LESSON PLAN OUTLINE

PROGRAM: SMOKEJUMPER

LESSON: SPOTTER

OBJECTIVES: This unit consists of all of the facets of fulfilling the duties as a smokejumper spotter. It involves classroom and practical application of navigation, aircraft procedures, jump spot selection, cargo dropping, aircraft emergency procedures, communication, and crew resource management. Becoming a fully qualified spotter takes smokejumping experience, time, and fulfilling the position as a trainee in practice and fire missions.

INTRODUCTION: Spotting smokejumpers on practice and fire missions is a very integral, important position in the safe deployment of firefighters. The decisions that are made by a spotter plays a key role in the success or failure of the mission, especially since no two missions are the same, therefore, it is essential that spotters are proficient and confident in their abilities.

PREFACE

PREFACE

The Smokejumper program, in order to be viable and productive, must be a safe program. Every effort must be made to totally eliminate the injuries which seem, at times, to plague the program. These injuries not only distract from the effectiveness of the program but, more importantly, cause unneeded and undue suffering to the injured jumper. Far too many jumpers have suffered jump related injuries to the extent that the effects of the injury are carried for life.

Within the Smokejumper organization no one individual shoulders more responsibility for the safe conduct of the Smokejumper operations than the Smokejumper spotter. It is the responsibility of the spotter, and the spotter alone, to decide if a jump falls within the parameters of safe Smokejumper operations. Many past Smokejumper injuries can be attributed either directly or indirectly to poor judgment on the part of the spotter.

Many times a poor decision on the part of a spotter stems not from the spotter's lack of knowledge or ability but instead from the aggressive "can do" fire staffing attitude that permeates the Smokejumper program. Many times in the past spotters have taken an aggressive stance when making the decision to jump fires when conditions were marginal or borderline. It is of the utmost importance that spotters consider all the possible alternatives when it comes to fire staffing and choose the safest and most effective one. The benefit to the individual jumper, and the jumper program as a whole, of staffing a few fires in marginal conditions is far outweighed by the adverse impact of a serious injury.

It is of the utmost importance that all aspects of spotters' training be approached with safety as the primary concern. Many times the right decision on the part of a spotter is the difference between a safe, successful Smokejumper mission or a serious injury.

CHAPTER I

Policies

Section A: 5700 Manual Policy and Smokejumper Handbook Direction

Section B: Fire Staffing and Other Policies

Note: Sections for this chapter will need to be developed by each smokejumper unit from the appropriate manuals and handbooks.

DETAILED LESSON PLAN OUTLINE

PROGRAM:	Smokejumper
UNIT:	Specialized
LESSON:	Spotter
CHAPTER I:	**Policies**
SECTION A	5700 Manual Policy and Smokejumper Handbook Direction
SUGGESTED TIME:	1 hour classroom plus study time
TRAINING AIDS NEEDED:	5700 Manual and Smokejumper Handbook
OBJECTIVE(S):	Upon completion of this section, the trainee will be able to:

1. Identify manuals and handbooks that control smokejumper policies and procedures.
2. Locate management direction and program and procedures within the appropriate manual or handbook.

DETAILED LESSON PLAN OUTLINE

PROGRAM:	Smokejumper
UNIT:	Specialized
LESSON:	Spotter
CHAPTER I:	**Policies**
SECTION B:	Fire Staffing and Other Policies
SUGGESTED TIME:	1 hour classroom plus study time
TRAINING AIDS NEEDED:	Policy documents
OBJECTIVE(S):	Upon completion of this section, the trainee will be able to recite the unit's smokejumper spotting mission and the applicable aviation policy.

CHAPTER II

Safety

Section A: Prejump Safety Check

Section B: General Aircraft Procedures -- Hookup to Exit

Section C: Aircraft Emergency Procedures

NOTE: All sections in this Chapter are taught on the ramp or in the jump aircraft on the ramp.

DETAILED LESSON PLAN OUTLINE

PROGRAM:	Smokejumper
UNIT:	Specialized
LESSON:	Spotter
CHAPTER II:	**Safety**
SECTION A:	Prejump Safety Check
SUGGESTED TIME:	30 minutes
TRAINING AIDS NEEDED:	Fully suited smokejumpers
OBJECTIVE(S):	Upon completion of this section, the trainee will be able to make a complete prejump safety check and to recognize and correct equipment problems that may be found during the inspection.

OUTLINE

A. PREJUMP SAFETY CHECK OF SMOKEJUMPER EQUIPMENT

The prejump safety check of a jumper is a spotter responsibility. This responsibility may be delegated to the assistant spotter. However, it is the spotter who must be the ultimate authority to see that the assistant spotter knows and follows the correct safety procedures. The correct sequence of an equipment safety check is:

1. Stirrup straps -- make sure they are tight and underneath boot soles. The adjustment straps should be tacked down to prevent them from hanging up on the step.

2. Leg pockets -- make sure they are securely closed and rope is inside.

3. Harness leg straps -- snapped securely to V-ring without any pant material folded or wrinkled underneath. Leg straps cinched tightly.

4. PG bag -- secured in normal manner, no excessively long gear or straps protruding and proper fastex attachments have been made.

5. Reserve -- make sure reserve is secured correctly to D-rings, pins are properly seated in loops, safety tie is not broken, ripcord handle is correctly positioned, safety pin is installed and positioned in butterfly snaps on FS-12Rs, reserve knife cutting edge is facing out, reserve is in date, and the proper fastex attachments have been made.

6. Tray belt - make sure it is snug and properly positioned.

7. Chest strap of harness tight.

8. Capewells -- by a physical, visual check make sure male portion is well seated left and right side.

9. Risers -- check to see that risers are not pulled from normal position or twisted.

10. Flap container -- good condition, no tears, and closed properly. There should be enough rubber bands on the retainer straps to keep static line stowed properly.

11. Container break tape -- check tape to make sure it is securely tied and looped through all four points on container plus being looped through the static line break tape loop.

12. Static line routing -- correct.

13. Static line snap -- properly functioning, safety wire attached and snap is properly stowed.

14. Helmet -- check for chin strap.

15. Gloves -- nomex or leather.

16. Ask if jumper has hard hat, fire shelter, packout bag, letdown rope, signal streamers, and other appropriate gear.

This safety check should be done in the sequence listed above. If for some reason the safety check of a jumper is interrupted by a distraction, the spotter should return to Step 1 and go through the entire sequence uninterrupted.

NOTE: This section is taught by a demonstration of a prejump safety check by the instructor; then by having the trainee go through the routine. The instructor should insure that several subtle problems exist in the jumpers' gear that the trainee will be required to identify and correct.

DETAILED LESSON PLAN OUTLINE

PROGRAM:	Smokejumper
UNIT:	Specialized
LESSON:	Spotter
CHAPTER II:	**Safety**
SECTION B:	General Aircraft Procedures -- Hookup to Exit
SUGGESTED TIME:	30 minutes per trainee
TRAINING AIDS NEEDED:	Smokejumper aircraft parked on the ramp. Pickup truck. Four fully suited smokejumpers. "Aircraft Procedures" Lesson Plan from parachute training unit.
OBJECTIVE(S):	Upon completion of this section, the trainee will be able to recognize and correct equipment problems and static line misroutes that occur in the jump door prior to exit.

OUTLINE

NOTE: One of the most critical safety related responsibilities of a spotter is proper handling of jumpers from static line hookup to exit. General safety-related procedures applicable to all aircraft are covered in this lesson. Specific procedures for the various approved smokejumper aircraft are covered in the "Aircraft Procedures" lesson plan of the Parachute Training unit. This lesson plan should be referred to for information concerning variations in procedures in different aircraft.

Training Procedure: This section should be conducted in a jump aircraft parked on the ramp. Four fully suited jumpers will be needed to assist in the training. A pickup truck should be backed up to the jump door, and the tailgate dropped so jumpers can simulate exiting by stepping out into the bed of the truck.

To begin this section, the signal from the spotter for the jumpers to hookup, first and second person hookup, safety check of static line routing and jumper equipment, positioning the first person in the door, and slap out signal to exit should be demonstrated and explained by the instructor. Then the trainee should be given a chance to practice the routine. The first time through, no attempt should be made by the instructor or jumpers to introduce special problems. However, the second or third time through the routine, subtle problems can be introduced by the jumpers. Examples might be a static line under the arm, a safety pin not properly inserted in the static line snap, or a helmet chin strap unfastened. The jumpers need to be carefully briefed by the instructor or specifically what problems they should present to the trainees. These jumpers should be cautioned not to overplay their part and introduce too many problems at once. As the exercise proceeds, trainees should identify and correct each problem. If they fail to notice a problem, the instructor should, at the last moment (or perhaps after exit), point it out. This exercise dramatically illustrates to trainees how easy it is to miss seeing a critical safety problem when handling jumpers in the door prior to exit.

Specific problems that may be used in this exercise corresponding to the outline are as follows:

A. Signal to Jumpers From Spotter.

After a repetition or two of the exercise, the first jumper should hookup and get in the door without being signaled by the trainee spotter. If the trainee tolerates this, the instructor should point out that a spotter needs to be in control of all moment and action near the jump door.

B. First and Second Person Hookup.

Hookup presents many opportunities to introduce problems. A safety pin left out of the static line snap is one; too much slack static line unstowed is another; not utilizing static line monitoring rubberband clusters (if present), is a third.

C. Safety Check of Static Line Routing and Equipment.

The jumpers can subtly arrange an under-the-arm misroute, an open leg pocket, a loose harness, etc.

D. Positioning First Person in the Door.

Problems initiated in B or C above may be unnoticed by the trainee. If so, the instructor should let the trainee proceed to slap the jumper out, then point out the problem. It is very easy to miss seeing significant problems such as an under-the-arm misroute. If a trainee should miss seeing one in this exercise, the experience may improve the chances that he will not make the same mistake later on a live jump.

E. To reduce the potential for a significant problem, emphasize the need for a final jumper check immediately prior to signal for exiting.

DETAILED LESSON PLAN OUTLINE

PROGRAM: Smokejumper

UNIT: Specialized

LESSON: Spotter

CHAPTER II: **Safety**

SECTION C: Aircraft Emergency Procedures

SUGGESTED TIME: 30 minutes (lecture)

TRAINING AIDS NEEDED: Smokejumper aircraft on the ramp

OBJECTIVE(S): Upon completion of this section, the trainee will be able to describe appropriate procedures and spotter responsibilities in emergency bailout and crash situations.

OUTLINE

In an aircraft emergency situation requiring bailout, or in the event of an aircraft crash, established emergency procedures can save lives. It is the spotter's responsibility to maintain positive control during an emergency bailout and to do everything to insure that all the jumpers get out of the aircraft safely. A spotter must be thoroughly familiar with the established emergency procedures.

I. BAILOUT PROCEDURES FOR A NON-CRITICAL EMERGENCY

In a non-critical emergency, the pilot will always confer with the spotter concerning the nature of the difficulties and the course of action. If emergency bailout is necessary, the spotter is responsible for seeing that the emergency bailout is accomplished in an orderly manner. Emergency bailout in a noncritical emergency will usually be accomplished in much the same manner as a normal jump. A jump spot may even be selected.

(A non-critical emergency would be a situation such as the pilot being unable to get his landing gear down. There is no immediate danger, but it might be advisable for the jumpers to evacuate the aircraft.)

ALL EMERGENCY PROCEDURES WILL BE IDENTIFIED WITH THE BELL! ALL SMOKEJUMPER THEN LOOK TO THE SPOTTER FOR DIRECTION

II. <u>BAILOUT PROCEDURES FOR A CRITICAL EMERGENCY</u>

Considerations and procedures for an emergency bailout in a critical emergency are as follows:

A. Aft Center of Gravity

Even under the best of circumstances, a pilot cannot maintain adequate control of his aircraft with an aft center of gravity. A spotter must never allow jumpers to rush aft toward the door of the aircraft in anticipation of an emergency bailout. Excess weight in the door of the aircraft will compound whatever problem exists.

B. Positive Control

The instinct for self-preservation runs high in human beings in an emergency situation, sometimes at the expense of clear thinking action that could improve the chances of survival. Positive control by the spotter is the only way to bailout in a critical emergency and should be carried out as quickly and as smoothly as possible.

C. The Decision to Bailout

The pilot is the first authority in matters pertaining to the conditions of the aircraft and the necessity for an emergency bailout. In situations where time permits, it will be the pilot who initiates an emergency bailout through the spotter. In other situations, however, the spotter may have only a few moments or an instant himself to recognize that bailout is required and must give the order himself without hesitation or word from the pilot. The spotter must be certain that the plane is high enough for a parachute to open before initiating bailout. 500 feet AGL is minimum altitude for reliable main or reserve parachute deployment and acceleration of a jumper prior to impact.

D. Speed

Along with the need for order in a critical bailout situation, the need for speed is the foremost concern. Protective clothing worn in smokejumping work is designed to give maximum protection, but it is not a necessity in an emergency. In the event of a critical emergency exit from a smokejumper aircraft, gloves, helmets, and other protective gear are usually best left behind in favor of a prompt exit.

E. Bailout Procedures with the Main Parachute

If jumpers are wearing an FS-14 backpack parachute when the order comes to bailout (except Caribou), the jumpers should hook to the overhead cable. They should not attempt to fasten the safety pin. One hand should be kept on the static line snap and while stowing the excess static line in a military bite grip glide the snap along the cable while moving toward the door. This procedure is necessary to prevent an accidental opening of the main parachute in the aircraft. Only jumpers who are in or near the door should attempt to hook to the standard anchor cable. This will help prevent congestion around the door. In a large aircraft, a more orderly exit may be achieved if the right side then move out; "left side move out"... again, congestion may be avoided.

F. Bailout Procedures with the Reserve Parachute

In situation where it is impractical for jumpers to hook their static lines to the overhead cable, or if they are not equipped with backpack parachutes, on a ferry flight for example, jumpers should jump with their chest packs.

The best exit procedure with the chest pack parachute is to leave the door in the standard manner, with one exception -- the jumper will be looking at the ripcord handle on the chest pack. It is very easy to miss the handle when not looking at it. The instant the jumper leaves the door, he should pull the ripcord.

G. The Spotter's Responsibility

The spotter is responsible to maintain positive control during an emergency bailout and to do everything he can to insure that all jumpers get out of the aircraft safely.

III. EMERGENCY CRASH PROCEDURES

Whenever possible, the following procedures should be followed when a crash landing is imminent:

1. Helmets and gloves on.

2. Restrict unnecessary movement in the aircraft. The pilots' control of the aircraft may be very marginal in an emergency.

3. If seat belts are provided in the aircraft, use them.

4. Keep to the rear of cargo, if possible.

5. Know where emergency escape hatches and equipment are located.

6. After a crash, vacate the aircraft as quickly and as orderly as possible. Fire may break out at any instant. Be alert to jumpers or crew members who may have been hurt or incapacitated in the crash and get them out as quickly as possible. Move well away from the aircraft once outside on the ground.

CHAPTER III

Navigation

Section A: Geography

Section B: Aeronautical Charts and Maps

Section C: Aircraft Instruments and Navaids

NOTE: Practical application of navigation skills is beyond the scope of Chapter 3. The information presented in this chapter should form a basis for the trainee to learn practical navigation skills on supervised spotting missions.

DETAILED LESSON PLAN OUTLINE

PROGRAM:	Smokejumper
UNIT:	Specialized
LESSON:	Spotter
CHAPTER III:	**Navigation**
SECTION A:	Geography
SUGGESTED TIME:	2-3 hours study time
TRAINING AIDS NEEDED:	Maps and aeronautical charts of the unit's primary coverage area. A prepared list of key geographic features, rivers, peaks, forests, districts, etc.
OBJECTIVE(S):	Upon completion of this section, the trainee will be able to identify on a map or aeronautical chart each of the geographic features listed on the prepared handout.

NOTE: To supplement aircraft navigation skills that will be covered in subsequent sections, spotter instructors should insure that the trainee has memorized the key features and important landmarks. A list of features and landmarks should be prepared by the spotter instructor at each smokejumper unit. Forests, districts, major drainages, peaks, and other features that are commonly referenced in locating or reporting fires should be included on this list. The trainee should be provided maps, charts, and study time. A verbal test should be used to complete this section in which the trainee is required to quickly point out features on a map or chart as they are named by the instructor.

DETAILED LESSON PLAN OUTLINE

PROGRAM: Smokejumper

UNIT: Specialized

LESSON: Spotter

CHAPTER III: **Navigation**

SECTION B: Aeronautical Charts and Maps

SUGGESTED TIME: 1 hour classroom

TRAINING AIDS NEEDED: Aeronautical charts and maps

OBJECTIVE(S): Upon completion of this section the trainee will be able to read important information from aeronautical charts and Forest Service maps that will be needed to carry out navigation and fire locating responsibilities on spotting missions.

OUTLINE

I. AERONAUTICAL CHARTS

The multitude of aeronautical symbols, etc., on Sectional and WAC charts provide a volume of information useful to a spotter. Runway lengths, terrain elevations, locations of restricted areas, etc., can be identified on these charts. However, real practical proficiency in the use of aeronautical charts involves more than memorizing symbols and color codes. A spotter's goal in the use of navigation charts should focus on developing the ability to look out the window of the aircraft, look at the chart, and see the same thing in both places. Aeronautical charts are a scaled down picture of the terrain outside of the aircraft, but it takes practice to make the connection. Once a spotter has become accustomed to the scale of the charts, navigation on smokejumper missions is easy to follow with no more than an occasional glance at the chart.

A spotter who fails to work at using aeronautical charts, however, will probably spend the majority of his spotting career lost, trusting his pilot with blind faith.

II. FOREST SERVICE MAPS

Forest maps are very useful tools for a spotter. As with aeronautical charts, the information on the maps needs to be pointed out to the trainee.

NOTE: This section needs to be conducted in the classroom for the purpose of discussing and familiarizing the trainee with how charts and maps are used on spotting missions. The flight exercise in Chapter 9 will provide some opportunity for practical instruction.

Various private pilot manuals or textbooks may provide instructors with good reference material regarding aeronautical charts.

DETAILED LESSON PLAN OUTLINE

PROGRAM:	Smokejumper
UNIT:	Specialized
LESSON:	Spotter
CHAPTER III:	**Navigation**
SECTION C:	Aircraft Instruments and Navaids
SUGGESTED TIME:	1 hour
TRAINING AIDS NEEDED:	Smokejumper aircraft parked on the ramp
OBJECTIVE(S):	Upon completion of this exercise the trainee will be able to demonstrate basic familiarity with aircraft instruments by describing the function of instruments and navaids found in smokejumper aircraft. NOTE: The spotter instructor may wish to enlist the help of a smokejumper pilot in teaching this section. This section should be conducted in the cockpit of the jump aircraft.

OUTLINE

While it is not necessary for a smokejumper spotter to have a pilot's knowledge of aircraft instruments and navigation, it is helpful
if the spotter has a general knowledge of aircraft radio navigation aids, particularly the VOR.

A spotter spends a lot of time sitting up front with the pilot. By being able to interpret the basic aircraft instruments, a spotter can
keep oriented as to direction of flight, altitude, and location of the aircraft.

I. THE MAGNETIC COMPASS

The magnetic compass is a magnet that aligns itself with the magnetic North Pole while the airplane turns around it.

Smokejumpers are familiar enough with the compass so an involved description isn't necessary, but some hints on using the compass in an aircraft might be helpful.

The magnets in the compass tend to align themselves parallel to the earth's lines of magnetic force. This tendency is more noticeable as the Magnetic North Pole is approached. The compass would, theoretically, dip or point straight down when directly over the pole. The compass card is mounted so that a low center of gravity location fights this dipping tendency. Dip causes certain errors to be introduced into the compass readings and should be noted as follows:

A. Northerly Turning Error

In a shallow turn, the compass leads by about 30 degrees when passing through south, and lags about 30 degrees when passing through north. On passing east and west headings in the turn, the compass is approximately correct (30 degrees is the rule of thumb for the U.S.).

For instance, the plane is heading south and makes a left turn to fly due north. As soon as the left bank is entered the compass will indicate about 30 degrees of left turn, when actually the nose has hardly started to move. So, when a turn is started from a heading of south, the compass will indicate an extra fast turn in the direction of the bank. It will then hesitate and move slowly again when approximately the correct reading as the heading of the east is passed. The compass will lag as north as approached so when the plane rolls out the magnetic compass indicates 30 degrees.

If the plane had made a right turn from a south heading, the same effects would have been noticed: An immediate indication of turn in the direction of bank; a correct reading at a heading of west, and a compass lag of 30 degrees when heading north.

If the plane starts a turn from a heading of north, the compass will initially register a turn in the opposite direction, but will soon race back and be approximately correct as an east or west heading is passed. It will then lead by about 30 degrees as the airplane's nose points to magnetic south.

B. Acceleration Errors

Because of its correction for dip, the compass will react to acceleration and deceleration of the airplane.This is most apparent on east or west headings, where acceleration results in a more northerly indication. Deceleration gives a more southerly indication.

C. Conclusions About the Magnetic Compass

The magnetic compass reads correctly only when the airplane is in straight and level unaccelerated flight. (And sometimes not even then. In bumpy air, the compass oscillates so that readings are difficult to take.) The fluid in the case (acid free white kerosene) is designed to keep the oscillations at a minimum, but the problem is still there. A spotter who observes an aircraft compass behaving strangely during turns or while climbing or descending may be assured that this is not out of the ordinary. Also, a spotter should realize that the compass is not necessarily the best place to look for an indication of aircraft heading. The best reference is a properly set directional gyro.

II. THE DIRECTIONAL GYRO

The directional gyro depends on one of the main properties of gyroscopes: "rigidity in space." Once spinning, the gyroscope resists any effort to tilt its axis (or plane of rotation.) In the case of directional gyro, the plane of rotation is vertical. The directional gyro has a compass card or azimuth scale which is attached to the gyro gimbal and wheel.The wheel and card are fixed, and, as in the case of the magnetic compass, the plane turns around them.

The directional gyro has no magnet that causes it to point to the magnetic North Pole, and must be set to the heading indicated by the magnet compass to a moment when the plane is flying straight and level and the magnetic compass is reading correctly. (Many gyros are self correcting.)

The advantage of the directional gyro is that it does not oscillate in rough weather and gives a true reading during turns when the magnetic compass is erratic.

Spotters will find the directional gyro the best aircraft instrument to refer to for information concerning heading. However, the spotter must be sure that the directional gyro has been set recently with the magnetic compass as reference. Frequently, pilots do not set the DG in the right seat instrument display. Particularly, after a series of turns and banks, a directional gyro may have to be reset by reference to the magnetic compass. In any case, it should be checked and reset, if necessary, every 20 or 30 minutes as directional gyros have some tendency to drift.

III. AIRSPEED INDICATOR

The airspeed indicator is nothing more than a specialized air pressure gauge. The airspeed system is comprised of the pitot and static tubes and the airspeed indicator instrument.

An airplane moving through the air creates its own relative wind. This relative wind exerts a ram pressure in the pitot tube where its effects are passed on into a diaphragm which is linked to an indicating hand. This relative wind force is calibrated in miles per hour, or knots, rather than pounds per square foot of pressure. The static tube acts as a neutralizer of the static pressure around the airplane and within the instrument, so that only the dynamic pressure is measured. For accuracy, static tube openings are placed at some point on the airplane where the most accurate measurement of the actual outside air static pressure is found. A usual spot is on the side of the fuselage somewhere between the wing and stabilizer. These points are selected as being places where the static pressure is least affected by the airflow about the airplane. The pitot tube is placed at a point on the aircraft where the actual relative wind is measured, free from any interfering aerodynamics effects. A particularly bad place, for example, would be just above the wing where the air velocity is greater than the free stream velocity.

Light plane airspeed indicators are calibrated for standard sea level conditions with a temperature of 59 degrees F and a pressure of 29.92 inches of mercury. Spotters should realize that as aircraft altitude increases, the air density decreased so that, for example, an airplane indicating 180 knots at 10,000 feet actually has a higher “true airspeed” than an airplane at sea level indicating the same dynamic pressure.

The FAA requires that the airspeed indicator be marked for various important speeds. These speeds are as follows:

Red Line -- never exceed speed.
Yellow Arc -- cautions range. Strong vertical gusts could damage the airplane in this speed range; therefore, it is best to refrain from flying in this speed range when encountering turbulence of any intensity.
Green Arc -- normal operating range. The airspeed at lower end of this arch is the flaps up, gear up, power off stall speed at gross weight. The upper end of the green arc is the maximum structural cruising speed.
White Arc -- the flap operating range. The lower limit is the stall speed at gross weight with the flaps in the landing positioning, and the upper limit is the maximum flap operating speed.

V. THE ALTIMETER

The altimeter is an aneroid barometer calibrated in feet instead of inches of mercury. Its job is to measure the static pressure and register this fact in terms of feet or thousands of feet.

The altimeter has an opening that allows static (outside) pressure to enter the otherwise sealed case. A series of sealed diaphragms or “aneroid wafers” within the case are mechanically linked to the three indicating hands. Since the wafers are sealed, they retain a constant internal "pressure" and expand or contract in response to the changing atmospheric pressure surrounding them in the case. As the aircraft climbs, the atmospheric pressure decreases and the sealed wafers expand; this is duly noted by the indicating hands an increase in altitude (or vice versa).

Standard sea level pressure is 29.92 inches of mercury and the operations of the altimeter are based on this fact. Any change in local pressure must be corrected by the pilot. This is done by using the setting knob to set the proper barometric pressure (corrected to sea level) in the setting window.

Pressure changes can give false indications enroute when using an altimeter if corrected local pressures are not set into the altimeter. For example, when a plane flies from a high pressure area into a low pressure area, the altimeter "thinks" you have climbed and will register accordingly -- even if you haven't changed altitude. If a pilot sees this, he may fly the plane down to the "correct altitude" and this will actually be low. Flying from a low to a high pressure area makes the altimeter think you have let down to a lower altitude and it registers too low. Temperature variations affect pressure and here too there is a chance for altimeter error.

With respect to reading altimeters in the jump ships, a spotter should be certain the altimeter has been set to local barometric pressure. Frequently, aircraft have dual altimeters and the pilot sets one altimeter but does not bother to set the altimeter in the right seat instrument display. If the altimeter has not been set and the spotter uses it to give altitude information, say to an air attack supervisor, a serious error in aircraft spacing may result.

V. VOR RADIO NAVIGATION

Jumpship pilots frequently use VOR navigation in flying point to point. Also, fire locations are often identified by reference to a particular VOR radial and a number of miles. It is desirable that a smokejumper spotter has at least a basic understanding of VOR navigation.

VOR stands for VHF omnirange. The omni receiver in the airplane is able to measure the aircraft's position relative to a particular VOR station by electronic timing.

The omni station puts out two signals. One is omni-directional; this signal is transmitted in all directions simultaneously at the rate of 30 times per second. The other is a rotating signal which is turning at the rate of 30 revolutions per second (clockwise). The rotating signal has a positive and a negative side. The all directional or reference signal is timed to transmit at the instant the positive side of the rotating signal passes magnetic north. So, let us suppose that instead of 30 times per second, the rotating signal turned one time a minute (and the reference signal also flashed once a minute as the positive side of the rotating signal passed north). Suppose that at your geographic position, the omni set in the aircraft receives the reference signal and 45 seconds later receives the rotating signal. Your position is 45/60 or ¾ of the way around (clockwise); you are somewhere on the 270 degree radial.

The airplane's VOR is composed of four main parts:

1. The frequency selector.
2. Azimuth or bearing selector, calibrated from 0-360 degrees (called OBS or omni bearing selector).
3. Deviation indicator or left-right needle.
4. TO-FROM indicator.

Suppose you are in a vicinity of a VOR and want to fly directly to it. The pilot would: 1) tune in the correct frequency and identify the station; 2) turn the omni bearing selector until the TO-FROM indicator says "TO" the station, center the needles, and then fly the needle; 3) if after a period of time, the needle drifts, for example, to the left, the pilot would turn left and fly until the needle is centered again. The aircraft would then be back on the pre selected course. The left - right needle is set up so that a full deflection to either side means that you are off 10 degrees or more. A half deflection to either side means that you are about 5 degrees from your selected bearing.

The VOR has the great advantage of being useable from all directions and is not affected by thunderstorms as are low frequency radios. One disadvantage of the VOR is that being VHF it is line of sight so you may not be able to pick up a station at any great distance.

One misunderstanding common with VOR navigation is that the airplane's heading has an effect on the OBS and TO-FROM indicator. The receiver merely tells your position relative to the VOR. If you made a tight 360 turn, the indicators would remain the same because you would still be at essentially the same position with respect to the VOR station.

VI. DME

The DME (distance measuring equipment) in an aircraft sends out interrogating pulses at specific spacing which are received by the ground station. The ground station then transmits a paired pulse back o the aircraft at a different pulse spacing and on a different frequency. The time required for the round trip of this signal exchange is measured by the DME unit in the aircraft and is indicated on a counter or dial as nautical miles from the aircraft to the station. An aircraft one mile high directly over a DME station would receive a reading of being one mile from the station; an aircraft some distance from the station will receive a readout closer to ground distance, depending on the angle. Like the VOR, DME depends on line-of-sight reception.

VII. LORAN/GPS

It is important that all Smokejumper spotters understand, and can operate, the Loran C and/or Global Positioning System (GPS) navigation equipment found in Smokejumper aircraft. Since many difference models are in use spotters will need to familiarize themselves with the models in use at their particular base. It is also important that they understand aspects of the Loran system such as proper calibration and entering of proper chains and stations so that accurate readings are given by the system.

Loran is an acronym derived from Long-Range Navigation. The Loran system was first introduced during World War II for ships and submarines at sea to navigate.

The principle of Loran consists of Loran chains or stations each consisting of a master and two to four secondary transmitters. They provide coverage for a specific area and have been established to serve coastal waters and land areas. The coverage over land is now so widespread that it is feasible for general aviation navigation. The station signals follow the earth's surface, therefore it is not limited to line of sight. Loran works at any altitude and under any terrain conditions.

The Loran's internal advanced microprocessor automatically searches, acquires and tracks all available stations in the chain. It measures the arrival time differences between radio signals from the master and each of the secondary stations and converts this to latitude and longitude.

A latitude is the angular distance north or south of the equator, measured in degrees, minutes and seconds or one hundreds of a minute. (Example: 45 30' 30" or 45 30.50') Each minute of latitude is equal to one nautical mile or 6076 feet from the Equator to the North Pole.

A longitude is the angular distance east or west of the prime meridian at Greenwich, England, measured in degrees, minutes and seconds or one hundreds of a minute. (Example: 121 35' 05" or 121 35.08') Each minute of longitude at the equator is equal to one nautical mile or 6076 feet but reduces in length moving north to south due to the convergences at the poles.

The Western United States lies between 102 degrees and 124 degrees longitude measured from east to west and 32 degrees and 49 degrees latitude measured from south to north.

The Loran computer, if properly programmed and operated, is capable of producing an exact and precise latitude and longitude constantly with position accuracy to within 60 feet.

The use of the Loran navigation can be invaluable to the Smokejumper spotter. Once the latitude and the longitude of the fire, or multiple fires, is received from dispatch the spotter can enter them into one or more of the up to 200 waypoints (storage numbers) in the computer. The waypoint can then be noted and called up at any time.

Once the waypoint has been called up the spotter will be able to read the heading and distance to the fire from the present location. Among other things the Loran will also give the spotter the ETA from present location, the ground speed, ground track, and the latitude and longitude at present location. If the jumper aircraft has been dispatched to multiple fires then the waypoint of the next fire can be called up and the aircraft can navigate precisely to the second fire. Once the mission is complete the Loran makes it possible to navigate back to base with an exact ETA. All of this can be accomplished regardless of altitude, terrain or distance from home base.

It is important that spotters acquire and maintain the skill needed to convert legal locations to latitude and longitude and vice-versa. It is also quite important that spotters practice and maintain their navigation skills in methods other than Loran navigation. These skills may be needed if the Loran computer malfunctions or spotters find themselves in an aircraft without a Loran system installed.

CHAPTER IV

Radio Communications

NOTE: Due to the differences in radio communication policies and procedures, each smokejumper unit should develop their own sections for this chapter.

DETAILED LESSON PLAN OUTLINE

PROGRAM:	Smokejumper
UNIT:	Specialized
LESSON:	Spotter
CHAPTER IV:	**Radio Communications**
SECTION A:	Spotter/Dispatch Communications
SUGGESTED TIME:	30 minutes classroom lecture, discussion, and practice.
TRAINING AIDS NEEDED:	Lesson plan covering specific procedures and requirements.
OBJECTIVE(S):	Upon completion of this section, the trainee will be able to correctly accomplish the required radio communications with dispatch while on spotting missions.

DETAILED LESSON PLAN OUTLINE

PROGRAM:	Smokejumper
UNIT:	Specialized
LESSON:	Spotter
CHAPTER IV:	**Radio Communications**
SECTION B:	Air Traffic Control
SUGGESTED TIME:	1 hour lecture, 30 minutes practical exercise.
TRAINING AIDS NEEDED:	Classroom, two hand-held talk radios
OBJECTIVE(S):	Upon completion of this section, the trainee will be able to correctly carry out spotter's radio communication responsibilities with regard to air traffic control when approaching and over fires.

DETAILED LESSON PLAN OUTLINE

PROGRAM:	Smokejumper
UNIT:	Specialized
LESSON:	Spotter
CHAPTER IV:	**Radio Communications**
SECTION C:	Spotter/Incident Commander Communications
TRAINING AIDS NEEDED:	Classroom, two hand-held talk radios
OBJECTIVE(S):	Upon completion of this section, the trainee will be able to correctly accomplish radio communication with smokejumper incident commanders.

DETAILED LESSON PLAN OUTLINE

PROGRAM:	Smokejumper
UNIT:	Specialized
LESSON:	Spotter
CHAPTER IV:	**Radio Communications**
LESSON D:	Aircraft Radio Communications
TRAINING AIDS NEEDED:	Smokejumper aircraft on the ramp
OBJECTIVE(S):	Upon completion of this section, the trainee will be able to effectively operate the FM and VHF radios in the cockpit of the aircraft, and the spotter's communication panel near the jump door.

CHAPTER V

Information Gathering and Reporting

Section A: Fire Size Estimation from Aircraft

Section B: Analyzing and Reporting Fire Weather

DETAILED LESSON PLAN OUTLINE

PROGRAM:	Smokejumper
UNIT:	Specialized
LESSON:	Spotter
CHAPTER V:	**Information Gathering and Reporting**
SECTION A:	Fire Size Estimation from Aircraft
SUGGESTED TIME:	20 minutes in classroom. (If desired, 10 minutes on a training flight may be added as a practical exercise.)
TRAINING AIDS NEEDED:	Blackboard
OBJECTIVE(S):	Upon completion of this section, the trainee will be able to explain techniques that can be used to estimate small and large fire size from an aircraft.

OUTLINE

I. INTRODUCTION

The smokejumper spotter is often the first person in a position to provide accurate information concerning five characteristics for fires to which initial attack forces are being dispatched. Early reports of new fires are often incomplete and estimated fire size inaccurate. It is part of the responsibility of the spotter to size up the fire and provide information back to the dispatch so decisions can be made to allocate resources and set priorities. An important part of sizing up a fire is estimation of acreage. It is important the spotter be able to accurately estimate the size of small initial attack fires and large project fires.

II. FIRE SIZE ESTIMATION

Fire size estimation can be divided into estimates of small fires, which for the purpose of acreage determination are under 50 acres, and estimates of large fires which are 50 acres or more. There is a tendency to over estimate the acreage of a fire from the air due to:

Smoke Drift An inexperienced observer will sometimes include the area obscured by drifting smoke with the actual fire area. This is especially easy to do if a temperature inversion holds the smoke on the ground. Poor visibility due to smoke can make it very difficult to see the actual burned area and fire perimeter.

A. Small Fire Size Estimation

Estimation of the size of a small fire from the air is for determining the potential of the fire to become a problem and for record of the fire size at initial attack. It is not practical for the spotter to fly the perimeter of a small fire. Small fire size estimation becomes an educated guess on the part of the spotter. However, it does help to have a standard by which to estimate the acreage of a small fire. The close similarity of an acre to a football field makes it a practical reference to use. This area should not be confused with the entire part inside the track, which totals 2.28 acres. Fires rarely burn in the shape of a football field, but an awareness of the similarity in size will allow spotters to use it as a standard.

(The instructor may want to mark an acre on the ground for the trainee to look at from the air.)

B. Large Fire Size Estimation

There are times when it will be necessary to estimate the acreage of a large fire. A spotter may be asked by the Incident Commander or Dispatcher to estimate the acreage and this estimate should be accurate.

The aircraft flight method of determining fire size is likely to be more accurate than an eyeball guess on a large fire. The jump ship is flown at a convenient airspeed, such as 120 mph, which equals 2 miles per minute. The spotter then times how long it takes to fly the length and width of the fire. Length and width flight times can easily be translated into miles. The spotter then selects an appropriate geometric shape to use in his size calculations which most closely matches the shape of the fire. The size of the fire is then calculated in square miles. Since we know that one square mile equals 640 acres, area of the fire in square mile X 640 = fire size in acres.

For example, we have just flown an approximately rectangular shaped fire for size. It took 15 seconds to fly the width, 30 seconds to fly the length. The formula for the area of a rectangle is A = length X width; in this case, .5 square miles. .5 square miles X 640 - 320 acres. The fire wasn't really quite a rectangle; there were rounded corners, etc., so eyeballing it now, we adjust our calculations and say that 250 acres looks like a good figure on size.

Commonly used formulas for area are as follows:

Rectangle: A = length X width
Triangle: A = base X height X ½
Circle: A = 3.14 X radius squared

DETAILED LESSON PLAN OUTLINE

PROGRAM:	Smokejumper
UNIT:	Specialized
LESSON:	Spotter
CHAPTER V:	**Information Gathering and Reporting**
SECTION B:	Analyzing and Reporting Fire Weather
SUGGESTED TIME:	30 minutes in classroom
OBJECTIVE(S):	Upon completion of this section, the trainee will be able to discuss and explain the various stages of thunderstorm development and observations that should be included when communicating weather information to a dispatch office.

OUTLINE

I. ROLE OF THE SPOTTER IN WEATHER OBSERVATION

Fire weather information is sometimes requested from smokejumper aircraft on patrol or enroute to a fire. Spotters should be familiar with cloud types, thunderstorm development, weather indicators of thunderstorms, and fire potential so that they can provide useful information back to dispatch.

II. CONDITIONS NECESSARY FOR THUNDERSTORM DEVELOPMENT

For thunderstorms to occur, warm air must be able to move upward through the atmosphere. Stable air will prevent this up-warm movement; neutral air will hinder it; and unstable air will encourage it. For thunderstorms to actually occur, the air must be unstable through a deep layer of the upper atmosphere so that lower air is lifted to the level of free convection where it is warmer than the surrounding air and will continue to rise freely until it is cooled by the upper air.

The rate of cooling is called the adiabatic lapse rate and is 5.5 degrees per 1,000 feet.

As the warm air cools, it condenses into water droplets at the dew point, and if convection continues, ice crystals begin to form at the freezing level. Convection must continue beyond the freezing level for sufficient electrical charge separation to occur to result in lightning discharge.

Weather indicators of unstable air are good visibility, gusty winds, clouds developing vertically (cumulus development) and smoke rising straight up to great heights. On the other hand, steady wind, stratiform clouds, poor visibility (fog layers), and inversion layers where smoke drifts apart and forms layers after rising, indicate stable atmospheric conditions and little likelihood of thunderstorm development.

Some form of lifting, called a triggering mechanism, must begin the upward movement of air. This can be orographic (physical features), thermal (usually requiring temperatures of 70 degrees or more), frontal (a cold air mass lifts warm air in front of it), or convergent (where two air masses meet in a low pressure area and force the air upward). All lifting mechanisms act to bring warm air up from below near the surface to the level of free convection where it attains its own buoyancy and no longer needs an external lifting force.

The third condition necessary is sufficient moisture for the condensation of water vapor into droplets and ice crystals. Heat is released in the condensation process, resulting in even greater air instability and making it easier for the lower air to reach the level of free convection. If little or no moisture is available, it is likely that no clouds will form at all, even though other factors may be favorable for thunderstorm development. The higher the moisture content, the easier the level of free convection is reached.

III. FACTORS THAT CAN STOP THUNDERSTORM DEVELOPMENT

Even when air instability, a triggering mechanism, and sufficient moisture at lower altitudes are all present, the building upward of cumulus clouds into thunderstorms may not occur. Very stable air at intermediate altitudes (6,000 - 15,000 ft.) may suppress the upward movement of the air. Very dry air at intermediate altitudes may also cause the building convection columns before they build high enough (25,000 ft.) to become thunderstorms. Thunderstorms require that air be lifted to the condensation level, lifting continue beyond the freezing point, a continuous supply of water vapor be available for condensation, and upper atmosphere winds are not too strong to interfere with the cloud development.

IV. THUNDERSTORM DEVELOPMENT

Each thunderstorm cell has its own identify and goes through a definite life cycle which may last from 20 minutes to 1-1/2 hours. A storm may last 6 hours or more with some cells growing while other dissipate. A single cell may range from a few miles in diameter up to 10 miles in diameter with clusters of cells ranging up to 50 miles in diameter. There are three stages in the development of a single cell. (See stages 2, 3 and 6 on Figure 1 and HO-IGR-1.)

A. Cumulus Stage

Cumulus clouds form when moist air is lifted and the water vapor condenses as it cools. Water droplets are carried upward and held in suspension. This stage is characterized by strong updrafts which can reach as much as 50 mph. Cloud types associated with this stage are fair weather cumulus and alto cumulus.

B. Mature Stage

The start of rain from the base of the cumulus cloud marks the beginning of the mature stage. The droplets of water have grown to a size where they can no longer be held in suspension by the updraft. This usually occurs 15-20 minutes after the cell has built upward beyond the freezing level. The top of the convection cell reaches its maximum height during this stage rising to as much as 30,000 - 40,000 feet. The visable cloud top flattens and spreads laterally into the anvil top, often characteristic of this stage of development. The cloud profile is distinct with sharp edges. A change in air circulation within the cloud occurs with a progressive switch from updrafts to downdrafts as the falling rain drags air down with it by friction and by cooling. As rain increases, downdrafts increase -- sometimes reaching 30 mph.

The horizontal outflow of air movement below the base of the cloud produces strong gusty surface winds which are strongest in the direction in which the cloud is moving. Updrafts also continue to increase in speed and the most intense air turbulence associated with the cell occurs at this stage. The start of rain during the mature stage also marks the start of the greatest lightning danger.

C. Dissipating Stage

As the downdrafts continue to develop, the updrafts weaken and the source of energy and moisture for continued cell growth and activity is cut off. Finally, the falling water particles available are exhausted and the downdrafts weaken and dissipation follows shortly. During this stage, the top of the cell glaciates or ices causing the appearance of the top to become wispy and the edges to lose their sharp outlines. Lightning will still occur at this stage. If lightning has not occurred during the mature stage, it will not occur during the dissipating stage.

V. LIGHTNING

The energy release from a single well-developed thunderstorm may exceed by 10 times the energy release from a WWII atomic bomb. This energy results from the latent heat released by the condensation of water vapor. For every pound of water that condenses, 1,000 BTUs of energy are released. Part of this energy is converted to the kinetic energy of motion which is released through violent winds, and the rest is released through lightning activity. Lightning occurs when the electrical potential exceeds the resistance of the atmosphere to a flow of electrons between the centers of opposite charge. Charge separation in a developing cell causes positive charges to accumulate in the upper portion of the cell while negative charges accumulate in the lower portion. The negative base induces a critical point, electrical current jumps the gap. Most lightning however, is within a single cell or between cells with only about 30 percent of the lightning associated with a storm system occurring between the clouds and the ground. A lightning discharge actually consists of two stages. A leader stroke works its way downward in a series of probing steps and once ground contact is made, an average of four return strokes flash back upward.

VI. THUNDERSTORM IGNITION POTENTIAL

Fire occurrence from lightning depends on a number of factors such as temperature, fuel moisture content of ground fuels, amount of precipitation, base of the clouds, and the rate of development of the cells. Recent research on thunderstorms indicates that approximately 1 percent of lightning strokes are of longer duration than a normal stroke and it is thought that these strokes, called hybrid strokes, are the ones that start fires. Rapidly building cells seem to create greater charge separation and produce lightning in greater quantities than convection columns that have developed slowly. Fire starts increase significantly when surface temperatures climb above 70 degrees and relative humidity drops between 30 percent. The amount of precipitation produced by a thunderstorm that actually reaches the ground, is perhaps the single most important factor in the potential of the thunderstorm to start fires. The altitude of the base of the cells above the ground level is extremely important in determining the ignition potential of the thunderstorm. The higher the base of the cells, the more rain will evaporate before reaching the ground, and the greater probability of fire starts. Thunderstorms are classified by the altitude of their bases above ground level as follows:

	DRY	8,500 ft. and above
MOSTLY	DRY	6,500 ft. to 8,500 ft.
AVERAGE	WET	4,500 ft. to 6,500 ft.
	WET	4,500 ft. and below

Fire starting potential is low when thunderstorms are wet because of weaker lightning strokes, higher fuel moisture, and colder surface temperatures. Fire potential is highest when bases are above 8,500 ft. since most, if not all, of the precipitation evaporates before reaching the ground and the humidity and fuel moisture remain low.

VII. CHECK LIST FOR AIRCRAFT WEATHER REPORTING

The following information should be included when reporting weather observations:

A. Visibility in miles

B. Cloud types

C. Base of clouds

D. Estimated top of clouds

E. Thunderstorm development is observed and stage of growth of the cells

F. Amount of precipitation with storm system

G. Whether or not lightning has been observed

H. If cloud-to-ground lightning was observed

DETAILED LESSON PLAN OUTLINE

PROGRAM:	Smokejumper
UNIT:	Specialized
LESSON:	Spotter
CHAPTER VI:	**Spotting and Streamer Dropping**
SECTION C:	Flight 1 -- Practical Training
SUGGESTED TIME:	¾ - 1- ½ hour flight, depending on number of trainees. (Three trainees is a suggested maximum per flight.)
TRAINING AIDS NEEDED:	Jump aircraft and appropriate smokejumper/spotting equipment. Drift streamers and stop watch. Pre-selected streamer drop spots appropriate to lesson objectives.
OBJECTIVE(S):	At the completion of this exercise the trainee will be able to (a) select and verify correct drop altitude; (b) determine wind drift; (c) select an exit point; (d) accurately drop check streamers; (e) initiate and control flight patterns in no-problem flat terrain.

OUTLINE

I. FLIGHT 1 - PRACTICAL TRAINING STRUCTURE

The effectiveness of training flights for instructing new spotters depends on careful preplanning. Specifically, appropriate drop spots need to be selected in advance of take-off; pilots need to be briefed on the objective of the training flight and their role; an ordered and logical sequence of applying classroom information to real streamer dropping and spotting needs to be preplanned prior to take-off; and trainees should be briefed in detail on the flight and informed of exactly what hey will be expected to do.

Flight 1 should be conducted in low to moderate wind conditions. Calm conditions and high wind conditions should be avoided. Elements of Flight 1 are as follows:

A. Determining Where the Aircraft is Over the Ground

The instructor will work with the trainee in the jump door to check the develop the trainee's ability to perceive exactly where the aircraft is over the ground. Buildings, ponds, crossroads, etc. can be used. Suggested techniques such as sighting over a rivet in the door sill, or sighting on a thumb positioned in the door sill will be explained. The effect of the aircraft banking will be demonstrated. The straight down appearance of trees will be pointed out.

B. Dropping Streamers Over the Jump Spot

1. The instructor will point out a pre-selected jump spot to the trainee. This spot should be small, well defined, and in flat terrain.

2. The instructor will tell the trainee to point out the drop spot to the pilot.

3. The instructor will ask which direction the trainee wants to make the streamer pass. The instructor will point out indicators of wind direction such as smoke, trees and brush swaying, dust on a road, etc. The trainee will instruct the pilot to fly an into-the-wind final for streamer drop.

4. On final, the instructor will work with the trainee to develop perception of correct line-up, possible aircraft crabbing, timing and magnitude of corrections, and perception of when the aircraft is over the jump spot.

5. After releasing the streamers, the trainee will inform the pilot "streamers away," and the instructor will work with the trainee as they watch the streamers descend. The instructor will point out the correct observation pattern, problems and solutions when visibility of streamers is blocked by a wing, and optimum points in the pattern to perceive direction and amount of drift.

6. Just prior to the streamers landing, the instructor will remind the trainee to concentrate and note exactly where the streamers land and simultaneously stop the stop watch. The instructor should caution the trainee not to look at the watch or break concentration before the streamer landing point is memorized and an appropriate exit point selected.

C. Selecting an Exit Point

The instructor will have the trainee identify an appropriate exit point based on streamer drift. The advantage of selecting a well defined exit point will be pointed out. Also, the advantage of selecting an exit point when adjacent to the jump spot, rather than up or down wind of the streamer landing point will be pointed out.

D. Altitude Determination

After the exit point has been selected, the instructor will ask the trainee if altitude is all right. The trainee will check stop watch time. (By prearrangement, the pilot should know and select a correct altitude to avoid dealing with altitude problems on Flight 1).

E. Check Streamers

The instructor should work with the trainee to initiate and drop a set of check streamers using an into-the-wind final pattern.

F. Simulated Jumper Drops

Several sets of check streamers should be dropped by the trainee to develop familiarity with correct aircraft drop pattern size, line up and correction on final, communications with the pilot, and correct perception of when the aircraft is over the exit point.

G. Debriefing

Immediately after landing, the instructor shall conduct a debriefing and critique of the training flight. If a trainee has particular difficulty understanding or performing any of the tasks required during the flight, the instructor is best advised to avoid lengthy discussions and explanations in the aircraft and wait for the debriefing. The noise and wind blast in the jump door precludes effective discussions to solve real problems of understanding.

DETAILED LESSON PLAN OUTLINE

PROGRAM:	Smokejumper
UNIT:	Specialized
LESSON:	Spotter
CHAPTER VI:	**Spotting and Streamer Dropping**
SECTION D:	Flight 2 - Practical Training
SUGGESTED TIME:	1 - 2 hour flight depending on number of trainees. (Two trainees is a suggested maximum per flight).
TRAINING AIDS NEEDED:	Jump aircraft and appropriate smokejumper/spotting equipment. Drift streamers and stop watch. Pre-selected streamer drop spots appropriate to lesson objectives.
OBJECTIVE(S):	At the completion of this flight the trainee will be able to recognize and appropriately take into account the many variables that affect spotting in difficult terrain and windconditions. Specifically, the trainee will be able to:

a. Recognize when there is a need for significant altitude adjustments prior to dropping.

b. Recognize the significance of high terrain up-wind in selecting a drop altitude.

c. Use the "timing method" of determining the exit point to check visual selection.

d. Recognize the effects and options available when confronted with thunderstorm winds, local winds, updrafts, and downdrafts.

e. Explain the effects of streamers landing in terrain significantly higher or lower than the jump spot.

f. Identify maximum wind for jumping.

g. Explain factors involved in selecting a good jump spot in rough terrain.

h. Recognize the jump hazard on lee side of the ridges.

i.. Recognize and correct flight pattern mistakes made by the pilot.

j. Recognize situations that call for crosswind or downwind pattern variations.

FLIGHT 2 - PRACTICAL TRAINING STRUCTURE

Even more than Flight 1, Flight 2 requires very detailed preplanning. This flight requires moderate to hind-wind conditions. Briefing of the pilot must be accomplished since the pilot will be required to intentionally commit certain errors in altitude and flight patterns for the trainees to identify and correct. Carefully pre-selected jump spots must be identified in advance that present specific terrain problems to the trainees. Finally, the instructor must carefully organize the information and problems to present at each pre selected jump spot in order to completely cover the objectives for this flight.

The structure and organization of this flight may vary in detail depending on the specific terrain and wind conditions. However, the objectives of this flight can usually be met if each trainee works three drop spots -- one on a ridge top, one mid slope, and one valley bottom. If wind conditions are such that a specific problem cannot be demonstrated at the selected spots, alternates may need to be selected.

For example, objectives a, b, c, and d can be incorporated in the valley bottom jump spot. The pilot can be briefed to make the initial streamer run at 1,000 feet while the instructor watches for the trainee to catch and correct the altitude problem -- objective "a." The valley bottom spot may offer a good chance to illustrate a situation where high terrain upwind must be identified and drop altitude adjusted -- objective "b." If the wind is not appropriate to result in high terrain upwind, the instructor can identify a hypothetical wind direction that would create a problem for the trainee to perceive the situation. The instructor can have the trainee use the "timing method" of determining the exit point to check a visually selected spot -- objective "c." Finally, the effects and options available when confronted with thunderstorm winds, local winds, and updrafts and downdrafts can be experienced if any of these conditions exist, or hypothetically discussed if they don't -- objective "d."

The remaining objectives can be systematically covered on the mid-slope and ridge top jump spots. The pilots can enhance many aspects of the training by playing dumb and requiring the trainee to really take charge of the spotting exercise and select jump patterns, keep the patterns tight and efficient, etc. Several sets of check streamers should be dropped at each spot to build streamer dropping skills.

The preflight briefing of the trainee by the instructor should be very complete. The objectives that will be the focus of each drop spot should be discussed in advance. The debriefing after the flight presents an excellent training opportunity since it will be clear to both the instructor and the trainee what knowledge and skills have been mastered, and what areas still need work.

CHAPTER VI

Spotting and Streamer Dropping

Section A:	Reading Assignment and Pretest
Section B:	Classroom Lecture and Discussion
Section C:	Flight 1
Section D:	Flight 2

DETAILED LESSON PLAN OUTLINE

PROGRAM:	Smokejumper
UNIT:	Specialized
LESSON:	Spotter
CHAPTER VI:	**Spotting and Streamer Dropping**
SECTION A:	Reading Assignment and Pretest
SUGGESTED TIME:	2 hours for reading assignment, 30 minutes for pretest, 30 minutes for instructor grading of pretest.
TRAINING AIDS NEEDED:	Handouts of narrative written material for classroom lecture on spotting and streamer dropping. Written test.
OBJECTIVE(S):	Upon completion of the pretest, the instructor will be able to identify the knowledge level of the trainees. The reading assignment and pretest is intended to enhance the effectiveness and quality of the classroom lecture and discussion lesson on spotting and streamer dropping.

SPOTTING AND STREAMER DROPPING PRETEST

1. Minimum jump altitude is ________ feet.

2. Minimum jump altitude is specifically related to the above ground level (AGL) altitude above the jump spot.

   True ________False

3. List two methods of determining drop altitude.

   A.

   B.

4. List two reasons why "timing the streamers" may not give an accurate indication of AGL altitude.

   A.

   B.

5. To provide the best determination of wind drift, the first set of streamers dropped should be released:

   A. Directly over the selected jump spot.

   B. An estimated distance upwind.

   C. Over high terrain upwind of the jump spot.

6. Check streamers are normally dropped directly over the jump spot.

   True _____ False

7. Describe the most likely error to be encountered using the "timing method" of determining the exit point rather than visually selecting an exit point. (short answer)

8. List three types of special wind air conditions that may make selection of a correct exit point impossible.

A.

B.

C.

9. By watching the streamers a spotter can gain very accurate information regarding wind velocity and direction at different altitudes during their descent.

True_________False

10. What effect does variation in terrain elevation between the jump spot and where the streamers land have on selection of an exit point and estimating wind velocity? (short answer)

11. Maximum wind for smokejumping with FS-12 canopies is considered to be how many____ mph.

12. List three factors a spotter needs to consider beyond the distance streamers drift when estimating ground wind velocity.

A.

B.

C.

13. List five possible hazards a spotter should look for when selecting a jump spot.

A.

B.

C.

D.

E.

14. List the four standard jumpship patterns used over a fire in the process of spotting.

A.

B.

C.

D.

15. Describe two methods a spotter may use to describe the desired jump run to the pilot after dropping streamers.
(short answer)

A.

B.

16. On “final” during a jump run, a 5 degree correction on long final will have less effect than a 5 degree correction on short final.

True ________False

17. Describe a situation where a cross wind pattern may be desirable when dropping jumpers. (short answer)

18. List three important pieces of information that can be obtained when making a low pass.

    A.

    B.

    C.

19. Why should jump spots on the lee side of ridges be avoided?

20. It is more desirable to use a marginal jump spot close to the fire rather than a large open jump spot which may be a twenty minute walk to the fire.

    True _____ False

DETAILED LESSON PLAN OUTLINE

PROGRAM:	Smokejumper
UNIT:	Specialized
LESSON:	Spotter
CHAPTER VI:	**Spotting and Streamer Dropping**
SECTION B:	Classroom Lecture and Discussion
SUGGESTED TIME:	4 hours
TRAINING AIDS NEEDED:	Classroom, blackboard
OBJECTIVE(S):	Upon completion of this section, the trainee will be able to demonstrate the principles of spotting and streamer dropping by (1) satisfactorily answering verbal questions on the material after classroom lecture and discussion; (2) correctly applying the material during subsequent training flights.

OUTLINE

I. JUMP ALTITUDE

A. Minimum Altitude

Jump altitude should be a minimum of 1,500 feet above the ground. A jump altitude lower than 1,500 feet does not allow a jumper enough time to recognize a pack closure or a full streamer and achieve full deployment of a reserve parachute at a safe altitude above ground level.

B. Jump Altitude = Altitude Above Exit Point

It should be emphasized that "jump altitude" is altitude above the exit point, not altitude above the jump spot. In many cases, the exit point upwind of the jump spot will be higher or lower terrain than the jump spot. This difference in terrain elevation must be taken into account when establishing drop pattern altitude. Smokejumper pilots should look ahead and anticipate this factor when selecting an altitude prior to streamer dropping. Spotters should point out high terrain upwind of the jump spot to the pilot and remind him to add extra altitude.

C. Methods of Determining Drop Altitude

There are a number of methods which may be used to determine and check drop altitude. No one method should be relied upon; rather, one method should be checked against another. As a final test of altitude, a spotter should "look" to see if the altitude seems reasonable.

1. The Low Pass

A low pass in the jump aircraft (500 feet or so) on approaching the fire is one good method of determining ground elevation. 1,000 feet or so added to ground elevation gives the pilot his altimeter reading at jump altitude. The low pass also affords a good look at the fire, hazards in the drop zone, etc.

2. The Radar Altimeter

Some smokejumper aircraft are equipped with radar altimeters. These altimeters give an accurate AGL read-out. In flat and rolling terrain, if the pilot is careful in taking a reading over the probable exit point, radar altimeters are extremely useful in determining drop pattern altitude. However, in steep terrain the cone-shaped "foot print" of the radar altimeter is too large to provide accurate AGL altitude information.

3. Timing the Streamers

A rough check on altitude is made by the spotter timing the descent of the streamers. For 20-foot streamers, 75 seconds of streamer descent indicates an altitude of approximately 1,500 feet. These streamers descend 20 feet per second. If the streamers descend and land in 60 seconds, the spotter would have the pilot increase altitude by 300 feet.

In rugged, hilly terrain, the spotter must be aware that if the streamers land down slope at a lower elevation than the exit point, the altitude will need to be increased even though there was 75 seconds of descent time. If the streamers landed in high terrain but the exit point is out over a valley, 45 seconds of descent may be sufficient.

Updrafts and downdrafts affect streamer descent time and if a spotter feels that the altitude indicated by a streamer descent time looks or seems unreasonable, this method of determining altitude should not be used.

Timing the streamers is only one of a number of tools a spotter uses to determine and check drop altitude and a spotter should not be under the impression that timing the streamers is a precise or universally reliable method.

D. High Terrain Upwind

Any time the jump run is being made toward high terrain, a spotter must take into account the possibility of a jumper hanging up in the door or exiting the aircraft late, well beyond the exit point. If significantly higher terrain lies upwind of the exit point, additional altitude or a crosswind pattern may be needed.

II. DETERMINING WIND DRIFT

The basic procedure used to determine wind drift is to drop a set of drift streamers (weighted to descend and drift as a jumper under the canopy) over the selected jump spot at jump altitude and then note the distance downwind from the "release point" where the streamers land. A point upwind of the jump spot equal to the distance the streamers landed downwind is then selected as the "exit point." A second set of "check streamers" may be dropped over this point and, in theory, should land in the jump spot.

A. Important of Accurately Releasing Streamers Over the Jump Spot

In the process of spotting smokejumpers, there is nothing that leads to more confusion than dropping the initial set of drift streamers incorrectly, 100 yards or so from the jump spot, with the idea that the initialerror in release point will be compensated for when the exit point is selected. This situation occurs frequently when the spotter has difficulty guiding the jump ship over the spot on the initial streamer run, but decides to drop streamers. From the pilot's point of view, confusion can easily begin here - the pilot assumes that the streamers have been let out over the jump spot and that the wind line is the line from where the streamers landed to the jump spot. While the spotter may tell the pilot that the streamers were let out 100 yards to the left, the pilot is left to guess just where the streamers were released. The pilot then must compensate for the error in release point and imagine where the streamers would have landed had they been let out over the jump spot. The spotter can also become easily confused making adjustments for the error in the release point.

Finally, the spotter must look upwind of the jump spot and pick an exit point based on the total result of his memory and compensations. Determining wind direction and release point is a very simple procedure if the streamers are released over the jump spot accurately. However, a combination of errors can add up in a hurry if the spotter does not direct the jump ship accurately over the jump spot before dropping the initial set of streamers.

B. Importance of Selecting Specific Exit Point

Once the streamers have landed, the spotter must immediately select an exit point upwind of the jump spot. It is important that the spotter select a specific object like a tree, rock, etc., and informs the pilot of the exit point. From this time on, the spotter will be directing the aircraft toward this exit point, and need not be overly concerned if the jumpship does not pass directly over the jump spot. If the spotter fails to select a specific exit point, the spotter may have a tendency to concentrate on lining the jump ship up on the jump spot and then flying an appropriate distance past for the release point. With this approach, the jumpship too often winds up flying over the jump spot and on out the correct distance past the spot but in somewhat the wrong direction. The result is that jumpers end up exiting the aircraft to one side of the correct exit point. Or, if a set of check streamers are dropped, the spotter can easily assume that the wind has changed between the first and second set of streamers. A good percentage of the spotting errors that occur are caused by not selecting an exit point.

C. Check Streamers

The second set of streamers is normally dropped over the selected exit point. This set of “check streamers” gives a spotter confidence that the correct exit point was selected. Any time rugged terrain, a tight jump spot, high winds, etc., are a factor, a spotter should not hesitate to spend the time to drop two or more sets of check streamers. The majority of smokejumper fires present a straight forward wind drift situation. A spotter who accurately drops the initial set of streamers over the jump spot, carefully selects the exit point, and drops one set of check streamers can usually feel confident dropping jumpers.

D. The Timing Method of Determining the Exit Point

An alternative method to visually selecting an exit point upwind is the “timing method.” This method is easily abused and can lead to inaccurate spotting if care is not used.

Specifically, the timing method of determining the exit point is accomplished by flying the jumpship over the streamers and timing or counting off the seconds it takes to cover the distance from the streamers to the jump spot. Over the jump spot, the count is reversed. Upon arriving at "O", the jumpship should be over the correct exit point exactly as far upwind as the streamers landed downwind. The problem of this method is that the spotter has no reference once he has passed the jump spot to direct the plane toward. It is easy for the plane to be flying at enough of an angle across the wind line by the time it has flown out 10 seconds to be considerably off to the side of the correct exit point. Counting can be most useful when combined with a selected ground reference exit point.

E. Significant Altitude Changes

Any time the drop altitude is changed significantly based on streamer descent time the spotter must be aware that the amount of drift indicated by the streamers will also be affected. A good rule of thumb is that any time a spotter makes an altitude change of 300 feet or more after dropping an initial set of streamers, another set of streamers should be dropped to check both drift and the new altitude. Generally, a spotter is well off in this situation to simply start over and drop the second set of streamers directly over the spot as if no streamers have been dropped.

F. Unusual Winds

There are a number of wind drift conditions which make selection of a correct exit point impossible.

1. Thunderstorm Winds

Winds coming out of thunderstorm cells change direction as the cells move and as the cells develop or dissipate. When the winds in the area of a drop are erratic because of thunderstorm winds there is simply no way in which a spotter can select a good exit point. In this situation, the spotter has the choice of abandoning the drop or perhaps orbiting the area for 15 to 20 minutes before trying again. If wind velocity is not a problem, and the terrain for a wide area surrounding the drop zone is not hazardous, the spotter may go ahead and drop after briefing the jumpers of the conditions.

2. Local Winds

There are situations where local wind caused by terrain can cause some unusual wind problems. One example would be converging drainages. It sometimes happens that drift from the exit point downwind indicates an area which will be affected by local winds from another drainage which are blowing in an entirely different direction.

Experience and an eye for the terrain are a help to the spotter here. Sometimes a different jump spot can be selected which will locate the exit point out of the influence of the erratic winds.

3. Updrafts and Downdrafts

Updrafts and downdrafts may extend or decrease drift. As long as the updrafts prevail, streamer indication of drift is valid (though altitude indication is not). However, updrafts and downdrafts seem to be erratic or so localized that in the course of dropping a load, some jumpers may be affected by them, others not. In this situation, accuracy in spotting can be a problem.

G. Reading the Streamers

Wind is a mass of air moving across the ground. A set of streamers descending on a windy day behaves just as if it were a calm day -- they descend through a still body of air which happens to be moving across the ground. The point is that the tail of the streamers do not lean any particular direction that gives the spotter any useful information about wind direction. It is true that the tail of the streamers may flutter when descending through turbulence, gusts, or shear layers of wind. However, there are limits to the useful information about wind direction that can be drawn from this.

A spotter can develop the ability to tell generally where the streamers are over the ground while looking at them from various angles. However, a spotter can't glance at the streamers at any point as the plane circles around the streamers and know "exactly" where the streamers are over the ground. A systematic approach to watching streamer descent can give a spotter a good idea of streamer drift throughout their descent. Specifically, if a spotter takes note of the streamers when the airplane is directly in line with the streamers and the jump spot, and 90 degrees on each side of the wind line, the spotter can quite accurately observe wind drift. See figures 1 and 2 and handouts HO-S-1 and HO-S-2.

H. Where the Streamers Land

1. Flat Terrain

With respect to selecting an exit point in flat terrain, the most critical time for a spotter to be watching the streamers is when they land, particularly when the streamers are descending into timber or non-distinct terrain. Unless the spotter has all of his attention focused on the streamers, it is easy to forget or become confused within a few minutes as to just where the streamers land. For this reason, it is a good idea for the spotter to use a stop watch for timing the streamers rather than the sweep hand of a wrist watch which requires the spotter to look away to check streamer descent time. Another solution is for the spotter to delegate the timing of the streamers to the assistant spotter.

2. Steep Terrain

In steep terrain where the streamers are descending into a valley, the landing point of the streamers is not the critical factor. The critical factor is how far the streamers have drifted when they have descended into the altitude of the jump spot. Conversely, if the streamers are landing in higher terrain than the jump spot, the spotter must estimate what additional drift there would have been had the streamers not landed up slope on the hill. (Figure 3 and handout HO-S-3)

III. DETERMINING WIND VELOCITY

A. Ground Wind

A spotter's primary concern with respect to wind velocity is the velocity of the wind on the ground that the jumpers will be landing in. In many cases the winds aloft are quite strong while ground winds are negligible. Occasionally, winds aloft are calm while ground winds are unjumpable. The distance the streamers drift is an indication of overall wind conditions from drop altitude to the ground, but a spotter must keep a close watch on the streamers the moment they land to get an idea of ground wind conditions. Also, the spotter must keep a close eye on other clues as to ground wind conditions such as the behavior of smoke drifting from the fire, waves on bodies of water, the swaying of trees, etc. (Figure 4 and handout HO-S-4)

B. Thunderstorm Winds

High winds are frequently associated with thunderstorms. When a spotter is prevented from dropping jumpers due to thunderstorm activity in the area, the plane may be able to orbit the area for 15 or 20 minutes or land at a nearby airport until the winds subside.

Terrain features are sometimes responsible for funneling or channeling wind through the area of a selected jump spot. A spotter confronted with this situation may be able to pull back and locate a sheltered area some distance from the fire where the jumpers can be dropped.

C. Maximum Wind

Drift of 550 yards is enough to tell the spotter to pay close attention to the various indicators of ground wind velocity. A 15 mph ground wind is about maximum for safe jumping.

(Note: The instructor may desire to mark off 600 yards in 100 yard increments and have the spotter trainee observe it from 1500 feet.)

D. The "Timing Method" of Determining Wind Velocity

As an alternative to judging the distance streamers drift downwind, the "fly over" method may be used. The aircraft is flown over the point where the streamers landed and the spotter counts off the seconds of flight from the streamers to the jump spot. Using 20-foot streamers, 12 seconds of fly over at 90 knots indicates an average wind of approximately 15 mph. This should alert the spotter to pay close attention to other clues of ground wind velocity.

E. The Decision Not to Drop

The decision not to drop because of wind is one of the toughest a spotter must make. When smokejumpers are unable to jump a fire because of wind an FMO must make alternative initial attack arrangements. Dry runs contradict the concept of smokejumpers being the fastest most economical tool to use for initial attack on fires. However, no fire is worth hurting a person and no FMO wants to be confronted with the complication of a medical evacuation. Due to differences in judgment, there are situations where one spotter will say "no" and dry run a fire because of wind where another spotter would not hesitate to drop on the same fire. Spotters must be extremely careful in determining that wind conditions actually do preclude jumping or that alternatives such as a sheltered jump are not available. While the spotter may want to ask the opinion of the assistant spotter or an experienced jumper to help with this decision, the spotter should guard against being unduly influenced by opinions voiced by the crew either for or against the prospect of dropping in high wind conditions.

Note: If not able to jump, the jumpers could be trucked or helicoptered from the closest airport, and the cargo dropped on the fire.

IV. JUMP SPOT SELECTION

Selection of the jump spot is one of the most important responsibilities of a spotter on a fire mission. An error in analyzing the hazards of the terrain or the potential behavior of the fire can result in injured jumpers, or parachutes and equipment being burned over and destroyed.

A. Hazards

1. Terrain Hazards

   A spotter should avoid dropping jumpers in snag patches, broken steep hillsides and bluffs, boulder strewn areas (especially if partially hidden by brush), excessively tall timber, areas where wind and air turbulence make jumping hazardous, areas with excessive windfalls, and any of the other varied hazards that may be present in rough mountainous terrain.

2. Water

   Jump spots near large streams or rivers should be avoided. A spotter should never select a spot in such close proximity to a large body of running water where any possibility of a jumper landing in the river exists. Ponds and small streams, on the other hand, are part of the normal range of obstacles that are found in the vicinity of jump spots. It is not necessary from the standpoint of safety for a spotter to be overly concerned about the proximity of ponds or small streams to a jump spot. However, if there is a satisfactory jump spot located a reasonable distance from the pond or stream, a spotter may want to give extra consideration to it.

3. Power Lines

   Power lines are sometimes difficult to see from jump altitude. Anytime a spotter is dropping in the vicinity of a road system, the spotter should look for power lines. A spotter should never select a drop zone so close to power lines that any possibility exists of jumpers landing in them.

4. Clear Cut Blocks

   Cut blocks should be avoided as jump spots since they contain many hazards such as stumps, downed logs, etc.

5. Old Helispots

   While old helispots may appear to be good jump spots from the air, they should never be used due to sharp stubs.

6. The Lee Side of Ridges

   Jump spots on the leeward side of ridges frequently present the hazard of severe downdrafts. Jump spots on the leeward side of ridges should be avoided.

7. The Fire

   The spotter must take a good look at the fire and use care to select a jump spot far enough from the fire that given a wind switch, etc., the fire is not likely to threaten the jumpers or their jump gear.

8. Small Jump Spots

   Many times small (or tight) jump spots may be a safe option. The hazard may exist when jumpers in the same stick compete for a small spot. In cases like this the spotter should consider dropping jumpers one at a time.

B. Positive Considerations in Jump Spot Selection

Positive considerations a spotter may weigh in selecting a jump spot are: A location that is advantageous to begin initial attack on the fire; a location that has close proximity to water that may be used for pumps or fedcos; a location that will be least likely to damage parachutes on landing; a location that may be advantageous as a helispot later; a good camping area; a location sheltered from the wind; a location that facilitates a flight pattern in which visibility will not be obscured by smoke or terrain during drop operations; multiple jump spots if initial attack on the fire or helispot construction would appear to make it advantageous to split the jump crew. A spotter should discuss jump spot location with the jumper crew boss.

V. THE MECHANICS OF SPOTTING

With regard to the pattern the jumpship flies, or the accuracy of the jump runs with regard to the wind line, etc., a spotter is never justified in coming home with the complaint that the "pilot wasn't flying right." It is the spotter's responsibility to take the initiative to correct whatever might be wrong with a streamer pattern or a jump run pattern. Too often a spotter feels the only job is to select an exit point and give minor corrections to the pilot on final. In reality, the spotter may need to step in at anytime and change a flight pattern a pilot has initiated. Efficient transitions from pattern to pattern should also be checked by the spotter. For example, a lot of time can be lost if a pilot drifts several miles away after a streamer run.

Following a normal routine the spotter should be able to drop streamers and two jumpers in about 6 to 8 minutes from the time the jumpship arrives over the fire.

A. Jumpship Patterns

1. The Observation Pass

A low pass is highly recommended. A low pass (500 ft.) over the jump spot gives the spotter a chance for hazards, check for any lower elevation turbulence and can also help determine drop elevation. The extra time spent making a low pass is time well spent.

2. The Streamer Run

After the low pass, the spotter points out the selected jump spot to the pilot and describes which flight direction is desired for the streamer run. Generally, the drift of the smoke provides a good indication of wind. The spotter moves back to the rear of the plane and informs the pilot when ready. With the jumpship up at jump altitude, the spotter guides the plane over the jump spot, releases the streamers, and informs the pilot of "streamers away."

3. The Streamer Observation Pattern

Upon receiving the signal "streamers away," the pilot banks the plane to the left (to maintain visibility for the spotter out the jump door on the left side of the plane) and orbits the streamers as they drift and descend. If the pilot can see the streamers when orbiting them, they are generally visible to the spotter as well.

There are, however, some common errors made by jumpship pilots when orbiting streamers. Getting too far away is probably the most common error and it is up to the spotter to tell the pilot to stay in closer if the plane seems to be circling too wide. Another common error is for the pilot to have the wing down obscuring visibility of the streamers. This seems to have a way of happening just at the critical moment when the streamers are landing. The solution here is simply for the spotter to tell the pilot to level the wings. Finally, an error which makes it difficult for the spotter to select an exit point happens when the jumpship is between the jump spot and the streamers as they are landing. In this situation, a spotter cannot see just how far downwind the streamers landed from the jump spot, nor can the spotter look upwind and select an exit point. Confusion and disorientation of the spotter can result when there is no readily identifiable terrain reference mark where the streamers landed.

4. The Jump Run Pattern

The jump run pattern resembles a small airport traffic pattern complete with a crosswind leg, a downwind leg, a base leg, and a final. Total time around the pattern should be about 90 seconds. Ninety seconds is a large enough pattern that is not difficult for the pilot to fly and it also allows plenty of time for the spotter to get the jumpers hooked up and briefed. Ninety seconds is still a small enough pattern that excessive time is not wasted. (Figure 5 and handout HO-S-5)

Figure 5

Once the exit point has been selected, the spotter describes to the pilot what flight direction is desired on final. The spotter watches as the jumpers hookup, briefs them on jump spot location, wind conditions, and the fire. The plane turns on final into the wind. The spotter guides the pilot toward the exit point, gives the jumpers a final safety check, and slaps the jumpers out over the exit point. As the jumpers exit, the spotter looks out the jump door, checks to see that their chutes deployed clear of the aircraft, and gives the pilot the signal, “jumpers clear.” The pilot then banks around for another pattern.

B. Methods of Describing the Desired Jump Run to the Pilot

1. Streamers to the Spot

Probably the easiest method for a spotter to describe to the pilot which direction is desired for the jump run after the streamers have indicated the wind line is to have the pilot fly over the streamers, over the jump spot, and on out to the exit point.

2. Ground Reference

It somestimes happens that the pilot loses sight of the streamers and does not see where they land. In this case, the spotter must come up with some method of describing the jump run desired. Use of ground references is probably the easiest way. Examples would be: "fly parallel to the creek, down the drainage, and over the jump spot " or " fly from the small pond downwind of the spot toward the jump spot."

3. The Clock Method

The nose of the aircraft is 12:00. A spotter can describe a new pattern to the pilot by saying, "fly from 8:00 to 2:00 in relation to our last pattern."

4. Corrections off Base Leg

One of the easiest places in a jump run pattern for a spotter to correct a slightly off-line final is on base leg. The spotter can simply tell the pilot to turn in early if the pilot has been turning in too late, or the spotter can tell the pilot to extend the base leg if the pilot has been turning in too soon.

5. Flying the Ship Around the Pattern

Sometimes, due to a lack of ground references and a communication breakdown in trying to describe a jump run, the spotter can simply take over and direct the ship around the entire pattern. The spotter would say something to the effect, "OK, start a left turn; OK, straighten it out. Now we are crosswind. Start a left turn; straighten it out. Now we are downwind..." and so on until the spotter has the pilot flying upwind on the correct final. Spotters should practice this technique to become familiar with the turning radius of the jump ship.

C. Corrections on Final

Minor corrections to head the jump ship precisely over the exit point are made by the spotter on final approach. These corrections are normally made in 5 degrees increments and accomplished by the pilot using flat rudder turns. A spotter must learn to time the corrections properly. If a correction is given too soon on a long final, the spotter may find that a correction back in the opposite direction is necessary before the exit point is reached. If a spotter waits too long to give a correction, it has little effect.

Corrections of greater magnitude than 5 degrees on final can be made. The spotter should call the corrections he wants. For example, '15 left" is sometimes useful for salvaging the jump run.

D. Determining Where the Jumpship is Over the Ground

Determining where the jumpship is over the ground is not a particularly difficult problem. Still, a spotter who is not careful can make considerable errors. One good technique for determining what is straight down in timber country is to look at the top of the trees. Trees which present only their crowns are straight down. If the spotter can see something of a side view of the tree, it is not straight down even though the altitude of the jump ship make it appear so.

E. Lead time

The exit point is the point a spotter would like the jumper to be after exiting the aircraft and is hanging under an open canopy. To accomplish this, the spotter must lead the exit point. The spotter must allow for the time it takes to pull in and slap the jumper out, for reaction time, and for trajectory. A 2-person stick requires the spotter to head the first jumper so the first jumper exits short and the second jumper exits long. It may be helpful for the spotter to think of spotting for an imaginary jumper between the two jumpers on a 2-person stick.

F. Crosswind/Downwind Pattern Variations

While on upwind pattern is standard, there are times when a crosswind or a downwind pattern may be desirable. Some examples of these situations are as follows:

1. The jump spot is on top of a steep ridge and the wind is blowing 90 degrees across the ridge. By making the jump run into the wind and across the ridge you increase the chance that long or short exits will miss the ridge top jump spot. In this situation it may be desirable to fly a crosswind pattern parallel to the ridge. With this pattern, jumpers getting out either short or long will still be in position to land along the top of the ridge.

2. In the case of a jump spot which results in an upwind pattern flying out towards a lake or a river, a crosswind pattern may protect jumpers from a wet landing if they were to hang up in the door or be carried long.

3. Sometimes an upwind pattern results in the plane flying toward excessively high terrain and a crosswind pattern is desirable.

4. In difficult terrain, a spotter may attempt to fly an upwind pattern for a jump spot on the left side of the fire.

   Because the fire is underneath the aircraft and out of sight, the spotter may become disoriented.This is a situation where a downwind pattern may be used. The fire becomes visible from the left side of the airplane and may be used as a reference.

   A spotter should not hesitate to use a nonstandard pattern when one is desirable. However, the spotter should brief the jumpers to avoid confusion on their part. Also, on the crosswind patterns, it is helpful to fly in a direction which puts the spotter looking out the jump door toward the jump spot. On downwind patterns, the spotter must guard against spotting long and letting the jumpers out short. This is easy to do because of the increased ground speed of the aircraft.

VI. COMMON ERRORS IN SPOTTING AND STREAMER DROPPING

A group of experienced spotters representing all the smokejumper units agreed that the following list includes some of the most common errors in spotting and streamer dropping.

1. Not getting the aircraft directly over the spot when dropping the initial set of streamers. This leads to confusion of both the spotter and the pilot.

2. Dropping too many sets of streamers and thereby causing the jumpers to lose confidence in the spotter's ability.

3. Altering the exit point every time a jumper misses the jump spot. Canopy handling errors, not errors in spotting are many times the problem here.

4. Reluctance to drop more streamers after several jumpers have missed the spot by a wide margin and the spotter does not know the correct exit point.

5. Not picking a specific terrain reference (object, tree, rock) for the exit point.

6. Failure to take into account the reaction time of a jumper (lead time).

7. Spotting for the first jumper and carrying the second jumper long.

8. Failure to recognize variable winds caused by thunderstorms in the area and halting streamer dropping until conditions stabilize.

9. Losing the reference point or failing to identify the exit point in solid timber or tundra.

10. Failure to take into account cues such as smoke from the fire which may signal a wind drift.

11. Not recognizing high and low winds when reading streamers.

12. Not watching closely the last 100 feet of streamer descent and streamers show high ground wind velocity.

13. Not carrying jumpers far enough. Jumpers seem more often to drift back past the jump spot rather than land short as a result of mis-spotting.

14. On downwind runs, carrying too far and putting jumpers out short. The spotter must take into account the increased ground speed of the aircraft.

15. Failure to accurately determine aircraft altitude over the exit point by relying on streamer descent time in situations where streamers are descending into a valley or landing on a ridge.

16. Descending the quality of prejump briefings for jumpers toward the end of the load.

17. Not looking for a sheltered drop zone some distance from the fire before deciding to give up and declare a dry run.

18. Dropping jumpers in rough terrain or large trees close to a fire instead of a better drop zone a reasonable distance away.

19. After incorrectly dropping the first set of streamers not going back and starting all over again.

CHAPTER VII

Records and Forms

Section A: Spotter Mission Recordkeeping

Section B: Aircraft Contract Familiarization/Flight Invoices

NOTE: Sections for this chapter will need to be developed by each smokejumper unit for the appropriate record keeping and forms required.

DETAILED LESSON PLAN OUTLINE

PROGRAM:	Smokejumper
UNIT:	Specialized
LESSON:	Spotter
CHAPTER VII:	**Records and Forms**
SECTION A:	Spotter Mission Recordkeeping
SUGGESTED TIME:	1 hour classroom
TRAINING AIDS NEEDED:	Smokejumper mission forms, jump requests, etc.
OBJECTIVE(S):	Upon completion of this section, the trainee will be aware of information recording the spotter must do on a spotting mission such as: Take off time, arrive over fire, chute numbers, fire size-up, departure time from fire, etc. The trainee will be able to correctly fill out required forms.

DETAILED LESSON PLAN OUTLINE

PROGRAM:	Smokejumper
UNIT:	Specialized
LESSON:	Spotter
CHAPTER VII:	**Records and Forms**
SECTION B:	Aircraft Contract Familiarization/Flight Invoices
SUGGESTED TIME:	1 hour
TRAINING AIDS NEEDED:	Aircraft contract and flight invoice forms
OBJECTIVE(S):	Upon completion of this section, the trainee will be able to explain the basic provisions of smokejumper aircraft contracts, daily availability, flight hour rate, pilot duty day limitations, etc., and will understand the process of signing and verifying flight invoice entries made by the pilot.

CHAPTER VIII

Operational Procedures and Responsibilities

DETAILED LESSON PLAN OUTLINE

PROGRAM:	Smokejumper
UNIT:	Specialized
LESSON:	Spotter
CHAPTER VIII:	**Operational Procedures and Responsibilities**
SECTION A:	Spotter Daily Routine Responsibilities
SUGGESTED TIME:	30 minutes
TRAINING AIDS NEEDED:	All facilities of the local smokejumper unit including a smokejumper aircraft on the ramp. Lesson plan prepared corresponding to local procedures.
OBJECTIVE(S):	Spotter daily responsibilities vary depending upon the organization and practices of each smokejumper unit. Upon completion of this section, the trainee will be able to explain the responsibilities in the local smokejumper organization. Checking aircraft load, pilot availability, briefing an assistant spotter, etc., are examples of responsibilities that may or may not be appropriate at the local unit.

OUTLINE

I. SPOTTER DAILY ROUTINE RESPONSIBILITIES

Note to Instructors: The daily routine responsibilities assigned to spotters vary in each smokejumper organization. This is because facilities and organizational structures vary. For example, a large smokejumper organization may assign aircraft loading to a load master. A smaller organization may assign aircraft loading responsibilities to the spotter. Each organization needs to develop a lesson plan that outlines specific spotter daily responsibilities for their organization. Examples of responsibilities that may or may not be assigned to the spotters include:

--Aircraft loading
--Daily inspection of aircraft load

--Insure aircraft pilot is on duty at assigned time
--Insure aircraft is properly fueled
--Brief assigned assistant spotter, delegate duties
--Check jumpers' gear is on suite up rack
--Other fire readiness responsibilities as assigned

DETAILED LESSON PLAN OUTLINE

PROGRAM:	Smokejumper
UNIT:	Specialized
LESSON:	Spotter
CHAPTER VIII:	**Operational Procedures and Responsibilities**
SECTION B:	Additional Responsibilities
SUGGESTED TIME:	45 minutes, lecture and discussion
TRAINING AIDS NEEDED:	Classroom
OBJECTIVE(S):	Upon completion of this section the trainee will be able to apply the special spotter responsibilities discussed in this section on subsequent training and actual firemission flights.

OUTLINE

I. THE SPOTTER'S SELF CONTROL

Inexperienced jumpers on a load are likely to look to a spotter as an ultimately wise, experienced, and infallible individual. They trust the spotter with their lives as they take their positions in the door. There is not reason for a spotter to do anything to disturb their trust. For example, if it is windy and the spotter feels a little uncertain about the exit point, the spotter is best advised not to show this uncertainty but to drop another set of streamers before making a decision. A spotter who visibly becomes flustered, excited, has a fit of temper, or seems in any way out of control will immediately affect the confidence of the jumpers -- particularly the less experienced jumpers. A lot of minor mistakes can and will be made by a spotter without affecting the safety or success of a mission. If these mistakes ruffle and disrupt the spotter's composure, a jumpers' confidence can be lost. A new spotter on the first spotting run may have as many butterflies as the new person making the first fire jump. However, the spotter better not let the jumper know it. More than appearances are involved here. It is expected that a spotter do the job without letting emotions override or distract from paying attention to the numerous critical details which can affect the safety or effectiveness of a mission.

II. RESPONSIBILITY OF A SPOTTER VS. THE JUMPERS' POINT OF VIEW

When a smokejumper assumes the responsibility of a spotter, suddenly there is a different relationship to other smokejumpers than in the past. A jumper's viewpoint is apt to be quite different from the spotter's in a number of situations. For example, a jumpship is orbiting a 2-person fire. The scenery is beautiful and there is a camp spot by a lake. the only problem is that it is extremely windy. The first two jumpers on the load want to jump and are willing to take their chances on the wind. The spotter, on the other hand, is concerned about the wind, and is responsible for deciding if it is too windy. In this case, the jumpers' emotional desire to jump the fire may well have overwhelmed their better judgment.

The spotter is in a better position to evaluate the situation objectively and the jumpers expect it. The only factor in the situation that is working against the spotter's objectively is the desire to please the two eager jumpers. In many situations, a spotter must forget the feelings of the crew to make a responsible decision. A new spotter needs to realize two important points: Responsibility will change the view of many situations and the spotter cannot be influenced by the emotionalism or self interest of the crew when safety or efficiency will be compromised.

III. SELECTING AN INCIDENT COMMANDER/CREW BOSS

Most smokejumper organizations have established local operational procedures that routinely place foreman or squad leader smokejumpers on each load dispatched to a fire. However, during fire bust level of activity it is not always possible to maintain these procedures. During fire busts, a spotter may well find that there are no supervisory smokejumpers on the load and may need to select a jumper incident commander or crew boss from the smokejumpers on the aircraft.

If we focus on the primary mission of a smokejumper organization -- to provide effective initial attack -- it seems reasonable that the most effective and experienced fireman should routinely be assigned to be an incident commander. Reasonable as this approach seems in principle, a number of factors work against a spotter applying it.

A. Individuals in a load who are passed over are likely to take exception with the spotter and feel that they are every bit as qualified as the jumper that is selected.

B. The spotter is in the awkward position of having to pass judgment on friends. It is easier for the spotter to pick the first jumper in the door to be incident commander than to pass over a jumper for a more qualified jumper further back in the load.

C. Inexperienced jumpers become frustrated, feeling that they will never be given the opportunity to show what they can do and will never become experienced incident commanders.

It may be tempting for the spotter to select the first jumper on the load automatically to be incident commander. If a spotter does this, a basic spotter responsibility is being neglected. The best qualified among the jumpers who will be dropped on a fire should be selected as incident commander.

There are enough occasions when quick correct action makes the difference in whether a fire is caught or goes over the hill. When a fire goes over the hill, it is routinely attributed to uncontrollable burning conditions. This is probably the case on a good percentage of the fires. However, while it is rarely mentioned, the failure of the incident commander to recognize blowup potential early enough in the day, to order retardant, to order extra people, or to fall back and try indirect attack has resulted in the fire going over the hill. A large project fire which costs hundreds of thousands of dollars can be the result of a spotter's reluctance to assign the best qualified person to be incident commander. Just one instance like this is one too many.

A spotter is responsible to select the most qualified jumper to be incident commander, not necessarily the first jumper in the door. Spotters who duck this responsibility and routinely assign the first jumper in the door to be incident commander are making a difficult situation worse. The more established the first jumper in the door routine becomes, the harder it is for the spotter to pass over a totally unqualified individual. If there is an expectation on the part of the jumpers that spotters will make the first jumper an incident commander, the insult and injury to a jumper who is passed over by a conscientious spotter is intensified, and the conscientious spotter is apt to be resented by the crew.

IV. PROPER STAFFING OF FIRES

In most locations requests for smokejumpers are received specifying a specific number of smokejumper be dropped on a specific fire. In some locations local fire personnel familiar with smokejumper personnel leave the determination of correct staffing to the smokejumper spotter. In any case, it is frequently appropriate for the spotter to contact local dispatch if the specified number of smokejumpers seems inappropriate when the jump aircraft arrives over the fire. Dispatch may be able to inform the spotter that ground crews or helitack are enroute to support the jumpers, or may accept a spotter's suggestion for adjustments in the number of smokejumpers that should be dropped on the fire.

Dropping the correct number of jumpers on a fire demands the best judgment of a spotter. There is no point in not dropping enough jumpers on a fire and having it get away. On the other hand, dropping too many jumpers on a fire may result in unnecessarily exhausting the jumper initial attack force.

Typically a fire bust begins suddenly after a period of inactivity. Particularly in the early stages of a bust spotters have a tendency to drop too many jumpers on fires. A spotter may be sympathetic to a crew of jumpers who are ready for action and feel "now's their chance"... the spotter drops eight jumpers on a fire that could have been handled by four or six. A spotter may not think of the possibility of multiple fires and take the viewpoint that it is better to drop too many jumpers and be sure, than not enough and be sorry. A spotter may be influenced to drop more jumpers than are needed by the jumper incident commander whose only concern is this particular fire and who may be looking at people needed to mop-up as well as to catch the fire. A spotter dropping too many jumpers on an isolated person-caused fire early in the morning may not be thinking about the forecast that called for widespread dry lightning in the afternoon.

In situations where it is appropriate for a spotter to suggest or determine the proper number of people needed, it is a spotter's responsibility to carefully assess the situation and avoid either dropping too many or not enough on the fire.
A spotter should put the number of jumpers on the fire needed to catch it, and should resist whatever temptation may exist to drop more.

V. SPOTTER VS. PILOT RESPONSIBILITIES

The operational smokejumping mission experience of smokejumper pilots varies greatly. Some locations are fortunate to have contract or Forest Service pilots assigned to their smokejumper aircraft who have years of operational (smokejumper mission) experience. In other cases, a spotter may be working with a pilot who possesses only minimum smokejumper pilot qualifications and has little operational experience. Particularly, when working with inexperienced smokejumper pilots, a spotter has a responsibility to provide instruction and correction in smokejumper flight patterns and mission procedures necessary to maintain established standards of efficiency. These responsibilities are not always easy for a spotter.

Most spotters are not pilots. For some reason, this situation may inhibit some spotters. There is a mystique that endows the pilot with special extra-human knowledge and capabilities when flying the airplane. There may be a reluctance on the part of the spotter to question anything the pilot does while flying. However, the pilot, as well as the spotter, is an ordinary human being. The pilot is not a fireman and is likely to have considerably less fire knowledge than the spotter. New smokejumper pilots are likely to have little practical understanding of the need for operational efficiency in contrast to the spotter. A spotter is not adequately performing the job if the spotter does not take charge and see that the pilot, for example, flies at max cruise enroute to a fire, flies at an appropriate altitude on patrols, and does not spend excessive time flying in circles when arriving over a fire. If standards of smokejumper mission efficiency are left to inexperienced smokejumper pilots, smokejumper program standards are not likely to be met. This is not because the pilot lacks a desire to do a good job, but because the pilot lacks experience and knowledge of operationally efficient smokejumper procedures.

There is one area where a spotter should not direct a pilot. When a question of flight safety is involved, the pilot is the final authority. As a firefighter, it is not hard for a spotter to get carried away with the desire to get the job done. For example, a spotter on patrol receives coordinates of a new fire from dispatch and is asked to respond. The spotter checks with the pilot on the fuel situation and the pilot says, “Well, by the time we get down to the fire, we wouldn’t be able to spend any more than 10 minutes dropping or we’ll be short getting back.. it’s cutting it a little close.” A spotter who responds, “Sure would like to give it a try” is putting pressure on a pilot to override his better judgment. Whether it is a question of runway condition or length, flying in bad weather or smoke, etc., the time to resolve any judgment questions of safety vs. operational efficiency is afterwards on the ground. Let the pilot decide flight safety questions and avoid inadvertently pressuring the pilot beyond what he feels comfortable doing.

There have been occasions when pilots seemed to ignore reasonable concerns for flight safety. In this situation, it is the spotter who needs to step in and take charge.

DETAILED LESSON PLAN OUTLINE

PROGRAM:	Smokejumper
UNIT:	Specialized
LESSON:	Spotter
CHAPTER VIII:	**Operational Procedures and Responsibilities**
SECTION C:	Fire Mission Procedures (Take-Off to Landing)
SUGGESTED TIME:	Two or three separate sessions. A total of three hours combined lecture, practical exercises and drill, in aircraft on ramp.
TRAINING AIDS NEEDED:	Smokejumper aircraft on ramp. Checklist of mission tasks corresponding to local procedures.
OBJECTIVE(S):	Upon completion of this section, the trainee will be able to explain the elements, tasks, and responsibilities of a spotter throughout a smokejumper mission.

OUTLINE

Note to Instructors: While each spotting mission has variations, the basic tasks of a smokejumper spotter on a fire mission follow a repetitive routine. Experienced spotters who are able to accomplish all the accumulated tasks of a spotting mission have memorized the routine. For an experienced spotter, the chronological order of tasks are carried out without great thought or difficulty – manifest and fire location are obtained; jumpers checked; chute numbers are recorded; a glance over the shoulder insures the door strap is fastened and the crew has helmets and gloves on for take-off; take-off time is recorded; the fire is located on the map; navigation is accomplished; required routine communications with dispatch are made; the pilot is reminded to begin a descent to an appropriate altitude when approaching the fire, dispatch is contacted with a fire size-up; time over the fire is recorded; the spotter briefs the pilot on jump spot and pattern direction; the spotter puts on emergency parachute; moves from the cockpit to jump door; checks spotter panel pilot/spotter intercom; initiates streamer drop; briefs jumpers; removes door strap; drops jumpers; kicks cargo; checks jumpers' safety, radios situation report to dispatch; etc. In contrast, spotter trainees have no detailed knowledge of the specific accumulation and order of tasks that combine to make up a spotter's job on a fire mission. Despite years of smokejumping experience, the trainee is likely to be unaware of many routine spotter mission tasks that experienced spotters take for granted. Unless the trainee is provided experience in the routine spotter tasks performed on a mission in the form of simulated exercises, the performance of the trainee on subsequent simulated fire mission flights, and on actual spotting missions, is likely be punctuated by errors. These errors have a way of snowballing, requiring the new spotter to try to catch up a missed step. Confusion is created which often results in a chaotic less-than-professional mission.

Simulated exercises that provide a spotter trainee with a routine to use on spotting missions can be conducted in the jump aircraft parked on the ramp. The natural order of a fire mission -- fire call, taxi, take-off, enroute, approaching the fire, over the fire, dropping jumpers, dropping cargo, return to base -- should be used to structure this exercise. The instructor should first describe and demonstrate the routine spotter tasks from fire call to return to base. Then the trainee should be asked to go through the routine. The first time or two through the exercise the trainee is likely to omit numerous tasks -- didn't check door strap, didn't record time off, forgot to get location of fire, didn't check spotter/pilot intercom, didn't time streamers, didn't check jumpers after drop, didn't tell pilot to drop down for cargo dropping, didn't tell pilot where cargo was to be dropped, etc. This exercise should be repeated until the trainee has memorized the entire routine and can easily complete it without missing a step.

The instructor should prepare a checklist that contains all the tasks for each phase of a spotting mission. Local variations such as communication requirements, radio frequencies, assistant spotter vs. spotter responsibilities, and variations in procedures in various types of aircraft require that this checklist be prepared by each smokejumper organization. A general example of this checklist that would require adjustment for local variations is as follows:

A. Fire Call

1. Obtain load manifest and fire location.
2. Check all jumpers present, pilot present.
3. Jumper equipment safety check, record chute numbers.
4. Load jumpers, fasten door strap.
5. Sit right front seat, seat belt on.
6. Set appropriate FM frequency, headset on.
7. Record time fire call and time taxi.

B. Taxi

1. Locate appropriate map/chart for fire location, fold open.

2. Contact dispatch for additional fire information (local procedures vary).

3. Inform pilot of general fire location.

C. Take-Off

1. Prior to take-off roll, check door strap closed.

2. Prior to take-off roll, check jumpers' helmets and gloves on.

3. After take-off, inform dispatch you are off (local procedures vary).

D. Enroute

1. Use PA, inform jumpers of fire information, size, etc.

2. Locate fire on map/chart.

3. Follow ground reference navigation procedures.

4. When level cruise, check that max cruise power is used.

5. Accomplish required position reports.

6. Check landing lights on 5 minutes out from fire.

7. Check descent initiated 5 minutes out from fire.

8. Contact other aircraft over fire 5 minutes out, if appropriate.

E. Over Fire

1. Record time over fire.

2. Contact dispatch with size-up, planned action (local procedures may vary).

3. Prior to moving aft, select jump spot, inform pilot of spot and of desired streamer pass direction.

4. Put on emergency parachute.
5. Move aft to jump door.
6. Check pilot/spotter intercom.
7. Set FM and VHF frequencies on spotter panel as appropriate.
8. Locate streamers and stop watch.
9. Issue radio, map case, to jumper crew boss (local procedures may vary).
10. Make a low pass to check for hazards in jump spot or ground level turbulence. Discuss jump spot with jumper in charge.
11. Inform pilot when ready for streamer run.
12. Drop and time streamers.
13. Drop and time check streamers, if necessary.
14. Determine altitude, wind, exit point, ready to drop.
15. Inform pilot ready for live drop.
16. Signal one or two jumpers to hookup.
17. Monitor and check hookup.
18. Signal first jumper to position in door.
19. Brief jumpers on jump spot location, drift, hazards.
20. Discuss cargo drop spot with jumper crew boss.
21. Remove door strap.
22. Spot jumpers, retrieve and stow D-bags.
23. Make contact with jumpers on the ground as soon as possible.
24. All jumpers on ground, inform pilot ready for cargo.

25. Inform pilot of cargo drop location.
26. During cargo dry run, prepare cargo, check static lines clear.

27. Kick cargo, retrieve D-bags.

28. All cargo on ground, contact jumper crew boss, check jumpers' safety, additional needs.

29. Contact dispatch, report action (local procedures vary).

30. Check, correct fire location -- inform jumper crew boss and dispatch if reported location is in error.

F. Departure and Return to Base

1. Record time left fire.

2. Complete spotter report form.

3. Accomplish routine position reports, as required.

4. Five minutes out from landing, inform dispatch aircraft will need fuel (local procedures vary).

5. Record time in blocks on ramp.

6. Deliver spotter report as required after landing.

CHAPTER IX

Integrated Spotter Skills

DETAILED LESSON PLAN OUTLINE

PROGRAM:	Smokejumper
UNIT:	Specialized
LESSON:	Spotter
CHAPTER IX:	**Integrated Spotter Skills**
SECTION A:	Problem Situation Exercises
SUGGESTED TIME:	2 hours
TRAINING AIDS NEEDED:	Handout of problem situations listed in this section.
OBJECTIVE(S)	Upon completion of this section, the trainee will be able to find solutions to the "real-life" type of problem situations that routinely confront a smokejumper spotter.

OUTLINE

I. PROBLEM SITUATIONS IN SMOKEJUMPER SPOTTING: POINTS FOR DISCUSSION

Good spotting is primarily a matter of good judgment. The following points for discussion are intended to improve a spotter's judgment in dealing with problem situations.

This section should be conducted as follows: the instructor should read one of the problem situations listed below and ask a trainee for the solution. After the trainee has responded, the instructor should open the situation problem for discussion among other trainees in the class, and perhaps offer a solution. Instructors should be able to provide additional problem situation from their own experiences.

1. The winds are marginal, but the spotter decides to drop. One jumper refuses to jump. What should the spotter do?

2. There has been an early morning fire call. Eight jumpers for a load have been notified. The spotter and pilot are ready for take-off but only five

jumpers have arrived; the other three are no where in sight but rumored to be coming. Should the spotter take-off with just five jumpers?

3. The jumpship is taxiing from the ramp with eight jumpers toward the runway for take-off and the spotter realizes that they are short two fire packs. Should the spotter turn around and get two more fire packs?

4. The spotter has dropped six jumpers on a fire. After the cargo is out, the jumper incident commander on the ground calls and asks the spotter to drop an extra cube container of water because one of the cube containers streamered in. The spotter realizes that if another cube container is dropped, there will not be any extra water left for the two remaining jumpers on board which may be dropped on another fire. Should the spotter drop the extra cube container?

5. On a patrol, the spotter is called by an observer in a detection ship flying the area. The spotter is requested to drop jumpers on a fire to replace helitack that wants to get back to base for initial attack. Should the spotter drop jumpers as requested?

6. It is a bust situation and the spotter takes off with the last four jumpers of the base. Upon arriving over the fire, the spotter finds that the fire is ¼ acre; there are 15 people on it already, it seems to be controlled, and the critical burning period of the day is over. From listening to the radio, the spotter learns that pumps and reinforcements are on the way by road. The FMO is over the fire in a light twin and the spotter establishes radio contact with the FMO. The spotter suggests that considering the shortage of jumpers it might be best if the jumpers didn't drop. Did the spotter do the right thing?

7. The spotter has dropped four jumpers on a fire. It look marginal, but the spotter thinks four jumpers can handle it. There are several other fires in the area that need jumpers. The jumper incident commander on the ground calls the spotter and requests the remaining jumpers on board. Down on the ground, the jumper incident commander isn't sure that four jumpers will be able to catch the fire. What does the spotter do?

8. The jumpers have been dispatched to reinforce helitack on a fire in fire-bust conditions. Upon arriving over the fire and looking at the natural barriers around the fire, the spotter doesn't feel there is any need to drop jumpers. The helitack incident commander still wants the jumpers. Should the spotter suggest to the helitack incident commander that jumpers are not needed or should the spotter go ahead and drop?

9. The jumpship, helitack, and a retardant plane are all approaching a fire at the same time. There is no air attack supervisor in the area. What does the spotter do?

10. The jumpers are dispatched to a fire. Upon arriving over the area, the spotter observes that the fire is located in a maze of lakes. It would be tight getting the jumpers on dry land, particularly considering one new-person on board; there is a good chance someone will get wet. What does the spotter do?

11. The jumpers receive a fire call for a fire 1-hour flight time away. As the pilot is cranking up the engine of the plane, the pilot tells the spotter, "I have only 1-1/2 hours of flight time left." What should the spotter do?

12. The spotter has dropped eight jumpers on a fire. It is obvious to the spotter that if the jumpers are going to have a chance to catch the fire they will need a pump right away. The spotter would like to go into base, pick up a pump and come back and air drop it. How does the spotter proceed?

13. After dropping two jumpers on a fire, the spotter is instructed to load and standby with the remaining six jumpers at an outlying station. Upon landing, the spotter encounters a situation where the six jumpers receive very poor treatment by the station manager. While there is a lodge and cafe available, this station manager wants the jumpers to spend the night in their airplane and eat C-rations. What does the spotter do?

14. It is the most miserable, roughest, most horrible fire the spotter has ever seen. It looks to the spotter like it is just too rough to jump. It looks that way to the jumpers on board too. What does the spotter do?

15. Two jumpers have been put on an eight-person fire. As the plane comes around for the second stick jump run the spotter receives a call from one of the jumpers on the ground saying that the other jumper is broken up and hurt really bad. The fire is starting to take off. What does the spotter do?

16. The jumpers have been dispatched to a fire. Enroute, the spotter finds a new fire that eight jumpers could handle. Should the spotter call dispatch and suggest the jumpers be dropped on this fire?

17. The jumpship is flying in the area of a large fire on patrol. The jumpship receives a request from an assistant FMO asking if the jumpship can work as lead plane for retardant on the large fire. The spotter has a load of jumpers on board. What does the spotter tell the assistant FMO? What would the spotter do if confronted with this situation after dropping all of the jumpers?

18. On patrol a spotter finds a new fire. The fire is located very close to Forest boundaries. In fact, the spotter is not sure which Forest the fire is on. The jumpers can catch the fire if they get on it quick enough, and the spotter doesn't want to spend any time figuring location and checking boundaries. The spotter drops the jumpers, then checks location and notifies the appropriate dispatch. Did the spotter do the right thing here?

19. The jumpship is orbiting a 50-acre fire along with the District FMO who is in a light twin. It is obvious that the jumpers will have a rough time with this fire. It is burning hot around the entire perimeter. The FMO tells the spotter to go ahead and drop the jumpers, that retardant and helitack are on the way. The FMO then flys off as the spotter starts dropping streamers. As the spotter is about to drop the jumpers, the wind shifts and the fire spots into heavy timber and makes a run. It is obvious that the fire situation has changed drastically and there is little that can be done to contain the fire under the present weather conditions. Should the spotter go ahead and drop the jumpers anyway? Should the spotter hold off until communications can be reestablished with the FMO?

20. On patrol, the jumpship finds a two-person fire and is instructed to drop on it. The second jumper on the jump list wants to switch with the number six jumper because a friend is arriving in 2 days. Should the spotter allow the switch?

21. On checking the jumpers prior to dropping an eight-person fire, the spotter discovers that one jumper has an out-of-date reserve. Does the spotter let that jumper jump with an out-of-date reserve?

22. The spotter is dropping a reburn. One of the jumpers on board, who was on the fire originally, points out the old camping area and helispot and suggests that it would be a good place for a jump spot. What problem is the jumper overlooking that the spotter should be aware of?

23. Over a fire in a canyon bottom, the spotter finds it impossible to drop streamers and be able to watch their descent. What does the spotter do?

24. On patrol, you stop at an airport for lunch. The pilot drinks a beer and says, "I am ready to fly." What should the spotter do?

25. The jump plane has been flying for 3 hours on patrol and is 20 minutes from an airport. The aircraft needs fuel, and the jump crew is hungry. What does the spotter do? The FMO has arranged hot meals at a restaurant in town and will haul the crew to the restaurant. It is 1400, hot, dry, and there are large cumulous buildups all around. What does the spotter do?

26. Upon approaching home base, the jumpship develops landing gear problems and a gear up landing is necessary. What does the spotter do?

27. On a cargo drop with four jumpers still on board, both engines suddenly feather. What does the spotter do?

28. During a cargo drop, a static line misroutes and a fire pack goes into tow. What does the spotter do?

DETAILED LESSON PLAN OUTLINE

PROGRAM:	Smokejumper
UNIT:	Specialized
LESSON:	Spotter
CHAPTER IX:	**Integrated Spotter Skills**
SECTION B:	Simulated Fire Mission, Flight 3
SUGGESTED TIME:	2 hours
TRAINING AIDS NEEDED:	Jump aircraft, role players for radio communications, jumpship to dispatch, other aircraft, and jumpers on the ground. Two suited jumpers. Streamers, stop watches. Appropriate charts or maps. Evaluation checklist.
OBJECTIVE(S):	Upon completion of this section the trainee will be able to person a wide range of the skills covered in the spotter training program as they occur on a fire mission. Specifically, the trainee will be able to:

(a) Follow correct operational procedures in response to fire call.

(b) Conduct a complete prejump safety check of jumper equipment.

(c) Enforce correct take-off procedures (i.e., helmet and gloves on).

(d) Navigate to a pre selected simulated fire.

(e) Correctly establish streamer drop patterns, drop streamers, and select an exit point.

(f) Conduct appropriate radio communications with dispatch, other aircraft, and jumpers on the ground.

(g) Respond appropriate to any unusual problem situation presented in the exercise.

(h) Correctly complete required fire mission records and forms.

(i) Correctly follow established aircraft procedures to hookup and position jumpers in the door.

(j) Accomplish tasks required of a spotter upon return to base.

OUTLINE

This flight should be structured as closely as possible to simulate an actual fire mission. In fact, this simulated fire mission can be far more effective training than an actual fire mission. This is because the simulated mission can be structured to include the full range of spotting skills, difficult jump spot problems, and special problem situations. In contract, real fire missions may vary from a simple no-problem fire to a complex and difficult fire. The simulated fire mission allows the instructor to control the scenario so that a wide range of spotting skills are required and special problems are presented to the trainee.

The specific structure of the simulated fire mission must be supervised by each smokejumper unit administering the training. This is because the structure of the training is dependent upon the specific spotter assigned responsibilities, facilities, aircraft, terrain, and communications requirements and procedures of the local area. A smokejumper organization that uses contract pilots with minimum experience in smokejumping procedures may want to focus the exercise more strongly on the spotter's role in maintaining correct mission procedures than does an organization that uses very experienced contract or agency pilots. However, since all spotters may be called upon to work with a pilot who has minimum operational experience, all exercises should include at least some problems that reinforce the spotter's responsibility to maintain control of the operational aspects of the mission. Suggested guidelines and common elements for this flight are as follows:

The flight needs to be structured to a reasonable degree of complexity. The demands of the trainee should exceed dropping a two-person fire on a calm day in flat terrain. However, the instructor should not introduce so much complexity, and so many problems, that the trainee is overwhelmed. This exercise needs to be realistic, demanding, and fair; not demoralizing.

The effectiveness of this flight depends on the instructor accomplishing very careful preplanning. Selection of the simulated fire location and terrain is important. Planning the specific problems to include in the exercise, such as radio communications with dispatch, air attack, helicopter, and jumpers on the ground needs to be carefully planned. The exercise may be preplanned to include a simulated jumper inquiry, or request for additional people from the jumpers on the ground that requires the trainee spotter to respond appropriately. The specific simulated problems included need to be selected and the scenario written down by the instructor. Each phase of the exercise -- the fire call, takeoff, enroute, over-the-fire, simulated dropping, and return to base phase of the exercise -- needs to be carefully planned.

Role players need to be selected and briefed. Provisions for radio communications with the jump aircraft by role players during the flight need to be arranged. If possible a dispatch office should be used. Both FM and VHF radio communications should be required so trainee spotters are confronted with the need to operate the aircraft audio panel as they would in a real fire mission.

Two suited jumpers should be included in the exercise. The trainee spotter should be required to accomplish equipment checks and hookup procedures and prejump briefings for these jumpers just as if the flight were a real fire mission. The instructor should brief the two jumpers to arrange several subtle equipment problems that the trainee will be expected to identify. These jumpers could be briefed to delay putting on their helmets prior to takeoff to give the spotter trainee an opportunity to take control and correct the problem.

The pilot should be briefed on his role. In general, the pilot should be instructed to be cooperative with the trainee, but not to correct mistakes made by the trainee unless absolutely necessary. The instructor may want the pilot to introduce a problem, such as setting up for streamer dropping several hundred feet high or low. These arrangements will need to be covered in a pilot/instructor briefing.

Finally the instructor should brief the trainee on the simulated fire mission. This briefing should fall short of revealing the specific problems planned during the flight, but should include a general description of the prejump check, take-off, time recording, communications, streamer dropping, hookup procedures, etc. that will be part of the exercise. The fact that problem situations will be included in the exercise should be explained to the trainee. In general, "make believe" should not be a part of the exercise. Specifically, fire behavior that cannot be seen should not be made important to the exercise. The trainee should be clearly briefed to work through the exercise as if it were an actual fire, and should be told that no help will be provided by the instructor.

The instructor must prepare an evaluation check sheet for the flight to note trainee performance, omissions in procedures, and comments on trainee performance during various stages of the simulated fire mission. Unless absolutely necessary, the instructor should not correct mistakes as they occur, but rather should note them on the evaluation check sheet. These notes can be used by the instructor during the debriefing after the flight. Trying to correct mistakes as they occur breaks the continuity of the exercise and is difficult amid the noise and wind blast of an open-door jumpship. Unless it is absolutely necessary for the instructor to intervene, the instructor should sit back during the course of the flight, take notes, and let the trainee succeed or fail in handling the situations of the exercise as they occur.

The debriefing from this flight is where the important instruction occurs. The pilot and role players should be included with the instructor and trainee. The debriefing should chronologically cover the flight from equipment check, take-off, enroute, streamer dropping, and return to base. Mistakes such as problems missed in an equipment check, navigation, communications, jump spot selection, streamer dropping, or special problems should be pointed out. The accuracy and completeness of the trainee completed jump request should be reviewed. Correct performance should be identified as well as mistakes. Perfect performance on an exercise such as this would be difficult for the most experienced spotter to achieve and the instructor needs to be careful to inform the trainee that mistakes are expected. Properly conducted, the debriefing is excellent training. Carelessly conducted the debriefing could unnecessarily demoralize the trainee. If the problems and structure of the exercise have been realistic and fair, as opposed to a series of tricks on the trainee, the trainee will have learned a great deal.

Suggestions for structure and problems to include in a simulated fire mission flight are listed below. Actual exercises should probably not include as many problems as are suggested. However, realistic problems should be included in each phase of the flight.

A. Prior to Fire Call

If inspection and check of the jump aircraft load is a spotter responsibility at the local unit, this inspection should be part of the exercise. The instructor may arrange for several items of standard equipment to be missing, such as spotter kit gear, spotter helmet, or cargo chutes.

B. Fire Call

The trainee should accomplish all normal spotter tasks that are part of local unit operating procedures. Obtaining fire location, maps, and load manifest are examples. Two smokejumpers should suit up and the trainee spotter should perform an equipment safety check. The instructor may have arranged with the role player smokejumpers to include several subtle equipment problems in the arrangement of their gear. An out-of-date reserve may be used, a letdown rope may be left behind, or a static line snap safety pin may be missing. The instructor may have arranged for the pilot to be late in responding to the fire call so that the trainee is required to take some quick action, such as using the PA system, to locate him.

C. Take-Off

Role player jumpers may have been briefed not to put on their helmets until requested by the trainee spotter.

NOTE: If the trainee spotter misses this point, role players should put their helmets on as the aircraft starts to role on take-off.

D. Enroute

The enroute portion of the exercise provides navigation and radio communications experience for the trainee. The pre selected simulated fire should be far enough out (20-25 miles) to allow time for navigation and communication exercises. The pilot may have been briefed to head 45 degrees off the correct course so the trainee will need to provide a correction. (NOTE: In this case, if the trainee misses the heading error, the instructor will need to correct it.) Prior arrangements could be made to have dispatch call and divert the jump ship to a different fire, requiring the trainee spotter to locate the new fire on the map enroute. Some communications between dispatch and the spotter trainee in the jumpship should be arranged that requires the trainee to contact another aircraft, station, or person on the ground when over the fire. The combined tasks of navigation and communication should be arranged to keep the trainee fairly busy, but not overloaded, enroute to the simulated fire.

E. Approaching the Fire

The pilot may have been briefed to be inappropriately high near the fire so it is necessary to lose time spiraling down to drop altitude. The spotter trainee may catch the problem and suggest to the pilot to stay at an appropriate altitude, or start a descent about 5 miles out. Any radio communication required approaching the fire should be attended to by the trainee spotter.

F. Over the Fire

The instructor should point out the simulated fire to the trainee. An old burn, a pond, or a clearing with defined boundaries is ideal. The simulated fire should be in rather difficult jump terrain. Selection of the jump spot, efficient initiation of the streamer drop pattern, direction of flight on final, the decision when stop dropping streamers and start simulated jumper drops should be left to the trainee spotter. Hookup procedures and positioning jumpers in the door should be accomplished but jumpers should not be dropped. The trainee should have been briefed by the instructor to drop streamers to simulate jumper drops. The trainee should accomplish routine communications with jumpers on the ground after completing the drop. On-the-ground jumper role players are to call the jumpship while dropping is in progress. Simultaneously, the scenario may call for a helicopter or other aircraft to arrive and call the jumpship on a VHF frequency rather than a FM frequency. In this situation the trainee spotter will have to set priorities and take appropriate action to sort out several things happening at once. Prior to departing the fire, the trainee should check and correct the reported location which may, by arrangement of the instructor, be a drainage off the reported location.

G. Return to Base

The flight home should allow the instructor to complete his evaluation notes, and the trainee a chance to fill in the blanks on the jump request, i.e.., take-off, time over fire, completed drop time, fire location, etc.

NOTE: If training funds allow, it is desirable to plan two flights of progressive difficulty, rather than one.

DETAILED LESSON PLAN OUTLINE

PROGRAM:	Smokejumper
UNIT:	Specialized
LESSON:	Spotter
CHAPTER IX:	**Integrated Spotter Skills**
SECTION C:	Supervised Practice Jump Spotting
SUGGESTED TIME:	½ - 1 hour flights
TRAINING AIDS NEEDED:	Jump aircraft, appropriate smokejumper/spotting equipment, and smokejumpers.
OBJECTIVE(S):	At the completion of these exercises the trainee will be able to effectively serve as a spotter on a fire mission under the supervision of a check spotter.

OUTLINE

The number of practice jump spotting missions a trainee will need to meet the objective will be determined by the instructor. During this phase of the spotter training all of the spotter training knowledge and skills taught should be practiced by the trainee. The instructor may desire to develop a checklist or some other tool to assist in critiquing the trainee after each mission.

DETAILED LESSON PLAN OUTLINE

PROGRAM:	Smokejumper
UNIT:	Specialized
LESSON:	Spotter
CHAPTER IX:	**Integrated Spotter Skills**
SECTION D:	Supervised Fire Mission Spotting
SUGGESTED TIME:	Depends on location of fires
TRAINING AIDS NEEDED:	Jump aircraft, appropriate smokejumper/spotting equipment, smokejumper request, map case, and smokejumpers.
OBJECTIVE(S):	Upon completion of spotting four supervised fire missions, the trainee will become a qualified spotter.

OUTLINE

A minimum of four actual spotter missions under the supervision of a check spotter must be performed before a trainee may become a qualified spotter. More than four missions may be necessary depending on the performance of the trainee. The instructor may desire to develop a checklist or some other tool to assist in critiquing the trainee after each mission.

DETAILED LESSON PLAN OUTLINE

PROGRAM:	Smokejumper
UNIT X:	Specialized
LESSON:	Spotter
CHAPTER X:	**Spotters' Refresher**
SUGGESTED TIME:	8 to 16 hours
TRAINING AIDS NEEDED:	See corresponding preceding chapters
OBJECTIVE(S):	It is of paramount important that experienced spotters maintain their skills at the optimum level. One way to accomplish this is to conduct and require a comprehensive spotters' refresher training session. This should be a yearly session and should be held just before, or in conjunction with, spring Smokejumper refresher training. The following is an outline of a suggested agenda for a spotters' refresher session.

OUTLINE

I. SPOTTING AND STREAMER DROPPING

Refreshers should begin by completing the pretest found in Ch. VI, Sec. A. Upon completion of the test the instructor should review the answers and promote discussion.

A review of spotting and streamer dropping procedures as outlined in Ch. VI, Sec. B should be conducted. The instructor should encourage open discussion.

II. FIRE STAFFING, FIRE MISSION AND OTHER POLICIES

This session should be conducted by the Smokejumper Base Manager or other upper level management personnel. At this time any policy changes can be discussed and continuing policies can be reaffirmed.

A session of familiarization with the current aircraft contract and the spotter's responsibility under the contract can be conducted at this time.

III. SAFETY

A review and update of safety procedures as outlined in Ch. II should be conducted. The review should include the pre-jump safety check, general aircraft procedures and aircraft emergency procedures.

IV. SPOTTER'S DUTIES AND RESPONSIBILITIES

A review of spotter's daily responsibilities along with operational procedures and fire mission procedures should be conducted.

V. NAVIGATION REVIEW

Session to include the following:

- -Maps, aeronautical charts and plotters
- -Aircraft instruments and nav-aids
- -Loran C/GPS

VI. RADIO USE

A review of radio use and procedures should be conducted. This session should include the use of aircraft radios as well as all other radios organic to Smokejumper operations.

VII. PROFICIENCY JUMP SPOTTING

Refresher spotters are required to display proficiency by spotting one proficiency before being placed in operational status (FSH 5709.14). This also means that one cargo drop will be done, dropping at least one 5 gal. cubie, prior to dropping jumpers and cargo on operational missions.

Every effort should be made to train beyond the minimum requirement. The instructor may want to consider using the proficiency jump to set up some hypothetical training situations. Some examples are: use of nonstandard jump run patterns, use of jump-run corrections, communication with the pilot, navigation training, etc.