



Designation: F 1633 – 97

Standard Guide for Techniques in Land Search¹

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1. Scope

1.1 This guide identifies and describes techniques that may be used by individuals or agencies when searching for persons, property or evidence, on land. The application of one or more of these techniques to any particular land search will depend upon the individual circumstances of the search and the judgment of the person responsible for conducting the search.

1.2 This guide assists individuals and agencies by providing a list of techniques for their consideration during a land search and by providing a brief description of the application of the technique to land search. Some advantages and disadvantages, as well as the most common uses of the techniques, are discussed in the guide. The guide does not, however, purport to discuss all aspects of conducting a land search.

1.3 *This standard does not purport to address all of the safety concerns, if any, associated with its use. It is the responsibility of the user of this standard to establish appropriate safety and health practices and determine the applicability of regulatory limitations prior to use.*

2. Referenced Documents

2.1 *ASTM Standard:*

F 1767 Guide for Forms Used in Search and Rescue²

3. Terminology

3.1 *Definitions:*

3.1.1 *attraction, n*—to get the attention of lost, missing or stranded subject(s) by sound or visual methods, or both, for example, whistle, light, smoke.

3.1.2 *clue awareness, n*—to be aware of evidence left by a subject(s) which may help to ascertain their location or direction of travel, or both.

3.1.3 *confinement, n*—the act of limiting the growth of the potential search area by minimizing the ability of the subject(s) leaving the search area undetected.

3.1.4 *electronic search, n*—technique(s) using electronic systems or devices to locate a subject(s) or evidence, or both.

3.1.5 *hasty search, v*—to send a fast moving, well-trained crew(s) of searchers to quickly check selected high probability area(s).

3.1.6 *investigation, n*—the systematic collection and analysis of information about the lost or missing subject(s) by interviewing (interrogation) or reviewing records or evidence, or both.

3.1.7 *line search, v*—to use searchers in a linear pattern(s) at specified intervals, to investigate a defined search segment.

3.1.8 *probability of area (POA), n*—the probability of a subject or clue being in the area or segment being searched.

3.1.9 *probability of detection (POD), n*—the probability that the subject or clue will be detected by the search action if the subject or clue is in the search area.

3.1.10 *search dog, n*—canine trained in techniques to locate a subject(s) or evidence or both.

3.1.11 *search dog crew(s), n*—canine and their handler(s) trained in search techniques to locate a subject(s) or evidence, or both.

3.1.12 *segment (search area), n*—a geographic unit within the search area established for the purpose of effective and efficient assignment of search resources.

3.1.13 *segmentation, n*—the process of partitioning the search area into segments.

3.1.14 *segmentation, binary, n*—to reduce the size of a search area through subdivision into increasingly smaller segments.

3.1.15 *tracking, v*—to follow a subject(s) footprint(s), track(s), or sign through varying types of terrain.

3.2 *Definitions of Terms Specific to This Standard:*

3.2.1 *breakage, n*—a physical rupture of material or the surface of material, such as frequently seen when vegetation is crushed or bent by external forces such as the passage of subjects.

3.2.2 *bruising, n*—changes in the subsurface of vegetation which generally leaves the surface intact but noticeably different and is the result of vegetation being crushed or squeezed by external forces such as the passage of a subject(s).

3.2.3 *color change, n*—changes in tone or contrast of a surface as a result of a disturbance which causes the disturbed area to appear different from the surroundings. An example of such a change would be the turning up of sub-soil with more

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² *Annual Book of ASTM Standards*, Vol 13.02.

moisture than the drier surface soil, thereby creating a darker pattern in the disturbed area. See also *shine*.

3.2.4 *disturbance, n*—evidence of recent change, displacement, or rearrangement such as dislodged rocks, pebbles, twigs, or bruised leaves. Other evidence could include breaks in branches, twigs, or bruised leaves at or above the ground.

3.2.5 *flattening, n*—when pebbles, twigs and other objects are pushed below their natural bed, indicating that something very hard such as a sole or hoof of an animal has stepped on them.

3.2.6 *scuff, n*—a disturbance caused by the dragging of a foot on a surface such as is evidenced by the displacement of a lichen on a rock.

3.2.7 *shine, n*—an apparent color change in the reflection of light from surfaces as a result of disturbance to the area. Frequently seen as dew laden grass that has had the moisture knocked from it as a subject walks through it or as flattened grass from foot pressure. This is most easily seen from distances between 5 and 10 m.

3.2.8 *sign, n*—any evidence of external forces acting upon the environment. Emphasis is placed on sign that indicates the passage of the subject(s) being sought. Examples include a sole pattern imbedded in the soil as a sign that a person or shoes have been there.

3.3 Terminology not defined in this guide but referenced in the text can be found in ICS 420,³ *Managing the Search Function*,⁴ and in *Search is an Emergency*.⁵

4. Summary of Guide

4.1 This guide presents the land search manager with a brief synopsis of various land search techniques that have been shown to be effective in locating missing subjects or evidence. Some known strengths and weaknesses are discussed to assist the land search manager in selecting the most appropriate set of techniques for the incident at hand.

4.2 Much of the information in the guide comes from classroom materials available through the National Association for Search and Rescue *Managing the Search Function*⁴ Course and from the Emergency Response Institute’s classroom text *Search is an Emergency*.⁵

5. Significance and Use

5.1 Lost persons are at risk of injury or death from extended periods of isolation, either mental, physical or both. Their inability to solve immediate problems requires that search and rescue (SAR) personnel use the most efficient and effective techniques to resolve the lost person’s situation and to minimize the risks of injury or death.

5.2 Searching for immobile or unresponsive subjects, including those deceased, places further limitations upon the

search options that are available to search managers. Where appropriate, the guide identifies these limitations.

5.3 The use of the listed techniques improves the probability of locating a lost or missing person when applied to land search incidents. These techniques may be employed at the discretion of and under the direction and control of a land search manager.

5.4 Terms used in this guide are not intended to be comprehensive, nor are they presumed to be inclusive of all terminology used in the search function.

6. General Considerations

6.1 Operational factors that are common to any search but not specific to any one phase or element of the operation are listed in Table 1. Each factor should be considered when initiating a search for a lost subject(s). Often these considerations can be summarized to a single form such as is given in the example in Appendix X1.

7. Land Search Techniques

7.1 *Attraction*—Method of searching, in which the searcher attempts to establish contact with the subject by audio or visual means, or both. When the technique is used it is important that the searcher remains stationary for a long enough period of time to be sure the subject will respond if able. This method is used when the subject is believed to be responsive. The subject(s) may or may not be mobile, although mobility improves the usefulness of the technique in many instances.

7.1.1 There are many ways of attracting a subject (see Table 2). Which method to use depends on a great variety of conditions that may exist during the search. Some of the conditions to be considered are local background noise, weather, natural and artificial lighting present, topography, time of day/year, and resources available.

7.1.2 Attraction can be used in conjunction with other search techniques. When searchers are moving it is important to stop at various intervals to look and listen for a response. Observation and listening posts may be established throughout a search area.

TABLE 1 General Considerations for Land Search

Subject Considerations:	number of subjects age physical condition and abilities mental condition and attitude knowledge and training clothing equipment self-rescue likelihood
Terrain Considerations:	difficulty of travel difficulty of access remoteness exposure to object hazards
Weather Considerations:	recent past present future
Time Considerations:	last seen remaining light, if any sign age/longevity
Resource Considerations:	available personnel available equipment knowledge, training and experience available air-evac assets

³ International Fire Service Training Association, *Incident Command System Field Operations Guide, ICS 420* available from the International Fire Service Training Association, Fire Protection Publications, Oklahoma State University, Stillwater, OK 74078.

⁴ *Managing the Search Function*, Third Edition, 1987. Available from the National Association for Search and Rescue, P.O. Box 3709, Fairfax, VA 22038.

⁵ LaValla, Rick and Stoffel, Skip. 1987. *Search is an Emergency*, Emergency Response Institute, 4537 Foxhall Drive, Olympia, Washington 98506.

TABLE 2 Examples of Attraction

Visual	Audio
lights	horns
flares	sirens
fires	voice
beacons	bells
strobes	firearms
smoke	PA systems
balloons	whistles

7.2 Confinement— A search technique that presumes the subject’s ability to leave a search area can be prevented or at least detected. It is most useful when several items of pertinent information are known, thereby enabling the subject’s rate of travel to be estimated. This information includes the point last seen (PLS), the time the person became lost, and the mobility of the subject keeping in mind that weather or darkness may further limit the subject’s mobility.

7.2.1 Confinement is less effective when the search area is not well defined or is extremely large. If search tools such as string lines or other temporary boundaries must be built, it will require much time and manpower, thereby increasing the chances that the subject(s) may leave the search area undetected.

7.2.2 Terrain features may be conducive to the confinement technique if the borders of the search segment are well defined by natural or man-made boundaries.³ Under these circumstances, boundaries tend to direct or restrict the subject’s travel.

7.3 Electronic Search—The use of electronic systems or devices to locate a subject(s) or evidence, or both. Which electronic search techniques can be used depends upon what equipment is available, whether or not the subject or evidence is specially equipped (for example, RECCO[®],⁶ ELT), and whether or not the subject(s) are responsive. Table 3 summarizes the suitability of the various techniques to specific circumstances of a search.

7.3.1 All of these methods, except for infrared illumination and light amplification, which can be used only at night, can be used day or night. Most infrared thermal imaging systems work only at night, but systems that produce color images can be used during the day. All the methods can be used in any weather or terrain, but the acoustic and seismic techniques need a relatively quiet environment to function properly.

7.4 Hasty Search— A planned, rapid, non-thorough search, of high probability areas, by small, fast moving, clue conscious crews. This active method of searching is usually used in the early phases of a land search to search the areas where the subject is most likely to be located, or to find a clue to give direction of travel, or both. Some areas in which a hasty crew may be used include known or suspected routes (for example, trails), the area around the point last seen, areas which might be attractive to the subject (for example, ponds, rivers, meadows, vistas), drainages, and ridge tops.

7.5 Investigation— The act of gathering information, often referred to as intelligence, about the lost person(s). In the

TABLE 3 Electronic Search Techniques

Subject Status/Technique	Examples
Not Specially Equipped, Not Responsive	
infrared thermal imaging	helicopter Forward Looking Infrared (FLIR)
infrared illumination	
light amplification	starlight or sniper scope
acoustic amplification	
magnetometer	
Not Specially Equipped, Responsive	
all of the above	
seismic sensing	
acoustic interrogation	loudspeaker, acoustic amplifier for listening
Specially Equipped, Not Responsive	
radio direction finding	automatically activated Emergency Locator Transmitter (ELT)
avalanche beacon	
transponder interrogation	RECCO [®] personnel locator ⁵
Specially Equipped, Responsive	
all of the above	
radio direction finding	
direct radio/telephone communication	manually activated transmitter

course of investigation, information is gathered regarding two elements of lost persons. The first involves subject behavior and survivability profiles within the boundaries of the search area. The second pertains to the potential whereabouts and plight of missing persons who are potentially outside the search area (staged incident⁵ or “bastard” search⁷). This could be information needed by criminal investigators should the search become criminal in nature.

7.5.1 Intelligence is gathered from interviews with persons other than the subject(s), review of records, and examination of evidence found during the course of the search. Relatives, friends, associates, and persons in the search area are prime candidates for interviews. Record reviews might include use permits, rental agreements, Department of Motor Vehicles, criminal history, and personal records left by the missing subject(s). Evidence examination may include vehicles, campsites and other items found in the search area.

7.5.2 Many agencies have found it desirable to develop standardized missing subject forms similar to the examples given in F 1767. The forms help remind investigators of the types of information to be gathered as well as to document the investigator’s findings. Forms are also a convenient way to communicate and review missing subject information during subsequent operational periods of a search.

NOTE 1—Missing subject forms come in a variety of lengths and complexities. Content and length vary to support the documentation requirements of the responsible agency and to supplement the abilities of the investigator. Many are designed to be specific to an agency’s primary form of response (law enforcement, land search, marine rescue, etc).

7.6 Line Search— Includes many methods of searching, all of which use a number of searchers forming a line of some sort to sweep a selected segment of the search area. These methods

⁶ RECCO is a registered trademark of RECCO Technologies, 2396 Caledonia Ave., North Vancouver, BC Canada V7G 1T9.

⁷ Stenicka, T. J., *Wilderness Search and Rescue*, 1985. Available from Appalachian Mountain Club, Boston, MA.

vary in their manpower and time requirements according to the desired percent of detection. Some line search methods use very tight spacing to find small clues or deceased subjects (for example, an avalanche probe line). Other methods use wide spacing while attempting to make sound contact with a responsive subject. In all cases the probability of detecting the missing subject is inversely related to the spacing between adjacent searchers.^{4,5} The objective of line searching is to achieve the desired percent of detection for the complete segment, thoroughly, without duplication. Often this is done by marking the edge of the searched area with flagging or string, and using this as a guide for the next sweep. In some methods, searchers start and end on a common line, but work independently or in small groups using a compass bearing as a guide.

7.7 Search Dog Crews—The use of search dog crews in land search involves the fielding of a trained canine, trained handler and often at least one other trained searcher who handles navigation and radio communications for the crew. Search dog crews are typically used to identify and develop clues that will lead searchers to the location of a missing subject. Search dog crews, however, are also frequently used to establish the subject's direction of travel and to quickly decrease the probability of area (POA) of one or more search segments.

7.7.1 Search dog crews have one or more capabilities in trailing, tracking and air-scent detection of missing subjects. The appropriateness of utilizing a trailing, tracking or air-scenting dog crew will depend upon the specific circumstances of the search. These circumstances include but are not limited to:

- 7.7.1.1 The availability of a viable, uncontaminated scent article,
- 7.7.1.2 The prior identification of a point-last-seen,
- 7.7.1.3 The length of time the subject has been missing,
- 7.7.1.4 The current and previous days' weather, and
- 7.7.1.5 The population of search and non-search personnel in the search area.

7.7.2 Trailing and tracking dog crews can be utilized most effectively when the first three of the above listed circumstances are known. Trailing and tracking dog crews are especially useful to confirm the presence or absence of a missing subject along a specific route. Air-scenting dog crews, on the other hand, can be utilized without knowledge of the first three circumstances, but the effectiveness of these crews is influenced much more by the last two circumstances listed. Failure on the part of the search manager to control the number of searchers and other extraneous personnel in the search area, or to heed the limitations of weather, especially meteorological factors that affect air movement, will almost always diminish the usefulness of an air-scenting dog crew. All types of dog crews perform more effectively when all of the above circumstances are known.

7.8 Segmentation—A search strategy that involves dividing the area to be searched into smaller more manageable units called segments. Segments are constructed to assist search crews in achieving strategic objectives in a defined amount of time (usually a single operational period⁴). They may or may not be equal in size. Properly constructed segments will

improve the coverage of the area being searched and will enhance a search manager's ability to set tactical priorities. Segmentation is also used as a basis for applying statistical probability theory to the prioritization of search resources and the estimation of and tracking of search success.

7.8.1 When distinct terrain features, and natural and man-made barriers exist (ridge lines, canyon bottoms, streams, fences, roads, etc.), segments may be created to limit search crews within these boundaries or to focus search coverage to these features. In the absence of such features, segments may be constructed to equally divide the area to be searched. Binary segmentation is often used in these situations to systematically reduce the search area (or segment) into smaller parts. The reduction is usually achieved by cutting for sign sequentially through the center of a search area and then eliminating from the search that portion of the area where no sign was found.

7.8.2 Segmentation is most often applied during preliminary steps to define and help record actions taken in the search area. The success of this strategy improves when the subject profile and knowledge of the terrain can be utilized to delineate the segments, and segment size can be limited to areas searched during a single operational period.

7.9 Tracking—The process of following a subject(s) over varying types of terrain based upon physical evidence of the subject's passage. This evidence may include footprints, bruised or broken vegetation, or far more subtle signs such as scuffs, flattening, color changes or shine. Highly skilled trackers can even suggest information about the subject's physical condition by studying their tracks and gait. For instance, long, even strides are often considered evidence of a subject in good physical condition while a deteriorating or otherwise uneven gait, foot dragging, aimless drifting from the trail, or frequent falls are often considered as an indication of a subject in poorer physical condition.

7.9.1 In concert with other search techniques, tracking can aid in verifying information and evidence provided by other land search techniques (for example, search dogs, eyewitness interviews, victim profiling). It can reduce the search area by establishing a known direction of travel of the missing subject(s). Finally, because it is basically a step-by-step technique, it can be especially helpful in locating hidden or otherwise unresponsive subjects.

7.9.2 Except for scent, footprints are usually the most numerous clues in a search area.⁵ However, one of the most difficult parts of tracking is the proper identification of the subject's footprints. Very often, the subject's tracks are in areas where numerous other persons have walked, both before and after the subject's passage. In some areas (for example, the desert), track identification can be further complicated by the almost fresh appearance of tracks that are many days old. Accurate communication of a tracker's identifications must also be maintained to prevent search crews from following persons other than the subject. For these reasons trackers and search managers often use some type of standardized form, such as the examples given in Guide F 1767.

8. Keywords

8.1 investigation; lost persons; lost subjects; missing persons; search



APPENDIXES

(Nonmandatory Information)

X1. RELATIVE SEARCH URGENCY RATING FORM⁸

X1.1 On the following chart, the lower the numerical rating of the factor, the higher the relative urgency becomes. The chart is intended as a guide. It is a tool for the manager to use in evaluating individual incidents. All figures are relative and the total derived from the chart only indicates a possible relative urgency. All factors bearing on the incident must also be evaluated by the Incident Commander (search manager) in the process of finally establishing urgency.

Factor	Rating
Subject Profile	
<i>Age</i>	
Very Young	1
Very Old	1
Other	2-3
<i>Medical Condition</i>	

Known/suspected injured, ill or mental problem	1-2
Healthy	3
Known Fatality	2
<i>Number of Subjects</i>	
One alone	1
More than one (unless separation suspected)	2-3
Subject Experience Profile	
Not experienced, does not know area	1
Not experienced, knows area	1-2
Experienced, not familiar with area	2
Experienced, knows area	3
Weather Profile	
Past or existing hazardous weather, or both	1
Predicted hazardous weather (8 h or less)	1-2
Predicted hazardous weather (more than 8 h)	2
No hazardous weather predicted	3
Equipment Profile	
Inadequate for environment and weather	1
Questionable for environment and weather	1-2
Adequate for environment and weather	3
Terrain/Hazards Profile	
Known hazardous terrain or other hazards	1
Few or no hazards	2-3

⁸ Derived from Figure 13.2 of *Managing the Search Function*, Third Edition, 1987. Available from the National Association for Search and Rescue, P.O. Box 3709, Fairfax, VA, 22038.

X2. MISSING SUBJECT FORM

X2.1 See Fig. X2.1 for example of a missing subject form.



LOS ANGELES COUNTY SHERIFF'S DEPARTMENT
SEARCH AND RESCUE CIRCUMSTANCE

DATE AND TIME OF CALL _____ FILE NO. _____

VICTIM _____ NICKNAME(S) _____
(MAKE OUT SEPARATE SHEET FOR EACH VICTIM)

ADDRESS _____ CITY _____ PHONE _____

SEX _____ RACE _____ AGE _____ HEIGHT _____ WEIGHT _____ BUILD _____ HAIR _____ EYES _____

MARKS/SCARS _____ AVAIL () SHOES _____
CLOTHING WORN _____ TYPE _____ COLOR _____ SIZE _____ DIMENSION _____ SOLE _____ AGE _____

MONEY CARRIED \$ _____

PERSONALITY	ATTITUDE WHEN	PHYSICAL COND	SMOKER	FAMILIARITY	ABILITY IN MTS
CALM ()	LAST SEEN	VERY GOOD ()	YES ()	NO ()	WITH AREA
NERVOUS ()	WORRIED ()	GOOD ()	NO ()	WITH AREA	NONE ()
CAUTIOUS ()	ANGRY ()	SICK ()	TYPE	FLYER ()	NONE ()
CARELESS ()	FRIGHTENED ()	TIED ()	COPR ()	SLIGHT ()	AWA'ELR ()
	HAPPY ()	WEAK ()	PLAIN ()	GOOD ()	GOOD ()
		MEDICINE	BRAND		EXPERT ()

ITEMS CARRIED:
FOOD & CANDY _____

EQUIPMENT _____

NUMBER	NO.	PERSONS
IN PARTY	LOST	W/VICTIM

LAST SEEN (PLACE/DATE) _____ TIME _____ AM _____ PM _____

LOCATION	AREA	DESTINATION
LOST ()	TRAIL ()	
FALL ()	STREAM ()	ROUTE OF TRAVEL
STRANDED ()	RIDGE ()	FROM _____
INJURED ()	CANYON ()	TO _____
SICK ()		TO _____
DEAD ()		ARR _____

WAS THERE A CHANGE OF PLANS _____ WHAT _____

AREA/PLACES VICTIM FAMILIAR WITH _____

KNOWN FRIENDS _____

INFORMANT _____ WAS INFORMANT MEMBER OF PARTY _____

ADDRESS _____ CITY _____ PHONE _____

NEXT OF KIN _____ RELATIONSHIP _____

ADDRESS _____ CITY _____ PHONE _____

NOTE: IF VICTIM IS LOST, SECURE ARTICLE OF CLOTHING FOR TRACKING DOG. CLOTHING MUST HAVE BEEN WORN NEXT TO BODY AND MUST NOT HAVE BEEN LAUNDERED. DO NOT HANDLE, PICK UP WITH FORK OR STICK AND PLACE IN CLEAN PAPER BAG. USE REVERSE SIDE OF FORM FOR REMARKS.

DEPUTY _____ BADGE _____

MOUNTAINEER _____

SAR NUMBER _____ DESK _____ STATION _____

FIG. X2.1 Missing Subject Form

X3. STANDARDIZED FORM

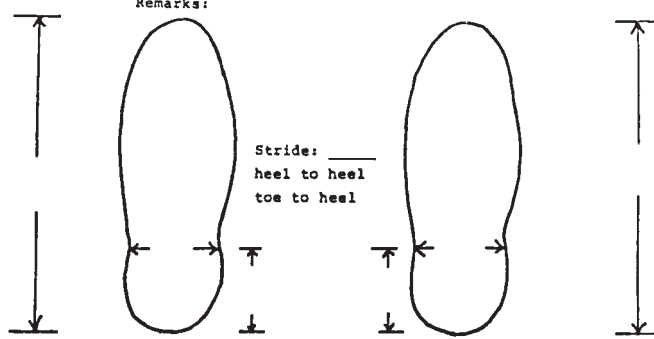
X3.1 See Fig. X3.1 for example of standardized form describing footprints. Trackers and search managers use to assist one another in

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TRACKING WORKSHEET

Location: _____

Remarks: _____

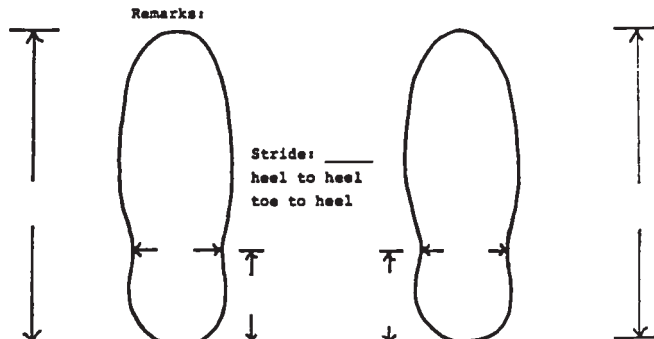


Stride: _____
heel to heel
toe to heel

Assigned ident. _____

Location: _____

Remarks: _____



Stride: _____
heel to heel
toe to heel

Assigned ident. _____

FIG. X3.1 Standardized Form

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