SECTION 5 - TACTICAL AIR OPERATIONS

The objective of tactical air operations is to aid in the effective and efficient protection of resources. In all aspects of fire suppression activities, safety must be the primary considerations when planning strategies and tactics.

Aircraft are often the most expensive single cost item on a fire. Well managed, effective aircraft use can result in reduced suppression costs.

The incident commander, operations section chief, or you, the tactical supervisor, must consider not only the cost of using aircraft, but also the cost of not using it.

FACTORS AFFECTING AIRCRAFT USE

Density Altitude

Heat, elevation and humidity make air less dense. When the density altitude exceeds 4,000 feet, performance usually begins to be affected. High density altitude reduces both the effective engine horsepower and the lift provided by the wing or rotor system, thus effectively reducing performance. To what degree this affects performance depends on the aircraft. Managers of various aircraft can determine if your objectives for tactical aircraft use can be met.

Size, Configuration, And Speed

Other factors affect the capability of the aircraft to perform a job. These include the physical dimensions and configuration of the aircraft (how it is equipped, number of seats, etc.) and its air speed. These are all factors that need to be considered when planning for tactical aircraft use.

Terrain

The lay of the land can limit the space available to orbit, turnaround, or pull-up. This certainly may limit what can be safely done.

Wind

Wind affects not only fire spread, but also air operations. Too much wind can shut down air operations. The capability to fly an aircraft in excessive wind conditions varies considerably with the weight class of the aircraft and the degree of turbulence associated with the wind.

Atmospheric Conditions

Inversions, turbulence, and position of the sun relative to the target area are some examples of atmospheric conditions that can affect air operations. Inversions can hold smoke in valley bottoms, preventing visibility of the flight path. In late afternoon, unstable conditions can create turbulence, especially along ridges and near converging drainages. The brightness makes it hard for pilots to see while turning or flying toward the sun. Brightness also makes it much more difficult to see the ground on shadowed sides of ridges.

Turnaround Times

Turnaround time is a big factor affecting aircraft use. All air operations are limited by the time it takes to return to re-load, re-fill, or get another load of people or equipment. This is especially important toward sundown when loss of daylight and pilot flight and duty limitations can adversely impact operations.

During a continuing operation, turnaround time is the lag time between time of completion of one step of a mission and the time the same aircraft is ready to perform the next step. For example, it is the duration of time in which an air tanker or helicopter departs after a drop, re-fills, and returns. Turnaround times depend on the mission, support facility locations (retardant bases, re-fueling sites, or dip sites), and the speed of the aircraft. Generally a 5 minute turnaround is considered the limit for helicopter drops; but this depends on remoteness of the location, availability of other aircraft, length of intended use, and other factors. Use of multiple helispots with re-load capability can shorten turnaround for helicopters.

Flight Hazards

Power lines, towers and cables, other aircraft operating in the area, and lack of visibility because of smoke are just a few examples of hazards. Some of these can only be seen from the ground. Make sure the pilot is informed of hazards. The only way to do this is through positive communication. You must be able to talk with the aircraft to use it safely and effectively. The presence of some hazards may preclude the desired mission, because they are too hazardous.

Aircraft Caused Fireline Hazards

Aircraft also can create hazards on the fireline. Air tankers can produce a pair of counter-rotating wake vortices about one wingspan in diameter. Normally these dissipate within two minutes. They sink at about 300 to 400 feet per minute, so they usually are weak or dissipated by the time they reach the ground if the aircraft is flying above 1,000 feet. Vortex velocity depends on the size of the wing, the aircraft speed, and the load on the wing. A vortex will feel like a wind gust which lasts from 15 to 20 seconds normally. This may be enough to initiate torching and spotting. Helicopters in level flight also can create wake vortices, but they are much weaker and are not associated with adverse fire behavior. The problems with helicopters are created by the downwash, the induced flow of air down through the rotor blades.

Environmental Considerations

Environmental considerations may affect air operations, such as restricting the use of retardants or foam, limiting landing areas and cutting of helispots in environmentally sensitive areas.

Agency Policy

Individual agencies have specific limits on pilot flight and duty hours, pilot and aircraft certification, down-loading of aircraft, and specific safety requirements. However, the current trend toward total interagency compatibility is to try and reconcile the different agency's policy within geographic areas and geographic area mobilization guides. As a fireline supervisor, these all should be a consideration for tactical aircraft use. Transportation of hazardous materials is one area that is of great significance to you as a fireline supervisor.

FACTORS TO CONSIDER IN RETARDANT AIRCRAFT USE

The following is intended to provide you with some basic and fundamental information in order to facilitate your decision to use or not use retardant aircraft. It is not intended to be comprehensive, nor does it contain technical specifications or aircraft capabilities and limitations, but does give you some common sense questions and simple guidelines. You should always consult and obtain your local agency policy on ordering or using retardant aircraft.

The best and most cost effective use of retardant is clearly initial attack. Most firefighters will also agree the best use of retardant is when there are ground forces available to follow up retardant drops.

Retardant Use Factors To Consider

1. Values at risk. The decision to use, not use, or discontinue use of retardant should be based upon the protection of, by priority ranking, life, property and resources.

Life	Firefighters and cooperators public threatened	Order immediately
Property	Homes—adjacent to public land	Highest priority
	Structures—adjacent to or on public lands	Next highest priority
	Improvements—fences, recreation sites	Priority if homes or structures not threatened
Resources	Cultural or historical sites	Use retardant to protect or prevent spread into these areas
	Watersheds	
	Range improvements	
	Threatened and endangered species	Local policy on use of retardant
	Timber stands	Does resource value justify cost of retardant?

2. Availability of other suppression resources. Retardant should be used in conjunction with other tactical resources. Retardant can be used to:

a. buy time for ground forces providing them the opportunity to complete sections of line.

b. tie in sections of line where line construction is difficult and slow.

c. cool off a section of line to allow ground forces to direct attack.

d. strengthen and reinforce control lines which may be too narrow to contain the fire.

e. pretreat fuels in advance of line building.

Remember, if you don't ask for it, you probably won't get it.

3. Fire behavior. Will the retardant be effective with the fire acting the way it is?

a. Crowning - difficult to get enough retardant applied to be effective.

b. Spotting - if spotting is widespread, fire intensity is too severe for effective use of retardant. Retardant can be very effective when used on isolated spots or slopovers.

c. Creeping - retardant can be very effective, but other tactical assets may be more cost effective to use if there is no threat of escape or sufficient ground forces are available.

d. Torching - retardant can be effective if the torching is not wide-spread. Retardant can prevent torching from becoming a crown fire.

e. Flame lengths –
retardant is inappropriate and not effective for direct attack when flame lengths exceed 8 feet.

4. Purpose. What will the tactical use of retardant be?

a. Holding - to allow time for crews to arrive.

b. Delay - to slow the advance so that the fire will hit barriers outside burning period, in front of highways, ridges and control lines.

c. Control--can the fire be controlled with retardant?

d. Herding-direct the fire head.

e. Cooling-reduce intensity of the fire so crews or equipment can work.

f. Spot control-keep the fire within the lines.

5. Timing. Considering fire behavior, rate of spread, values threatened and other factors, will the use of retardant be effective?

   a. Can an adequate volume or amount be delivered to the fire to be effective?

      - Are flight times too long to get enough retardant to do the job?

      - Are enough aircraft available to have a continuous volume delivered?

   b. If flight times and number of aircraft are not sufficient to be effective, then ground attack may be the only alternative unless a single load will provide protection for crews, threatened structures or improvements.

   c. When is retardant needed? Sporadic use-continuous-morning-afternoon?

   d. Will competition with other incidents limit retardant aircraft availability?

6. Environmental conditions.

   a. What are the winds? Retardant generally is ineffective when wind speeds exceed 20 mph.

   b. Can the pilot see the fire? Smoke conditions may prevent the pilot from seeing the target.

   c. Will topography allow the airtanker to make its drop and hit the target?

   d. A guideline for airtanker drops is down-sun, downhill, and upwind. Asking pilots to do otherwise could jeopardize their safety.

TYPES, EFFECTS, AND USE OF RETARDANTS

Types Of Retardants

Retardants are generally defined as either long term or short term, which describes their overall capability.

1. Long-Term Retardant-a formulation that has the ability to reduce or inhibit combustion after the water it originally contained has evaporated.

2. Short-Term Retardant-a formulation that relies on the moisture it contains to reduce or inhibit combustion and is ineffective once the moisture has evaporated (generally in 1 to 2 hours).

3. Wetting Agent-a formulation which, when added to plain water in proper amounts, will materially reduce the surface tension of the water and increase penetration and spreading capabilities. Also called surfactant. Ineffective when moisture content has evaporated.

4. Foam-foam solution which provides for adhesion to and penetration of fuels. Foams have the same effect on fuels as short-term retardants and wetting agents. Ineffective when moisture content has evaporated.

Effects Of Retardant

Retardants and foams used by fire agencies assist the firefighter in the suppression effort by doing all or some of the following:

1. Fuel coating - the fuel is coated by the liquid and robs the fire of fuel.

2. Fuel modification - the fuel is modified by the salts or other chemicals in the retardant. This modification inhibits combustion or causes a decrease in intensity.

3. Fuel cooling - the ambient air temperature is reduced by the evaporation of the water, as well as reducing the temperature of fuel making it harder to ignite.

Use Of Retardant

Almost all retardant bases have the capability of delivering long-term retardant. Some bases have the capability of loading short-term, long-term or foam, so find out what your options are in your operating area.

1. Short-term retardant and foam can be very effective in light to moderate burning conditions with immediate ground follow-up. If ground forces are an hour or longer away-short-term and/or foam will not hold.

2. If flame lengths are greater than 4 feet-go with long-term.

3. Short-term and foam costs are considerably less than long-term. When you can use them effectively, particularly with helitankers - use them.

4. When retardants and foams are no longer effective, quit using them.

5. If flame lengths are greater than 8 feet in length-find another target on the fire or shut down the aerial application operation until conditions allow effective use.

6. Table 1 shows the recommended retardant coverage levels for various fuel types. Identify the coverage level retardant drop you want when communicating with the airtanker pilot, lead plane pilot, or air tactical group supervisor. The airtanker pilot will then determine the number of doors and sequencing, etc. to give you the requested coverage level.

Table 1 – Recommended Coverage Levels

COVERAGE LEVEL gal/100 ft^2	FIRE BEHAVIOR FUEL MODEL	DESCRIPTION
1	1	Annual & perennial western grasses; tundra
2	2 8 9	Conifer with grass Short needle closed conifer; summer hardwood Long needle conifer; fall hardwood
3	2 3 5 11	Sagebrush with grass Sawgrass Intermediate brush (green) Light slash
4	10	Short needle conifer (heavy, dead litter)
6	4 6	Southern rough Intermediate brush (cured); Alaska black spruce
Greater than 6	4 12 13	California mixed chaparral; high pocosin Medium slash Heavy slash

Table 2 describes the approximate amount of retardant line that can be expected using the various coverage levels. The aircraft type, drop speed, drop height, type of retardant (waterlike vs. thickened), and gating system all affect the length and quality of the retardant line.

Table 2 – Airtanker Production Rates in Feet/Chains Per Load*

Tanker Volume (gallons)	Feet (chains) of retardant line per load by coverage level							
	.5	1	2	3	4	6	8	10
800	924 (14.0)	631 (9.6)	305 (4.6)	155 (2.4)	95 (1.4)	28 (0.4)	0 (0)	0 (0)
1,200	1200 (18.2)	862 (13.1)	489 (7.4)	302 (4.6)	208 (3.2)	106 (1.6)	59 (0.9)	21 (0.3)
2,000	1754 (26.6)	1323 (20.0)	857 (13.0)	597 (9.0)	435 (6.6)	260 (3.9)	179 (2.7)	121 (1.8)
2,400	2031 (30.8)	1554 (23.5)	1041 (15.8)	744 (11.3)	549 (8.3)	337 (5.1)	239 (3.6)	171 (2.6)
3,000	2446 (37.1)	1990 (28.8)	1317 (20.0)	965 (14.6)	719 (10.9)	453 (6.9)	329 (5.0)	246 (3.7)

*These production rates are a generalization of information derived from research data.

RETARDANT EVALUATION CRITERIA

Evaluation of retardant effectiveness can be very complicated and subjective, however, there are some very simple and visible indicators to look for.

1. Did it stop, reduce or change the rate of spread or intensity of the fire?

2. Did it hit the target? Are you providing adequate and descriptive target identification to the pilot?

3. Did it allow you the opportunity to catch up? Did it buy you the time you needed? Did it provide you with a tactical advantage?

4. Remember that overuse of retardant is also inappropriate, if one load will do, don't order two or three. If you do have a continuing need to use retardant, consider an air tanker coordinator (most of us call them lead planes), or an air tactical group supervisor, but remember they work for you. **Don't be timid, when you feel that retardant isn't helping you achieve tactical objectives, terminate its use.**

AIR TANKER TACTICS

When applying retardant or water from the air:

1. Determine the location of the retardant line using the same criteria as you would a hand line, dozer line, or engine line.

2. Take advantage of natural barriers and light fuels where retardant is most effective.

3. Utilize breaks in topography such as ridges.

4. Always pick an anchor point to tie the retardant line into. It may be a natural barrier, a road, or a segment of line that is held.

5. Build the retardant line just as you would any other line. Avoid sharp angles.

6. Direct Attack-retardant dropped directly adjacent to or on the fire.

    a. Initial first attack--direct attack across the head of a small fire.

    b. Flank attack-must have an anchor point to prevent outflanking.

    c. Spot fires-cool and corral until ground forces arrive.

7. Indirect attack is an action away from the fire's edge in anticipation of the fire's movement.

    a. Pretreatment of fuels in preparation or support of a backfire.

    b. Widening or strengthening of constructed control lines, natural fuel breaks, or human-made barriers to prevent escape of the fire.

8. Don't expect miracles from retardant.

Directing Drops

One of the hardest tasks for ground forces to master is directing aircraft to specific targets and locations.

1. Give general location of the fire.

2. Finalize location with:

    a. Clock direction-Straight in front of the aircraft is 12 o'clock, and the left door is 9 o'clock. When giving direction, remember that helicopters and air attack generally orbit in a right hand pattern (clockwise) and lead planes and air tankers in a left hand pattern (counter-clockwise).

    b. Position on slope-lower 1/3, upper 1/3, mid slope, top of ridge, etc.

    c. Aspect-direction slope is facing.

    d. Prominent landmarks - don't say "I have a red hard hat, I'm wearing a yellow shirt, I'm waving, I'm by the big tree," etc. Visualize what the pilot sees from the air. If on an engine, give its number if on the roof of the engine.

    e. Use signal mirrors-stand in drop location (when safe) for identification and move away before the drop.

    f. Use a flag - take bundles of brightly colored flagging, put them on a stick and wave back and forth to get attention of pilots. When working with helicopters in close support, you can throw the stick and flagging in the direction of the target once you have radio contact with the pilot.

3. Describe target from your location and explain mission. The pilot (lead plane or air tanker) will decide drop technique and flight path.

4. Be sure you know aircraft intentions before the drop. Inform and assure pilot when all personnel are out of the drop area. Supervisors have responsibility for the safety of all resources assigned to them.

5. Give feedback to the pilot about drop accuracy and quality. Be honest and constructive. Let pilot know if drop was early, late, uphill, downhill, on target, etc. Report low drops immediately.

Safety

Make sure that you adhere to the principles of safety whenever you are involved with ground forces and retardant dropping operations.

1. Clear the area of the drop-move back in as soon as the aircraft has left the area-take advantage of the retardant.

2. Caution your ground forces to watch their footing when working in the area where the drop has been made, as wet retardant is slick.

3. If the retardant has been dropped across a highway, slow down the traffic or wash it off, it makes cars slip and slide too.

4. If working in timbered areas, be alert for snags, tree tops or the possibility of other falling debris knocked loose by retardant.

5. Be cautious of low drop heights by aircraft. The resulting retardant drop will pick up and move rocks, dirt, brush, logs, fire tools, engines, etc. The smaller airborne materials will travel at the drop speed of the retardant.

PRINCIPLES OF RETARDANT APPLICATION

1. Determine tactics, direct or indirect, based on fire sizeup and resources available.
2. Establish an anchor point and work from it.
3. Use the proper drop height, which is approximately 150 to 200 feet. However, many factors such as topography, type of airtanker and gating system, wind direction and speed, type and height of fuel, etc. affect drop height.
4. Apply proper coverage levels.
5. Drop downhill and down-sun when feasible.
6. Drop into the wind for best accuracy.
7. Maintain honest evaluation and effective communication between you and the aircraft.
8. Use direct attack only when ground support is available or extinguishment is feasible.
9. Plan drops so that they can be extended or intersected effectively.
10. Monitor retardant effectiveness and adjust its use accordingly.