraft in SAR

This chapter describes which missions benefit from aircraft (both fixed wing and helicopters) in SAR and the primary functions fulfilled by aircraft during SAR missions. We describe their limitations, attributes, and sources. A major portion of this chapter centers on personnel safety in and around SAR helicopter operations. Passenger loading, unloading, hand signals for ground personnel working around helicopters, and safety briefings for passengers are all covered in detail. We discuss and diagram setting up helicopter landing zones in both the daylight and at night under varying conditions. This section explains patient considerations for helicopter evacuations, including hoisting and patient preparation for rotor-wash, flying debris and other patient protective requirements. Directing an aircraft to a specific ground location (vectoring) is covered extensively along with aircraft emergency procedures for crash landing.

(Click an image for a full page sample)



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SAFE APPROACH ZONES

BOARDING AND EXITING

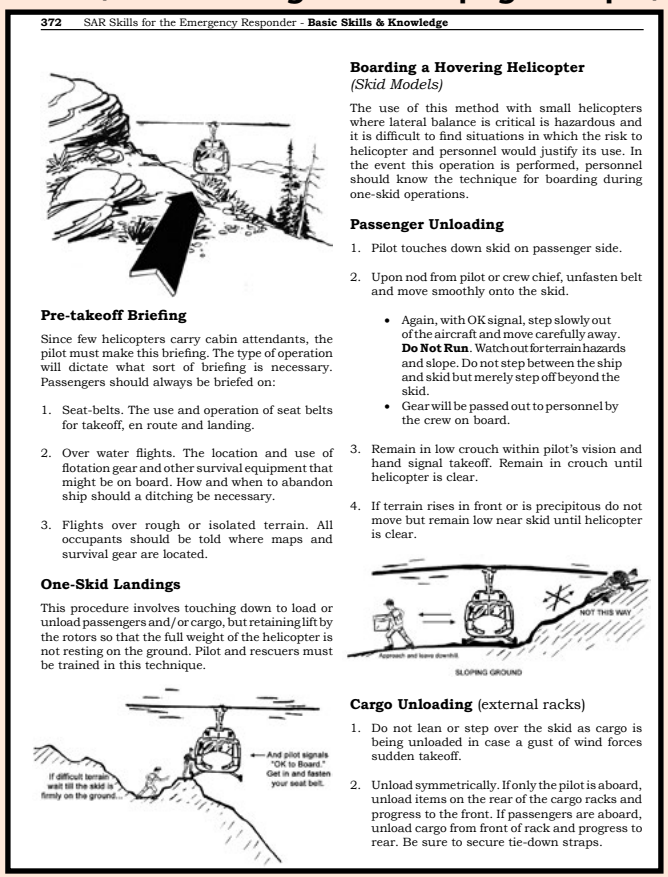
Ideally, a helicopter should be completely idle when injured parties are boarded. However, this is often impossible, and the loading has to be done with the machine running. This requires the utmost cooperation and safety orientation.

The injured person must be briefed and reassured when being winched into the ship from above. While smaller ships are seldom adequate for such a maneuver, the military helicopters commonly used on rescues very often have this capability. However, most military units will not casually use a hoist/winch except in life-and-death emergencies.

Occasionally, rescue personnel will have to exit a helicopter while it is in a low hover because the ship cannot land. The risks are obvious, and the need for caution is extreme. Seldom does anyone jump from a distance of more 4 feet. In jumping, it is important not to push off from the helicopter, as this may upset the balance of the ship. Occasionally, the reverse is necessary, as the rescuer may have to climb onboard while the ship is hovering. This is a very calculated risk and is rarely called for.

GENERAL RULES

1. Stay away from the rear of the helicopter.
2. Crouch low before getting under the main rotor.
3. Approach from the side or front, but never out of the pilot's line of vision.
4. Hold firmly to hats and loose articles.
5. Never reach up or dart after a hat or other object that might be blown off or away.
6. Protect eyes by shielding with a hand or by squinting.
7. If suddenly blinded by dust or a blowing object, stop - crouch lower - or better yet - sit down - and await help.
8. Never grope or feel your way toward or away from the helicopter.



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Pre-takeoff Briefing

Since few helicopters carry cabin attendants, the pilot must make this briefing. The type of operation will dictate what sort of briefing is necessary. Passengers should always be briefed on:

1. Seat-belts. The use and operation of seat belts for takeoff, en route and landing.
2. Over water flights. The location and use of flotation gear and other survival equipment that might be on board. How and when to abandon ship should a ditching be necessary.
3. Flights over rough or isolated terrain. All occupants should be told where maps and survival gear are located.

One-Skid Landings

This procedure involves touching down to load or unload passengers and/or cargo, but retaining lift by the rotors so that the full weight of the helicopter is not resting on the ground. Pilot and rescuers must be trained in this technique.

Boarding a Hovering Helicopter
(Skid Models)

The use of this method with small helicopters where lateral balance is critical is hazardous and it is difficult to find situations in which the risk to helicopter and personnel would justify its use. In the event this operation is performed, personnel should know the technique for boarding during one-skid operations.

Passenger Unloading

1. Pilot touches down skid on passenger side.
2. Upon nod from pilot or crew chief, unfasten belt and move smoothly onto the skid.
   - Again, with OK signal, step slowly out of the aircraft and move carefully away. **Do Not Run**. Watch out for terrain hazards and slope. Do not step between the ship and skid but merely step off beyond the skid.
   - Gear will be passed out to personnel by the crew on board.
3. Remain in low crouch within pilot's vision and hand signal takeoff. Remain in crouch until helicopter is clear.
4. If terrain rises in front or is precipitous do not move but remain low near skid until helicopter is clear.

Cargo Unloading (external racks)

1. Do not lean or step over the skid as cargo is being unloaded in case a gust of wind forces sudden takeoff.
2. Unload symmetrically. If only the pilot is aboard, unload items on the rear of the cargo racks and progress to the front. If passengers are aboard, unload cargo from front of rack and progress to rear. Be sure to secure tie-down straps.

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Chapter 15
Rescue Gear and Equipment

A significant number of missions in SAR operations end up with some type of rescue or extraction for the person in distress. Rescue (technical or otherwise) is not the major focus of this book, but imparting knowledge about the equipment used in SAR incidents is. The basics of equipment, and the care of that equipment involved in rescue forms part of the knowledge base of any SAR responder. This chapter provides a basic review of rescue equipment found in most SAR team equipment inventories; what the equipment is used for, and how to care for it. The descriptions start with rope (their construction, use, inspection and care), and move on to webbing (the types, ratings and care) with guidelines on protocols for protection and inspection of all rescue software (ropes –webbing). From there the chapter covers climbing harnesses, (types, their attributes and care as well as some shortfalls in design). The rest of the chapter describes and illustrates rescue hardware starting with carabiners, screw links, descenders like the Brake Bar Rack, and Figure 8 variations. Ascenders both cam and handled are described and pictured along with pulleys and edge protectors. The final area covered is equipment for transporting an injured patient. This included backboards and litters (basket style and wrap around) which described and pictured.

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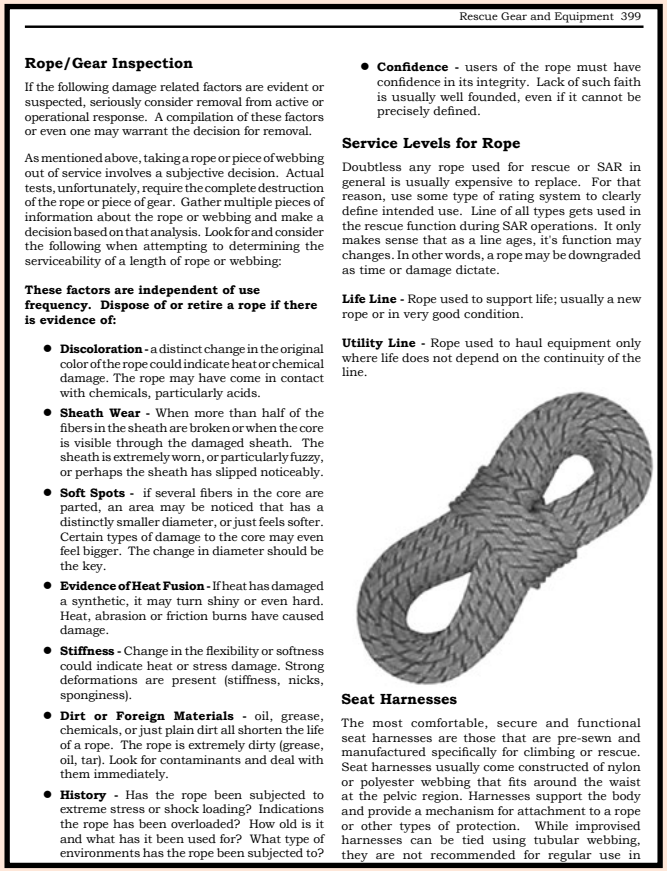

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Rope/Gear Inspection

If the following damage related factors are evident or suspected, seriously consider removal from active or operational response. A compilation of these factors or even one may warrant the decision for removal.

As mentioned above, taking a rope or piece of webbing out of service involves a subjective decision. Actual tests, unfortunately, require the complete destruction of the rope or piece of gear. Gather multiple pieces of information about the rope or webbing and make a decision based on that analysis. Look for and consider the following when attempting to determining the serviceability of a length of rope or webbing:

These factors are independent of use frequency. Dispose of or retire a rope if there is evidence of:

- **Discoloration -** a distinct change in the original color of the rope could indicate heat or chemical damage. The rope may have come in contact with chemicals, particularly acids.
- **Sheath Wear -** When more than half of the fibers in the sheath are broken or when the core is visible through the damaged sheath. The sheath is extremely worn, or particularly fuzzy, or perhaps the sheath has slipped noticeably.
- **Soft Spots -** if several fibers in the core are parted, an area may be noticed that has a distinctly smaller diameter, or just feels softer. Certain types of damage to the core may even feel bigger. The change in diameter should be the key.
- **Evidence of Heat Fusion -** If heat has damaged a synthetic, it may turn shiny or even hard. Heat, abrasion or friction burns have caused damage.
- **Stiffness -** Change in the flexibility or softness could indicate heat or stress damage. Strong deformations are present (stiffness, nicks, sponginess).
- **Dirt or Foreign Materials -** oil, grease, chemicals, or just plain dirt all shorten the life of a rope. The rope is extremely dirty (grease, oil, tar). Look for contaminants and deal with them immediately.
- **History -** Has the rope been subjected to extreme stress or shock loading? Indications the rope has been overloaded? How old is it and what has it been used for? What type of environments has the rope been subjected to?
- **Confidence -** users of the rope must have confidence in its integrity. Lack of such faith is usually well founded, even if it cannot be precisely defined.

Service Levels for Rope

Doubtless any rope used for rescue or SAR in general is usually expensive to replace. For that reason, use some type of rating system to clearly define intended use. Line of all types gets used in the rescue function during SAR operations. It only makes sense that as a line ages, it's function may changes. In other words, a rope may be downgraded as time or damage dictate.

Life Line - Rope used to support life; usually a new rope or in very good condition.

Utility Line - Rope used to haul equipment only where life does not depend on the continuity of the line.

Seat Harnesses

The most comfortable, secure and functional seat harnesses are those that are pre-sewn and manufactured specifically for climbing or rescue. Seat harnesses usually come constructed of nylon or polyester webbing that fits around the waist at the pelvic region. Harnesses support the body and provide a mechanism for attachment to a rope or other types of protection. While improvised harnesses can be tied using tubular webbing, they are not recommended for regular use in

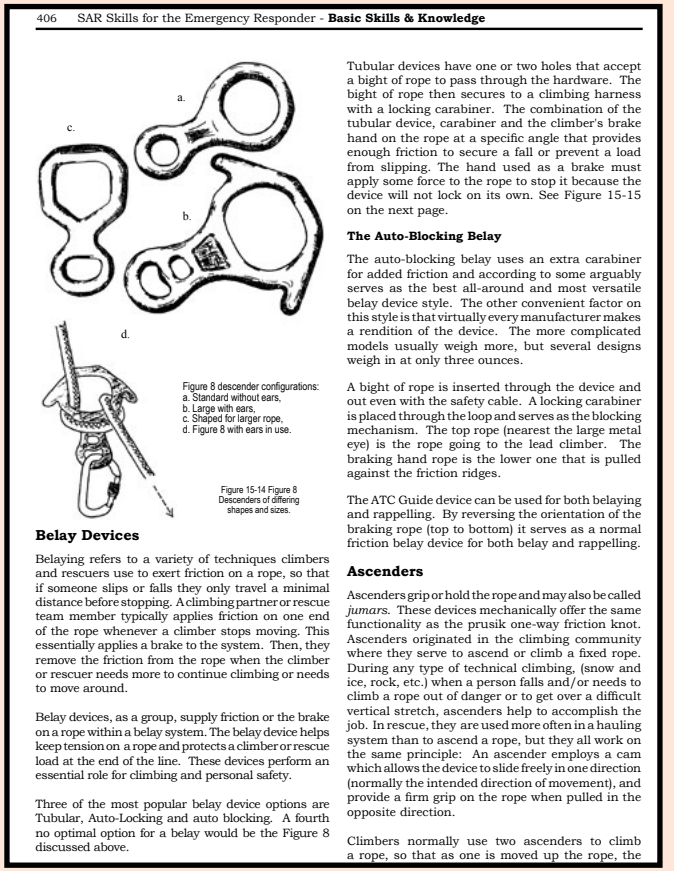

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Figure 8 descender configurations:
a. Standard without ears,
b. Large with ears,
c. Shaped for larger rope,
d. Figure 8 with ears in use.

Figure 15-14 Figure 8 Descenders of differing shapes and sizes.

Belay Devices

Belaying refers to a variety of techniques climbers and rescuers use to exert friction on a rope, so that if someone slips or falls they only travel a minimal distance before stopping. A climbing partner or rescue team member typically applies friction on one end of the rope whenever a climber stops moving. This essentially applies a brake to the system. Then, they remove the friction from the rope when the climber or rescuer needs more to continue climbing or needs to move around.

Belay devices, as a group, supply friction or the brake on a rope within a belay system. The belay device helps keep tension on a rope and protects a climber or rescue load at the end of the line. These devices perform an essential role for climbing and personal safety.

Three of the most popular belay device options are Tubular, Auto-Locking and auto blocking. A fourth no optimal option for a belay would be the Figure 8 discussed above.

Tubular devices have one or two holes that accept a bight of rope to pass through the hardware. The bight of rope then secures to a climbing harness with a locking carabiner. The combination of the tubular device, carabiner and the climber's brake hand on the rope at a specific angle that provides enough friction to secure a fall or prevent a load from slipping. The hand used as a brake must apply some force to the rope to stop it because the device will not lock on its own. See Figure 15-15 on the next page.

The Auto-Blocking Belay

The auto-blocking belay uses an extra carabiner for added friction and according to some arguably serves as the best all-around and most versatile belay device style. The other convenient factor on this style is that virtually every manufacturer makes a rendition of the device. The more complicated models usually weigh more, but several designs weigh in at only three ounces.

A bight of rope is inserted through the device and out even with the safety cable. A locking carabiner is placed through the loop and serves as the blocking mechanism. The top rope (nearest the large metal eye) is the rope going to the lead climber. The braking hand rope is the lower one that is pulled against the friction ridges.

The ATC Guide device can be used for both belaying and rappelling. By reversing the orientation of the braking rope (top to bottom) it serves as a normal friction belay device for both belay and rappelling.

Ascenders

Ascenders grip or hold the rope and may also be called *jumars*. These devices mechanically offer the same functionality as the prusik one-way friction knot. Ascenders originated in the climbing community where they serve to ascend or climb a fixed rope. During any type of technical climbing, (snow and ice, rock, etc.) when a person falls and/or needs to climb a rope out of danger or to get over a difficult vertical stretch, ascenders help to accomplish the job. In rescue, they are used more often in a hauling system than to ascend a rope, but they all work on the same principle: An ascender employs a cam which allows the device to slide freely in one direction (normally the intended direction of movement), and provide a firm grip on the rope when pulled in the opposite direction.

Climbers normally use two ascenders to climb a rope, so that as one is moved up the rope, the

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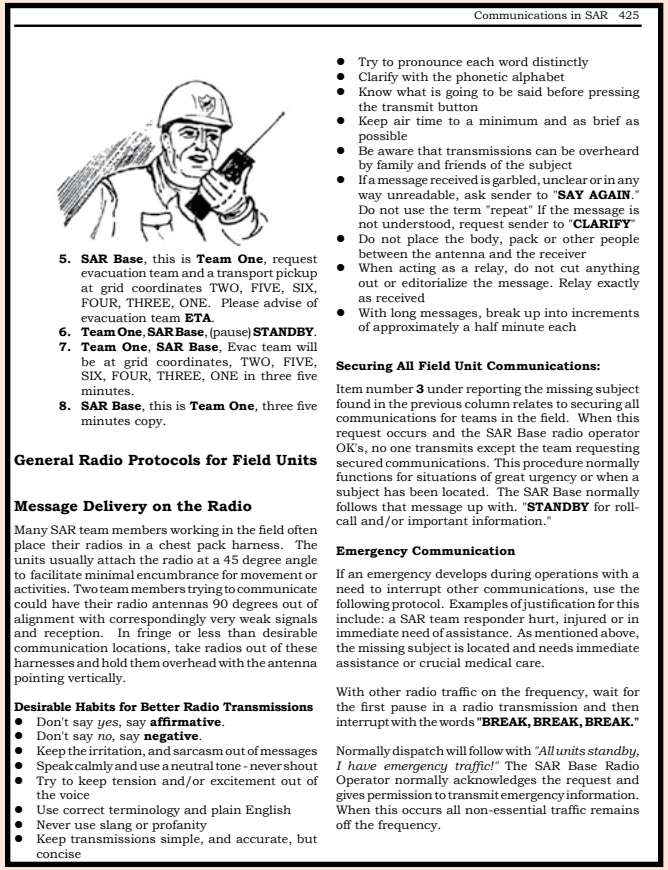
Chapter 16
Communications in SAR

This Chapter highlights the common functions of a critical resource in all of Search and Rescue: Communications. We discuss the attributes and limitations of various radio types and some common techniques to maximize their effectiveness and battery life.

We describe available systems and cover the fundamental protocols used in radio communications by Aviators, SAR personnel and Law Enforcement.

(Click an image for a full page sample)



5. **SAR Base**, this is **Team One**, request evacuation team and a transport pickup at grid coordinates TWO, FIVE, SIX, FOUR, THREE, ONE. Please advise of evacuation team **ETA**.
6. **Team One**, **SAR Base**, (pause) **STANDBY**.
7. **Team One**, **SAR Base**, Evac team will be at grid coordinates, TWO, FIVE, SIX, FOUR, THREE, ONE in three five minutes.
8. **SAR Base**, this is **Team One**, three five minutes copy.

General Radio Protocols for Field Units

Message Delivery on the Radio

Many SAR team members working in the field often place their radios in a chest pack harness. The units usually attach the radio at a 45 degree angle to facilitate minimal encumbrance for movement or activities. Two team members trying to communicate could have their radio antennas 90 degrees out of alignment with correspondingly very weak signals and reception. In fringe or less than desirable communication locations, take radios out of these harnesses and hold them overhead with the antenna pointing vertically.

Desirable Habits for Better Radio Transmissions

- Don't say *yes*, say **affirmative**.
- Don't say *no*, say **negative**.
- Keep the irritation, and sarcasm out of messages
- Speak calmly and use a neutral tone - never shout
- Try to keep tension and/or excitement out of the voice
- Use correct terminology and plain English
- Never use slang or profanity
- Keep transmissions simple, and accurate, but concise
- Try to pronounce each word distinctly
- Clarify with the phonetic alphabet
- Know what is going to be said before pressing the transmit button
- Keep air time to a minimum and as brief as possible
- Be aware that transmissions can be overheard by family and friends of the subject
- If a message received is garbled, unclear or in any way unreadable, ask sender to "**SAY AGAIN**." Do not use the term "repeat" If the message is not understood, request sender to "**CLARIFY**"
- Do not place the body, pack or other people between the antenna and the receiver
- When acting as a relay, do not cut anything out or editorialize the message. Relay exactly as received
- With long messages, break up into increments of approximately a half minute each

Securing All Field Unit Communications:

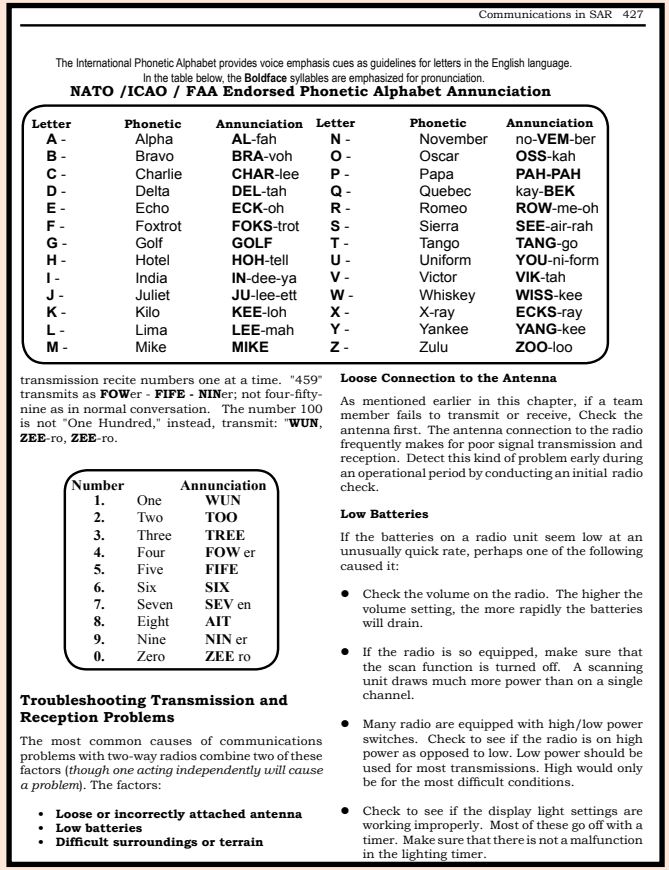
Item number **3** under reporting the missing subject found in the previous column relates to securing all communications for teams in the field. When this request occurs and the SAR Base radio operator OK's, no one transmits except the team requesting secured communications. This procedure normally functions for situations of great urgency or when a subject has been located. The SAR Base normally follows that message up with. "**STANDBY** for roll-call and/or important information."

Emergency Communication

If an emergency develops during operations with a need to interrupt other communications, use the following protocol. Examples of justification for this include: a SAR team responder hurt, injured or in immediate need of assistance. As mentioned above, the missing subject is located and needs immediate assistance or crucial medical care.

With other radio traffic on the frequency, wait for the first pause in a radio transmission and then interrupt with the words "**BREAK, BREAK, BREAK.**"

Normally dispatch will follow with *"All units standby, I have emergency traffic!"* The SAR Base Radio Operator normally acknowledges the request and gives permission to transmit emergency information. When this occurs all non-essential traffic remains off the frequency.



The International Phonetic Alphabet provides voice emphasis cues as guidelines for letters in the English language.
In the table below, the **Boldface** syllables are emphasized for pronunciation.

NATO /ICAO / FAA Endorsed Phonetic Alphabet Annunciation

Letter	Phonetic	Annunciation	Letter	Phonetic	Annunciation
A -	Alpha	**AL**-fah	**N** -	November	no-**VEM**-ber
B -	Bravo	**BRA**-voh	**O** -	Oscar	**OSS**-kah
C -	Charlie	**CHAR**-lee	**P** -	Papa	**PAH-PAH**
D -	Delta	**DEL**-tah	**Q** -	Quebec	kay-**BEK**
E -	Echo	**ECK**-oh	**R** -	Romeo	**ROW**-me-oh
F -	Foxtrot	**FOKS**-trot	**S** -	Sierra	**SEE**-air-rah
G -	Golf	**GOLF**	**T** -	Tango	**TANG**-go
H -	Hotel	**HOH**-tell	**U** -	Uniform	**YOU**-ni-form
I -	India	**IN**-dee-ya	**V** -	Victor	**VIK**-tah
J -	Juliet	**JU**-lee-ett	**W** -	Whiskey	**WISS**-kee
K -	Kilo	**KEE**-loh	**X** -	X-ray	**ECKS**-ray
L -	Lima	**LEE**-mah	**Y** -	Yankee	**YANG**-kee
M -	Mike	**MIKE**	**Z** -	Zulu	**ZOO**-loo

transmission recite numbers one at a time. "459" transmits as **FOW**er - **FIFE - NIN**er; not four-fifty-nine as in normal conversation. The number 100 is not "One Hundred," instead, transmit: "**WUN**, **ZEE**-ro, **ZEE**-ro.

Number		Annunciation
1.	One	**WUN**
2.	Two	**TOO**
3.	Three	**TREE**
4.	Four	**FOW** er
5.	Five	**FIFE**
6.	Six	**SIX**
7.	Seven	**SEV** en
8.	Eight	**AIT**
9.	Nine	**NIN** er
0.	Zero	**ZEE** ro

Troubleshooting Transmission and Reception Problems

The most common causes of communications problems with two-way radios combine two of these factors (*though one acting independently will cause a problem*). The factors:

- **Loose or incorrectly attached antenna**
- **Low batteries**
- **Difficult surroundings or terrain**

Loose Connection to the Antenna

As mentioned earlier in this chapter, if a team member fails to transmit or receive, Check the antenna first. The antenna connection to the radio frequently makes for poor signal transmission and reception. Detect this kind of problem early during an operational period by conducting an initial radio check.

Low Batteries

If the batteries on a radio unit seem low at an unusually quick rate, perhaps one of the following caused it:

- Check the volume on the radio. The higher the volume setting, the more rapidly the batteries will drain.
- If the radio is so equipped, make sure that the scan function is turned off. A scanning unit draws much more power than on a single channel.
- Many radio are equipped with high/low power switches. Check to see if the radio is on high power as opposed to low. Low power should be used for most transmissions. High would only be for the most difficult conditions.
- Check to see if the display light settings are working improperly. Most of these go off with a timer. Make sure that there is not a malfunction in the lighting timer.

A New Standard for Training SAR Personnel!

Why do you need This Book?

Every jurisdiction needs a reliable program to ensure the baseline knowledge of the people who work in Search and Rescue Operations. *SAR Skills for the Emergency Responder* gives you a resource to provide required skills and knowledge for every SAR responder. Use it to help create competent emergency responders in your jurisdiction.

Try, Learn and Practice SAR Skills

Gain Knowledge of the U.S. and International Search and Rescue Systems - Discover the results of search theory, lost person behavior, good search technique, and the basics of SAR organizations. Sharpen Your Practical Skills - Learn about the physiology of human survival, ropes and knots, emergency shelters, clothing systems, navigation, signals, equipment use, and searching.

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The SAR System

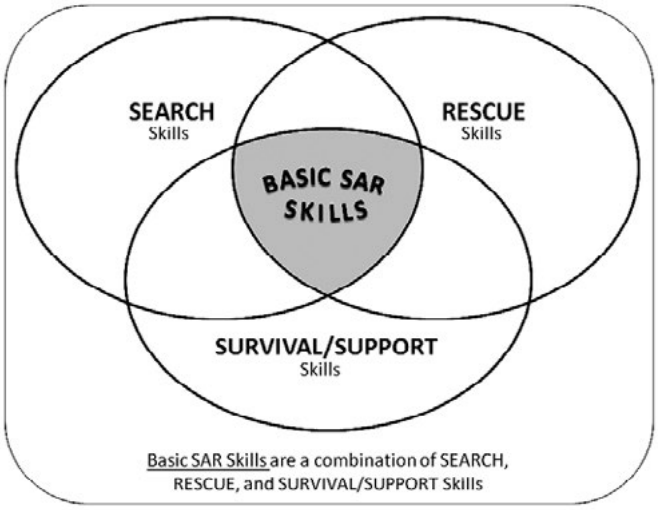
International-Federal-State-Local - Air & Ground

1

Basic search and rescue skills cover a diverse collection of topics across many functional areas. For our discussions in this text, all of these skills fall into three categories for organizational purposes.

Those categories are: **SEARCH**, **RESCUE** and **SURVIVAL/SUPPORT**. All of the skills and knowledge contained in this publication can be grouped into one or more of these categories.

- **Search training** continues one's education in the area of searching only.
  - Specialties include land search, water search, air search, etc.
- **Rescue training** includes diverse specialties that differ in terrain and equipment.
  - Specialties such as mountain, wilderness, ice, water, urban, and many others.
  - Equipment differs greatly from rescue type to rescue type as well.
- **Survival/Support** training is an area of study that includes many skills associated with search and rescue, but may come up independent of both.
  - Such skills include survival, navigation, improvisation, fitness, communication, management etc.



International SAR System

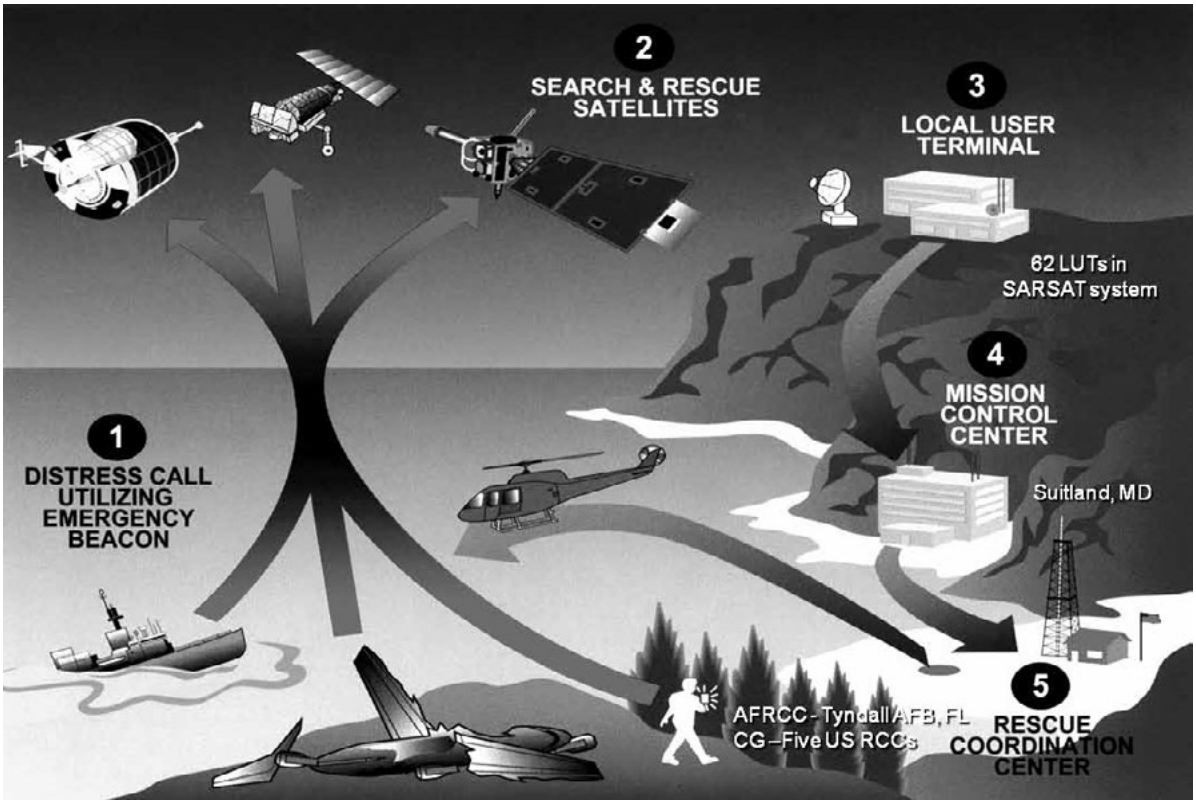
The international SAR System, used extensively worldwide since the 1950s, was first institutionalized under the ICAO's Chicago Convention for international civil aviation, and later for maritime SAR by IMO, *(International Maritime Organization)* with associated guidance and standards provided in the IAMSAR *(International Aeronautical and Maritime Search and Rescue)* Manual. Today, most nations use and supplement the international SAR system for their own use as practicable for civil SAR within their own boundaries. The U.S. has used the international SAR system for decades and continues to provide for its use via the U.S. National SAR Plan.

The Chicago Conventional's Annex 12 (Search and Rescue) applies to the establishment, maintenance, and operation of SAR services in the territories of States or nations adhering to the Convention, over the high seas, and for coordination of SAR operations between nations.

IMO's 1979 International Convention on Maritime Search and Rescue ("SAR Convention") provides that Parties follow relevant IMO guidelines for SAR, which are incorporated into the IAMSAR Manual. The U.S. is signatory to both the Chicago and Maritime SAR Conventions.

Annex 12 (Search and Rescue) and the SAR Convention are the basis for developing and implementing international SAR plans so that no matter where a distress situation occurs, persons in distress will be rescued by a SAR organization, and when appropriate, by cooperating SAR organizations of neighboring countries.

Parties to these conventions must ensure that effective arrangements are in place to provide adequate SAR Services, and should enter into agreements with neighboring nations involving the establishment of SAR regions, pooling of SAR



In the United States, PLBs saw limited use until July 1, 2003, after which they were fully authorized for nationwide distribution. The National Oceanic and Atmospheric Administration encourages all PLB users to learn about the responsibility that comes with owning one of these devices. PLBs work exceptionally well; but, users should only use one in an emergency. PLB users need to familiarize themselves with proper testing and operating procedures to prevent false activation and to avoid their use in non-emergency situations.

Beacon Frequency Issues

- Many existing analog beacons use 121.5 and 243 MHz. Other devices, such as homing transmitters that operate at 121.5 MHz, do not rely on satellite detection; so, the termination of satellite processing of 121.5 MHz fails to affect them. Plus, pilots still use the 121.5/243.0 frequency in aviation for voice communication during an emergency.

- Digital beacons exclusively use 406 MHz to transmit distress and location data, and the COSPAS-SARSAT satellite system only listens to that frequency. The new version 406 MHz ELTs utilize digital technology to transmit a high power burst signal (5 Watts). The digital data burst includes a unique electronic serial number (ESN) for the transmitting unit. The National Oceanic and Atmospheric Administration (NOAA) maintains a mandatory registry for all owners/operators of 406 MHz beacons. These beacons have been available since the mid 1990's and now range in price from $250 to $1500.

and the United Nations recommends its use as an international standard.

As a system, ICS flexes and adapts to a variety of emergency situations. It even functions well on small searches where just one person, the Search Manager (*or Incident Commander)*, performs all of the major functions. He or she directly supervises all of the searchers, develops and implements an action plan, provides logistical support and also manages the planning aspects of the operation.

ICS allows the Search Manager (Incident Commander) to integrate all available resources into an effective response organization without the problems of *turf,* inadequate communications or conflicting objectives. It also allows all responding personnel to focus on the main objective - locating the lost or missing person.

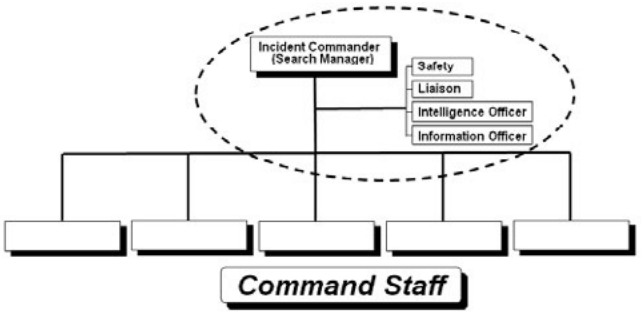
As mentioned before, most successful searches involve small areas, just a few searchers and wind up in a fairly short time frame. Occasionally though, the *"wheel falls off"* and a search exceeds these routine operational capabilities. If the situation escalates and the structure grows faster than the overhead team's ability to control, or the management structure fails to grow fast enough or large enough to handle increased demands, the entire effort can be compromised. Even a routine search requires good management.

Think Functions, Not People

To organize any search effort effectively, the person in charge must think of the jobs to be performed in terms of functions or categories of tasks. The leadership must fulfill certain functions, regardless of the number of searchers involved or the size of the search area. Management orchestrates the response into a dynamic, emerging organization; one that changes to meet the increases or decreases in complexity of the situation. The team of managers that make up the primary functional positions of management tasks in any organizational structure make up the *Overhead Team.* In the ICS structure, the *Overhead Team* consists of the *Command Staff* and the *General Staff.*

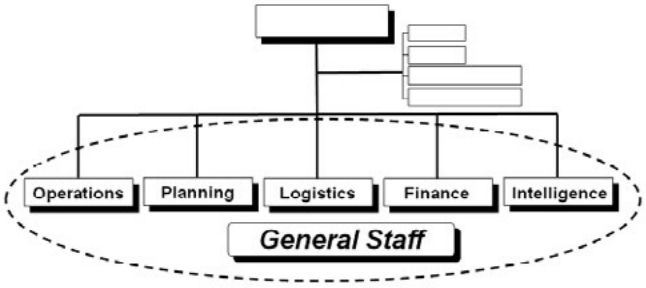
Command Staff Functional Positions

- Incident Manager - *(Incident Commander)*
- Information Officer
- Safety Officer
- Intelligence/Investigations Officer
- Liaison Officer

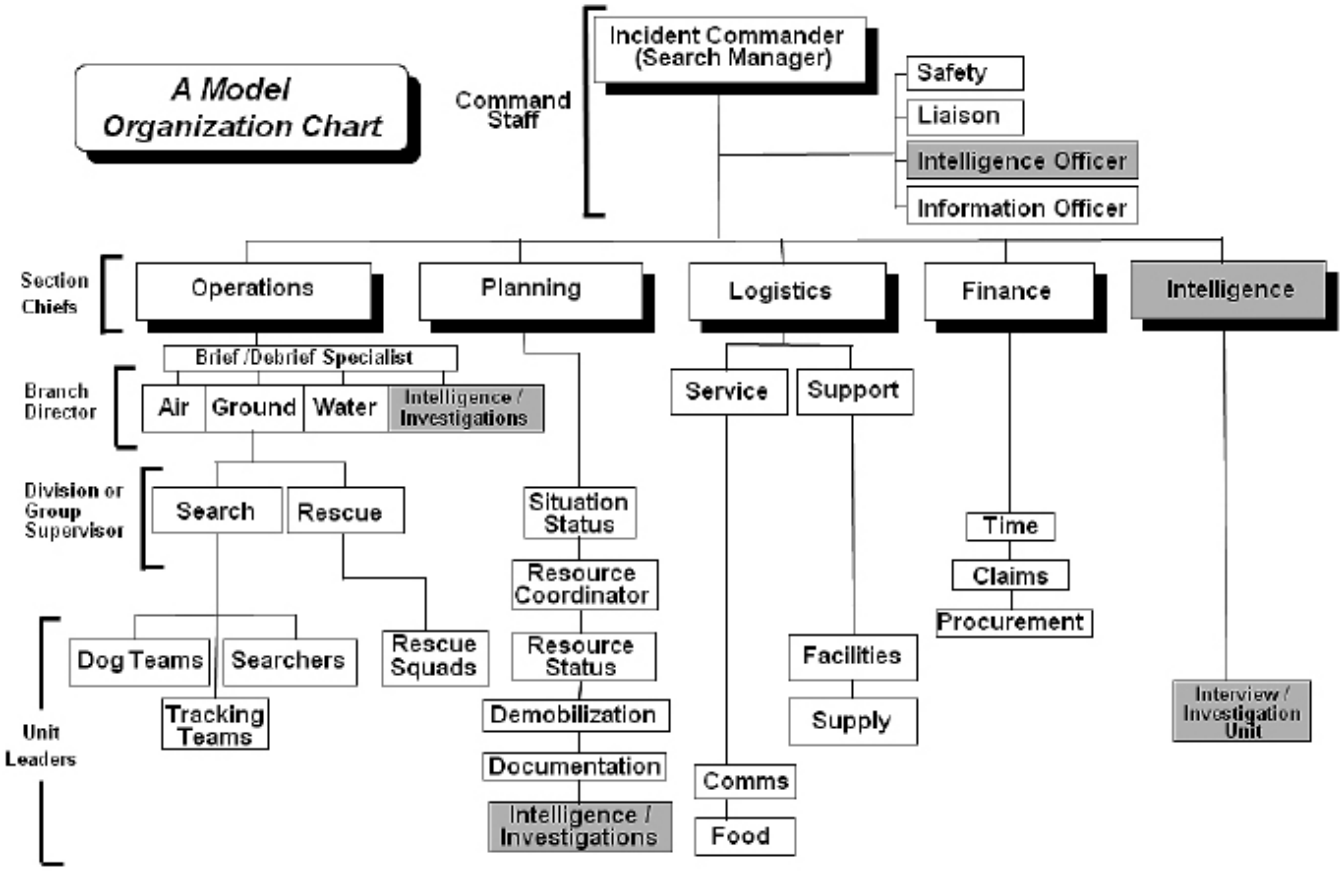


General Staff Functional and Unit Positions

- Operations
- Planning
  → Technical Specialist
- Logistics
  → Communications
- Finance/Administration
- Intelligence/Investigations



The focus on functions and not people means that the most qualified person, regardless of rank or organizational status, gets responsibility for managing particular functions as necessary. Although impossible for some organizations due to structure, precedent or procedures, this approach represents a highly desirable goal. Management of search operations centers on *finding missing persons,* not status, politics or building a career. The most capable people always need to carry out the required functions.



A Model Organizational Chart (With Optional Placement of Investigations Function)

During large, complex incidents, the Demobilization Unit ensures an orderly, safe, and cost-effective movement of personnel at the conclusion of the operation.

The Planning Section is also the initial place of check-in for any Technical Specialists assigned to the incident. Technical specialists serve as advisors with special skills required at the incident. They come from any discipline required, e.g., aviation, environment, hazardous materials, etc. Depending on their assignment, Technical Specialists may work within the Planning Section, or be reassigned to other incident areas.

The Logistics Section. Logistics service and support to an incident provides all the critical materials and facilities needed for everyone else to perform their duties. Early recognition of the need for a separate logistics function and section reduces time and money spent on a SAR incident. The Logistics section provides:

- Whatever support Operations requires.
- Supplies and equipment to carry out the mission.
- Transport, medical services, food, sleep facilities, personal hygiene facilities, etc.
- Installation, maintenance and operation of necessary communications networks.
- Interface between communications systems.
- Messengers, operators, message logs and improvisation *(they set up and run the search base).*

The Incident Commander determines the need to establish a Logistics Section for the incident. As mentioned in other sections, the size of the incident, complexity of support, and how long the incident may last all contribute to that decision. Once the IC determines a need to establish a separate Logistics function, he/she assigns an individual to the duties of Logistics Section Chief.

The Logistics Section Chief often establishes separate units for one or more of the logistics support or service activities. On large incidents after activating all six Logistics Section units, or with many facilities and large amounts of equipment, a two branch structure will reduce the span of control for the Logistics Section Chief. The two branches operate as the Service Branch and the Support Branch to manage the following responsibilities:

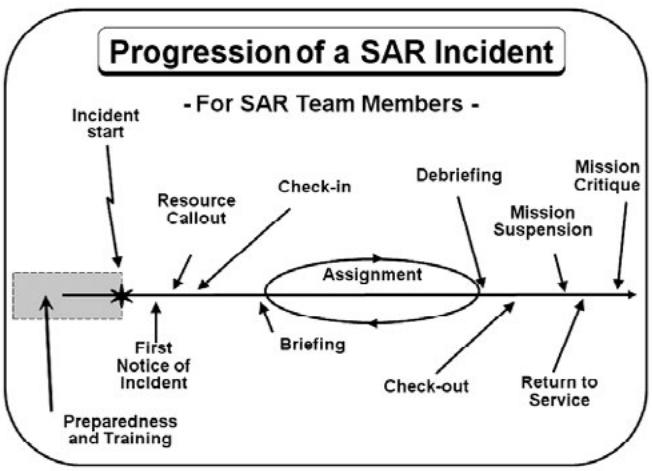
Anatomy of a SAR Incident 3

The initial report of a SAR incident will reach team members and responsible agency personnel in a variety of ways; everything from actual cries of distress to a call from a distraught friend or relative.

> *"Regardless of how improbable or unfounded the report appears at the time, a compelling firehouse response is essential until SAR personnel have arrived on the scene and determined the accuracy of the information."*
> Tim Setnicka
> - *Wilderness Search and Rescue*

In the first chapter of this text we emphasized that every SAR event flows through a series of phases following an evolutionary process. These phases or *components of a SAR incident*, include: Preplanning; Notification; On-scene Planning and Strategy; Tactics and Operations; Suspension; and finally Debrief/Critique. While these components relate more directly to the management end of SAR than to the field team members, the responder still needs to know about required actions, e.g. when and where to act. Let's take a look at these components to better explain the process a searcher travels during a SAR event.

The components discussed here take the searcher from before a mission, through the operation, into post-mission critique, and back into service. The details of the process mean the most to the field team leader and the team members; since, there will probably be no one to explain the process at the scene of an incident. Efficient operations, without exception, require advance training. The way one enters the system, contributes, and flows through it provide team members the chance to evaluate capability. Everyone's awareness of the process allows more focused effort on the primary objective: *finding the missing person.*



Preplanning - Preparation

Preplanning for the SAR Responder differs greatly from the preplanning of the Incident Commander. To a SAR Team member, preplanning means having the necessary skills, knowledge, and equipment to contribute an integral part of the effort on scene as well as staying physically and mentally fit. SAR responders must know about team expectations before an incident occurs. Bottom line, expect standards by which leaders will assess and measure you on every mission.

Assess Yourself Continuously

What makes a good SAR Team member? How do local law enforcement agencies perceive successful team members in the emergency response system? In other words, what constitutes a *professional* in the area of SAR?

Many respond to the questions above by saying that "*SAR Responder is not a profession and usually those that serve in that function only hold the position locally for a relatively short period of time.*" Professionalism in any avocation flows from adherence to a higher standard than that needed to just get by. A constant effort to meet and then exceed recognized standards defines a true professional. However, a review of the *accepted marks* of a recognized professional competency often proves instructive, if not humbling.

Assignment

Individual Responsibilities

While deployed on a SAR incident and assigned in the field, individual SAR responders maintain certain responsibilities with direct implications to effectiveness and safety. SAR teams vary in size, but normally fall within the ICS doctrine for span of control. ICS parameters dictate the five to one *rule of thumb* for unit size and supervision. Certain obligations exist for team members and each individual needs to ensure they get carried out.

1. All members of the team need their own personal gear, without dependence on anyone else for equipment. Criteria for good SAR equipment follows:
   - Versatility
   - Functional but not elaborate
   - Tough and able to stand up under hard use
   - Quality without extra expense
   - Lightweight but compact

2. SAR missions require self sufficiency and solid equipment. That means primary, supplemental and backup clothing for all environments as well.

3. SAR demands a lot, mentally and physically! Team members regularly perform difficult and arduous operations. Easy missions come hand-in-hand with tough missions.

4. If you find skill limitations or shortfalls in your personal training, make sure you give the team leader a heads up. Assume nothing!

What Does the IC Expect from Individual SAR Responders?

- Discipline to accomplish assignments and debriefs accordingly.
- High performance standards directly related to high training standards.
- Proper clothing and equipment for virtually any local climatic conditions.
- Individual self-sufficiency for at least 72 hours.
- To perform pinpoint navigation and record it on a map.

Team Responsibilities

Before deployment into the field, every SAR team needs to assign at least one member to the following responsibilities: Navigator, Tally or Distance Keeper, Time Keeper, and Team Leader.

Team leaders require very specific qualifications and will probably accept the role before the establishment of the rest of a field unit. Normally unit members and qualifications stem from rosters at call-out.

Every member of a team needs a constant awareness of their location. All levels involved in the incident, from the public to the command staff, expect this of operationally trained responders in SAR. This translates to knowing relative position in the search area at any given time. One member always acts as team navigator to check accuracy with GPS, compass readings or way points on the map.

The tally or distance measurer keeps track of distance traveled within a search segment for each assignment. The overhead team at Base uses this essential information to calculate *Area Effectively Swept* within POD calculations (Downloadable GPS tracks work well, but keeping count of stride works too). Some teams calculate the average speed of search through certain kinds of terrain and vegetation. This becomes a *SAR team benchmark* used to calculate how far the team searches in a set time. In that case, they simply multiply the benchmark speed by time spent for a *total trackline length* (More on this later).

The Time Keeper maintains a chronology, in writing, of what goes on, with specific time hacks, during the assignment period. This documentation plays an essential role in the debrief process. One person who writes down important events or comments while on the move through a segment makes other members memory or recall much more complete during debrief.

The Team Leader orchestrates the entire move through the field assignment. His or her job ensures to the extent possible, the satisfactory completion of the entire assignment. Not only that, but he/she keeps mental (if not physical) notes to accomplish an effective debrief at the end of the Op period. The Team Leader also ensures the efficiency of his/her team mates. Reminders about the *Searcher Cube* and due diligence about technique, snapshot visual scanning, looking through vegetation and ground cover, all form an effective team leader's skill-set.

What Does the IC Expect from SAR Responder Teams?

- Organization and functional position structure suggested by ICS.
- Reliability.

they found the victim. Since the victim was unconscious during the rescue, a legal doctrine called *res ipsa loquitur* (absent *other evidence, negligence is the only explanation for the injury)* was applied to allow a suit against the rescue team for negligence. The court dismissed the suit only after the friends admitted to moving the victim before rescuers arrived. This movement caused the additional injury, and not the actions of the rescue team.

Checklist For Keeping Out Of Trouble

One of the most frequent questions received by lawyers is, "How can I/we keep out of legal trouble?" While no one action answers the question, the general principle "you should do no harm" holds up pretty well. This principle derives from medical practice and helps in the legal sense as well.

So, to protect yourself by not harming others, both individuals and organizations must practice their craft as carefully as possible to avoid making the mistakes which create the potential for liability. A good emergency medical technician (EMT) will not make the mistakes that harm patients or even create additional risk for patients.

If an organization orients toward searching for lost persons they will do so utilizing the best techniques taught by nationally recognized organizations, they will search urgently and efficiently and utilize the right resources in the right order. If the organization fights fires they will use proper extinguishment practices, respond immediately with enough personnel and equipment to fight the fire and to protect the lives of persons endangered.

Doing all of this right happens beyond the incident scene as well. It happens long before when the organization chooses its mission and goes into business. Keeping out of trouble starts with an attitude adopted at the time founding and continues throughout the existence of the organization. The members and the officers of the organization jealously guard it and carefully nurture it through training, equipment, supervision and actual missions successfully conducted. It is a pride in accomplishment.

The individual responder, dedicates her/himself to serve fellow man, to do the right thing, and joining a fine response organization (or by joining a lesser organization and assisting in turning it into a fine one) which leads to training, learning the use of the equipment and techniques of the organization. Thsi also concludes with successful missions.

Document everything your organization does. Training, equipment maintenance, incident reports, meetings, and everything else. No one likes paperwork but good incident documentation, training, and everything else certainly beats trying to remember what happened, months or even years after the fact.

What Should a Team Member Expect from their SAR Team Organization?

1. An organization with a written, defined mission.

2. An organization with strong membership and good officers.

3. A place for himself/herself in the organization based upon personal needs and the needs of the organization.

4. A guidebook and rule book explaining the organization, its mission, guidelines and rules.

5. Initial training relating to the organization, its mission, guidelines, rules, meetings, call-out procedures, etc.

6. Initial training related to his/her intended position within the organization. This training may be conducted by the organization, government agencies, educational institutions, or others. The team member should expect to pay for his/her own books, equipment, and training unless told to the contrary.

7. Following or during initial training related to his/her intended position (EMT, SAR, Rescue, Communications, etc.) he/she should expect organizational training. "This is how we do it," which should compliment his initial training.

8. He/she should expect to become a member of a team within the organization with duties appropriate to his/her level of experience and training.

9. He/she should expect not to become proficient or a chief over night.

10. He/she should expect to be utilized in situations for which he/she was trained, both in exercises

and in actual responses but he/she should remember that actual responses may be limited.

11. He/she should expect to be used in combination with other resources, other agencies, and be able to adapt him/herself to this situation.

12. He/she should expect adequate supervision at all times. Organizations which do not have adequate, trained supervision are more likely to have troubles than those who don't. He/she should likewise expect the organization to be properly equipped for its mission and have the equipment to do the job. He/she should expect the equipment to be kept in good repair and should do his/her best to use it properly and avoid its misuse. Supervision, training and equipment—are keys to success.

13. He/she should expect to be required to attend training, actual responses, and to obey the rules of the organization, and take direction from those in command, but he/she should do so willingly.

14. He/she should take an active part in the operation and management of the organization by attending business meetings and accepting advancements for which he/she is qualified. He/she should expect the organization to have business meetings and provide opportunities for member input.

15. He/she should expect the organization to provide opportunities for specialized and advanced training related to his/her field. These opportunities may be in the form of training or seminars by others and may be joint training opportunities with others. He/she should not expect the organization to pay.

16. He/she should expect the organization to provide in-service training and training on new equipment obtained by the organization.

17. Since most emergency organizations, particularly volunteer ones, don't have lavish budgets, he/she should not expect the organization to feed, clothe, equip, and train him/her at no expense to him/herself. In fact, he/she should be prepared to take part in the fund raising activities of the organization so as to enable the organization to better serve its community.

18. He/she should expect the organization to be integrated into the emergency service structure of the community. Whether or not the organization is part of another agency or is independent it must have a valid emergency service role to play in the community and be part of the community's overall emergency response plan.

19. He/she must recognize, particularly as a volunteer, that his/her organization must be professional in the manner in which it operates and he/she must do his/her utmost to contribute to that professionalism.

20. He/she should realize that to survive in the emergency service community that his/her organization should have a good image, provide needed services, and cooperate with other agencies. He/she should demand this of the organization and him/herself.

21. He/she should expect the organization to have scheduled inspections of vehicles and equipment.

22. He/she should expect the organization to maintain its vehicles and equipment and should participate in it to the extent of his/her ability and knowledge and should report defective equipment.

23. He/she should expect to be told how the organization is funded and for what purposes funds are expended.

24. He/she should expect to be told if the organization has vehicle insurance, general liability insurance, workers compensation coverage, or other insurance coverage which may be important to him/her.

25. He/she should expect to be told what the organization will or will not do for him/her in case of accident, illness, auto accidents, or lawsuits arising out of his/her membership or activities with the organization.

26. He/she should expect to know what equipment may be issued to him/her and what is expected of him/her in relation to the issuance of that equipment.

27. If the organization issues membership cards, light and siren permits for private vehicles, or other similar identification he/she should expect to know this and his/her responsibilities with regard thereto.

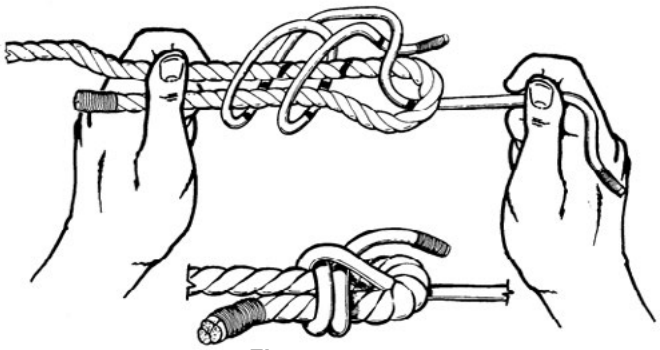


Figure 5-7
Double Sheet Bend

3) Quick Release Sheet Bend: The Quick Release Sheet Bend allows an individual to attach a line directly to a twisted corner of a tarp, plastic bag or even an article of clothing for shelter construction; see Figure 5-8 below. The knot also works exceptionally well to secure multiple lines with one tie down or a single large line to a smaller line. See Figure 5-9 above right. This beautiful knot releases in seconds by pulling on the free running end of the line, yet stays robust and secure under tension.

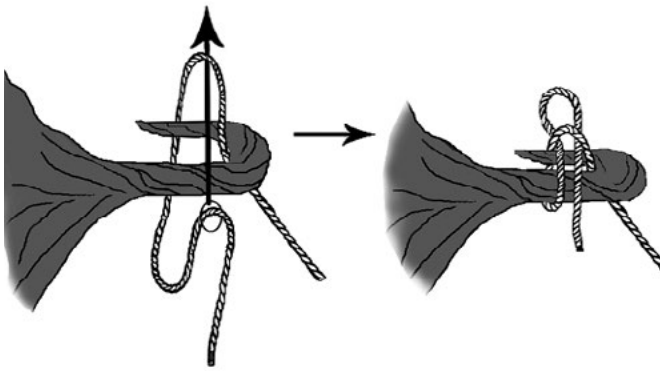


Figure 5-8
Quick Release Sheet Bend

Immediate action shelter from plastic tarp or cut open bag using the quick release sheet bend at the corners.

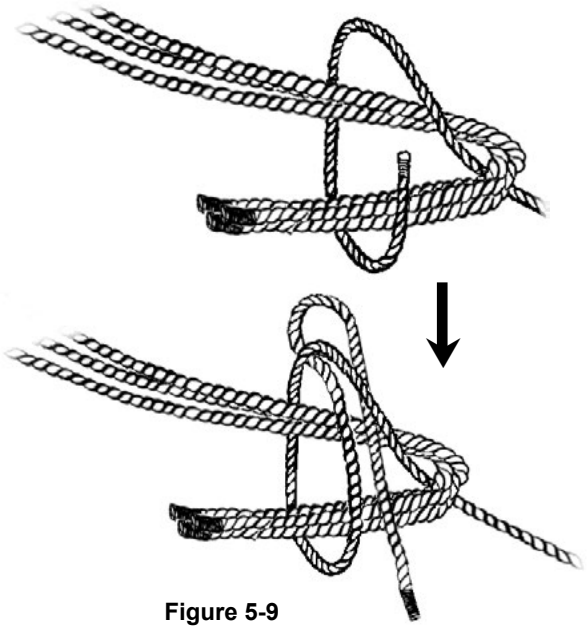


Figure 5-9
Quick Release Sheet Bend on multiple lines

Finished Quick Release Sheet Bend on the corner of a plastic tarp

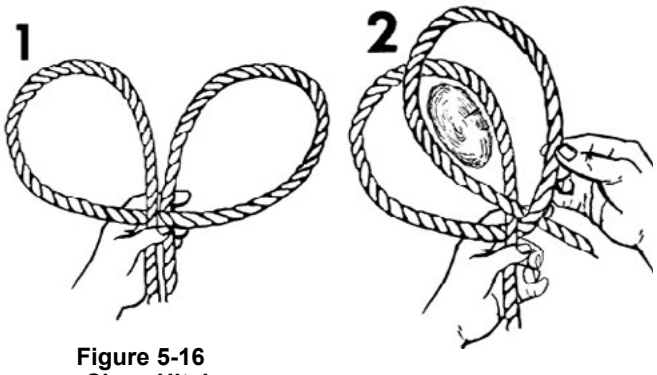


Figure 5-16
Clove Hitch

To tie the Clove Hitch at the end of a rope, (Figure 5-17 below) pass the rope around the pole in two turns so that the first turn crosses the standing part of the line and then the running end comes up under itself on the second turn.

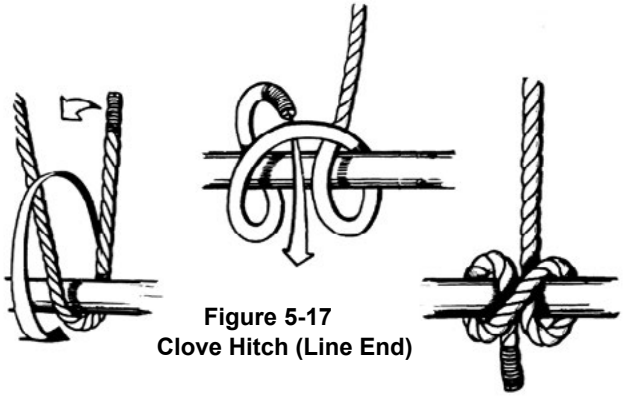


Figure 5-17
Clove Hitch (Line End)

3) Timber Hitch: The Timber Hitch (Figure 5-18 below) provides a simple attachment which never jams, and readily comes undone when tension ceases. This hitch traces its origin to the logging industry, hence it's name. Loggers used it primarily to tow or pull logs, trees, posts, or poles. In shelter construction we use it as an anchor knot to pull tension on a line between two objects. **To Tie:** Pass a rope around the anchor object and take a turn with the running end around the standing part of the line (creating a half hitch to start). Then as shown below continue to wrap the running end around and around itself. Usually three to four turns are sufficient on all except very smooth surface objects. See Figure 5-19 (above) for one more view of the Timber Hitch.

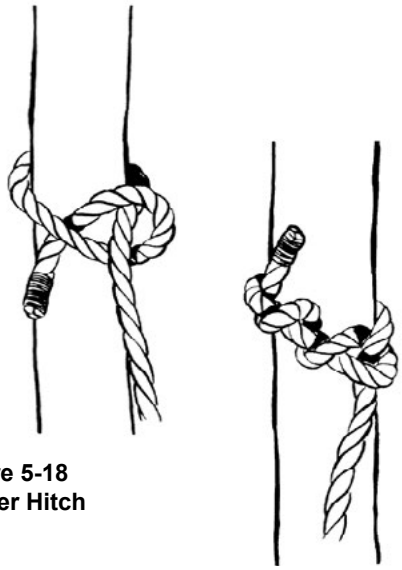


Figure 5-18
Timber Hitch

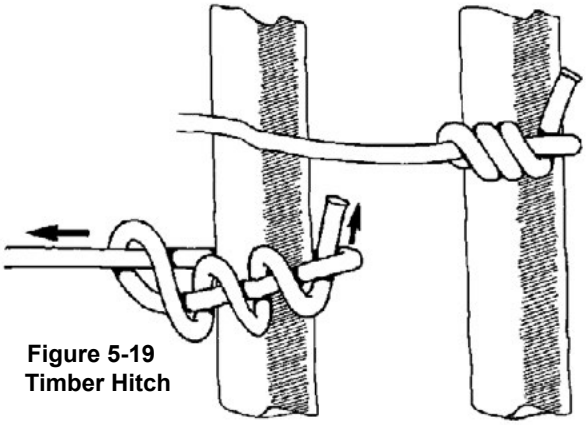


Figure 5-19
Timber Hitch

4) Girth Hitch: The Girth Hitch (Figure 5-20 below) quickly attaches a line to hardware rings or buckles on packs, clothing, equipment, or grommets in a tarp. This hitch also works with poles, or even tie downs on a vehicle. **To Tie:** Make a bight at the end of a line. Reach through the bight grasping the running end and the standing part of the line and pull back through the bight. Place the double bight formed over the post or object being secured to and draw up tight. If attaching to a loop or buckle in hardware put the bight through the eye of the hardware and then draw the running end and standing portion through the bight.

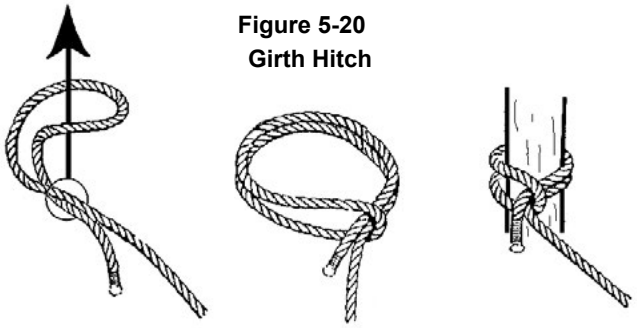
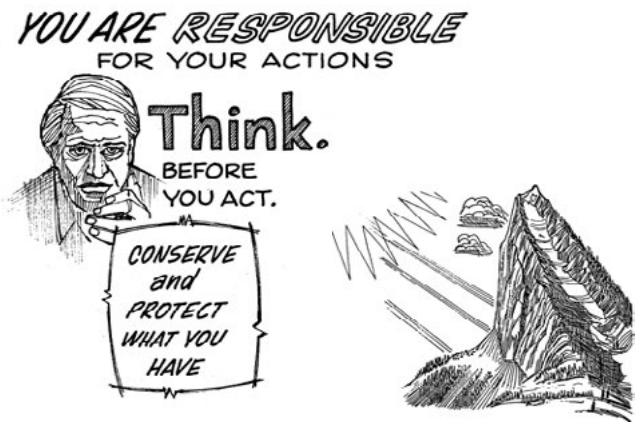


Figure 5-20
Girth Hitch

Body Adversaries To System Balance	
Adversary to Normal Balance	**Nature of Threat**
1. Your Mind	Attitude, imagination, fear, panic
2. Temperature	Body core temperature must be maintained within narrow 12 degree range for effective rational behavior
3. Injury	May affect mobility, coordination and ability for self-help
4. Infection or Disease	Constant threat, normally held in check by body's defense mechanisms
5. Dehydration	2 to 3% deficit in water levels can result in 25% loss in physical efficiency
6. Energy Levels	In severe adverse cold temperatures, energy levels directly impact both physical capabilities and warmth. Conserve available levels and rest often.

with the unknown. During any emergency many variables will fall outside of our normal comfort zone. Some variables compound a situation, while at the same time, others act to simplify the situation. Rational, coherent thinking will recall similar situations or circumstances from past education and experience, in most cases, to give you the most effective method for gaining control of the situation.

Modern technology makes people expect light-switch conveniences that eliminate thirst, hunger, cold, heat and, in most cases, fear. In unexpected life threatening situations, confidence and self-reliance play a key role in determining the ultimate outcome. Unfortunately, most of us depend upon technology, and come from a culture that ostensibly eliminates the necessity for self-reliance and sustenance in the natural environment. In short, people depend on technology and everyday amenities. We know that self-reliance develops through direct experience and meeting your every day needs alone. There is no substitute for performing a task which ultimately saves your life.



Priorities and Necessities

What are the real life priorities and necessities needed to keep a human being alive for an indefinite period of time? Off the cuff answers might include clothes, a house, a car and three meals a day. But shift back several hundred or even a few thousand years when humans had no conveniences, yet they still survived. As mentioned before, we need to list the real necessities of life and ask the question, "how long could a human survive without each necessity?" What follows describes how it works:

The List

Research, anecdotal accounts, and the science of physiology all tie together to established this basic list of necessities for humans to survive indefinitely. Keep in mind that some of these concepts include broad based groups, consolidated for generalized purposes. For instance, everyone agrees that we need clothing, but clothing falls under the broad based category of shelter for the body.

The List In Order of Priority

- **Positive Mental Attitude**
- **Air**
- **Shelter**
- **Rest**
- **Water**
- **Food**

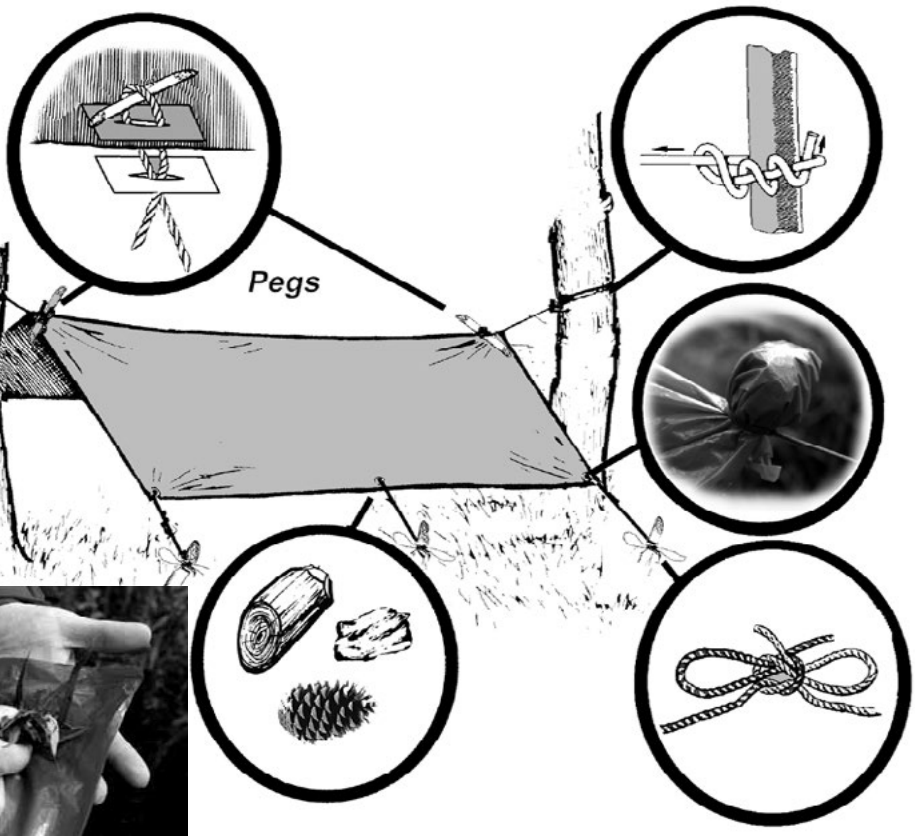
Mental Attitude and The Whole-Person Concept *(The Physical Necessities Of Life Working In Concert with Mental Processes)*

The whole person concept represents an extremely important personal approach to emergency response. This basic theorem helps put the priorities and necessities of a life threatening emergency situation into perspective. It ties both mental and physical body processes together. It boils down to this: what affects a person physically, also affects them mentally, and whatever affects them mentally will ultimately affect them physically. Realization of this relationship between the mental and physical tremendously impacts a person's ability to counteract and cope with stressful environments.

Use a **cut-open shelter bag** or a small tarp as a quick, versatile resource in constructing protection against precipitation and wind.

Improvised grommet: For cut-open shelter bag or plain plastic sheet. Tape both sides of plastic with duct tape. Cut through both layers of tape & plastic. Use peg with improvised grommet.

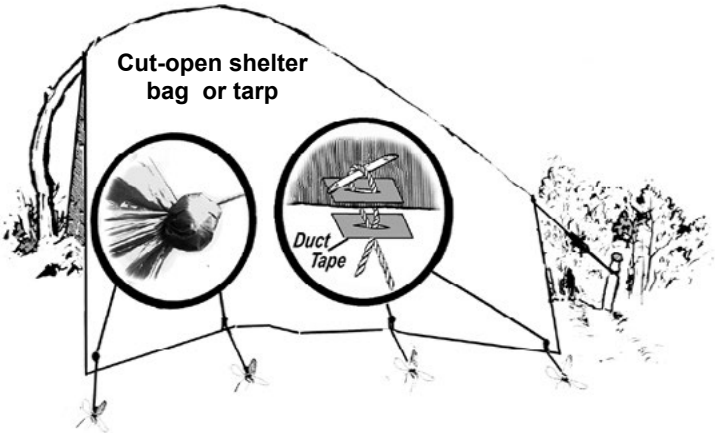
Use the quick release sheet bend on a twisted shelter bag corner or tarp for attachment when buttons are not available.



Buttons Can be fashioned with grass, pieces of wood, small pebbles or seed cones.

A small sapling stripped of limbs, bent over and staked down makes a quick structure to support a cut-open shelter bag or tarp for an expediant shelter with very little time, resources or expenditure of energy.

This is an example of a limbed sapling bent over and supported with small poles to bear the weight of a tarp, boughs and snow piled on top for added insulation in the winter.



Pile

Pile (fiberpile) is a relatively late comer to the American clothing scene, although it has been widely used in Scandinavian countries for years — chiefly by sailors and commercial fishermen. Pile is essentially a rug made of single synthetic fiber or a blend of synthetics. Pile garments offer reasonable thickness per unit weight and the non-absorptive qualities you would expect from a synthetic fiber. As an insulating garment, pile has excellent properties and conforms nicely to the wearer's body. However, its compressibility is poor and its resistance to wind penetration is virtually nonexistent due to the loose scrim backing on which it is woven.

Principles of Good Clothing Construction

The most common use of clothing material in fabrication is to form a relatively thin, single-layered cloth. Occasionally, single-layered material is doubled or tripled in order to trap more air or offer some other advantage over single-layered material. Single-layer, however is still the primary building block in the clothing industry.

Batting and mat materials are sandwiched between other materials in order to offer insulation or other desirable characteristics. The insulation offered by batting material can be adversely effected if the batting clumps or shifts, removing insulation from an area. Down, as an example, is notorious for this. To help prevent insulation shifts, bat materials are designed into a baffle, quilt, or tube construction.

Whichever method of constructing a garment is used, the design and its complexity can be as important to the wearer as the material. Design is especially important when it directly affects a garment's protective qualities, such as insulation or windproofness.

Closures can be problems if they are not designed or applied properly. Zippers offer little insulation or windproofness and necessitate some type of covering or at least some additional consideration. A second covering over the zipper usually does the job for warmth, but a second closure may be required for waterproofness.

Seams can be a problem, especially if waterproofness is important. Seams can be placed in a different area of a garment to help minimize its disadvantages, e.g. away from the top of the shoulder in rain gear. Seams can be sealed to prevent leaking.

Protective Zones of the Body for Planning Clothing Systems

Clothing for the body should be thought of as a system. A complete system includes five protective zones for the body. Frequently used as a planning tool for expeditions, and military missions, the five zones of the body constitute areas where a primary, and secondary plan should be considered.

Many parts of the body deserve special attention with regard to protection and added insulation. That's one of the reasons why this five zone system for the body works. As an example, when the head remains unprotected it pumps a tremendous percentage of body heat lost to the environment, mostly by radiation and convection. Since the head has relatively little of its own insulation, cold weather mandates an effective insulation system for that area of the body. This includes protecting the ears, neck, and occasionally the nose.

If you look at the head and neck zone for cold or winter weather, consider the primary source of protection, (a ball cap or standard wide brimmed hat), then consider additional layers or alternatives such as a balaclava, knitted watch cap, neck gaiter or heavy bandana that can be tucked into the Ready Pack or supplemental clothing bag.

As a general rule for clothing, avoid really tight fitting garments as they lead to circulatory problems which then lead to cold injuries. Locations where constriction often compromises circulation include the wrists, ankles, hands, feet, neck, waist and head. Elastic at these locations also causes a problem with

exercises in the cold for several weeks. This emphasizes the fact that energy intake must increase to meet the increased energy demands.

Both fats and carbohydrates are used as fuel when exposed to the extremes of cold environments. However, a high CHO diet is preferred as it will replenish glycogen stores that are rapidly being used to maintain core temperature. A high fat diet is discouraged as it would require a prolonged period of adaptation and may result in gastrointestinal problems. Ideally 60% of your energy should come from CHO, 30% from fat and around 10% from protein. This of course should be supplemented with high carbohydrate snacks eaten in between meals. (See below) Protein supplements or high protein diets are not recommended as they would increase water losses.

Calculating Energy Requirements for Cold Weather Example

A SAR Responder requires 4000 cals./day
A 25% increase in energy would be:
4000 X 0.25 = 1000 calories/day
Goal: Eat 5000 calories / day.

Eat frequent snacks during the day and a large snack before going to bed.

Snacks for SAR Operations in the Cold

When working in cold weather, snack on foods that are high in carbohydrates. CHO (*carbohydrate*) foods produce more heat when digested than either fat or protein. To go along with the food snacks, beverages like cocoa or soup serve very well.

Trail Mix

3 cups seedless raisins
1 cup dried apricots
1 cup dried apples
1 cup almonds
1 cup dry roasted peanuts
1 cup dried pineapple
1 cup dried dates
1/2 cup sunflower seeds.

Mix all ingredients together in a large bowl or bag. This recipe makes 10 - 1 cup servings.

Nutrition Information per 1 cup serving:
560 Calories Total
62% Carbohydrate - 7% Protein - 30% Fat

- Granola / Sports bars
- Fig Newtons
- Fruit bars
- Trail mix
- Crackers / Bread with jam
- Chicken noodle soup
- Hot chocolate
- Hot apple cider

24 hour sustained operations may require nutritional intervention

SAR Ops Sustained (24 + hrs)

Sustained Operations are work periods that last longer than 24 hours because of extenuating circumstances. (This could be as a result of an extended search, where the subject is found and a long extrication ensues with existing resources. Or a protracted operations due to lack of resources because of logistical problems. What this frequently results in is extreme fatigue, sleep loss as well as both physical and mental stress. Nutritional interventions can partially offset the effects of fatigue and sleep deprivation on physical and mental performance. The most effective nutritional interventions include:

- Carbohydrate intake
- Hydration status
- Caffeine intake

Carbohydrate Intake

A high carbohydrate (CHO) diet is needed for replacing muscle glycogen stores that are used up during prolonged activity and for maintaining a sufficient blood glucose level. Thus, your diet during sustained operations should provide 60 to 65 % of energy from carbohydrates, 10% from protein and the remaining calories from fat.

High CHO snacks or carbohydrate containing fluid replacement beverages providing 15 to 30 grams of CHO/hour will also help to maintain blood glucose and delay fatigue during strenuous prolonged

Suggested Ready Pack Contents

Shelter

1 - Silicone impregnated nylon tarp for ground cloth or improvised cover(8'x 10')
2 - Heavy duty shelter bags, bright blue colored (38" X 74")

Fire

1 - Metal match (ferrocerium)
12 - Matches & striker pad (all weather- storm-proof) REI or UCO
1 - Match Container, waterproof for matches
1 - Match container with Vaseline impregnated cotton
1 - Candle, short, (long burning)
1- Pitch wood or other extra accelerant for fire starting in wet conditions

Signaling

1 - Signal mirror (military style, with aiming device)
1 - Whistle, (multichambered)
1 - Spare small flashlight with combination strobe
1 - Optional - Laser flare

Water

1 - Hydration system w/drinking tube, ≥ 2 liters
1 - 1 qt. water container hard or soft sided
1 - Chlorine dioxide tablets
4 - Heavy duty "Zip-Lok" bags, freezer type
1 - Small compact disposable water filter for backup e.g. Pre Mac SWP.

Light

1 - Flashlight/Head lamp, for night ops.
1 - Flashlight/small, with extra batteries & bulb plus headband (for no-hands operation)
4 - Chem-light sticks

Navigation

1 - Clear Baseplate orienteering type compass
1 - Optional - GPS

Clothing and Backup

Primary and Backup for the 5 body zones

1 - Pair, foot gear, sturdy and adequate for climate/ terrain
1 - Clothing, extra set (dry), adequate for seasonal conditions
1 - Clothing, cold weather - synthetic insulated vest or long sleeved insulated jacket
1 - Rain gear, coat and pants (durable, not disposable)
1 - Pair extra socks, in addition to other clothes
1 - Gaiters set,
1 - Cap/hat, (ball cap or Booney type)
1 - Balaclava, head sock, neck gaiter, ear band or knit watch cap (for winter)
1 - Pair gloves, adequate for climate (leather for summer and utility)
1 - Bandana or handkerchief (protection and utility)

Hygiene Kit

1 - Toilet tissue in zip lock
1 - Disinfectant wipes
1 - Small bar of disinfectant soap
1 - Small wash cloth

First Aid & Personal Care

1 - Special container for contents, (e.g. aLOKSAK)- waterproof
4 - Acetaminophen or ibuprofen, tablets or capsules
8 - PolyMem Band-aids, 4-(2"X4") strip + 4-(2" X 3") oval
1 - Personal medication(s)
1 - Small Roll gauze (Kling, Kerlex)
1 - Adhesive silk tape
1 - Gauze pads
1- Ace bandage
1 - Container of Aspirin
4 - Antacid/Rolaids - anti gas tablets
1- Imodium AD tablets (antidiarrheal)
2 - Antihistamine, 25 mg dyphenhydramine (Benedryl)
1 - Razor blade, single edge safety (in sheath)
2 - Betadine swab antiseptic pads (for wound cleansing)
2 - Safety pins - large
2 - Cotton swabs, not necessarily sterile
2 - 2nd Skin - Adhesive Knit, or Moleskin (3"X 5")
1 - Triple antibiotic ointment (or Neosporin.)
1 - Splinter forceps / tweezers
1 - Towelettes, (disinfectant wipes/swabs)
1 - Lip balm (Chap-stick) with sunscreen
1 - Sunscreen cream - (even in winter)
1 - Insect repellent (e.g.Ultrathon by 3M)
1 - Hand sanitizer
4 - Pr. Exam gloves

Sleeping System

1 - Sleeping pad, (*closed cell foam or ThermaRest are both good*)
1 - Closed cell foam pad for sitting & kneeling
1 - Seasonal sleeping bag with Bivy sack

Utility

1 - Knife, single shank blade, (utility and splitting wood)
1 - Knife sharpening tool
1 - Mil-spec para-cord at least 150 ft.(colored for visibility?)
1 - Goggles, light-weight and comfortable eye protection
1 - Multipurpose utility tool (e.g. Leatherman)
1 - Folding saw - (e.g. Buck, light weight, cuts both ways)
1 - Scissors, heavy duty, (i.e. clavicle shears)
1 - Aluminum foil roll (Without internal tube) (4' length)
1 - Duct tape, 8 feet (wrapped around match containers)
1 - Sunglasses, sturdy (> 97% UV protection)
1 - Metal cup or pot, for cooking & drinking
1 - Wire lengths, 2'-3', heavy gauge, for improvised repair
1 - Spare batteries and bulbs

Food & Snacks

- Base food and snacks choices on SAR operations in hot or cold environments, 24 hour sustained operations, or even elevations consistently above normal. (See Chapter 7 – Dressing and Eating to Respond) **Example:** High protein intake causes water loss which then leads to dehydration in hot environments. **Another Example:** Military experience and research shows that extreme cold causes weight loss without substantially increased calories during cold conditions.

- Choose nonperishable snacks

Personal Support Gear for SAR

1 - Pack, sturdy internal frame adequate for a diverse array of contents

Outside Pouches of Pack (for easy access)

1 - Extra eyeglasses or contacts (as necessary)
1 - Rain cover or liner for pack
1 - Water resistant note pad and pencil
1 - Personal identification and SAR Log
1 - Roll flagging tape (high visibility) or surveyors tape
1 - Tracking combination walking stick, > 42"
1 - Digital camera - (small, compact)

SAR Ready Pack - Considerations and Reminders

Because SAR Responders always carry their ready pack, consider weight when compiling a list of what to put in it. Don't fall into a false sense of security using the following attitude: "*All I need is a few basic tools and I can improvise the rest.*" While the ability to improvise helps tremendously, it is not an excuse for lack of preparation. Carry what you need and get the knowledge to properly use those resources.

Keep in mind that many pieces of gear or equipment fall into the convenient category, but are they essential? Weight and bulk also factor in. Sometimes extra weight and bulk trade-off in terms of utility and sometimes not. Responders will just have difficulty improvising some things. As an example, a compact and efficient saw cannot be improvised. Nor can a person improvise a good utility knife or multi-tool. SAR responders need to have the ability to meet any challenge in the field.

The following tips come from experienced outdoorsmen and SAR instructors and relate directly to carrying gear/equipment in the field:

Always Keep the Pack and Contents Close at Hand

No matter what a person puts in their ready pack and transports to the SAR operational site, it will all be for naught if it's unavailable when needed. Often, no warning precedes the need for tools, resources, and equipment during an operation. The ready pack needs to stay with *the SAR responder* at all times. Never put it down to go do something else, just keep it with you. Never respond to a SAR incident without a ready pack (*whether working in the field or not*). Make it a habit.

Also leaving a part of the pack, or part of the gear behind, at camp for instance, to lighten the load, or for any other reason, never works well. Attempting an assignment without the right tools places you and your team at risk, not to mention the lack of efficiency. Regularly not needing a specific piece of gear means it probably shouldn't have been included in the first place. An experienced SAR responder knows what the job requires and then carries it all the time.

Don't Share With Others

When committed into the field, or located at the operational Command Post site, the ready pack represents the responder's home away from home. A

Emergency Kit Components and Gear 9

Emergency or Survival Kits for SAR Responders

With hundreds of survival products (advertised or oriented) and dozens of specialty kits available through retail outlets and web sites, just exactly what is it that a SAR Responder needs in a grab bag of items or skills to save your life (or another SAR Team member's); or, even make a situation more tolerable? More pointedly, is a personal survival kit and the skills to effectively use it really necessary when responding as a searcher on a missing person incident? Let's take a look and try to answer that question.

As already discussed in Chapter 6, survival situations rarely occur on lost or missing person incidents. However, incidents don't need to be long term or remote to threaten a responder's life. Factors like hazardous terrain, unexpected equipment failures, lack of resources and even inexperience of personnel create situations where people in the field walk a tightrope between life and death.

Every geographic region presents unique challenges for individuals trying to stay alive in the outdoors. No kit will suffice for all types of situations and in all locations. Virtually every kit manufactured or personally assembled was designed to aid a person in a particular environment. A classic example of this can be found in Pierce County, Washington with the Tacoma Mountain Rescue Organization.

Years ago they discovered that if hunters and other outdoor users simply had the resources to successfully spend a wet night in the woods, most would walk out or turn up alive the next day. Tacoma Mountain Rescue came up with the *All Purpose Storm Kit for Emergency Overnight* and it is still used extensively in the Pacific Northwest. These regionally specific environments provide the basis for the large diversity in the contents of currently available emergency/ survival kits. The best collection of emergency items is the one that you put together yourself. This ensures the survival kit's user knows all of the kit's contents and not just the contents but how to effectively use them. If this isn't your style, and you'd rather have someone else put one together for you, then keep the following in mind.

In putting together a grab bag of potentially needed items, or in purchasing an already assembled kit, plan to protect yourself from environmental hazards first. Managing the body in that environment is key to survival. S*urvival experts* further emphasize the need for prioritizing skills and equipment. Most *experts* express conflicting views about what skill or item is the most important, and who says which authority is right under what conditions? The answer to this question evolves from both the environment and the particular circumstances.

Going back to our survival starting point we asked, *What does it take for a human to stay alive indefinitely under extreme conditions?* We established that by listing the necessities of life and then asking how long a human would live without each of them, produced a way to prioritize the necessities in order of importance. Those times, of course, vary between minutes, hours, days and weeks. While this approach seems rather elementary, it provides an excellent perspective for good judgment when faced with survival conditions and what resources a person needs to stay alive.

As related before research and study quickly point out that the physical necessities of life include Air, Shelter, Rest, Water and Food in that order. The additional factor that ultimately assumes the highest level on the list ends up positive mental attitude. The formula that helps put these necessities of life into context for planning and preparedness purposes isn't magic, but it certainly captures the essential elements in their simplest form. To review, that

formula is **PMA** + **98.6°F** = **BCS**. This equates to **P**ositive **M**ental **A**ttitude plus 98.6°F (**normal body temperature**) gives the Best Chance for Survival. Let's break that down just a little more. If we can maintain a positive mental attitude, use all of our skills and abilities to maintain a 98.6 body temperature, then we will have the **Best Chance of Survival**. Not a guarantee, but the best chance. Skills, abilities and attitude then keep the body in balance if we maintain our problem solving ability and have the right resources.

A survivor always protects their problem solving ability by providing the body with adequate protection (*shelter*). Hypothermia and other physiological body upsets directly affect our ability to think and reason. Combine these factors with search and rescue data concerning length of missions and a 24 to 72 hour time frame for response and the real survival priorities begin to show through.

Preconceived ideas about survival generate incorrect priorities and actions that can lead inexorably to a fatal end. Survival means adapting, and that adaptation means a change. The change (*what we do and how we react*) gets driven by an accurate reading of the environment and the hazards it poses. In other words, "*What's going to kill me first?*" Every incident presents different challenges just as every individual brings different skills and tools to the situation. But the necessities and priorities of life do not change, and a look at that list outlines a general course of action and the needed equipment. Environmental hazards pose threats so constantly assess the current (highest priority) threat to determine immediacy of actions and priorities.

Let's run down the list. Positive Mental Attitude based on knowledge, training or experience when faced with a survival ordeal gives the capability to render aid to yourself and anyone with you. Shelter rises as the next most important concern in the majority of cases. Protect the body's balance of resources and problem solving ability at all costs by maintaining normal temperatures and creating protective defenses. Conservation of existing energy stores, heat and water are also paramount to survival. Only do what is necessary. Keep the body's systems in balance. Signal distress and solve problems from the resources at hand and stay alive until rescue.

Three Lines of Defense

The first line of protective defenses in a survival kit and against any hazardous environment includes the clothing worn by that person. If they get hurt, knocked unconscious, or incapacitated in any way, the layers of clothing become the only defense against cold, heat or moisture. The second line of defense centers on what else you brought with you to the environment. That includes extra clothing, preparedness items (your survival kit), a vehicle and any improvised protection that comes from the parts and pieces of those resources. The third line of defense lies in the natural environment such as snow blocks, grass, boughs, leaves or other natural insulation material.

Essential Groups of Kit Components and Skills:

- **Shelter -** Heavy duty plastic shelter bags (for immediate action), plastic tube tents, rubber or plastic quick-don suits, nylon reinforced plastic bags, and bivy sacks all serve. Silicone impregnated nylon tarps allow for greater construction options and help shelter multiple people. Include 50 feet of nylon mil-spec para-cord. Also consider eight to ten feet of duct tape. This component group immediately protects the radiated layer of warmth around our bodies and reduces the possibility of hypothermia by keeping clothing and the body dry and protected from the wind.

  After listing some of the components satisfying the first category (shelter), consider the skills necessary to really use these resources in a challenging environment. Knots, techniques and innovative options should come to mind as naturally and freely as in any other activity in SAR. Training, orientation and practice represent familiar concepts for the SAR Responder.

  Every environment presents different protection requirements addressed by utilizing basic concepts. For instance, in wet, swampy or water laden areas a survivor needs to get off of the wet ground. A heavy mil DOT bag not only protects the body when you put it on correctly, it easily works as a chair, a stretcher, an overhead roof, a water catchment for drinking water, plus a myriad of other functions. It's not only very useful, it only takes up about as much space as a small wallet when vacuum packed (i.e. with a Food Saver unit). Minimizing a kit means using items to fill multiple needs.

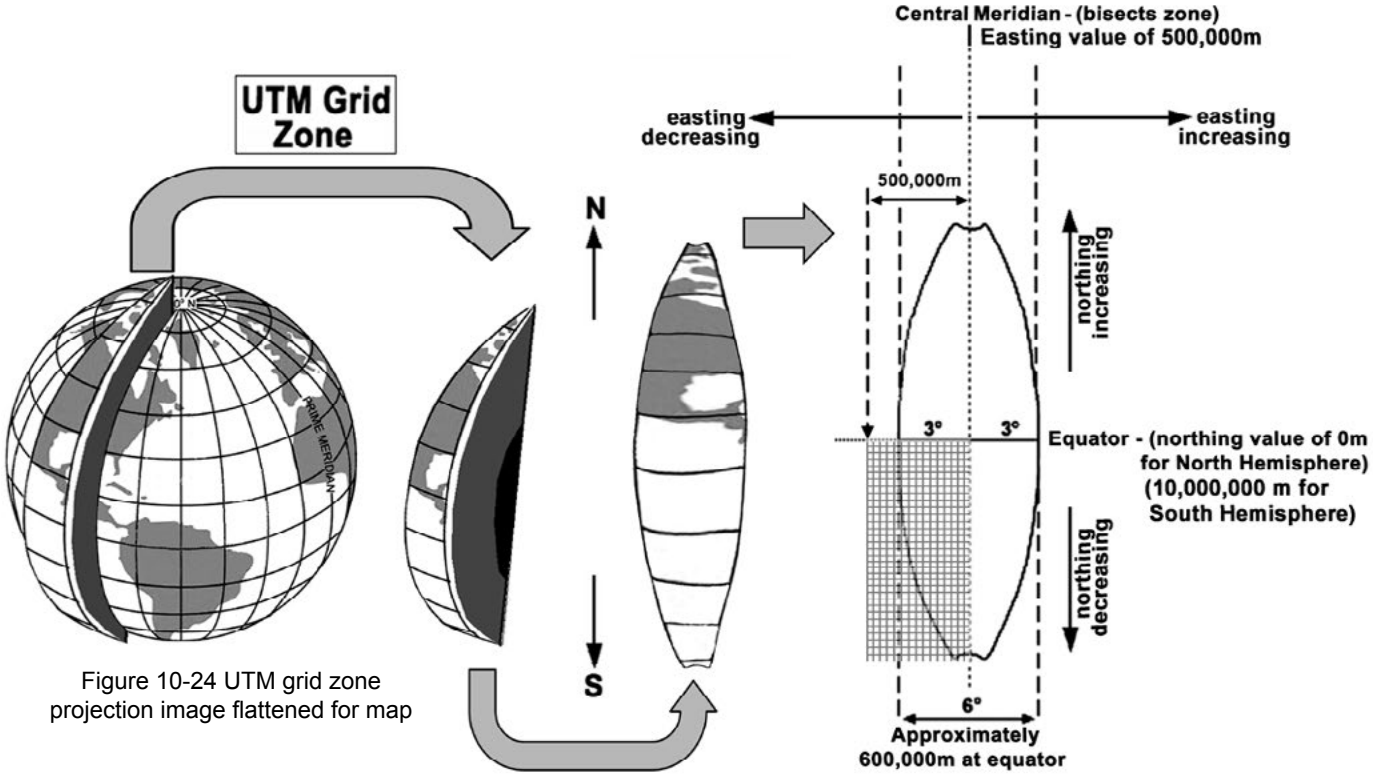


Figure 10-24 UTM grid zone projection image flattened for map

Referring to the illustration above (*Figure 10-24*), imagine we cut a 6 degree wedge out of the earth just like we would with an orange we wanted to eat. The peel, which represents the surface of the Earth, comes off of that slice and flattens into what we call a zone within the UTM Grid. On the right side of the illustration we labeled the dimensions of the zone in meters.

Using the Universal Transverse Mercator System (UTM Grid)

The National Imagery and Mapping Agency (NIMA) (formerly the Defense Mapping Agency) adopted the UTM system for military use throughout the world and officially named it the Universal Transverse Mercator (UTM) grid. Virtually all NIMA-produced topographic maps and many aeronautical charts also show the UTM grid lines. Within this system, as described above, the world is divided into 60 north-south zones, each covering a strip 6 degrees wide in longitude. These projection zones each receive a number consecutively beginning with Zone 1 beginning at the International Date Line (*180° East or West using the Lat./Long. coordinate system*). The numbered zones progress from west to east, so zone 2 begins six degrees later at 174° W and extends through 168° W. The last zone (*zone 60*) begins at 174° E and extends the rest of the way to the International Date Line. (*See Figure 10-27*) Thus, the contiguous 48 States are covered by 10 zones, from Zone 10 on the west coast through Zone 19 in New England (*See Figure 10-26 next page*).

Each zone then further subdivides into an eastern and western half by a line drawn north and south right down the middle. This line, called the zone's ***central meridian***, represents the only line, within the zone, truly perpendicular to the equator that stretches from pole to pole. This line behaves similar to the ***equator*** in standard mercator projections and conveys the least amount of distortion for the map zone. For this reason, all other vertical grid lines in the UTM system orient parallel to the central meridians of each zone. The central meridian also provides the origin for the grid reference system.

Within each zone, coordinates measure north and east in meters (*One meter equals 39.37 inches, or slightly more than 1 yard*). UTM vernacular labels meters north, ***Northings*** and meters east, ***Eastings***. The Northing values are measured continuously from a reference point at the Equator. To avoid negative numbers for locations south of the Equator, NIMA's cartographers assigned the Equator an arbitrary northing value of 10 million meters for measurements south of the equator only. This double value at the equator allows counting up from zero

The Compass and Its Use

Compasses

The compass is a fairly simple instrument that uses a magnetic needle (small strip or card of steel) mounted on a pivot. The needle responds to the earth's magnetic field in a predictable way allowing us to use it for navigation. The better compasses use a fluid filled housing to dampen the motion of the needle. Some compasses, like the military style lensatic, use electromagnetic induction instead of fluid to dampen the movement of the card so that a person can use them without holding perfectly still. The compass is an integral part of effective cross country-navigation.

Compasses may be used to accomplish the following functions:

- Determine direction to a destination or landmark.
- Remain on a straight course to a given position or landmark even though it is not in sight.
- Avoid obstacles or barriers in the route to a destination or landmark.
- Return to a starting point after a days activities in a remote or unfamiliar rural environment.
- Identify locations on a map and in the field.
- Properly orient a map so that it matches the surrounding environment.
- Determine specific points on a map.
- Plan and plot a specified route of travel on a map.

While these instruments vary greatly in price, style, and quality, a discussion about which type seems to offer the most for SAR work is appropriate.

The Base Plate, or Orienteering Compass

The base-plate type, protractor or orienteering compass uses a magnetic needle dampened by fluid, in a clear, plastic housing. (*See Figure 10-46 to the right)* A rotatable dial, called a bezel, sets the desired compass heading. Many models use a folding mirror to help read the compass while sighting objects in the distance and holding the compass at eye level. Compasses like this are precise enough for navigation and position location in SAR.

A baseplate compass needs the user to *set* it by adjusting the dial before reading the direction from the index line. This feature also allows the baseplate compass user to correct for magnetic declination, if desired.

In the alternative, a lensatic compass uses a magnetic disk, called a card, with compass directions printed on it. The rotating card takes the place of a magnetic needle. The lensatic compass has long been preferred and used by the US military because of its precision and durability. (*See Figure 10-48 opposite*) However, a more precision instrument takes a bit more study and practice to use effectively. The baseplate orienteering compass offers plenty of precision for virtually all SAR operations. In fact, novices should probably learn with the orienteering base-plate compass first.

If SAR responders choose the lensatic compass, determining direction of travel and bearings to objects occur almost intuitively. A person simply faces different directions and watches the card move to indicate the direction as observed through the lens. The lensatic compass lens serves the same function as the mirror on a baseplate compass.

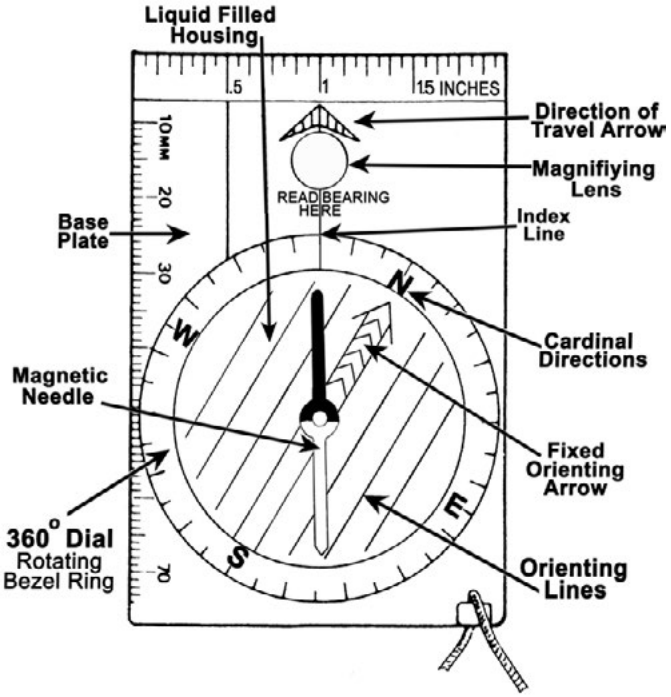


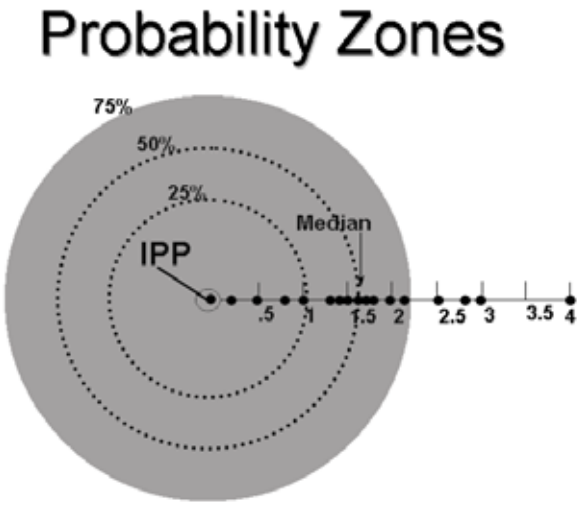
Figure 10-46 Base plate-type Orienteering compass. with it's functional parts and normal configuration.

- Decide whether or not to suspend or when to suspend an unsuccessful search.
- Rationalize your actions to the family, media, or higher authority.
- Potential defense in litigation.

The Area - Where are We Going to Search?

Probability of Area - POA

Basic investigation concerning the facts of the incident coupled with a thorough subjective assessment of terrain factors determines the smallest search area consistent with available information. The Search IC or Search Planner will determine several plausible scenarios explaining why and where the missing person disappeared. Through a consensus process the overhead team usually determines the chances that each of the scenarios is correct and based on this consensus, which areas have the highest chance of containing the missing person. Planners then establish a probability map. *(Where is the missing person most likely to be?)*



Planners then segment the area into manageable *(or searchable)* segments. Based on the probability distribution *(chances the missing person is any given location)* and the capabilities of available resources, the search IC decides which areas present the greatest chance of success in the shortest possible time. *(This process is all part of establishing the search area.)* It is important to note that the search area and probability distributions are not static. They will change and be modified as a search progresses.

Can We Find What it is That We Are Looking For?

Probability of Detection (POD)

If it is assumed that the missing person is in a specific segment, or region of the search area, what are the chances that the searchers will find the missing person (*or a clue*) while searching that area. *(this question must consider the type of resource doing the searching, the <u>way</u> they search, and how many times they search the segment)* The answer is some probability *(between 0% and 100%).* However, a number of factors affect whether the subject will be found or will be missed.

> *(Considerations involving effort in a segment and how to determine the probability that the missing person will be detected are part of the training course Introduction to Management and Planning of Land Search Operations. Procedures for determining an Effective Sweep Width or **detection index** are discussed later in this chapter and accomplished in the field portion of the training.)*

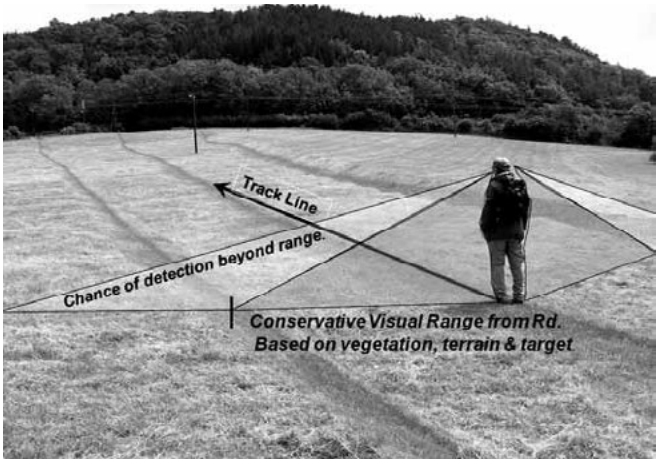
This analysis and prioritized hierarchy applies to searching for virtually anything including:

- Finding lost car keys *(everyday life)*
- Finding lost cities *(Archeology)*
- Finding oil and minerals *(mining)*
- Finding old shipwrecks *(treasure hunting)*
- Finding lost persons *(SAR, sea and land)*

> *"Only with the advance of modern technology have we learned to examine search in the light of science as an operation having various structural patterns and obeying laws of its own."*
> – B.O. Koopman, 1946

- **Track Line** - The track or route that searchers or a search resource follows as they pass through a search segment.

- **Track Line Length** - *(Notation* - **TLL***)* The length of the path that a resource took while it was searching in a designated segment. Track Line Length is computed by multiplying the speed of the resource by the time spent searching in the segment. *(e.g. One mile per hour X 4 hours = A four mile Track Line Length)* It is usually measured in yards, meters, miles or kilometers.



Track Line Length multiplied by the Sweep Width gives us the Area Effectively Swept (*How much area did we eyeball?*)

- **Total Track Line Length** is the length of the path multiplied by the number of resources or people searching in a segment. Simply multiply the length of one searcher's path by the number of searchers.

- **Effort Allocation –** Of primary concern in any search operation is "*How long is it going to take to search that area?*" The effort required to search a portion of the search area is derived from a number of different ***variables listed below.***

  With *effort allocation,* there are a number of variables that can be manipulated to accomplish the tasks in a rapid, but efficient manner to bring about success in the shortest time.

Variables for Effort Allocation

- Time spent by searchers
- Number of searchers
- Speed of Searchers
- Different Resources
- Sweep Widths of Different Resources
- Multiple Searches - Same Resource
- Multiple Searches - Different Resources

- **Area Effectively Swept** - *(Notation* - **Z***).* This value is needed to compute coverage. This is a designation of geographic area expressed as square feet, yards, meters, miles or kilometers. Sweep Width designates a range of visual distance on either side of the resource and Total Track Line Length represents how far the resources traveled. If you multiple those two values together, the product is an area. This is essentially how much terrain was actually looked at. It is calculated by multiplying the *Sweep Width* (**W**) by the *Track Line Length* (**TLL**) or distance covered by the resource. It describes an area of ground that has length *(Track Line Length) and width (Sweep Width).* How much ground was actually eyeballed?

$$Z = W \times TLL$$

- **Coverage** *(Notation* - ***C****)* This value is the ratio of the area effectively swept (**Z**) to the total area being searched.

  A search segment has a specific area. This is normally computed in square yards, meters, miles, kilometers, acres, or hectares and is derived by multiplying length times the width. If a Search Planner compares this area to the size of the area effectively swept *(that which has been searched by a particular resource and which is derived by multiplying sweep width times the track line length)* a value is derived that describes how much of the search segment was covered or eyeballed by the resource.

  Essentially coverage is a ratio comparison between the size of the segment and the area effectively swept *(searched).* With this ratio or coverage factor, we can determine probability of detection on a graph developed through long years of research in search theory. *(See Figure 11-5 on the next page)*

  If the particular segment being searched is 40,000 sq. meters and we calculate that the area effectively swept by the searchers was 20,000 sq. meters, then the coverage would be 20,000 divided by 40,000 which is ½ or 0.5.

  The 0.5 coverage can be used to obtain the POD for that search by using the graph on the next page *(Figure 11-5).* The graph tells us that coverage of 0.5 gives a POD of 39%.

A preliminary subject profile should contain the following as a minimum:

- ☐ **Physical and mental description.**
- ☐ **Names,** nick names or aliases.
- ☐ **Physical resources** being carried by the subject.
- ☐ **Known activity** at the time of the loss.
- ☐ **Point last seen or last known position** (PLS/LKP)
- ☐ **Personality traits -** aggressive, despondent, confident, low self esteem, happy-go-lucky, stable, etc..
- ☐ **Interest and activities,** i.e. hobbies, alternate vocation, outdoor pursuits, etc..
- ☐ **Experience -** novice versus seasoned veteran etc.
- ☐ **Has subject been lost** before?
- ☐ **Predetermined** emergency **strategies** or options discussed with other party members - *e.g. bad weather routes or options, alternative goals, turn-back policy, etc.*
- ☐ **Other possible scenarios -** stranded, medical, overdue, trauma, etc.
- ☐ **Personal tragedies, family crisis, work environment or relationship problems** - could influence behavior.
- ☐ **Known friends, family and associates** for contact and assistance in compiling the subject profile.

Use the Missing Person Report Form for guidance on gathering subject profile info about the missing or lost person.

It is impossible to remember all of the facts and information that must be gathered about missing or lost persons *(Regardless of experience or SAR mission exposure).* **The Missing Person Report Form must be used as a foundation by responding officials conducting search operations for lost or missing persons.**

Missing and Lost Person Behavior Data

Early studies by Dennis Kelley and Bill Syrotuck concerning lost person behavior were primarily rural/wilderness based and they emphasized behavior of subjects who were truly "lost" in the traditional sense within those environments. Later studies have expanded the subject category types and also address people that are missing for other reasons. Initially Robert Koester's research into Dementia (*Alzheimer's*) patients in Virginia was the most notable. That really provided the springboard into data that specifically focused on the urban environment. While pure urban data is still in short supply, that is changing rapidly and Koester's latest publication that uses the ISRID database is the most comprehensive of those works.

Behavior studies really give us two important things:

Number 1: Distances traveled by category of subject. Not exact distances, but generalities that reduce the potential area to be searched for planning purposes. These statistics can also be used to generate probability of area maps.

Number 2: Statistics that provide more and less likely places to look.

The purpose of studying lost/missing person behavior is to facilitate prediction of a missing person's location with some reasonable degree of accuracy. It is not an exact science and therefore only deals with generalities. Some missing people don't necessarily fall into any of the categories represented in the collected data. Don't fall into the trap of thinking that every person that is the focus of a search will fall into some nice neat category with all the appropriate distances and characteristics recorded. Sometimes it will take some investigation to uncover factors that can be used from several categories.

in the field. This is comforting for family, media, peers or companions at the scene. Reflex Tasking shows an immediate purpose and solidly gives the impression that someone is doing something based on facts. Overall impression is that someone knows what they are doing.

Functional Groups for Reflex Tasking

Koester has established six (6) functional groups of tasks for each of the subject categories. These functional groups of tasks remain constant throughout each category of subject. The functional groups of tasks are as follows:

- Investigation
- Initial Planning Point
- Containment
- Hub/Immediate Area
- Travel Corridors
- High Probability Tasks

While the functional groups remain constant throughout all categories, specific tasks in those functional groups will depend on the subject category. As an example under the subject category of **Dementia** *(Alzheimer's)* under functional group Travel Corridors, Reflex Tasks for this group would be as follows:

- **Travel Corridors**
  - ☐ Hasty search of trails, roads, drainages, and other routes leading away from the IPP, patrol roads.
  - ☐ Look for decision points and cut for sign at turn off points.
  - ☐ Dogs into drainages.
  - ☐ Corridor search parallel to roads and routes.

By comparison look at the same functional task group *(Travel Corridors)* and the Reflex Tasks for **Children 7-9:**

- **Travel Corridors**
  - — Hasty search of trails, roads, drainages, and other routes leading away from the IPP.
  - — Cut for sign along routes and at shortcuts.
  - — Look for various routes to familiar places.

Going back to the example database for Dementia (*Alzheimer's*) in Koester's manual it is instructive to fill in the other Reflex Tasks under the other five functional groups.

- **Investigation**
  - → Determine planning data
  - → Determine searching data
  - → Start MPQ (Missing Person Questionnaire/ Lost Person Questionnaire) Ask specific questions.
  - → Previous wandering?
  - → Potential destinations.
  - → Severity of dementia.
  - → Check taxis, mass transit *(all shifts)*, hospitals, EMS, jails, shelters, etc.
  - → Alert municipal workers.
  - → Issue ***Silver*** alert.

- **Initial Planning Point**
  - → Preserve IPP.
  - → Locale search.
  - → Highly systematic grounds and structure search.
  - → Repeat search of grounds and structure.
  - → Task sign cutters/trackers.
  - → Tracking/Trailing dogs; ideal if they have practiced with persons with dementia.

- **Containment**
  - → Establish containment.
  - → Use statistical max zone or theoretical zone.
  - → Containment provided by road patrols/air.
  - → In urban environment, use road, bike, air patrols. Contain entrances to gated developments.

- **Hub/Immediate Area**
  - → Canvass campground.
  - → Canvass neighborhood.
  - → Thorough search of 25% zone. Sweep/area dogs.
  - → Notify community by media, flyer, door to door, and/or telephone system.

- **High Probability Tasks**
  - → Check historical finds.
  - → Previous lost locations.
  - → High hazard areas.
  - → Previous homes.
  - → Ensure heavy brush is searched.

Searching the *Cube* – an analysis of basic searcher scanning techniques and training

Virtually all training related to Basic Search and Rescue Skills refers to or references searching what we call the ***Searcher Cube***. This section defines the often referenced *searcher cube* and identifies a training shortfall in the SAR community concerning ways to effectively search that *hypothetical visual zone*. To thoroughly understand the implications of this, readers must also understand the results of the *Sweep Width Estimation for Ground Search and Rescue* study funded and conducted through the National Search and Rescue Committee published in late 2004. We suggest a simple visual routine to insure efficient and thorough coverage of the searcher cube to directly influence (*and increase*) both coverage and probability of detection during any search.

Imagine the searcher cube as a six sided transparent cube surrounding a searcher as he or she walks through an assigned search segment. Each side or plane of that cube (top, bottom, sides, front and back) must be scanned constantly and effectively as a searcher's movement takes them through the segment. It sounds simple, but successful searching takes a fairly complicated and coordinated effort to get the job done. For instance, how does a searcher check the six o'clock position (*effectively look back*) while proceeding through an area of mixed vegetation or very dangerous and tenuous footing? The dimensions of the searcher cube form the basis of how the searcher covers the environment with his or her attention. Each of the six faces of the cube should be one full sweep width (*2 x the lateral range curve*) in height and width with the searcher at the center. The sweep width is estimated by the Average Range of Detection procedure in the field at the beginning of the operational period (see The Textbook for Managing Land Search Operations, *Page 338-339*). This dimension provides an accurate foundation for the searcher's coverage calculation and ultimately his or her probability of detection (*POD*). This means that the probability of detecting an object outside the cube is equal to the probability of missing an object inside the cube (see The Textbook for Managing Land Search Operations, *Page 353*).

To understand and improve what really happens in the field on a search: we will look at both the research and the experiments conducted so far; the searcher errors recorded in those experiments; and finally, we will suggest the use of a visual routine very similar to that used by instrument pilots as well as military and police patrols to keep track of very busy and complicated visual environments.

During the Sweep Width Estimation Studies, a valuable secondary benefit of the experiments centered on how searchers detected or missed search targets *(randomly placed objects)* while data loggers observed them. Searchers seldom have an opportunity to get feedback on why they missed a search object and hence they don't get an opportunity to improve their skills.

Members of the experiment staff who placed the targets made relevant observations of the searchers in action. Because the experiment staff placed the targets, they knew the location of each object and they closely observed searcher technique while they looked for the targets. After the first experiment, the staff recorded additional details concerning the search targets. This information included the location along the track where the search target first became visible (detection opportunities), the maximum range at which it remained visible, what percentage of the time while in the visible range it could be detected, a qualitative term describing its visibility, and any features that might complicate its detectability. Unfortunately, since this facet of search was not the ultimate goal of the experiment no standardized form was made to collect this data. However, based upon the observations of the experiment data loggers (*observers*) the following were the most common errors in technique leading to missed visible targets.

- **Not looking behind or back.** (*Checking the 6 o-clock position*) Many targets in the experiments were only visible if the searcher looked back. Often over the entire course the

Track & Clue Awareness (TCA)

This portion of the chapter is not strictly about tracking although that is a valuable skill in SAR. An understanding of vision and the concepts discussed previously in this chapter are essential for this skill to be perfected. The concept of TCA involves a lot more than expected and requires many more observation and visual skills than normally addressed in a straight forward man tracking course.

The primary catalyst for this section of the chapter is clearly a result of influence by Ross Gordon from the Search and Rescue Institute of New Zealand. It was his vision of Track and Clue Awareness that shaped the progressive cutting edge approach to scene processing and clue awareness that elevated New Zealand to the top of this skill capability.

Track and Clue Awareness (TCA) is a discipline (methodology) and skill set for effectively and efficiently processing all sign (evidence) and clues germane to a specific SAR incident and/or site. The ultimate goal of TCA is to find people faster by maximizing opportunities to detect meaningful clues and travel vector indications.

TCA also means discovering what activities occurred at a specific site (*point of departure, crime scene, trail junction, campsite, etc.*) Being accomplished in track and clue awareness, applied to search is definitely a more complex skill than initially surmised in just man tracking in the field; TCA consists of tracking and clue processing. It means correctly and efficiently processing a site. It is knowing where to search and what to search for (*clues, sign and evidence*). It also means analyzing what is discovered. The skill is both an investigative (*strategy*) and an operational (*tactic*) search tool.

Don't get led blindly into the assumption that once track and clue awareness is applied to a search, every lost person or persons will be found. Instead, think of track and clue awareness as really having searchers aware of both subtle and blatant evidence that will provide a much better chance to locate the missing person. TCA can also prove *(or disprove)* that a missing person is within a designated area and what their activities mostly likely consisted of while they were there.

Track and clue awareness in the planning and management arena is integrating results with personal profiles in Lost Person Behavior. That means direct comparison with existing database factors. Clues, the Initial Planning Point, Point Last Seen, Last Known Position and direction of travel are all given added credibility with quick action by TCA trained responders. Incident Commanders and Search Planners trained in the concepts of TCA will make more efficient and effective assignments for initial responders in the Reflex Tasking phase of the incident. This means knowing where to search, how to search efficiently, and specifically briefing on those functions.

When and Where to Use Track and Clue Awareness Skills

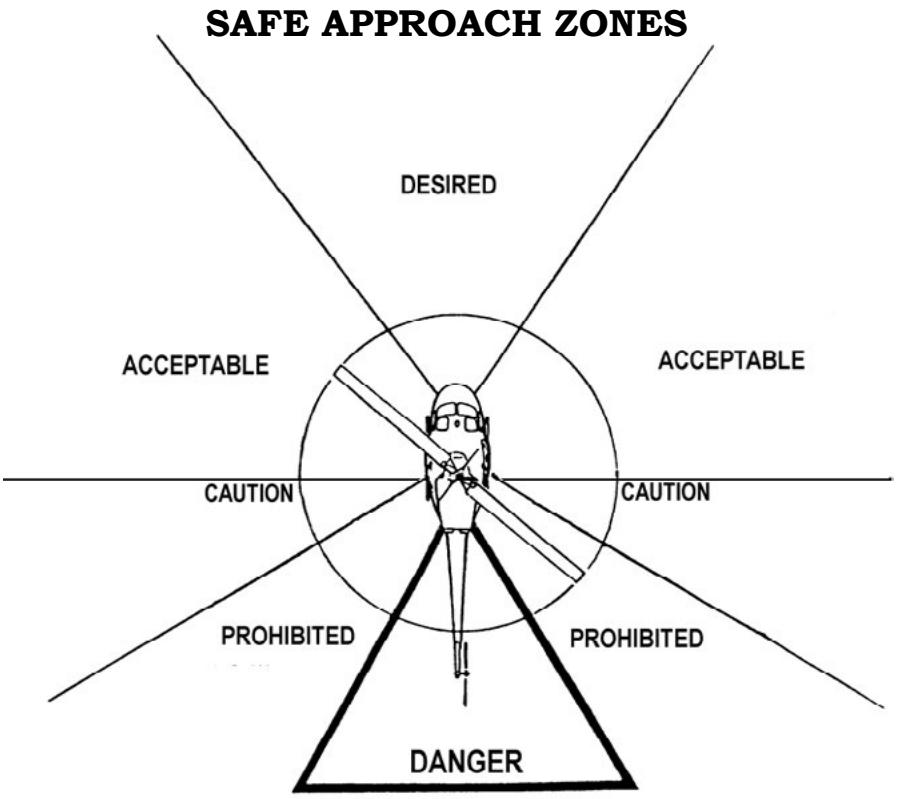
TCA can give management a great deal of information but like many skills in search, success is dependent on specific conditions and the skill level of the responders.

This information might include:

- What activity has occurred in the area.
- Direction of travel.
- Number of people.
- Identifying characteristics.
- Sex of the individual who left the sign.
- Time.
- The individual was or was not carrying a load?
- Confusion or disorientation in the subject.

Tracking is best utilized in the early stages of a search when evidence *(sign/clues)* is least contaminated by well-meaning searchers. Early application of trackers or track and clue aware searchers also allows preservation of some clues or track *(time and weather-sensitive)* components of evidence.

Can finding clues and also tracking be useful in all environments? What about while its raining? How about at night? The answers are all yes, but



BOARDING AND EXITING

Ideally, a helicopter should be completely idle when injured parties are boarded. However, this is often impossible, and the loading has to be done with the machine running. This requires the utmost cooperation and safety orientation.

The injured person must be briefed and reassured when being winched into the ship from above. While smaller ships are seldom adequate for such a maneuver, the military helicopters commonly used on rescues very often have this capability. However, most military units will not casually use a hoist/ winch except in life-and-death emergencies.

Occasionally, rescue personnel will have to exit a helicopter while it is in a low hover because the ship cannot land. The risks are obvious, and the need for caution is extreme. Seldom does anyone jump from a distance of more 4 feet. In jumping, it is important not to push off from the helicopter, as this may upset the balance of the ship. Occasionally, the reverse is necessary, as the rescuer may have to climb onboard while the ship is hovering. This is a very calculated risk and is rarely called for.

GENERAL RULES

1. Stay away from the rear of the helicopter.
2. Crouch low before getting under the main rotor.
3. Approach from the side or front, but never out of the pilot's line of vision.
4. Hold firmly to hats and loose articles.
5. Never reach up or dart after a hat or other object that might be blown off or away.
6. Protect eyes by shielding with a hand or by squinting.
7. If suddenly blinded by dust or a blowing object, stop - crouch lower - or better yet - sit down - and await help.
8. Never grope or feel your way toward or away from the helicopter.

Pre-takeoff Briefing

Since few helicopters carry cabin attendants, the pilot must make this briefing. The type of operation will dictate what sort of briefing is necessary. Passengers should always be briefed on:

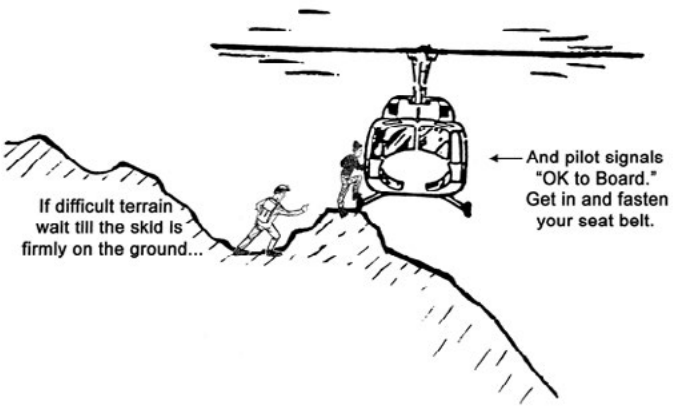
1. Seat-belts. The use and operation of seat belts for takeoff, en route and landing.

2. Over water flights. The location and use of flotation gear and other survival equipment that might be on board. How and when to abandon ship should a ditching be necessary.

3. Flights over rough or isolated terrain. All occupants should be told where maps and survival gear are located.

One-Skid Landings

This procedure involves touching down to load or unload passengers and/or cargo, but retaining lift by the rotors so that the full weight of the helicopter is not resting on the ground. Pilot and rescuers must be trained in this technique.



Boarding a Hovering Helicopter
(Skid Models)

The use of this method with small helicopters where lateral balance is critical is hazardous and it is difficult to find situations in which the risk to helicopter and personnel would justify its use. In the event this operation is performed, personnel should know the technique for boarding during one-skid operations.

Passenger Unloading

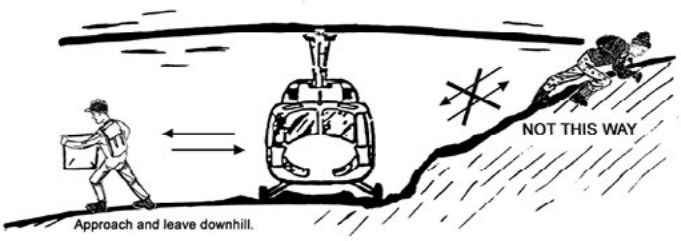
1. Pilot touches down skid on passenger side.

2. Upon nod from pilot or crew chief, unfasten belt and move smoothly onto the skid.

    - Again, with OK signal, step slowly out of the aircraft and move carefully away. **Do Not Run**. Watch out for terrain hazards and slope. Do not step between the ship and skid but merely step off beyond the skid.
    - Gear will be passed out to personnel by the crew on board.

3. Remain in low crouch within pilot's vision and hand signal takeoff. Remain in crouch until helicopter is clear.

4. If terrain rises in front or is precipitous do not move but remain low near skid until helicopter is clear.



SLOPING GROUND

Cargo Unloading (external racks)

1. Do not lean or step over the skid as cargo is being unloaded in case a gust of wind forces sudden takeoff.

2. Unload symmetrically. If only the pilot is aboard, unload items on the rear of the cargo racks and progress to the front. If passengers are aboard, unload cargo from front of rack and progress to rear. Be sure to secure tie-down straps.

Rope/Gear Inspection

If the following damage related factors are evident or suspected, seriously consider removal from active or operational response. A compilation of these factors or even one may warrant the decision for removal.

As mentioned above, taking a rope or piece of webbing out of service involves a subjective decision. Actual tests, unfortunately, require the complete destruction of the rope or piece of gear. Gather multiple pieces of information about the rope or webbing and make a decision based on that analysis. Look for and consider the following when attempting to determining the serviceability of a length of rope or webbing:

These factors are independent of use frequency. Dispose of or retire a rope if there is evidence of:

- **Discoloration -** a distinct change in the original color of the rope could indicate heat or chemical damage. The rope may have come in contact with chemicals, particularly acids.
- **Sheath Wear -** When more than half of the fibers in the sheath are broken or when the core is visible through the damaged sheath. The sheath is extremely worn, or particularly fuzzy, or perhaps the sheath has slipped noticeably.
- **Soft Spots -** if several fibers in the core are parted, an area may be noticed that has a distinctly smaller diameter, or just feels softer. Certain types of damage to the core may even feel bigger. The change in diameter should be the key.
- **Evidence of Heat Fusion -** If heat has damaged a synthetic, it may turn shiny or even hard. Heat, abrasion or friction burns have caused damage.
- **Stiffness -** Change in the flexibility or softness could indicate heat or stress damage. Strong deformations are present (stiffness, nicks, sponginess).
- **Dirt or Foreign Materials -** oil, grease, chemicals, or just plain dirt all shorten the life of a rope. The rope is extremely dirty (grease, oil, tar). Look for contaminants and deal with them immediately.
- **History -** Has the rope been subjected to extreme stress or shock loading? Indications the rope has been overloaded? How old is it and what has it been used for? What type of environments has the rope been subjected to?
- **Confidence -** users of the rope must have confidence in its integrity. Lack of such faith is usually well founded, even if it cannot be precisely defined.

Service Levels for Rope

Doubtless any rope used for rescue or SAR in general is usually expensive to replace. For that reason, use some type of rating system to clearly define intended use. Line of all types gets used in the rescue function during SAR operations. It only makes sense that as a line ages, it's function may changes. In other words, a rope may be downgraded as time or damage dictate.

Life Line - Rope used to support life; usually a new rope or in very good condition.

Utility Line - Rope used to haul equipment only where life does not depend on the continuity of the line.

Seat Harnesses

The most comfortable, secure and functional seat harnesses are those that are pre-sewn and manufactured specifically for climbing or rescue. Seat harnesses usually come constructed of nylon or polyester webbing that fits around the waist at the pelvic region. Harnesses support the body and provide a mechanism for attachment to a rope or other types of protection. While improvised harnesses can be tied using tubular webbing, they are not recommended for regular use in

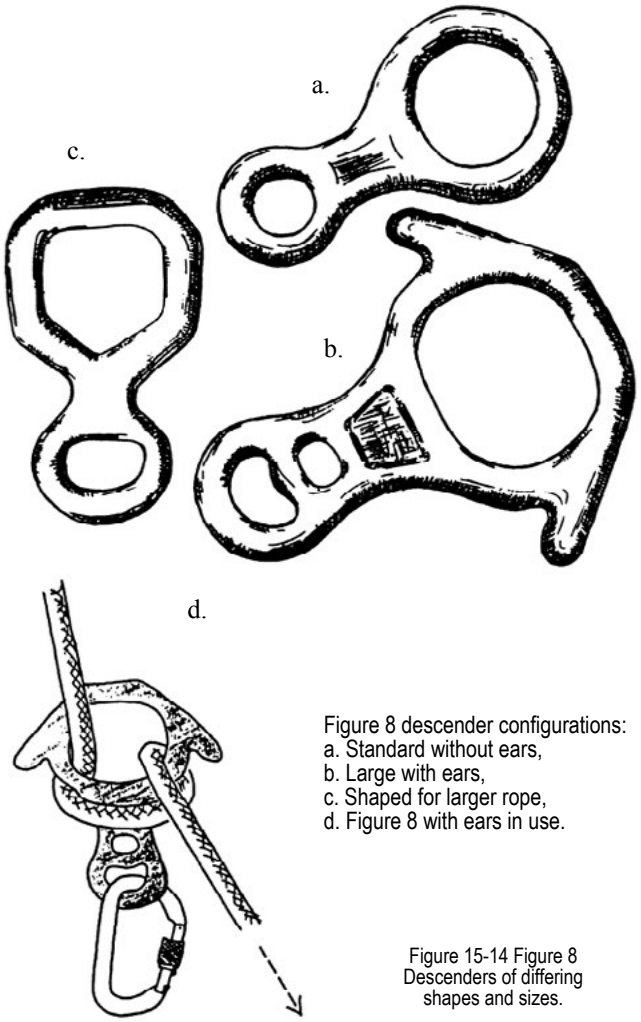


Figure 8 descender configurations:
a. Standard without ears,
b. Large with ears,
c. Shaped for larger rope,
d. Figure 8 with ears in use.

Figure 15-14 Figure 8 Descenders of differing shapes and sizes.

Belay Devices

Belaying refers to a variety of techniques climbers and rescuers use to exert friction on a rope, so that if someone slips or falls they only travel a minimal distance before stopping. A climbing partner or rescue team member typically applies friction on one end of the rope whenever a climber stops moving. This essentially applies a brake to the system. Then, they remove the friction from the rope when the climber or rescuer needs more to continue climbing or needs to move around.

Belay devices, as a group, supply friction or the brake on a rope within a belay system. The belay device helps keep tension on a rope and protects a climber or rescue load at the end of the line. These devices perform an essential role for climbing and personal safety.

Three of the most popular belay device options are Tubular, Auto-Locking and auto blocking. A fourth no optimal option for a belay would be the Figure 8 discussed above.

Tubular devices have one or two holes that accept a bight of rope to pass through the hardware. The bight of rope then secures to a climbing harness with a locking carabiner. The combination of the tubular device, carabiner and the climber's brake hand on the rope at a specific angle that provides enough friction to secure a fall or prevent a load from slipping. The hand used as a brake must apply some force to the rope to stop it because the device will not lock on its own. See Figure 15-15 on the next page.

The Auto-Blocking Belay

The auto-blocking belay uses an extra carabiner for added friction and according to some arguably serves as the best all-around and most versatile belay device style. The other convenient factor on this style is that virtually every manufacturer makes a rendition of the device. The more complicated models usually weigh more, but several designs weigh in at only three ounces.

A bight of rope is inserted through the device and out even with the safety cable. A locking carabiner is placed through the loop and serves as the blocking mechanism. The top rope (nearest the large metal eye) is the rope going to the lead climber. The braking hand rope is the lower one that is pulled against the friction ridges.

The ATC Guide device can be used for both belaying and rappelling. By reversing the orientation of the braking rope (top to bottom) it serves as a normal friction belay device for both belay and rappelling.

Ascenders

Ascenders grip or hold the rope and may also be called *jumars*. These devices mechanically offer the same functionality as the prusik one-way friction knot. Ascenders originated in the climbing community where they serve to ascend or climb a fixed rope. During any type of technical climbing, (snow and ice, rock, etc.) when a person falls and/or needs to climb a rope out of danger or to get over a difficult vertical stretch, ascenders help to accomplish the job. In rescue, they are used more often in a hauling system than to ascend a rope, but they all work on the same principle: An ascender employs a cam which allows the device to slide freely in one direction (normally the intended direction of movement), and provide a firm grip on the rope when pulled in the opposite direction.

Climbers normally use two ascenders to climb a rope, so that as one is moved up the rope, the

5. **SAR Base**, this is **Team One**, request evacuation team and a transport pickup at grid coordinates TWO, FIVE, SIX, FOUR, THREE, ONE. Please advise of evacuation team **ETA**.
6. **Team One**, **SAR Base**, (pause) **STANDBY**.
7. **Team One**, **SAR Base**, Evac team will be at grid coordinates, TWO, FIVE, SIX, FOUR, THREE, ONE in three five minutes.
8. **SAR Base**, this is **Team One**, three five minutes copy.

General Radio Protocols for Field Units

Message Delivery on the Radio

Many SAR team members working in the field often place their radios in a chest pack harness. The units usually attach the radio at a 45 degree angle to facilitate minimal encumbrance for movement or activities. Two team members trying to communicate could have their radio antennas 90 degrees out of alignment with correspondingly very weak signals and reception. In fringe or less than desirable communication locations, take radios out of these harnesses and hold them overhead with the antenna pointing vertically.

Desirable Habits for Better Radio Transmissions

- Don't say *yes*, say **affirmative**.
- Don't say *no*, say **negative**.
- Keep the irritation, and sarcasm out of messages
- Speak calmly and use a neutral tone - never shout
- Try to keep tension and/or excitement out of the voice
- Use correct terminology and plain English
- Never use slang or profanity
- Keep transmissions simple, and accurate, but concise
- Try to pronounce each word distinctly
- Clarify with the phonetic alphabet
- Know what is going to be said before pressing the transmit button
- Keep air time to a minimum and as brief as possible
- Be aware that transmissions can be overheard by family and friends of the subject
- If a message received is garbled, unclear or in any way unreadable, ask sender to "**SAY AGAIN**." Do not use the term "repeat" If the message is not understood, request sender to "**CLARIFY**"
- Do not place the body, pack or other people between the antenna and the receiver
- When acting as a relay, do not cut anything out or editorialize the message. Relay exactly as received
- With long messages, break up into increments of approximately a half minute each

Securing All Field Unit Communications:

Item number **3** under reporting the missing subject found in the previous column relates to securing all communications for teams in the field. When this request occurs and the SAR Base radio operator OK's, no one transmits except the team requesting secured communications. This procedure normally functions for situations of great urgency or when a subject has been located. The SAR Base normally follows that message up with. "**STANDBY** for roll-call and/or important information."

Emergency Communication

If an emergency develops during operations with a need to interrupt other communications, use the following protocol. Examples of justification for this include: a SAR team responder hurt, injured or in immediate need of assistance. As mentioned above, the missing subject is located and needs immediate assistance or crucial medical care.

With other radio traffic on the frequency, wait for the first pause in a radio transmission and then interrupt with the words **"BREAK, BREAK, BREAK."**

Normally dispatch will follow with *"All units standby, I have emergency traffic!"* The SAR Base Radio Operator normally acknowledges the request and gives permission to transmit emergency information. When this occurs all non-essential traffic remains off the frequency.

The International Phonetic Alphabet provides voice emphasis cues as guidelines for letters in the English language.
In the table below, the **Boldface** syllables are emphasized for pronunciation.

NATO /ICAO / FAA Endorsed Phonetic Alphabet Annunciation

Letter	Phonetic	Annunciation	Letter	Phonetic	Annunciation
A -	Alpha	**AL**-fah	**N** -	November	no-**VEM**-ber
B -	Bravo	**BRA**-voh	**O** -	Oscar	**OSS**-kah
C -	Charlie	**CHAR**-lee	**P** -	Papa	**PAH-PAH**
D -	Delta	**DEL**-tah	**Q** -	Quebec	kay-**BEK**
E -	Echo	**ECK**-oh	**R** -	Romeo	**ROW**-me-oh
F -	Foxtrot	**FOKS**-trot	**S** -	Sierra	**SEE**-air-rah
G -	Golf	**GOLF**	**T** -	Tango	**TANG**-go
H -	Hotel	**HOH**-tell	**U** -	Uniform	**YOU**-ni-form
I -	India	**IN**-dee-ya	**V** -	Victor	**VIK**-tah
J -	Juliet	**JU**-lee-ett	**W** -	Whiskey	**WISS**-kee
K -	Kilo	**KEE**-loh	**X** -	X-ray	**ECKS**-ray
L -	Lima	**LEE**-mah	**Y** -	Yankee	**YANG**-kee
M -	Mike	**MIKE**	**Z** -	Zulu	**ZOO**-loo

transmission recite numbers one at a time. "459" transmits as **FOW**er - **FIFE - NIN**er; not four-fifty-nine as in normal conversation. The number 100 is not "One Hundred," instead, transmit: "**WUN**, **ZEE**-ro, **ZEE**-ro.

Number		Annunciation
1.	One	**WUN**
2.	Two	**TOO**
3.	Three	**TREE**
4.	Four	**FOW** er
5.	Five	**FIFE**
6.	Six	**SIX**
7.	Seven	**SEV** en
8.	Eight	**AIT**
9.	Nine	**NIN** er
0.	Zero	**ZEE** ro

Troubleshooting Transmission and Reception Problems

The most common causes of communications problems with two-way radios combine two of these factors (*though one acting independently will cause a problem*). The factors:

- **Loose or incorrectly attached antenna**
- **Low batteries**
- **Difficult surroundings or terrain**

Loose Connection to the Antenna

As mentioned earlier in this chapter, if a team member fails to transmit or receive, Check the antenna first. The antenna connection to the radio frequently makes for poor signal transmission and reception. Detect this kind of problem early during an operational period by conducting an initial radio check.

Low Batteries

If the batteries on a radio unit seem low at an unusually quick rate, perhaps one of the following caused it:

- Check the volume on the radio. The higher the volume setting, the more rapidly the batteries will drain.
- If the radio is so equipped, make sure that the scan function is turned off. A scanning unit draws much more power than on a single channel.
- Many radio are equipped with high/low power switches. Check to see if the radio is on high power as opposed to low. Low power should be used for most transmissions. High would only be for the most difficult conditions.
- Check to see if the display light settings are working improperly. Most of these go off with a timer. Make sure that there is not a malfunction in the lighting timer.