# Helicopter Firefighting

By

Thomas Eggleston

1998

## Introduction

The helicopter water bucket is used extensively as a tool for wildland fire suppression. The bucket is slung externally below the helicopter, utilizing the helicopter's cargo hook. It has a low cost when compared to fixed tanks, a simple installation, is easily jettisoned, and is readily filled from lakes and streams. The SEI Bambi Bucket is extremely reliable and is almost foolproof in its operation.

Rapid response in initial attack is important in containing a wildfire to a small size and preventing large conflagrations. The bucket fills this need quite well, allowing it to be carried internally while enroute at high cruise airspeeds. Since a cargo hook is standard equipment on almost all civil and military helicopters, a water bucket is an efficient accessory that can be shared among several helicopters.

The light weight and portability of the Bambi Bucket makes it possible to carry one within an aircraft most of the time. This is especially useful when operating in remote regions far from other firefighting resources.

Worldwide, swift wildland firefighting has become an important issue as natural resources become more scarce and as populations move into heavily vegetated areas, further and further from local fire agencies. The Bambi Bucket provides an exceptional and cost-effective tool for aerial firefighting.

This document describes firefighting terminology, safety issues, fire behavior and flight techniques for use with the water bucket. Basic information on wildland tactics is given and a troubleshooting section on the Bambi Bucket is included.

The author operates a wildland firefighting information WebSite at:

http://www.sonnet.com/usr/wildfire

# Contents

# Introduction to Wildland Fire Behavior

Fire is the combustion of a fuel in the presence of oxygen. Heat is needed to start and maintain combustion. The three factors that make up combustion are Heat, Fuel, and Oxygen, commonly called the "fire triangle.” By removing any one of these three elements we can interrupt the combustion process. The method most often used in fighting fires, is to remove heat by the application of water.

## 1. Fuel Types

Fuel types are categorized as light, medium and heavy and these would correspond to grass, brush and timber, the most commonly found fuels in wildland firefighting. Each fuel type has distinct characteristics that require different techniques for fire suppression. Obviously, combinations of these fuel types are commonly found.

Grass is a light fuel that is greatly affected by the relative humidity. When a rain storm occurs, the grasses rapidly increase in humidity. However, when the relative humidity drops, especially with any wind, grass loses humidity almost as fast as the surrounding air. Grasses burn readily and with much heat energy but, they burn so rapidly that they often run by structures and heavier fuels without igniting them. Extreme heat, but of a very short duration.

Brush and heavier vegetation absorb and lose moisture more slowly than grass and are therefore less affected by rain or changing humidity levels. Brushes are frequently ignited by the underlying grasses. The heat energy from the grass is driven by the wind, preheating the bushy fuels, allowing them to ignite. Due to their greater bulk and density the bushy fuels burn longer than the grasses. This presents an ignition source for structures and heavier fuels.

Timber and other large woody fuels hold moisture well, due to their thickness. Several years of drought may be needed to appreciably reduce moisture levels in these heavy fuels. Conversely, if the fuel moisture in heavy fuels is low, it would take considerable rainfall and time to increase the moisture level. Although more difficult to ignite, these heavy fuels are the most difficult to extinguish. Water drops are less effective because of poor penetration due to the thickness and the high heat energy.

These different fuel types aid each other in maintaining the fire. Grasses burn hot enough to ignite brush. Brush is taller than the grass and can carry the flames up into branches, igniting timber, an effect called **laddering**. Once timber is burning, flames reach the tops of the trees where the wind carries **fire brands**, or burning pieces, forward ahead of the main fire. When these fire brands fall to the ground, they can start new fires in the grass called **spot fires**. This process can continue until something interrupts it.

2. Wind

The driving force behind wildland fires is wind. Wind is the source of oxygen and is a propelling force in the forward movement of a fire. A wildland fire that starts on a calm day tends to draw wind inward from the sides of the fire as the convective column rises. A fire in this situation is actually fighting to expand outwardly. These are relatively easy to control as they do not have rapid horizontal movement.

On a windy day the situation is very different. The wind propels the fire along, providing ample oxygen for combustion. Additionally, the wind carries the heated air from the fire forward, preheating and drying the fuels that are ahead of it, making them ignite more readily. Wind always presents the possibility of spot fires, from sparks being carried by the wind. Wind on a wildland fire must be constantly monitored since all strategic planning is dependent on it. If a wind shift occurs, the fire will move in a new direction and the efforts that have been made to contain the fire may now be rendered useless.

A knowledge of local weather conditions is very useful in fighting a fire. In mountainous terrain it is normal to have down canyon winds beginning in the late evening and continuing until late morning. As the day proceeds, these winds will shift to up canyon winds as a result of solar heating and rising air. Similar effects can be found near large bodies of water, with daily onshore and nightly offshore winds.

3. Terrain/Slope

The surface features of the terrain have a great influence on fire behavior. If a fire starts in a low area, the heated air from the fire will warm and dry the fuels that are above it. These fuels will burn readily and will warm and dry the fuels above them, all in the absence of a prevailing wind. The effect is even more pronounced in rising troughs or gullies in hilly or mountainous terrain. These are called **chutes** and they funnel and increase the action of this preheating, making these areas burn with great intensity.

This will continue until reaching the top of a slope. When a ridge top is reached, the fire loses its energy since the heated air is rising above the surrounding fuels, no longer preheating them. Fires that are burning down-slope tend to progress slowly as the preheating effect is not very effective.

Flat, open terrain is influenced dramatically by surface winds. If there is little or no wind, the fire activity will be low but, if there are strong winds, the fire will move very rapidly and burn with greater intensity. Open fields, with few trees to shelter the surface from the wind, are affected the most.

4. Weather

Weather plays an important role in fire behavior. Thunderstorms provide strong winds which can drive fires and often bring lightning strikes that are frequent causes.

Relative humidity affects the rate of burning, and when relative humidity decreases, light fuels such as grasses burn more rapidly. As noted earlier, an increase in the relative humidity, whether from an air mass or from precipitation, will quickly increase the fuel moisture of light fuels. This will cause the rate of burning to decrease. A water drop can have a pronounced effect on the humidity in localized areas, slowing or stopping the fire even though water is not placed directly on the flames.

Frontal weather must be monitored since the associated wind shifts may cause the fire to go in a new direction and could place ground fire fighters in jeopardy.

Localized weather conditions must always be considered since they influence other non-local weather.

## Tactical Considerations

1. Planning

Strategic planning is done by the **Incident Commander** (I.C.) and his or her staff. However, a helicopter on initial attack may be the only fire personnel for some time. In this case it is the helicopter crew that must plan both the long range strategy and the immediate tactical methods until other forces arrive.

Consideration must be given to protecting persons and property, while at the same time making the most effective use of the terrain and available resources to stop the fire. If the fire can be stopped quickly, that is the most effective way to protect people and property. It is not efficient to work to save one home while the fire races by, getting larger and becoming an even more formidable threat to many homes.

In the United States, an **Air Tactical Group Supervisor** (AirTac), when present, is the controlling person for all aircraft. He receives his orders from the Incident Commander. If no AirTac is on the scene, then the helicopter crew will work directly with the I.C. or his Operations Officer. On large fires which include many aircraft, both fixed and rotary wing, a Helicopter Coordinator may be assigned to direct all helicopter operations.

2. Execution of the Plan

Once a plan is formulated and personnel are briefed, it must be implemented. The aerial fire-fighter is in an excellent position to observe the fire and as such should be prepared to deal with unexpected situations and to keep ground personnel advised on changes in fire behavior, both for safety and for planning. A helicopter will often be assigned to support a particular division on the fire and in this case the pilot will work directly with that division's supervisor.

3. Maximizing Water Delivery

Proper use of water is essential for maximum effectiveness. Placement of water/foam on key targets will accomplish the objectives of the plan. It is important not to get tunnel vision while fighting the fire. **Remember, your first priority is to always maintain control of the aircraft.**

Often, a target will appear that seems to need immediate attention. Careful analysis of this new target should be made to determine if it is truly critical to the overall plan. A snag burning well inside the burnt area usually presents little threat. Time and resources would be better spent to work directly on the fire line to contain the fire. It is very easy to see large flames and think that they need to be put out. If they are well within the burn, it would actually be better to just let them burn out completely.

Sometimes ground firefighters will ignite **backfires**, which are fires that burn fuel between the main fire and a control line. The purpose of these backfires is to widen the control lines, by eliminating fuel. Backfires are critical operations that require exacting conditions for them to be completed successfully. A pilot must be able to recognize a backfire and not attempt to extinguish it. Ground firefighters will use road flares, drip torches, very pistols, and even matches to start backfires and the pilot should pay attention to the ground firefighters to see if they are in fact starting a backfire.

Similar to backfiring are **firing out** operations which are intentionally set fires. These operations are used to control a ragged edge along the fire line and to burn out unburnt islands within the perimeter.

Drop patterns will vary with fuel type, use enough water/foam to stop the fire but no more water than is necessary. Increase speed on light fuels and decrease speed on the heavier ones. Always remember your best single engine or autorotation speeds for flight safety.

Experience has shown that the pilot new to firefighting tends to go too slow. Rotor downwash will inflame the fire, safety is compromised and the water dropped is more concentrated than need be.

If wind drift is an ongoing problem, then err on the unburnt side of the fire line. Water dropped in the already burnt area does little to slow the fire, however, water on the unburnt fuels can actually raise the localized relative humidity enough too slow or even stop the combustion process. This method has worked very well when dropping across the head of grass fires. The wind may carry the water ahead of the flame front but, as the flames reach the dampened area, they usually go out or slow down dramatically. This often allows a second drop to finish things off.

4. Tactics

Attacking the flames directly, is called **direct attack**, dropping on the burning fuel along the fire line or head for direct extinguishment. This is usually the most efficient way to control a wildland fire and is the method used by helicopters.

Often, because of difficult terrain, it is impractical to go direct and airtankers carrying fire retardant will be used to build indirect fire line.

Water drops are also used on spot fires which occur outside the perimeter of the main fire and are usually downwind. Spot fires may even be caused by burning animals fleeing the fire or by burning materials that roll downhill. Spot fires have the highest priority since they may develop into several large fires. This situation is especially dangerous for ground crews since they could be trapped between multiple fires.

5. Standard Procedures

Conventional wisdom dictates that the attack on a fire begins at the **heel** or starting point of a fire and continuing along the **flanks** or sides of the fire, continuing until all that is left is the **head** or the newest and usually furthest point on the fire. The flanks will be named as the left or right as viewed from the heel or origin. By using the terminology Head, Heel, and Flank, specific areas of a fire are better identified for the AirTac, ground personnel and pilots. Efforts are then made to pinch-off the head and finish up. It is very important to completely extinguish the fire line as you move along and prevent rekindling and startup again. These rekindled areas can move along outside the extinguished flanks and sneak up on firefighters, putting them is grave danger.

If terrain or fuels allow, it may be best to go directly to the head and try to cut off the forward movement. This will limit the ultimate size of the fire and resources can then be used to work back along the flanks toward the heel.

The I.C. will communicate his or her desires to the AirTac and the AirTac will direct the aircraft to specific areas. These directions may seem to contradict the previously listed methods but, The I.C. and AirTac may have different objectives than the individual pilot is aware of.

As a fire grows in size, it will be divided up into **divisions** which are lettered alphabetically, clockwise from the point of origin, thus giving the pilot a clue as to where a specific division is located. Occasionally divisions are not named according to this standard plan, leading to confusion. On larger fires and especially those that have been burning for some time, it is a normal procedure to create maps that identify the key points of the fire and particularly the division breakdowns. Radio frequencies for the different divisions should be marked on the maps.

6. Special Situations

When a fire is burning up a slope, it will move very rapidly if there is sufficient fuel. The preheating effect is very pronounced and it would take extra resources and/or time to stop a fire on the slope. It is easier and usually more efficient to allow those fires to continue up to the top. The preheating effect dies off at the top and several water drops may easily extinguish it. If however, people or structures are in the path as it burns uphill, then additional resources will be needed to slow or stop the fire.

A word of caution . . . as a fire hits the top of a ridge or hill there is always a potential for wind driven spot fires on the lee side. It is important to keep a sharp lookout for them.

Areas where the fire has broken through the control line are called **slop-overs**. These can occur when very hot areas close to the fire line (**hot-spots**) ignite unburnt fuels across the line or where retardant drops have been eaten through. Constantly look for problems along the fire line since these slop-overs could overtake ground crews that have moved ahead.

A technique that is very effective when fire retardant drops have been made, is to back up the retardant with a water drop. This wetter retardant is a very effective fire stopper.

The hottest portions of the flank of a fire are termed hot-spots. These areas need constant monitoring to prevent slop-overs and the lateral spread of the fire across the fire line.

## Aircraft/Bucket Systems

1. Installation Considerations

Bambi buckets are designed for a 24 volt electrical system. The water drop button, usually installed in the cockpit in civil helicopters, or operated by the crew chief in military aircraft, should be a momentary, normally open switch. The installation of the drop button and associated wiring must meet the applicable regulations, whether military or civilian. Use approved methods, with wire size designed to meet the load carrying needs and with fuse/circuit breaker protection. The switch itself should be mounted securely in a way that it is protected from damage and is easily operated by the pilot. It is suggested that it be mounted on either the collective or the cyclic stick grips. Civil operators working for U.S. Federal agencies should read contract specifications concerning installation details.

2. Bucket Operation

The mechanical operation of the Bambi bucket is quite simple and is therefore almost foolproof. The bucket has a spring reel that winds up the cable which is attached to the dump valve (udder). When the bucket is empty, the reel retracts the cable and, in its fully rewound position, is locked by a cam mechanism. A fill is accomplished by dipping the bucket into the water source and then gently lifting until clear of the water. Because of the lock, the water cannot escape. When ready to drop, the release button is depressed and a solenoid releases the locking system, allowing the weight of the water to unwind the spring reel and open the valve. After the water flows out, the spring reel rewinds and the lock resets, preparing the bucket for the next drop.

The drop control switch should be pressed before the target is reached to allow for the slight delay while the dump valve opens and for the time required for the water to fall. By trial and error, through practice, this lead time can be easily learned. It is important to release the drop button a second or two after pushing it, since the solenoid could burn out if current is kept applied for a lengthy period of time. Actual drop techniques will be covered later, but remember, practice makes perfect. The Bambi Bucket is very reliable and should need only occasional preventive maintenance.

3. Trouble Shooting & Preventative Maintenance

Failure of solenoid to release dump valve.

- Check electrical connections on connectors.
- Check solenoid operation or sticking of toggle lock mechanism, this is often remedied by lubrication.
- Check for continuity of solenoid coil.

Solenoid works, but valve does not release.

Check toggle locking mechanism for freedom, wear and lubrication.
Make sure steel cables are not tangled, crossed or kinked.

Failure of dump valve to reset after drop.

Rewind spring may be broken - very rare.
Internal parts of control head are corroded, clean and lubricate inside of control head.
Debris in bucket may be obstructing valve.

Preventive maintenance:

Rinse the bucket and control head after missions, when using foam concentrates.
Lubricate interior mechanism prior to long term storage.
Lubricate all steel cables frequently with a light preservative oil.
Occasionally spray a WD-40 or LPS type of lubricant into the spring reel, this is prone to rusting if put away wet.
Inspect and repair damage when found, this will keep your bucket serviceable.

It is recommended that pilots **and** maintenance personnel read the Bambi Bucket Operations Manual.

## 4. Foam System Operation

The most efficient use of water is obtained by adding a foam concentrate. SEI Industries manufactures several different systems to meet varying aircraft needs. Foam is added to the bucket in levels of 0.5% to 1.0%. Special circumstances may require deviation from these levels, but these concentrations are very cost effective in wild-land situations. As with the water bucket interface with the aircraft, use approved installation methods for wiring and mounting of the foam tank, if an internal system is used. An external system only requires an electrical interface for the pump power.

The foam system uses a reservoir to contain the concentrate, an electrical pump to transfer concentrate into the water bucket, a timer control to vary pump run time and thus the concentration level, tubing or hose to carries the concentrate to the bucket.

The Class A foams used for wildland firefighting have proven very useful in fighting tire fires, landfill fires and fires at junk yards.

## 5. Preflight Considerations

A proper preflight of the bucket, cargo hook and foam system is essential for safety and reliable operation:

Check electrical and mechanical cargo hook release mechanisms.

Check cargo hook for cracks, wear and other damage.

Check Bambi control head lifting ring for wear and security.

Check Bambi support cables for wear, broken strands and corrosion.

Check cable attack lugs on control head for cracks and bolt security.

Inspect bucket shell for damage and wear.

Ensure foam system is operational.

## Flight Techniques

<u>Bucket Fill Procedures</u>

The approach to the water source should be made carefully, observing for obstacles and planning for unseen ones. Wires frequently cross bodies of water and their support poles or towers may be difficult to see. Rivers in mountainous regions often have cables crossing them near the surface and low head dams are occasionally found.

1. Lakes and Slow-Moving Water

The basic technique in filling is to approach the water in a steep approach. Watch the bucket's shadow on the water surface and note that the bucket itself and the shadow will appear to move toward each other as the bucket nears the water surface. This reference will aid the pilot in determining the bucket height. Very slight forward movement will help tip the bucket over when it touches the surface. This method will also help prevent rotor wash from blowing the bucket forward of the aircraft as it reaches the surface.

As the bucket sinks, refer to fixed objects on the shore to prevent drifting. It is very easy to watch the water surface and try to reference to the ripples, which will cause drifting as the ripples and waves move. Staying near the shoreline aids in remaining stationary and makes for a short swim if a power failure occurs.

Continuing forward at a VERY low speed will fill the bucket rapidly and, after minimal practice, a pilot should be able to dip and go without stopping. Do NOT maintain enough forward speed to cause jerking on the cargo hook. It is recommended that the neophyte dipper touch down with NO forward movement and remain stopped before lifting the bucket out of the water.

When empty at low airspeeds, the bucket cables may occasionally wind up. While lifting, the weight of the bucket will cause the cables and bucket to unwind as the cables straighten out. If the bucket unwinds too rapidly, it will place a severe twisting load on the cargo hook. Try to watch the bucket as it is being lifted, either in a mirror, directly, or by using a crew member. If the cables have in fact wound up, do not lift the bucket completely out of the water. Lifting it partially out will control the rate of this unwinding effect.

Dipping should be practiced thoroughly before actually working on a fire.

2. Large Bodies of Water

Very large bodies of water can present some difficulty in maintaining a stable hover during filling. The illusion of movement from the swells and waves is very pronounced, with the pilot trying to maintain a static horizontal position by referencing his/her position with this moving surface. It is even more important to fix on points on the shore, or even rocks and pilings in the water, to prevent drift.

Since swells present a rising and falling surface, try to time the lift with a rising swell. When operating over salt water, pay attention to corrosion and rinse the aircraft frequently with fresh water. Maintenance personnel should be informed of any salt water operations.

3. Fast-Moving Water

Rapidly moving water, such as that found in mountain streams, presents some challenges. The bucket will act as a drag chute in the fast current and may overpower the helicopter. Be alert and ready to release the water or jettison the bucket itself. Since the current will tend to pull the helicopter downstream, it is safest to face the helicopter upstream against the current. This will place the aircraft in a nose low attitude, much safer than being drug downstream and having the helicopter in an extreme tail low attitude where a tail rotor strike in the water could occur.

During mornings in the mountains, down-canyon winds will usually be found. This will allow the helicopter to take-off into the wind and into the current. This gives the best control but does mean a climb upstream. As the day progresses the winds will switch to up-canyon ones, and now the pilot must decide on which is the greater to overcome, the current or the wind. This is a judgement call and each situation will require it's own individual decision. If confronted with these problems, remember to look for bends in a river that may give the best winds, and look for pools where the speed of the current is the least.

4. Portable Tanks

Occasionally, portable tanks will be set up due to a lack of natural water sources. It is necessary to come to a stationary hover during dip and lift off to prevent damage to the tank. A person on the ground can be helpful in guiding the helicopter.

Filling portable tanks is a mission that may occur. Use techniques similar to dipping out of one. Come to a stationary hover centered over the tank, being careful not to bump the full bucket against the sides of the tank, and release the water. Be aware of any movement of an empty tank from rotor-wash. It may be necessary for the ground personnel to place some large rocks in the tank to hold it down. After a few drops have been made into it, the water will hold it in position.

## Drop Procedures

1. Airspeed/Altitude Management

Controlling drop density is done with varying airspeeds and altitudes. It is recommended that initially the pilot start with an airspeed of 60 kts. or above (consult the flight manual for the best single engine climb speed or the best autorotational airspeed), and a bucket altitude above the drop zone of approximately 50 feet. As the pilot develops his flying technique with this starting point, departure from it can be practiced for different conditions.

On light fuels (grasses), fly at higher airspeeds up to 90 kts. to lay the longest line. If length is not needed, but a greater width in a small space is required, then go slower but at a higher altitude. The greater altitude will allow the water/foam to aerate more and be dispersed over a larger area.

Heavier fuels or more concentrated areas such as brush piles may dictate a slower or a lower drop to help concentrate the water. This is a compromise with safety as low airspeeds and low altitudes do not allow any margin for error or mechanical failure. A slow drop at a high altitude may provide the wetting necessary without undue rotor wash, but it may place the aircraft in a critical part of the height-velocity envelope. Experience has shown the low airspeeds usually do not gain as much benefit as expected for the increased risk.

2. Basic Flying With a Water Bucket

Flying a water bucket is very straight forward. Use good basic technique, keeping the ball centered, avoiding slipping and skidding and keeping turns coordinated. Clumsy or careless use of the pedals will certainly start sideways oscillations of the bucket. When a bucket is full of water, it is very stable and should not present any problems to the pilot. When empty however, it may have a tendency to swing at certain airspeeds. The important point to remember is that like other external loads, airspeed must be adjusted accordingly.

Fore and aft swinging of the bucket is also a result of pilot induced oscillations. To stop these, it is usually easiest to slightly increase airspeed and then maintain it. Notice any fore and aft movement of the cyclic stick, you may not be aware that you are inducing it.

Flight trainers and standardization pilots please note:

> If a pilot is having difficulty flying the bucket,
> you should review basic flying techniques.

3. Wind Drift

For precise water drops a correction for wind must be made. The higher the drop, the greater the drift will be. In high wind conditions it may be necessary to lower the drop altitude. If possible, do a turn after the drop, a visual check can inform the pilot on the degree of drift. This information can be used to adjust the next drop. An error towards the unburnt area of the line is more efficient than having the water land inside the burn.

4. Approach/Departure

When approaching the drop zone it is important to plan both the approach and departure routes. The safest way in to the drop zone must allow for the safest way out, and must consider the possibility of a bucket malfunction and the inability to release the water. A cautious pilot will be constantly planning for an engine failure.

5. Flight Hazards

Water dropping has several hazards that must be constantly considered, including the hazards of low level flight, steep terrain, poor visibility, and aircraft congestion on larger fires. A vigilant eye must be kept for an unannounced news aircraft.

## Flight Safety

Aerial fire fighting operations are frequently conducted in steep terrain, with turbulent wind conditions, and with reduced visibility due to smoke. Fires are often very congested, with many aircraft working in a small area.... the potential of a mid-air collision or a wire strike is ever present. You must constantly think safety and know your own limitations.

<u>Operational Considerations</u>

1. Communications

Coordination of all aircraft on a fire is the responsibility of the Air Tactical Group Supervisor. Constant monitoring of the dedicated communications channel is required for safe traffic flow. Discreet channels for communication with ground fire fighters is needed for efficient mission completion and for assistance, should the ground crew need it, in an emergency.

It is suggested that helicopter crews make appropriate radio calls to aid the AirTac and other pilots in flight route coordination. Good practice would include calls when departing a helibase or helispot, departing the water source, arriving on the fire scene, departing the fire scene and when arriving at a helibase.

Often an assignment will be to work with other helicopters, in this situation the pilots can work out a flight path procedure and maintain a **daisy chain**. The daisy chain is simply an informal “follow the leader” pattern.

2. Obstructions

Working in close proximity to the ground presents an ever present potential for wire strikes. It is therefore essential that a thorough search for wires be made before dipping or conducting water drops. During a reconnaissance, look for supporting towers, corners that may have wires cutting diagonally and places where power would likely be needed, such as a pump house.

Information should be immediately relayed to other flight crews as wires, towers, and other hazards are discovered. It is also recommended that wire cutters be installed. Make hazards known to the AirTac and helibase manager and ensure that they are posted for everyone to see.

3. Mid-Air Conflicts

Since there are frequently other aircraft working the fire, and the occasional unannounced news helicopter, it is necessary that constant vigilance be maintained. Notify AirTac of rogue aircraft.

4. Visibility

Reduced visibility presents an increased hazard in terrain avoidance, wire strikes and mid-air collision. Be certain that you know what is on the other side of the smoke before flying through it. DO NOT fly through it if you cannot see through it. If you do go IFR, get on the instruments and climb above the surrounding terrain. Let AirTac and the other aircraft know what you are doing.

5. Flight Routes

Plan flight routes to avoid flying over personnel and equipment and plan an escape route when setting up for a drop. The loss of power, failure of bucket to open, wind shift, or other unforeseen situations could seriously jeopardize safety. Always be prepared to jettison the water or, if necessary, the entire load. Keep the cargo hook release armed when in the drop area. Keep airspeed high enough to achieve the best autorotational glide or single engine performance.

6. Maneuvering

Plan all maneuvers so that they may be completed even if the load does not jettison. Be on the guard for a power settling situation while loaded. Avoid abrupt maneuvers that increase loading, particularly near the ground.

7. Unimproved Landing Areas

Landings on a fire site are usually to an unimproved area and proper surveillance for obstacles on the ground, sloping terrain, and debris must be made. Landing in the burned area presents a condition similar to the "white-out" that snow landings present. The fine ash remaining after an area has been burnt over must be dealt with in the same manner as powder snow. Several water drops on the LZ would likely eliminate this problem. One technique is to make a low, slow pass over the proposed LZ and watch to see how much ash is stirred up.

8. Safety Equipment

Flight crews must be equipped with and use personal protective equipment;
flight helmets, nomex flight suits, gloves and personal floatation devices.

Helicopter firefighting is an exciting and beneficial use of the helicopter. It requires skill and sound judgement. Firefighting is demanding on both man and machine, but the ability to provide this service makes it one of the most rewarding jobs available!