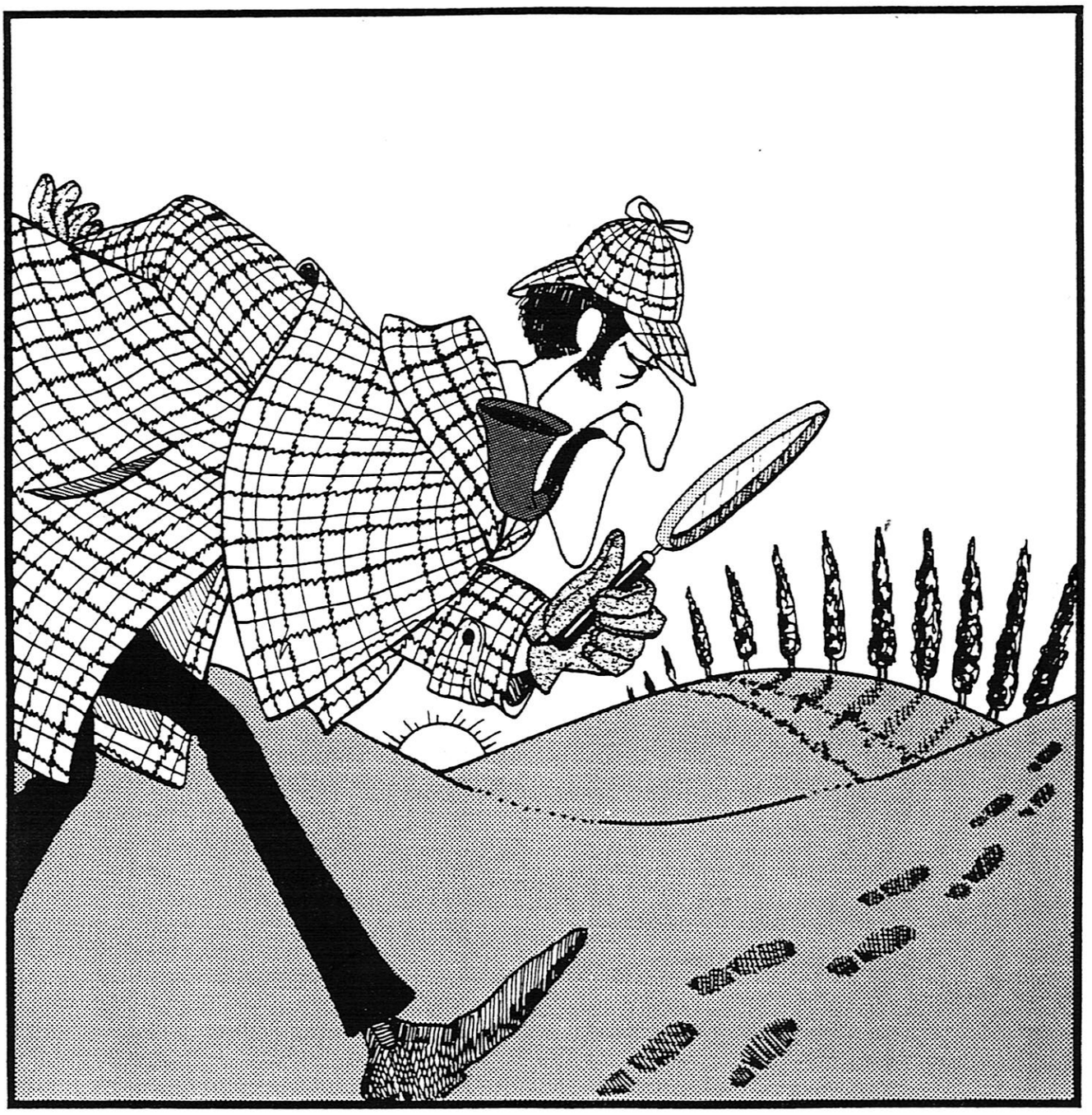
DF Techniques For Ground Crews



STUDENT WORKBOOK

Name _____

Collecting The Evidence

ELT System consists of two parts: transmitter (ELT or EPIRB) and receiver (SARSAT or L-Per).

We don't know whether ELT is distress or accidental until we find it. We must be detectives to quickly conclude mission.

Detective collects evidence, sees certain patterns encountered before to develop suspects. May even use "gut feelings."

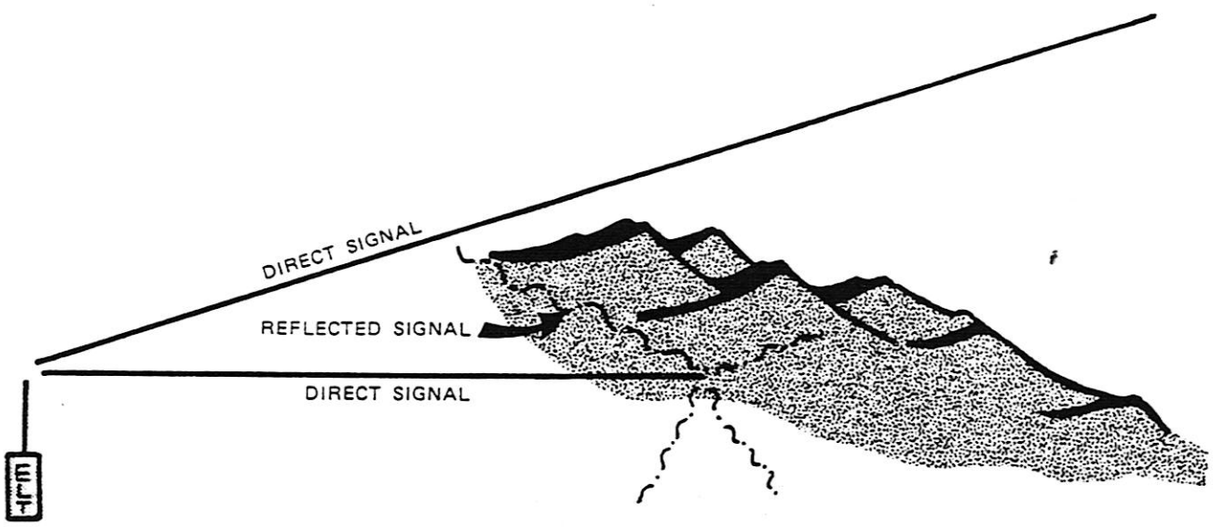
DF teams must develop leads, too. We need to know how ELT and DF work and use our knowledge and experience to gather leads.

NOTES

ELT Signal Propagation

Three characteristics of the ELT signal we MUST understand to locate the transmitter:

1. Unimpeded, radio signals travel in a straight line.
2. Signals get stronger near the source. Also, the RATE of change in signal strength will be faster as you get closer. (Rate of change is a more reliable indication of how close you are than absolute signal strength.)
3. Conductive objects reflect and/or block the signal. They are called "reflectors" because they cause the ELT's signal to bounce off, much like a mirror reflects images.



NOTES

Reflectors

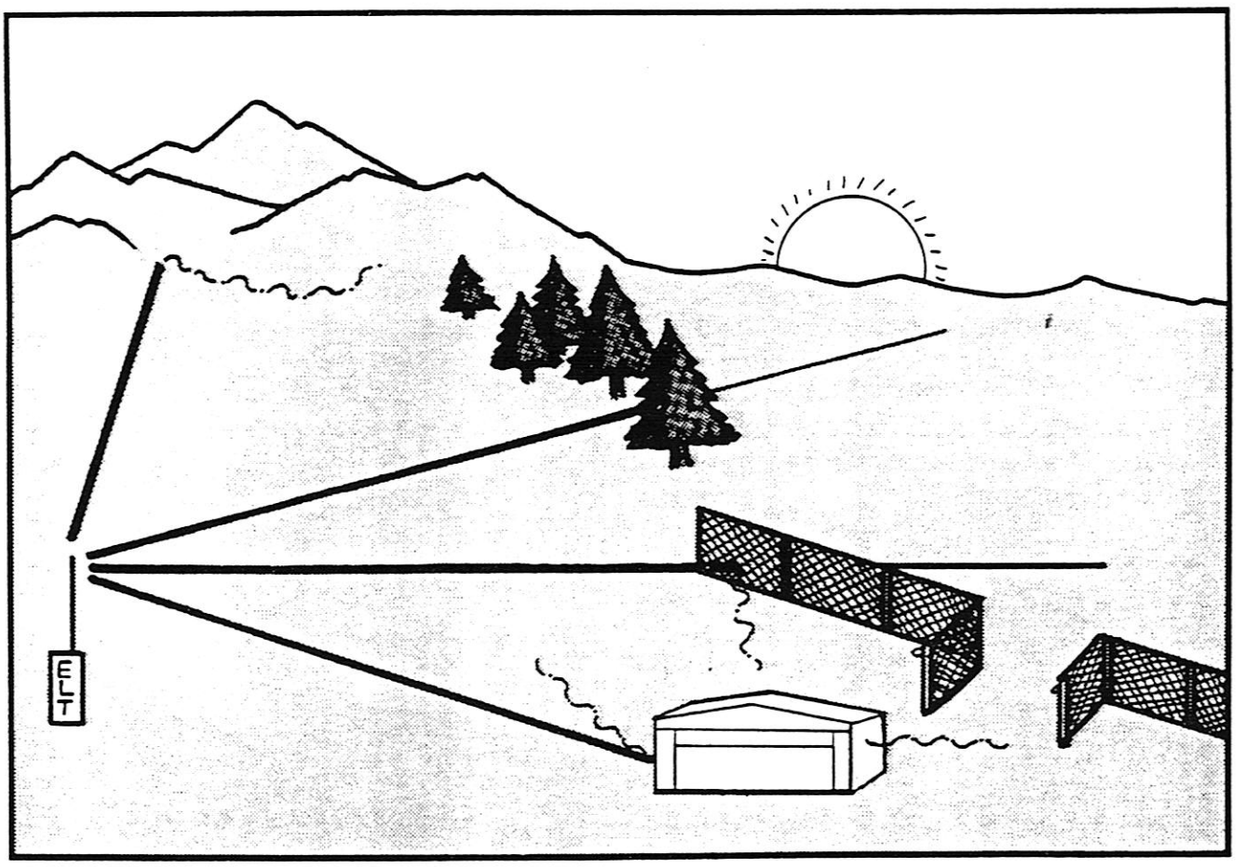
The third principle (conductive objects reflect and/or block the signal, cause almost all problems in ELT location.

Solid conductive objects (metal buildings, mountains) both reflect and block the signal.

Non-solid objects like metal fences reflect some of the signal, allow most of it to pass through.

Non-conductive objects allow signal to pass through, but absorb some of its energy.

The L-Per's response depends on the reflector's location: near the transmitter, near the receiver, or between the ELT and the L-Per.



NOTES

Reflectors Near The Transmitter

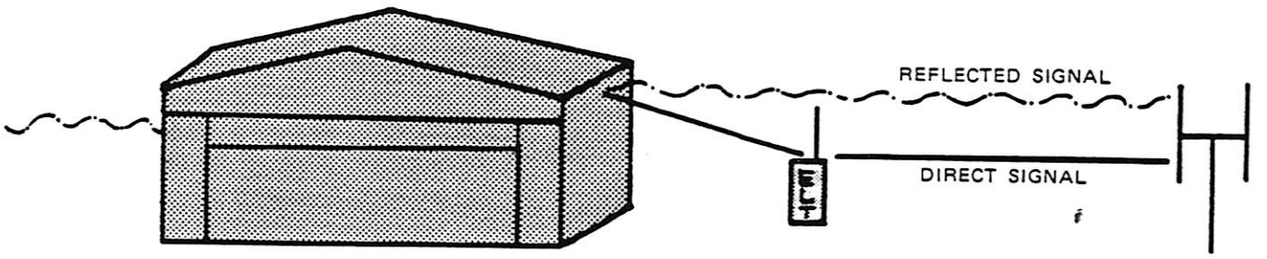
Reflector near the transmitter can affect your ability to hear the signal.

Usually causes no problem in tracking once the direct signal is heard.

ELT next to metal hangar will have most of the signal reflected.

Signal will be difficult to hear from behind hangar (signal blocked).

When L-Per can hear the ELT's direct signal, it will track it.



NOTES

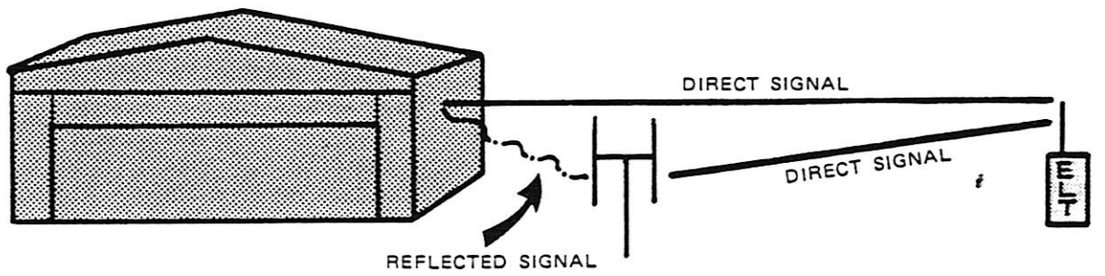
Reflectors Near The Receiver

Reflector near the receiver can cause severe problems for the L-Per, but when recognized, they can usually be avoided.

Reflector within 200 feet of L-Per will cause it to see both direct and reflected signal, each from a different direction.

Direct signal from ELT will be stronger than reflection; L-Per will prefer the direct one.

Reflections always lose power. They will be weaker than the direct signal IF NOTHING IS BLOCKING the direct signal.



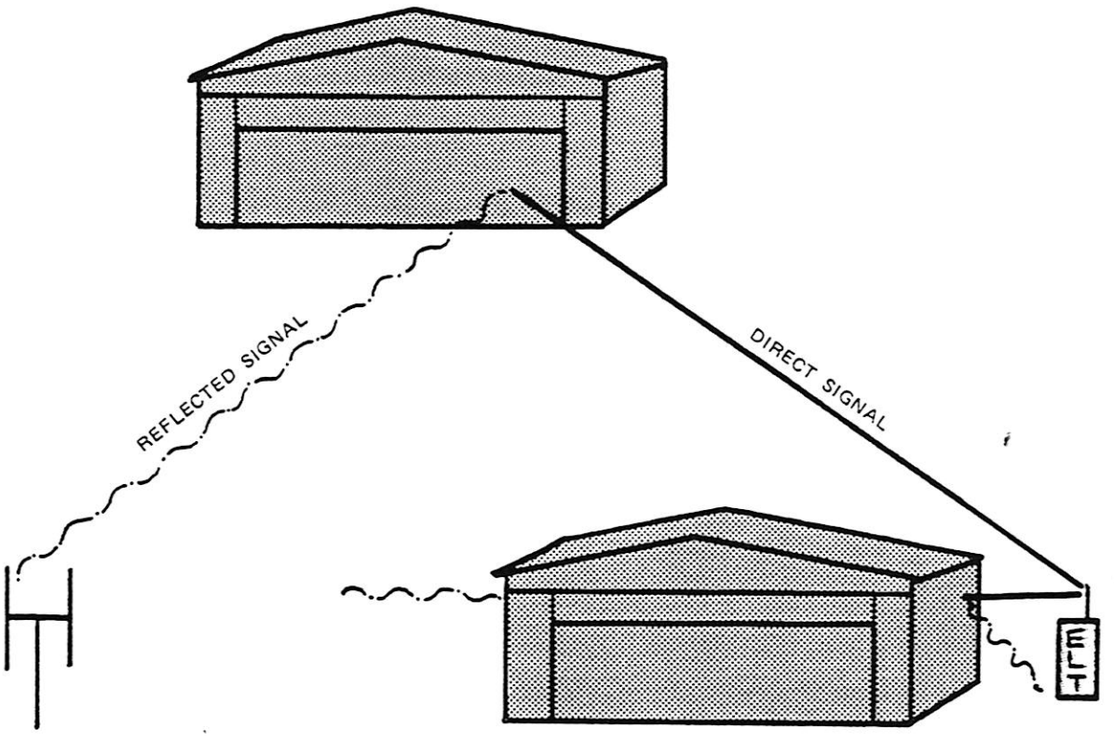
NOTES

Blocked Signal, Single Reflector

When ELT blocked from L-Per, DF will "see" reflections, which vary in strength and direction (choppy lake effect).

If L-Per has reflected signal from one direction, it will track it until it hears the direct signal.

Once L-Per hears the direct signal, it will track it.



NOTES

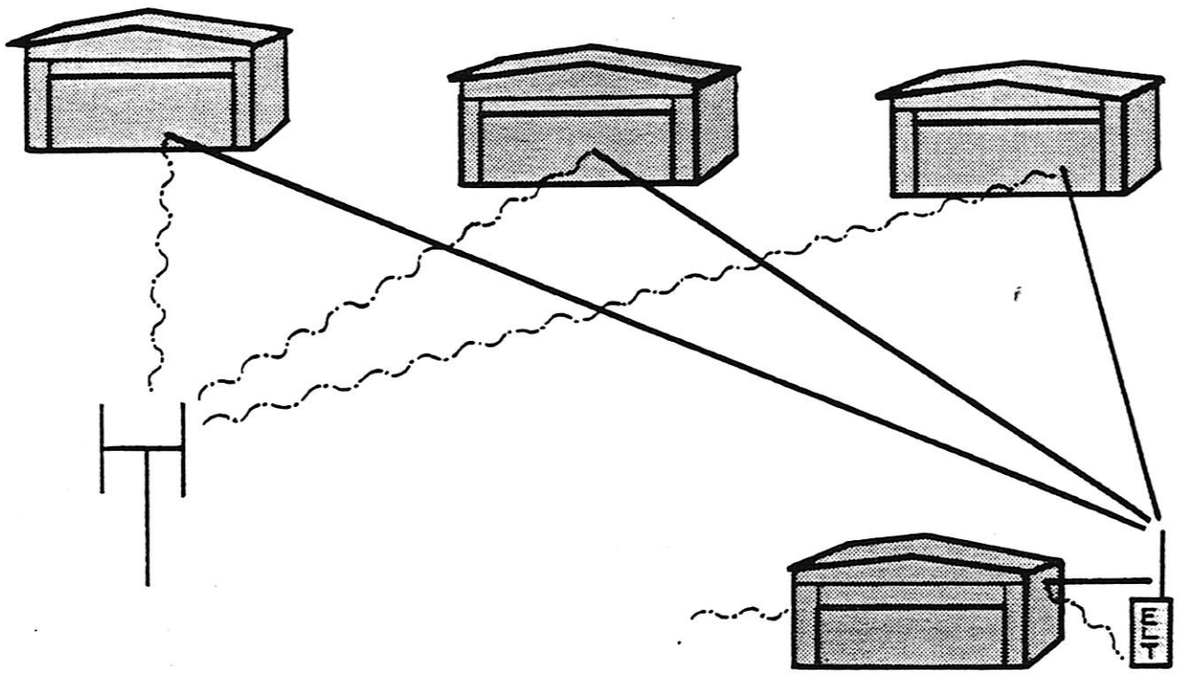
Blocked Signal, Multiple Reflectors

Multiple reflections from same general direction when direct signal blocked act much like single reflector.

L-Per tracks reflections until it hears stronger, direct signal.

You may notice apparent direction swings left and right, but walk in a direction representing the average.

Illustration shows only one reflection from each building for clarity. There will really be many reflections from each building, but the results and effects will be as shown.



NOTES

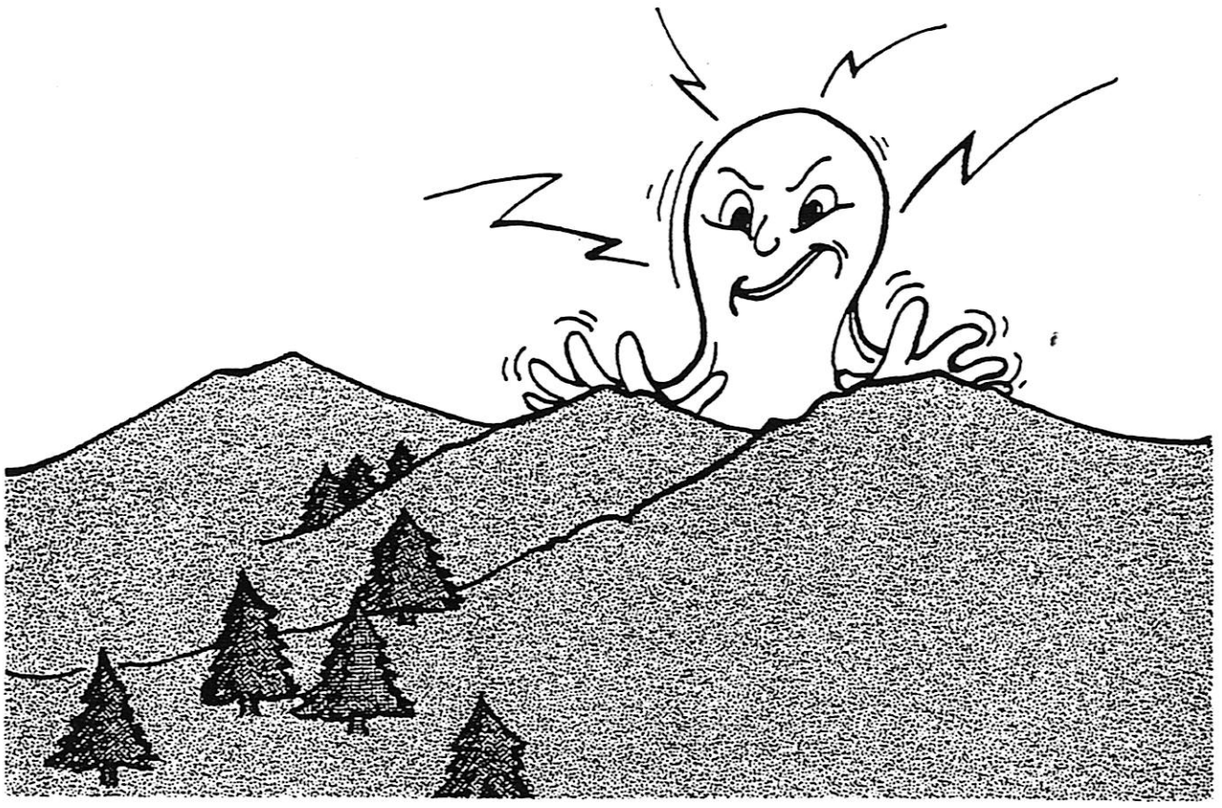
"Ghost" Signals

L-Per can DF signal too weak to hear. It will also DF on 121.5 MHz carrier signals and random noise.

If L-Per gives bearing with no audible signal, switch from 121.5 to 121.6. True signal will cause meter to change; random noise will be the same on both frequencies.

Track inaudible signals the same as audible one. Propagation characteristics are the same. Some "carrier only" signals are very high-powered; watch Sensitivity to avoid overloading.

Only difficulty is not being able to hear signal, causing teams to mistrust or not understand L-Per.



NOTES

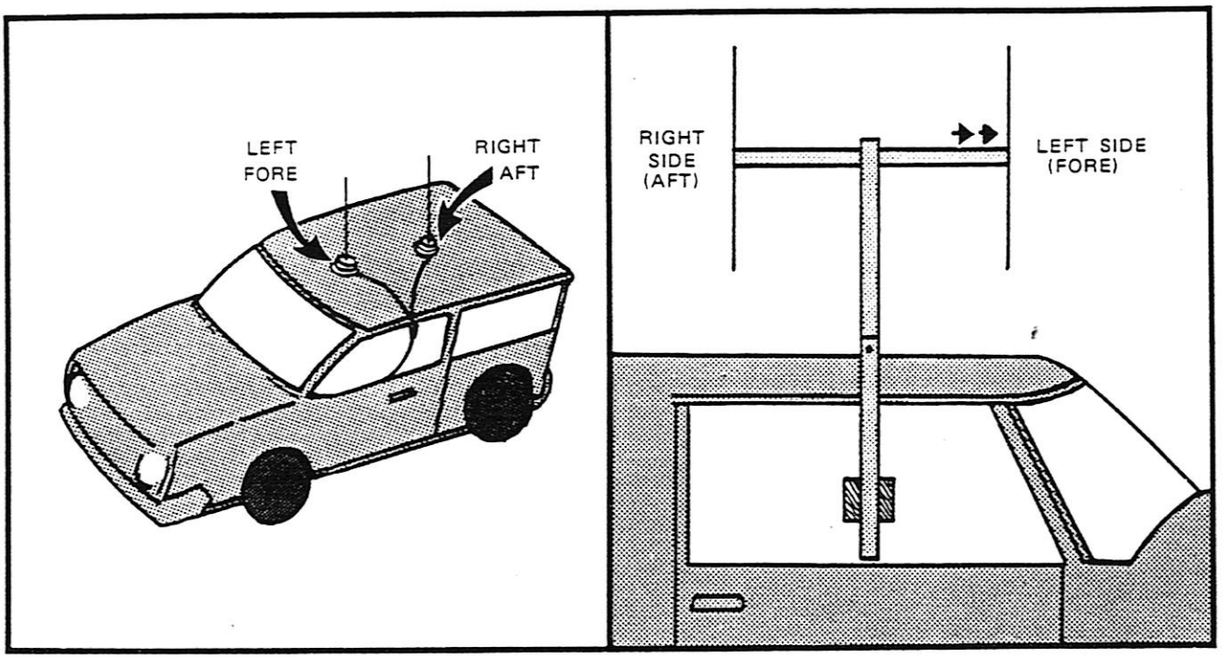
Monitoring In Motion

If you don't listen to ELT while driving, you might pass right by ELT.

Monitor for signal strength with aircraft band whip on car.

DF while moving with magnetic or fixed antennas on car or hand-held antenna out window. Put roof-top antennas so one marked "left" is forward and "right" one to back.

As long as car is moving, meter readings will be to left of center when ELT is forward, go left and right when passing by, and go to right of center when it's behind you. After you pass, turn left or right to determine direction toward ELT.



NOTES

Closing In On The Target

- *Drive while monitoring 121.5*
- *Keep notes*
- *Reduce sensitivity as necessary*
- *Trust high site bearings*
- *When using fore-aft DF, drive in direction that keeps needle to left of center (toward ELT)*
- *Watch for clues!*

NOTES

Airport Search

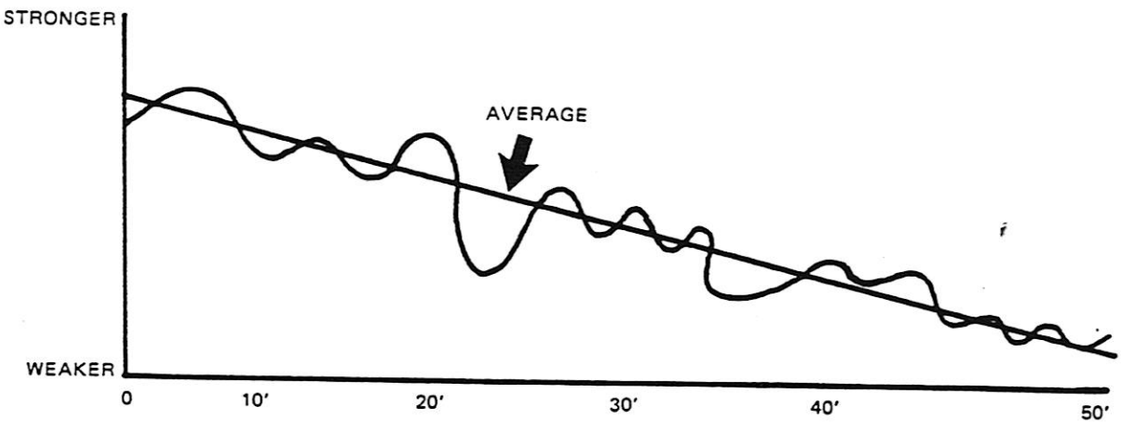
- *Needle will flicker left and right when passing ELT*
- *Note area and access*
- *Keep driving until needle goes right (passed ELT)*
- *Drive perimeter to get likely location*
- *Don't forget—may be crash near airport!*
- *When on foot, take bearings away from obstructions*
- *Center meter and make reliability turn*
- *If bearing points to building, walk around it and watch meter. DF will point to it from all sides*
- *Enter hangar and look and ask around*

NOTES

DF mode often not practical because of reflections.

Switch to Receive mode, Sensitivity minimum. Put DF antenna within a few inches of ELT antenna on each plane. You'll hear signal when at the right plane. Confirm by selecting 121.6, advance Sensitivity until ELT audible. Signal will disappear when you move DF antenna a few feet away.

If you can't locate ELT, fold right hand elements and use Receive mode in "build and fade" method. Walk in direction that makes ELT stronger. Set Sensitivity for half-scale meter; reduce when needle nears right-hand edge. When you're close, Sensitivity will be at or near minimum. Ignore small strength variations 5 to 10 feet apart; trends will show in 50 to 200 feet.



VARIATIONS IN SIGNAL STRENGTH WITH DISTANCE

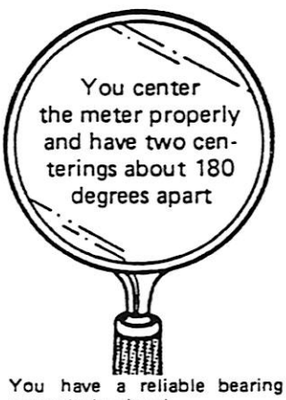
Notice small variations in strength and gradual overall increase in signal strength.

NOTES

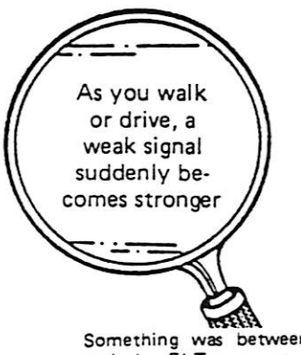
Clues And Assumptions

The L-Per's reaction under certain conditions can give us clues we can use to help solve the mystery of where the ELT is located. Here are some examples. The clues are inside the magnifying glass; the assumptions below.

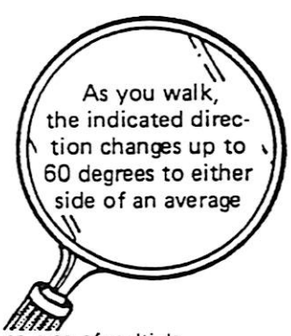
You are getting closer to the ELT.



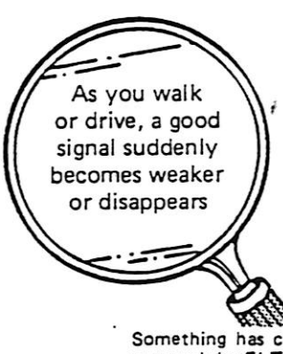
You have a reliable bearing to track the signal.



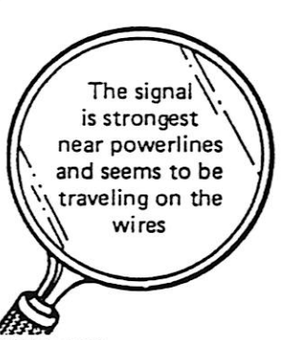
Something was between you and the ELT; you now hear the direct signal.



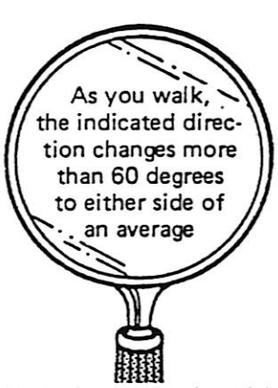
You're in an area of multiple reflections from the same general direction. Use average of indicated directions.



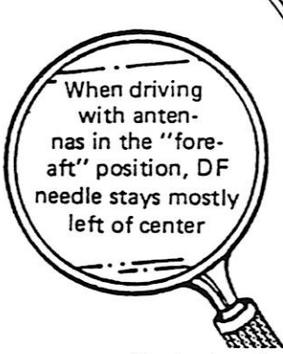
Something has come between you and the ELT.



The direct signal is blocked from ground level; powerlines above blockage and reflecting signal.



You're in an area of multiple reflections from different directions. Averages won't work. Move.



You're traveling toward the ELT.

Clues And Assumptions

You circle a building or plane; L-Per points to it from all sides

The ELT is inside.

You're tracking a signal when it becomes stronger and the indicated direction changes

You've been tracking a reflection; you can now hear and track the direct signal.

The L-Per is completely confused. Multiple centerings when you make a 360 degree turn

You are in an area of multiple reflections from many directions.

L-Per is DFing an inaudible signal on 121.5, but the meter reading is the same on 121.6

The L-Per is tracking random noise.

You have peaks of nearly equal strength around doors, light switches, parts of an airplane

You're not close to ELT. When you're close, you'll get one predominate peak.

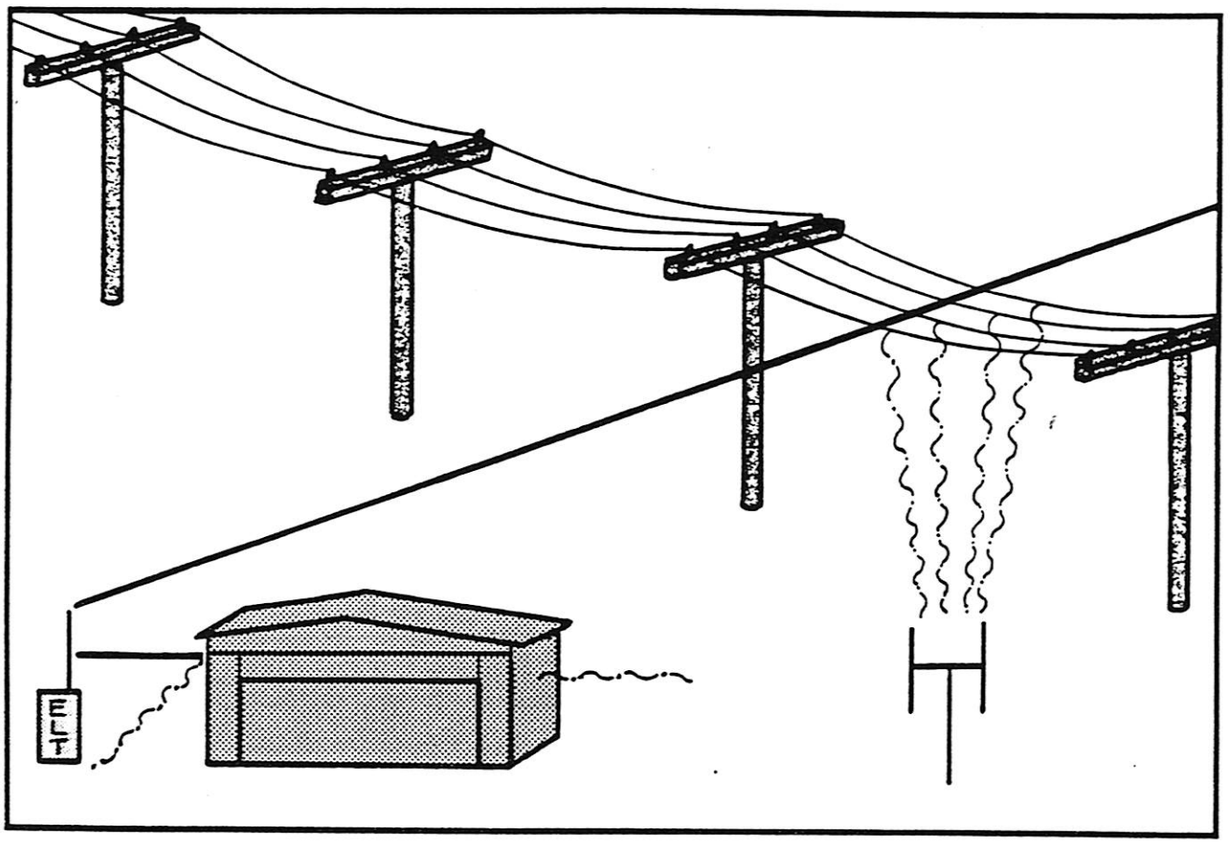
NOTES

Blocked Signal, Overhead Reflectors

Overhead objects can be confusing I F the direct signal is blocked.

They reflect some of the signal back to the L-Per. Since L-Per can't hear the direct signal, it will point to the reflections.

Get above blocking objects to hear direct signal.



NOTES

Resolving Multiple Reflections

If bearings on airport point to area of reflections, like hangars, expect L-Per to have difficulty averaging directional information among them.

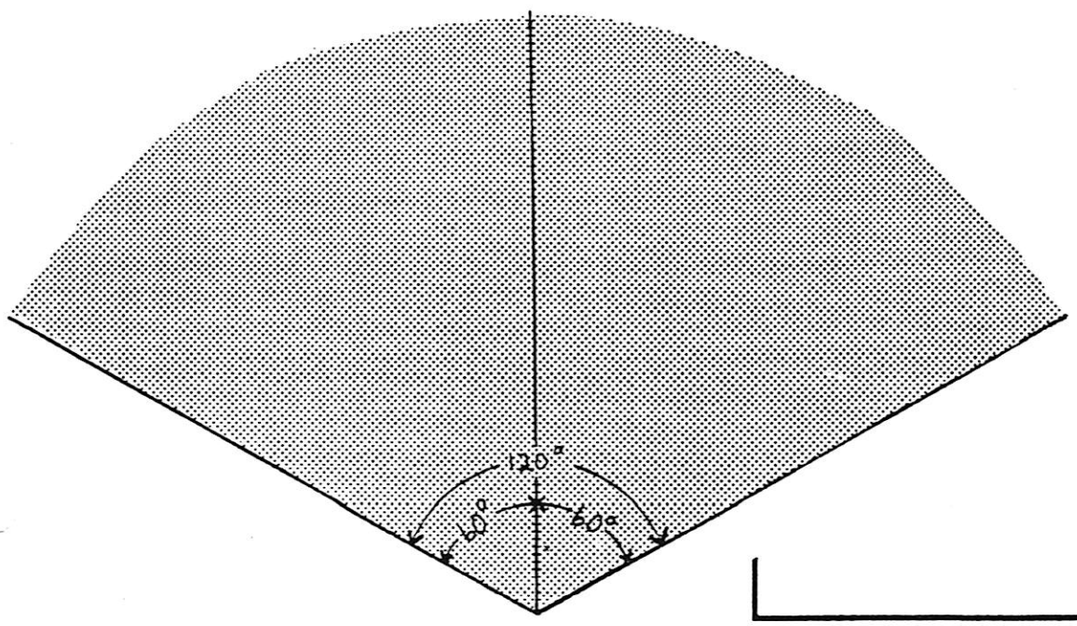
To evaluate severity of reflections, make 360-degree turn and watch meter. Multiple meter centerings show reflections.

Next, walk 15-20 feet and keep meter centered by swinging antenna. If swings are in an arc of more than 120 degrees, DF is unusable because of reflections from many directions.

If swings are less than 120 degrees, walk in direction that is average of headings.

When reflections are NOT a problem, it's OK to walk in direction that keeps swings equal in number left and right while holding the antenna steady, as demonstrated in last lesson.

NOTES

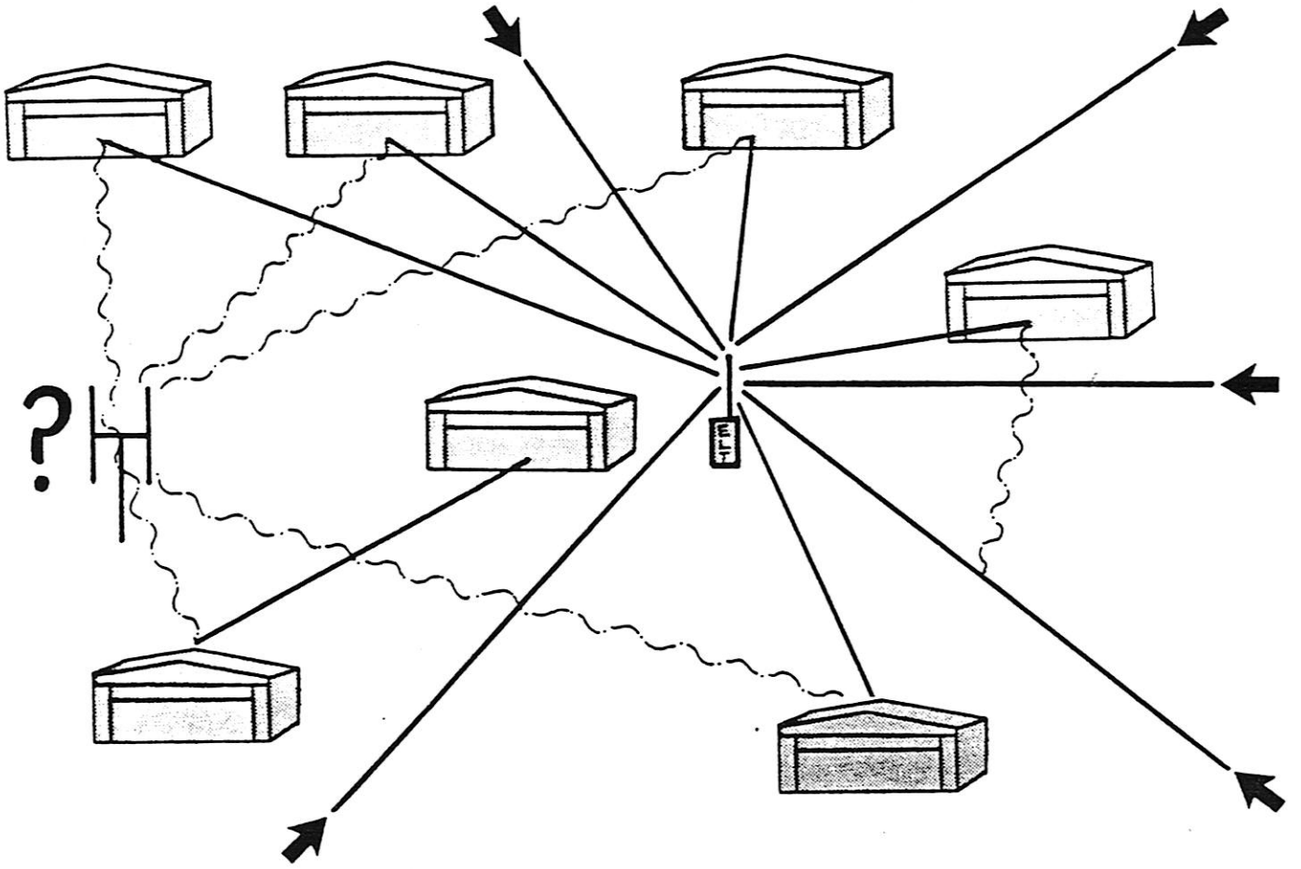


Resolving Multiple Reflections

Reflections from many or all sides of L-Per will cause L-Per to be confused.

If you're in such an area, move 200 feet or so away and walk completely around reflectors. L-Per will give good DF information from all sides. You can often isolate a single suspect building or area using this method.

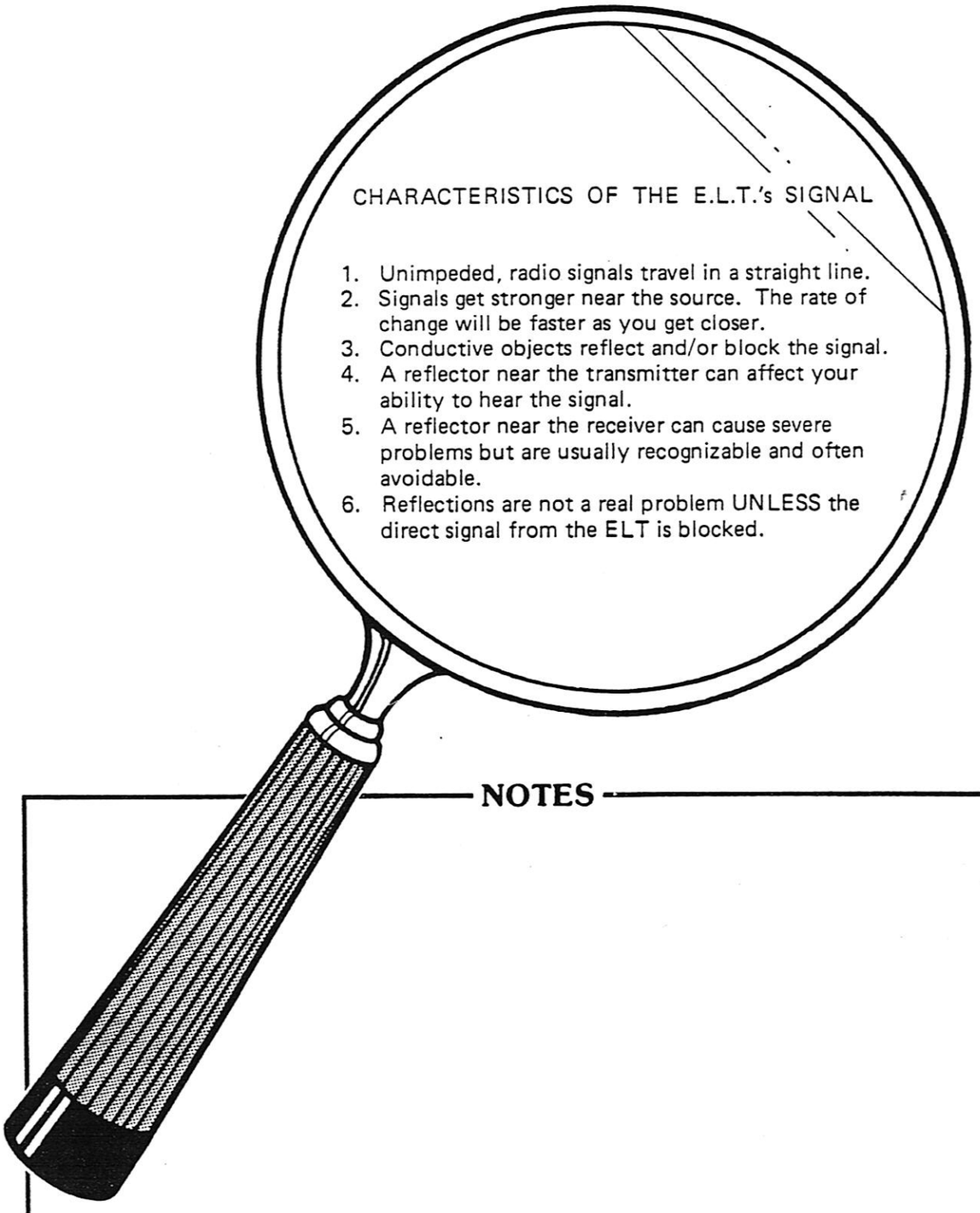
When you're in among reflections, DF mode may not work. Use "build and fade" method.



NOTES

Summary

Remember these principles to solve most ELT location problems.



NOTES

"Preponderance of The Evidence"

Police detective gathers lots of evidence and sorts it as to type and quality to develop suspect.

When at least 50% of good quality evidence points to certain suspect, theory of a "preponderance of the evidence" would suggest detective investigate him further.

You can do same thing in ELT location. Don't base whole mission on one bearing. Evaluate and weigh the type and quality of information L-Per gives.

When at least 50% of your most reliable evidence indicates a certain direction, act on it. Keep open mind to changing conditions.

In chart below, Super Sleuth questioned Suspect A. From the other chart, which direction would a preponderance of the evidence suggest you go?

SUSPECT A – motive
- access to property
- matches eye-witness description
- car license only one letter different than suspect vehicle
- prior arrests for same crime

SUSPECT B – opportunity
- seen in area
- has similar car to suspect vehicle
- informant saw "B" with large amount of cash

SUSPECT C – no alibi
- prior arrests for similar crime
- approximately right age of suspect

TOWARD MOUNTAINS –
- weather bad
- plane reported 2 hours overdue
- airliner at 32,000' over area heard ELT

TOWARD CITY –
- near SARSAT coordinates
- bearing from Site 2 in general direction of city, but quality poor (more than 2 meter centerings)

TOWARD AIRPORT –
- near SARSAT coordinates
- bearing from Site 1 shows airport; quality good (2 meter centerings with reliability turn)
- bearing from Site 3 toward airport; quality good
- team at Site 1 went below ridgeline, blocking view from airport; ELT nearly disappeared

NOTES

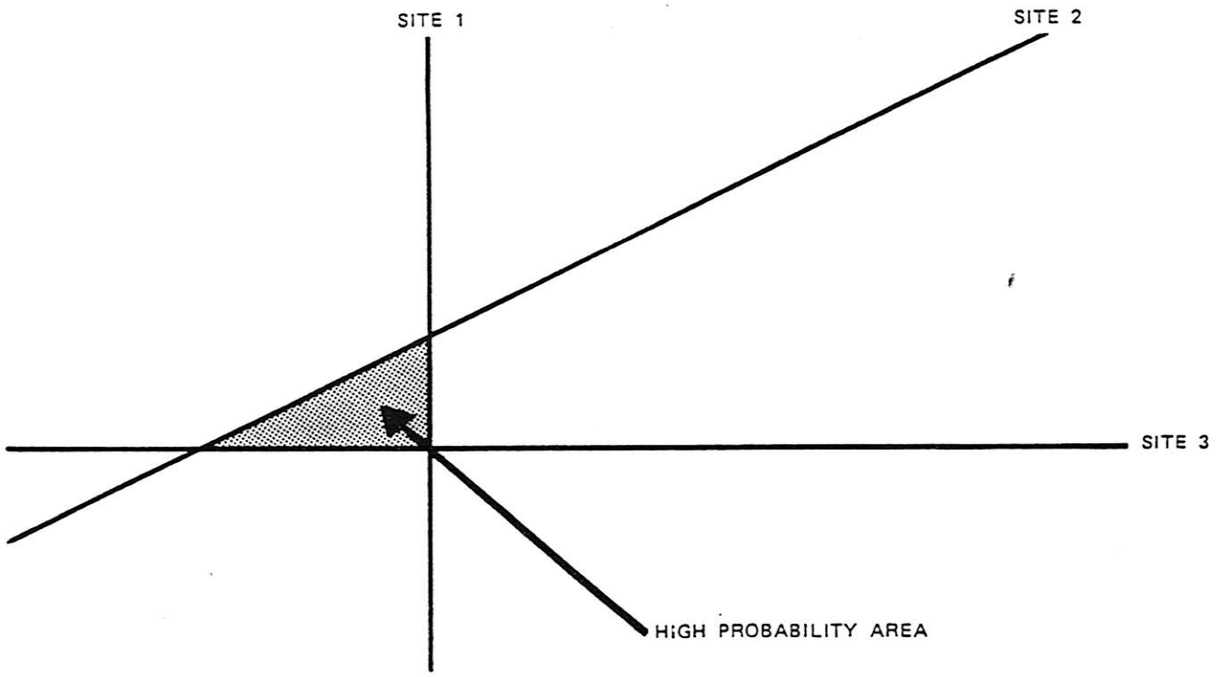
High Site Bearings

Select high sites in advance where ELT likely to be heard and good DF possible: easy to reach, high as practical, at least 50 feet clear of ground objects.

Proceed to high site first. Set L-Per to "operating position." Select 121.5, DF mode, Sensitivity maximum, volume about mid-scale.

Make reliability turn for two meter centerings 180 degrees apart. Walk in indicated direction 15 to 20 feet and keep meter centered by moving antenna. If swings less than 60 degrees to either side, bearing OK. Take a bearing on line representing center of left and right fluctuations.

Bearings from three or more sites won't converge exactly, but will bracket an area of highest probability.



NOTES