O-2005

OPERATE THE AIRCRAFT DIRECTION FINDER

CONDITIONS

You are a Mission Observer trainee and must operate the aircraft Direction Finder.

OBJECTIVES

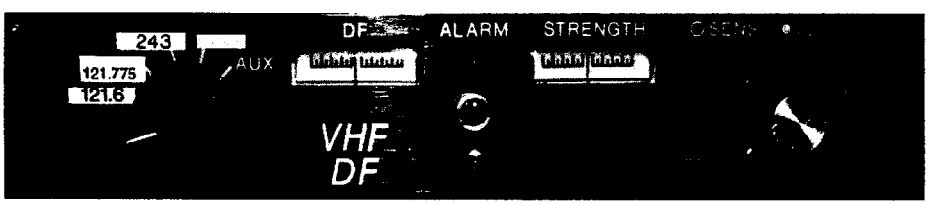
Operate the aircraft Direction Finder (DF) in both the Alarm and DF modes, and discuss how the DF should respond during a typical mission.

TRAINING AND EVALUATION

Training Outline

1. As a Mission Observer trainee, knowing how the aircraft DF works and how to operate it is essential.

2. L-Tronics DF. The L-Tronics LA series Aircraft Direction Finder, the most common DR unit found in CAP aircraft, consists of VHF and UHF receivers, two- or three-element yagi antennas (normally mounted on the bottom of the aircraft) and circuitry. The controls consist of a frequency selector switch, an alarm toggle switch (works like a light switch), and a dual-knob control switch for volume (inner knob) and sensitivity (outer knob). There are two indications: a DF meter and a signal Strength meter. [Note: Some have only the DF meter, but the operation is the same.]



The DF unit is normally connected to the aircraft audio system. This connection allows an audible as well as a visual alarm when an ELT signal is detected in ALARM mode.

The Alarm mode is the normal mode for routine conditions. It enables the pilot to monitor the emergency frequency (121.5 MHz) without dedicating a communications radio to the task. DO NOT USE THIS MODE DURING A DF SEARCH because the DF function is disabled in the Alarm mode.

a. Normal setup. To select the Alarm mode, place the Alarm toggle switch on (up). Set the SENSitivity so that the needle just comes on-scale and the VOLume to a comfortable level (the ear will detect a weak signal far sooner than the alarm). [Note: The Alarm mode is designed to work with weak signals; if an ELT is transmitting nearby and the unit is set to full sensitivity, the receiver may overload.]

b. DF setup. If an ELT activates the Alarm, turn the Alarm toggle switch off (down) and verify or select 121.5 on the frequency switch. This activates the DF function and allows you to track the signal. Set the SENSitivity to maximum and the VOLume to a comfortable level. **The Alarm mode must not be used during a DF search because the DF function is not operable in the Alarm mode (toggle switch up).**

c. Searching for an ELT signal. The pilot should climb to an altitude of *at least* 3000 to 4000 feet AGL, if possible, and fly to the area of the reported ELT signal (but remember, an ELT search begins the minute you take off). If the ELT cannot be heard in the expected area, climb to a higher altitude. If this fails to acquire the signal, start a methodical search (e.g., area or expanding square). Unless the beacon is known to be a 406 MHz

O-2006

PERFORM ELT SEARCHES

CONDITIONS

You are a Mission Pilot trainee and must perform ELT searches.

OBJECTIVES

Locate an Emergency Locator Transmitter (practice beacon) using the homing and wing null ELT search methods. Discuss the aural and metered search methods, and reflection and interference.

TRAINING AND EVALUATION

Training Outline

1. As a Mission Pilot trainee, knowing how to plan for and locate an Emergency Locator Transmitter (ELT) is essential. There are several methods that can be used, the most common of which are the homing and wing null methods. You should also be familiar the aural and metered search method, and how reflections and signal interference can affect the search.

2. *Homing* is an electronic search method that uses the Direction Finder (DF) to track the ELT signal to its source. Tune the direction finder (DF) to the ELT operating frequency; the pilot will fly the aircraft to the transmitter. ELT's may transmit on either 121.5 MHz VHF, 243.0 MHz UHF, or both frequencies simultaneously. These emergency frequencies are *usually* the ones monitored during a search, but homing procedures can be used on any radio frequency to which *both* a transmitter and DF receiver can be tuned.

a. L-Tronics DF Unit. First you have to determine the direction to the ELT. When you fly directly toward a signal, the left/right DF needle remains centered. However, when you head directly *away* from the signal, the needle also centers. A simple, quick maneuver is used to determine if you are going toward or away from the signal. Starting with the left/right needle centered, the pilot turns the aircraft in either direction so that the needle moves away from center. If he turns left, and the needle deflects to the right, the ELT is in front. If the pilot turns back to the right to center the needle, and then maintains the needle in the center, you will eventually fly to the ELT. If, in the verification turn, the pilot turns left and the needle swings to the extreme left, then the ELT is behind you. Continue the left turn until the needle returns to the center. You are now heading toward the ELT, and as long as the pilot maintains the needle in the center, you will fly to the ELT.

Flying toward the ELT, maintaining the needle in the center of the indicator *is* the actual homing process. If the needle starts to drift left of center, steer slightly left to bring the needle back to the center. If it starts to drift right, turn slightly back to the right. Once you have completed the direction-verification turn, you will not need large steering corrections to keep the needle in the center.

When passing over the ELT or transmission source, the left/right needle will indicate a *strong* crossover pattern. The needle will make a distinct left-to-right or right-to-left movement and then return to the center. This crossover movement is *not* a mere fluctuation; the needle swings fully, from one side of the indicator to the other and then returns to the center.

During homing you may encounter situations where the needle *suddenly* drifts to one side then returns to center. If the heading has been steady, and the needle previously centered, such a fluctuation may have been caused by a signal from a second transmitter. Another aircraft nearby can also cause momentary needle fluctuations that you might not hear, but the needle in the DF will react to it. Signal reflections from objects or high terrain can also cause needle fluctuations at low altitudes in mountainous terrain or near metropolitan areas.

EPIRB or a military beacon (which uses 243 MHz), switch between 121.5 and 243 MHz at least once each minute until a signal is heard. All civil beacons and some military beacons transmit on both frequencies.

d. Phases of a typical ELT search:

Initial heading. When first heard, the ELT signal will probably be faint and will build slowly in strength over a period of several minutes. Continue flying until a reasonable level of signal is acquired. The DF needle should deflect to one side and the Strength needle should come on-scale. Resist the urge to turn immediately and follow the needle; instead, make a 360° turn at no more than a 30° bank to ensure you get two needle centerings (approximately 180° apart) to verify the heading. When the turn is complete, center the DF needle and fly toward the ELT. Note your heading (write it down) for reference.

If the ELT is heard on both 121.5 and 243.0 MHz, compare the headings. If they differ by more than 45° or if the turn produces multiple crossovers, try a new location or climb to a higher altitude to escape from the reflections.

While flying toward the ELT the DF needle may wander back and forth around center at 10- to 30-second intervals. This is caused by flying through weak reflections and should be ignored. Fly the heading that keeps needle swings about equal in number, left and right.

Signal fade. Don't become concerned if the signal slowly fades out as you fly towards the ELT. If this happens, continue on your heading for at least six minutes. If you are still headed toward the ELT the signal should slowly build in strength in three or four minutes and be somewhat stronger than before the fade. If the signal does not reappear, return to where the signal was last heard and try a different altitude.

Getting close. As you get close to the ELT the signal will get stronger, and you will have to periodically adjust the SENSitivity control to keep the signal strength needle centered (*do not* decrease the VOLume control as this could overload the receiver). You also need to do this if the DF needle gets too sensitive. Periodically yaw the aircraft and observe the DF needle respond (left and right).

Passing over the ELT. A "station passage" is often seen as a rapid fluctuation in signal strength and confused DF readings. Yaw the aircraft to see if the course has reversed (needle goes in the direction of the aircraft turn). If the course has reversed, continue on your heading for a few minutes. Then turn and make several confirmation passages from different angles while continuing your visual search.

3. Becker SAR DF 517. The SAR DF 517 is a precision direction finder was developed for professional SAR (search and rescue) purposes. It has the ability to bear and analyse traditional 121.5 MHz and 243.0 MHz emergency frequencies in the VHF and UHF bands, maritime radio channel 16, and the new digitally encoded 406.025 MHz COSPAS/SARSAT emergency signal. This system incorporates a newly developed and patented antenna (small, rugged and wideband), as well as sophisticated bearing analysis algorithms, allowing delivery of a quick and steady indication for both the 121.5 and 406.025 MHz signals. It also has the ability to track a wide range of training frequencies for training exercises. The direction finder was developed for working under stressful mission conditions such as in an aircraft, helicopter or vehicle. The SAR DF 517 has two modes of operation:

a. Emergency Mode. This mode is used for actual SAR missions. In this mode the unit will search for 121.5 MHz, 406.025 MHz, Marine Channel 16 and COSPAS/SARSAT Emergency Signal Transmissions. Depending on selection, the unit will either SCAN all of these frequencies or search on a single selected frequency. To operate the unit in the emergency mode, follow the checklist below:

Subject: Aircraft L-tronics DF radio Operations
From Bernie

"ALARM MODE" Switch in UP position.
Following provided by Bruce Gordon: L-tronics

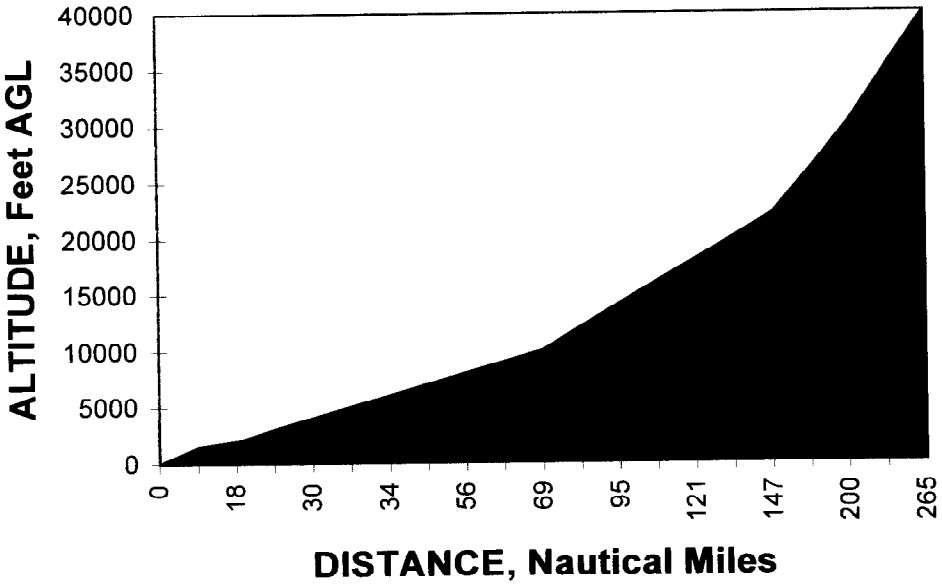
- The ALARM is a tone coded squelch circuit that turns off the audio output of the DF receiver until the sweeping tone characteristic of ELTs and EPIRBS is received for more than 15 to 30 seconds.
- Its purpose is to allow the DF receiver to remain on with the volume up during operations other than ELT search without distracting the crew. It will alert (alarm) the crew to the presence of any active ELT that may be in range so they may take action if necessary.
- The ALARM is "ON" and the audio silenced when the switch is up.
- When the ALARM is ON (switch up), THE DF NEEDLE DOES NOT WORK, even if an ELT is heard.
- ALL search operations should be done with the "ALARM OFF" (switch down). The trained ear is more sensitive to weak signals and the DF is operational.

Reference Material from L-tronics:

For your classroom work, you might consider our Basic ELT Location Course ($28.95) which covers the basics of both air and ground DF and has locally reproducible work sheets for students. There are also two papers on DF techniques available for download on the website. Replacement aircraft manuals are available for $8.00. This covers the basics of operation but is primarily an installation and overhaul book.

DF SEARCHES (CONT'D)

ELT RECEPTION DISTANCE



L-TRONICS VHF DIRECTION FINDER

✓ FUNCTIONAL CHECK - NO TRANSMITTER

FREQ - **121.5 MHZ**

ALARM - **TOGGLE OFF (DOWN)**

SENS - **MAX**

VOL -**ON**

CHECK SIGNAL STRENGTH *(HISSING SOUND ON AUDIO, SIGNAL STRENGTH NEEDLE ¼ TO ½ WAY BETWEEN CENTER AND LEFT END. DF NEEDLE CENTERED.*

SENS – **MIN, THEN MAX** *(DF NEEDLE SHOULD MOVE SLOWLY AND RANDOMLY BACK AND FORTH.) CHECK AUDIO FOR BACKGROUND NOISE.*

ALARM- **TOGGLE ON (UP).** *LIGHT SHOULD FLASH FOR 10 TO 20 SECONDS AND THEN STOP.*

L-TRONICS VHF DF (CONT'D)

WARNING! USE OF HIGH-POWER TRANSMITTERS CLOSE TO THE DF ANTENNAE CAN DAMAGE THE UNIT. DAMAGE CAN OCCUR FROM A 50-WATT TRANSMITTER IF IT IS WITHIN 12 FEET OF THE ANTENNAE (3 FEET FOR 5W; 4 1/2 FEET FOR 10W; 15 FEET FOR 80W). ELT TESTER SHOULD BE KEPT AT LEAST 50 FEET AWAY FROM THE ANTENNAE WHEN USING TO TEST FOR OPERABILITY OF THE DF

FUNCTIONAL CHECK - WITH TRANSMITTER

PARK AIRCRAFT IN THE OPEN, AWAY FROM METAL BUILDINGS, WITH XMITTER AT LEAST 50' IN FRONT OF AND 15°- 30° TO ONE SIDE OF THE AIRCRAFT.

FREQ - **121.775 MHZ**

SENS - **MIN**

VOL – **MID SCALE**

ALARM – **TOGGLE DOWN**

VOL - **ON**

SENS - **ADJUST UNTIL AUDIBLE**

DF NEEDLE SHOULD POINT TOWARD THE XMITTER. DIRECT PERSONNEL TO MOVE XMITTER TO THE OTHER SIDE OF THE AIRCRAFT. DF NEEDLE SHOULD FOLLOW XMITTER. NEEDLE MAY NOT CENTER WITH TEST XMITTER DIRECTLY FORE OR AFT. DF IS OK IF THE NEEDLE POINTS CORRECTLY WHEN THE XMITTER IS ON EITHER SIDE OF THE AIRCRAFT.

SENS– **TURN CLOCKWISE** *(STRENGTH NEEDLE SHOULD MOVE)*

NORMAL FLIGHT OPERATION

FREQ - **121.5 MHZ (121.775 MHZ FOR TRAINING MISSIONS)**

ALARM – **TOGGLE UP (DOWN FOR DF MODE)**

SENS – **MAX**

VOL – **MID SCALE**

DF NEEDLE WILL DRIFT SLIGHTLY LEFT AND RIGHT

ELT SEARCH INFORMATION REQUIRED BY AFRCC

Once an ELT has been located, certain information needs to be collected. Contact the Incident Commander with any of this information that you can gather. He or she will also relay to you the appropriate action for silencing the ELT.

Date and time (Zulu) that you left on the sortie	
Date and time the ELT/EPIRB was first heard	
Number of aircraft [IC]	
Number of sorties [IC]	
The time in the search area (hours and tenths)	
The time enroute (hours and tenths)	
Total flight hours (Hobbs)	
Number of CAP personnel [IC]	
Area(s) searched	
Actual location of the ELT/EPIRB, including lat/long	
Date and time the ELT/EPIRB was located	
Date and time the ELT/EPIRB was silenced	
ELT/EPIRB model, manufacturer, serial number, and expiration date	
Position of ELT/EPIRB switch: ON, ARMED or OFF	

Other useful information:

1. The type of airplane or boat that contained the ELT/EPIRB.
2. The 'N' number or hull number of the airplane or boat.
3. Names of law enforcement officers and other personnel that assisted you (add to your list for future missions).
4. The name, address, and phone number for the owner of the ELT/EPIRB. *
5. The cause of activation (e.g., mishandling, damaged unit, broken switch, or hard landing) *

* If information can be easily obtained.