BY ORDER OF THE COMMANDERS	**MCH 11-HH60G**
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AIR EDUCATION AND TRAINING COMMAND	
AIR FORCE MATERIAL COMMAND	**Flying Operations**
AIR NATIONAL GUARD	**FUNDAMENTALS--HH60G HELICOPTER**

This handbook provides HH-60G crew members a comprehensive document containing fundamental employment procedures and techniques that may be used to accomplish the various missions of the HH-60G. This handbook is the primary HH-60G fundamentals reference document for Air Combat Command (ACC), Pacific Air Forces (PACAF), Air Force Reserve Command (AFRC), Air National Guard (ANG), and Air Education and Training Command (AETC). This handbook applies to ANG units when published in ANGIND2 and to AFRC units when published in AFRCIND2. Designed to be used in conjunction with MCM 3-1 (S) and AFI/MCI 11-series directives, this handbook addresses basic flying tasks and planning considerations for combat search and rescue. Although the techniques and procedures contained in this volume are not regulatory, they have been tested and proven to be safe and effective. Send comments and suggested improvements to this publication on AF Form 847, **Recommendation for Change of Publication**, through channels, to HQ ACC/DOTV, 205 Dodd Blvd, Suite 101, Langley AFB VA 23665-2789.

NOTE: Contact HQ ACC/DOT before releasing this document to a foreign government or contractor.

SUMMARY OF REVISIONS

This instruction, in conjunction with MCI 11-HH-60G, Volume 3, incorporates the information, procedures, and techniques formerly in MCR 55-41. This is the first publication of this material as a separate publication and it contains substantial changes. This volume deletes references to H-1 and H-3 series helicopters and eliminates redundancy between this volume and other flight publications.

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Chapter 1

INTRODUCTION

1.1. Overview In March 1991 Air Rescue Service (ARS) activated its first world wide deployable HH-60G combat rescue unit at Nellis AFB, Nevada. Two years later, ARS was deactivated and all air rescue forces were transferred to the Combat Air Forces (CAF). Since that time, the basic principles of CSAR and the mission of rescue changed dramatically. The opening of a combat rescue division at the United States Air Force Weapons School, along with a test and evaluation center, gave rescue forces the means to develop and test new procedures and techniques. The HH-60G is the worlds most advanced combat survivable rescue helicopter, and the crews flying the HH-60G are seasoned with the experience of continuous world wide deployments. The operating techniques, procedures, and methods contained in this volume are designed to aid in building a strong foundation of aircraft knowledge, equipment operation, and employment skills.

1.2. Purpose. This handbook is designed to supplement both formal and continuation training programs. It is designed to be used in conjunction with MCM 3-1 Vol 24 (S), MCI 11-HH60G Vol 3, and other training/operations guidance. This publication provides aircrew with information to operate the H-60 effectively, to assist in mission planning, and to aid aircrew in making decisions. It is not all inclusive, but presupposes a working knowledge of basic aircraft operations and mission employment. It is not meant to reprint information found in technical orders or regulations. This handbook is intended for all qualified HH-60G aircrew members and is not directive in nature. This handbook provides no authority or sanctions to depart from directives contained in MCI 11-HH60G Vol 3, the H-60 flight manual, or other Air Force Instructions.

1.3. Change Procedures. Aircraft modification and operational/training experience will, and should, dictate changes to this text. Submit recommendations for changes to this handbook on AF Form 847, Recommendation for Change of Publication (Flight Publication), to the parent MAJCOM.

1.4 Distribution:

- Commanders (Squadron, Group, Wing)....1
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Chapter 2

FUNDAMENTALS OF FLIGHT AND AERODYNAMICS

2.1. Introduction. Aircrew members should periodically review a helicopter aerodynamics manual (e.g., DA FM 1-203 or commercial equivalent) for a thorough discussion of aerodynamics, terms, and phenomena. This section is not designed as a stand-alone aerodynamics text, but provides a cursory review of the more common phenomena and applications. This section assumes a basic understanding of the terms relative wind, angle of attack, and stall. The lift equation provides a useful starting point for analyzing basic flight fundamentals:
$L = C_L \times \_r \times S \times V^2$

2.1.1. L = Lift

2.1.2. C_L = Coefficient of Lift; the equivalent weight in pounds that 1 square foot of wing area will lift at a speed of 1 foot per second. The two factors that most affect the coefficient of lift (and drag) on an airfoil are the shape, as established by the manufacturer, and the angle-of-attack, which is controlled by the pilot. We do have control over the coefficient of lift (angle-of-attack) via the flight controls.

2.1.3. _r = Air Density; in slugs per cubic feet. Density is affected by temperature, pressure, and humidity. An increase in temperature or humidity or a decrease in pressure (increase in pressure altitude) will all decrease air density and therefore decrease lift. It is important to note that at high density altitudes

(DA), helicopter rotors produce less lift for a given angle-of-attack and airflow speed, while helicopter engines also produce less power.

2.1.4. S = Total Wing Area; in square feet.

2.1.5. V^2 = Airspeed; airflow over the airfoil in feet per second. In a hover, the speed of the airflow over an airfoil (blade) is determined by blade rotational velocity (a function of blade length and RPM). In directional flight, airflow speed is also influenced by aircraft or wind speed. It is critical that 100% Nr be maintained throughout all powered flight regimes. The lift equation shows that lift varies as the square of the velocity of the airflow over the rotor. If the engine trim incr./decr switch is set to a low value (less than 100% Nf/Nr), lift is reduced for a given angle-of-attack. If we reduce our Nr by only 2% (at a given angle-of-attack), we lose 4% of our main rotor lift. At 98% Nr, in order to attain the lift that would have been generated at 100% Nr (for that given angle-of-attack), we must change the coefficient of lift (increase the collective/angle-of-attack). It is important to understand that at maximum available power (the point at which droop begins), increasing the collective adds pitch, which adds drag, and ultimately slows the main rotor RPM.

2.2. Dissymmetry of Lift. There is a difference in lift between the advancing half of the rotor disk and the retreating half. In directional flight, the aircraft relative wind is added to the rotational relative wind on the advancing blade and subtracted on the retreating blade. The blade passing the tail and advancing around the right side of the helicopter has an increasing speed which reaches maximum at the 3 o'clock position. As the blade rotation continues, the speed reduces to essentially rotational speed over the nose of the helicopter. The blade speed then decreases progressively and reaches minimum airspeed at the 9 o'clock position. The blade speed then increases progressively and again reaches rotational speed as it passes over the tail.

2.3. Blade Flapping. The up and down movement of a rotor blade, in conjunction with cyclic feathering, causes dissymmetry of lift to be minimized. The advancing blade, upon meeting the progressively higher airspeeds brought about by the addition of forward flight airspeed to rotational airspeed, responds to the increase of speed by producing more lift. The blade climbs or flaps upward, and the change in relative wind and angle of attack reduces the amount of lift that would have been generated. In the case of the retreating blade, the opposite is true.

2.4. Cyclic Feathering. Blade flapping alone is not sufficient to compensate for dissymmetry of lift. During forward flight, the blade pitch angle is lower on the advancing side of the disk to compensate for increased blade speed on that side. Blade pitch angle is increased on the retreating blade side to compensate for decreased blade speed on that side. These changes in blade pitch are introduced by the blade feathering mechanism and are called cyclic feathering. Pitch changes are made to individual blades throughout their rotation independent of the others in the system, and they are controlled by the cyclic stick.

2.5. Gyroscopic Precession. This is a phenomena occurring in rotating bodies in which an applied force is manifested 90 degrees ahead in the direction of rotation from where the force was applied. The swashplate input to tip the rotor disk to the left (9 o'clock) must be applied at the 12 o'clock position. A loss of lift at the 9 o'clock position (e.g., retreating blade stall) will cause the disk to tip toward the 6 o'clock position, causing the helicopter nose to pitch up.

2.6. Drag. The force that opposes the motion of the aircraft through the air is drag. Total drag produced by an aircraft is the sum of the profile drag, induced drag, and parasite drag. Total drag is primarily a function of airspeed. Induced drag is incurred as a result of the production of lift. Higher angles of attack, which produce more lift, also produce increased induced drag. Induced drag decreases as aircraft airspeed increases. Parasite drag is incurred from the non-lifting portions of the aircraft. It includes the form drag and skin friction associated with the fuselage, cockpit, engine, cowlings, rotor hub, landing gear, and tail boom. The External Stores Support System (ESSS) adds considerable parasite drag, as shown in charts throughout the Operator's Manual. Parasite drag increases as aircraft airspeed increases. Profile drag is incurred from frictional resistance of the blades passing through the air. It does not change significantly with the angle-of-attack of the airfoil section, but increases moderately as airspeed increases. There is some airspeed at which the parasite and profile drag increase to a point where the maximum available power from two engines will produce no increase in airspeed (in level flight). This airspeed (V_h) is briefed in the Takeoff and Landing Data (TOLD) by the Flight Engineer (FE).

2.6.1. The lowest point of the total drag curve (refer to the flight manual) indicates the airspeed that normally determines the aircraft's maximum rate-of-climb speed, maximum-endurance speed, and minimum rate-of-descent speed for autorotation. This airspeed also reflects the area of greatest specific excess power (P_s), critical in energy-maneuvering. As speed increases or decreases from this point, more power will be required to maintain a constant altitude and airspeed. If you want to loiter in a search area for the maximum amount of time, you should fly at this most efficient (maximum rate-of-climb/maximum-endurance) airspeed.

2.6.2. As you move farther from this most efficient airspeed, either slower or faster, total drag increases. As you decrease airspeed, induced drag increases. In order to decelerate from cruise airspeed to desired approach entry airspeed (e.g., from 100 knots to 50 knots), you reduce power. You will notice that at a constant altitude, after you decelerate below max rate-of-climb/max-endurance airspeed (e.g., 65 knots), a collective increase will be required even though you are decreasing airspeed. As you increase airspeed, parasite drag and profile drag increase.

2.6.3. At some airspeed below maximum rate-of-climb/maximum-endurance airspeed, the induced drag increases to point where a single engine is not capable of producing enough power to sustain altitude. At some airspeed above max rate-of-climb/max-endurance airspeed, parasite and profile drag increase to the point where a single engine is not capable of producing enough power to sustain altitude. These points of increased total drag define minimum and maximum single-engine airspeed, and are briefed in the TOLD by the FE. As gross weights and density altitudes increase, this single-engine airspeed range narrows.

2.6.4. If one engine fails during flight, you must adjust to some airspeed anywhere in the range between minimum and maximum single-engine airspeed in order to maintain level flight. If you need to climb single engine, climb performance should improve the closer you adjust the airspeed to match the maximum rate-of-climb/maximum-endurance airspeed. If this airspeed still provides an inadequate rate of climb, the only alternative is to lighten the helicopter (e.g. dump fuel, etc.).

2.7. Translating Tendency. During hovering flight, the helicopter has a tendency to drift laterally to the right. This tendency results from right lateral tail rotor thrust that is exerted to compensate for main rotor torque. Many pilots find themselves drifting to the right at the termination of approaches. This is due to insufficient compensation for translating tendency occurring with the increasing collective pitch (and tail rotor pitch) application required to terminate at a hover. This right lateral drift of the helicopter is overcome by tilting the main rotor disk to the left (either automatically through flight control/transmission design or manually by pilot input). The HH-60G rotor system design includes an offset between the main rotor mast and the blade attachment point. Centrifugal force acting on the offset tends to hold the mast perpendicular to the tip-path plane. As a result, when the rotor disk is tilted left to counteract translating tendency, the fuselage will follow the main rotor mast and hang slightly low on the left side.

2.7.1. The main rotor mast on the HH-60G is designed with a forward tilt of 3° relative to the fuselage. Forward tilt provides for a level longitudinal fuselage attitude during forward cruise flight (resulting in reduced parasite drag), but results in a tail-low fuselage attitude when hovering (the mast is vertical). When the fuselage is tail-low, the tail rotor gearbox will be lower than the main rotor. This makes the fuselage tilt laterally to the left during hovering maneuvers due to a twisting moment about the longitudinal axis.

2.7.2. You will notice that during hovering flight, the Vertical Situation Indicator (VSI) confirms this slightly nose-high, left tilt aircraft attitude. While a level attitude on the VSI during cruise flight generally yields a straight-ahead flight path, this is not true at low airspeed. If a restricted-visibility takeoff is required due to white-out, brown-out, or instrument conditions, care should be used when referencing the VSI. A level attitude on the VSI at very low airspeeds places the aircraft in an attitude that fails to compensate for translating tendency or the mast tilt. Therefore, the aircraft will drift forward and right with a level VSI attitude. If obstacles (trees, buildings, or other formation aircraft) are to the forward right of the helicopter, a level VSI attitude may not be advisable.

2.8. Slope Operations. When the helicopter rests on a slope, the mast is nearly perpendicular to the inclined surface, while the plane of the main rotor must parallel the true horizon or tilt slightly up-slope (refer to the flight manual for specific slope operation limitations). Thus, the rotor tilts with respect to the mast. Normally, the cyclic control available for this rotor tilt is limited by cyclic control stops or by contacting the droop stops. These control limits are reached much sooner in down-slope wind conditions. Also, since the HH-60G characteristically hovers slightly left side low, there will be less control travel when landing with the left side up-slope.

2.8.1. Landing down-slope is usually the most difficult operation. The helicopter will have a tendency to roll down the slope. Setting the parking brake prior to attempting the slope operation will help prevent this rolling tendency. Due to the normal tail-low hover attitude, a great deal of aft cyclic must be applied to accomplish a down-slope landing. The tailwheel will touch very early, while the main gear is still at a considerable height above the ground. Droop-stop contacts can easily occur when the nose is down-slope, and the collective is minimized with aft cyclic applied. Landing up-slope provides certain advantages. Due to the tail-low attitude in a normal hover, an up-slope landing enables the tailwheel and main gear to touch almost simultaneously with minimal cyclic input. The disadvantages of landing up-slope are the reduced main rotor clearance off the nose (due to mast tilt) and a tendency to roll downhill (backwards). When landing cross-slope, the uphill main gear is placed on the ground first, and the collective is slowly reduced while cyclic inputs are made toward the hill to keep the helicopter on the landing point. Positive heading (pedal) control on a forward reference point is critical during this maneuver.

2.8.2. Abort the landing attempt if cyclic control travel limits are reached (or droop-stop contact occurs) before the downhill main gear is firmly on the ground. Once the aircraft has weight on all three wheels, the collective should be carefully lowered as far as corrective cyclic inputs permit. Once safely on the ground, some pilots maintain the cyclic and rotor tip path plane with the last required tilt for the landing, while other pilots attempt to level the disk with the slope (perpendicular to the mast). Maintaining the tilted tip path (that was required for landing) ensures stable ground contact, but provides marginal clearance from the tip path to the up-slope. This could be very hazardous to crewmembers/teams entering/exiting the rotor path from the up-slope side. The technique of leveling the tip path (with respect to the slope) avoids this hazard, but may be less stable, with a greater tendency to roll down-slope.

2.8.3. The takeoff from the slope is basically the reverse of the landing procedure. Instead of "guessing" where the cyclic and rotor tip path plane should be, always adjust the main rotor disk to a near level (true horizon or VSI) position, or perhaps very slightly biased to the left rear. This is approximately the cyclic/tip-path position in a normal hover. Slowly increase collective to raise the down-slope main gear, then carefully bring the helicopter up vertically off the slope.

2.9. Dynamic Rollover. Dynamic rollover may occur on level ground, but is more critical during slope or crosswind landing and takeoff maneuvers. Every helicopter has a critical rollover angle beyond which recovery is impossible. If this angle is exceeded, the helicopter will roll over on its side regardless of cyclic corrections introduced by the pilot. The rate of rolling motion is also critical. As the roll rate increases, it reduces the critical rollover angle at which recovery is still possible. The critical rollover angle is dependent on which wheel is touching the ground, crosswind component, lateral offsets in center of gravity, and left pedal inputs for torque correction. Dynamic rollover starts when only one main wheel is on the ground and that wheel becomes a pivot point for lateral roll. The wheel may become a pivot point for a variety of reasons. It may be caught on something projecting from the landing surface, it could be stuck in ice or mud, or it could be forced into the slope by improper landing techniques.

2.9.1. Prevention of down-slope rollover during landing. If the combination of slope, wind, and center of gravity (CG) conditions exceed lateral cyclic control limits, the mast forces the rotor to tilt down-slope, resulting in lift with a down-slope component, even with full up-slope cyclic applied. To prevent down-slope rollover during landing, slowly descend vertically to a light ground contact with the up-slope main gear. Slowly and cautiously lower the down-slope wheel. As the cyclic nears the lateral stop, compare the distance to go with the lateral control travel remaining. If it appears that the cyclic will contact the up-slope control stop before the down-slope gear is firmly on the ground, return the helicopter to a level flight attitude and abort the slope landing. The wind direction/velocity, CG, or amount of slope must be changed.

2.9.2. Prevention of down-slope rollover during lift-off. This is not usually a concern, because if adequate control was available for the slope landing, it should be adequate for the lift-off. If winds have become adverse, or if CG is now adverse (due to passenger onload) or the gear is stuck or sunk in soft ground, this type of rollover could be a possibility. In these situations, you should reduce power at the first sign of lateral roll around the down-slope wheel, and abort the lift-off attempt. Before making another lift-off attempt, await different wind conditions, change CG loading, or dig out under the up-slope gear.

2.9.3. Prevention of up-slope rollover during lift-off. This primarily results from excessive use of cyclic to hold the up-slope gear against the slope. Improper use of collective pitch could then result in a rapid pivoting around the up-slope main gear to the point of rollover. To prevent up-slope rollover, the pilot should cautiously lift the down-slope side of the helicopter to the level point and simultaneously work the cyclic control to neutral. Once the cyclic is neutral and/or the up-slope main gear has no side pressure applied, a vertical ascent can be continued.

2.10. G-Loading. Load factor, expressed in Gravity (G) units, is the total load imposed on an aircraft, divided by the aircraft weight. Load factor during a turn varies with the angle of bank. Airspeed during a turn does not affect load factor, because for a given bank angle, the rate of turn decreases with increased airspeed and results in no change of centrifugal force. For a 60-degree bank, the load factor for any aircraft is 2 Gs regardless of airspeed. This means that a 20,000-pound HH-60G in a 60-degree bank will, in effect, exert 40,000 pounds of force on the aircraft structure. Load factors do not begin to increase significantly until bank angles exceed 30 degrees. Above 30 degrees, the load factor rises at an increasing rate and may produce unacceptable rotor disk loading, depending upon the aircraft gross weight and flight conditions.

2.11. Turn Performance and Energy. A level turn is one in which altitude is kept constant, which could be accomplished with or without a constant airspeed. To cause the helicopter to turn, a turning (centripetal) force must be applied perpendicular to its flight path. This force is created by banking the rotor system in the direction of turn. The horizontal component of the thrust is the turning force and the vertical component is equal and opposite in weight. A steeper bank angle will produce a greater turning force, but will require additional power (thrust) to maintain altitude. The percentage of increase of power required during turning flight, as opposed to straight flight, is directly related to the bank angle. A 15° bank requires only a 3.6 percent increase in power, while a 45° bank will require a power increase of over 41 percent (refer to Table 2.1). Sufficient power may not be available for a sustained 45° bank angle at very high or low (high drag) airspeeds, and a sustained 60° bank angle may only be maintained at speeds near the maximum rate-of-climb/maximum-endurance (least drag) airspeed. Sustained turning maneuvers that require more power than is available can be completed only at the expense of losing altitude. During low-level flight, such an altitude loss could be disastrous.

Table 2.1. Effect of Bank Angle on Thrust Required.

BANK ANGLE	INCREASE IN MAIN ROTOR THRUST REQUIRED
0°	0 %
15°	3.6 %
30°	15.4 %
45°	41.4 %
60°	100.0 %

WARNING: *At steep bank angles (over 60°) a rate of descent will occur. If the descent is not arrested shortly after its onset, it can increase to 5000 FPM. Recovery from these high rates of descent can only be made by rolling to a near wings level attitude.*

2.12. Settling with Power. Settling with power can occur at any airspeed or altitude combination whenever power required exceeds power available. This condition is not to be confused with power settling or vortex ring state.

2.13. Power Settling or Vortex Ring State. Power settling or vortex ring state is a condition of powered flight were the helicopter settles in its own down wash. Conditions conducive to power settling are a vertical or near-vertical descent of at least 300 feet-per-minute and low forward speed. The rotor system must also be using some of the available engine power (from 20 to 100%) with insufficient power available to retard the sink rate. These conditions typically occur during approaches with a tail wind or during formation approaches when some aircraft are flying in turbulence from other aircraft.

2.13.1. The helicopter may descend at a high rate which exceeds the normal downward induced flow rate of the inner blade sections. As a result, the airflow of the inner blade section is upward relative to the disk. This produces a secondary vortex ring in addition to the normal tip vortex system. The secondary vortex ring is generated about the point on the blade where airflow changes from up to down. This results is an unsteady turbulent flow over a large area of the disk that causes loss of rotor efficiency even though power is still supplied from the engine. During vortex ring state, roughness and loss of control is experienced because of the turbulent rotational flow on the blades and the unsteady shift of the flow along the blade span. Power settling is an unstable condition. If allowed to continue, the sink rate will reach sufficient proportions for the flow to be entirely up through the rotor system. If continued, descent will reach extremely high rates.

2.13.2. The vortex ring state can be completely avoided by descending on a flight path shallower than about 30 degrees (at any speed). At very shallow angles of descent, the vortex ring wake is dispersed behind the helicopter. For steeper approaches, the vortex ring stage can be avoided by using a speed either faster or slower than the area of severe turbulence and thrust variation. At steep angles, the vortex ring wake is below the helicopter at slow rates of descent and above the helicopter at high rates of descent. Recovery may be initiated during the early stages of power settling by applying a large amount of excess power, which may be sufficient to overcome the up flow near the center of the rotor. If the sink rate reaches a higher rate, power will not be available to break this up flow and thus alter the vortex-ring state of flow.

2.13.3. The normal tendency is for pilots to recover from a descent by application of collective pitch and power. If sufficient power is not available for recovery, application of pitch may aggravate power settling. This results in more turbulence and a higher rate of descent. Recovery can be accomplished by lowering collective pitch and increasing airspeed. Increasing airspeed normally is the preferred method of recovery, since less altitude loss usually results than by lowering collective pitch method. Both of these methods require sufficient altitude in order to be successful.

WARNING: *A considerable loss of altitude may occur before the power settling or vortex ring state condition is recognized and recovery is completed.*

2.14. Retreating Blade Stall. The speed of the airflow over the retreating blade (the blade moving away from the direction of flight) decreases as forward speed increases. The retreating blade, however, must produce an amount of lift equal to that of the advancing blade. Therefore, as the speed of the retreating blade decreases with forward speed, the blade angle-of-attack must be increased to equalize lift throughout the rotor disk area. As this angle increase is continued, the blade will stall (exceed the critical angle-of-attack) at some high forward speed.

2.14.1. As forward speed increases, the no-lift areas move left of center, covering more of the retreating blade sectors. This requires more lift at the outer retreating blade portions to compensate for the loss of lift of the inboard retreating sections. In the area of reversed flow, the rotational velocity of this blade section is slower than the aircraft airspeed. Therefore, the air flows from the trailing to leading edge of the airfoil. In the negative stall area, the rotational velocity of the airfoil is faster than the aircraft airspeed. Therefore, air flows from the leading to trailing edge of the blade. However, due to the relative arm and induced flow, blade flapping is not sufficient to produce a positive angle-of-attack. In the negative lift area, blade flapping and rotational velocity are sufficient to produce a positive angle-of-attack, but not to a degree that produces appreciable lift.

2.14.2. Upon entry into blade stall, the first effect is generally a noticeable 4-per-rev vibration. This is followed by a left rolling tendency and a tendency for the nose to pitch up. If the cyclic stick is held forward and collective pitch is increased (or not reduced) this condition becomes aggravated. The vibration greatly increases, and control will be lost.

2.14.3. In operations at high forward airspeeds, the following conditions are most likely to produce blade stall:

2.14.3.1 High blade loading (high gross weight).

2.14.3.2 High density altitude.

2.14.3.3 Steep or abrupt turns.

2.14.3.4 Turbulent air.

2.14.4. Warnings of approaching retreating blade stall are:

2.14.4.1. Increase in 4-per-rev vibration level.

2.14.4.2. Pitch-up of the nose.

2.14.4.3. Tendency for the helicopter to roll left.

2.14.5. You need to take corrective action when blade stall is likely. Exercise extreme caution when maneuvering. An abrupt maneuver such as a steep turn or pull-up may result in dangerously severe blade stall. Aircraft control and structural limitations of the helicopter would be threatened. Blade stall normally occurs at high airspeeds. Low rotor RPM can contribute to blade stall; therefore, increasing rotor RPM is a corrective action. This, however, is normally not a likely concern in the HH-60G provided 100% Nr is maintained. To prevent blade stall, the pilot should fly slower than normal when:

2.14.5.1 Density altitude is high.

2.14.5.2 Operating near maximum gross weight.

2.14.5.3 Flying high-drag configurations (ESSS).

2.14.5.3 The air is turbulent.

2.14.6. When blade stall is suspected, corrective action includes:

2.14.6.1 Reducing power.

2.14.6.2 Reducing airspeed.

2.14.6.3 Reducing G-loading during maneuvering.

2.14.6.4 Checking pedal trim.

2.14.7. In severe blade stall, the pilot loses control. The only corrective action, then, is to accomplish the procedures indicated previously, to shorten the duration of the stall and regain control.

2.15. Translational Lift. The efficiency of the hovering rotor system is improved with each knot of incoming wind gained by either horizontal movement or surface wind. As the incoming wind enters the rotor system, turbulence and vortices are left behind and the flow of air becomes more horizontal. This improved rotor efficiency resulting from directional flight is called translational lift. At approximately 1 to 5 knots, the downwind vortices begins to dissipate and induced flow down thorough the rear of the rotor disk is more horizontal than at a hover. At 10 to 15 knots, airflow is much more horizontal than at a hover. The leading edge of the down wash pattern is being overrun and is well back under the helicopter nose.

2.15.1. At approximately 16 to 24 knots, the rotor completely out runs the recirculation of old vortices and begins to work in relatively undisturbed air. The rotor no longer pumps the air in a circular pattern, but continually flies into undisturbed air. The air passing through the rotor system is more horizontal, depending on helicopter forward airspeed.

2.15.2. As the helicopter speed increases, translational lift becomes more effective, causing the nose to pitch up. This tendency is caused by the combined effects of dissymmetry of lift and gyroscopic precession. Pilots must correct for this tendency in order to maintain a constant rotor disk attitude that will move the helicopter through the speed range where effective translational lift (ETL) occurs. If the nose is permitted to pitch up while passing through this speed range, the aircraft may also tend to roll slightly to the right.

2.15.3. The tail rotor also becomes more aerodynamically efficient in forward flight. The tail rotor works in progressively less turbulent air as airspeed increases. As tail rotor efficiency improves, more thrust is produced for a given tail rotor position (angle-of-attack). This causes the aircraft nose to yaw left, requiring the application of right pedal as speed increases.

2.16. Transverse Flow Effect. Between approximately 10 to 20 knots, air passing through the rear portion of the rotor disk has a greater induced flow angle than air passing through the forward portion. This downward flow at the rear of the rotor disk tends to cause a reduced angle-of-attack, requiring greater pitch to produce enough lift to keep the forward portion of the rotor disk lower than the rear. Less induced flow and more lift is produced at the front portion of the disk because airflow is more horizontal. These differences between the fore and aft portions of the rotor disk are called transverse flow effect. They cause unequal drag in the fore and aft parts of the disk, resulting in vibrations that are easily recognizable by the pilot. Due to gyroscopic precession, the increased lift at the forward portion of the rotor system will result in a right rolling motion in the helicopter.

2.17. Tail Rotor Considerations. Many pilots do not appreciate the effect that the tail rotor has on power applied. The torque indicator displays power supplied by the engines to the entire drive train, not just the main rotor. As with collective changes, if you move the pedals, you can change the torque applied (displayed on the torque indicator). Let's say an HH-60G is stabilized in a 20-foot hover, in a no-wind environment, with a constant collective position, at 65% Q. If you push right pedal for a moderate-rate pedal turn, you will see the torque decrease approximately 5%. If you push left pedal instead, you will see the torque increase approximately 5%. Knowledge of this has applications in a variety of maneuvers.

2.17.1. If you are hovering with a crosswind, the application of pedal to hold heading will result in power (required to hover) readings that will not match those estimated for a no-wind environment. Hovering with a right crosswind requires more left pedal (and more torque) to counteract the wind-vaning. Hovering with a left crosswind requires more right pedal (and less torque) to counteract the wind-vaning.

2.17.2. As you transition from a hover to forward flight, the increased efficiency of the tail rotor requires the application of right pedal. If the collective position is held constant, the torque applied (displayed on the torque indicator) will decrease. If you are executing a marginal power (or maximum performance) takeoff and desire to hold a constant power setting (simulated or actual maximum available), as forward airspeed increases, the collective must be increased slightly in order to make up for the power reduction that occurs due to the application of right pedal. In a marginal power (or maximum performance) takeoff situation, application of right pedal affords a few percent more torque available for vertical thrust (collective).

2.17.3. Several factors lead to degraded tail rotor performance. Some situations require the application of increased collective and consequently, the anti-torque required by the tail rotor. These situations include high gross weights, and hovering OGE. High rates of descent on final may require a large collective application to check the rate of descent. This collective application will also require additional left pedal inputs. In all of these cases, if operating with narrow power margins, rotor RPM may droop. High density altitude decreases the effectiveness of a given tail rotor angle-of-attack. This means that more tail rotor pitch must be applied to provide the proper amount of anti-torque for a given collective setting.

2.17.4. A right crosswind requires application of left pedal (requiring more engine power) to counteract the wind-vaning. During marginal power (or maximum available) situations, large left pedal application may result in a droop of the main rotor. The tail rotor turns at a much faster rate than the main rotor, so a slight reduction in main rotor speed will greatly reduce the speed of the tail rotor. As the tail rotor slows, the thrust produced decreases. If more left pedal is applied (to increase the tail rotor angle-of-attack to provide the required thrust) the situation will continue to deteriorate. In extreme cases, low tail rotor RPM and high tail rotor pitch (angle-of-attack) can exceed the critical angle, resulting in a tail rotor stall. If possible, crews should avoid landing with obstacles on the left side of the aircraft during marginal power conditions. This will allow an unobstructed right turn in the event tail rotor effectiveness is lost.

2.17.5. A left crosswind requires the application of right pedal (requiring less engine power) to counteract the wind-vaning. While this may be an aid in marginal power (or maximum available) situations, extreme wind from the left can cause the tail rotor to work in its own down wash, decreasing its effectiveness. This airflow pattern can even develop into a vortex ring state (like the main rotor during settling with power). Also, when the winds are approximately 10 to 20 knots from 9 to 11 o'clock (relative to the aircraft nose), the vortices shed from the main rotor blades may impinge on the tail rotor. This disrupts the airflow over the tail rotor and may reduce tail rotor effectiveness.

2.17.6. HH-60G helicopters are rigged with collective to yaw coupling so that increases in collective will automatically increase tail rotor pitch to compensate for the main rotor torque. At gross weights lower than the design weight of 16,825 pounds, the mixing will overcompensate for the increase in collective and at higher gross weights, the mixing will not provide enough compensation.

2.17.7. If you encounter LTE, consider the following:

2.17.7.1 Reduce power.

2.17.7.2 Allow the aircraft to align into the wind.

2.17.7.3 Increase forward airspeed.

If you have adequate maneuvering area, the old adage -- "the remedy for LTE is ETL" is a good one.

2.18. Indicated versus True Airspeed. For any aircraft, the indicated airspeed (IAS) is influenced by the density of the surrounding air. As the air becomes less dense (higher density altitude), IAS will decrease for a given true airspeed (TAS). For example, at a DA of 12,000 feet, an aircraft traveling at an IAS of 100 knots is actually traveling at a TAS of 120 knots. At high DA, if you continue to fly the same IAS you use at low DA, several problems can result, because you are actually moving faster than you are accustomed. If you don't shorten the time of each traffic pattern leg, your patterns will get larger. Your rate of closure on final will be faster. Due to the increased inertia, you may overshoot the intended landing area. Power changes on final will be greater.

2.19. Power Required to Hover. Gross weight has the single biggest impact on power required to hover. As hover height increases, power required to hover also increases. This is due to the diminished influence of ground effect. The power required to hover increases slightly as the pressure altitude increases. There is a misconception that as the temperature decreases, the power required to hover decreases significantly. In certain cases, at extremely high PA and low temperatures, the power required to hover increases at a given gross weight. Winds also have an effect on the power required to hover. As the wind velocity increases to transverse flow and ETL speeds, there will be a decrease in the power required to hover because of increased efficiency of the rotor system. When executing an approach with a narrow power margin, the approach must be smooth and controlled. An approach airspeed below ETL reduces rotor efficiency and could lead to power settling or settling with power. An airspeed moderately above ETL requires the application of power to control closure rate. At the bottom of an approach (unlike a stabilized hover) the lift vector has a rearward component (to stop forward motion) which must be compensated for. Flying the approach at the airspeed where ETL just begins (using the transverse flow burble as a target) usually requires the least power. During the approach, power applied should slowly increase (to compensate for increasing induced drag and control the rate of descent), but should be below hover power. Remember, at the bottom of the approach, if you desire to terminate at 10 feet, you must have the power available to hover at 10 feet, stop your descent, and compensate for a rearward lift vector.

2.20. Power Available. Power available is a function of engine design/condition and atmospheric conditions, such as temperature and PA. If the outside air temperature or the PA increases, maximum power available decreases.

Chapter 3

MISSION PREPARATION AND PLANNING

3.1. Purpose. Thorough mission preparation and planning provides the foundation for successful mission accomplishment. Mission preparation, planning, crew resource management (CRM), and flight leadership are some of the most important factors in maintaining an ability to think and react in a combat environment.

3.1.1. Preparing yourself for a mission requires careful consideration, discipline, and effort on your part. You must prepare yourself both physically and mentally. Units should also adhere to policies and scheduling practices that minimize the negative effects of psychological and physiological factors.

3.1.2. Agencies external to your crew/flight will usually set mission objectives and priorities. Your job is then to prepare for the mission as best you can, using whatever resources you have at your disposal. Much of the preparation you must accomplish for any mission must be done long before you receive any tasking.

3.2. Physiological/Psychological Factors.

3.2.1. Mental Preparation.

3.2.1.1. Combat Rescue missions demand total concentration and effort on the part of the entire crew. No one knows how they will react when placed in a combat situation. This, along with other factors, such as long sortie duration, fear of the unknown, under/over estimation of one's abilities, the opponent's ability, the combat area, and unexpected adverse situations, can quickly overwhelm the unprepared. You establish the foundation for overcoming anxiety by developing confidence in yourself, aircraft, aircrew, and wingman.

3.2.1.2. When crewmembers find themselves in white-knuckled situations, their performance tends to follow previously learned habit patterns. The knowledge and skills you develop in training and use on every flight are the same skills your mind will draw upon in tight situations. This is why it is important to stay in the books, develop disciplined techniques to adhere to established procedures and to train like you will fight. Combat is not a catalyst that brings hidden qualities magically to the surface. Neither will combat suddenly squelch poor habits learned in the past. As we train to fight, professionalism is a quality that must exist and be evident in all crewmembers.

3.2.2. Circadian Rhythm.

3.2.2.1. Circadian rhythm is based closely on the body's natural biological clock. The biological clock is set by a number of factors including the accustomed awake period, light exposure, meals, and other factors. There are two ways we disrupt it. One is to be active during normal rest periods and the other is to transit numerous time zones. Disrupting circadian rhythm causes fatigue. Restless sleep, caused by trying to sleep during periods when you are conditioned to be awake, affects both mental clarity and coordination.

3.2.2.2. When advanced planning is possible, the effect of circadian rhythm disturbance can be minimized. For instance, crews flying night sorties can be placed on a night cycle where they do not report for duty until later in the day or evening, even on non-flying days. This will permit adjusting to the new schedule. Operational constraints may not allow such a strategy, but if it can be used, it should be followed for a minimum of two weeks at a time with four to six weeks being preferable. Flight surgeons should be involved in operations planning when unusual sleep-work schedules are involved.

3.2.2.3. When deploying across many time zones, consideration should be given to allow ample time for your body to adjust to the new time zone. During deployments, commanders should consider the effects of travel across many time zones before tasking crews to perform flight duties.

3.2.3. Fatigue.

3.2.3.1. Highly motivated crewmembers often disregard the symptoms of fatigue and press on. This attitude has been a factor in class-A mishaps and has cost lives and aircraft. Although fatigue affects people in different ways, the general trend is for complex and voluntary functions to fail first. Some symptoms include:

- Inability to remain awake
- Poor altitude control
- Reduced clearing
- Irritation
- Slow reaction times
- Poor hand-eye coordination
- Less voluntary eye movement
- Improper switch setting
- Speech changes
- Channelized attention

3.2.3.2. As fatigue grows, the crew member will tend to withdraw from the outside world, stop doing tasks, and mentally detach himself from his environment. This can become a deadly condition if allowed to build while the individual continues to perform crew duties.

3.2.4. Physical Conditioning. Maintaining good physical condition will help you to reduce stress, stay alert, and maintain your situational awareness. Each crewmember is encouraged to participate in regular aerobic physical activity.

3.3 Mission Planning. Effective mission planning establishes the foundation for a well-executed mission. Each crew should strive to know the mission from start to finish, focusing first on mission critical items, then, as time allows, concentrating on those items that, though not critical to the mission, would enhance situational awareness.

3.3.1 Mission planners at the AOC/JSRC may plan and deconflict the entire combat SAR mission. Line pilots may be given a mission already planned. In this case, the crew needs to ensure they are thoroughly briefed on the plan and have all the mission material and data required to execute the mission.

3.3.1.1 Before any mission, it is important to know what the objective is. By understanding the real intent of the mission, you are better able to meet priorities, determine your limits, and make logical decisions in a fluid environment.

3.3.1.2 If the objective of your mission is to train for combat, plan to achieve each objective in a way that will enhance/develop your crew's combat capability and their proficiency level. Your overall goal is to train to a fully combat ready aircrew level.

3.4. Map Preparation:

3.4.1. Map Selection. Select maps which provide the detail desired to satisfy navigation requirements. Maps with a scale of 1: 250,000 or greater are normally desired for low level operations. Recent imagery of the route and objective area can be beneficial if available. Consider using a 1:50,000 map to ensure precise navigation when needed (e.g. IP inbound). Exercise caution when transferring from one scale map to another and make the transition at a prominent terrain feature, which is readily identifiable on both maps. TPC charts (scale 1:500,000) and JOG charts (scale 1:250,000) depict terrain contours every 500 feet and 100 feet respectively at higher elevations. Be aware that TPC and JOG charts could have an inherent error in depicting terrain elevation of up to 499 feet and 99 feet respectively, and obstructions below 200 feet are not charted and/or required to be lighted. The map's datum must be noted and accounted for with aircraft navigation systems and plotted coordinates. Since different datum's can introduce location errors, determine which datum was the source of significant coordinates (survivor, hazards, etc). Ensure the navigation system reflects the proper Datum.

3.4.2. Map Preparation. Carefully review maps to identify obstacles and hazardous terrain. Annotate enemy threats and turning/checkpoints on the map. (This information may classify your map.) Establish specific course lines between turning points for low level navigation. When terrain masking, these lines do not necessarily represent the ground track to be flown. Time tick marks based on an established ground speed are optional. Other flight planning data and information may be annotated; however, use caution to avoid obscuring pertinent information. Mission commanders are allowed to determine the symbols used based on the actual mission profile, threats, terrain, political considerations, etc.

3.4.3. Distance tick marks denote distance between waypoints. If used, place them on the left side of the course line. A good technique is to count down the distance between waypoints (i.e. 5, 4, 3, 2, 1). When portrayed in miles, this will align with distances displayed on the H-60 CDU/VSDS with the tick marks on the map and is useful in identifying obstacles (e.g. power lines).

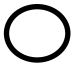
3.4.4. Waypoints. Label waypoints on the map consistent with the aircraft navigation systems. Use a circle to depict points where changes or navigation updates occur. Consider placing occasional waypoints over precisely defined features to allow navigation system updates or verification. However avoid population concentrations, LOCs, or other man-made features when possible. Also avoid mountains/hill tops which will tend to highlight the flight. Picking a waypoint adjacent to a distinct terrain feature is a good technique to minimize detection by a threat. If the mission involves a TOT, it is useful to indicate a crossing time next to each waypoint.

3.4.5. Hazard Avoidance. Probably the greatest threats to low level operations are man-made hazards, primarily powerlines and towers. Navigational maps should be annotated with Chart Updating Manual (CHUM), low-level survey hazards, and probable wire locations. The entire crew should scan for indications of wires such as swaths through vegetation, poles, roads, towers, and buildings. When flying in narrow canyons or gorges be especially cautious for wires strung from edge to edge. Support structures for these wires are usually massive and easily seen. Ridge lines should also be scanned for the presence of poles, antennas, or power line support structures. For combat operations, Defense Intelligence Agency (DIA) route analysis products are available that indicate hazards within a user-specified corridor. Any low level air traffic corridors (VR, SR, and IR routes) should also be annotated. A useful technique is to highlight enroute hazards with distance or time marking to ease avoidance. Exercise care when decelerating in a low level environment. When flying a terrain profile and maintaining 50 feet obstacle clearance, pilots must rotate the helicopter around the tail rotor. This is accomplished by increasing collective to maintain tail rotor altitude and then applying aft cyclic to decrease airspeed.

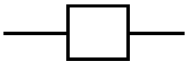
3.4.6. Altitude Selection. Planned flight altitudes are commensurate with threat, hazards, and weather conditions. In friendly territory, keep altitudes higher if tactically sound. This reduces flight hazards, crew fatigue, and allows attention to be dedicated to mission coordination, if required. In enemy territory, make a pre-planned as well as real-time assessment weighing low level hazards against enemy threat to determine the safest flight altitude. The greatest threat may come from wire/tower hazards that increase altitude requirements. In areas of concentrated enemy threat, keep the altitude to a minimum to degrade acquisition and engagement. High altitude operation (above 5000 feet AGL) may be useful to defeat small arms and light AAA but is only appropriate if the enemy has no SAM or heavy AAA capability. Flight altitudes are often driven lower by reduced visibility or low illumination. In these cases, there is a point where it is unsafe to go lower despite the visibility or illumination degradation. Once this point is reached, a decision to turn around, climb and continue IMC, or abort the mission must be made.

3.4.7. Standard Symbols For Map Preparation. The following standard annotations and symbols should be used in preparing maps for both combat and noncombat operations. Recommend the use of black ink, pencil, or symbol tapes to portray data on inflight materials. Navigation computer, tactical airlift mission plotter, or suitable substitute should be used for annotating standard symbols. Other symbols may be used in addition to those listed. Ensure any non-standard symbols or notations are thoroughly briefed to all crew members.

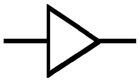
3.4.7.1. Waypoint. Use a circle to depict en route points where the aircraft course is altered or key actions occur. Number waypoints consecutively to facilitate identification. If used, place corresponding navigation information blocks (NIB) immediately adjacent to the course line.



3.4.7.2. Initial Point (IP). The IP is identified by a square centered on the point. If the IP is simply a coordinate, a dot will be positioned on the coordinate location centered within the square.



3.4.7.3. Objective Point (OP). The OP is identified by a triangle centered on the planned point with the apex pointing in the direction of flight to the point.



3.4.7.4. Navigation Information Block (NIB) (Optional) The NIBs are designed to give the crew the required navigational data from the present waypoint to the next waypoint.

3.4.7.4.1. TO Waypoint. The designator of the next waypoint and ARIP, PIP, IP, LZ, etc., if applicable.

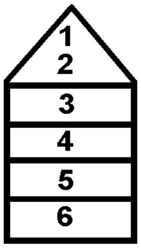
3.4.7.4.2. MAG Heading. The magnetic heading to the next waypoint.

3.4.7.4.3. Distance. Enter the distance to the next waypoint or leg distance. Required if AF Form 70, WING approved, computer generated form, or more detailed navigation form is not used.

3.4.7.4.4. ETE. The time to fly to the next waypoint.

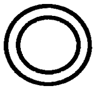
3.4.7.4.5. Fuel. Required if AF Form 70, Wing approved, computer generated form, or more detailed navigation form is not used.

3.4.7.4.6. MSA. Minimum safe altitude for each leg (see paragraph 5.17.4.).

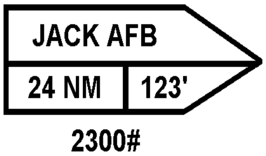


3.4.7.5. Emergency Landing Bases (Optional) Use a single circle with a diagonal line to identify those airfields compatible with unit aircraft and which may be used in an en route emergency. The number of emergency bases selected and the frequency of occurrence are at the discretion of the mission planner.

3.4.7.6. Alternate Recovery Bases (Optional). Use two concentric circles to identify those airfields compatible with unit aircraft and which are preferred for recovery in case the primary base is unusable because of weather, damage, or other reasons.



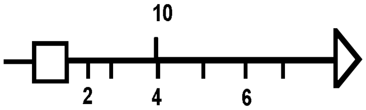
3.4.7.7. Recovery Arrow Box (Optional). Use a horizontally divided arrow box pointing in the general direction of the alternate recovery base to provide navigational information to the alternate base. This box depicts base name, distance in NM from divert point to alternate base, the mag course from divert point to alternate base, and fuel required to fly to the base.



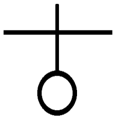
3.4.7.8. Course Line and Time/Distance Marks. Draw course lines for the entire route inbound to the objective and continue on to portray the return route to the primary.

3.4.7.8.1. Time Marks (Optional). When used, they should be placed on the right side of the course line. Time marks are of particular value along the pre-initial point route segment.

3.4.7.8.2. Distance Mark (Optional). When used, they should be placed on the left side of the course line.



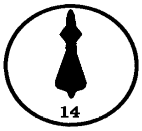
3.4.7.9. Combat Entry Point (Optional). A heavy line identifies and locates the point at which the flight route crosses the FEBA/FLOT. The line extends at least 1 inch on either side of the course line. The entire FEBA should be annotated, if known.



3.4.7.10. Operational Advisory Annotations. Advisory annotations concerning operational aspects of the mission are positioned to the side of the course line. The annotations consist of a line at the point en route where the function should be performed and the action is noted on the side end of the line. The action description may be either enclosed in a box or left open at the discretion of the mission planner. Examples of these operational advisories are: start climb, start descent, IFF/SIF Stby, Lights off, lights on, TACAN receive only, IFF/SIF-On, TACAN-T/R.

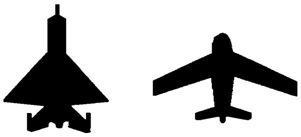
3.4.7.11. Order Of Battle (OB). Depict friendly/enemy order of battle information directly on the navigation chart using the following symbols and annotations. Chartpak symbols are recommended. (Symbols are mandatory, Radii are optional).

3.4.7.11.1. Surface-to-Air Missiles (SAM). The number associated with the symbol indicates the specific type weapon system (SA-2, SA-6, etc.). The actual SAM location is at the base of the symbol. Use circles to indicate effective radii of the system at the planned mission altitude.



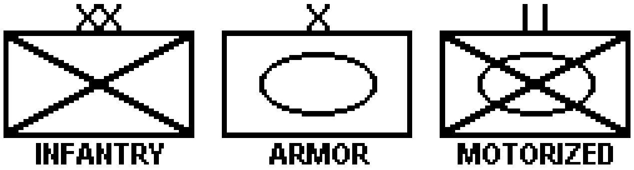
3.4.7.11.2. Antiaircraft Artillery (AAA). Depict known AAA sites and indicate type (i.e., ZSU 23-4, 57MM, etc.) The base of the diagram indicates the known position.

3.4.7.11.3. Aircraft. Indicate locations of enemy airfields supporting aircraft capable of intercepting the mission. The delta-Wing symbol indicates all-weather capable aircraft and the swept-Wing symbol indicates clear-air mass (CAM) interceptors.



3.4.7.11.4. Ground Forces. Indicate ground forces with the appropriate box symbol. Be aware that forces are usually spread over an area much larger than the physical symbol size. The symbol above the box indicates the ground forces size as follows:

XX = Division (about 7000-10,000 personnel)
X = Brigade (about 2000-5000 personnel)
I I I = Regiment (about 1000-2000 personnel)
I I = Battalion (about 300-500 personnel)
I = Company (about 50-100 personnel)



3.5. Route Selection.

3.5.1. Route Selection. Planning a route is often easier if you start from the objective (if known) and work backwards. Pay particular attention to the objective area run-in, border/lines of communication (LOC) crossing, and any high threat enroute areas (e.g. troop concentrations, radar facilities, populated areas, air defense units, etc). Normally, plan to use available terrain features for masking and navigation purposes. To avoid disclosing the objective, try to avoid a direct routing by incorporating sufficient course changes, if practical. Select routing to avoid enemy threats, LOC's, populated areas, and hazards as much as possible. Consider routing along terrain features for masking and navigation. Waypoints should be selected which are identifiable, but not so obvious that the enemy is drawn to them also. Vertical development and high contrast (especially at night) will help identification in flight. When practical, avoid crossing LOC's, ridge lines, and flat, open terrain. Ingress and egress routes should be different to avoid flying over threats that may have been alerted during the ingress.

3.5.1.1. Objective Run-in. The routing from the IP to the objective is often the single most critical route segment. Ideally, the IP would be located in a relatively secure area with line-of-sight to the objective to allow visual as well as radio contact with the survivor. This allows observation and authentication before committing the helicopter and disclosing the survivor's location.

3.5.1.2. Waypoint Selection: Normally, do not exceed 20 NM between waypoints when dead reckoning. Since power lines, poles, towers, and other significant vertical man-made obstacles are difficult to see during NVG operations, try not to select waypoints immediately adjacent to them. Establish an initial point (IP) over a prominent feature, easily identifiable from low altitudes. The distance from the IP to the objective will vary with the situation, but ideally should be approximately 3 to 12 NM from the objective.

3.5.1.3. LOC Crossings. Minimize LOC crossings to reduce the potential for detection and engagement. Crossing direction should be perpendicular to the LOC to reduce exposure time. Approaches should allow line-of-sight observation from a relatively secure area to assess the actual threat. Plan departures to allow immediate re-masking. Many LOC's may include power lines that will force you to higher altitudes during the crossing. Consider using DASH speed (maximum cruise speed) when performing LOC crossings.

3.5.1.4. Border Crossings. These are often the most highly observed/defended enemy areas. Plan the crossings in detail. Try to use the most inaccessible, uninhabited areas of terrain for border crossings. Considerations include friendly safe passage procedures and type/depth of enemy air defense. If the air defense zone is deep, consider planning a "committed" point which indicates where it is safer to continue the ingress through the zone if engaged instead of reversing course to abort. Alternate border crossing locations and safe passage procedures should be planned in the event the primary location is unusable.

3.5.1.5. Time On Target (TOT) Considerations. Missions that require a TOT greatly increase mission complexity and reduce probability of success since an abort may be required if the TOT is missed. Air refueling, border crossing/safe passage, and survivor recovery are examples which may require TOTs. TOT refers to the time you must be established in the LZ (either landed, established in a hover, or over the point of operation as required by the mission). In some cases, consider arriving at the IP or other secure area within line-of-sight communications range at the TOT. This will allow you to authenticate and instruct the survivor before committing the aircraft to the run-in and compromising his location. Based on the mission, authentication may not be required when using a TOT. TOT management is usually accomplished by airspeed adjustments. If a TOT is required, it may be for the following reasons: 1) The survivor is concealed and can only afford to expose himself or a ground signal for a short time. 2) The survivor was instructed to monitor his radio during a specific window or is following his EPA comm. plan. 3) The TOT serves as an authentication to the survivor in an area where enemy helicopters are present. The following tools will aid you in TOT management.

3.5.1.5.1. Pre-Planned Delays. Intentional delays may be built in at selected waypoints or route segments to provide a buffer if the flight runs late. A planned delay of 5-10 minutes can be eliminated to make up for actual delays due to late takeoffs, weapons/systems malfunctions, or any other reason. Obviously, plan the delay in a relatively secure area. If an area to orbit or land is not available, add additional route segments that can be eliminated. An example of this technique is the use of Timing Triangles. These are planned route segments that form a triangle of waypoints with the planned option of skipping the triangle's point to make up time. If, for example, a timing triangle with equal, 2 minute legs along waypoints A, B, and C, is planned, it takes 4 minutes to fly A-B-C, or 2 minutes to fly A-C allowing you to make up 2 minutes if you're late. You should avoid direct routing when using a TOT. Direct routes allow little flexibility when the need arises to make up lost time due to strong headwinds, late takeoffs, maintenance delays, etc.

3.5.1.6. Planned Ground speed. Plan the route at a ground speed that allows flexibility to speed up or slow down during the mission. Power available and Vh should be considered. MCM 3-1, Vol 24, contains additional guidance on planned ground speed considerations. Consider the following limitations to your maximum speed when determining the planned ground speed: Low enroute visibility limits higher speeds; At night, poor terrain definition, low illumination, or flight toward light sources limits higher speeds.

3.5.1.6.1. Consider basing your maximum cruise airspeed on continuous power available. For formations, further reduce this at least 10% to allow wingmen to maintain position without routinely operating at maximum power settings.

3.6. Night Operations.

3.6.1. Survivability and success in combat operations are a function of minimizing threat capabilities while maximizing one's own. One way to maximize our capabilities is through the use of night low-level operations which reduce the probability of detection by visual, electro-optic, or electronic means. Night operations increase the chance of surprise and decrease the chance of detection and weapons engagement by enemy forces. Night operations place increased emphasis on night imaging devices, which operate in the optical radiation portion of the electromagnetic spectrum. The use of these devices requires a thorough understanding of the night environment. This understanding includes the relationship between ambient illumination, the terrain, the night imaging device, and the human eye. Each of these are critical links in the night vision chain. This section presents techniques and considerations specifically for night operations. Special emphasis is placed on NVG operations since the use of NVGs is the safest means of conducting low-level night operations in the HH-60G. Detailed mission planning/preparation, alternate contingency planning in the event of mission changes, effective crew resource management, and situational awareness are all crucial elements to successful night operations.

3.6.2. Dark Adaptation. For the average human, it takes approximately 30 minutes for the retina to be fully dark adapted. Use of NVGs will lessen dark adaptation. Crews should remember this after removing their goggles as they will most likely be taxiing unaided and moving around a dark aircraft after shutdown.

3.6.2.1. Controlling exposure to bright sunlight is important. It may take your eyes up to five hours to recover from intense sunlight. If you are out on a bright, sunny day prior to a night flight, sunglasses are recommended. Additionally, your eyes need oxygen to maintain good night vision and smoking reduces oxygen intake and decreases night vision.

3.6.2.2. The most critical hours for night flying are morning and evening twilight. This is because some sunlight is visible during twilight, and the rods and cones in your retina haven't fully adapted. You're not getting full night vision or full day (color) vision. Consequently, objects on the ground and in the air won't be easy to see. Also, be aware that when you have full night vision, your best visual acuity is

20/200 (unaided), and you will have a blind spot in the center field of vision that you will have to "look-around" to see objects clearly. This blind spot will be reduced with a high moon illumination.

3.6.3. Ensure your helmet, visor and aircraft windscreens are clear and clean. Dirty or scratched glass cuts down on the contrast between an object and its background contrast, that helps you see objects at night.

3.6.4. Dim cockpit lights to the lowest practical level. As the mission continues and your dark adaptation increases, dim the lights further. Use no more light in the cockpit than is necessary. HH-60G cockpit instruments have back lighting, but the lower console radios are not lit. In order to see some radios, it may be necessary to have your own chemlight, finger light, or flashlight. Keep all lights dim as possible to minimize reflections on the cockpit windows. Minimize use of lip/finger lights in threat areas. Dim other interior lights as much as possible to avoid detection.

3.6.5. Mission Requirements. Refer to MCI 11-HH60G Vol 3 for minimum equipment, illumination requirements, altitude restrictions, weather minimums and power requirements for conducting night operations.

3.7. NVG Planning Considerations.

3.7.1. Mission Planning. Thorough and detailed mission planning is absolutely critical to successful NVG operations. As a minimum, aircrews must consider the tactical environment, terrain, illumination, weather, crew capability and length of mission. Aircrews need to ensure they use the scale map(s) providing as much detail as necessary for mission accomplishment, and that all maps used are updated with the latest CHUM, with emphasis on any obstructions to their planned route of flight. Additionally, a thorough knowledge and understanding of some very specific terms is necessary to fully appreciate the NVG operations environment. See HQ ACC CAF NVG CONOPS for additional NVG information.

3.7.2. Illuminance vs. Luminance. The most common photometric terms used are illuminance (expressed as either lumens, lux, or foot-candles) and luminance (usually expressed as foot-lamberts).

3.7.2.1. Illuminance. Illuminance refers to the amount of light which strikes an object or surface. An example of illuminance is the amount of ambient light which strikes the ground from the moon.

3.7.2.2. Luminance. Luminance refers to the amount of light reflected from a surface. An example of luminance is moonlight which is reflected from certain aspects of the terrain which enables us to see those features. The moonlight striking the ground is illumination while the light reflected off the terrain which enables us to see the terrain is luminance. The relationship between illumination and luminance yields a ratio (incident light to reflected light) which is called albedo. While illumination from the moon may remain constant, luminance from different terrain varies. This is why the features of a blacktop road are more difficult to see than the features of a light colored concrete road. In summary, ambient light sources provide illumination or illuminance. However, what our eyes "see" and night imaging devices detect is the light reflected from objects and terrain or luminance. A high illuminance or lux means a large amount of light is striking an object or surface. Whereas a high luminance means a lot of light is being reflected by an object or surface.

3.7.2.3. Night Sky Illumination. There are many sources of ambient illumination which combine to light the night sky. Natural sources include the moon, stars, solar light, and other background illumination. There are also artificial sources, which are sometimes referred to as "cultural lighting". Some examples of artificial sources include lights from urban areas, automobiles, fires, weapons, searchlights and flares. Remember, illumination includes only light which strikes the object or terrain to be observed. It does not include the light reflected off the object or terrain; this is luminance.

3.7.3. NVG Preflight/Malfunctions. It is imperative each crew member performs a thorough preflight of their NVGs prior to mission execution. The NVGs should be visually inspected for any obvious deficiencies. Clean the lenses to ensure no fingerprints or smudge marks will obstruct the wearer's vision. Crew members should then check their NVGs using the Armstrong Laboratory NVG Resolution Chart and associated test lane procedures or portable testing equipment. If the NVGs do not meet specified minimum visual acuity requirements as specified in the Armstrong Laboratory NVG Resolution Chart (Model 3X3A) and associated test lane procedures, obtain another pair. Do not fly with goggles that fail to meet the prescribed visual acuity standards. Use care to prevent accidentally turning on NVGs in daylight or looking directly at bright sources of illumination as this will damage the light sensitive material in the goggles. Some common malfunctions encountered while preflighting NVGs are: battery problems, interpupilary distance adjustment, one tube will not focus, and light intensifying element damage resulting in large black spots obstructing the crew member's vision. If any of these malfunctions are encountered, obtain another set of NVGs. Battery failure is a common malfunction that manifests itself differently depending on the type of batteries used. For example, AA penlight batteries tend to fade slowly, causing the viewed image to gradually darken.

3.7.4. Environmental Effects. The environment can have a major impact on the success or failure of NVG missions. Aircrews must consider available illumination, visual illusions, and weather conditions to be encountered during the planning and execution of any NVG mission. Any condition of the atmosphere which absorbs, scatters, or refracts the illumination, either before or after it strikes the terrain, will effectively reduce the usable light available. The exact amount of reduction is difficult to predict because a common factor cannot be applied to each condition of cloud or fog coverage. Make an estimation of light reduction by considering the basic illumination as a starting point and then knowing the particle size of the atmospheric condition (i.e., clouds or fog) and its density (lack of space between particles). Table 3.1 provides factors which affect luminance used by night vision goggles.

Table 3.1. Factors Affecting Luminance.

Atmospheric Transmission Weather; Clouds, Fog, Rain, Snow Obscurants; Dust (Brownout), Snow (Whiteout), Chemicals, Smoke
Terrain Contrast; Albedo, Texture Shadows; Moon Angle
Aircraft Heading, Altitude, Attitude Cockpit Lighting Cockpit Structures

3.7.4.1. Illumination Considerations. In addition to moon illumination, consider other light sources and their effect on the mission. Bright lights (direct or reflected) from internal or external sources seriously degrade the NVG effectiveness. Avoid flying directly toward moonrise/moonset or sunrise/sunset as vision may be severely restricted by the intensity of the light. Bright lights can create shadows that may hide obstacles. In marginal to poor illumination conditions (effective illumination approaching 5% such as starlight only conditions) aircrews should fly lower and slower. The low altitude/slow airspeed combinations required to adequately discern landscape and surface obstructions can be prohibitive to conducting safe NVG operations. Do not operate below the minimum altitudes specified in MCI 11-HH60G Vol 3. Aircrews should also consider how sky conditions affect available illumination. For instance, if the sky condition is overcast, and you are near a large city or other light source, the amount of reflected light may be more than sufficient for your NVG mission. On the other hand, you may have 100% moon illumination with overcast skies and the effective illumination may not be sufficient for safe NVG operations. The bottom line is aircrews must evaluate conditions every night and apply common sense and good judgment prior to conducting NVG operations.

3.7.4.2. Terrain Luminance. Our ability to see terrain features and objects is greatly influenced by the amount of light they reflect. Natural or artificial illumination reflects off terrain in varying amounts (albedo). Two characteristics of the illuminated terrain are responsible for our ability or inability to see and distinguish differences in terrain features; contrast and shadows.

3.7.4.2.1. Contrast. Contrast is a measure of the luminance difference between two or more surfaces. Contrast can vary from 100 percent to 0 for surfaces darker than their backgrounds, and from 0 to infinity for surfaces brighter than their backgrounds. Contrast in the night terrain environment is dependent upon differing albedo values for each type of terrain surface. Albedo is the ratio of light which strikes an object to the amount of light an object reflects. Since the eyes and NVGs use reflected light to see, reflectivity is critical to determining the amount of light available for vision. In order to get an accurate picture of reflectance in the near infrared, where NVGs are most sensitive, specific IR albedos must be calculated for this portion of the spectrum. These differences can become very important, especially at lower ambient light levels. As an example; a flight progressing from fields covered with fresh snow (0.85 albedo) to a stand of coniferous trees (0.13 albedo) on a clear moonless night (.00022 lux) creates very different levels of terrain luminance. Over the snow, 85 percent of the light is reflected off the terrain, while the coniferous trees reflect only 11-13 percent of the same light. The effect of contrast is usually more pronounced at lower ambient light levels. The ability to camouflage military targets is enhanced because of the reduced contrast cues provided by NVGs.

3.7.4.2.2. Reflectivity. Reflectivity will also vary with conditions of the terrain even though terrain type remains constant. For instance, dry sand is twice as reflective as wet sand. Overall contrast is usually improved with higher light levels. As the ambient light increases, more light is reflected. Shades become more recognizable and an object's overall definition is improved. Objects with a poor reflective surface appear black during low light levels and dark green with NVGs during high light levels. Objects or terrain features with good reflective quality appear green and become progressively lighter as the ambient light increases. Some specific examples of the effects of contrast are as follows:

3.7.4.2.2.1. Roads. The surface of some dirt roads provides excellent contrast with surrounding terrain. Roads that cut through heavily forested areas are easily recognized if visible through foliage. The light color of concrete highways, normally an excellent reflective surface, is easily identified during most conditions. Asphalt roads, however, are usually difficult to identify because the dark surface absorbs available light. Although, in desert areas, the resulting contrast can make asphalt roads readily detectable.

3.7.4.2.2.2. Water. There is usually very little contrast between a land mass and a body of water during low light conditions. When viewed from the air, lakes and rivers appear dark green in color. As the light level increases water begins to change color, land-water contrast increases, and reflected moonlight is easily detected. When a surface wind or sea state exists, the ripples on the surface or wave action improve the contrast further aiding in surface identification and providing height and distance cues.

3.7.4.2.2.3. Open Fields. Contrast is usually very poor in fields covered with vegetation. Most crops are dark-colored and absorb light. During harvest or the dormant season, the color of the vegetation changes to a lighter color improving contrast. A freshly plowed field lacks vegetation. The coarse texture of the upturned soil absorbs light, reflecting very little.

3.7.4.2.2.4. Forested Areas. Contrast is usually poor in heavily forested areas. If the leaves have chlorophyll, which is an excellent near IR reflector, the trees will appear very light. This is true for all plant material which contains chlorophyll. Vegetation will appear darker if there is no chlorophyll present. When heavy vegetation provides no contrast, objects and terrain features are concealed. Excellent contrast does exist, however, between deciduous and coniferous trees as well as between open fields and surrounding forested areas.

3.7.4.2.2.5. Desert or Snow. Flight over the desert or snow covered fields has good and bad aspects. It can be good because of the high reflectivity which provides more light for the NVGs to use. However, because of the usually poor contrast cues, less texture and detail is available to the NVG user.

3.7.4.2.2.6. Mountains. Mountain ranges can be easily identified because of the dark color of barren mountains against the light color of the desert floor or snow covered field. Lower rises in terrain between the viewer and the higher ranges can be difficult to identify in low ambient light.

3.7.4.2.3. Shadows. Shadows are created when an object impedes light from striking a surface. Objects which may create shadows include terrain, buildings, clouds, and aircraft. The amount of terrain obstruction within a shaded area, as perceived with NVGs, is dependent on the amount of ambient illumination and relative position of the moon. Shadows will appear darker and obscure the terrain within the shadow more on a night with high illumination than a night with low illumination. This phenomenon is a function of the gain or automatic brightness control of the NVGs. Flying directly into a low angle moon or setting sun amplifies the problems created by shadows due to the goggles "shutting down" or "washing-out" with a bright light source in their field of view and makes it nearly impossible to detect terrain in front of you. Shadows created by scattered clouds may give the NVG user certain visual illusions, especially in mountainous terrain. Shadows cast on the sides of mountains may give the NVG user the perception that the lighted areas are low lying clouds or fog which may give a false perception of a ridge line or horizon. Shadows from clouds cannot be predicted during mission planning.

3.7.5. Light Prediction and Measurement. Ambient light level prediction and measurements are very complex processes requiring an appreciation for the limitations involved. Computer models currently exist, for example, the Computer Generated Global Light Level Calendar, which has the ability to predict illumination for any given latitude/longitude for the next thirty years with greater accuracy and reliability than previous methods. As useful as this system is for planning purposes, the predictions only provide limited information concerning ambient illumination based on moon phase, azimuth and elevation. This is due to the fact that there are many factors which affect the amount of light reaching the intensifier tubes of NVGs. The prediction process, while useful for baseline planning, does not provide real time enroute light level data. Variables such as weather, moon angle and terrain shadowing, terrain albedos, and aircraft heading can significantly alter the luminance used by the NVGs. Light level variations are insidious and their recognition is critical to mission success. An example of limitations encountered in attempting to predict usable illumination may prove beneficial here. For a given night, the Light Level Calendar may predict an illumination value of .0093 lux (based on a moon phase of 84%, located 12 degrees above the horizon). NVG flight would certainly be possible under these conditions. During flight planning take into account the low moon angle and associated terrain shadowing hazards. Weather must also be taken into account. For example, a thick overcast or broken layer, regardless of the predicted illumination levels, may reduce the actual illumination striking the terrain below those levels in which NVGs can effectively operate.

3.7.6. Visual Illusions. Many of the visual illusions encountered while flying at night unaided are present when using NVGs. Lack of depth perception is one of the most common problems. For example, when flying over terrain that is flat or flying over large bodies of water it can be extremely difficult to judge aircraft altitude. You can easily start a very slow descent and not catch it visually. Use the aircraft Voice Altitude Warning System (VAWS) to avoid this. Another visual illusion encountered while using NVGs is that a small hill in front of a larger hill will blend in and become difficult to see. A good scanning pattern, to include a cross-check of the FLIR, is vital to avoid ground impact. FLIR in the Flight Path Vector (FPV) mode will enhance your scanning. Use of the IR searchlight, tactical situation permitting, can decrease this hazard. In some environmental conditions, however, the IR searchlight may make the illumination situation worse.

3.7.7. Weather Considerations. Due to reduced visual cues and inherent depth perception problems, aircrews must exercise caution when conducting NVG operations in areas of inclement weather. Weather may appear further away than it actually is, and you could inadvertently enter IMC. Additionally, you may be able to see through very thin fog and not realize you're entering an area of IMC until it's too late. Aircrews should use all available weather forecasting resources to avoid areas of IMC. Be aware of cues in the flying environment to assist in avoiding inclement weather. Large halos around ground lights, areas of extreme darkness where there is a known light source and the loss of a visible horizon all indicate possible areas of IMC. In addition to restrictions to visibility, wind information can also be hard to obtain. When accurate wind information is not available, base wind determination on forecast winds, on-board systems and any available outside indications.

3.7.8. Effects of Altitude. Generally, the higher you fly the less visual terrain definition you have and you may lose the ability to pick out distinguishing features that are useful for navigation. If available illumination prevents you from flying at a lower altitude, increase altitude as necessary IAW MCI 11-HH60G Vol 3 altitude restrictions.

3.7.9. Crew Coordination. Effective crew coordination is absolutely essential for successful low-level night operations. Crew members must communicate in a clear and concise manner and provide useful and timely inputs as necessary. This is especially crucial in light of the following limitations and cautions which must be observed when operating on NVGs.

3.7.9.2. Brownout/Whiteout conditions may greatly degrade the NVG user's pre-existing visual acuity even further. On approach and landing, the FLIR, and VSDS indicators may be used to detect drift during the final few feet of the approach. The pilot not flying may call out drift based on FLIR indications to augment those calls made by the flight engineer.

3.7.9.3. Terrain/other obstacles in the "shadow" of more distant/higher terrain, man-made obstacles, or clouds may not be seen when wearing NVGs.

3.7.9.4. Different colored lights cannot be distinguished (i.e., all lights appear to be the same color). Situation permitting, it may be beneficial to glance under the NVGs to identify an unknown light source. NVGs have the capability of "seeing" through light rainshowers, despite the fact unaided visibility may be at zero. Should the rainshowers intensify to the point where the goggles are no longer effective, the crew should be prepared to execute IMC procedures.

3.7.9.5. Wearing NVGs for an extended period can cause extreme fatigue. Eye fatigue can be lessened by periodically removing the NVGs to rest the eyes. NVG users must guard against mission effectiveness degradation due to prolonged usage. Commanders and operations officers must weigh crew experience, qualification, weather conditions, and other environmental factors when required to perform long NVG sorties which are not normally part of the unit's mission or which require an aircrew to fly a maximum crew duty day.

3.7.10. With adequate available outside illumination, NVG vision enhancement is inversely proportional to altitude and airspeed--the lower and slower you fly, the better you see. In marginal or poor illumination conditions, the low/slow altitude and airspeed combinations required to adequately see may be prohibitive in conducting safe NVG operations at normal cruise airspeeds.

WARNING: *Electric power lines, unlighted towers, poles, antennas, dead trees, and all types of wires are extremely difficult to see while conducting NVG operations.*

3.7.11. Aircrews should avoid flying directly toward moonrise/moonset or sunrise/sunset as vision may be severely restricted by the intensity of the light.

3.7.12. Alternate Light Sources. Alternate light sources can provide the illumination needed to successfully complete NVG missions. The IR searchlight, laser pointers and LZ lighting add illumination and increase mission safety.

3.7.12.1. IR Searchlight. External infrared lighting is useful during NVG remote/tactical terminal operations and low-level navigation. The IR searchlight has proven to be extremely useful when flying on low illumination nights. By using the searchlight to scan the area along the flight path it is possible to pick out the smaller hills that are "hidden" by the larger hills in the background. It has also proven to be helpful in locating obstructions such as power line poles and towers. Caution: Use of IR lighting in brownout/whiteout conditions can seriously degrade visibility. When these conditions are anticipated, IR lighting, if used, should be dimmed to the lowest level necessary to safely accomplish the landing. The pilot must be prepared to immediately extinguish the light if encountered conditions warrant. Extreme caution must be used to ensure that non-IR white lights are not illuminated accidentally during an approach. White lights will degrade NVGs, and after extinguishing the light, the time required for the NVGs to recover may exceed several seconds. When using the searchlight in a formation, you can inadvertently "blind" the scanners on the preceding aircraft. Additionally, too much movement of the searchlight can cause visual illusions for crew members in preceding aircraft.

3.7.12.2. Laser Pointers. Hand-held laser pointers are another alternate light source that has proven useful for NVG operations. They enable scanners to pinpoint obstacles, LZ's or survivors. A technique for scanners and fixed wing aircraft is known as "roping". "Roping" is when a scanner or Rescort aircraft identifies the point with a circular motion of the laser pointer. This circling motion, resembling a cowboy's lasso, makes it easier for the helicopter crew to pick out the point. As with all lasers, caution should be exercised to keep from pointing the laser directly at someone. Additionally, NVGs do not provide any protection from lasers, therefore aircrews need to be careful not to look directly at the laser source.

3.7.12.3. LZ Lighting. Artificial light sources can aid the crew in accomplishing NVG terminal operations. Some examples are ground lighting patterns and external IR lights from other aircraft. All improve visibility during terminal operations. Lighting patterns may be established in blowing snow, dust, tall grass, and similar environments by a variety of methods. Bundles of chemlights and chemlights in plastic water bottles are useful in marking a landing zone. The crew should make a low pass over the LZ to throw out the marking devices at a prescribed time and interval from both sides of the aircraft. This technique is similar to the NVG water operations pattern and results in an excellent reference for landing or hover.

NOTE: If communication is established with ground party, ensure they know the rescue helicopter crew will be using light sensitive NVGs to avoid inadvertent blinding of the crew.

3.7.13. Weapons Delivery Effects. Muzzle blast created by aircraft weapons can seriously degrade NVGs. Aircrew members must coordinate with the pilots when employing the weapons. Firing full forward should be minimized to reduce the possibility of shutting down the pilots NVGs. Additionally, if weapons have to be fired while in a hover, the pilot on the opposite side of the weapon being fired should be on the controls if possible. If weapons are being employed during a formation flight all members of the formation need to pay particular attention to the effect their firing is having on the other members of the formation. Aircrew briefings need to be very specific in assigning field of fire for each weapon in the formation.

3.7.13.1. When the Gau-2B Minigun is being fired, voice communication in the cockpit is impaired significantly. Consideration should be given to this and briefings should cover what actions will be taken to ensure communications if an emergency or other event requiring immediate communications occurs while the miniguns are being fired.

3.7.13.2. Gunners can improve visibility by not sighting over the weapon but to the side, making head sweeps away from the barrels, and firing short bursts. Use of NVG-compatible tracer should be considered.

3.7.14. Aircraft Preparation. Refer to MCI 11-HH60G Vol 3 and AFI 11-206 for external/internal aircraft lighting requirements. Ensure that any chemlights that are taped to the interior of the aircraft for over-water operations are not visible from outside the aircraft once they are activated.

3.8. Cold Weather Operations.

3.8.1. This section establishes some techniques and suggestions for flying in hot/cold weather operations.

3.8.1.1. When operating in cold weather conditions consider using pitot heat at all times. There is no temperature limit for its use and there is no performance penalty. If one of your pitot tubes freezes up you may loose stabilator auto-mode. If both pitot tubes freeze then the stabilator will program down with no master caution or associated warning horn.

3.8.1.2. It is recommended that you do not use windshield anti-ice when performing salt water operations. The windshield anti-ice causes the salt water to "bake" on the windshield and will degrade visibility.

3.8.1.3. On aircraft without center windshield anti-ice, a technique to determine ice build up is to look at the corners of the windows. Ice will tend to build up in these places. Crews should monitor power required during cruise flight to help detect aircraft icing.

3.8.1.4. During shutdown ensure that the heater is off before starting the APU. The heater will draw bleed air from the APU regardless of the position of the air source/heat start switch. This may cause a over-temperature reading and subsequent shutdown of the APU. If this occurs there will be no BIT indications even though the APU shut itself down.

3.8.1.5. If you are having trouble getting the droop stops to come in on rotor shutdown, then turn on the blade de-ice. This will heat the droop stops and allow them to move more freely. If you suspect trouble then turn on the blade de-ice 10 minutes before landing.

3.8.1.6. If the aircraft is being washed in a cold environment it is possible for water to infiltrate the hoist limit switches. This may prevent operation in the normal mode, however the backup mode will still work normally.

3.8.1.7. The main landing gear struts tend to show that they are under-serviced in very cold temperatures.

3..8.1.8. The tailwheel may not straighten out when being taxied on ice. Recommend two solutions; first try to find a dry patch of ramp without ice and attempt to lock the tail wheel. Second, pick the aircraft up to a hover and allow the tailwheel to swing and lock. When making turns on ice, lead the turn with a slight amount of cyclic to aid in preventing the tail from sliding.

3.9. Hot Weather Operations.

3.9.1. The average aviator generally associates hot weather flying with deserts, jungles, or tropical regions; however, hot weather flying conditions may also be found in northern latitudes. Hopefully, the following information will assist you by providing some planning considerations for you when faced with hot weather conditions.

3.9.2. Hot weather flying increases requirements on the aircrew and aircraft. Such conditions impose added stresses on aircraft and flight personnel, reduce the overall capability of an aircraft and flight crew, and increase the elements of danger. The main factor you need to be aware of is the reduction in torque available and the resulting decrease in helicopter performance due to reduced air density. High temperatures can cause density altitude problems regardless of the geographic location. Therefore, a greater emphasis must be placed on determining performance during mission planning. You must be aware of this factor, and you must be familiar with how it reduces the efficiency of aircraft performance in decreased densities of the atmosphere. Hot weather mission planning must include computations of weight, balance, and performance from the applicable charts in the Dash 1. Crews should bring water with them to help avoid dehydration.

3.9.3. During your preflight inspection, extra emphasis must be placed on equipment that may be affected by higher temperatures, such as tires, seals, and hydraulic components. Be aware that the surface of the aircraft will be extremely hot, so be cautious when doing your preflight and ground operations.

3.9.4. The high daytime temperatures severely restrict the lift capability of the helicopter by reducing shaft horsepower output, rotor efficiency, decreasing takeoff ability and rate of climb.

3.9.5. When taxiing use minimum braking to prevent overheating. Closely monitor engine and transmission temperatures for signs of overheating. Whenever possible, limit ground operations to the minimum time necessary to prepare for flight.

3.9.6. Engine performance is degraded in hot weather. The hotter it is, the less performance you will receive from the engine. An increase in temperature decreases the hovering capability. This is indicated by computing power available/required to hover in high temperature areas. Under certain gross weight and density altitude conditions, the helicopter may not have sufficient power to lift off vertically. You may be forced to do a rolling takeoff if you need to get airborne. Consideration should also be given to scheduling flights during the cooler times of the day, when practical.

3.9.7. During hot weather operations, many difficulties encountered are due to inadequate engine cooling. Operations require close monitoring of oil temperatures, TGTs, etc. You must be aware of all aircraft limitations associated with high ambient temperature operations, as specified in the flight manual.

3.10. Combat Mission Planning Considerations.

3.10.1. Conditions Of Employment:

3.10.1.1. Night Operations:

3.10.1.1.2. Advantages.

3.10.1.1.1.1. Executing missions at night enhances security, survivability, and tactical surprise through concealment and a degraded enemy defensive posture.

3.10.1.1.1.2. Darkness conceals the approach and withdrawal of RESCORT forces from optical systems. It also conceals the size and composition of the force, enhancing the potential to escape if detected.

3.10.1.1.1.3. If enemy forces are operating in a daytime-fighting mode, commanders can exploit the relaxed readiness of enemy defensive forces at night. Frequently, the enemy reduces its security force at night and, if the enemy is not acclimated to night operations, alertness decreases due to circadian rhythms. Depending on enemy weapons, detection, and communications system capabilities, darkness can adversely affect the enemy's ability to coordinate a response.

3.10.1.1.2. Disadvantages. The lack of visual references during darkness increases the difficulty and need for precise navigation.

3.10.1.2. Adverse weather:

3.10.1.2.3. Advantages. Adverse weather gives us the same advantages as darkness: it provides concealment, enhances tactical surprise, and degrades the enemy's defensive posture. Adverse weather offers unique operational advantages and limitations. Precipitation attenuates enemy radar returns enhancing the ability to approach and withdraw from objectives undetected. Extreme temperatures induce enemy forces to remain in shelters, further reducing the potential exposure to the enemy.

3.10.1.2.4. Disadvantages. Adverse weather presents us with the same navigational challenges as night operations. Additionally, extreme hot or cold temperatures may degrade crew performance. Commanders can decrease the impact of extreme temperature and weather conditions by ensuring their crews are properly equipped to conduct missions in that environment.

3.10.1.2.2.1. Meteorological information for a particular area may be found in each country's National Intelligence Survey Section 23. If further information is required, contact the weather representative. Adverse weather and night operations offer significant advantages for rescue. While commanders should exploit the opportunities offered by darkness and adverse weather, they must not underestimate the effects inclement weather and circadian rhythm have on crews or overestimate the ability of rescue forces to operate in extreme adverse weather.

3.10.1.3. Enemy Defenses. Enemy defenses are a key mission planning factor. Many countries possessing low-threat weapons capability could easily modernize to high-threat thresholds either through resupply or outright occupation by a more advanced power. Since the desired planning objective is to avoid detection and/or engagement with the enemy, the most critical factor will be the location and capabilities/limitations of the enemy's orders of battle. Without timely, accurate OB intelligence, mission routing may result in detection or engagement. For instance, premature EW/GCI detection of a penetrating aircraft could provide the enemy time to reinforce ground forces or even launch air interceptors (AI). The following types of OBs must be studied:

3.10.1.3.1. Ground order of battle (GOB)

3.10.1.3.2. Air order of battle (AOB)

3.10.1.3.3. Electronic order of battle (EOB)

3.10.1.3.4. Naval order of battle (NOB)

3.10.1.3.5. Defensive missile order of battle (DMOB)

3.10.1.3.6. Anti-aircraft artillery order of battle (AAAOB)

3.10.1.3.7. Radio-electronic combat (REC)

3.10.1.4. Command, Control, Communications, Computers, and Intelligence. Rescue rotary and fixed-wing flying units require a clear and effective C2 structure. It is vitally important that mission commanders understand the C2 systems in their tactical area of operations (TAOR). Rescue assets may be operating concurrently with theater air and air defense operations. Planners need to ensure close coordination for mission planning with the theater air controlling agency (i.e., air operations center [AOC] and the Joint Search and Rescue Coordination Center [JSRC] or rescue coordination center [RCC]) for airspace deconfliction, safe passage, and other pertinent data. (Reference Joint Pubs 3-56.1, *Command and Control for Joint Air Operations*; Joint Pubs 3-50.2/21, *Joint CSAR Operations*; ACCI 13, *Air Operations Center*).

3.10.1.4.5. Command, control, communications, computers, and intelligence (C4I) systems and communication nets serve two major purposes: (1) dissemination of rules of engagement (ROE) changes and relay of command decisions and (2) mission-oriented functions (i.e., support aircraft control, threat warning, and survivor data). Any or all of these functions may be denied by enemy electronic control or friendly site attrition. As C4I is disrupted, the execution of prebriefed game plans, while retaining flexibility, may be the only way to ensure mission success. Regardless of the expected level of C4I, unit contingencies should include an autonomous game plan. When planning, remember other mission activities or objectives may not be known by other individual crews. Last minute changes breed confusion, require extra communication, and may affect other mission aircraft profiles.

3.10.1.4.2. Combat Search and Rescue Command and Control Execution. After receiving word of an isolating incident, the controlling agency will notify the AOC, who will then alert the rescue center for the appropriate response. The rescue center weighs possible response options available to recover isolated personnel, depending on such factors as threats, location, environment, and recovery assets available. After gathering survivor data and initial coordination, the rescue center will seek execution authority by the component commander. The JSRC/RCC will notify, scramble, and divert rescue forces as required. The AOC combat plans division (with rescue augmentation) will incorporate CSAR assets into the ATO for alert and preplanned taskings.

3.10.1.4.3. Evaders Evasive Plan of Action (EPA) and Isolated Personnel Report Data and Specific Information. Evader's EPA/ISOPREP data and specific information on the mission will be passed through intelligence channels. In addition to ISOPREP data, the survivor ID code must be known before mission execution. With the HOOK-112 and the PRC-112, the survivor's personnel locator system (PLS) code will be programmed into the radio and interrogated by the HOOK and PLS installed in the rescue aircraft. A secondary source for this information is through intelligence channels via the combat intelligence system (CIS).

3.10.1.4.4. National Systems Capabilities for Survivor Identification. National intelligence collection systems have a fair to good capability of detecting, locating, and reporting on search and rescue (SAR) beacons. Historically, these systems are tasked to support regions of hostile conflict for the purposes of intelligence gathering, but can be called upon to support SAR operations. Some National systems can support threat warning at the same capability level while increasing the emphasis on identifying a search beacon. However, other systems require specific tasking to allocate system resources to locate and identify a rescue beacon. Note that protection of US forces, including CSAR, and warning of imminent hostilities are the number one priority for National systems. The capability of National systems to support CSAR operations is dependent upon several variables including signal duration time, angle of transmission to National collection system, and beacon signal strength. Operational or environmental conditions may prevent National systems from accessing a SAR beacon such as Co-Channel Interference, terrain masking, antenna orientation (such as "cone of silence" that points towards the National collection system [i.e., on PRC-90 and PRC-112s]), short duration and weak signal strength from exhausted batteries. Coordination with the National intelligence community is critical to make them aware of the CONOPS of survivor tactics (i.e., radio frequency, time of transmission, duration of transmission). This may be done through distributing a copy of the SPINS to the National community prior to allied aircraft over flying denied areas. National system collection of a SAR beacon may be reported through multiple channels including sensitive compartmented information (SCI) messages to the AOC, broadcast on the Tactical Related Applications (TRAP), Tactical Data Dissemination System (TDDS) UHF SATCOM at SECRET, or other means that may be coordinated prior to engaging in denied area allied over flight. For more information on the National systems capable of supporting SAR beacon collection, reference *Joint Service Tactical Exploitation of National Systems Manual*, section 4, "SIGINT Support."

3.10.1.5. Mission Planning Process. The planning process can be executed at several levels starting from JSRC and continuing down to the actual crew. The products available to crews that fly the mission remain the same. Depending on available resources and time, only the point where the product is produced changes.

3.10.1.5.1. Intelligence Support. Intel personnel should be thoroughly integrated within the planning cell and available throughout the planning process. Intelligence information combined with tactics provides the best criteria for route selection and threat avoidance. Current intelligence information is a fundamental requirement for mission planning through hostile or sensitive areas. Incomplete or dated material will significantly reduce the success and survivability of these missions. It is important for information to flow full circle to the crews and then back to Intel so that the circle can start all over again. Specific information (such as ROE and survivor data) will be extracted from the SPINS. Alert tasking times will be extracted from the ATO.

3.10.1.5.2. Pertinent ATO Information. If crews do not have access to the ATO, the planners must ensure that all pertinent ATO information is supplied to the crew via the combat mission folder (CMF). These include deconfliction from the airspace coordination order (ACO), communications matrix, code words, SAR SPINS for the period of operations, and proper IFF/SIF codes and procedures. In addition, mission planners must have a good picture of threats in relation to ATO operations and make educated estimates of probable shoot downs and areas. This is extremely important for rescue forces in support of daily combat operations. This "big picture" estimate will help crews better prepare for response to possible shoot downs and expedite the in-flight execution phase of CSAR operations.

3.10.1.5.3. Threat Degradation/Avoidance. Planners should consult MCM 3-1, Volume 2, and MAJCOM-directed intelligence reference documents specific to their area of operation. Intel personnel should plot all OB and significant intelligence information on an appropriate scale chart which can be referenced during the mission planning process. With current and future automated planning systems for aircrews, this information should be processed through IMOM and loaded into the mission planning systems. Intelligence data handling systems like Constant Source and Sentinel Byte can be utilized to develop spider routes, showing radar coverage based on terrain, altitude, and radar cross section (RCS). These routes should be known and used by all aircraft tasked for combat rescue. An IMOM overlay is required if the Air Force mission support system (AFMSS) and/or tactical sensor planner (TSP) is not available to the crew(s). The CIS is capable of performing a route threat analysis after the route selection process is completed.

3.10.1.5.4. Objective Area Imagery. These provide an excellent source of information for developing preplanned navigation routes; however, these might not be available for individual missions. If this product is not readily available, a request should be forwarded through proper channels to obtain this for the crew(s) flying the mission. This product should be properly annotated by analysis/targeting personnel to enhance premission planning and study.

3.10.1.5.5. Integrated Refractive Effects Prediction System (IREPS). IREPS is a computer-based interactive program used to predict the effects of atmospheric refraction on active or passive collecting systems. Refractive effects (ducting) can extend the capabilities well beyond LOS. This data will be theater dependent and may or may not be required.

3.10.1.5.6. Electro-Optical Tactical Decision Aid (EOTDA). EOTDA predicts the performance of NVGs and FLIR based on environmental and tactical information. This data must be provided to crews in user-friendly format. For pre-planned missions, the enroute and terminal areas are of the greatest interest.

3.10.1.5.7. High Frequency Propagation Tables. This may be established for the theater of operations and does not require daily updates. As a minimum, a theater specific review cycle should be established to ensure maximum communications capabilities.

3.10.1.5.8. Objective Illumination/Azimuth and Elevation of Moon Data. This data is available through numerous sources, and the key point is that the data must be user friendly.

3.10.1.5.9. Sea State and Tidal Data. This should include sea surface temperature and sea current information, when applicable.

Table 3.2. Horizontal Shifts Between WGS-72 and Other Ellipsoids.

Ellipsoid	Shift (ft)	Area
Clarke 1866	305	North American
International	485	Europe
Bessel	1,630	Korea/Japan
Clarke 1880	860	Africa
South America	320	South America
Airy	1,900	United Kingdom
Everest	1,200	India
Australian	660	Australia
WGS-84	30	Worldwide

Chapter 4

BASIC HELICOPTER MANEUVERS AND INSTRUMENT FLYING TECHNIQUES

4.1. Introduction. This chapter is designed to aid the aircrew member in performing H-60 transition, emergency procedures, and instrument maneuvers.

4.2. Purpose. This information is not to be used as a replacement or a justification to exceed the limitations of the HH-60 Operator's Manual or MCI 11-HH60G, Vol 3, but rather to enhance the guidance provided in these manuals. It is not feasible to cover every circumstance that may present itself, therefore use sound judgment when encountering abnormal situations.

4.3. Ground Operations. Ground speed should be commensurate with the ability to see and remain clear of obstructions/obstacles. Normally, crews should not exceed 5 knots ground speed in congested areas, and 10 knots ground speed in open areas. Hover taxi speed should be no more than 15 knots.

CAUTION: *Make sure the taxi area is well clear of any hazards. Deploy wing walkers if you must taxi within 25 feet of obstacles (10 feet minimum) or any time you are unsure of obstacle clearances.*

NOTE: *It may be difficult to lock or unlock the tailwheel if the tailwheel pin is not exactly centered. As you taxi, adding a slight amount of either pedal will usually get the tailwheel to complete its contact to locked or unlocked position. Forcing the pedals with the tailwheel locked my result in a bent or sheared pin.*

4.3.1. Use the brakes judiciously to regulate your taxi speed. Be aware of position of rotor path plane and do not tilt the plane too far in any direction.

NOTE: *Use caution when operating on slippery surfaces with ground personnel present. On slippery surfaces such as ice, a small amount of cyclic into the turn should aid in turning the helicopter, and alleviate the possibility of a tail skid. The use of slower taxi speeds and aerodynamic braking will also help prevent skidding and slipping on slippery surfaces.*

4.3.2. Ground Taxi (Rearward). Ground speed should allow for safe operations. Ensure scanners are positioned appropriately to scan and prevent the pilot from running the tail section into an obstacle.

CAUTION: *Make sure the taxi area is well clear of any hazards. Deploy wing walkers if you must taxi within 25 feet of obstacles (10 feet minimum) or any time you are unsure of obstacle clearances.*

NOTE: *Do not attempt rearward taxi without some collective pitch added prior to the aft cyclic input. With ALQ-144 installed, use extreme caution when applying aft cyclic. Also be aware of contacting the droop stops.*

4.4. Takeoff To A Hover (10 Feet Main Wheel Height)..

4.4.1. The H-60 hovers in a slightly nose up attitude (3-4°) and slightly left side low (1-2°). The Automatic Flight Control System (AFCS), Flight Path Stabilization (FPS), heading hold function will normally make a sufficient control input to the tail rotor to maintain heading on takeoff. Keeping your feet lightly on the pedals without depressing the microswitches is a good technique. This permits the FPS to make adjustments and enables the pilot to make minor corrections and over ride the FPS input when necessary.

NOTE: *The mechanical mixing is designed for optimal performance at a gross weight of 16,825 lbs., therefore any weight under this figure will result in a mechanical mixing over correction. Any weight over this will result in an under correction. Keep this in mind especially when lifting the helicopter over terrain that may not permit any type of drifting.*

4.4.2. Stationary Hovering (10 Feet Main Wheel Height).

4.4.2.1. Maintain a visual reference for ease in picking up drift. Try to use a reference point with vertical development; these types of cues usually result in a more stable hover. Having more than one reference will aid in picking up the helicopter movement faster. Using a reference directly outside your window, will help you pick up fore and aft movement, and having one off the nose of the helicopter (or using the probe on the pilot side), will help in detecting heading and sideward drift. If you have only one reference attempt to position it at a 45° angle so that both fore/aft and sideward cues are available.

4.4.2.2. If you have hover symbology (VSDS), consider using a cross check to incorporate position/acceleration cues.

NOTE: *The mechanical mixing may help in holding a stationary position, but only at the design gross weight of 16,825 lb. Consider putting your feet on the side of the pedals to keep from depressing the pedal microswitches. This will allow FPS heading hold as an aid in holding a stationary position.*

4.4.2.3. Common Tendencies: Not using the FPS and over-controlling the pedals when a drift is detected. Not choosing the appropriate reference points for the situation. Selecting a reference point that is too far away resulting in decreased drift cues, or selecting one that is too close resulting in over-correction. Altitude control problems are often caused by pumping the collective and can usually be eliminated by increasing collective friction. A common problem resulting in an unstable hover is not referencing the VSDS hover symbology, or over-reliance on it.

4.5. Hovering Flight (Left/Right/Aft). At higher gross weights, higher density altitudes and certain wind conditions, there is a possibility that you may run out of tail rotor authority. Reference the flight manual for limits. Additionally, there is a tendency to descend when performing sideward and rearward hovering. Control heading drifts by using pedals and/or FPS heading hold.

4.5.1. Common Tendencies: Contacting the ground, due to lack of altitude prior to initiating the maneuver or not cross-checking the radar altimeter and descending during the maneuver. Additionally, heading drift or inconsistent ground track due to improper use of references or lack of a cross-check.

4.6. Hovering Turns (Around The Mast). Maintain position by using the cyclic as necessary and cross check the radar altimeter to assist in maintaining the desired wheel height.

4.6.1. Common Tendencies: Drifting away from the spot while turning due to lack of cross check; Turning too fast resulting in running out of pedal to stop the turn.

4.7. Hovering Turns (Around The Nose). The concept of performing a turn or hover around the nose is to get the helicopter moving in an arc around the reference point.

4.7.1. Common Tendencies: Turning around the mast halfway through the turn; Alternating between turning around the nose and turning around the mast. Drifting sideways while turning because too much cyclic was applied in the turn.

4.8. Hovering Turns (Around The Tail). The concept of performing a turn or hover around the tail is to get the helicopter moving in an arc around the reference point.

4.8.1. Common Tendencies: Turning around the mast halfway through the turn; Alternating between turning around the tail and turning around the mast; Drifting sideways while turning because too much cyclic was applied in the turn.

4.9. Normal Takeoff (From The Ground/Hover).

4.9.1. As the aircraft breaks ground, apply forward cyclic to achieve an accelerative attitude. An angle that will achieve 70-80 KIAS at 100 feet AGL will result in a comfortable climb attitude that will keep the aircraft out of the red area of the height-velocity chart.

CAUTION: *Using more than 10 degrees nose low when in close proximity to the ground, can lead to difficulty during a single engine or uncommanded stabilator movement emergency. It can also result in inadvertent probe-to-ground contact.*

4.9.2. Adjust the pedals to maintain the appropriate ground track/heading. Below approximately 50 feet, use the wing-low method to maintain proper ground track; above 50 feet, crab the aircraft into the wind.

4.9.3. As the airspeed reaches 70-80 KIAS, adjust the attitude to maintain a 70-80 KIAS climb attitude. Adjust the torque to maintain the desired rate of climb at 70-80 KIAS. If the maximum rate of climb is desired, adjust torque and airspeed accordingly.

4.9.4. Common Tendencies: Applying too much torque and essentially performing a maximum power takeoff. Not correcting for winds and allowing the heading/ground track to drift. Exceeding 10 degrees nose low at low altitudes.

4.10. Maximum Performance Takeoff.

4.10.1. Initiate from the ground or 10 foot hover. As the helicopter lifts off, slowly and smoothly apply collective until the desired torque is reached.

4.10.2. As the helicopter climbs, use a side reference to check on forward movement and adjust accordingly. Practice using a purely vertical climb as well as a climb that allows some forward movement. The intent of forward movement is to translate induced flow to maximize the return on power applied. Note that since the H-60 normally hovers in a nose high attitude, if you establish a level attitude in a climb, you will stabilize at about 40 KIAS.

4.10.3. As the helicopter clears the obstacle, apply a small amount of forward cyclic to increase airspeed. As the aircraft accelerates, the tail rotor will become more effective and the power will decrease slightly. It will be necessary to add 3-4% torque to maintain the desired power.

4.10.4. Terminate the maneuver when the obstacle is cleared and the desired airspeed (at least safe single engine airspeed) and rate of climb is achieved.

4.10.5. Common Tendencies: Abruptly increasing power resulting in the helicopter "lurching" off the ground. Not applying enough left pedal to compensate for the increased power demand. Side drifts due to fixation on the obstacle. Tendency to dump the nose as the desired altitude is reached resulting in a descent. Failure to reset torque as the aircraft accelerates through translational lift.

4.11. Marginal Power Takeoff.

4.11.1 Initiate from the ground or a hover. Always plan to takeoff into the wind if possible. Position the aircraft to make use of all available space.

4.11.2. Initiate the takeoff by smoothly applying forward cyclic. If the takeoff is initiated from the ground apply forward cyclic after reaching a 10 foot hover height. Adjust pedals as necessary to control heading.

4.11.3. As the aircraft accelerates, it may settle (depending on wind velocity and direction). During training attempt to maintain simulated maximum power available, but add additional power if ground contact is imminent.

4.11.4. Accelerate to safe single engine airspeed and desired rate of climb. Below approximately 50 feet, use the wing-low method to maintain proper ground track; above 50 feet, crab the aircraft into the wind.

4.11.5. The maneuver is terminated once the simulated/actual obstacle is cleared, and above safe single engine airspeed.

4.11.6. Common Tendencies: Applying more than desired torque. Applying too much forward cyclic and allowing the aircraft to contact the ground with either the main gear or the probe. Once the simulated obstacle is cleared, applying excessive forward cyclic and descending below the simulated obstacle altitude.

4.12. Rolling Takeoff: Rolling takeoffs are used under certain conditions such as high gross weight and high density altitudes where power available is limited. This type of takeoff will require a prepared surface in nearly all cases.

4.12.1. To begin the takeoff, increase collective until the helicopter becomes "light" on the main landing gear, usually about 30% to 40% torque. Recommend using 10% below hover power for training.

4.12.2. Apply a small amount of forward cyclic.

4.12.3. Adjust heading by use of the pedals.

4.12.4. Hold the cyclic and collective settings until passing through translational lift. At this point the helicopter's tail wheel should begin to leave the ground. Continue to use the tail rotor pedals to control heading.

4.12.4.1. When you feel the tail wheel start to come off the ground, make a small aft cyclic input and increase collective to simulated maximum power available. The aircraft should "fly itself" off the ground. Maintain the aft cyclic input until the helicopter is clear of the ground to avoid probe-to-ground contact. Below approximately 50 feet, use the wing-low method to maintain proper ground track; above 50 feet, crab the aircraft into the wind.

4.12.5. Continue the maneuver until reaching 70-80 KIAS, and until the desired rate of climb is attained.

NOTE: *Slowing below ETL will degrade climb performance.*

4.12.6. Common Tendencies: Applying too much forward cyclic, resulting in droop stop or probe-to-ground contact. Trying to hold the helicopter on the ground as it passes through translational lift, resulting in tail wheel bounce.

CAUTION: *Applying too much forward cyclic after the helicopter lifts off the ground may result in ground contact with the refueling probe.*

4.13. Approaches.

4.13.1. Normal Approach. Attempt to execute all approaches using no more than computed hover power. Normal approaches can be initiated from any airspeed, but will normally be initiated between 50-80 knots ground speed and at an apparent 30^0 approach angle. Establishing the final course alignment with a specific ground track on the surface may provide a valuable reference and aid in flying traffic patterns. These techniques may better prepare the aircrews for performing other than normal operations where the terrain and landing area may not allow for an approach at the higher airspeeds. The goal is to establish normal sight pictures and closure rates, ground speed might be a better indication of movement over the ground. IAS and TAS differ greatly between high density altitudes and low density altitudes.

4.13.1.1. Prior to initiating the approach, determine the appropriate approach angle for the distance from the intended point of landing. The greater the distance from the point of landing, the shallower the approach angle should be used, obstacles permitting.

4.13.1.2. Initiate the approach by decreasing collective until the desired rate of descent is attained.

NOTE: *The Climb/Descent charts in the operator's manual will give you an idea of how much torque decrease is required for a given rate of descent.*

4.13.1.3. Maintain the desired angle by adjusting collective pitch.

4.13.1.4. Adjust the rate of closure and approach angle at the point where it seems like the helicopter is accelerating, by applying aft cyclic. A further increase in pitch attitude may be needed when flying at higher airspeeds.

4.13.1.5. Use reference cues 90 degrees from the helicopter's flight path for indications of proper rate of closure. Voice inputs from other crew members are extremely helpful. A cross-check of instruments and navigation systems will verify visual references.

4.13.1.6. Heading alignment can maintained by using a ground reference off the nose of the helicopter.

4.13.1.7. As the helicopter approaches ground effect, a reduction in torque may be needed to descend through the "cushion" to touchdown.

4.13.1.8. A requirement to increase collective can be expected when decelerating below translational lift. This is the point when it feels like the helicopter begins to sink.

4.13.1.9. Slowly increase collective to stop the "sinking" and adjust the pitch attitude. In most cases you will need to apply a little forward cyclic to level the helicopter.

4.13.1.10. Common Tendencies: Starting the approach too early and dragging it in. This results in prolonged exposure in the avoid area of the height/velocity region. Not making the proper power change at the beginning of the approach can result in either a over/under shoot, or "porpoising" (chasing the glide path) throughout the entire approach. Not adjusting for a high rate of closure resulting in a very aggressive flare at the bottom or overshoot of the intended landing area. Landing off centerline--usually to the side of the pilot flying. Pulling more than intended hover power because of a high rate of descent and closure caused by starting the approach too late.

4.13.2. Steep Approach. This approach is used when obstacles restrict a normal approach angle. Don't limit yourself to performing steep approaches to a touchdown. Practice shooting steep approaches to various hover altitudes. This will prepare you for approaches to unprepared LZs.

4.13.2.1. As with the normal approach, the later you start your approach, the steeper the approach angle will be, normally a 45^0 apparent angle is used. If you desire to make an approach with a near vertical angle, you may need to use a lower airspeed (but above translational lift) to avoid aggressive flares to slow the helicopter. Due to the limited pilot visibility in steep angles, it is recommended that a reference point adjacent to the intended point of landing be used to aid in keeping a constant approach path.

NOTE: Reference Height Velocity Diagrams in the H-60 Flight Manual. Generally, operating below 50 KIAS increases exposure in the avoid region.

4.13.2.2. Once the desired angle for the approach is attained, initiate the approach by reducing collective enough to begin a rate of descent. For example, the flight manual Climb/Descent chart (above 40 knots, clean configuration, 700 and 701c engines) shows that a torque reduction of approximately 20% is required to achieve a rate of descent of 800 fpm at 20,000 lbs.

4.13.2.3. Apply enough aft cyclic to achieve proper closure rate.

4.13.2.4 Adjust collective to maintain the desired approach angle and rate of descent.

4.13.2.5. Once in ground effect, there may be a need to reduce the collective slightly to descend through the "ground cushion" if continuing the approach to a touchdown. If terminating the approach to a hover, this ground effect may be helpful in stopping the rate of descent.

4.13.2.6. Common Tendencies: Flying less than a steep approach angle due to an incorrect sight picture for a steep approach. Not slowing enough initially, causing a higher rate of descent and aggressive flare (and a loss of visibility) to regain control of the airspeed. Initiating the approach correctly by reducing collective, but not using aft cyclic to slow the forward movement of the helicopter, resulting in a high rate of descent and a greater than normal power requirement during the termination. Not establishing a sufficient rate of descent, resulting in over-arcing and landing past the intended touchdown point.

WARNING: *Operations at higher density altitudes, higher aircraft weights, and/or with a tail wind increase the power required to safely terminate the approach.*

4.13.3. Shallow Approach**.** A shallow approach is approximately an apparent 10° approach angle. Once the pilot intercepts the approach angle, maintain that angle until termination. If that angle is intercepted when turning from a base leg to final (if performing rectangular traffic patterns), continue descent on the angle.

4.13.3.1. Initiate the approach by first intercepting the desired approach angle.

4.13.3.2. Once the angle is intercepted, apply the same techniques as a normal approach.

4.13.3.3. Common Tendencies: Terminating short because of an illusion caused by the pilot perceiving a fast closure rate when closer to the ground. This illusion makes it appear that the closure rate is faster than it actually is. Therefore, the pilot applies too much aft cyclic, slowing the aircraft too early and passing through ETL prematurely.

4.13.4. Rolling Landing. Since there are different emergencies that require a rolling landing, it is recommended that aircrews practice various techniques for performing rolling landings. Practice rolling landings on prepared or approved surfaces that will provide enough room to go around or land in the event of brake failure or hot brakes.

WARNING: *To avoid droop stop contact at termination, do not lower the collective prior to centering the cyclic.*

NOTE: *Keep in mind that droop stop contact is most prevalent at airspeeds near 40 knots. It is possible to contact the ALQ-144 when performing aerodynamic braking.*

4.13.4.1. After establishing an approach angle and the collective is reduced to start the descent, maintain the airspeed between 60-70 KIAS (or above minimum safe single engine airspeed) while on final approach.

4.13.4.2. Use the collective to maintain the desired approach angle.

4.13.4.3. Maintain a crab for winds down to 50 feet, then align the helicopter with the landing area using the tail rotor pedals.

4.13.4.4. Maintain 60-70 KIAS (or above minimum safe single engine airspeed) until it is determined that the landing area can be reached in the event of a loss of power.

4.13.4.5. Once it is determined that the area can be reached, initiate a small flare by raising the nose of the helicopter only a couple of degrees. This should be sufficient enough to slow the helicopter below 60 knots ground speed. The higher the ground speed, the more effective your aerodynamic braking will be.

4.13.4.6. As the aircraft approaches the ground, generally around 4-7 feet, (depending on aircraft attitude), increase collective to cushion tail wheel contact. Ground speed will be no more than 60 knots upon touchdown. If the tailwheel is unlocked, attempt to maintain 25 knots ground speed or less upon touchdown.

4.13.4.7. As the tail wheel contacts the ground, reduce the collective slightly to ensure the tail wheel remains on the ground.

4.13.4.8. Once you've got the aircraft on the ground, you will use two types of braking to stop the aircraft. The first is "aerodynamic braking" and the second uses the aircraft brakes.

4.13.4.8.1. Aerodynamic Braking. Aerodynamic braking is normally used during a running landing where wheel braking action may be inadequate, or there is a concern that the brakes may overheat. By using the aerodynamic forces of the main rotor system, the aircraft can be stopped or slowed down significantly in a relatively short distance.

4.13.4.8.1.1. Once the tail wheel is firmly on the ground, increase the collective slightly while maintaining cyclic position. Do not add additional aft cyclic. Maintain heading by use of the pedals. Apply only enough collective to aid in aerodynamic braking and to keep the main gear off the ground.

4.13.4.8.1.2. As the helicopter slows it will tend to settle, requiring a further, (but slight) increase in collective to cushion the main landing gear.

4.13.4.8.1.3. When the main wheels contact the ground and the helicopter is cushioned, center the cyclic and then lower the collective. Apply brakes as needed and use caution when on slippery surfaces. Care must be taken when applying the brakes to prevent them from overheating.

4.13.4.8.2. Wheel Braking. Use of wheel brakes only should only be accomplished when necessary due to the high potential of overheating the brakes. One instance when the use of wheel braking only is required is during a tail rotor control problem when aerodynamic breaking would cause yawing on short final.

4.13.4.8.2.1. The idea is to land with both mains and the tail wheel touching down almost simultaneously (essentially a three-point landing) which typically requires a faster touchdown speed (40-60 knots ground speed). This type of roll-on landing will normally require a longer landing surface.

4.13.4.8.2.2. Following the touchdown you will have to use differential braking to control heading due to the torque imbalance caused by the tail rotor malfunction.

4.13.4.9. Common Tendencies: The most common tendency is to bounce the tail wheel. When the pilot feels the tail contact the ground, there is a tendency to immediately increase collective causing the tailwheel to bounce. Another common problem is runway alignment. Because of the position of the cockpit seats, pilots fly their seat (instead of the aircraft), down the centerline of the runway, causing the helicopter to be about 3-4 degrees right/left of center.

4.14. Turning Approach. This type of approach can be used whenever a straight-in approach is not practical.

4.14.1. As a technique, if the terrain permits, use an entry altitude of 300 feet above the touchdown spot and an entry airspeed of 60-80 KIAS. This will provide a normal sight picture during the approach.

4.14.2. Decrease the airspeed and altitude during the turn so that when you roll out, you are flying the final portion of a normal approach prior to reaching the landing spot.

4.15. Practice Emergency Procedure Maneuvers.

4.15.1. Accomplish the appropriate emergency procedure checklists and simulate those items which would be shutdown during an actual emergency.

4.15.2. If possible you should always make an inflight emergency into a ground emergency by landing the aircraft. For example, don't do a low approach over a runway or taxiway to complete the "cleanup" items in the emergency checklist; get the aircraft on the ground!

4.16. Boost Off/AFCS Off Flight.

4.16.1. With the boost off and SAS/TRIM on, the control forces will be slightly less than with the SAS/TRIM off. It is recommended that aircrews practice Boost off with full SAS/TRIM on and off as well as full SAS/TRIM off with Boost on. This will give the aircrew greater exposure to helicopter characteristics in various configurations.

4.16.2. At the time of the failure, adjust the collective and pitch attitude to attain a comfortable/controllable speed (80 KIAS is recommended).

4.16.3. With the aircraft at a safe airspeed, practice increasing and decreasing the collective to get an idea of how much pedal is needed in both cases.

4.16.4. The approach angle should be more of a normal to slightly shallow approach angle. A shallow approach angle requires fewer power changes on short final. In addition, you should use a slower than normal approach speed. This will decrease the amount of control inputs necessary during the termination phase of the approach.

4.16.5. It is important to anticipate the requirement for increased left pedal when collective is increased to bring the helicopter into a hover or landing.

4.16.6. Either establish a 10 foot hover or continue to the ground.

4.16.7. If a hover is established, stabilize the helicopter prior to initiating the landing. A slight amount of forward movement may make landing from a hover easier. Use extreme caution to prevent drifting to either side upon touchdown.

4.16.8. When landing from a hover with the boost off, expect higher control forces than normal. When landing with the SAS off, avoid over-controlling the aircraft. Stabilize the aircraft in a low hover and reduce the collective to start a positive descent to the ground. Use cyclic and pedals in small amounts to dampen yaw and drift movements.

4.16.9. Once the wheels touch down, slowly but firmly reduce the collective to minimum and center the cyclic. Use brakes to stop any forward movement that may exist. During training, if boost is to be re-engaged prior to the next takeoff, relax the forces and center the controls prior to re-engaging the boost.

4.16.10. Common Tendencies: Over controlling the pitch attitude with the pitch boost off, resulting in "rocking" the nose of the helicopter. Over-controlling the pitch and roll attitude with the AFCS off, resulting in unstable flight. Not controlling the yaw quickly or sufficiently enough resulting in excessive yawing on short final.

4.17. Stabilator Malfunctions. If the stabilator auto mode fails, lowering the collective reduces the amount of rotor down wash on the stabilator, causing the tail to pitch up and the nose to pitch down. Acceleration and collective settings must be considered prior to making any control inputs.

4.17.1. If a malfunction occurs on takeoff, do not exceed placard airspeed for the given stabilator angle.

NOTE: When flying with the stabilator at zero, it takes more time to slow the helicopter at a given pitch attitude.

4.17.2. In a situation where the stabilator auto mode fails on takeoff, the pilot flying should stop the acceleration to prevent exceeding placard limits.

WARNING: *If the acceleration is continued with the stabilator in the fully down position, longitudinal control will be lost. The pilot not flying should identify the situation by calling out "STAB Malfunction".*

4.17.3. If manual control of the stabilator is available, the aircrew has the option of manually slewing the stabilator down when decelerating through 40 KIAS.

4.17.4. If landing can be made safely, consider aborting the takeoff and initiate a landing.

4.17.5. Common Tendencies: Misidentifying the specific type of stabilator emergency and applying the wrong emergency procedure for the situation. Lowering the collective instead of keeping it fixed or increasing it. Flying too fast of an approach for a stabilator set at 0 degrees. Exceeding the stabilator placard limits when flying with a stabilator in the fixed position.

4.18. Straight Ahead Autorotation (Training). The minimum entry altitude for a straight ahead or 90° turning autorotation is 500 feet AGL, 800 feet AGL is required for turning autorotations greater than 90°. It is important to remember that these are minimum altitudes for entry. Pilots should brief the specific spot they are attempting to reach.

NOTE: Brief crew members on their specific duties during the maneuver. The flight engineer will normally monitor NR and other instruments during the autorotation.

4.18.1. Initiate the maneuver by reducing collective to minimum to start a power-off type descent. As you lower the collective the stabilator will program up slightly maintaining pitch attitude; however, it may be necessary to make a slight cyclic input to maintain airspeed.

4.18.2. Depending on density altitudes, a collective increase may be required to control NR within power on autorotational limits. Keeping the NR slightly above 100% is a good technique.

4.18.3. Maintain the desired airspeed for the best glide or rate of descent. An airspeed of about 90 KIAS works well for training autorotations.

4.18.4. Initiate the flare at an appropriate altitude (125 - 75 feet AGL). An aggressive flare with an increase in collective may result in "ballooning" the helicopter. A gradual flare with a slight increase in collective should result in slowing the helicopter without ballooning. Airspeed variations also affect the NR build-up in conjunction with the flare.

4.18.5. To start the flare, make an aft cyclic input to establish the desired nose-up attitude and increase the collective initially to anticipate the NR build, then reduce it once established in the flare.

4.18.6. The flare attitude should be held (or increased slightly to bleed off the remaining airspeed) until a power recovery is initiated when approaching the recovery airspeed of 30 knots ground speed.

4.18.7. Initiate the power recovery by leveling the attitude of the helicopter to a normal hover attitude and applying collective to recover no lower than 15 feet and no greater than 30 knots ground speed. A hover attitude will prevent any increase of ground speed when the collective is increased. When flying an H-60 with T-700 engines, you may need to increase the collective to about 10% torque at the end of the flare to prepare the engines to produce the power required for the power recovery. If you do not "wake up" the -700 engines, they may not spool up fast enough to prevent ground contact during the power recovery. Keeping flat pitch until the final cushion may result in excessive rotor droop (as low as 80-85% NR) because the HMU can't respond quickly enough to increase fuel flow.

WARNING: *The "wake up call" technique only applies to practice autorotations and must not be done during an actual autorotation for failure of both engines.*

4.18.8 Common Tendencies: Abruptly lowering the collective during entry resulting in a brief negative G loading. "Chasing" the NR during descent. Flaring aggressively resulting in ballooning the helicopter and over-shooting the desired landing spot. Carrying too much torque throughout the descent, and not actually autorotating. Failing to maintain proper trim resulting in a higher rate of descent. Drifting to the side of the pilot flying during the flare.

4.19. Turning Autorotation. When conducting turning autorotations, the lateral separation from the intended point of landing directly affects the amount of turn. The closer to the intended point of landing, the steeper the turn required. It is recommended aircrews vary the lateral separation when conducting turning autorotations. Once the turn is completed, the turning autorotation becomes a straight ahead autorotation. The 90° and 180° autorotations follow similar basic principles.

4.19.1. Initiate the autorotation by reducing collective.

4.19.2. If the lateral separation is minimal, immediately enter the turn (usually, at 90 KIAS, a turn of 45° angle of bank is sufficient to complete the turn with adequate recovery altitude).

4.19.3. Lead with a slight amount of pedal into the turn and add a slight amount of collective to anticipate the NR build. A 180° auto will require more collective to control the rotor speed than a 90° auto, and the tighter your turn, the more collective you will need.

4.19.4. When performing cross cockpit turns, the landing area will not come into view until approximately one half to three quarters of the way through the turn.

4.19.5. It is important to monitor trim throughout the turn and realize that there is a tendency to loose airspeed.

4.19.6. Proceed with the rest of the autorotation as with applicable steps in the straight ahead autorotation.

4.19.7. Common Tendencies: Carrying excessive power throughout the turn. Sustaining an out of trim condition throughout the turn resulting in an excessive rate of descent. Not completing the turn fast enough resulting in a wings level attitude lower than 150 feet.

4.20. Night Contact (Aided or Unaided).

4.20.1. Cockpit Familiarization. Aircrew must know where all switches and controls are located so they can be easily located during reduced cockpit lighting. Aircrew must be able to find critical switches (such as the APU switch, 1st and 2nd stage primary servo switches, and fire extinguisher switch). Be careful when adjusting the landing and searchlight positions on the collective so you don't accidentally change engine trim.

4.20.2. Maneuver Procedures. Night transition maneuvers are flown using the same basic procedures as transition maneuvers during the day.

4.20.2.1. Taxiing. Use the landing light or controllable searchlight to clear your taxi path. Avoid shining your search or landing light in the direction of a marshaller or other landing/taxiing aircraft. Monitor taxi speed closely--there is a common tendency to taxi too fast at night. A good technique is to cross-check your ground speed on the HDD during taxi operations.

4.20.2.2. Hovering. Turn on the landing and/or searchlight to illuminate the area in front of the helicopter. Use care when moving the searchlight, because it does not move in a level plane and can induce spatial disorientation.

4.20.2.3. Takeoff. Position the landing and/or searchlight beams well out in front of the helicopter to check the takeoff path for obstacles. During departure, adjust lights as necessary to continue illuminating your flight path. After takeoff, position the landing and/or searchlights for an autorotative descent and then turn them off.

4.20.2.4. Approach. After turning final, turn on the landing and/or search light. During night approaches, you will not have many external cues to help determine altitude and ground speed. Cross-check altimeters, VVI, and airspeed indicator for trend information. Monitor rates of closure and be ready for a go-around if necessary. Approaches at night tend to be flown slower than in daylight. During the approach, a good rule-of-thumb is to be at 200 feet AGL and 30 knots. While on final approach, you should adjust your lights as necessary to keep your landing area illuminated during the deceleration.

4.21. Instrument Flying Techniques.

4.21.1. General. Check the Terminal Change Notice (TCN) as well as NOTAMs for changes to planned approaches. Items such as NAVAID maintenance or decommissioning, DH/MDA changes, etc., listed in the TCN or NOTAMs could have a severe impact on the planned mission.

4.21.2. Weather Planning.

4.21.2.1. Consider cold temperatures in fuel burn planning. Cold temperatures may call for the use of cabin heat. Low OAT and moisture may also require the use of engine anti-ice. Use of these systems will increase fuel flow. Of course, adverse wind along a route may significantly impact ground speed, increasing enroute time. Failing to consider these factors in preflight planning may yield inadequate estimates for the fuel required for the mission.

4.21.3. Navigation Equipment Preparation. Pilots should program the NAVAID coordinates they plan to use into the Enhanced Navigation System (ENS). If you reference the FLIP En Route Supplement (IFR), you may find the coordinates for a NAVAID listed under the name of the particular NAVAID, but this is not always the case. A better way to save time searching for these coordinates is to look under the airport name. This listing will have all of the NAVAIDs associated with approaches into that field. The FLIP Enroute Low Altitude (ELA) will list most NAVAIDs. The ELA coordinates are usually given to the nearest 1/100th minute, while the IFR supplement usually lists coordinates only to the nearest 1/10th minute.

4.21.3.1. RNAV Operations. Currently the H-60 navigation system does not meet the approval criteria outlined in FAA Advisory Circular 90-45A, and is not approved for RNAV operations. Until specifically approved in AFI 11-206, and/or MAJCOM supplements, do not use the H-60 navigation system (INS, GPS, DNS) for primary enroute navigation or instrument approaches. The procedures in this section describing the use of the H-60 NAV system during instrument flight are provided only as techniques for general aircrew knowledge, backup monitoring, and for emergencies.

4.21.3.2. Pilots should develop the habit of selecting <u>five</u> items when Tuning/Identifying/Monitoring and Selecting NAV equipment. For any navigation system check, approach, etc., after proper tuning, identifying, and monitoring, it is necessary to check/set at least five switches for proper instrument indications. First, on the Nav Mode Select Panel, the INST and ADF switches must be properly set for the approach. Second, on the Horizontal Situation Indicator (HSI)/Vertical Situation Indicator (VSI) Mode Select Panels, the BRG 2 switch must be set to INST (VOR/TACAN) or ADF for NDB position orientation. Third, on the HSI/VSI Mode Select Panels, the INST switch must be actuated to provide Course Deviation Bar (CDB), Course Deviation Pointer (CDP), and Glideslope deviation information for approaches (TACAN, ILS,VOR). This may be thought of as an on-off switch, with "on" being spelled VOR [INST] or ILS. This switch will illuminate based on the frequency selected in the VHF nav-comm radio. Fourth, on the HSI/VSI Mode Select Panels, the CRS/HDG switch must be actuated to the correct position, indicating which HSI settings will control the output (either PLT or CPLT). Fifth, on the HSI itself, the Course Set Knob must be set to the proper course (self-test course, proceed-direct course, holding course, etc.). This habit of selecting five items will prevent errors in testing systems as well as preventing errors during flight.

4.21.3.3. Pilots should conduct all equipment checks on both the pilot and copilot VSI and HSI. Many pilots will conduct checks of different systems simultaneously (for example, the pilot checks the ADF while the copilot checks the VOR). While this may provide a slight savings in time, it may not identify a disparity between the pilot and copilot instruments. The VOR indications may be correct on the pilot's instruments, yet be incorrect on the copilot's instruments. In addition, by having both the pilot and copilot check each system together, there is a greatly reduced chance that the check will be performed incorrectly.

4.21.3.4. The HH-60G Commmand Instrument System (CIS) Roll Command Bar is compatible with TACAN output. Many pilots who previously flew non-ENS aircraft overlook this modification to the helicopter.

4.21.3.5. If the VHF nav-comm has an ILS frequency selected, and TACAN is the selected navigation mode on the Nav Mode Select Panel, it is normal to receive glideslope information. Pilots must remember to disregard glideslope information when executing TACAN approaches.

4.21.3.6. Proper CIS operation requires the VOR [INST]/ILS switch on the pilot's HSI/VSI Mode Select Panel be actuated. This holds true even if the copilot has control of the CIS CRS/HDG, and his (copilot's) VOR [INST] / ILS switch actuated.

4.21.3.7. If the copilot desires to execute an ILS approach, even without CIS assistance, it is imperative that the VOR {INST] / ILS switch on the pilot's HSI/VSI Mode Select Panel be actuated. Failure to do so may result in loss of ILS raw data indications on the copilot's HSI/VSI.

4.21.4. Departure. You may find it helpful to have the flight engineer monitor the NAVAID identifiers. Monitoring NAVAIDs is important, and the flight engineer is the least-tasked crewmember during instrument flight. Make sure the audio is set to a reasonable volume.

4.21.4.1. When you transfer (take) the controls, take the radios and the CIS CRS/HDG. If you get into the habit of setting the other pilot's radio selector (wafer switch) to intercom (INT) and setting your own to the appropriate transmitter, communication errors are minimized. You may have your instruments (HSI CRS/HDG, BRG #2 sel, etc.) set properly, but if the CRS/HDG switch is set to the other pilot, great navigation errors may occur if the other pilot has incorrect settings. In short, you may be following the CDB/CDP course perfectly, but it may be the wrong course. Remember, many pilots use the HDG bug for settings other than the last heading. The other pilot's bug could be set to forecast winds, the inbound course, the missed approach course, etc.

4.21.4.2. If time permits, aircrews should listen to ATIS one additional time as late as practical prior to takeoff.

4.21.5. Instrument Departure Briefing. On training flights crews should make the "emergency return approach" the first planned approach, if it is suitable. On many training flights, the first approach is expected so soon after takeoff that the Instrument Approach Briefing is conducted prior to takeoff. Some pilots, however, then brief a completely different approach for an emergency return, which provides a great deal of confusion for setting the navigation and communications radios. In addition, the departure airfield may not necessarily provide for the swiftest return in case of a departure emergency in IMC. It may be faster to continue to a nearby airport for an approach.

4.21.6. Instrument Takeoff (ITO). Aircrews should practice all authorized types of ITOs (composite, restricted visibility, etc.). Obviously, if the weather permitted, most pilots would prefer to make a normal takeoff, establish a proper rate of climb, and attain a near normal airspeed prior to entering IMC. The restricted-visibility ITO may be necessary, however, in very marginal conditions, and provides good practice for operations in white-out or brown-out conditions. The restricted-visibility type takeoff is usually the most difficult for pilots.

4.21.6.1. Preplan a suitable torque for the ITO. There are many factors to be considered for the proper amount of takeoff power. If too little power is applied, the rate of climb may be insufficient for obstacle clearance/climb gradient. In some instances, the use of cabin heat and engine anti-ice may limit power margins, especially at higher elevations and gross weights. Preplan and announce to the crew your target power.

4.21.6.2. You may find it helpful to use a moderate amount of collective friction for the ITO. This will help prevent two common tendencies. First, having to "work" against an increased amount of collective friction may reduce jockeying the collective, "hunting" for the proper torque. Second, increased collective friction will decrease collective downward "creep", which is usually present during all takeoffs and climbs. Such inadvertent collective reductions could be hazardous if not identified and corrected.

4.21.6.3. You may find it helpful to set the HDG bug to the desired takeoff heading and engage the CIS in HDG mode. The eye-catching roll command bar provides an easy reference and greatly reduces the tendency to overlook adverse yawing during takeoff. Ensure the HSI/VSI Mode Select Panel shows the proper PLT/CPLT indication, and the proper heading is set on the Heading Set Knob.

4.21.6.4. You may find it helpful to turn on the landing light and leave it on. The FAA encourages pilots to fly with the landing light on at all times below 10,000 feet, especially in areas around airports. Also, FARs require that the landing light be illuminated inside the FAF when not in direct continuous contact with the tower.

4.21.6.5. Maintaining a level attitude on the VSI during an ITO will result in a right drift. A level aircraft attitude during an ITO fails to compensate for translating tendency below ETL. Never attempt a restricted-visibility ITO from an area with obstacles in close proximity, especially to the right forward of the aircraft.

4.21.7. Enroute. Flying with slightly increased collective friction and limiting torque adjustments during standard turns is sometimes a good technique for maintain altitude. Due to changes in total aerodynamic force, a turn executed without adding some additional power, above the cruise flight torque setting, will result in either a loss of altitude or a loss of airspeed (or both). In the HH-60G, many pilots find it easier to fly standard turns without adjusting the collective, and simply fly the cyclic. This allows for a more constant altitude held throughout the turn, and results in a very small loss of airspeed, typically only a couple of knots. Adding power into turns and reducing power out of turns frequently yields greater airspeed and altitude deviations.

4.21.7.1. Consider not depressing the trim release switch during turns. The HH-60G, due to its inherent sensitivity in the pitch axis, proves difficult for some pilots to fly turns in a level plane. It may be helpful for these individuals to trim the aircraft for cruise flight (using either the trim "hat" or trim release "button"), and simply fight against the trim during turns. Another similar technique is to perhaps trim in the turn using the "hat", in one axis only, and not trim using the release "button".

4.21.7.2. You may find it helpful to make switch adjustments prior to or after turns, so that during the turn, you can concentrate on the turn. During Undergraduate Pilot Training, many pilots developed the habit of "time-turn-tune-talk." In the pitch-sensitive HH-60G, many pilots who actuate switches or tune HSI Course Set and Heading Set Knobs during the turn inadvertently assume a pitch-up or pitch-down attitude, causing deviations in airspeed and altitude. Pilots who "tune" just prior to the turn usually have a better pitch control than those who attempt to turn and "tune" simultaneously.

4.21.8. Proceeding Direct To a Station. Engaging the CIS NAV mode can assist the pilot in maintaining ground track. The roll command bar is wind corrected, therefore reducing pilot workload.

4.21.8.1. You may find it helpful to engage the CIS ALT mode. If your cross-check has deteriorated such that you missed the deflection in the vertical velocity indicator and the altimeter, the displaced collective position indicator may provide the needed signal to initiate an altitude correction.

4.21.9. Holding Pattern Entry. You may find it helpful to determine the proper method of entry using the HSI and the HDG bug. This technique may appear somewhat complex, yet in practice is extremely easy. Very rapidly, without drawing any patterns on paper, pilots can determine the correct holding entry type, turn direction, turn amount, when to start timing, and direction of inbound turn.

4.21.9.1. Entry Type. Refer to AFMAN 11-217 for holding entry procedure specifics and requirements. Set the holding course with the HSI Heading Set Knob (this is a technique that uses the HDG bug as a marker). The index marks along the upper half of the HSI case highlight the 0°, 45°, and 90° points. Halfway between the 45° and 90° marks on either side is the unmarked position of 67.5°. For our purposes, consider this position halfway between the 45° and 90° marks as 70°. We will now refer to this as the "70° index position". If the HDB bug (set to the inbound holding course) falls anywhere between the two 70° index positions, a direct entry is required. If the HDB bug falls anywhere outside the two 70° index positions, a parallel entry is required.

4.21.9.2. Direction of Entry Turn. If a direct entry is indicated, turn in the prescribed direct direction (right for standard patterns). If a parallel entry is indicated, turn away from the HDG bug (which is the shortest direction to parallel the holding course outbound).

4.21.9.3. Amount of Entry Turn. Continue the turn outbound until the your HDG bug is at the bottom of the HSI case (no wind). This applies to parallel or direct entries.

4.21.9.4. Determining the Abeam Position. If the HDG bug is anywhere in the upper half of the HSI case during the initial station passage, there will be some abeam point reached during (or very soon after the completion of) the turn outbound. As the #2 bearing pointer falls perpendicular (90°) from the HDG bug, start timing. If the HDG bug is anywhere in the lower half of the HSI case during initial station passage, the abeam point will be reached at station passage and timing should be started.

4.21.9.5. Direction of Turn Inbound. If you turned left to enter, you should turn left again inbound. If you turned right to enter, you should turn right again inbound (this assumes you pay attention to the #2 bearing pointer during the outbound leg and don't get blown through the holding course). Again, we are ignoring teardrop entries here. Remember, this applies only for the entry turn and the first turn inbound; subsequent turns are always in the direction of holding (right turns for standard patterns).

4.21.9.6. If you elect to make a teardrop entry, you could set the HSI CRS to the selected teardrop course to be flown. Some pilots mistakenly believe this is procedure, but it is not. You must use course guidance, if available. If you wish, you may use the tail of the #2 bearing pointer for course guidance (and keep the inbound course selected on the HSI Course Set Knob). If desired however, you may tune the teardrop course (usually approximately 30° from the holding radial) for more precise guidance. Don't forget, however, to tune the inbound course back just prior to the turn inbound.

4.21.10. Holding Pattern Circuits. Pilots may find it helpful to execute the entire pattern using raw data only. This offers several advantages. By removing the roll command bar, it is more likely the pilot will keep the #2 bearing pointer in his cross-check. If the #2 bearing pointer is displaced 30-40° from the holding course at the end of the one-minute outbound leg, a standard rate turn should place the aircraft on the inbound course (no-wind). If pilots are preoccupied with switching various CIS modes on and off, they are more likely to follow an incorrect mode, and are more likely to forget leg timing. An obvious disadvantage of the technique of using raw data only is that the pilot is not using available tools (CIS) to calculate wind corrections during the turn inbound and while tracking the inbound course.

4.21.10.1. Pilots may find it helpful to use the HSI CDB and ignore the VSI CDP during holding. The CDB provides an overhead plan view of the flight path, and always shows the correct relationship of the aircraft to the course selected on the HSI. The VSI CDP provides a profile view, and is reverse-sensing in many cases. If the HSI Course Set Knob is tuned to a course that will take the aircraft to the station (a TO indication is present), yet the aircraft continues to head in a direction that is away from the station, the VSI CDP will give reversed indications. An example of this happens during holding. When established on a correct outbound leg of the racetrack, the HSI CDB will show where the selected inbound course actually is (to the right for standard patterns) yet the VSI CDP will be displaced to the left (during the inbound leg, both the CDB and CDP match). By concentrating on the CDB, the worry of positive and negative sensing is eliminated.

4.21.10.2. A good technique is to execute the pattern using the CIS NAV mode on the inbound leg. This provides for a wind-corrected turn from the outbound leg and provides a wind-corrected heading to track the inbound course. While these are important advantages, this technique offers distinct disadvantages. If the NAV mode is engaged at the end of the outbound leg (or left ON at that portion of the pattern) the roll command bar will likely show a turn opposite the correct run to the inbound course. If the NAV mode is engaged for the entire pattern, for more than half of the pattern (outbound), the indications will likely be incorrect due to the system switching in and out of NAV/HDG/Station Passage Submode. Many pilots find it difficult to ignore the roll command bar, and seek to roll to it. For a portion of the inbound leg, the CIS goes into the station passage submode, and stops actively correcting for wind drift. The NAV mode may cause a fixation to the (incorrect) roll command bar on the outbound leg, resulting in insufficient attention to the #2 bearing pointer for important position information discussed above. The NAV mode works very well for a small portion of the pattern (from approximately half-way through the turn inbound to the point short of the NAVAID where the station passage submode engages).

4.21.10.3. You may find it helpful to execute the pattern using the CIS NAV mode on the inbound leg, and the CIS HDG mode on the outbound leg. Many pilots find this technique useful, because it provides wind-corrections during the inbound track, and eliminates the erroneous NAV roll commands outbound. The HDG mode during the outbound track helps keep the pilot on the selected heading. This requires a correct inbound course set on the Course Set Knob, and the proper outbound heading selected on the Heading Set Knob. This technique should be used with caution, due to several disadvantages. At the beginning or end of each leg, one CIS mode must be disengaged and another engaged. This gives the opportunity for the selection of an incorrect mode. Also, preoccupation with the CIS buttons sometimes leads to missing more important items, like leg timing and airspeed/altitude. During the outbound leg, pilots may fixate on the roll command bar (HDG) and keep it perfectly centered, yet not notice that this heading allowed the aircraft to drift well away from (or more likely, drift through) the inbound course. This is brought about from fixation to the eye-catching roll command bar instead of the less obvious #2 bearing pointer.

4.21.10.4. Using the CIS ALT mode can be helpful for maintaining altitude. If your cross-check has deteriorated such that you missed the deflection in the vertical velocity indicator and the altimeter, the displaced collective position indicator may provide the needed signal to make an altitude correction

4.21.10.5. Pilots may find it helpful to use the HSI deviation dots to highlight the abeam position. If the inbound course is selected with the Course Set Knob, the HSI deviation dots form a line exactly 90° from the inbound course. During the turn to the outbound course, as the #2 bearing pointer passes this position on the HSI, timing can be started, eliminating the sometimes confusing process of determining an abeam point radial. Remember, the suggested technique is easy, fast, and effective, but requires the inbound course be selected on the HSI Course Set Knob.

4.21.10.6. Pilots may want to use displayed ground speed to assist in leg timing. The ground speed readout on the upper left corner of the VSDS can be a great aid during leg timing. By noting a difference in indicated airspeed and ground speed, pilots can readily see wind influence and can derive much more accurate estimates for outbound leg timing.

4.21.10.7. Always report reaching the holding fix and always report departing the holding fix. This report has recently been added in FLIP documents. These reports may be omitted by pilots of aircraft involved in instrument training at military terminal area facilities when radar service is being provided. However, instead of wondering whether or not the report is necessary, if you always report, you will always be covered. Many US Air Force Bases are tenants on civil airports (joint-use facilities) and are <u>not</u> in military terminal areas.

4.21.10.8. When cleared for the approach from a holding pattern, and the holding course and procedure turn course are the same, pilots may elect to fly out the holding pattern before turning inbound. Many pilots misinterpret the guidance in AFM 11-217 in this matter. When cleared for an approach in this case, you <u>may</u> turn immediately toward the fix <u>if you wish</u>, but this is <u>not required</u>. You may also continue the holding pattern , and fly out your usual holding pattern leg outbound. This keeps you in your same thought pattern, and will give you more time to re-select nav/comm radio settings, if required, prior to the fix.

4.21.10.9. When cleared for the approach from a holding pattern, and the holding course and procedure turn course are <u>not identical</u>, but are <u>close</u>, query the controller. Although a technical interpretation of AFM 11-217 would require proceeding to the fix, then going outbound again for a procedure turn, this may not be desired by ATC controllers. In cases where the holding course and procedure turn courses are reasonably aligned, ATC may expect you to continue inbound upon reaching the fix. These controllers may be working you into a dense traffic flow. When in doubt, communicate!

4.21.11. TACAN Fix-to-Fix. The ENS provides a direct, wind-corrected course to the fix and may be used as a backup while flying a fix-to-fix using the TACAN (See AFI 11-206 for information on RNAV). The exact procedure for using the NAV system for accomplishing a fix-to-fix will depend on the particular software installed in the aircraft. The basic procedures however are similar regardless of software. The swift use of this technique is predicated on having the NAVAID already entered into the system as a waypoint. As an example, imagine you are proceeding direct to the ABQ R-270 at 10 DME and you have entered the ABQ VORTAC as waypoint 44.

4.21.11.1. The procedures for a fix-to-fix using the H-60 NAV system as a backup is as follows:

4.21.11.1.1. On the CDU, select FIX → RNG/BRG.

4.21.11.1.2. On the RNG/BRG sub page, enter the waypoint number that corresponds to the TACAN (VOR/DME) station programmed into the ENS (e.g., 44). Then enter the RNG (desired DME), and BRG (desired radial). The system will store the information in the next available storepoint. It is important to note the storepoint available, then press STORE.

4.21.11.1.3. Select FPN → DIRECT → WAYPOINT → (enter the storepoint that was noted in the last step) <ENT> → RTN → START (Direct).

4.21.11.2. The procedures for a fix-to-fix using the TACAN/HSI (primary NAV method) are as follows:

4.21.11.2.1. Tune, identify, and monitor the TACAN (or VOR/DME).

4.21.11.2.2. Set the desired radial with the HSI Course Set Knob. Don't worry about figuring reciprocals, reverse-sensing, etc.

4.21.11.2.3. Turn in the shorter direction to a point halfway between the #2 bearing pointer and the desired radial (the course pointer/HSI "dagger"). Employ the techniques described in AFM 11-217 for the fix-to-fix. Many pilots refer to the imaginary line used to figure heading as the "pencil line". Don't forget that the perfectly vertical pencil line is for no-wind conditions. If a wind drift correction is to be applied, this line will be proportionally offset from vertical.

4.21.11.2.4. It is the final portion of the fix-to-fix that becomes very difficult to visualize with the relationship between the tail of the #2 bearing pointer and the "dagger." The instant that the HSI CDB becomes active ("breaks the case"), adjust heading to point the HSI "airplane" directly at the end (tip) of the

CDB. This should not require a massive heading change, but a "refinement" heading correction. You should cross the desired fix within very close tolerances. This technique works well, but has some important conditions. This technique does not work until the CDB becomes active, so don't be concerned with turning to the tip of the CDB initially. Use the "pencil" method until the CDB starts moving. It is also important to understand that when the CDB does become active, the heading adjustment to the tip of the CDB must be made immediately. If you wait until after the CDB has been "off the case" for a few moments, this technique will not help.

4.21.11.2.5. Remember, unless you are trying to cross a fix exactly (e.g., for holding), you probably want to employ a lead point (for arcing, proceeding down a radial, etc.).

4.21.12. TACAN Arc-to Radial Turns. Ensure your lead point is appropriate for your ground speed. Many pilots still use the "30 over the DME" rule regardless of airspeed. The 30/DME technique is no longer referenced in AFM 11-217, and because of the higher approach speeds flown by the H-60 it is no longer an accurate rule. Faster ground speeds require more airspace in turns. At 120 or 130 knots you need 4000-4500 feet to make a standard rate turn. In summary, the 30/DME technique is good for 90 knots, but when flying close to 120 knots, 40/DME will yield a better lead point.

4.21.12.1. Ensure your lead point is correct for the NAVAID providing arc guidance. There are many approaches that incorporate several NAVAIDs for various portions of the approach. For example, you may arc from a VORTAC, then intercept a localizer course (or even a LOM bearing) for final. Make sure the lead radial you select is suitable for the combination of NAVAIDs.

4.21.13. TACAN Radial-to-Arc Turns. Ensure your lead point is appropriate for your ground speed. Some pilots, due to lack of attention, arrive at an arc before initiating a turn to stay on the arc. This will result in an overshoot, requiring a correction back to the desired arc. Many helicopter pilots use a 0.5 DME prior to the desired arc DME as a lead point to begin a turn from the radial to the arc. While this is certainly better than using no lead point at all, this 1/2 NM lead point will likely be insufficient. As explained above, a 1/2 NM (3000 ft) turn radius is applicable to 90 knots ground speed. If you fly at a 120 knots ground speed (due to TAS, wind, etc.), you will use approximately 4000-4500 feet instead. Try a radial-to-arc lead point of 0.7 DME at these higher ground speeds.

4.21.14. Radar Vectoring to Final. Pilots may find it helpful to set the heading bug to the desired vector heading and engage the CIS in HDG mode. This will reduce the tendency to inadvertently drift from the prescribed heading. Deflections of the roll command bar are more eye-catching than the insidious movements of the HSI heading ring. Be sure that you don't fixate on the roll command bar at the expense of airspeed and altitude control.

4.21.15. Instrument Approach. If you are flying from the copilot position and engaged the CIS early in the approach, have the pilot call out CIS switch condition at various locations throughout the approach. If the CIS NAV mode has been engaged outside the azimuth and glideslope capture zones, pushing this single button (NAV) will illuminate all three CIS lights (HDG, NAV and ALT). From the left seat, you may be expecting NAV, but really get HDG when the pilot engages the CIS for you. If the HDG bug is not set properly at this point, you could inadvertently stray significantly off course. The pilot (right seat) should announce "NAV engaged, but HDG also illuminated," etc. During the course of the approach, the pilot should keep the copilot aware of the CIS status (e.g., "HDG mode just disengaged", etc.). If the copilot pays very close attention to the roll command bar and/or collective position indicator throughout the approach, he should notice them "jump" or "flux" the instant the modes change. If you notice such a "jump," and the pilot fails to announce a CIS status change, query him as to current CIS status. The pilot (right seat) should have no trouble keeping aware of the CIS condition as he flies his approaches, and should look to the CIS Mode Select Panel if he sees a "jump" in the roll command bar and/or collective position indicator.

4.21.16. In-flight Emergencies in IMC. If the emergency warrants, fly an approach that will ensure getting the aircraft into VMC as rapidly as possible. You may want to execute a non-precision approach, which would allow you to make a rapid descent down to MDA. If you had to follow a precision glideslope, your rate of descent is quite limited. If the weather did not permit your breaking out at MDA, however, the missed approach and subsequent approach could be tedious and possibly dangerous, depending on the severity of the emergency. The following scenario (NAVAID dependent) may be a good, standard thought process. First, immediately request minimum vectoring altitudes. This descent may break you out of IMC. Be aware that this may not provide you with adequate terrain clearance. If you are still IMC, execute a localizer approach. This non-precision approach will permit a rapid rate of descent to break you out of IMC. If you are still IMC, continue to fly the localizer MDA until you run into the ILS glideslope, then maintain the glideslope to DH.

4.21.16.1. Assign specific crew duties at the onset of the emergency. A commercial airliner flew into the Florida everglades when the entire cockpit crew fixated on a faulty landing gear indicator light and failed to maintain aircraft control. One of the pilots should be instructed to do nothing but fly the aircraft (and perhaps communicate with ATC), while the PNF and the flight engineer work the emergency.

4.23.17. Instrument Approach Briefing. Check weather/ATIS before commencing the briefing. This may seem obvious, yet many pilots fail to do so. How do you decide what type of approach to execute without first knowing the weather? How do you know what the barometric altimeter setting should be? It is not always necessary to off-tune a comm radio to check ATIS. Many VORTACs broadcast ATIS information, so you can listen via the VHF nav/comm. You could also simply query the controller on the comm frequency being used for current weather and altimeter information.

4.21.17.1 Ensure both pilots have correctly set "Navigation and Communication Radio Settings". Confusion as to course alignment have developed because the pilot was seeing a different course-aircraft relationship on his HSI and VSI compared to the copilot. The pilot may be referencing an ADF #2 bearing pointer while the copilot is referencing a VOR #2 bearing pointer. Pilots may have different courses selected on their respective HSIs. A "set pilot" response is a prompt for a "set copilot" response.

4.21.17.2. Ensure both pilots have correctly set "Altimeters-Barometric/Radar". For obvious safety reasons, it is vital that the correct barometric altimeter be set by both pilots, to prevent inadvertent descent below the correct DH or MDA. It is also very important that both pilots correctly set the radar altimeters. Incorrect or non-matching radar altimeter settings can cause a variety of problems, including VAWS activation too early/late, level off mode early/late, DH indicators illuminating early/late, and LO indicators illuminating early/late. When you call out a setting for either the barometric or radar altimeter, look over to see the other pilot make the adjustment, and/or listen for a response from that crew position.

4.21.17.3. Thoroughly brief "Crew Duties and Responsibilities". Many pilots simply respond, "standard." Consider directing the flight engineer to monitor NAVAIDs. Have the pilot not flying read step-down altitudes throughout the approach, make UNICOM advisory calls, and re-tune NAVAIDs as required. A good response to "Crew Duties and Responsibilities" is to say, "In addition to standard procedures, I want you to……"

4.21.17.4. Thoroughly brief "Lost Comm Intentions."

4.21.17.5. Thoroughly check "Heading and Attitude Systems." Check pilot and copilot attitude indicators identical? Are the pilot and copilot heading cards identical, and do they agree with the standby compass? Are warning/off flags visible in the VSI or HSI? Have the five "selects" been properly set?

4.21.18. Procedure Turns. When possible fly full procedure approaches instead of receiving radar vectors. Unless you cross the IAF at an altitude considerably higher than procedure turn fix altitude and require some distance to make a normal descent, it may be quicker to fly a short procedure turn than get vectored by very conservative controllers. If you plan a full procedure and are notified that radar is out of service, you continue with your plan. If you plan on radar vectors when such an outage occurs, the sudden change in plans could prove taxing. Finally, most pilots have been "forgotten" by controllers at one time or another, and vectored through the final approach course.

4.21.18.1. Instead of a small displacement parallel entry, you many find it helpful to fly the 45/180 barb. In high winds, the 45/180 barb may be easier to fly than parallel tracks. If you approach the procedure turn fix at a very obtuse angle, and make a parallel entry, it is likely that your outbound leg of the "racetrack" is very close the procedure turn course. In such instances, the inbound turn will likely need to be very steep indeed, in order to keep from "blowing through" the inbound course. Also, regardless of entry angle, in high winds, it is quite difficult to maintain a good track. By flying the procedure turn radial, you can maintain an exact course (use the CIS in NAV mode, if desired). The first 45° turn is printed on the approach plate, as is the 180° turn back toward the inbound course. By flying the barb, you know where you are in space during the outbound leg, and you know you will run into the inbound course with approximately a 45° intercept. Remember that for procedure turn entry, ± 70° does not apply (as it does to holding pattern entries). The correct entry for procedure turns is always the shortest direction outbound.

4.21.18.2. Check position before descent. Before you may descend from procedure turn altitude, you must be cleared for the approach, established on the inbound course, and within the remain within distance. The word "established" is defined by the pilot. Descending from procedure turn altitude beyond the remain within distance may be very hazardous, due to unforeseen terrain or obstacles. If the NAVAID was entered into the ENS as a waypoint, accurate distance from the station can be obtained, even though no DME is associated with the NAVAID. This is particularly convenient in windy conditions, when timing may not accurately determine distance. Remember, that use of the ENS is for backup use only, it cannot be used for primary navigation (refer to AFI 11-206 for restrictions on RNAV).

4.21.19. Non-Precision Approaches. Always report final approach fix inbound. Although this additional report is required by FLIP only when not in radar contact if you always report it, you will never be wrong.

4.21.19.1. You may find it helpful to use the ground speed readout to aid in determining non-precision approach timing. Even if you do not have the NAVAID programmed as a waypoint, you can always use the ground speed readout on the VSDS to backup your approach timing.

4.21.19.2. Pilots may find it helpful to use the ENS to aid in determining the MAP on non-precision approaches that do not offer DME (refer to AFI 11-206 for restriction on RNAV). If DME is available during the approach, it should certainly take precedence over timing. If the NAVAID was programmed into the ENS, even if there is no "real DME" from the NAVAID, the ENS can provide very accurate distance to the station information for backup reference.

4.21.19.3. Pilots may find it helpful to use the ENS as a backup NDB approach aid (refer to AFI 11-206 for restrictions on RNAV). While "nav" or "off" flags are not usually associated with an ADF system, the #1 and #2 bearing pointer can provide similar warnings. With the NDB as the active waypoint in the ENS, the #1 and #2 bearing pointers should be superimposed. If there is a difference or split, a problem is highlighted: either the ADF is not properly tuned, the ENS is not properly programmed, or the NDB is unreliable. By referencing only a #2 bearing pointer, it is very difficult to estimate distance remaining to the NDB; ADF bearing pointers frequently waiver at moderate distances just like they do near station passage. By having the NDB as an ENS waypoint, you get "DME" to the NDB by referencing the distance remaining on the VSDS. This eliminates a great deal of guesswork. This NDB "DME" is also a great aid in determining the MAP. As always, the VSDS ground speed can be adjusted for a specific FAF-to-MAP time.

4.21.19.4. Pilots should tune the HSI Course Set Knot to the inbound course when executing NDB approaches. Even though tuning the HSI Course Set Knob has absolutely no effect on ADF information (#2 bearing pointer), many pilots find it useful to have this eye-catching "picture" highlight the magnitude of the track error, the relative intercept, or the amount of wind drift correction being applied during the NDB approach. It also serves to reinforce the habit pattern of setting the HSI for other approaches (the five "selects").

4.21.19.5. Pilots may find it helpful to turn the CDB/CDP to OFF (deselect VOR/ILS or INST/INST) when executing NDB approaches. If the VOR/ILS switch is deselected on the Mode Select Panels, the CDB/CDP will lock to center. This will be less of a distracter from your primary NDB course indicator, the #2 bearing pointer. Although CDB/CDP deviations have nothing to do with NDB approaches, many pilots find it difficult to ignore a wavering CDB/CDP (tuned to some other nearby NAVAID). Even though the #2 ADF bearing pointer shows "on course", you may try to mistakenly follow the CDB/CDP to "correct" them to the center.

4.21.19.6. Use an appropriate power reduction for a suitable rate of descent. If cruise flight requires 50% torque, you should realize that 45% will probably give an inadequate rate of descent. Similarly, 10% torque will probably yield an excessive rate of descent. Obviously the relationship of torque to rate of descent is dependent on several variables, but a nominal reduction of 15% below cruise torque may be a fair starting point. Small inputs, in a timely manner, are much better than huge inputs at a later time.

4.21.20. Precision Approaches. Instead of looking in the FLIP table for a proper rate of descent on precision glidepaths, you may find it helpful to use the often-overlooked rule of thumb from AFM 11-217. Look at your VSDS for an accurate ground speed readout. Add a zero to this number, then divide by 2. The solution is a target rate of descent to fly a perfect 3° glideslope. For example, 120 knots→1200→1200/2→600 FPM. And finally, 90 knots→900→900/2→450 FPM. This technique is for 3° glideslopes (the most common), and must be adjusted slightly for other glideslopes.

4.21.20.1. Approaches flown with the CIS should be cross checked with raw data. For the HH-60G, all yellow needles are processed data and all white needles are raw data. If you are outside the glideslope and LOC capture zones, pressing NAV on the CIS panel will also illuminate the HDG and ALT segments. If you receive radar vectors at an altitude significantly above the glideslope, the ALT segment will never disengage, and the collective position indicator would try to keep you at the engagement altitude. Some CIS units are not as precise or as "tight" as they should be. These may generate small errors, like "snaking" down a glideslope or LOC azimuth, or may yield great errors due to complete malfunction. It is important to remember that the goal is to have the raw data (CDB, CDP, GSI) centered; the CIS is simply a tool to help you achieve this.

4.21.20.2. Pilots may find it helpful to fly the entire approach by engaging the CIS NAV mode early. When you are notified you are on radar vectors for an ILS approach, tune, identify, monitor and select (five selects) including setting the ILS approach course with the HSI Course Set Knob. Push the CIS NAV button. Due to your position outside the capture zones for the glideslope and LOC azimuth, all three CIS segments will illuminate (HDG, NAV, ALT). Make sure you tune the HSI Heading Set Knob to select the heading issued by the ATC controller. At this point, the roll command bar is in HDG mode, keeping you on the directed heading, while the collective position indicator is in ALT mode, helping you maintain the altitude constant for the vectors. During the vectoring, you need to simply adjust the HSI Heading Set Knob to the current vector heading. If you are given altitude changes during the vectoring, you should deselect the CIS, the re-engage it at the new altitude to be held. When the aircraft enters the capture zone for the LOC azimuth, the HDG segment will extinguish, indicating that the CIS is in NAV mode, with ALT hold. When the aircraft enters the capture zone for the glideslope, the ALT segment will extinguish, indicating the CIS is now in the ILS approach mode, and providing cues to fly a great ILS. The only CIS segment illuminated is the NAV light. All of this took place from start to end by pushing just one CIS button (NAV) early in the vectoring. Pilots should be cautioned to pay close attention to what CIS mode is currently active. Always compare CIS commands with raw data indications. The capture zone for the glideslope is very narrow. If you continue to fly even slightly above the glideslope, the ALT hold mode may never engage.

4.21.20.3. Pilots may find it helpful to use raw data up to the glideslope intercept point, then engage the CIS NAV mode. When using this technique center the CDB/CDP/GSI using raw data and engage the CIS just prior to initiating descent. The CIS will indicate NAV (ALT and HDG should not illuminate). If any of these other lights illuminate, you know instantly that something is amiss; turn the CIS off and continue using raw data only. With NAV on (ILS approach mode) the pitch command bar will center (for engagement airspeed), the roll command bar should nearly center, and the collective position indicator should nearly center. If any of these don't occur, you know instantly that something is amiss; turn the CIS off and continue using raw data only. The CIS will provide "eye-catching" guidance which will help minimize collective jockeying to maintain glideslope, and will help prevent inadvertent airspeed loss (or gain) due to pitch excursions. It is also a great help having wind-corrected roll guidance to keep you centered on the LOC azimuth.

4.21.21. Approach Termination. On almost all instrument approaches, ATC controllers ask how will the approach terminate? Pilots should respond with "low approach", "stop and go", "full stop", or "option." This information allows coordination between RAPCON/TRACON controllers and tower controllers. Tower controllers need to know your intentions so that they may sequence landing and departing traffic. When flying multiple approaches follow-up with your next requested approach (e.g. low approach followed by a second ILS') so that RAPCON/TRACON controllers may better modify climb out instructions. Remember, the terms "missed approach" and "climb-out" are <u>not</u> synonymous.

4.21.21.1. During climb-out or missed approach, pilots may want to disengage the CIS to eliminate useless guidance. Many pilots will continue to have the roll command bar, pitch command bar and collective position indicator cluttering the VSI during missed approach. These eye-catching indicators can easily lull a pilot into following an incorrect course or heading. If the CIS indications are not helping you, they will likely be confusing you.

4.21.21.2. Listen carefully to circling instructions. Controllers may use a variety of confusing phrases when issuing circling instructions. Some examples of these phrases include, "turn right to enter left downwind for..." or "circle north to enter right base for..."etc.

Chapter 5

ALTERNATE LOADING AND

ALTERNATE INSERTION/EXTRACTION (AIE) OPERATIONS

5.1. Purpose. The purpose of this chapter is to provide techniques for alternate loading and AIEs. Specific procedures and directives are contained in regulations and flight manuals. It is imperative FEs and PJs thoroughly review the individual technical orders specific to the individual AIE device employed. These technical orders detail preflight preparation, operation, and post flight of the various devices. The safe and expedient execution of AIEs are critical not only in combat, but in peacetime SAR operations as well. The following insertion/extraction methods provide an effective alternate means of delivering/extracting personnel during a tactical operation when landing is not feasible. These procedures apply to both day and NVG operations.

5.2. Planning Considerations. Determining whether it is necessary to perform an AIE is a critical factor in mission planning. The crew must decide if the increased difficulty of performing an AIE outweighs the benefits of having the survivor move to a location where a landing can be made. Performing an AIE usually results in higher power requirements, demands greater crew coordination, increases hover exposure time, and is more hazardous and difficult for survivors who may not be familiar with rescue devices. If the aircrew anticipates a narrow power margin, the heater and engine anti-ice switches should be turned off prior to beginning the approach. Refer to the H-60 flight manual for power loss due to bleed air system activation and specific requirements for engine anti-ice system operations. Additionally, the air source/heat-start switch should be moved to the OFF position if the heater is not needed.

5.3. Alternate Loading.

5.3.1. Concept. Restrain all personnel by the safest means possible for the type mission being flown. Standard troop seats are too narrow to accommodate combat-equipped personnel (backpacks, weapons, etc.). The use of standard seating normally requires this combat equipment be removed and secured. This method is satisfactory for administrative transportation, but is impractical in a tactical environment where rapid PJ employment for survivor recovery is required.

5.3.2. Planning Considerations. Alternate loading methods are provided below wherein all seats and equipment not required for the mission are removed. The cabin floor itself is defined as the seat and either a seat belt or personal snap-link device restrains the occupants. All restraints may be removed upon landing in the recovery zone (RZ) or while taxing to the off load point. For hover operations (including water ops), restraining devices are removed as required. These procedures are normally used during contingency operations and training missions when standard seating reduces the crew's ability to recover and medically treat survivors.

5.4. Alternate Insertion/Extraction Rope Operations.

5.4.1. Concept. The following rope insertion/extraction methods provide an effective means of delivering/extracting personnel during a tactical operation when landing is not feasible. These procedures apply to both day and NVG operations.

5.4.2. General. Ensure intercom cords are clear of pathways. Route them up the walls, along ceilings, and down from above to the safetyman. The team leader's cord should only be long enough for necessary movements. Ensure gunner belts are clear of personnel and paths of travel. The V-Blade knife or other similar tool should be readily available to use if the ropes need to be cut during aircraft emergencies or rope entanglement.

5.4.3. Use of Chemlights. To facilitate night AIE operations, the following chemlight configurations are recommended. Activate chemlights attached to insertion/extraction equipment at or prior to the 5-minute out call.

Table 5.1. Chemlight Configurations

OPERATION	CHEMLIGHT CONFIGURATION
Rappel	1 green stick on the top of the drop sack
Fast Rope	2 red sticks at the bottom of the rope 1 red stick 10 feet from the bottom 1 green or blue stick at the top of the rope
Rope Ladder	1 red stick on each side of the ladder at the 1st and 5th tube from the bottom

Hoist	1 red stick on bottom of each forest penetrator paddle
Stokes Litter	2 red sticks on head, one on foot

5.4.3.1. Keep FEs and PJs informed of position and distance to the LZ. Standard announcements of "time remaining to the LZ" at the 20-, 10-, 5-, and 1-minute-out points greatly aids in preparation for the AIE. Employ these calls regardless of the specific type of AIE. The FE (primary) and the PJ (secondary) should keep the pilots informed of the status of the AIE equipment prior to and throughout the operation (e.g., "The H-bar is extended and pinned."). Other calls could include (but not limited to) "ladder is deployed, the first person is at the door, the first person is on the ground, the rope is released" etc. At the end of the operation, when the device is retrieved or released, and the aircraft is ready for forward flight, the FE states the "(status of device) cleared for forward flight."

5.4.3.2. The FE should keep the pilot informed of hover status using common terminology.

Table 5.2. Hover Status Terminology.

Terminology	Meaning
Drifting Forward (Back) Drifting Right (Left) Descending /Climbing	You are moving in the direction indicated and should make a correction. These are "trend" calls.
Stop Forward (Back) Stop Right (Left) Stop Down (Up)	Your movement in the direction indicated must stop immediately due to possibility of contact with obstacles or injury to deploying/enplaning personnel. These are "directive" calls.
Hold your hover	Indicates the helicopter is in the proper location, and requires no corrections.
Up 5 (Down 5) Forward 5 (Back 5) Right 5 (Left 5)	To position over the correct hover spot, the aircraft needs to move in the direction and distance given. These are "directive" calls. The distance need not necessarily reflect actual feet, yards, etc., but may simply reflect countdown units ("right 5, right 4,3,2,1, stop right").

5.4.3.3. The approach may vary from a slow gradual deceleration and descent to a tactical approach. For all rope operations (rappel, fast rope, rope ladder) stabilize over the correct spot, ensure correct altitude via the radar altimeter, and ensure a good hover reference is available. The pilot flying will give the command "ROPES ROPES ROPES" when ready for device deployment. The ROPES command from the pilot gives approval to the safety man (normally the FE) to deploy the team when conditions are safe. The safety man will always be up intercomm and in a position to observe the entire AIE operation. Because the deploying team is not wearing NVG's, the safety man is responsible for ensuring the ropes are on the ground, and that the surface below the helicopter is safe for the deployment. The safety man will deploy the team by yelling "GO."

5.4.3.4. The pilot flying must be the one who calls "ROPES, ROPES, ROPES." The safetyman (usually the FE) ensures the ropes are not deployed until the pilot calls for them.

5.4.3.5. If a pilot gives the command "ROPES, ROPES, ROPES" without stability, a good hover reference, or at the wrong hover altitude, serious injury could result to the deploying crewmember. During the hover, scanners must relay sufficient information to the pilot flying to ensure the ropes do not leave the ground and/or the aircraft is not drifting. Pilots who find themselves without good hover references should immediately tell the crew what is needed to acquire a good reference. If normal hover references are not readily available, it may be helpful to locate a fixed reference through the chin bubble, while continuing to monitor drift. Cross check the radar altimeter while hovering. To aid in maintaining a stable hover, incorporate in your cross check the Heads Down Display (HDD) hover symbology cues for altitude, velocity, and acceleration. Many pilots find it helpful to "plan" to terminate at a hover altitude approximately 5 feet higher than the requested hover height. As the aircraft rotates forward from an approach attitude to a hover attitude, it is common to lose 5 feet on the radar altimeter.

5.4.3.6. If the helicopter experiences an engine malfunction or other critical emergency during any AIE operation, deploying personnel should descend as rapidly as possible and move from beneath the helicopter. Normally personnel move right and the helicopter left (terrain permitting).

5.4.3.7. If the aircraft comes under fire during AIE or hoist operations and the pilot must maintain a hover, turn the tail toward the fire to expose the smallest area to the enemy while shielding the cabin and cockpit.

If a FE/PJ is available to return fire, the pilot may elect to turn the aircraft to bring the enemy into the field of fire. These maneuvers may require a very rapid pedal turn. As this turn is initiated, announce the intended movement to the crew. Crewmembers must immediately notify the pilot of obstacles prohibiting the turn. To enhance crew coordination, use standard terminology. The pilot states "right turn" and the right scanner should echo "clear right", after checking for obstacles. Employ this method in all flight phases instead of saying a more confusing phrases like "clear right, nose right/tail left, tail's coming left, etc.

5.4.3.7.1 The pilot must remember that large pedal turns will alter torque and power required to hover.

5.5. Rope Ladder Operations. A rope ladder is used to recover personnel from water or land. Ladder operations offer an alternative to hoist recovery. In the event of enemy fire, it is possible to fly out of the LZ with personnel on the ladder, however, the ladder may be unstable due to twisting and turning which could dislodge the personnel. Jettison the ladder, when required, by activating the emergency release handle, if so equipped, or by cutting the tiedown strap. The aircraft commander makes the decision to jettison the ladder, either at his command or as briefed.

5.5.1. In the event the ladder becomes entangled on the ground and aircraft control is questionable, release the ladder. Aircraft and personnel safety dictate the course of action to be taken.

5.5.2. In an emergency or if the aircraft comes under fire, personnel should secure themselves to the ladder so the aircraft can depart the immediate area. Accomplish slow forward flight to a safe area if flight characteristics and power requirements allow. Exercise caution during forward flight due to the twisting and turning of the ladder. Do not exceed 40 KIAS with personnel on the ladder.

5.5.3. When rope ladder retrieval is accomplished over water, it may be necessary for the team to position themselves along the wind line at approximately 25-foot intervals between team members to allow the pilot to hover taxi the aircraft for pickup. Hover taxiing at approximately 2 to 5 knots will reduce water spray and aid in a more rapid exfiltration of personnel. During high sea state extractions, particularly at night, the deployed team may group together in order to maintain contact with all team members. Altitude of the aircraft will depend upon ladder length. The safetyman monitors the ladder to ensure at least 2 steps are in the water prior to reaching the first member and advises the pilot of required altitude changes to maintain this altitude.

5.5.4. Inspection and Installation of Ladders. The flight crew is responsible for providing, inspecting, and rigging rope ladders.

5.5.4.1. When use of the ladder is anticipated, the following inspection will be performed during the aircraft preflight.

5.5.4.1.1. Check for oil or grease on the cabin floor.

5.5.4.1.2. Check applicable anchor fittings for security.

5.5.4.1.3. Check ladder for frayed cable and/or fabric.

5.5.4.1.4. Ensure all aluminum tubes are secure to the cable and/or fabric and check for cracks.

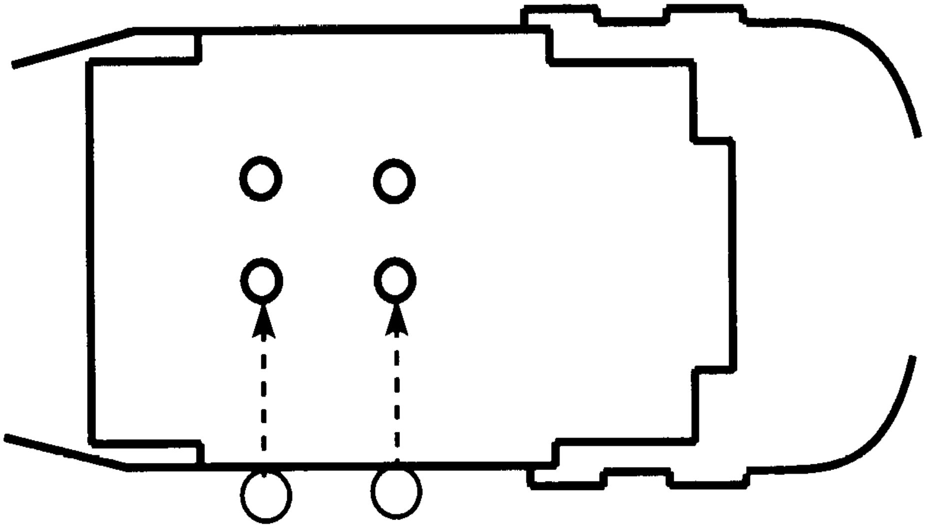
5.5.4.1.5. Check for any sharp pieces of metal or extending wires which may cause cuts or scratches.

5.5.4.1.6. For night operations, a chemlight will be attached to each side of the ladder at the first and fifth ladder tube from the bottom.

5.5.5. Installation. The ladders will be secured to the aircraft at the desired length. The ladder will be attached using steel locking carabiners at the location depicted in figure 5.1. On ladders manufactured prior to 25 March 96 it will be necessary to hook the carabiner through the snap hook's mounting eye. Ladder(s) will be rolled up and secured before flight.

5.5.5.1 Minimum steel locking carabiner specifications are: Load Rating of 5000 pounds and Gate Diameter of 7/16 to _ inches .

Figure 5.1 H-60 Rope Ladder Attaching Points.



ATTACH ROPE LADDER TO THE TIE-DOWN RING USING LOCKING STEEL CARABINERS.

5.6. Rappelling Operations. Helicopter rappelling is a rapid deployment procedure used when the helicopter cannot land. Rappelling is faster than hoist operations and reduces aircraft exposure in a tactical environment, however, it requires more specialized equipment and preparation than a fast rope. Rappels are useful when high hovers are required. Rappellers should be ready for deployment and the team leader should inspect all team members prior to the 5-minute warning. After the "ROPES, ROPES, ROPES" call is made and team members are on the ground, the FE/PJ should direct the pilot to descend approximately 5' to 10'. This ensures there is enough slack in the ropes to allow the team member to disconnect from the rope. Maintain altitude while any team members are handling the rope. A safetyman (normally the FE) monitors these activities. The safetyman relays communications, monitors the deployed ropes to ensure ground contact is maintained, and recovers or releases the ropes when rappelling is complete. If required for tactical employment, secure deploying personnel using alternate loading procedures.

5.6.1. Installation:

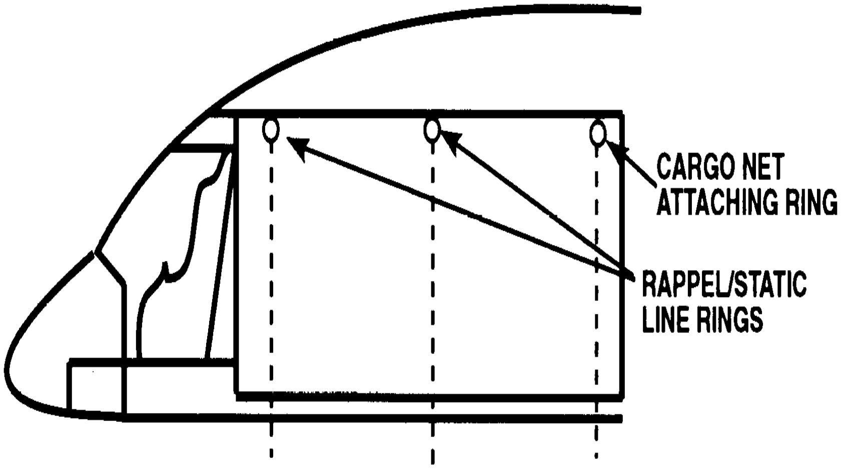
5.6.1.1. Aircraft seats will be removed from the center cargo compartment.

5.6.1.2. Cargo compartment doors will be placed in the locked-open position prior to final approach.

5.6.1.3. Pad or tape any sharp edges that could damage ropes.

5.6.1.4. The primary anchor points for the H-60 are the four cabin ceiling rappelling fittings. The upper cargo net attaching rings (Figure 5.2), may be used as anchor points, provided the overhead "I" cable is installed. When using the four cabin rappeling rings as the primary anchor point, a cargo net ring may be used as a secondary safety attachment point.

Figure 5.2. H-60 Rappel Anchors.



ATTACH RAPPEL ROPES TO THE RAPPEL/STATIC LINE RINGS AND TO THE CARGO NET ATTACHING RING USING LOCKING STEEL CARABINER AND A FIGURE EIGHT KNOT.

5.6.1.5. All ropes will be attached to the anchor points using locking steel carabiners.

5.6.2. Operating Procedures:

5.6.2.1. The safety man will monitor intercom and be secured with a crewman's harness.

5.6.2.2. Deploying personnel are responsible for aircraft rigging and proper hookup of rappelers. The deploying team is responsible for providing rappel ropes, harness, and rappel devices.

NOTE: The cargo hook door may be opened and the hook placed in the down position to provide a view of the rappelers during descent.

5.6.2.3. Once hooked to the rappelling equipment, personnel may release other restraints in preparation for the exit. On short final, personnel may position themselves to facilitate immediate deployment.

5.6.2.4. The safety man will confirm the deployment location and direct the rappelling when a hover is established.

5.6.2.5. Do not deploy ropes until the aircraft is in a stable hover over the intended deployment area.

5.6.2.6. As the aircraft comes to a hover, the pilot will give the command "ROPES, ROPES, ROPES." At this time, the safety man will relay the signal by yelling "ROPES" and pointing out the door.

WARNING: The safety man will ensure the ropes reach the ground prior to final positioning of rappelers for deployment. The safetyman will coordinate with the pilot to ensure the aircraft maintains a hover altitude keeping the ropes in contact with the ground.

NOTE: To facilitate rappelling through obstacles (i.e., trees), rappels may be accomplished using rappel bags which velcro to the lower leg of the rappeller. If this procedure is used, the rope must be at least 50 ft. longer than the intended deployment altitude (i.e., 150 foot rope to accomplish a 100 foot rappel). The rope will be secured to the inside of the rope bag using a figure eight knot to ensure the rappeller cannot come off the end of the rope.

5.6.2.7. The safetyman will release or retrieve the ropes after the last rappeller is off the rope. The safety man will ensure that personnel are clear before dropping ropes with caribiners. During training units may want to remove caribiners before dropping the ropes.

WARNING: Ropes will be released or retrieved prior to commencing forward flight to prevent possible entanglement.

5.6.3. Safety Procedures:

5.6.3.1. If the helicopter experiences an engine(s) failure or an aircraft emergency during rappelling, the rappelers on the rope will descend as rapidly as possible and move from beneath the helicopter.

5.6.3.2. If the helicopter gains altitude above the length of the rope, the rappeller will immediately brake and lock-in, and wait for the helicopter to descend to a safe rappelling altitude.

5.6.3.3. The V-blade knife or other similar tool should be readily available to use if the ropes need to be cut during aircraft emergencies or rope entanglement.

5.7. Fast Rope Operations. Use of the fast rope allows the rapid insertion of personnel, limiting aircraft and personnel exposure time. Fast ropes are typically used for hovers at 50' and below and do not provide the descent control of deploying personnel that rappels do. The flight engineer installs ropes and inspects attaching points. Normally, the deploying team is responsible for providing and inspecting the ropes.

5.7.1. With H-bars installed, it is possible to deploy personnel from each cabin door. If used, extend and pin the H-bar at or prior to the IP. At the 5-minute point, the safetyman disconnects the fast rope from its storage point and prepares it for deployment. Perform this by handing it to the first person out of the aircraft or setting it up on the edge of the door, ensuring it is back-coiled.

WARNING: *Rope must be coiled toe to head.*

WARNING: *If doing multiple deployments or landing on the deployment site, ensure the deployed individuals are cleared from below the aircraft prior to landing. This is especially critical during night deployments when injured personnel are difficult to see on the ground.*

5.7.2. Rope Installations. The ropes are interwoven hemp with a diameter of approximately 2 inches and a hookup point on one end. Lengths will vary, depending on the needs of the mission (terrain, tactical environment, user requirements, etc.). There are two different types of hookups. One rope is looped and braided back into itself. The second type has a sleeve slipped over the end with a bolt passing through the middle of the sleeve and rope. At the end of the sleeve is a metal ring on a swivel.

5.7.3. Cabin Configuration. The cabin is configured for the number of personnel and type of mission. Deploying personnel may be secured using alternate loading procedures.

5.7.4. Overhead Support Straps. The straps are cargo tiedown straps hooked to the overhead litter strap rings to help balance the deploying individuals.

5.7.5. Floor Straps. If seats are removed, rig according to appropriate alternate loading procedures.

5.7.6. Deployment Procedures. The following procedures are recommended for all operations. Any changes to these procedures will be thoroughly briefed prior to deployment.

NOTE: The team leader may require more than the minimum time calls. The team leader should be on intercom until the 5-minute call.

5.7.6.1. The rope may be attached to the H-bar before takeoff or any time during the flight, as the mission dictates. Checklist items not applicable to fast rope operations may be omitted.

5.7.6.2. The ropes will be secured to the floor with a cargo tiedown strap or seat belt during the flight prior to insertion.

5.7.6.3. At the "5-minute" call, team members will move to the front of the aircraft if deploying from the crew entrance door. The H-bar will be extended and pinned at or prior to the "5-minute" call. At this time, the safetyman will disconnect the fast rope from its storage point and prepare it for deployment. This may be performed by handing it to the first man out of each stick or setting it up on the edge of the door, ensuring it is back-coiled.

WARNING: Rope must be coiled toe to head.

5.7.6.4. At the "1-minute" call, all team members will move into position for deployment at the door.

5.7.6.5. As the aircraft comes to its hover, the pilot flying will give the command "ROPES, ROPES, ROPES". The fast rope will be deployed on the command "Ropes." The safety man will relay the signal by yelling "ROPES" and pointing out the door. When the command "ROPES" is given, and the ropes deployed, the safety man is authorized to clear the team to deploy after confirming the ropes are on the ground. No further commands are required from the pilot flying or aircraft commander.

5.7.6.6. PJs will not deploy wearing NVGs. During NVG operations the safetyman must ensure the team leader can see the appropriate hand signals.

5.7.6.7. As the last man touches the ground, the safetyman is cleared to release/retrieve the rope(s).

5.7.6.8. Fast rope release procedures. The safetyman may pull the rope back in or activate the quick release to drop it.

5.7.6.8.1. Fast Rope disconnect Precautions:

WARNING: Prior to rope release when using the rope with the sleeve and metal ring, ensure all personnel are cleared from below the aircraft.

WARNING: If doing multiple deployments or landing on the deployment site, all scanners should ensure the deployed individuals are cleared from below the aircraft prior to landing. This is especially critical during night deployments when injured personnel may be hard to see on the ground.

5.7.6.9. Night Deployments. Procedures remain the same. Chemlights are used to identify ropes and exits.

5.7.6.9.1. Three chemlights will be used on each fast rope. Two are taped at the bottom and one taped 10 feet from the bottom. The chemlight, 10 feet from the bottom, is to ensure at least 10 feet of rope are on the ground.

5.7.6.9.2. A vertical chemlight will be taped to the top of the rope where it is visible to deploying team members.

5.7.6.9.3. A chemlight may also be taped horizontally just above the crew entrance door in line with the rope.

5.7.7. Other Considerations:

5.7.7.1. Ensure communication cords are clear of pathways. Route them up the walls, along ceilings, and down from above to the safetymen. The team leader's cord should be only long enough for necessary movements.

5.7.7.2. Ensure gunner belts are clear of personnel and paths of travel.

5.7.8. Aircrew Procedures:

5.7.8.1. Normal checklist sequencing should be used prior to deployment.

5.7.8.2. Safety men should ensure the ropes have been back coiled on the floor in position for deployment. Both the ropes and employing personnel should be positioned and ready for deployment prior to the 1-minute call. Safety men will relay time calls to the personnel to be deployed.

5.7.8.3. On final, the pilot will maneuver the aircraft over the target, terminating in a hover. The type of maneuver flown will be dependent on the tactical environment. The aircraft should be in a stabilized hover with a maximum of 5 knots of forward ground speed, as required. The pilot flying the approach will ensure the aircraft is in position for deployment. The pilot will only call "ROPES" when he has ensured the aircraft is at the correct altitude and in a stabilized hover. The safety man will give the hand signal for rope deployment (a sweeping motion of the hand with the index finger extended toward the exit). The first man of each team will kick out the rope, and deploy after receiving clearance from the safety man.

5.7.8.4. Altitude trend information is essential and normal crew coordination procedures should be used to maintain a stable hover clear of obstacles.

WARNING: Altitude deviations while personnel are on the ropes will have an adverse effect on their braking ability and can cause serious injury. During the hover, the scanners must relay sufficient information to the pilots to ensure the ropes do not leave the ground during altitude deviations. The importance of a stabilized hover cannot be overemphasized.

NOTE: If a go-around is necessary, it should be initiated as soon as possible. Normal go-around procedures should be used; however, with an aft CG, the aircraft tends to pitch up when left turns are initiated below 60 KIAS. This causes no control problems, but should be anticipated if the turn is required.

NOTE: Since the pilot flying the aircraft is the only one who knows precisely when he will be rolling over the nose, he must be the one who calls "ROPES." The safetyman must ensure the ropes are not deployed until the pilot calls for them.

5.7.8.5. Scanners will advise the pilot when ropes are in and secured or released.

WARNING: It is essential the ropes are completely recovered or released prior to departing the hover.

5.8. Hoist Operations. The following procedures apply to both day and night operations. Hoist operations can be safely accomplished using aircraft lighting and/or NVGs. Use these procedures unless there is a conflict with the flight manual.

NOTE: In the event the hoist cable breaks, and if time and the situation permit, refer to the aircraft flight manual for information on hoist cable splice kit procedures.

5.8.1. Smoke Drop Pattern. Determination of wind direction and velocity is important to successful hoist operations. The navigation system, water, vegetation movement or smoke can all be used to determine wind direction and velocity. The most accurate of these methods is to observe smoke indications. If you decide to deploy a smoke generating device, do so on either the high or the low recon to confirm winds. Complete the smoke drop checklist and deploy the smoke device near the survivor. Deploy the device close enough to the survivor to give accurate wind information and, if possible, in an area visible from anywhere in the hoist pattern. Select a nonflammable target area for the smoke device.

5.8.2. Hoist Pattern. Complete the alternate insertion/extraction and the hoist operator's checklist prior to starting the final approach for the hoist recovery. If possible, establish a right-hand rectangular pattern with the final approach oriented into the wind. This aids in keeping the survivor in sight while preparing for the pickup. The pilot flying will keep the crew informed of the helicopters position the pattern. Likewise the hoist operator advises the pilot when ready to deploy smokes or accomplish the pickup.

5.8.3. Rescue Devices. The aircrew determines which device to use. A survivor unfamiliar with the rescue device should be assisted by a crewmember, briefed over a loud hailer, or provided printed instructions attached to the device to ensure proper entry and security for a safe pickup.

NOTE: Rescue devices used for hoist training will be identical to and configured the same as operational equipment. If live hoist training is to be conducted, only operational equipment will be used.

5.8.3.1. Forest Penetrator:

5.8.3.2. The description and maintenance instructions for the forest penetrator are found in TO 14S6-3-1 and TO 00-25-245, Section 4.

5.8.3.3. The forest penetrator can be used for single or multiple recoveries from land or water. It is recommended for recovering personnel whose parachutes have become entangled in trees. It allows assisting personnel use of both hands to aid the survivor.

5.8.3.4. Procedures:

5.8.3.4.1. Fold the seat paddles and stow safety straps before lowering the forest penetrator through trees or dense foliage.

5.8.3.4.2. If the hoist operator loses sight of the rescue device, the cable tension must be relied upon to detect when the penetrator has reached the ground. If it appears the penetrator has reached the ground, it should be raised several feet and lowered back to the surface to ensure it is not hung up.

5.8.3.4.3. When there is no communication with the survivor, the hoist operator will hold the hoist cable for survivor's signal. Jerks on the cable is the signal to start retrieval. Hoist retrievals from trees must be slow enough to allow survivors to fend off branches and prevent cable entanglement.

5.8.3.4.4. It may be possible for a crewmember on the penetrator to recover the survivor without unstrapping from the penetrator.

5.8.3.4.5. It is possible to recover three people at one time with the penetrator. This should only be done when time is critical since it may load the hoist to the limit.

5.8.3.4.6. If the crewmember leaves the penetrator to assist the survivor during a tree recovery, fold the seat paddles and stow the safety straps so they will not snag on obstructions if the helicopter moves or the hoist cable has to be retrieved.

5.8.3.4.7. For water recoveries, install the flotation collar prior to lowering the penetrator. Place at least one seat paddle in the down position and remove one safety strap from the stowed position. Do not unhook the safety strap fastener from the penetrator.

5.8.3.5. Stokes Litter:

5.8.3.5.1. Description. This device is constructed of wire mesh and lightweight steel tubing that holds a survivor immobile in a supine position. The sides of the litter protect the survivor from bumping against obstructions or the side of the helicopter during retrieval. The stokes litter will be configured with the sling, flotation devices, and three restraining belts when stowed on the aircraft. Construction, modification, inspection, and maintenance instructions for the stokes litter are contained in TO 00-75-5.

5.8.3.5.2. Applicability. The stokes litter should be used to immobilize the survivor. The stokes litter will be secured to helicopter prior to takeoff.

5.8.3.5.3. Procedures:

5.8.3.5.3.1. To lower the litter, place it outside the aircraft foot end first, then move it parallel to the side of the helicopter. The hoist operator may be required to lean out of the door to maneuver the litter.

NOTE: For water recoveries, the stokes litter may be deployed utilizing the low and slow deployment procedures (see this chapter, section D). This is the quickest means of deployment and subjects a critically injured survivor in the water to less exposure to rotor wash.

5.8.3.5.3.2. Lower the stokes litter to the survivor after the helicopter is established in a hover. The hoist operator provides enough slack so the crewmember can disconnect the hoist cable. It is not necessary to stay over the survivor once the litter is removed. After the survivor is secured in the litter and ready for hoisting, the crewmember reconnects the hoist cable ensuring the rescue hook safety pin and carabiner locking sleeves are properly positioned. When using the stokes litter, ensure the survivor is securely strapped in the litter prior to hoisting. For small patients, the belt can be routed directly across the patient. For large patients, the belt can be routed outside and over the top bar before securing patient to the litter.

WARNING: Immediate action must be taken to prevent hoist cable to aircraft contact when the rescue device is exhibiting a pendulum action and or/rotation.

WARNING: Do not place any part of your body between the hoist cable and aircraft while applying any pendulum action or rotation dampening techniques.

WARNING: Failure to use a tag line during stokes litter operation could result in uncontrollable litter rotation.

NOTE: Use extreme care when hoisting the stokes litter because of litter pendulum action and/or rotation. (Pendulum action is defined as a 2-dimensional movement of the cable (swing). Rotation refers to the normal rotation of the hoist hook on the hoist cable.) The pendulum action or rotation of the litter may increase to unmanageable proportions if they are not quickly stopped by the hoist operator. The pendulum action is dampened by first stopping the hoist cable up/down movement, then by moving the cable in the opposite direction of the swing. Litter rotation can be arrested by first stopping the hoist cable up/down movement, then by rotating the hoist cable in a small circle in the opposite direction of the rotation of the litter. Another technique, which is 100% effective in stopping all pendulum action and rotation, is to lower the rescue device to the surface. However, caution should be exercised when using this technique due to the effect on the survivors. In extreme emergencies, if litter rotation cannot be stopped by the hoist operator, the pilot can transition to forward flight at an airspeed of up to 40 knots to stop a swinging or rotating litter. The use of a tag line has proven to be 100% effective in preventing litter rotation and pendulum action of the hoist cable. The above techniques should also be used to dampen and control any pendulum action or rotation when the forest penetrator is attached.

NOTE: Installation of the snow shield on a stokes litter may result in uncontrollable rotation. Consideration should be given to the use of a tag line when the snow shield is installed.

5.8.3.5.3.3. Stop the litter just below the helicopter. Then maneuver the litter to align it parallel to the aircraft. At the same time, push the litter outward so that the basket does not contact the side of the helicopter. Litter maneuvering may require both hands. This maneuvering may be accomplished by using the litter cables.

5.8.3.5.3.4. When the stokes litter is parallel, raise the hoist to the full-up position so the litter is above the cabin floor level. Turn the litter perpendicular to the aircraft and pull it into the cabin head first. The pilot or another crewmember may have to provide cable slack at this point.

5.8.3.6. Rescue Net:

5.8.3.6.1. Description. The rescue net is constructed of stainless steel tube frame and 5/16-inch polypropylene netting. The net weighs approximately 20 pounds. A sea anchor drogue is provided to position and stabilize the net and allow for flight path corrections. The sea anchor drogue may be replaced by a 10-foot line with a 3- to 5-pound bag of shot for stability.

5.8.3.6.2. Applicability. The rescue net is particularly useful for recovery of personnel not familiar with the forest penetrator and/or stokes litter. Because entry is easier and more rapid for a survivor than a forest penetrator, it is perhaps the best device for recovery of survivors from frigid waters.

5.8.3.6.3. Procedures:

5.8.3.6.3.1. The rescue net may be lowered on final approach at airspeeds below 30 knots. While in forward flight for a water recovery, the 10-foot line may be allowed to contact the water prior to reaching the survivor. Lower the net to the water short of the survivor at an approximate ground speed of 3 to 5 knots.

5.8.3.6.3.2. Raise the net as soon as the survivor enters it. Do not wait for a signal from the survivor. As soon as the net clears the surface, the survivor is forced to his/her back and prevented from falling out.

5.8.3.6.3.3. An immobile survivor may be recovered in the same manner except a crewmember may have to ride down in the net to assist. A stable hover is required for this type pickup.

5.8.3.6.3.4. Due to the size of the net, remove the survivor from the net prior to bringing the net into the helicopter.

CAUTION: The rescue net must be held firmly against the helicopter while the survivor or crewmember departs the net.

5.8.3.7. Survivor's Sling (Horse Collar).

5.8.3.7.1. Description. The survivor's sling is a buoyant device consisting of a fiber filling encased in a brightly colored waterproof cover to facilitate high visibility during rescue operations. Webbing, weeved through the cover with both ends terminating in two v-rings, is used to attach the sling to the hoist hook. Two retainer straps, one long with a quick ejector snap, and one short with a v-ring, are provided for personnel security. Additional information on the survivor's sling is found in NAVAIR 13-1-1-6.5

5.8.3.7.2. Applicability. The survivor's sling is used by personnel performing rescue operations when it is impossible for the helicopter to land. The sling can be used to lower a rescuer, as well as raise a survivor over land or water.

5.8.3.7.3. Procedures. The procedures for the use of the survivor's sling are the same as those described for the Forest Penetrator with the exception of the obvious differences between the two devices. Up to three slings may be lifted at one time, not to exceed hoist weight limitations.

5.8.3.8. Hoist Operator. The primary hoist operator will be the flight engineer, however, any crewmember may be designated the rescue hoist operator as the mission dictates. Therefore, all crewmembers should understand these duties. The hoist operator's duties are to relay directional instructions on interphone and to operate the hoist from the cabin position leaving the pilot free to concentrate on hovering. When radio contact is not available, hand signals will be used between ground personnel and the recovery helicopter.

5.8.3.8.1. Ground the hoist prior to pickup to discharge static electricity to prevent personnel on the ground or water from sustaining a shock. To preclude ignition of fuel, do not ground the hoist near spilled fuel from damaged aircraft or vehicles.

5.8.3.8.2. Use caution during hoist operations; ensure cable slack is held to the minimum necessary to perform the recovery. Excessive slack can be especially dangerous during water recovery where the survivor cannot see the cable.

5.8.38.3. Notify the aircraft commander any time the hoist cable cannot be adequately monitored. In such cases, alternate methods of making the pickup should be considered or an additional crewmember should be used to help monitor the hoist cable.

5.8.3.8.4. Greater than normal oscillations may occur when the hoist cable is raised and lowered without some weight attached.

5.8.3.8.5. It is imperative that pendulum action or rotation of the rescue device be recognized and corrected immediately. Delay in doing so may produce oscillations or rotations of unmanageable proportions. The oscillations and/or rotations may reach a magnitude sufficient to cause hoist cable-to-aircraft contact.

5.8.3.8.6. The pendulum action may be dampened by moving the cable in the opposite direction of the movement of the rescue device. Rotation of the rescue device can be stopped, if detected early, by rotating the hoist cable in a 1- or 2-foot circle in the opposite direction of the rotation of the rescue device. The techniques used for the control of stokes litter oscillations are the same as any rescue device.

WARNING: Raising an oscillating load will only increase the oscillation. An oscillating load should be stopped where it is until the oscillation is stopped. Avoid trying to raise the load too quickly when oscillations are present. If the oscillation is severe, return the rescue device and/or survivor(s) to the ground or enter forward flight. Forward airspeed should be minimized until the cable can be fully retrieved.

5.8.3.8.7. Hoist Training should not be conducted with the hoist operator's interphone inoperative.

5.9. Water Operations. Water hoist recoveries may be accomplished day or night.

5.9.1. Lack of depth perception and possible disorientation in marginal weather require more precise smoke drop patterns and procedures.

CAUTION: Smooth water adversely effects depth perception.

5.9.2. The hover position for water hoist is directly over the survivor. However, once the rescue device is lowered to the water, the pilot flying may elect to move to a holding hover. Once the survivor is ready for hoisting, the pilot flying should establish the hover over the rescue device prior to hoisting the survivor out of the water.

5.9.3. Day Pattern (see Figures 5.3 and 5.4):

5.9.3.1. Complete alternate insertion/extraction briefing and hoist operator's checklist prior to final approach.

5.9.3.2. After initial sighting of the survivor, maneuver to a position approximately 100 feet downwind of the survivor from which an observation pass can be accomplished If the survivor's condition is unknown or swimmer deployment is anticipated, the observation pass will be made at a maximum of 10 feet AWL and 10 knots from zero to 90^o of the wind line to allow for swimmer deployment. In high sea states, consider use of AIE devices from a higher hover altitude to deploy swimmers. If swimmer deployment is not required, make the observation pass above translational lift at a minimum of 25 feet AWL.

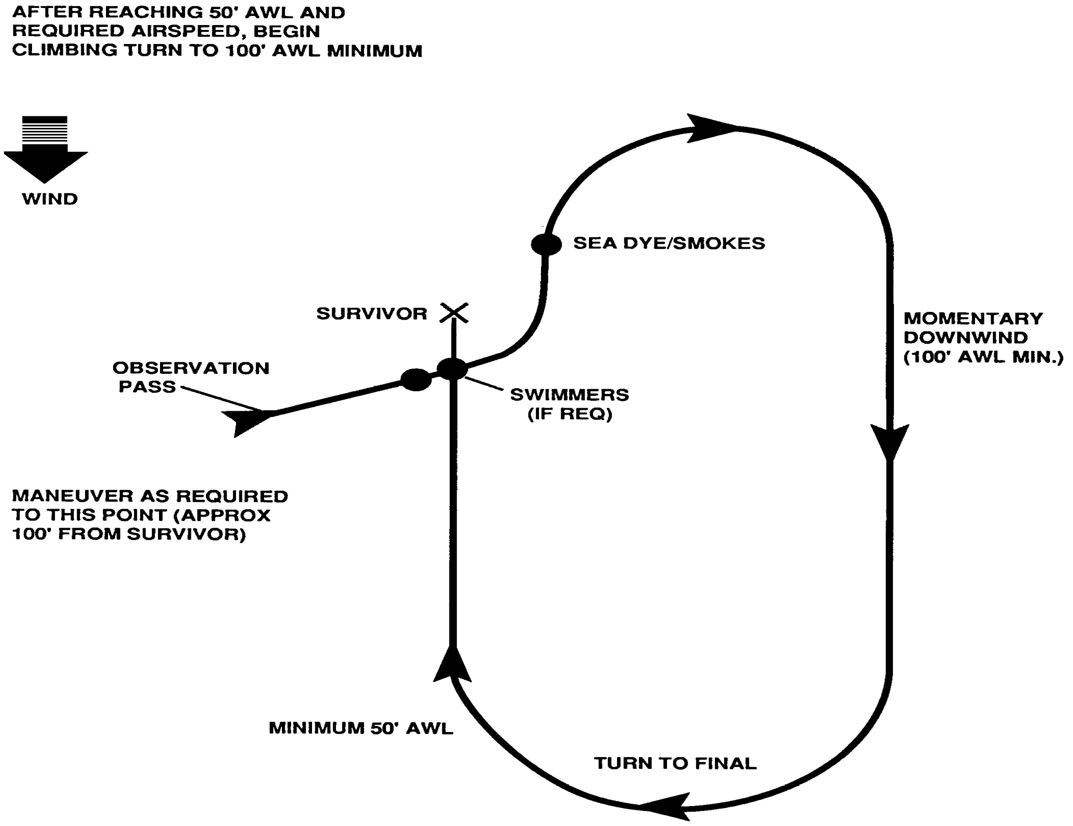
5.9.3.3. After the observation pass, initiate a climbing right turn at 50 feet AWL to a 100 feet AWL minimum downwind altitude. Deploy sea dye or smoke markers as directed by the pilot flying. If OGE power is not available, a minimum of 50 KIAS and 50 feet AWL is required prior to initiating the climbing turn to downwind. With OGE power, start the turn at a minimum of translation lift airspeed and 50 feet AWL. Use sea dye instead of smoke markers to avoid detection during combat or when an oil or fuel spill is near the survivor. In high sea states or high winds, use of more than one sea dye is recommended. During combat water training at locations that prohibit use of a sea dye marker, aircrews may use a smoke marker as a hover reference. If use of sea dye or smoke markers is prohibited or not required proceed without them.

5.9.3.3.1. TO 1H-60(U)A-1 states that a TGT increase of 30^0 to 40^0 for the same torque represents a maximum that can be accepted without complete loss of stall margin. A good technique for monitoring this increase is to check TGTs during pattern down wind. To accomplish this, prior to descending from pattern altitude record the TGT for both engines at a torque setting that maintains downwind altitude and airspeed. On subsequent patterns, reset the same torque setting that was used to record the first TGT reading and note that TGT. Compare the new TGT reading to the first one and when the difference approaches 30^0 discontinue water operations.

5.9.3.4. Roll out on downwind and then continue turn to final. Do not descend below 50 feet AWL until established on final. If the survivor is not ready for immediate pickup, tactical situation permitting, establish a holding hover approximately 75 feet downwind of the survivor.

5.9.3.5. On final, descend to hover altitude and slow to approximately 5 knots forward hover speed 75 feet downwind from the survivor. If the helicopter instrument panel interferes with forward visibility, the final approach may be displaced to the side.

Figure 5.3. Example Water Hoist Pattern.



1. Deploy swimmers 10-30 yards downwind from survivor.
2. Deploy sea dye 10-30 yards from survivor.
3. Do not deploy sea dye directly upwind from survivor.
4. Maintain 50 KIAS minimum during climbing turn and downwind if OGE power is not available.

5.9.3.6. If the survivor appears to be injured and is attached to the parachute, hover at an adequate distance to prevent the rotor wash from billowing the parachute and dragging the injured survivor.

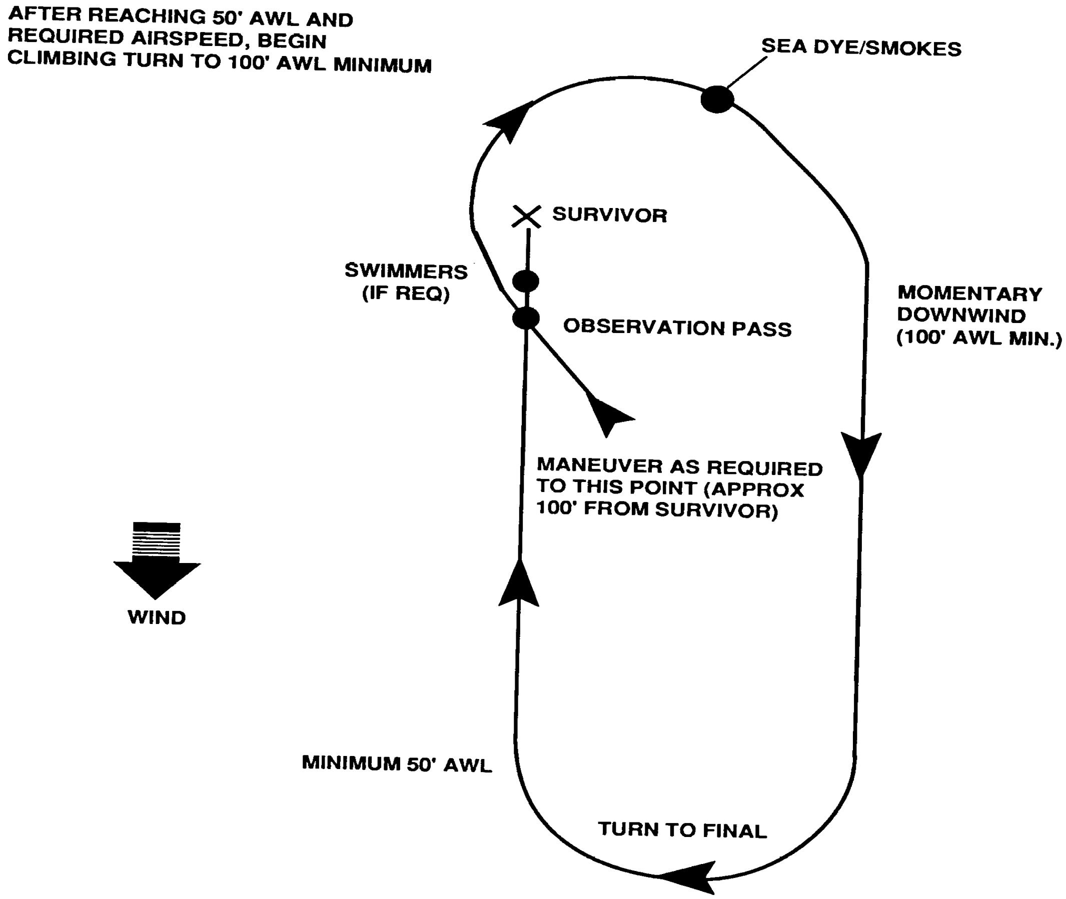
5.9.3.7. The pilot flying must not attempt to watch the pickup as spatial disorientation may result. Pilot vertigo can become a problem during hoist recovery. Use the attitude indicator as an additional reference in conjunction with the dye and smoke markers.

5.9.3.8. Beware of the tendency to drift backwards while hovering over water. This may result in a loss of relative wind and loss of lift causing the helicopter to descend. If allowed to continue, sufficient power may not be available to recover.

5.9.3.9. Water Hoist Precautionary Measures. Anti-exposure suits should be worn by crew members on any preplanned overwater flight when the water temperature ranges between 60° F (15.5° C) and 51° F (10.5° C), and the local air temperature is 70° F (21.2° C) or less. See MCI 11-HH60G Vol 3 for specific guidance on anti-exposure suits.

5.9.3.9.1. Anti-exposure suits are not required when only the approach and departure is flown overwater.

Figure 5.4. Example Water Hoist Pattern (Most Common).



1. Deploy swimmers 10-30 yards downwind from survivor.
2. Deploy sea dye 10-30 yards from survivor.
3. Do not deploy sea dye directly upwind from survivor.
4. Maintain 50 KIAS minimum during climbing turn and downwind if OGE power is not available.

5.9.4. Inert Survivor Recovery. Hoisting procedures for the recovery of an unconscious or inert survivor from water or land areas are as follows:

5.9.4.1. The hoist operator determines if the victim is unconscious or unable to enter the rescue device. If the survivor cannot get on the hoist without assistance, a crewmember may lowered.

5.9.4.2. The hoist operator ensures the crewmember being lowered is properly equipped and the equipment is properly adjusted.

5.9.5. Voice Procedures. The hoist operator directs the pilot flying over the survivor or hover point using standard terminology. Instructions should be clear and concise with commentary on the progress of the approach and hover operation. The hoist operator can aid the pilot flying with airspeed control during the approach by describing the reduction of distance, in a numerical sequence, from a given point from the survivor to a hover point over the survivor. The frequency of numerical calls made should indicate the speed of the helicopter toward the survivor or closure rate. A closure rate is not necessarily given in a preset distance of feet, yards, or meters, but is normally associated with one of them. An example would be "survivor at twelve for one hundred, seventy five, fifty, forty, etc.." The faster the call, the more rapid the closure. Five, four, three, two, one, stop." If too fast and the helicopter cannot be safely slowed down in time, do not hesitate to call a "go around." Standardized terminology for directions and motion may be added to better describe actions necessary for safe operation; i.e., "Slow forward, turn right, stop back." See the following examples:

5.9.6. Tag Line. The tag line aids the pilot by reducing the time required to hover without a reference and prevents pendulum or spinning motion caused by rotor wash during hoisting. It may be used to guide the rescue device or survivor to or from confined areas, such as ships, trees, or canyon areas.

5.9.6.1. A weight should be attached to the end of the tag line without the weak link. The other end of the tag line may be fastened to either the hoist hook small eye or the rescue device. Snap the tag line to the hoist hook or the hoisting device by the weak link, just before the device goes out the door.

5.9.6.2. Deliver the tag line from a hover while using extreme care to avoid fouling the line in the rotor system.

5.9.6.2.1. To deliver the tag line to a small vessel, establish a hover short of the vessel and lower the tag line to the water, and then raise it approximately 5 feet above the water. The hoist operator will then direct the pilot flying to the vessel.

5.9.6.2.2. To deliver the tag line to a large vessel with a restricted pickup area, the tag line should be lowered after the helicopter is in a hover over the vessel.

5.9.6.3. The pilot flying normally loses sight of the vessel during deployment of a tag line and has to rely entirely on the hoist operator for position information.

5.9.6.4. Once the tag line is on the vessel and the boat crew is tending it, the hoist operator directs the pilot flying clear of the vessel while paying out slack in the tag line. The tag line weak link will be attached to the rescue device. When the pilot flying can again see the vessel, the hoist operator begins to lower the hoist.

5.9.6.5. Shipboard personnel use the tag line to guide the rescue device into the desired location.

5.9.6.6. When the rescue device is on the vessel's deck and the survivor is ready for hoisting, the hoist operator gives directions to position the helicopter back over the deck. Retrieving the rescue device vertically may not always be possible. Be aware of this and be prepared to recover the rescue device at an angle. However, when conditions permit, always recover the rescue device vertically. As soon as the survivor is clear of the deck and all obstructions, the hoist operator clears the helicopter away from the vessel, usually left but sometimes back. Maintain this position until the survivor is in the cabin and the tag line is either retrieved or discarded, and the crewmember has reported ready for forward flight.

5.9.6.7. The tag line may be used in lieu of the hoist cable to lower small items to a boat. The item to be lowered will be attached to the snap link with a weight. Use the same procedure as previous for delivery of the tag line to small and large vessels. The weak link end of the tag line will be attached to a cabin tiedown ring.

5.9.7. Hoist Safety Procedures.

5.9.7.1. Throughout the entire recovery phase, the pilot not flying/flight engineer monitors the flight instruments and advises the pilot flying when reaching the altitudes, airspeeds, and rates of descent prescribed. When in a hover, the pilot not flying cross-references the attitude indicator and the reference marker. If the pilot flying becomes disoriented, initiate an instrument takeoff or direct the other pilot to assume control of the aircraft.

5.9.7.2. Monitor the hoist mechanism to ensure proper cable feedout and retrieval. Crew briefings prior to hoisting will include positive actions to be taken in the event of equipment malfunctions or impending failures, such as overheating, oil seepage, unusual cable vibrations, etc. During training missions, terminate live hoisting immediately at the first indication of equipment malfunction. If possible, return the individual to the surface by lowering the aircraft. For actual SAR missions, existing circumstances will dictate actions to be taken. The hoist operator will advise the pilot not flying to check hoist power sources and hoist controls, and request another crewmember to operate the hoist, if necessary.

5.9.7.3. Exercise caution during hovering operations to preclude anchoring the helicopter hoist hook or cable around an immovable object. The hook and cable should be kept in view at all times to prevent the cable from becoming entangled with ground objects. If the hook or cable should become fouled, attempt to free it by playing out slack and manipulating the hoist. Use caution when applying tension to the cable. If the cable should break, cable whiplash action can cause rotor damage.

5.9.7.4. The hoist operator will wear a heavy, work-type glove on the hand used to guide the hoist cable and have the helmet visor down (visor down is not required when wearing NVGs).

5.9.7.5. When pulling the survivor into the helicopter, the easiest method is to turn the survivor's back to the helicopter and pull in. This procedure reduces the possibility of semiconscious or injured survivor fighting the hoist operator.

5.9.7.6. To prevent dropping the rescue device, use the hoist hook safety/retaining pin. ***EXCEPTION:*** When raising or lowering an empty stokes litter for water recoveries, the use of the safety/retaining pin is not required. This makes it easier to remove the litter from the hoist cable. Install the safety/retaining pin prior to hoisting the litter with a survivor.

5.9.7.7. If a loss of engine power is experienced while hoisting, continue to hoist the person into the helicopter or attempt to lower the person to the surface, whichever is most feasible. It may be necessary to cut the cable. Should an inadvertent landing occur, make every attempt to clear personnel on the ground, but primary consideration must be given to maneuvering to a clear area so a safe landing can be made.

5.9.7.8. Interphone Failure. If interphone failure occurs between the pilot flying and hoist operator and cannot be remedied by changing interphone cords, have the copilot or another crewmember relay the hoist operator signals to the pilot flying. The hoist operator gives directions by moving an open hand with the palm turned in the desired direction of movement. To hold position, clench the fist. The hoist operator can direct use of the hoist control or indicate hoist operation by extending the thumb of a clenched fist either up, down, in or out, as applicable. To indicate "survivor in and secure, and ready for takeoff," point in the direction of intended takeoff.

5.9.7.9. During live hoist training and/or exercises, personnel should wear goggles and helmet when riding the hoist. The aircrew or PROTEC-type helmet may be used.

CAUTION: *Smooth water adversely affects depth perception.*

5.10. NVG Water Operations.

5.10.1. Cockpit Preparation. Place green or blue chemlights on exits, emergency exit handles, windshield wiper switch, and hoist master power switch.

5.10.2. AIE Equipment Preparation.

Fast Rope	Place red chemlights at top, bottom, and 10' from bottom
Hoist	Place red chemlights on bottom of paddles, 2 bands around suspension ring
Rope Ladder	Place red chemlights on each side of 1st and 5th tube from the bottom
Stokes	Place two red chemlights on head, one on foot, and one band around ring.

5.10.3. Pattern Preparation. Prepare a chemlight star, (5 or more lights), which is used to simulate the survivor during training, and enough individual lights for each pattern. Red or IR lights are normally used, however, swimmers can't see IR lights. If they drift out of the pattern be ready to deploy another pattern over them.

5.10.4. Purpose Of The Chemlight Lane. The object of deploying the chemlight lane is to give the crew a reference for approach and hover. The lane normally consists of at least three sets of three lights on each side of the survivor. Use additional chemlights as sea state and team size dictate. Deploy the chemlight lane in a manner which allows references for the entire aircrew. One good technique is to deploy the lane so the first set of chemlights are abeam the survivor. Actual position of the lane may vary, however, keep in mind chemlights too far off the nose are not useful hover references. Initially fly directly over the survivor and mark the survivor's position using the navigation system. Then align the chemlight lane into the wind unless an overriding safety of flight condition requires otherwise. Setting the desired approach course in the HSI course window aids in flying a precise pattern. Fly towards the survivor/star on the desired approach course at 100' AWL and 50 KIAS. Have one of the pilots give the required "throw" calls approximately two seconds apart. It is best to give the crew a countdown for deploying the chemlights. A five second countdown using "five, four, three, two, one, throw, ready, throw, ready, throw," will aid in a well-defined lane. On each throw call both scanners deploy the chemlights directly out the scanner's windows parallel to the rotor disk.

5.10.5. Terminal Operations. Fly oval "race track" patterns during terminal operations. Consider setting the pilot's low bug at 80% of the lowest altitude you intend to use on any given pattern. Turn on VAWS. Any time the low altitude warning sounds correct the situation by pulling collective until the warning goes off. Night water operations requires a strict cross-check of visual and instrument cues. As weather conditions deteriorate (visibility, illumination) instrument cues become more important. Try to stay close to the pattern so the scanners can keep sight of the survivor. Make the turn from downwind to final when the #1 needle and/or scanner calls the lane at 4 to 5 o'clock (as winds increase extend the upwind and turn from downwind earlier). Make a normal to shallow approach to a position near or over the lane that allows you to perform the desired AIE. The actual performance of AIE's at night over water is the same as in the day with the exception of fewer visual references.

5.10.6. Common Mistakes.

5.10.6.1 Altitude control in turns or during the lane deployment.

5.10.6.2 Using the copilot's low bug. VAWS warnings only work off the pilots low bug.

5.10.6.3 Leaving on the searchlight or landing light will "wash" out the NVG's.

5.10.6.4 Flying too long a final, or too wide a pattern in a low illumination situation. This can cause you to lose sight of the lane.

5.10.7. Equipment. The following equipment is recommended for NVG water operations:

5.10.7.1. Chemlites.

5.10.7.2. Electrical component tiedown strap.

5.10.8.   Chemlite Preparation:

5.10.8.1. The chemlite "star" is a group of five chemlites tied together through the eyelets. The loop should be 0.75 to 1.25 inches in diameter to enable the chemlites to lay in a star pattern in the water. A larger loop should not be used, as it will allow the chemlites to clump together and reduce the quality of the pattern as a source of illumination.

5.10.9. Equipment Preparation.

5.10.9.1. Fast Rope Preparation. The equipment is prepared by taping one chemlite to the top of the fast rope. The purpose of the chemlite is to enable personnel not on NVGs to identify the location of the fast rope. Tape two chemlites at the water end and another 10 feet from the water. The fast rope is then attached in standard fashion.

5.10.9.2. Hoist preparation. The forest penetrator is prepared by taping one 12-hour red light stick to the bottom of each unfolded paddle. Two 7.5-inch flexible bands may be looped through the suspension ring down and around the black rubber bumper.

5.10.9.3. Stokes litter preparation. The stokes litter is prepared by taping two chemlites to the head and one chemlite to the foot. One flexible band may be looped through the attachment ring.

5.10.9.4. Rope ladder preparation. The rope ladder is prepared by placing a chemlight on each side of the rope ladder at the first and fifth tube from the bottom of the ladder. Ensure the chemlite extends beyond the sides of the rope ladder to ensure the ladder is visible from 360^o.

5.10.10. Pattern. Once in the desired area for insertion/extraction, fly the full pattern as shown in Figures 5.6. and 5.7. To fly the pattern, enter into the wind at 100 feet above water level (AWL). Maintain 100 feet AWL and 50 knots indicated airspeed (KIAS) through the insertion/extraction zone.

5.10.10.1. Deploy a chemlite star to indicate the beginning of the insertion or extraction zone. In the case where there is no flare, strobe, or other locating device, this will ensure the insertion or extraction zone can be reacquired.

5.10.10.2. One second after entering the insertion/extraction zone, the pilot not flying will make a minimum of three "throw" calls approximately 2 seconds apart. At each call, the left and right scanners will each throw a group of three chemlites as hard as possible on a path parallel to the surface of the water.

5.10.10.3. At the end of the insertion/extraction zone make a turn to downwind. Do not exceed 30° bank angle.

5.10.10.4. For subsequent patterns, obtain 50 KIAS/50 feet AWL prior to turning downwind if OGE power is not available. With OGE power, start the turn at a minimum of translational lift and 50 feet AWL.

NOTE: With the exception of terminal operations, the minimum altitude for NVG water operations will be 100 feet AWL.

5.10.11. Fast rope final: Descend to fast rope altitude while decelerating to deployment speed. Deploy the fast rope at the pilot's command. Once personnel are deployed, start a slow climb to allow release/recovery of the fast rope.

NOTE: At the request of the deploying team, a slow forward movement of the aircraft may be accomplished.

5.10.12. Low and slow final: Once on final, descend to approximately 10 feet AWL and approximately to 10 KIAS when entering the insertion zone. When stable, deploy personnel then climb to cruise altitude. In high sea states, consider use of AIE devices from a higher hover altitude to deploy swimmers.

5.10.13. Rope ladder final: Once on final, descend to the desired altitude and at the pilot's command deploy the rope ladder. While passing through the extraction zone, guide the rope ladder to the personnel in the water. Slowing to a hover momentarily may be required to enable personnel to climb onto the rope ladder. Once personnel are on board recover the ladder and climb out to cruise altitude.

5.10.14. Recovery Phase. Pilots must devote full attention to altitude control and power settings during the transition from the approach to the hover phase.

Figure 5.5. NVG Water Ops Pattern (Side View).

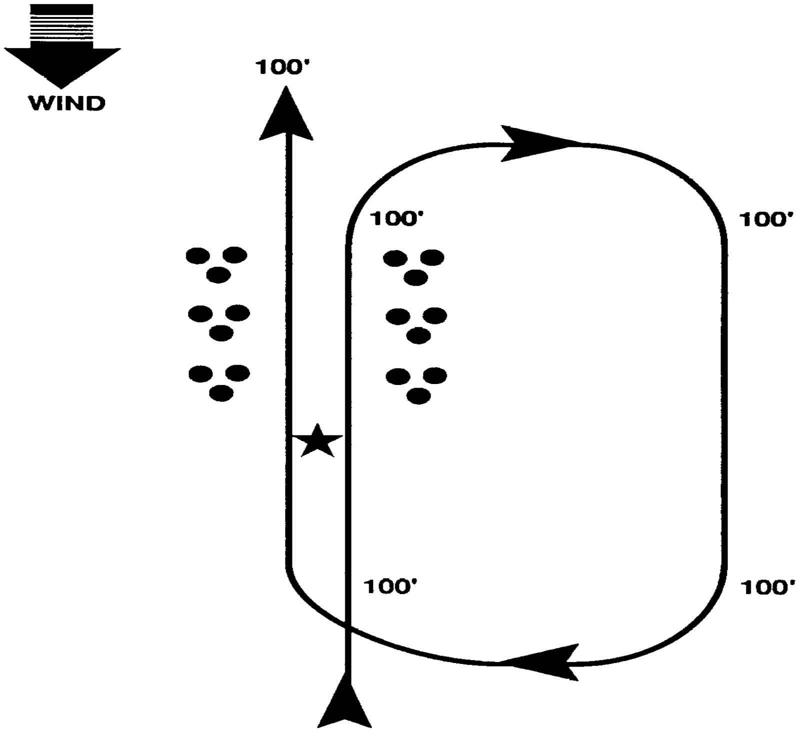
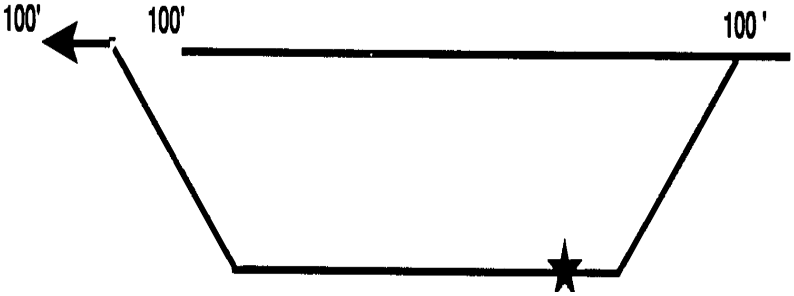


Figure 5.6. NVG Water Ops Pattern (Top View).

1. Deploy lightstick groups a minimum of two seconds apart.
2. All altitudes shown are minimums.
3. For subsequent patterns, obtain 50 KIAS/50 ft AWL prior to turning downwind if OGE power is not available. With OGE power, start the turn at a minimum of translational lift and 50 ft AWL.



5.10.14.1. Prior to losing sight of the survivor, direct the hoist operator to "Go Hot Mike."

5.10.14.2. The hoist operator should shift visual references from the water to the horizon at frequent intervals to prevent spatial disorientation.

5.10.14.3. When the survivor is in the rescue device and ready, the hoist operator gives instructions to position the helicopter over the survivor and takes up any slack in the cable. Normally, the hoist operator will raise the survivor; however, he may request the pilot to "raise helicopter." The hoist operator will keep the pilot informed of the survivor's position.

5.10.14.4. When the survivor is in the cabin, complete the after pickup checklist.

5.10.14.5. A raft approached very slowly will be blown along slowly in advance of the rotor wash. As a raft is approached, do not excessively slow the closing speed, but move smoothly toward and directly over the raft. Hovering over small boats may present the same drift difficulties as a raft. Personnel supported by life jackets present no drift problem.

5.10.15. Safety Considerations.

5.10.15.1. Be aware of the tendency to drift backwards while hovering over water. This results in a loss of relative wind and loss of lift causing the helicopter to descend. If allowed to continue, sufficient power may not be available to stop the rate of descent.

5.10.15.2. With winds less than 10 knots it is possible for the left position light to illuminate the water spray thus restricting your vision of the chemlight lane. This is most prevalent during low and slow deployments and rope ladder recoveries. If this occurs, consider placing position lights to IR.

5.10.15.3. As the water spray approaches the cockpit have the pilot not flying prepare to turn on the wipers. Winds and hover altitude determine if/when the wipers are necessary.

5.10.15.4. In marginal power situations consider turning off engine anti-ice and cabin heater to enhance safety.

5.10.15.5. In calm winds consider turning off windshield anti-ice to keep the salt spray from glazing the windshield.

5.10.15.6. The pilot not flying should place his hand underneath the collective to be ready to pull power in the event of a descent during all phases of NVG water operations.

5.10.16. Flight Engineer Duties.

5.10.16.1. In the pattern, keep the survivor in sight and continually update the crew as to the survivor's position.

5.10.16.2. Advise the crew as to the position of the water spray.

5.10.16.3. Provide hover directions to the pilot.

5.10.17. Signals From PJ To Helo. For successful night water extractions, prebrief PJ to helicopter signals that indicate ready for pickup and for immediate emergency extraction. PJs should twirl a red chemlight on a two foot string in indicate ready for pickup. PJs should turn on their strobe without the night filter to indicate ready for immediate emergency pickup. Once it is evident the helicopter is on approach they should turn the strobe off to prevent the aircrew's night vision goggles from shutting down.

5.11. Hoisting From Vessels. This section describes general techniques and procedures for hoisting from water vessels.

5.11.1. Predeparture. Upon notification of a mission, try to find out what type of vessel is involved. Usually, you can find a picture of the vessel in either "Lloyds of London Registry Book" or "Janes Fighting Ships". This information may provide you with useful for the best location on the ship to conduct a hoist operation.

5.11.1.1. Estimate the amount of time you will operate over the vessel. The common tendency is to underestimate the time required for the pick-up. A good estimate for fuel planning purposes is one hour. Be advised it usually takes more time to recover a survivor in a stokes litter than using any other hoisting device.

5.11.1.2. Determine if a translator is required. A translator may be required if the vessel is from a non-English speaking country. Because of space limitations on the HH-60G, send the translator on the HC-130, when practical.

5.11.2. Enroute. If the mission will require air refueling, plan to refuel early in order to check and verify both the HC-130 and HH-60G refueling systems.

5.11.2.1. If time permits, send the tanker ahead to perform the following functions: ascertain the condition of the survivor, relay the HH-60's ETA to the crew of the vessel so they can prepare the survivor for hoisting, and have the crew of the vessel lower all antennas and secure loose equipment thus clearing an area for hover operations.

5.11.2.2. Compute your power required for the operation. Consider using OGE + 10% to provide an acceptable safety margin. Hovering over a vessel in high sea states can require more power than a stable OGE hover over land due to significant required collective inputs.

5.11.3. Arrival and Pickup. Immediately upon arrival at the vessel, perform observation passes paying special attention to obstacles that cannot be stowed. If the pickup occurs during darkness, you will probably have to get the vessel to turn off its lights. Ships captains are usually hesitant to turn off their navigation lights so you may have to specifically request them to do so.

5.11.3.1. Based on the survivors' condition, you must decide whether or not to deploy a PJ and what type of rescue device to use. If the survivor is injured and requires a stokes litter, a PJ is normally required. If the survivor is not hurt, then a horse collar/forest penetrator with a floatation collar may be adequate.

5.11.3.2. After you have evaluated and looked the vessel over, determine the best place to perform the extraction. Remember, the primary objective is to have the vessel turn to a heading which will provide the helicopter a relative headwind while conducting the desired maneuver over the required location on the vessel. Also, use care for turbulence caused by wind disruption around the vessel's superstructure and temperature increases from ship exhaust. If you are in communication with the vessel's crew (either directly or via the HC-130), have the vessel turn to the optimal heading based upon the pickup position shown below. The normal vessel's speed for all of these maneuvers (except dead in the water) is clutch speed (vessel's minimum speed) to 10 knots. The following are possible hover positions with respect to the vessel:

5.11.3.2.1. Position #1; pilot side stern pickup. Have the vessel turn 35° to 45° right of the wind line.

5.11.3.2.2. Position #2; copilot side stern pickup. This is the same as position #1, except have the vessel turn 35° to 45° left of the wind line.

5.11.3.2.3. Position #3; pilot side bow pickup. Have the vessel turn 215 to 225 degrees right of the wind line.

NOTE: *The helicopter's ground track during this maneuver will actually be rearwards.*

5.11.3.2.4. Position #4; copilot side bow pickup. This is the same as Position #3, except have the vessel turn 135° to 145° right of the wind line.

5.11.3.2.5. Position #5; mid-ship pickup. This pickup should only be used if both the bow and the stern are not suitable for pickup. Hovering over the center of the vessel results in fewer hover references and results in an increased possibility of contact with the ship. Actual headings may vary, however, the ideal situation is to have the vessel turn 35° to 45° right of the wind line.

5.11.3.2.6. Position #6; dead-in-the-water. This is the most difficult of all the pickups because there is no control over which way the vessel is moving. If seas are rough, the vessel may pitch violently. Operations can be facilitated by using the following maneuver, called a buttonhook maneuver. Hover directly downwind of the vessel. To avoid "pushing" the vessel, swiftly hover over the ship while lowering the tag line. As the tag line becomes draped across the deck, crew members on the vessel should be able to recover it. Move the helicopter back and to the left/right so the pilot flying can use the vessel as a hover reference. Once the vessel's crew has the tag line, minimize the time actually spent over the vessel since you will have limited hover references and your rotorwash will be pushing the vessel around.

5.11.3.3. If you are going to deploy a PJ to expedite the recovery, have him take a radio so you can communicate. This will allow you to depart the hover operation and conserve fuel. If more than one PJ is required to stabilize/handle the patient and you have two helicopters on station, consider deploying one PJ from each aircraft. That will leave each aircraft with an adequate crew and provides two PJs to work the patient.

5.12. Pyrotechnics. This chapter covers the preparation and manual launch of pyrotechnics. TO 11A10-24-7, TO 11A10-26-7, TO 11A8-5-7, TO 11A8-2-1, and TO 11A10-25-7 contain the technical data on pyrotechnics, and AFMAN 91-201 contains mandatory explosive safety standards. Eye protection and/or visor will be worn when deploying all pyrotechnics.

WARNING: Prior to arming pyrotechnics inflight, a door will be open to permit emergency jettisoning.

5.12.1. Parachute Flares.

5.12.1.1. The LUU-4/B is a 1.6 million candlepower flare which is activated by a 30-pound pull on a lanyard during launch from an aircraft. The flare descends approximately 1,500 feet while burning. Approximate burn time is 3 minutes. Because the pyrotechnic candle consumes the flare case, the parachute may tend to hover during the last minute of burning time. Approximately 10 to 20 seconds prior to candle burnout, the heat of the burning illuminate activates the cable fitting explosive bolt, releasing a parachute shroud line and collapsing the parachute, allowing the flare to fall quickly to the ground, clearing the air of debris.

5.12.1.2. Use parachute flares to illuminate areas of operation. C-130s may deploy parachute flares in support of helicopter operations using the patterns shown in Figures 12.1 or 12.2 or other alternate patterns. If parachute flares are to be deployed, ensure a face-to-face briefing with he deploying crew is conducted so each aircrew is familiar with where the other will be. The flare aircraft must establish precise patterns prior to committing the recovery helicopter into the target area.

5.12.1.3. Obtain wind direction and velocity from the most reliable source. Constantly monitor the winds throughout the operation to preclude a wind shift from drifting the flares into the recovery helicopter. If flares are to be used over land or over flammable areas, ensure they are launched at a sufficient height to allow for burnout prior to impact.

5.12.1.4. The flare aircraft should drop 2 flares on each pass, one immediately after the other, to assure continued illumination in the event of a dud. On training flights, one flare may be dropped with another readily available for immediate deployment.

5.12.1.5. Upon locating the target, the recovery helicopter will establish the pattern direction (left or right) into the wind. The flare aircraft will establish a pattern which will keep the pattern of the recovery helicopter clear of descending flares. Normally, the flare aircraft will fly a right-hand pattern and the recovery helicopter will fly a left-hand pattern.

5.12.1.6. The recovery helicopter will advise the flare ship, as necessary, on corrected drop heading and timing to ensure sufficient illumination during the hoist recovery; i.e., "Correct 5 degrees left and time to drop of 18 seconds."

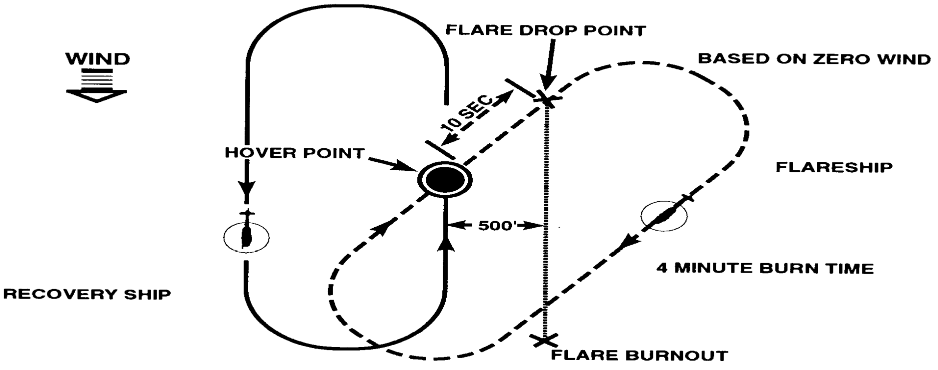
5.12.2. AN-MK 6, MOD 3; Aircraft Smoke and Illumination Signal.

5.12.2.1. Use. This signal provides long-burning surface smoke and illumination for day or night use. It is used to mark sightings at sea, make sea evaluations, mark sea lanes for night water landings, or wind drift determination prior to deploying personnel. It may be used to provide smoke on land surfaces if a fire hazard does not exist. Burn time is 40 minutes (approximately).

5.12.2.2. Operation. Prior to launching the signal, remove the adhesive tape covering the pull ring.

Figure 5.7 Flare Drop Pattern.

FLARE DROP PATTERN



	DROP HEADING AND TIME	70 KIAS	90 KIAS
AVERAGE W/VEL	HEADING CORRECTION	TIME/SEC	TIME/SEC
0	045°	10	10
5	020°	20	15
10	015°	40	30
15	010°	60	45
20	008°	90	70
25	006°	120	90
30	004°	180	120

NOTE: 90 KIAS RECOMMENDED FOR WINDS OVER 15 KNOTS

NOTE: Do not remove the 4 square patches of adhesive tape covering the metal caps in the holes from which flame and smoke issue after ignition of the candle. When the signal is launched, actuate the pull-type igniter, either by hand or by a lanyard. This signal may be deployed from altitudes up to 5,000 feet AGL.

WARNING: The illumination and smoke signal must be launched immediately after the igniter has been actuated.

5.12.2.3. Special Precautions. Do not use a static line or lanyard to actuate the smoke signal when used for wind determination prior to personnel deployment.

5.12.3. MK 25, MOD 3; Marine Location Marker.

5.12.3.1. Use. This marker was designed for day or night use for any and all sea surface reference point marking purposes which call for smoke and flame in the 10 to 20 minute range.

5.12.3.2. Operation. To activate the marker, rotate the base plate from the safe to the armed position to allow the battery cavity ports to be opened. Open the ports by pressing the 2 brass colored port plugs into the battery cavity. This device is considered to be a sealed unit until its base plugs(one or both) have been pushed in. For use in fresh water, open only one port and pour in approximately one tablespoon of dry table salt (crushed salt tablets may be used). To preclude needless waste of flares, do not push in the brass plugs until committed for deployment.

WARNING: Do not return armed markers to storage.

WARNING: When required, retrieve the expended flare from the water with asbestos gloves and place the burned end down in a metal container filled with water. Transport flares to a point where EOD can receive them. The bucket, water, and flares must be transported as a unit. Do not pour out the water as it may be contaminated with phosphorous capable of spontaneous reignition.

CAUTION: Use only dry salt.

5.12.4. MK 25, MOD 4.

5.12.4.1. Use. The MK 25, MOD 4 is designed to be launched from aircraft to provide day or night reference points. The marker is suitable for any type of sea-surface reference-point marking that calls for both smoke and flame for a period of approximately 15 minutes.

5.12.4.2. Description. When the marker is launched, sea water enters the battery cavity and serves as an electrolyte causing the MK 72 battery to produce current which activates the MK 13 squib. The squib ignites the starter composition which in turn, ignites the red phosphorus pyrotechnic candle. Gas buildup forces the valve assembly from the chimney in the nose and yellow flame and white smoke are emitted. Burning time ranges from 13.5 to 18.5 minutes.

5.12.4.3. Operation. Remove the marker from the shipping container and inspect for damage of any kind. Dented, corroded, or otherwise damaged markers shall not be used. Remove the protective cover by rotating (unthreading) counterclockwise. Fully depress (0.3 inch, using 18 pounds of force) arming cap and remove. Throw the marker into the water. The marker contains a pyrotechnic scuttle element and 3 .013 diameter flood holes to assure that the marker will scuttle and sink within 3 to 12 hours after water impact or one to 3 hours after ignition.

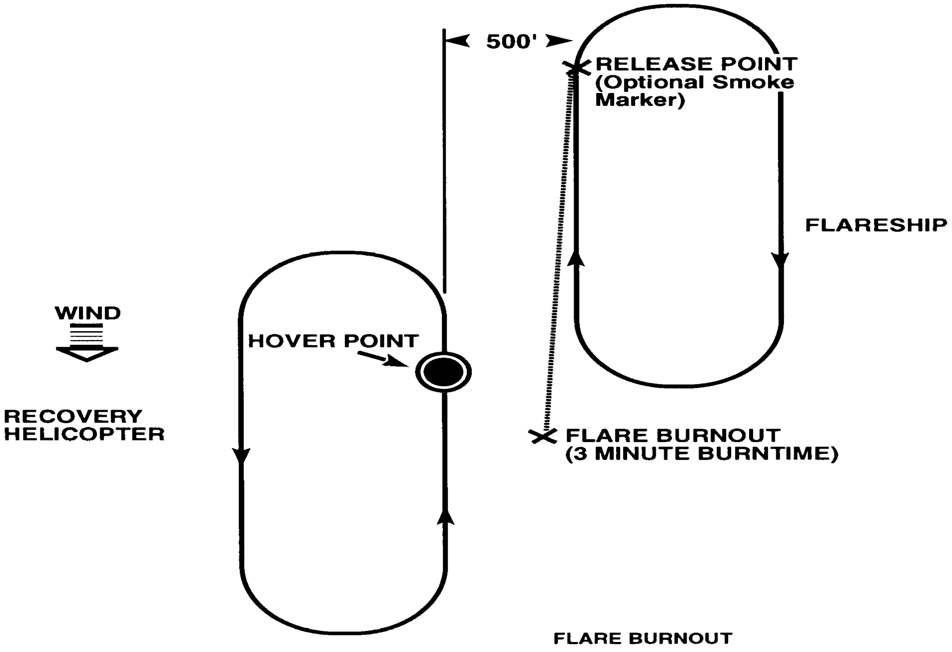
WARNING: To avoid possible injury, personnel should stay clear of the end of the marker containing the nose valve. Nose valve ejection can spontaneously occur due to internal pressure from hydrogen generation.

WARNING: This marker contains more than 26 ounces of red phosphorus which burns to produce high temperature, flame and abundant smoke which is a caustic irritant to the skin and mucous linings of the nose and throat.

5.12.5. AN-MK 59; Marine Location Marker.

5.12.5.1. Use. This marker is designed to produce a reference point on the ocean's surface in the form of a fluorescent green dye slick. It is used to mark sightings or as a signal in search and rescue operations. Dye persists for approximately 2 hours.

Figure 5.8 Alternate Flare Drop Pattern.



5.12.5.2. Operation. Open the cardboard container and remove the barrier line and completely open the end of the barrier bag overpack. When ready for deployment, invert the bag and allow the dye bag to free-fall from the protective bag. Upon striking the surface, the plastic bag ruptures, releasing the dye.

NOTE: Due to the fragile nature of the plastic bag containing the dye, it should be left in the barrier bag until deployment.

5.12.6. AN-MK 13/124, MOD 0; Marine Smoke and Illumination Signal:

5.12.6.1. Use. This signal is a combination distress signal for use under day or night conditions. It may be used to signal search aircraft and to indicate wind direction. Smoke or flame time is approximately 20 seconds for each end.

5.12.6.2. Operation. Determine which end of the signal to use. (Orange smoke for day and flare for night.) The flare end of the tube can be identified by a series of embossed projections extending around the case approximately one-fourth-inch below the closure. Remove the cap and give a quick pull on pull ring which will come away from the can, thereby igniting the composition.

NOTE: If unable to remove the soldered cap in this manner, bring the pull ring down over the rim of the can and press down using the ring as a lever to break the seal. Hold the signal at arm's length at an angle of about 30 degrees upward to prevent hot drippings. The Signal may be restored to its original packing after cooling and retained for use of the opposite end.

5.12.6.3. Special Precaution. Never attempt to ignite both ends of the signal at the same time.

5.12.7. AN-MK 8; Smoke Grenade (White, HC Hexachloroethane).

5.12.7.1. Use. This smoke grenade is used for daytime ground and ground-to-air signaling of search aircraft to indicate wind direction or for prearranged visual communications. Smoke time is approximately 3 minutes.

5.12.7.2. Operation. To launch, grasp the signal firmly in one hand holding the safety lever firmly against the grenade body while the cotter pin is removed and until the grenade is launched.

5.12.7.3. Special Precautions. Do not remove the safety cotter pin from the firing mechanism unless the smoke is held properly and is ready for launching. The grenade-type firing mechanism must be held so as to assure the safety lever is secure against the body of the smoke until it is launched. Only a small movement of the release lever is required to free the striker igniting a 1.2 to 2-second delay element of the fuse.

WARNING: Do not remove the safety pin until just prior to deployment. Once prepared for use, the smoke must be expended.

5.12.8. MK 18; Smoke Grenade (Red, Green, Yellow, or Violet). This grenade is used for the same purpose as the AN-MK 8. Its operation and precautions for handling are identical. Smoke time is approximately 1 minute.

5.13. Personnel Parachute Delivery Operations. Helicopter parachute operations have no mission or tactical application. Parachute operations from helicopters are conducted solely to provide a jump platform for qualified military parachutist who must maintain currency in personnel parachute operations.

5.13.1. Mission Briefing. A thorough briefing will be given by the aircraft commander. All aircrew members and the jumpmaster will attend. Ensure a passenger briefing is given. In addition, cover the use of restraining devices, exits, and movement in cargo compartment.

5.13.2. Personnel Parachute Drop Zone Markings.

5.13.2.1. Placement and markings for both night and day drops will be as outlined in FM 31-20, USREDCOMM 10-3, ACCI 11-PJ Vol 3, and this regulation. Command emphasis must be focused to ensure the DZ controllers and aircrews are fully coordinated on markings used, configuration on the DZ, method of identification and/or authentication, and release point.

5.13.2.2. For training or exercise missions, a "Regular L" is normally used. The helicopter flies up the base of the "L" and the jumpers exit when abeam the flanker panels. When using this marking system, the helicopter does not normally fly the 50-meter offset.

5.13.3. DZ Identification/Authentication.

5.13.3.1. Surface-to-Air:

5.13.3.1.1. The primary method of confirming DZ identification is by radio contact or the display of a specified target marker during the scheduled time block. (Example: 2 minutes prior to, 2 minutes after a scheduled (TOT) and oriented to the approach azimuth and/or track at the specified geographical location may serve as DZ identification and authentication.)

5.13.3.1.2. An additional code light or smoke signal may be used for identification/authentication.

5.13.3.1.3. All authentication requirements indicated on the mission request must be met or the drop will be aborted.

5.13.3.2. Air-to-Surface. The aircraft identified or authenticated by arriving in the objective area within the specified time frame on the designated approach azimuth and/or track.

5.13.4. Personnel Parachute Delivery Abort Procedures. When conditions are not safe for the drop or if the drop is aborted for any reason, the following procedures will apply: The term "abort" will be used to alert the crew of an aborted deployment. A crewmember will display a closed fist to personnel not on intercom. Do not attempt to stop a jumper who has already initiated exit.

5.13.5. Wind Limitations for Personnel Parachute Delivery. Wind limits will be prebriefed to the aircraft commander by the jumpmaster.

5.13.6. Personnel Parachute Delivery Positions. Sitting on floor at edge of cargo doors. From either/both sides (if only one side is used, it should be the side opposite the tail rotor).

NOTE: On the H-60, to keep the static line from becoming entangled, all excess static line will be restowed in the jumper's parachute static line retaining bands.

5.13.7. Aircraft Preparations.

5.13.7.1. The anchor line/jump strap will be connected through the tiedown rings as depicted in Figure 5.10.

5.13.7.2. During preflight, the crew will ensure the following actions are accomplished: all protruding objects and sharp edges in the vicinity of the exit doors must be removed or taped, the anchor line cable/jump strap is secure, a seat belt is provided for each parachutist, a safety harness is provided for the aircrew safetyman and jumpmaster, and troop seats will be configured to avoid damage or entanglement.

NOTE: The flight engineer does not normally perform safetyman duties, however, he will assist the jumpmaster as required.

5.13.8. Delivery Procedures.

5.13.8.1. Head directly toward the target, regardless of the wind direction.

5.13.8.2. Release the spotter chute/streamer directly over the target (if required).

5.13.8.3. Immediately upon release, turn to observe descent and position of spotter chute/streamer.

5.13.8.4. Establish rectangular drop pattern oriented so the final approach will be aligned with the spotter chute and/or streamer and the target, respectively.

5.13.8.5. Turn on approach. Make minor changes in heading to pass over the spotter chute and the target on a direct line. Aircraft drift correction should be established prior to passing over the spotter chute.

5.13.8.6. Initiate uniform count over the spotter chute and/or streamer.

5.13.8.7. Reverse count over the target.

5.13.8.8. Deploy the second spotter chute and/or streamer (if required) or parachutist when the last digit in reverse count is reached.

5.13.8.9. After the jumper clears the aircraft the flight engineer states, "jumper away". When the flight engineer retrieves the static line and deployment bag he states "clear to turn". The purpose of the turn is to maintain visual on the jumper.

5.13.9. Communications.

5.13.9.1. Air-to-Surface. Radio contact with the DZ is normally required. This requirement is waived if: lost radio procedures are prebriefed, red smoke grenades or flares are available to the DZ control party, or marker panels and DZ markers are visible to the pilot or jumpmaster when inbound to the DZ.

NOTE: Lost radio procedures are not authorized for night jumps.

5.13.9.2. Aircrew Communication Procedures:

5.13.9.2.1. Voice terminology. The accuracy of a personnel delivery mission depends on the coordination between crewmembers. The pilot will normally give 10-minute, 5-minute, and 1-minute warnings prior to reaching the drop zone. The pilot will call 1 minute prior to drop and will acknowledge "clear to drop" after he receives the response "safetyman check completed." The final decision whether or not to jump rests with the aircraft commander. The jumpmaster will acknowledge all calls from the pilot. The jumpmaster provides heading corrections on final approach using the following standard terminology:

5.13.9.2.1.1. "Steady." Present course is satisfactory.

5.13.9.2.1.2. "Right." Change direction to the right 5 degrees.

5.13.9.2.1.3. "Left." Change direction to the left 5 degrees.

5.13.9.2.1.4. "Right/left degrees." Change direction as indicated. This direction is utilized to direct changes in excess of 5 degrees.

5.13.9.2.1.5. "Abort." Abort call will be made for unsafe or unknown conditions or unsatisfactory positioning over target.

5.13.9.2.1.6. "Jumper away, clear to turn." The pilot is clear to turn and begin the next pass or observe the results of the drop just accomplished. The safetyman retrieves all deployment bags prior to issuing a clearance to turn.

5.13.9.2.1.7. Special considerations. To inform the pilot of the location of the spotter chute, streamer, or jumper, use clock positions relative to the last final flown; i.e.; "The spotter chute landed at the 12 o'clock position, 100 yards away."

5.13.10. Hand signals. When off intercom, the jumpmaster will use the following hand signals to relay course corrections through the safetyman. Hand signals will be briefed prior to flight.

5.13.10.1. Thumb left/right indicates 5 degree corrections.

5.13.10.2. Straight ahead is indicated by a vertical "slicing" motion parallel to the longitudinal axis of the aircraft, hand held perpendicular to the floor.

5.13.10.3. Abort jump or lost target is indicated by clinching the fist and placing it in front of the first jumper for an aborted jump.

5.13.11. Personnel Parachute Delivery Emergency Procedures. The jumpmaster and/or safetyman notifies the pilot that a parachutist is being towed. The jumpmaster/safetyman recovers and stores all other deployed static lines and deployment bags. The pilot slowly descends to the DZ or other appropriate site and brings the aircraft to a hover. The jumpmaster/safetyman unhooks the towed parachutist's static line, deplanes, and detaches the towed parachutist. Avoid flying over land if jumper is scuba equipped.

WARNING: An unconscious jumper will not be lowered into the water.

Figure 5.9. H-60 Anchor Line Cable.

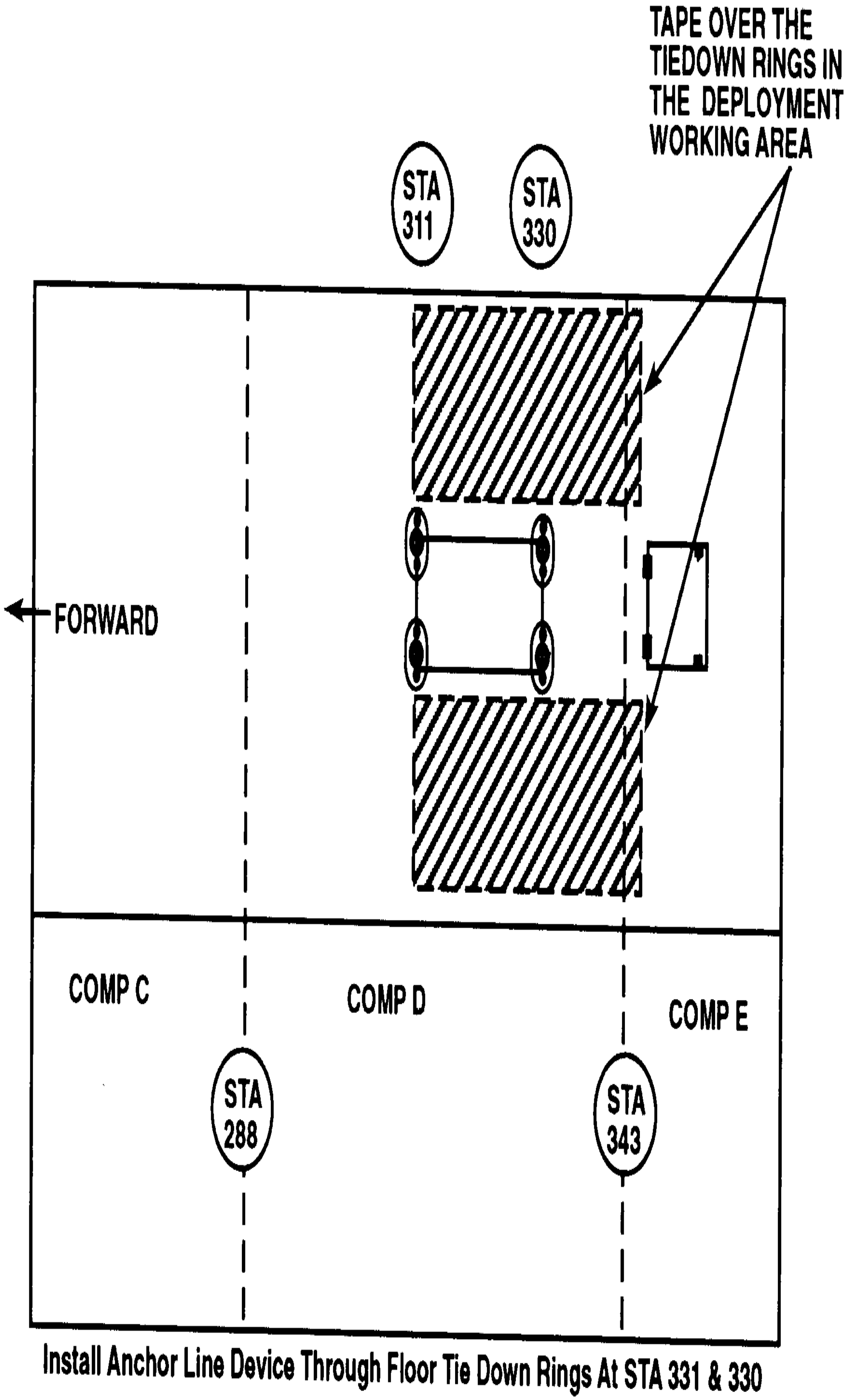
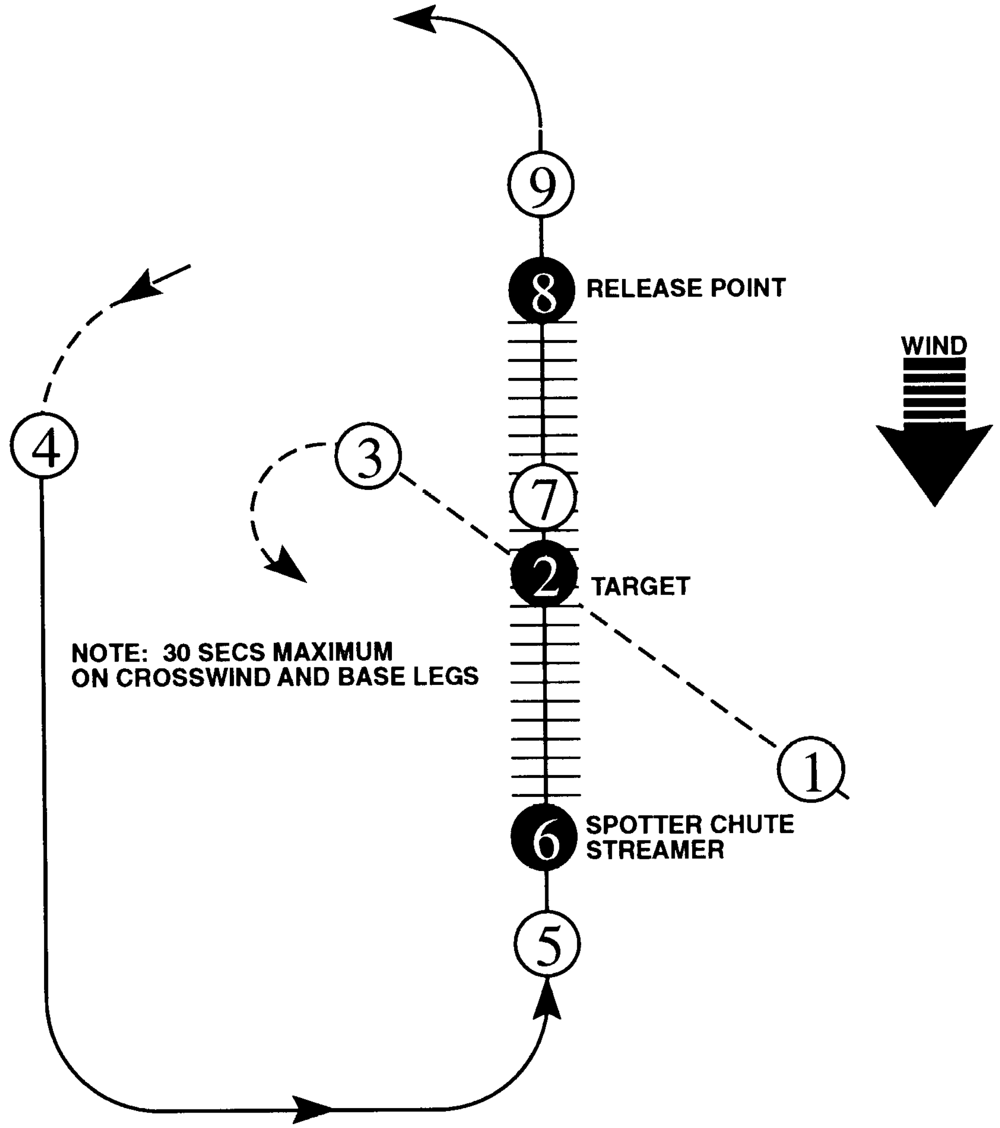
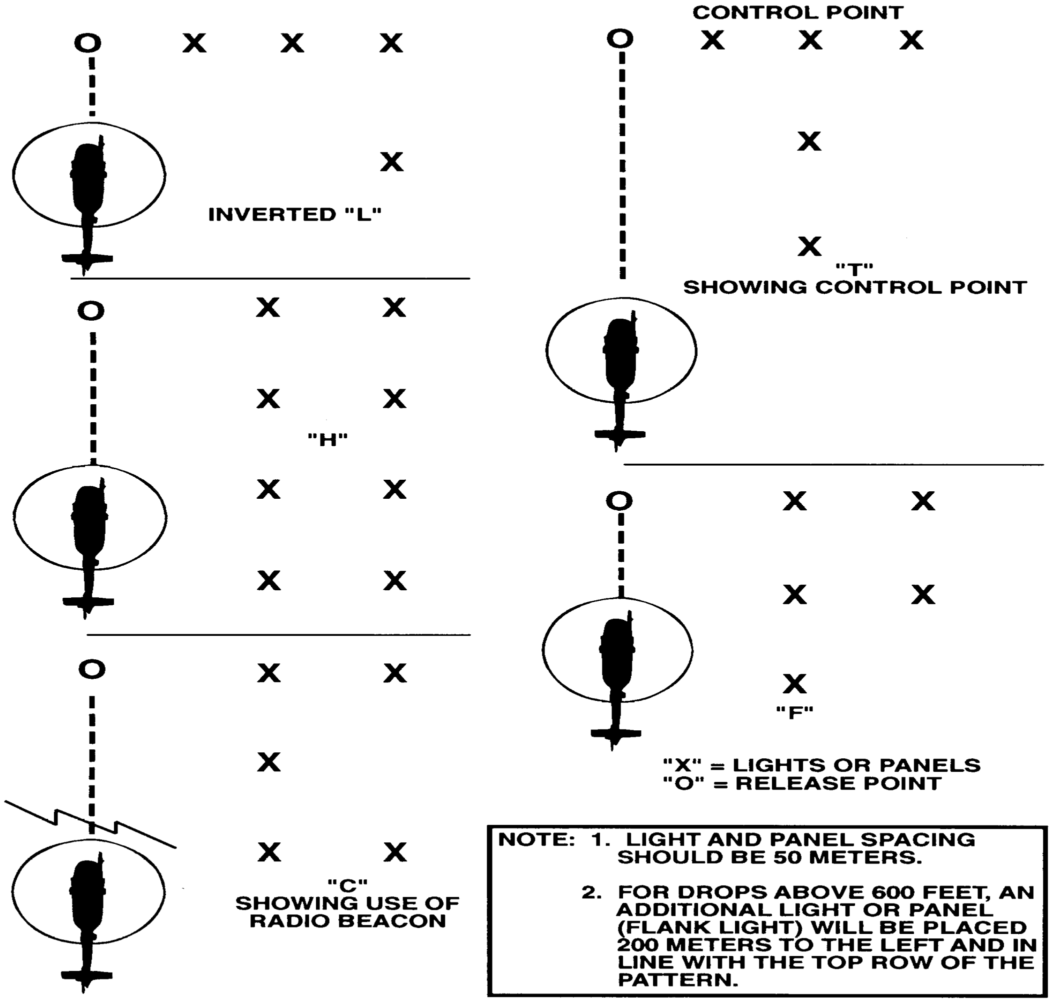


Figure 5.10 Non-Tactical Spotting and Personnel Parachute Delivery



1. Head directly toward the target, regardless of the wind direction.
2. Release the spotter chute/streamer directly over the target (if required).
3. Immediately upon release, make left/right turn to observe descent and position of spotter chute/streamer.
4. Establish rectangular drop pattern oriented so that the final approach will be aligned with the spotter chute/streamer.
5. Turn on approach. Make minor changes in heading to pass over the spotter chute and the target on a direct line. Aircraft drift correction should be established prior to passing over the spotter chute.
6. Initiate uniform count over the spotter chute/streamer.
7. Reverse count over the target.
8. Deploy the second spotter chute/streamer (if required) or parachutist when the last digit in the reverse count is reached.
9. After the jumper clears the aircraft and the flight engineer states; "Jumper away, clear to turn", turn to observe the accuracy of the drop.

Figure 5.11. DZ Markings.



NOTE: 1. LIGHT AND PANEL SPACING SHOULD BE 50 METERS.

2. FOR DROPS ABOVE 600 FEET, AN ADDITIONAL LIGHT OR PANEL (FLANK LIGHT) WILL BE PLACED 200 METERS TO THE LEFT AND IN LINE WITH THE TOP ROW OF THE PATTERN.

5.14. Free-Fall Swimmer Deployment Operations. This maneuver provides an effective method of delivering a swimmer (s) near a target or objective area. Free-fall swimmer deployment may be utilized by all DOD forces.

5.14.1. Determine the wind direction prior to personnel delivery. Some objectives can drift up to 10% of the wind velocity. Usually, personnel deliveries should be made down drift of the objective. When mission circumstances warrant, deliver swimmers up or off wind.

5.14.2. Make an approach into the wind at approximately 10 feet AWL and 10 knots.

5.14.3. Deployment Procedures:

5.14.3.1 Safety man positioning should be forward of the deploying team, and the team may exit from either/both cabin doors. Deployment may be from the standing or sitting position.

5.14.3.2. Safety considerations during final approach:

5.14.3.2.1. The team leader should be in a position to view the objective area at approximately 50 feet AWL.

5.14.3.2.2. All deploying exits will be open at 50 feet AWL and below. Deploying personnel will be secured until established on final approach.

5.14.3.2.3. The "thumbs up" from the safetyman to the deploying team on final indicates 10 feet AWL and 10 knots is confirmed, and the team is cleared to deploy at the team leader's discretion.

WARNING: The safetyman will ensure the departing team members have removed their restraining device(s) prior to deployment.

5.14.3.2.4. It is recommended all rescue hoist checklists be completed in the event an injury occurs to the departing team. An immediate extraction may be required.

5.14.3.2.5. The team leader will brief equipment delivery procedures.

5.14.3.2.6. The safetyman will ensure adequate gear/airframe clearance exists during deployments.

5.14.3.2.7. Deploying team members should show a "thumbs up" signal after water entry. This indicates they are "OK" and have not sustained injuries.

5.15. Swimmer Recovery Procedures. Hoist recovery procedures in this chapter apply for all water hoist recoveries. An alternative method of recovery is by rope ladder. Procedures listed in this chapter concerning rope ladder operations apply to water operations. Ensure the rope ladder is grounded in the water prior to reaching the first swimmer.

5.16. Life Raft Delivery (non-emergency).

5.16.1. Preparing the raft for drop:

5.16.1.1. Remove the raft inflation D-ring from its pocket and leave the pocket unsnapped. Install a chemlight on the D-ring during night operations.

5.16.1.2. Securely tie a 14-inch piece of MIL-T-5661-C web tape through the D-ring to form an approximate 5-inch loop.

5.16.1.3. Secure raft in forward section of cabin. Attach a 10-foot lanyard to a tiedown ring located by the cargo door. Attach the other end to the 5-inch loop of web tape.

5.16.1.4. Snap the carrying handles together beneath the raft.

5.16.1.5. Chemlights will be attached to the raft at night prior to deployment.

5.16.2. Delivery Procedures:

5.16.2.1. Use a smoke device on all life raft drops to assist in determining the exact wind direction and a drop reference (if required).

5.16.2.2. Use normal traffic pattern airspeeds/altitudes.

5.16.2.3. Make a shallow approach in order to establish level flight at 40 knots and 75 feet altitude on final. Two crewmembers work together, one to monitor the survivor and one to signal the other crewmember to deploy the raft when directly over the survivor. Delay the drop 1 second for every 5 knots of wind over 10 knots. After dropping the raft, call "raft away" and immediately recover the lanyard.

Table 5.3. Free-Fall Drop Ballistic Data Chart.

FREE-FALL DROP BALLISTICS DATA CHART						
Ground Speed (Knots)	**120**	**110**	**100**	**90**	**80**	**70**
Vertical Distance (Feet)	**Horizontal Distance (Feet)**					
600	228	210	191	173	155	137
540	217	199	182	164	146	128
480	205	189	172	155	138	121
420	193	177	161	147	131	115
360	179	164	150	135	120	105
300	163	150	137	123	109	95
240	147	135	123	111	99	87
180	128	117	107	96	87	77
120	105	96	88	79	70	61
60	74	68	62	56	50	44

5.16.3 Safety Procedures:

5.16.3.1. When scanning or conducting life raft deployments, all personnel will wear the safety harnesses to preclude accidental exit from the helicopter.

5.16.3.2. A V-blade knife should be available to cut the raft if it should become entangled.

5.16.3.3. Do not hold the 10-foot lanyard after the raft is dropped.

Chapter 6

AIR REFUELING

6.1. Purpose. This chapter is intended to provide techniques for performing air refueling safely and IAW applicable directives. It is not intended to replace the procedural guidance contained in TO 1-1C-1 and TO 1-1C-1-20, but to augment the information in these technical orders.

6.2. Planning. Deciding where to perform the air refueling is critical to a successful mission. If an air refueling track is not already established in your AOR work with the tanker crew to design a track which meets mission requirements while considering threats and tanker/helicopter capabilities. Be sure to coordinate the track with the theater airspace managers to aid in deconfliction. If air threats are a possibility to the tanker consider requesting dedicated CAP to provide coverage. This would be considered go/ no-go if tanking is required for the success of the mission.

6.2.1. Profile of an Air Refueling Track. For training, an air refueling track is usually planned along a TACAN/VORTAC radial with a predetermined length (defined by DME). Most likely, the air refueling track at your operational squadron will take you back and forth along a relatively short track. In a tactical environment, the track may be established between geographic land marks, geographic coordinates, TACAN DME positions, or any combination of the these points.

6.2.2. Combat AR. During possible threat encounters/hostilities the methods, techniques, etc. of establishing AR tracks, ARIP's, AREP's, etc. may be prosecuted as the situation dictates.

6.3. Air Refueling Checklist Sequencing:

6.3.1. Rendezvous Checklist. This checklist should be completed prior to reaching the ARIP. Don't wait until the last minute to run the Rendezvous checklist. Initiating this checklist 10 to 15 minutes prior to reaching the ARIP will allow time to troubleshoot any problems with the probe or other equipment prior to the refueling operation..

6.3.2. Joinup Checklist. This checklist should be completed prior to the tanker reaching 1/2 nautical mile in trail. Joinup altitude and airspeed should be established by the ARIP. Beginning the checklist at the ARIP works well.

6.3.3. Pre-contact Checklist. This checklist should be completed prior to making a contact. The best technique is to complete this checklist prior to being established in the observation position.

6.3.4. Refueling Checklist. The non-flying pilot or flight engineer confirms the fuel flow while in the air refueling position.

6.3.5. Post Air Refueling Checklist. You may accomplish this checklist at the end of each air refueling sequence, but if you are performing multiple rendezvous, you run the risk of a probe malfunction. The best technique is to accomplish this checklist at the end of all refueling operations once you are clear of the tanker.

6.4. Emission Options. Four emission options are given in T.O. 1-1C-1. These are useful in tactical situations to avoid enemy detection via electronic and visual means. For air refueling training, we normally use emission option 3 (communications out) to simulate the combat environment. Light signals are used both day and night as a substitute for radio transmissions. These signals can be found in T.O. 1-1C-20 and 11-HH60G Vol 3 Attachment 1. The signals from the tanker can be seen while looking at either troop door. The pilot not flying and the scanner on the appropriate side of the receiver must keep a lookout for the light signals, especially while flying on NVGs.

6.5. Rendezvous. You should be at join up altitude and airspeed at the ARIP (do not climb to join up altitude prematurely in a tactical environment). Plan enough time enroute to allow a slowdown, if required to stow defensive weapons. Complete the rendezvous checklist prior to the ARIP. Rendezvous procedures are covered in TO 1-1C-1-20.

6.6. Join-Up: The tanker is expecting you to fly from the ARIP to the ARCP. Along that course line is where the tanker crew will look to visually acquire you. Therefore you should fly the track segment between the ARIP and the ARCP as closely as possible to the briefed ground track and air refueling airspeed. Try not to make any large (5^o or more) course corrections once the tanker gets within 1/2 NM in trail.

6.7. Observation Position: A good technique is to align the tanker's horizontal stabilizer leading edge tip with the Air Force star decal. If the star decal is not visible, as would be the case at night, align the horizontal stabilizer with a point approximately just aft of the window on the troop door. You should be just outside the tanker's wing tip but no more than two rotor disks away. This position will allow the crew a clear view of light signals from the tanker's jump door window. Prior to arrival in the observation position, perform the pre-contact checklist. If in a formation, the wingman maintains 200 feet laterally and 200 feet behind the tanker until lead signals his final disconnect.

6.8. Crossovers: When cleared for crossover, perform a smooth climb using the collective until you reach the desired height. Position yourself so the tip of the probe aligns with the leading edge of the tanker's main wing. This position prevents you from falling back while crossing over. Slightly increase collective and use a 5^o heading change to begin moving laterally across the tanker's wing. When you reach the 6 o'clock position on the tanker, you will probably need to add some more power to keep from falling back. Once you are outside the tanker wing tip descend to observation position.

6.9. Pre-Contact: When cleared to move from observation position to pre-contact position, move straight down, until your probe is level with the drogue, then move toward the tanker and forward so you are lined up with the drogue about 5 to 10 feet back and in the upper half of the drogue assembly. A good habit to get into is to check your trim prior to each movement. Once you are in the pre-contact position note the wing flap vs. pod relationship. This will help you maintain your position for the run-in. For the pilot in the right seat, the flap appears to line up with the edge of the strut on the left hose, and be at a slight angle on the right hose.

6.10. Contact: Try to maintain your sight picture primarily on the wing of the tanker while periodically cross checking the drogue. The wing is the best indicator of drogue movement. As the wing moves up or down, the drogue will follow shortly after the wing moves. To start your contact make a smooth collective pull and add a very small amount of forward cyclic to increase closure on the drogue. About halfway through the run-in, check your position relative to the drogue. If required, a very small cyclic correction may be made to regain a proper line-up. Make a smooth transition forward while maintaining your sight picture on the wing until you make contact. Once contact is made continue to move the helicopter into the refueling position. Common mistakes to avoid during refueling are:

6.10.1. Staring at the drogue: Staring at the drogue will result in erratic aircraft control and make contacts more difficult.

6.10.2. Diving at the basket: Diving at the basket may cause hose to blade contact if you miss and should never be attempted.

6.10.3. Stepping on the pedals: Attempting to make alignment corrections at the last second by making tail rotor pitch inputs, which can damage the probe nozzle.

6.10.4. Pumping the cyclic: This comes from staring at the drogue and results in approaching the drogue at varying angles and speeds, and can cause the probe to penetrate the spokes.

6.10.5. Lining up low or inside (towards the tanker): This can result in flying the probe to the drogue at an angle which would allow the probe to penetrate the spokes. This attitude may also result in an excessively high miss and cause the pilot to lose sight of the drogue.

6.10.6. Excessive closure rate: A fast run-in can lead to abrupt control movements to avoid drogue, hose, or tanker contact if you miss.

6.10.7. If the probe penetrates the drogue smoothly, stop your closure and stabilize your position. Rapid aft cyclic inputs may damage the probe and/or drogue. Aft cyclic usually causes the drogue to collapse around the probe. Smoothly lower the nose to the horizon and the drogue should re-inflate. This will allow you to slowly decelerate and disengage from the spokes.

6.11. Misses: Following a miss, decelerate smoothly while maintaining altitude until you can see the drogue again. Then descend back to the pre-contact position. If you fall back beyond the normal pre-contact position, consider moving laterally away from the tanker, until the helicopter is outside the rough air created by the tanker. Then move forward until you can maneuver back into the pre-contact position. Common errors when missing.

6.11.1. Missing low or inside of the drogue.

6.11.2. Using too much aft cyclic when missing.

6.11.3. Dropping too far rearward after clearing the drogue.

6.12. Refueling: After making contact, continue moving forward and up into the refueling position. In the left refueling position, the pilot looks directly down the fuel dump tube located at the aft tip of the left wing. On the right side, the co-pilot looks directly down the fuel dump tube. Elevation should be just below the wing tip. This provides adequate lateral clearance and provides an elevation that avoids the relatively turbulent air just above the wing. Depending on winds and tanker weight, you may have to move up or down to find the smoothest air. Position the refueling hose in the refueling range just aft of the near, (relative to the helicopter's nose), white band. Common terminology is to call the band closest to the helicopter the "near band" and the band closest to the tanker "far band". A continual cross-check between the tanker wing and the refueling hose is necessary. If you stare at the wing, your hose position will suffer and could result in an inadvertent disconnect. If you stare at the hose, your vertical and lateral position with respect to the tanker will vary. On extremely dark nights, the tanker's lighting can cause distraction, or prohibit you from seeing the hose bands. Be prepared to ask the tanker to reconfigure their lights.

6.13. Disconnect: When you are ready to disconnect, position the helicopter so that the probe and hose appear to make a straight line. Attempt to keep the hose in the refueling range. Once you are properly aligned, descend until you can just see the tanker's entire engine exhaust. This sight picture may be different depending on the tanker's flap setting. Another technique is to descend until you are about eye-level with the tanker's belly. While maintaining altitude, slightly reduce your airspeed and let the tanker fly away until the drogue and probe disconnect. It is critical to maintain altitude/hose alignment and keep the aircraft in trim to prevent possible damage to the probe nozzle. If you are in formation and your wingman will be refueling after you, continue straight back, maintaining the same lateral and vertical position, being careful not to move toward the tanker or your wingman. Once you have your wingman in sight, move to the outside of the formation. When in formation, even if you are not doing simultaneous air refueling, the best technique to signal your disconnect is to put your position lights to flash about 5 seconds before disconnecting. This will let your wingman know to begin moving up to the observation position, and allow you to drop back and move to the outside of the formation in an expeditious manner. When lead puts his position lights to flash, the wingman concentrate on moving forward and not moving back. This will expedite the next receiver's movement to precontact and allow lead to move out from behind the tanker's wing quickly. A common mistake is to drop back with lead when he is disconnecting from the tanker.

6.14. Receiver High Option Techniques. This option may be used if heavy-weight operations are conducted or if it is more expeditious than receiver low. Consider conducting this comm-in. The only difference in receiver low is where the join-up is initiated. Single Engine Air Refueling procedures in the TO 1-1C-1-20 are for that purpose and should not be used for Receiver High AR as listed above.

6.15. Refueling Drogue Types.

6.15.1. Low-Speed Drogue. This type is normally used by helicopters, with a maximum airspeed of 130 KIAS. It has an outside diameter of approximately 46 inches and an inside diameter of approximately 27 inches.

6.15.2. High-Speed Drogue. This type is usually used by Navy fixed-wing aircraft. It is approximately one-half the size of a normal drogue and tends to become less stable at helicopter-compatible airspeeds. It has an outside diameter of approximately 23 inches and an inside diameter of approximately 12 inches. This type drogue may require the receiver to request the tanker to pressurize the refueling hose to help stabilize the drogue.

6.16. Night Vision Goggle Refueling Operations. NVG operations are the same as day operations. The obvious difference is the lack of visual references. The lack of a visible horizon can be extremely disorienting. Use the tanker as your horizon or visual reference. Have the PNF monitor instruments and be prepared to take over on instruments in the event of spatial disorientation. Have the tanker announce turns to help keep you oriented. Minimize turns while in the refueling position. Require one crewmember (usually the scanner on the tanker's side) to be unaided in order to receive light signals and relay them to the pilot. Scanners may look under goggles yet remain on NVGs. Tankers and receivers must configure lighting prior to rendezvous in accordance with the training/operational scenario. Both the lead and trail receivers must have strobe lights turned on until after join-up.

6.17. Crew Responsibilities/Duties.

6.17.1. Pilot Flying (P). Maintain visual contact with the tanker at all times. Maintain positive control of aircraft at all times.

6.17.2. Pilot Not Flying (PNF). Backs up the pilot flying. Maintain contact with the tanker to allow you to take control if the pilot flying becomes disoriented. Be prepared to receive all incoming radio calls from tanker, ATC, etc. As a technique, while operating on NVGs, lead may delay turning his strobe light on until reaching the ARIP. Maintain/monitor navigation systems (INS, GPS, etc.). Monitor fuel status, transfer, and distribution of fuel to main and/or auxiliary tanks. Monitor Barometric altitude and engine instruments. The PNF monitors trim and hose position and informs the flying pilot of any deviation, (i.e. falling back, moving forward). Be ready to operate the probe light and the refueling panel as necessary. Assist pilot with trim calls (e.g. "Right Ball or Left Ball"). Provide next course steering after completion of air refueling operations.

6.17.3. Flight Engineer (FE). Maintains visual contact with the tanker while connected to the left refueling hose. Completes all checklists as required. Notifies crewmembers of the tanker's position as the tanker approaches the three o'clock position. Maintains visual contact with the troop entrance door of the tanker to receive light signals. Ensure the trailing receiver in formation has anti-collision lights on. Assist scanners with light signals IAW AFI 11-2-HH60G, Vol 3, Attachment 1, light signals.

6.17.4. Scanners(s). Notifies crewmembers of the tanker's position at all times when the tanker is on your side. Check/monitor the cabin area for fuel leaks and fumes. Monitors external aircraft for overboard fuel siphoning. Be prepared to pass light signals to the tanker as necessary. Look under the NVGs for light signals sent by the tanker as required.

6.18. Miscellaneous Techniques and Information.

6.18.1. Tactical Breakups: Inbound threats, missile launches, and small arms may require in-flight tactical breakups. The primary consideration is survival. Once clear of the tanker, standard defensive response procedures apply, (i.e. terrain masking, missile breaks, use of on board defensive systems, etc.) If in formation, allow ample room for maneuvering without risking collision with the tanker or formation elements. Flight leads must brief a breakup plan that includes actions to take during air refueling.

6.18.2. Drafting: This technique is very useful in limited power situations and single engine situations. The receiver maneuvers to a pre-contact position and drafts off the tanker. This position may vary depending on conditions. Power required will be significantly less than in free air and higher indicated airspeeds will generally be available. This position requires constant attention and, over long periods of time, can be fatiguing. The increase in range as a result of the lower power required may be a consideration for low-fuel situations, battle damage, or when AR is unsuccessful but the need to continue flying to dry land/ friendly territory is required.

6.18.3. Probe Light. Use the Probe light to inspect the drogue for damage. Additionally, the shadow cast by the probe can be used as an aid to line up on the drogue when sitting in the left seat. To use this technique, line up the shadow of the probe onto the 3 O'clock position of the drogue. This puts the actual position of the probe very close to the center of the drogue.

Chapter 7

FORMATION PROCEDURES

7.1. Purpose. The purpose of formation flight is to provide a method to employ and control two or more aircraft to accomplish a mission and to minimize the effectiveness of enemy opposition. Tactical formations provide for each of the following requirements and balance the demands of each: 1) mutually supportive lookout doctrine for threat detection. 2) control of the flight. 3) flight maneuverability and flexibility to evade threats. 4) unity of effort. 5) techniques and flexibility of action within the flight to prevent collisions.

7.2. Mission Preparation and Planning Considerations. Mission preparation is one of the most important responsibilities you have as flight lead. As a minimum, all participating formation pilots should be involved in the planning phase. By getting each involved early on, the formation pilots will become familiar with all aspects of the mission and give each phase of the plan a critical examination.

7.2.1. Mission planning. It is your duty as flight lead to act as a focal point to interface between planners, customers, and your formation. There are several aspects of mission planning which need careful examination. These include, but are not limited to: route analysis, weather, landing zone (LZ) considerations, communication plan, air refueling operations, formation type, size and spacing, escort requirements, and briefings.

7.2.1.1. Route analysis. An important step in mission planning is route analysis. In reviewing the route, you should take several factors into consideration: terrain, simulated/real threats, suitability of navigation waypoints, and power requirements. All of these factors will have an effect on the formation. The terrain and visual conditions normally dictate the route, the type formation, and spacing. In large open areas, most approved formations can be used at night, providing sufficient illumination is available. However, if you are operating in a mountainous environment which dictates navigation through narrow valleys, fluid trail or staggered formation may be necessary. This will allow flight lead to maintain clearance for the entire flight. Additionally, as in the case of mountainous operations, you may need to increase rotor disk separation, or plan a new route because of high density altitudes or gross weight restrictions. This allows a greater margin of safety in the event of inadvertent closure or evasive maneuvering, and reduces the stress on both man and machine.

7.2.1.2. Power requirements. Power requirements must be thoroughly evaluated. It is necessary to review projected power requirements for all members of your formation. Adjust the route, if necessary, to give the aircraft with critical power requirements an added margin of safety. Consider placing the aircraft with the worst power margin in the lead of formations.

7.2.1.3. Weather. The impact of deteriorating weather must be considered during the route analysis. Many times, a weather plan isn't formulated until the flight is airborne and encounters deteriorating conditions; by this time, it's too late! How you handle your formation when the weather goes bad will determine the difference between a successful mission or one which will destroy the confidence of your flight in your ability to lead. In reviewing the route for weather options, your primary goal should be to maintain flight integrity. Several options are available to you: 1) plan an alternate route, if possible 2) alter the course to circumnavigate the weather 3) execute a course reversal to remain in VMC conditions 4) send a "weather ship" ahead of the formation to alert the formation of unavoidable IMC conditions 5) perform a landing. These options will allow you to maintain formation integrity until an alternate plan of action can be determined. This plan should be briefed during the formation briefing prior to the flight. As in all weather considerations, the worst case IMC scenario must be planned for. If possible, try and use just one IMC procedure for the entire route of flight. That is, when operating in a combination of mountainous and flat terrain, use mountainous IMC procedures for the duration of the flight. This will keep matters simplified at a time when simplification is needed. Another technique is to pre-brief waypoints where different IMC procedures will be used.

7.2.1.4. Landing zone procedures. Considerations in planning the mission need to include procedures for formation approaches and landings to a pre-planned LZ. These must be planned and briefed in detail. Situation permitting, the procedures should be executed exactly as briefed. This does not preclude common sense deviations, should an unexpected situation be encountered. As flight lead, you must consider the capabilities of your wingmen (e.g. gross weight, power requirements, abilities, etc.) when determining the type approach to be flown. In deciding the type of formation for landing, adequate spacing must be considered. When landing a formation in dusty conditions or in trail, you may want to increase spacing. A point to begin the approach should also be briefed. At this planned point, lead should have his formation configured in the proper formation for landing. Additionally, go-around procedures must be planned and briefed in detail. Preparing, briefing, and including in one's knee board cards LZ diagrams which depict all hazards, planned landing positions and directions, go-around headings, holding positions, etc. can alleviate much anxiety in the terminal phase.

7.2.1.5. Communication plan. One way to manage communication calls in a formation is with a mission execution checklist. This is simply a list of events in the order they should occur. Initially, you need to check-in the flight on a common frequency at a pre-briefed time. Technique: You should check-in all members of the flight prior to engine start. This ensure that fuel consumption for the flight starts at the same time. If there is a problem with one aircraft, a decision should be made at this time whether to delay starting engines or proceed without the broken aircraft. Once the flight is checked-in, you direct frequency changes each time you change to clearance delivery, ground control, tower, or approach. The decision to utilize positive frequency changes or prebriefed geographic frequency changeover points, etc. rests with the flight lead. Whatever the course of action, this must be briefed and understood.

7.2.2. Air refueling operations. Another pre-mission consideration you need to plan for is air refueling operations. A plan must be briefed and understood by all flight members to enable them to air refuel with minimum confusion. Additionally, contingencies must be looked at for aborts and aircraft low on fuel needing priority. Aircraft low on fuel can notify you via radio or, if communications-out (comm.-out), by a pre-briefed signal.

7.2.3. Formation type, size and spacing. The type of formation employed may vary depending on mission requirements.

7.2.3.1. Formation size. A mission that requires several aircraft should be planned around the smallest maneuver element capable of accomplishing the assigned mission. A helicopter flight of two aircraft is most often the preferred size because of the following considerations: 1) it is maneuverable, 2) it is easy to control, 3) it provides mutual support. A helicopter flight of three or more aircraft is not preferred because of the following: 1) It is less maneuverable and especially unwieldy during defensive maneuvering and 2) It is more difficult to control. If large numbers of aircraft must be used for the mission, it is recommended they be separated into two-ship elements due to the above considerations.

7.2.3..2. Formation spacing. The space between aircraft in any given formation represents a tradeoff between the previously mentioned formation requirements. In meeting the requirements for sound tactical formation flight, the flight leader must consider these factors and how they affect the formation: 1) the threat 2) the terrain 3) illumination, time of day, and weather as it affects visibility 4) communications environment 4) supporting aircraft (i.e. Sandy) 5) the capabilities of the crews and aircraft in the flight.

7.2.3.2.1. Generally, the higher the threat, the looser and smaller the formation should be. Such formations are more difficult to detect. Should the formation be detected, an adversary must choose one helicopter and will potentially lose SA on the second helicopter which may pass completely unnoticed. This is true for both air and surface threats.

7.2.3.2.2. Generally, the rougher the terrain, the tighter and smaller the formation should be. The tactical advantages of loose formations must be balanced with the difficulty of controlling those formations in rough terrain. The formation you choose should enhance the following: 1) The cover and concealment of all aircraft in the flight 2) The ability for each member of the flight to select his own terrain and seek concealment while still maintaining SA on the lead aircraft (visual contact is desired but not required at all times if visual contact is lost momentarily due to terrain.) 3) The capability of all members of the flight to navigate and avoid obstacles without excessive worry about colliding with other members of the flight.

7.2.3.3. Generally, the lower the illumination or visibility, the tighter and smaller the formation should be. Close formation is required in order to see adjacent aircraft. Rejoining multiple smaller formations in a threat area may prove more dangerous than starting with one large formation. A balance must be struck between the ability to control the flight while staying in a good defensive position.

7.2.3.4. Escorted formations. Formations which are escorted may have to employ techniques which are different from unescorted formations. The function of armed escorts is to ensure the survivability of the rescue flight. If a rescue aircraft receives fire, the escort must be able to react quickly and deliver fire to neutralize the threat. Consequently, escort formations and the division of actions on contact need to be considered and pre-briefed. Certain types of escort aircraft prefer one type of formation over another. Both close and loose formations have their own demands and difficulties. It's up to you as flight lead to evaluate your flight's capabilities and not to exceed them.

7.2.3.5. Briefings. The most critical item of mission preparation which deserves attention is the formation briefing. The way you conduct the briefing will set the tone for the entire mission. A professional briefing will lead to a professional flight. Information passed during the briefing must be clear, concise, and understood by all formation members. A briefing which is confusing and disjointed creates many unanswered questions and will lead to problems during the flight. There are several areas of the briefing which deserve careful consideration by the flight lead. We will not attempt to cover in this chapter all items in the formation flight briefing. However, here are some helpful techniques and topics to consider when conducting a formation briefing.

7.2.3.5.1. Prior to the briefing, review all the mission details, sit down with the Mission briefing guide, and make sure all applicable areas have been planned for. This review and preparation will display the confidence necessary to lead the formation. flight lead. When finished with the briefing, encourage questions and make sure everyone understands what you, as the flight lead, expect of them. The flight briefing is a good place to emphasize flight discipline and reconfirm the capabilities of your wingmen. It is their responsibility to inform you of their limitations.

7.2.3.6 Communication plan. A communication plan, as discussed earlier, should be briefed to include: communications-check, enroute frequencies, changeover points if applicable, and contingencies for lost communications. Prior to conducting a formation flight, lead must have positive communications with all participating members. However, once airborne, it is up to flight lead to direct the actions of flight members with radio failure. Usually, pre-briefed signals are sent to lead and the pre-briefed option is executed. Example: The flight returns to base or to the nearest suitable landing area where maintenance can be performed. A designated flight member can execute the above procedure. It may be more practical and feasible for the aircraft with lost communications to stay with the formation using a survival radio for emergency communications. Additionally, a chattermark can be briefed to get the flight members back on a common interplane frequency. This code word when broadcasted on guard directs all flight members to check radios to ensure they are on the pre-briefed interplane frequency. This technique is simple and effective. These are options, not procedures, available to flight lead. The key is to make your communications plan simple and understood by all.

7.2.3.7. Aircraft lighting. How the formation initially sets up its lighting is determined by the lead, based on the operating environment. At night, available ambient light plays a major role in determining aircraft lighting... Aircraft lighting, in many cases, is used for signaling purposes when comm-out. This can vary from using your lights to signal when "ready for takeoff", or while enroute to indicate a formation change. The use of aircraft lighting to signal formation changes is a good technique when time is critical. However, it is your responsibility as flight lead to brief all light signals different than those listed in MCI 11-HH60G, Vol 3, Attachment 1.

7.2.3.8. Aborts. Another area of the briefing which needs to be understood by all formation participants is aborts). The flight lead must have a procedure for handling aborting aircraft. On departure, this matter is usually taken out of your hands, but enroute, you must plan to aid the aborting aircraft and rejoin the formation if necessary. It is at this time the "bump" plan is activated, if required. A "bump" plan provides flight lead the flexibility to carry out the assigned mission with minimum difficulty and confusion. This can be as simple as continuing on with the remaining aircraft in your formation to complete a local training mission, or as complex as rearranging an entire formation complete with tankers, and dissimilar aircraft, which may require you to reassign missions based on available aircraft. While it is impossible to brief all contingencies, you should at least brief those contingencies which are realistic and would adversely impact your training or assigned mission. It should be noted that "bump" plans are commonly referred to as "what-ifs". Terminal operations and other areas of the briefing will be covered in later sections.

7.3. Formation Procedures. procedures and requirements were developed from lessons learned and to ensure safety of flight. These procedures do not, and cannot, however, cover all the unknown factors in all missions. During a given mission, not all procedures may be used. In other cases, new procedures may have to be developed to accomplish the mission. For example, when planning a comm-out mission, the light signals found in MCI 11-HH60G, Vol 3, Attachment 1, cover only the basics. You may have to develop your own unique signals for certain missions. The eleven basic tactical formation maneuvers (reference MCI 11-HH60G, Vol 3) are designed to give the formation flight lead maximum control of the flight while increasing flexibility and space for individual aircraft to maneuver in formation. These maneuvers are employed both enroute and during evasive maneuvers.

7.4. Formation Discipline and Responsibilities.

7.4.1. Formation discipline. Discipline is perhaps the most important element for successful formations. On an individual basis, it consists of self-control, maturity, and judgment in a high-stress emotionally-charged environment. Teamwork is an integral part of discipline; each individual must evaluate his own actions and how they will affect the flight and mission accomplishment. An effective formation lead displays flexibility, and aggressiveness tempered by wingmen consideration. A wingman must always maintain a precise, responsive position off his lead; but more importantly, a flight lead must always maneuver the formation to provide maximum flexibility and advantage to his wingmen. Discipline within a flight has a synergistic effect; if the flight lead and wingmen know their respective duties, they will work together as a team. Experience and realistic training will lead to solid and professional air discipline.

7.4.1.1. Discipline in a formation is the responsibility of individuals and aircrews to maintain position, follow orders, stay off the radio during comm.-out flights, and follow procedures and pre-briefed events. Formation flying is a team effort. In the same light, flight lead must ensure wingmen are performing their assigned duties. Lead must execute the mission according to the plan or backup plan(s). Otherwise, the formation members won't know what's going on. Lead must also know the capabilities and limitations of the type of formation being flown and aircraft involved. As the commander of the formation, lead sets the example for flight discipline, and orders must be followed. Good formation discipline makes flight leads job easier.

7.4.1.2. Situational awareness (SA). SA is the key ingredient to being a good flight lead. Knowing when to make a decision, making the right decision, and knowing what effect that decision will have on the formation is a big responsibility. Don't wait to be taken by surprise. During a lull in the flight, plan ahead, anticipate problems and verify your plan. Don't take anything for granted. SA must be present in every aspect of flight lead's duties. During mission planning and execution, you must be aware of aircraft capabilities as well as aircrew capabilities. You should be the first to say a mission can't be done, when appropriate, and look for an alternative. More importantly, inform the Operations Officer or Mission Commander when a mission should not be done. There are several barriers to SA--complacency and overconfidence are the most serious. Complacency can cause you to lower your guard. Overconfidence tempts you to exceed your capabilities and limitations. Self-discipline is an important quality which helps in preventing complacency and overconfidence.

7.4.2. Formation responsibilities. Formation lead (chalk #1) and wingman, are roles flight members fulfill based upon their positions within the flight. Normally, the flight lead is the formation leader. However, the flight lead may designate another member of the flight to fly as formation lead. The formation lead aircraft is in front of the formation wingman. Formation lead's responsibilities include navigation, enroute communication, obstacle and threat avoidance, awareness of the positions of formation wingmen, and consideration of the energy states of the wingmen. Formation wingmen fly their aircraft in positions relative to formation lead. Their responsibilities include maintaining the desired formation, collision avoidance, obstacle and threat avoidance, and providing mutual support to the flight through lookout, navigation, firepower, and mass. They are also responsible for accomplishing additional tasks assigned by flight lead and questioning flight lead any time a significant deviation occurs that jeopardizes mission accomplishment. Qualified aircraft commanders designated as alternate leads should be prepared to lead the flight

7.4.2.1. Mutual support. The best chances for successful survival and weapons employment depend on maintenance of mutual support between flight members at all times. Formation tactics (reference MCM 3-1, Vol 24) are developed around the concept of mutual support. Flight lead is in charge of the conduct and employment of the flight at all times; other flight members must know and properly execute their supporting responsibilities. In short, the flight, or element, functions as a team rather than separate aircraft flying together. There will be times in the dynamic combat environment that the desired mutual support may deteriorate or be lost. However, even during those times, the critical task at hand should be to regain mutual support as soon as possible.

7.4.2.1.1. Visual mutual support. Visual mutual support is the desired form of mutual support in virtually all tactical situations, whether offensive or defensive. It is a primary factor in the arrangement of most tactical formations.

7.4.2.1.2. Non-visual mutual support. Non-visual mutual support can occur at night, in weather, in the execution of pre-planned attacks, or when defensive reactions force loss of visual mutual support. For example, maintaining mutual support through the use of radar, radio, and SA of each flight member's position and actions may be necessary. These techniques can also permit maximum capability when confronting adversaries from different aspects and altitudes. Some combat situations may also dictate mutual support through non-visual means, due to the number and tactics of the adversary. Although non-visual mutual support can be temporarily effective, all flight members must have a plan to regain visual mutual support when practical. Experience has shown that careful use of AA TACAN between formation members can keep S.A. between flight members, and should be utilized whenever the potential for momentary lost visual contact is high, for example, during tactical formations with large spacing and in terrain which allows wingmen to stay masked, yet stay in the basic formation. The call in all cases should be "Jolly 2 Blind." If S.A. is high via TACAN AA, and the non-blind member sees no danger, the response would be, "Jolly 1 Blind, Sweet-lock, continue" indicating that he has AA TACAN Lock and that it is appropriate to continue as visual will be reestablished shortly. A good rule of thumb is to set a minimum AA TACAN distance to utilize this procedure, and this distance must be briefed and understood prior to execution.

7.4.2.1.3. Command and control aspects of mutual support. Command and control when an engagement is imminent or in progress consists mainly of rules of engagement (ROE), briefed tactics and plans, individual discipline, and the ability to meet the mission objectives. While this list in not all-inclusive, it points out that command and control procedures and technique must be worked out during mission planning.

7.4.2.3. Flight lead responsibilities. Flight lead is responsible for planning, organizing, and briefing the mission, leading the flight, delegating tasks within the flight, ensuring flight integrity, flight discipline, and mission accomplishment. The flight lead is in charge of the entire flight's resources and must know the capabilities and limitations of each member of the flight. Flight lead must develop mission objectives to the lowest common denominator and be ready to correct wingmen who are not performing their briefed responsibilities. An effective flight lead must maintain a high level of SA and be able to control the aircraft, monitor the environment, observe the performance of wingmen, and control the flight's execution. Upon mission completion, flight lead must be able to reconstruct the mission and make an accurate evaluation during the debriefing. Under normal operations, the flight lead will never relinquish his responsibility to ensure mission accomplishment, flight safety, and air discipline. However, in the event that flight lead is forced to leave a flight because of an in-flight emergency or situational requirements force a return to base, the designated alternate flight lead assumes flight lead responsibilities.

7.4.2.3.1. Effective flight lead. You are a leader and manager. You recognize the personal limitations of yourself, your crew, and your flight. You are able to accomplish the mission in a decisive and highly professional manner. As a technique, begin by establishing a logical order of priorities and formulate a plan. Use all available resources to gather pertinent data for the mission. Be assertive and communicate your plan and intentions. Encourage open communications so each crewmember is willing to speak up. Listen carefully to inputs provided and consider them individually. Make sound decisions based on all factors; however, be willing to change your position if someone advocates a better plan of action. As a good flight leader, resolve conflicts as they arise within the crew or flight, and seek mission accomplishment through harmonious relations within the flight. Resolve disagreements and get the flight working together as a team. A good flight lead is always evaluating and seeking information to ensure early detection of a possible problem and reduce the potential for a mishap. You should continuously challenge information and beliefs, including your own. Your optimum leadership style must be firm. Take complete charge of the formation; and direct all position changes, maneuvering, radio changes, lead changes, and other operational requirements.

7.4.2.4. Tactical leader responsibilities. The tactical leader is a role flight members fulfill based upon their SA relative to the rest of the flight and irrespective of their position within the flight. The tactical leader is the aircraft in a position to best direct flight actions to defend against threats or to avoid obstacles. For example, a formation wingman becomes the tactical leader as he calls for a break turn in response to enemy anti-aircraft fire. Another example is when a formation wingman becomes the tactical leader and directs the actions of another flight member in response to enemy fighter attacks. The tactical leader may change several times during the conduct of a mission and may change rapidly during defensive engagements. However, the tactical leader never assumes the responsibilities of the flight lead.

7.4.2.5. Wingmen responsibilities. Wingmen are assigned the supporting role in the flight. They help the leader plan and organize the mission. They have visual lookout and radar responsibilities, and perform backup navigation tasks. Wingmen engage as briefed, or when directed by the leader, and support when the leader engages. It is essential that wingmen understand their briefed responsibilities and execute their offensive or defensive contract in a disciplined manner. During pre-mission planning, the feasibility of conducting the formation flight comm.-out should be studied. This greatly reduces the workload of lead. One technique to consider is designating navigation waypoints as frequency changeover points. This way, the entire formation knows which frequencies to be on and at what time to be "up" that frequency. Designate a primary air-to-air frequency and maintain it throughout the duration of the flight, if possible. Develop your communications plan to provide a minimum number of frequency changes. This is especially important during formal exercises where the comm. plan is complicated. Lead must sort out what the flight actually needs.

7.4.3. Radio techniques and procedures. Using proper radio discipline is the most effective means of formation communications. Transmissions should be accurate and concise. After establishing radio contact between aircraft, formation lead is responsible for all radio calls pertaining to the flight.

7.4.3.1. Frequency changes. Frequency changes should only be initiated by formation lead. Flight lead may pre-brief waypoints or events which signal an automatic frequency change. Wingmen will acknowledge (by position in the flight) a frequency change prior to switching to the new frequency. Throughout the formation mission, an acknowledgment of a frequency change indicates all checklists are complete and you are ready for the next event. If you are not ready, reply with "standby." Do not change the frequency until all formation aircraft have acknowledged the change.

7.4.3.2. Frequency check-in. Formation lead will check in on the new frequency followed by all wingmen, in order. To avoid confusion during frequency changes, pre-brief check-in, and other planned radio procedures. If a wingman fails to check in after a reasonable length of time, lead should attempt contact on another radio. If this fails, direct the flight back to the previous (or a pre-briefed) frequency to reestablish contact. As a last resort, lead may initiate a pre-briefed chattermark code on guard in order to establish contact on pre-briefed frequencies.

7.4.4. Signals. Formation signals are specified in MCI 11-HH60G, Vol 3, Attachment 1. Additional signals may be used if pre-briefed. Flight lead must weigh the benefits and tactical considerations between using formation signals rather than radio communications to relay required information. If light signals are to be used, aircraft commanders should ensure their aircrews have the appropriate equipment to pass light signals.

7.4.5. Threat calls. Threat calls or directive commands to flight members are standardized to be quickly understood by all crew members and flight members in a combat environment.

7.4.5.1. Call signs are a must.

7.4.5.2. Maintain a controlled voice.

7.4.5.3. Directive supersedes descriptive.

7.4.5.4. Defensive supersedes offensive.

7.4.5.5. Clarity before brevity; build the picture.

7.4.5.6. Multiple short calls are better than one long call.

7.4.5.7. Your transmissions should enhance SA, so building the picture (i.e. observation) must transition to sorting bandits (orienting the observation to your SA).

7.4.5.8. Success overrides perfection.

7.4.5.9. Listen.

7.5. Types of Formations.

7.5.1. Echelon. This position is attained by aligning the stabilator formation (slime) light with the forward most spine formation (slime) light for a 30° line and the stabilator formation (slime) light with the aft spine formation (slime) light for a 45° line. Aircraft spacing is 1-3 rotor disks.

7.5.2. Staggered. This position is attained by aligning up the stabilator formation (slime) light with the engine exhaust for a 10° line and the stabilator formation (slime) light with the forward most spine formation (slime) light for a 30° line. Aircraft spacing is 1-3 rotor disks.

7.5.3. Fluid trail. This formation is attained by establishing a variable position 30° left to 30° right from formation lead and between 1-3 rotor disks from adjacent aircraft. For a spacing of 3-10 rotor disks, the angle may be increased to 45° left and 45° right of formation lead. Instead of maintaining a fixed position, wingmen are allowed to maneuver within the 60°-90° cone in aft quadrant.

7.5.4. Line abreast. The line abreast formation is a defensive formation where the flight is in a line 10° forward or aft of formation lead with a minimum of 10 rotor disks lateral separation.

7.5.5. Combat cruise. Wingmen should fly on an arc 10° to 60° of the abreast position on either side of formation lead. Aircraft spacing is a minimum of 10 rotor disks.

7.6. Flight Management.

7.6.1. Engine Start/Taxi. The engine start and taxi sequence begins the physical process of bringing the formation together for departure. This may be a simple task at your home base, but it is usually a complicated one when conducting large formation operations on a deployment, since all the helicopters may not be parked in the same area. To accomplish this task safely and efficiently you should designate specific control times when each significant event will commence. For example, start time, communications checks, and taxi, to list a few. Specifically, you should designate an engine start time for all aircraft to ensure the formation will ultimately be ready for departure at the required takeoff time. Also, designate a specific time for the communications check with all members of the flight and a specific taxi time to obtain clearance for the flight. The taxi plan to the takeoff area must be thoroughly understood by each crew for safety reasons. The taxi plan also facilitates the proper formation line-up for takeoff.

7.6.2. Takeoff. As flight leader, you should execute the takeoff with consideration for all wingmen, which may require a shallower-than-normal climb angle and/or slower-than-normal rate of climb. Be sure to fly the takeoff as you briefed it; that is, at the specific rate of climb and airspeed which were briefed.

7.6.3. Lead changes. Although a common event, experience has proven that the change of lead is a critical phase of flight. Lead changes require an unmistakable transfer of responsibilities from one flight member to another. Lead changes may be initiated and acknowledged with either a radio call or visual signal; however, a radio call is the preferred method. As the flight leader, you must be very specific on the sequence of maneuvers required to effect the change. Additionally, all flight members must continue to ensure aircraft separation as positions are changed.

7.6.4. Formation changes. The formation leader sets up each type formation and changes formation positions, as required, to reduce pilot fatigue and to provide terrain clearance. As flight lead, you should direct formation changes by using radio, light or visual signals, or as pre-briefed.

7.6.5. IMC avoidance. Avoiding Instrument Meteorological Conditions (IMC) will greatly reduce the chance of entering a situation which would require the use of lost visual contact procedures and a climb to MSA. This could be the difference between mission failure and success. Spend some time while mission planning to formulate your IMC options, and brief options thoroughly in the mission briefing.

7.6.6. Lost visual contact. Whenever the formation is operating in the vicinity of instrument meteorological conditions, the possibility of losing visual contact with one or more members of the flight is real. As flight leader, you must always have a plan to deal with this situation and ensure that is understood by all members of the flight. Two types of lost visual contact can occur. One situation is when a wingman loses sight of the preceding aircraft because of terrain, excessive distance, or low illumination, yet maintains VMC, and the other is due to entering IMC.

7.6.6.1. Lost visual contact VMC. In the event of a VMC lost visual contact, a "BLIND" (lost sight of a wingman) and "TERMINATE" (in order to cease maneuvering, if required) call should be made. The wingman losing sight of the preceding aircraft should call "Call sign, position, BLIND" (e.g., "JOLLY 51 FLIGHT, TWO'S BLIND"). All aircraft should proceed with pre-briefed rejoin plan. Formation lead should call out his radial and DME from the active waypoint or a prominent feature or Bullseye. Position lights, strobe lights, and IR search can be used to aid in re-acquisition of the formation.

7.6.6.1.1. Once the aircraft re-acquire each other, a "VISUAL" call should be made and the formation should configure their lights as required, rejoin, and continue the mission.

7.6.6.1.2. If the aircraft are unable to re-acquire each other, they should proceed to the next waypoint, and orbit. If the threat environment permits, formation lead should orbit at 300 feet AGL, #2 at 500 feet AGL, #3 at 700 feet AGL, etc., as a good rule of thumb.

7.6.6.1.3. If the formation is not rejoined after five minutes, make a determination based on mission requirements and pre-briefed contingency plans, to either backtrack to find the missing aircraft, continue the mission, or abort the mission and RTB.

7.6.6.1.4. At night, excessive separation or illumination may cause a loss of SA on the other aircraft in the formation. If this happens, make a "FLASHLIGHT" call. All aircraft then turn on their IR searchlight until a "VISUAL" call is made. It may not always be tactically sound to make a flashlight call. If a "FLASHLIGHT" call is made, the call "KILL FLASHLIGHT" may be used to indicate two's request for lead to turn off his IR searchlight. The call "TACAN" may be used to indicate that both aircraft should go up prebriefed TACAN A/A T/R frequencies for no more than five seconds to determine a separation status. Once again, this may not be tactically sound depending on the situation.

7.6.6.2. Lost visual contact IMC. The other type of lost visual contact is when a wingman goes inadvertent IMC and loses sight of the preceding aircraft. All members of the formation must react quickly and precisely IAW AFI 11-2-HH60G, Vol 3, procedures in order to prevent a midair collision. A second option to consider for a non-mountainous IMC breakup is a two-ship course reversal. During this breakup, both aircraft turn in opposite directions 180°, formation lead climbs to MSA and chalk #2 climbs to 400 feet above MSA. After completion of the breakup, follow procedures in AFI 11-2-HH60G, Vol 3.

7.7. Enroute Maneuvering. Refer to AFI 11-2-HH60G, Vol 3, for the authorized tactical maneuvers, specific guidance and procedures for each enroute maneuver, and the associated restrictions for each maneuver. Essentially, there are ten basic tactical maneuvers aircrews may employ while maneuvering enroute: tactical turns, center turns, hook turns (in-place turns), split turns, cross turns, break turns, the dig, the pinch, check turns, and the cover maneuver. These maneuvers are designed to give the formation flight lead maximum control of the flight while increasing flexibility and space for individual aircraft to maneuver in formation. Single-ship enroute tactical maneuvering may include break turns, hook turns, and check turns. Formation enroute tactical maneuvering may utilize all ten basic tactical maneuvers. The following is provided as additional information and techniques to AFI 11-2-HH60G, Vol 3.

7.7.1. Maneuverability. Maneuverability is a prime consideration for formations engaged in combat conditions. The flight lead must employ the formation as an integral unit and still be able to turn, climb, or dive the formation with few restrictions. Separation between aircraft of the formation is dependent upon the tactical situation, mutual support, the degree of control and maneuverability required, and upon the weather conditions. During maneuvering flight, it is vital that the pilot not flying assist in cross-checking the aircraft instruments to assure operation of the aircraft remains within operational limits. Torque, altitude, airspeed, rate of descent or climb, and angle of bank are some of the more important limits.

7.7.2. Avoidance Techniques. Adequate formation spacing is the key to preventing a dangerous overtake situation. The decision on spacing goes hand-in-hand with the selection of a particular type of formation since it is influenced by the same factors and considerations. The spacing selected should provide a reasonable margin for error for each formation event, that is, takeoff, enroute and terminal (landing) operations. Remember, you can't expect your wingmen to fly in perfect positions all the time. It doesn't happen! When a wingman develops an excessive overtake within the formation, it must be corrected immediately in a safe, controlled manner that is recognized and understood by all members of the flight. The overshoot procedures for straight ahead and turning rejoins (reference AFI 11-2-HH60G, Vol 3) apply for an excessive overtake situation within the formation when flying either straight and level or in a turn. Each procedure is initiated by raising the nose to decelerate followed by a lateral spacing maneuver if necessary. The deceleration maneuver decreases the closure rate and cues the succeeding wingman that an overtake has developed and a correction back to the proper spacing is in progress. The lateral movement is used when necessary by the overtaking wingman primarily in staggered and fluid trail formations. It is used to decrease closure, increase spacing, and maintain visual contact with the preceding aircraft. Most importantly, it removes the overtaking wingman from the flight path of the succeeding aircraft, so as not to create another overtake situation in the formation. In large staggered and fluid trail formations, the effects of a deceleration by one wingman progresses rapidly back in sequence to each successive wingman. The lateral maneuver is designed to prevent this "ripple effect".

7.8. Evasive Maneuvering. Refer to MCM 3-1, Vol 24 (S). All formations should employ tactics which use mutual support to defeat the enemy. The following information provides some additional considerations for evasive maneuvering.

7.8.1. Small formation considerations. A small formation should employ tactics which use mutual support to defeat the enemy. Lead, of course, must be free to maneuver, as necessary. The wingman then maneuvers so as to maintain visual contact with lead. Several advantages can be realized:

7.8.1.1. Two or three targets of opportunity may help to throw off the aggressor as he takes a split second on each pass to decide on which helicopter to attack.

7.8.1.2. If the formation is attacked by more than one aggressor and those aggressors go after one aircraft, the free helicopter(s) may be able to warn the engaged wingman of an undetected attack from a blind quadrant.

7.8.1.3. The supporting helicopter(s) may also have more time to call for armed assistance (if available) while monitoring the attack.

7.8.2. Large formation considerations. For large formations, especially at night, the response to an attack can quickly become very complicated. The response may vary greatly based on many factors, such as the nature of the airborne threat, the number and types of aircraft in the formation, the terrain, etc. Some basic principles should be observed, however. If the intention is to break up the formation, consider the following:

7.8.2.1. All members of the formation should be aware of their location within the flight and should be prepared to break away from the formation to avoid a midair collision. The breakup should be pre-planned and pre-briefed to avoid conflicts.

7.8.2.2. If possible, an attempt should be made to maintain element integrity, thus allowing use of the two-ship tactics mentioned in MCM 3-1, Vol 24 (S), if applicable.

7.8.2.3. After receipt of a break call for a bandit, all aircraft should turn away from the flight and descend to terrain flight altitude and maneuver individually against the threat. When the enemy threat has passed, the aircraft will proceed to the rendezvous point. The rendezvous point should be a pre-briefed point clear of the threat (e.g. a breakup between point four and five will rendezvous at point six).

7.8.2.4. The type of rejoin at the rendezvous point must be pre-briefed. Consideration should be made for time available for delay at rendezvous, the number of aircraft required for the mission, ability to land at the waypoint, responsibilities of those unable to accomplish a timely rejoin, and new threat situation.

7.8.3. Threat Lookout Procedures. Each aircrew member shall be assigned a sector of lookout responsibility. Within the limitations of aircraft configuration, the aggregate of such sectors shall provide 360° of lookout around the aircraft. Lookout sectors shall be designated by clock coding with twelve o'clock coding oriented on the nose of the aircraft. Vertical sectors shall be designated with reference to the horizon so "low" is a position below the horizon or below your aircraft's altitude, "level" shall refer to a position on the horizon or at your aircraft's altitude, "high" to a position above the horizon and below the rotor path, and "high-high" above the rotor path. Scanning sectors shall overlap when possible. Individual lookout sectors and responsibilities shall not be modified or relaxed when a helicopter is operating in a flight.

7.8.3.1. Exact terminology should be used when calling threats. Some examples are:

7.8.3.1.1. Bogie-Any aircraft not positively identified as friendly.

7.8.3.1.2. Bandit-Any aircraft positively identified as hostile.

7.8.3.1.3. SAM-Visual sighting of missile launch.

7.8.3.1.4. Triple A-Visual sighting of antiaircraft weapons.

7.8.3.1.5. Ground Fire-Visual sighting of small arms fire.

7.8.3.2. The sequence and content of threat calls must be accurate and succinct. When calling a break, use the following sequence: call sign, the desired evasive maneuver, type of threat, clock position, altitude (for airborne threats), distance, description of threat (if applicable).

7.8.3.3. Examples of threat calls are:

7.8.3.3.1. "JOLLY 51 FLIGHT, BREAK LEFT, BANDIT, TEN O'CLOCK, HIGH, 5 MILES, FAST MOVER."

7.8.3.3.2. "JOLLY 51 FLIGHT, BREAK RIGHT, SAM, FOUR O'CLOCK, LOW, 2 MILES."

NOTE: The "Break" call implies two critical elements: You are engaged, and the aircraft is CLEAR in the direction of the break called. If a break is required to the opposite side of the scanner calling the break, the opposite scanner is responsible to immediately call "CLEAR RIGHT/LEFT" or "STOP TURN" and the reason the aircraft is not clear to turn.

7.9. Terminal Operations. Refer to MCM 3-1, Vol 24 (S) for terminal operation procedures. The following information provides some additional considerations for conducting terminal operations.

7.9.1. Performance/Limited power considerations. You should plan and brief in detail procedures for formation approaches and landings. The procedures, situation permitting, should be flown as briefed. You need to consider all factors when you choose a particular formation and required spacing. A primary factor will be performance limitations. Performance data for each aircraft in the formation will have been reviewed during the pre-mission planning phase. Adjustments in gross weight or time on target may be required to take advantage of lower density altitudes. Power considerations must be present in all phases of terminal operations and must be constantly updated/evaluated by the flight leader. Other factors which influence terminal operations are: mission requirements, LZ size, and at night, available illumination.

7.9.2. Slowdown/Approach techniques. During the formation briefing, you should have already briefed a point to begin the approach. Before Landing checklists are accomplished as part of the Ingress checklist, which will usually be accomplished before crossing the FEBA. It is a good idea for lead to brief a prearranged signal to have the formation perform their landing checklists. Once crossing the IP, the flight should decelerate to approach airspeed and assume landing formation, if required. If in a large formation and power requirements are critical, consider having the formation take more spacing. Additionally, it may be feasible for the formation to form smaller elements, take spacing, and land in elements of two more. A staggered or echelon formation may be preferred over a trail formation because more visual cues are available to pilots when judging rate of closure. This is especially important at night. However, obstacles in an LZ or landing to a narrow, blacked-out runway may require a trail formation. Again, power available will play an important role in the approach.

7.9.2.1. Shallow approaches, when feasible, are best for marginal power situations, since power changes and flare attitudes are minimized and all aircraft normally arrive in ground effect at approximately the same time. Shallow approaches may also minimize brown-outs in dusty conditions (depending on touch-down speed).

7.9.2.2. Ideally, wingmen should be briefed to stack level to slightly higher in order to enter ground effect at about the same time as lead. Stacking low will subject the helicopter to intense rotor wash, significantly increasing the power required at the bottom of the approach. Stacking high may result in an OGE hover condition. Both situations result in significantly higher power requirements. These factors also aid in making a simultaneous landing. Flight leads must always be aware that any drastic aircraft attitude change on their part will have an effect on all formation members. The resulting changes in airspeed, power, and sink rate will be amplified significantly as they progress from lead to the end of the formation. When this situation occurs at slow airspeed and/or low altitude, the result can be disastrous.

7.9.3. Simultaneous landings. Training or mission requirements will dictate if a simultaneous landing is required. Conditions which have been previously discussed will determine if simultaneous landings are feasible. If possible, simultaneous landings are the preferred method of formation landings. If properly executed, they will require less power than formation approaches to a hover.

7.9.3.1. As the flight lead, you will face several problems when executing a simultaneous landing. You must not be too fast, too slow, too steep, or too shallow. Exceeding any of these parameters will create problems for your wingmen. Another pitfall to avoid is having the lead or wing aircraft come to a hover prior to landing. If this happens, all proceeding helicopters should be briefed to continue their approach to a touchdown if conditions permit.

7.9.4. Go-arounds. As previously mentioned, you must plan and brief go-around procedures in detail. Go-arounds can be executed as a flight or individually.

7.9.5. Individual Crew Member Responsibilities. Each crewmember has the responsibility to provide mutual coverage for other aircraft in the formation. This includes scanning the six o'clock position of other helicopters in the formation since rear visibility is extremely limited. Mutual coverage is especially important in any combat environment where the flight is susceptible to an attack from enemy ground and airborne weapon systems. Scanners are also responsible for notifying the pilot of all changes in the relative position of other aircraft in the formation.

7.9.5.1. Flying Pilot. The pilot flying has a primary responsibility to fly the aircraft in such a manner as to deny/minimize weapons employment by threats while maintaining a safe flight profile. The pilot will communicate with wingmen to coordinate defensive maneuvers. The pilot flying also communicates to the crew intended plans of action to accomplish the mission or defend against a threat.

7.9.5.2. Pilot Not Flying. The pilot not flying monitors the flight profile of the aircraft, providing the pilot flying with information about altitude, power requirements, terrain avoidance, airspeed, and angle of bank (with the two most critical factors being terrain avoidance and power management). The pilot not flying is normally tasked to navigate and communicate with escorts and command and control. The pilot not flying must be able to assume control of the aircraft any time the pilot flying becomes fatigued or incapacitated.

7.9.5.3. Scanners. The flight engineer and pararescuemen must maintain situational awareness relative to the terrain, threats, and other formation members. This can be extremely demanding in a combat environment, especially during defensive maneuvering, where the crew is often required to direct the actions.

7.9.6. LZ Options. See MCM 3-1 Vol 24.

7.10. Debriefings. Use the debriefing to discuss both positive and negative performances of the flight. An important element of the debriefing is "lessons learned".

7.11. Tactical Formation Considerations.

7.11.1. Purpose. Tactical formations must provide for each of the following requirements and balance the demands of each: 1) mutually supportive lookout doctrine for threat detection, 2) control of the flight, 3) flight maneuverability and flexibility to evade threats, 4) unity of effort, and 5) techniques and flexibility of action within the flight to prevent collisions.

7.11.2. Conditions. The flight lead will consider the following when directing formation flying: 1) the nature of potential and actual threats, 2) the terrain, 3) the mode of flight (e.g., low-level, contour, or high altitude), 4) the weather, visibility, and effective illumination, 5) the time of day, 6) the communications environment, 7) the existence of supporting aircraft, if any, and 8) the capabilities of the aircrews and aircraft in the flight.

7.11.3. Effects of Terrain. When a mission requires a flight to be flown over a varied terrain, the formation and the route of flight should provide for the following: 1) cover and concealment of all aircraft in the flight, 2) the opportunity for each aircraft in the flight to select their own terrain and seek concealment while still maintaining contact with the lead aircraft, and 3) the capability of all flight members to navigate to avoid obstacles without creating a hazard for another flight member.

7.11.4. Maneuverability. Maneuverability is a prime consideration for formations engaged in combat conditions. The flight lead must employ the formation as an integral unit and still be able to turn, climb, or dive the formation with few restrictions. Separation between aircraft in the formation is dependent upon the tactical situation, mutual support, weather conditions, and the degree of control/maneuverability required.

7.11.5. NVG Conditions. Under low illumination, the formation should be tight, with about 1-3 rotor disks separation, in order to allow the wingmen to easily pick up cues from lead. As the illumination increases, the distance between formation aircraft may increase to up to 20 rotor disks (~ 1000 ft.) under high illumination. This allows wingmen to employ day tactical formation procedures to offset the advantage the higher illumination gives to an enemy gunner. As formation spacing increases with illumination (day and night) the need for precision formation position decreases accordingly and each aircraft in the formation is allowed to pick their own flight path for the tactical situation allowing freedom of maneuver and navigation to maximize the use of terrain.

7.12. Engine Start and Taxi. Start engines by visual signal, radio call, or as prebriefed. Prior to requesting taxi clearance, flight lead will check-in the flight (NA for comm-out). The flight will normally taxi in order with a minimum of 100 feet spacing from main rotor to tail rotor.

7.13. Lineup for Takeoff.

7.13.1. Lead will normally taxi to downwind side of the takeoff area/runway to permit lineup and hover checks. Lead must allow adequate room on the takeoff area/runway for all formation members to maneuver.

7.13.2. Spacing should be commensurate with the type helicopters and conditions with a minimum of one rotor disk. Increased spacing may be required; e.g., heavy gross weights, dusty conditions, rolling takeoffs.

7.13.3. Indicate ready for takeoff by stating aircraft position in the formation. If not ready state, "stand by." During comm-out, each aircraft will indicate ready for takeoff by extinguishing its strobe and/or position lights, beginning with the last aircraft in the formation. When all aircraft have extinguished their strobe and/or position lights and ATC clearance is received, lead will extinguish its strobe lights, wait 5 seconds, and initiate takeoff. (Alternate procedures may be used if pre-briefed). During training, the last member of the flight, as a minimum, will fly with a strobe light on. The strobe light will be on prior to takeoff.

7.14. Takeoff. There are two types of formation takeoffs: "wing" and "delayed." Either type may be initiated from the ground or a hover. Prebrief the type to be used.

7.14.1 Wing Takeoff. Aircraft take off simultaneously maintaining formation separation. Lead may be required to hold a slightly lower than normal power setting to enable the wingmen to maintain position without requiring excessive power.

7.14.2. Delayed Takeoff. Lead initiates takeoff. Wingmen delay executing the takeoff as briefed. Lead will climb at briefed airspeed and rate of climb. Ensure all aircraft have strobe lights on until the join up is completed.

7.15. Aborts.

7.15.1. Prior to takeoff, an aborting aircraft will notify lead, clear the formation (as appropriate), and return to base, as directed.

7.15.2. If an abort occurs during takeoff, the aborting aircraft will call flight call sign, position, abort, and state intentions. For example, "Jolly 49 Flight, two, aborting, straight ahead." If conditions permit the aborting aircraft should turn on a strobe light at night. The aborting aircrew will, if possible, maintain the side of the formation they were on when the takeoff was started. The aborting aircraft is responsible for avoiding any aircraft in front of it.

7.15.3 Other aircraft may continue takeoffs or delay as the situation dictates or as briefed.

7.15.4. If an abort occurs, all other aircraft will assume a new position (maintain original formation call sign) and complete the mission or abort as briefed.

7.16. Join-Up. Two types of join-ups may be used: straight ahead or turning. Unless prebriefed or directed by lead, wingmen will request permission to rejoin. Lead will direct which type of rejoin to be used.

7.16.1. Straight Ahead. Lead establishes a heading while wingmen accelerate until established in position.

NOTE: If an overshoot becomes unavoidable, the joining aircraft should reduce power, raise the nose to decelerate, and, if necessary, turn slightly away from the formation. Keep lead (or the preceding aircraft) in sight. Resume the rejoin once closure rate is under control.

7.16.2. Turning. Lead establishes an angle of bank (no greater than 20^0 at Night). Wingmen then turn inside of lead/preceding aircraft until established in position.

NOTE: If an overshoot becomes unavoidable, the joining aircraft should pass behind the preceding aircraft so as not to lose visual contact. Never pass directly under or over any aircraft in the formation.

7.16.3. Night Join-Ups. Exercise extreme caution during night join-ups, especially turning join-ups and rejoins, due to the difficulty in estimating distance and closure rates. It is essential that all formation aircraft maintain prebriefed parameters (i.e., airspeed, heading, bank angle) and maintain visual contact with lead. Adjust lights as requested by the wingmen.

7.17. Night Formation. NVGs are the primary method of conducting night formation. Unaided night formation is restricted to a minimum of 500 feet AGL. If unaided night formation is required, increased vigilance is an absolute necessity due to decreased visual references. Unaided formation light settings should be adjusted to provide sufficient illumination and outline of the preceding aircraft. NVG formation light settings are:

7.17.1. Formation Lights (Slime Lights)-On (intensity as required).

7.17.2. Cargo Compartment Lights-As Required.

7.17.3. Strobe Light(s)-IAW AFI 11-206 or MAJCOM waivers.

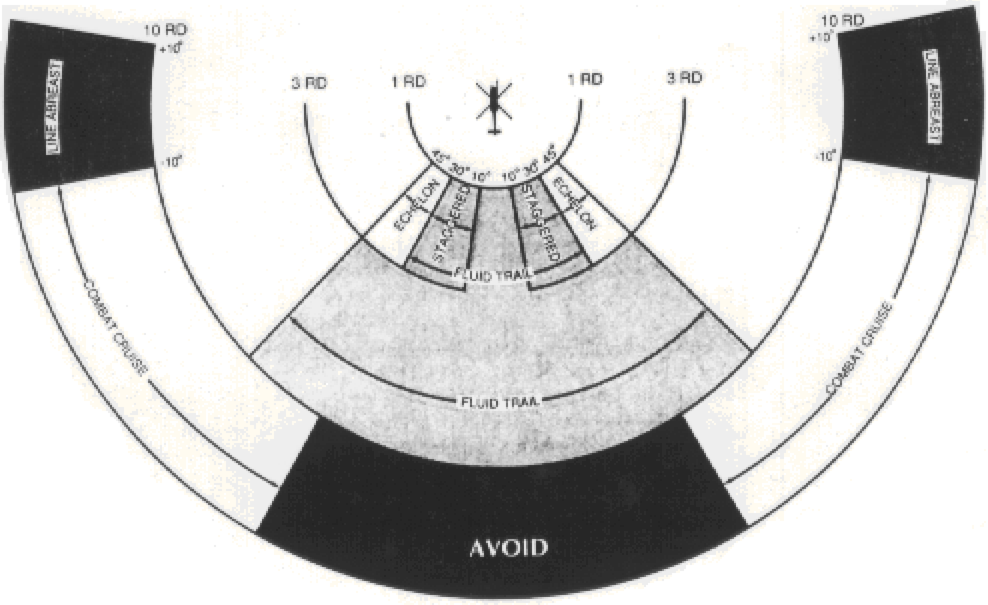
7.17.4. Position Lights-IAW AFI 11-206 or MAJCOM wavers.

NOTE: Whenever conditions permit, aircraft should operate with strobes on to minimize midair potential.

7.18. Formation Maneuvering. Formations normally have a maximum of 5 aircraft per element.

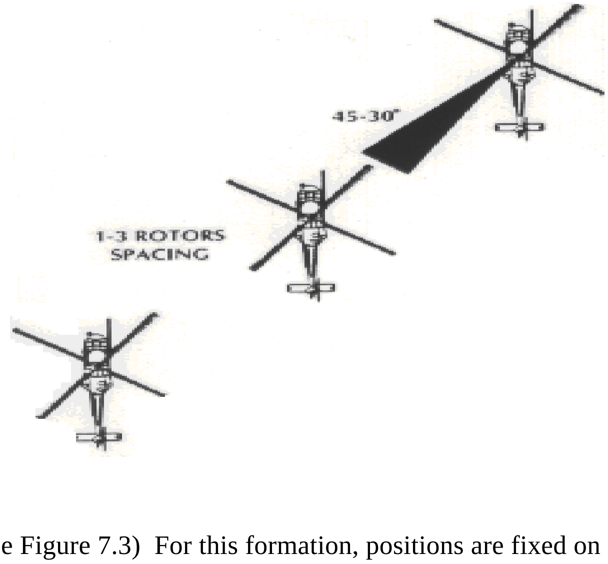
7.18.1. Formation positions. See Figure 7.1.

Figure 7.1. Formation Positions



7.18.1.1. Echelon. (see Figure 7.2) This formation should be considered a non-tactical formation as it severely limits the maneuverability of the flight. It is normally used during air refueling with two or more receivers or when two flights of two join. Aircraft fly a fixed position on a 30^0-45^0 line from lead and at 1-3 rotor disks spacing on the left or right of the aircraft ahead in formation. The flight maneuvers as if a welded wing. All formation aircraft will be positioned on the same side of the lead helicopter. Formation changes from a left to a right echelon will be directed by the formation lead. During the crossover, wingmen will maintain appropriate clearance. Pilots will use a heading change of approximately 5^0 to cross from one side to the other. As the #2 helicopter initiates crossover, the aircraft following will initiate a crossover on the aircraft ahead in formation to end up on the opposite side. A slight vertical stacking is recommended during the crossover. Unlike "true" echelon the HH-60G should not attempt to maintain a level plane in regards to maneuvering in formation.

Figure 7.2. Echelon Left Formation

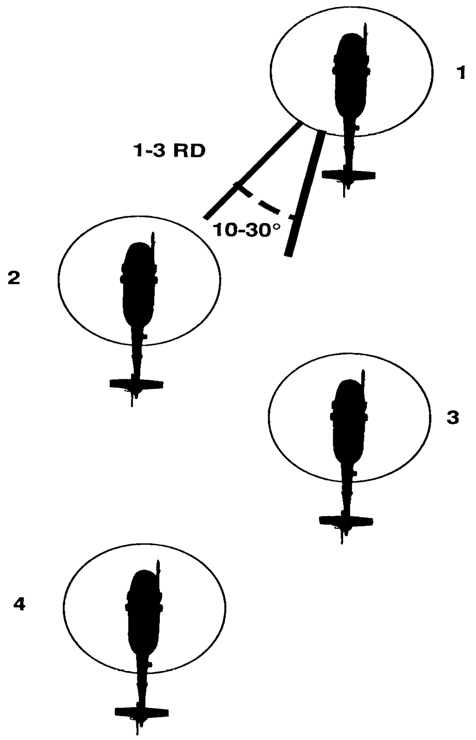


7.18.1.2. Staggered. (see Figure 7.3) For this formation, positions are fixed on a line 10^0 - 30^0 from the formation lead and between 1-3 rotor disks on the left or right of the aircraft ahead in formation. When operating with three helicopters, the formation will stagger left or right behind lead. The #2 helicopter's position will determine if the formation is staggered right or staggered left. This formation gives the wingmen more flexibility in relation to adjacent aircraft while still affording the formation lead control of the flight. Formation changes between a left and a right staggered formation will be directed by the lead aircraft unless the #2 helicopter is given the leeway to set the formation. During the crossover, wingmen will maintain appropriate clearance. The #2 helicopter will use a heading change of approximately 5^0 to cross from one side to the other. The #3 helicopter will maintain position behind the lead aircraft. A slight vertical stacking is recommended during the crossover.

7.18.1.3 Fluid Trail. (see Figure 7.4) This formation establishes a variable position 30^0 left to 30^0 right from formation lead and between 1-3 rotor disks from adjacent aircraft. For a spacing of 3 -10 rotor disks, the angle may be increased to 45^0 left and 45^0 right of lead. Instead of maintaining a fixed position, wingmen are allowed to maneuver within the 60^0 - 90^0 quadrant. This formation allows wingmen to see both the aircraft ahead in formation and the terrain flown over without requiring head movement. Thus the possibility of contact with obstructions is reduced while maximizing lead's maneuverability. Lead may direct an in-trail formation whenever terrain or maneuvering dictates. When directed to trail, aircraft will line up directly behind and stack slightly above aircraft ahead in formation.

7.18.1.4. Line Abreast. (see Figure 7.5) The line abreast formation is a defensive formation where the flight is in a line 10^0 forward or aft of lead with a minimum of 10 rotor disks lateral separation. Lateral separation varies depending upon terrain, visibility, experience, pilot ability, the need to maneuver, and the enemy weapon envelopes. This formation is normally used in flat, open terrain where masking options are limited in order to minimize exposure time and to allow increased defensive lookout along the route of flight. The advantages of this formation are: 1) it has a high degree of lookout, 2) it provides for good mutual support, and 3) it provides individual flight aircraft with maneuvering flexibility. ***This formation is authorized for day operations ONLY.***

Figure 7.3. Staggered Formation.



Note: Each Helo Stacks Level or Slightly Above Helo In Front

Figure 7.4. Fluid Trail.

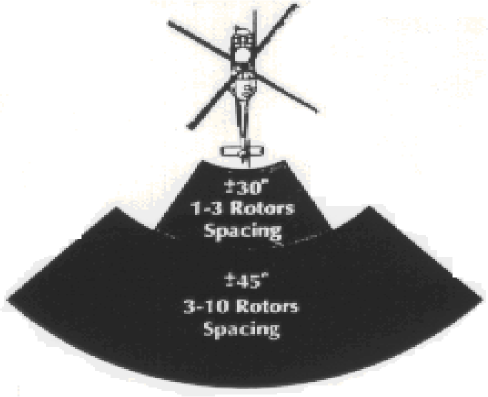
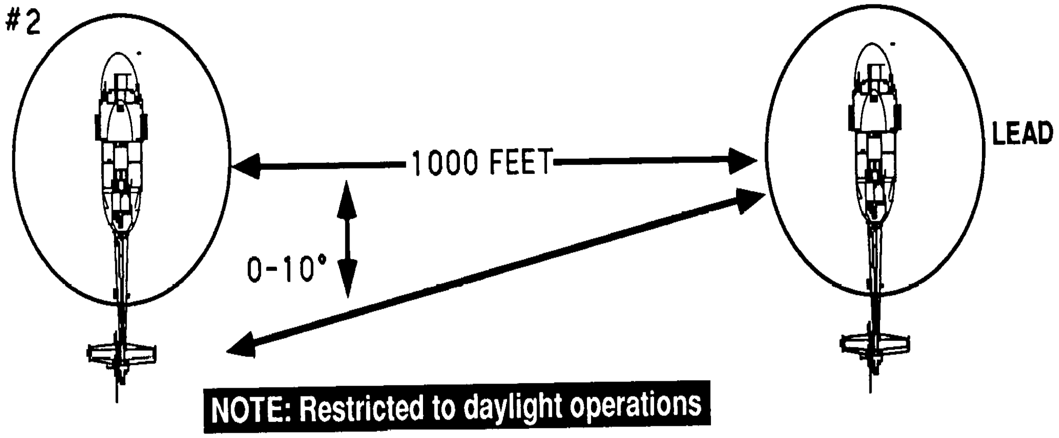


Figure 7.5. Two-ship Line Abreast.



7.18.1.5. Combat Cruise. (see Figure 7.6) This formation is designed to allow maximum flexibility and individual pilot freedom to increase maneuverability, lookout, and terrain masking for the formation as a whole. Wingmen should fly on an arc 10^0 to 60^0 aft of the abeam position on either side of the lead aircraft. In absence of other tactical considerations, the optimum position of the wingman is level with lead and 45^0 from abeam lead with a minimum of 10 rotor disks spacing. However, the wingman's position should always be dependent on the tactical situation. Since the formation does not require an absolute position, flight members can concentrate on navigation, terrain masking, enemy detection, and avoidance. Because of the formation's flexibility, it requires more effort for lead to know where the wingmen are at all times. Pilots will avoid prolonged flight in the area 0^0- 30^0 right and left of the tail of the aircraft ahead in formation. Wingmen should position themselves where they can best visually cover the lead aircraft, and they should be prepared to deliver ordnance in support of the lead aircraft whenever necessary. In rough terrain, the formation is normally tighter than in open terrain. When maximum observation to the front is desirable or when attempting to limit exposure time over open areas, wingmen should move toward a line abreast position. When flown in a three-ship formation, #3 will fly a position to allow room for #2 between himself and lead. When lead initiates a turn, wingmen will maintain longitudinal clearance on the aircraft directly ahead by sliding and utilizing the radius of turn created by lead. As soon as lead rolls level, positions will be resumed with the #2 aircraft balancing the formation.

7.18.2. Tactical Formation Maneuvering.

7.18.2.1. Control of the Flight. The combat cruise and line abreast formations increase the flight leader's flexibility in controlling the flight. They also promote security by providing overlapping fields of view. Normal cruise principles can be used for most turns in the combat cruise position. As the position in combat cruise varies from the optimum, then turns must be adjusted so as not to present a linear target during break turns.

7.18.3. Tactical Flight Formation Maneuvers. MCI 11-HH60G, Vol. 3, prescribes the limits and minimum illumination/separation for these maneuvers. Descriptions of applications and utility are as follows:

7.18.3.1. Tactical Turns. The Tac turn is used to maneuver the flight to maintain lookout doctrine and mutual support. Aircrews use two types: 1) Tac turn away from the wingman, and 2) the Tac turn into the wingman. These turns can be executed from the following formations: combat cruise, line abreast, or loose fluid trail (greater than 3 rotors spacing). These maneuvers are used to change the direction of the formation 60^0 - 120^0. The radio command is, "Jolly 1 flight, TAC Left" a turn of 90^0 is understood if not stated. If a smaller or larger heading change is desired, the formation leader may specify a new heading in the command. "Jolly 1 flight, Tac Right, 270^0." At night, the roll out heading will be specified. Tac turns also enable aircrews to turn into an approaching enemy while maintaining formation integrity, and they can be used to avoid presenting a linear target to an approaching enemy aircraft. All TAC turns follow 3 basic principles: 1) the formation wingman always change sides in the formation, 2) the aircraft on the outside of the turn will always turn first, 3) the formation wingman is always responsible for separation.

7.18.3.1.1. Tac turns away from the wingman in the combat cruise or loose fluid trail formation. Formation lead initiates the maneuver with a command. The wingman will start the turn and will roll out at a new heading. The formation lead will turn to the new heading as the wingman reaches lead's 5 o'clock position for a left turn or lead's 7 o'clock position for a right turn.

7.18.3.1.2. Tac turns into the wingman in the combat cruise or loose fluid trail formation. Formation lead will give the command and will immediately turn to the new direction. Depending upon the wingman's position, formation lead will pass behind or in front of the wingman. The wingman will maintain separation and turn to the new heading when lead has passed their flight path. At the completion of the maneuver the wingman will always be on the opposite side of lead.

7.18.3.1.3. Tac turn away from wingman in the line abreast formation. Formation lead initiates the maneuver with a command. The formation wingman will start the turn and roll out at the new heading. The formation lead will turn to the new direction as the wingman reaches lead's 5 o'clock position for a left turn or lead's 7 o'clock position for a right turn. The wingman will reposition as necessary to maintain the formation.

7.18.3.1.4. Tac turns into wingman in the line abreast formation. Formation lead will give the command and will immediately turn to the new direction so as to pass behind the wingman. The wingman will hold heading until the lead reaches the 5 o'clock position for a left turn or 7 o'clock for a right turn. Then the wingman turns to the new heading and positions himself in the line abreast with lead.

Figure 7.6. Combat Cruise Formation.

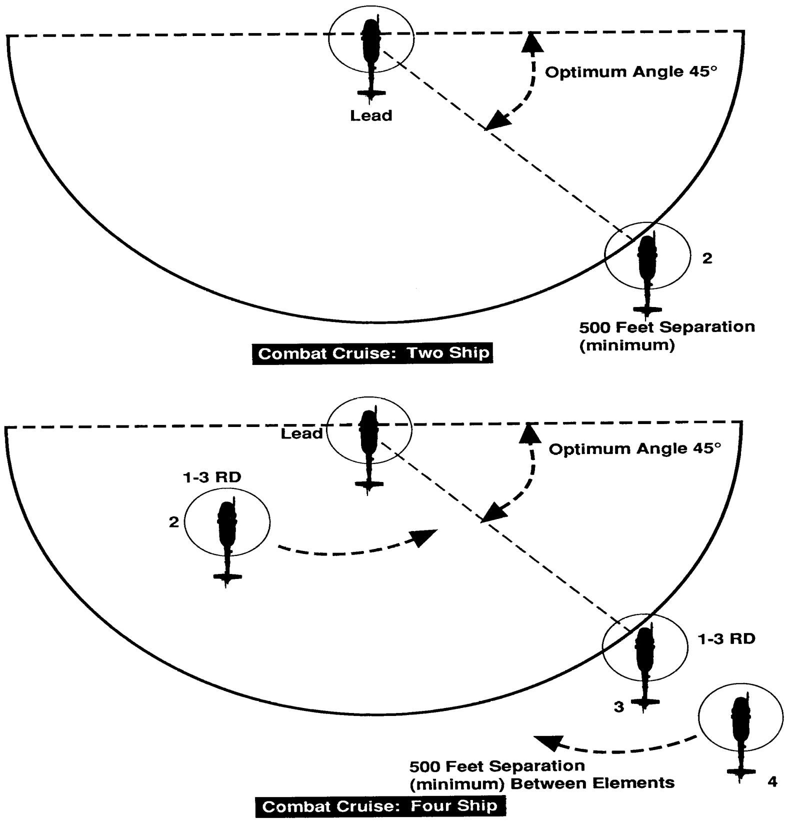
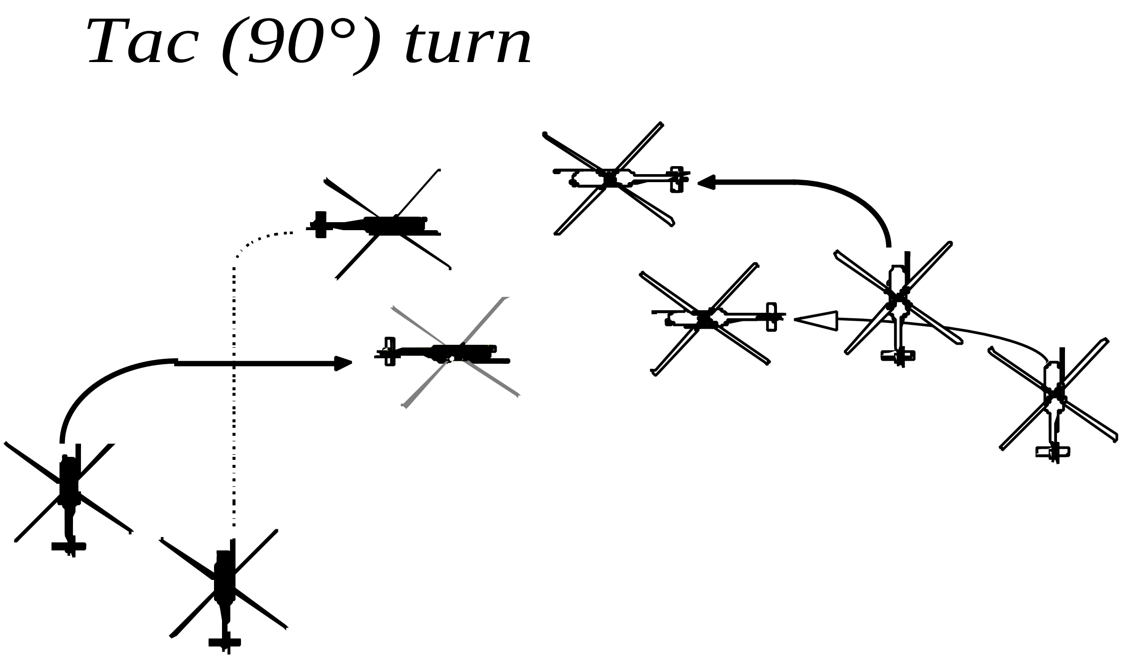


Figure 7.7. TAC Turns.



7.18.3.2. Shackle Turns (see figure 7.8.) enable aircrew to more thoroughly check the formations 6 o'clock position for enemy aircraft without changing the general direction of the flight. Turns of 30^0 are used to keep the flight moving smoothly along its intended course. Shackle turns can be executed from either the combat cruise, line abreast, or loose fluid trail formation. The maneuver terminates in the same formation it began except that the wingman is on the opposite side. The maneuver is initiated with a radio command, "Jolly 1 flight, shackle." Lead will maintain heading while the wingman initiates a 30^0 turn towards lead. Lead will verify that the wingman has initiated the turn, and then initiate a 30^0 turn in the opposite direction. Properly executed, the wingman should always pass to lead's 6 o'clock position. This creates the image of a large X in the sky. As the wingman passes lead's 6 o'clock position, lead will execute a turn to the original heading. Maintaining separation, the wingman will then maneuver to keep formation.

7.18.3.3. Dig and Pinch (see figure 7.9.). These maneuvers are used to adjust the separation of the flight while the flight moves in a constant direction. The dig increases lateral separation while the pinch decreases it. Aircrews begin the dig or pinch while flying a constant heading in either the combat cruise or line abreast formations. Lead will initiate a dig with a radio command. "Jolly flight, Dig" and the formation aircraft will simultaneously turn away from each other for 30-45 degrees of heading change. When the desired lateral separation is attained, lead will command, "Jolly flight, Resume" and the formation aircraft will return to the flight's original heading. When lead commands, "Jolly flight, pinch," the flight aircraft will simultaneously turn toward each other for 30-45 degrees of heading change. As with the dig, when the formation aircraft are at the desired separation, lead will command, "Jolly flight, Resume."

7.18.3.4. Hook Turns (see figure 7.10.) can be accomplished from either side of line abreast, combat cruise, or loose fluid trail formations. They can be used for changes of 120^0 - 240^0. A change of 180^0 is understood with the radio command, "Jolly Flight, Hook Left/Right." If a smaller or larger change is desired, lead may specify the new roll out heading, "Jolly Flight, Hook Left, Roll Out Heading 270, or specify the change in the number of degrees, "Jolly Flight, Hook Right, 30".

Figure 7.8. Shackle Turn.

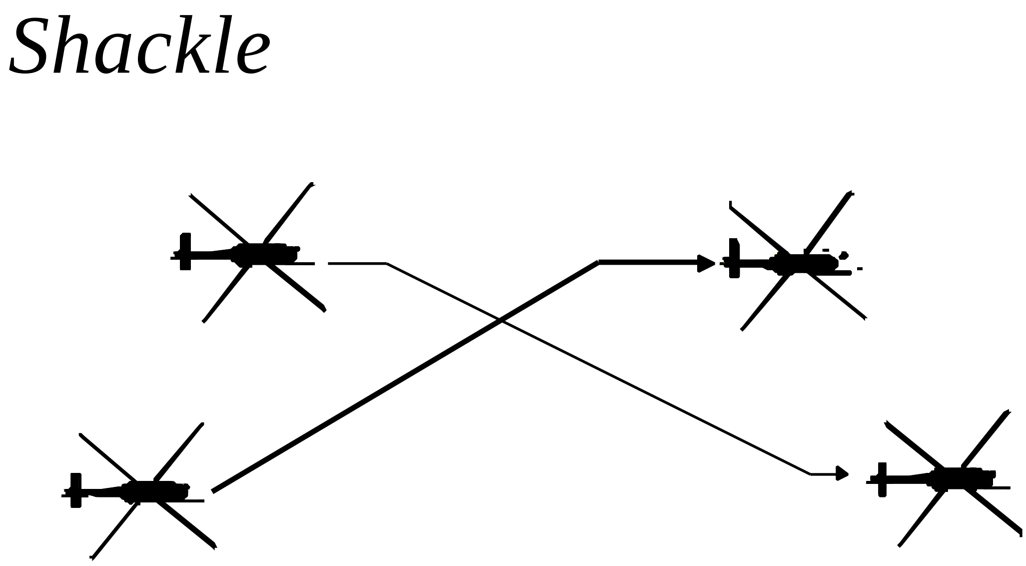


Figure 7.9. Dig and Pinch.

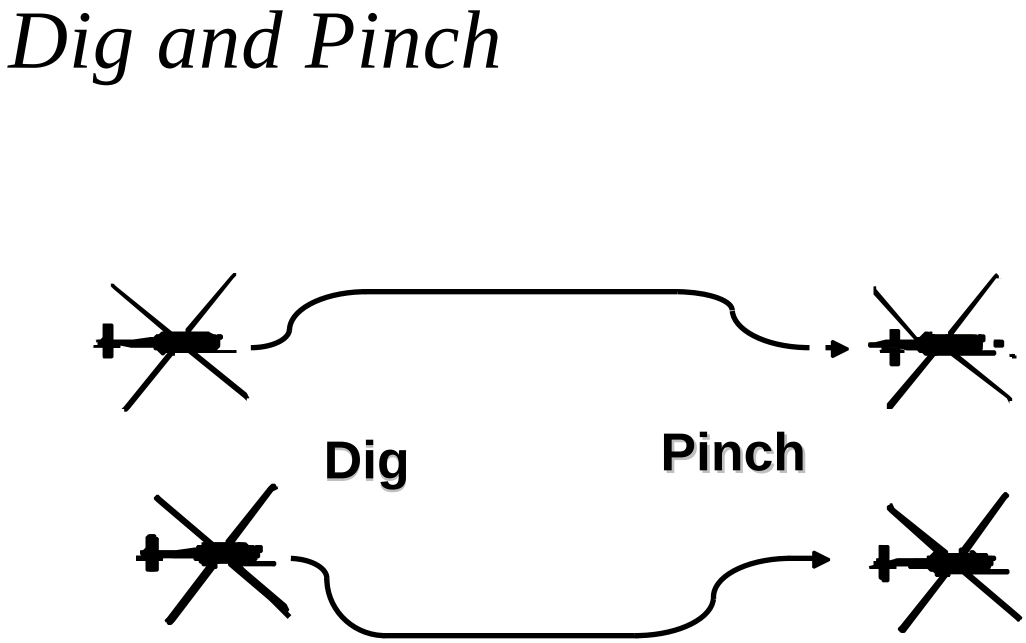
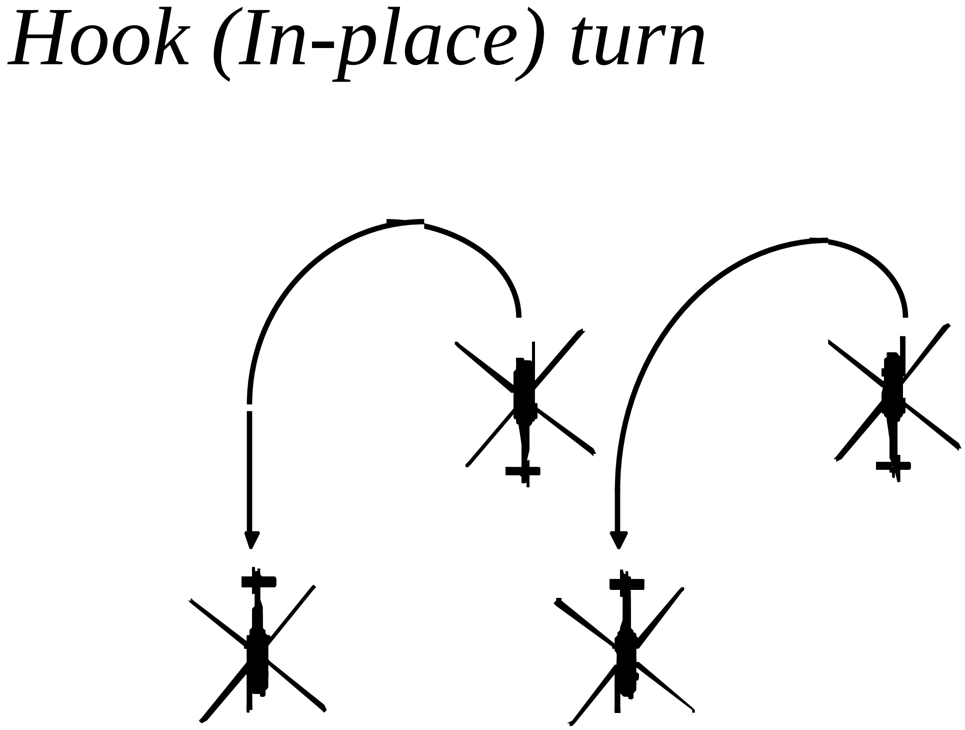


Figure 7.10. Hook Turns.



7.18.3.5. Split Turns (see figure 7.11.) are turns of 180^0 of heading change. They can be performed from either the combat cruise, line abreast, or fluid trail formations. On the radio command "Jolly flight, Split," both aircraft will initiate a 180^0 turn away from each other. The angle of bank and power should be maintained as briefed so the wingman should be in opposing trail at the 90 degree position. The maneuver is completed with a roll out in the new direction (180^0 from the initial heading). At night, the roll out heading will be specified during all split turns.

7.18.3.6. Center turns (see figure 7.12) are turns of 180^0 degrees of heading change that can be performed from either the combat cruise or the line abreast formation. This turn is used to reverse the flight's heading while decreasing the horizontal distance between the aircraft. The maneuver is initiated with the radio call, "Jolly Flight, Center Turn." After the radio call both aircraft will turn toward each other while maintaining power but WILL NOT cross flight paths. Separations will determine the angle of bank necessary to establish each aircraft on the new heading with the desired separation. This is normally .8 to 1.2 NM spacing. Center turns will be performed only during day operations.

7.18.3.7. Cross turns (see figure 7.13)are turns of 180^0 that can be performed from either the combat cruise, line abreast, or loose fluid trail formation. This turn can be used to reverse the flight's heading in channelized terrain. The radio command, "Jolly flight, Cross turn" is used to initiate the maneuver. Once initiated the flight will turn 180 degrees towards each other. It is understood that the formation wingman will fly on the outside of the turn. Because of positioning lead may elect to fly on the outside of the turn, in this case the radio command will be: "Jolly flight, Cross turn, Lead's outside" indicating that he will assume the outside position in the turn. The aircraft that will assume the inside position will turn first toward the other aircraft. After the inside aircraft has completed 20^0 - 30^0 of heading change the outside aircraft will begin its turn. Initial separation determines the angle of bank needed to reestablish each aircraft on the new heading with the desired separation. Aircraft separation is the responsibility of the aircraft that is going to be on the outside of the turn. Cross turns will not be performed at night.

Figure 7.11. Split Turns.

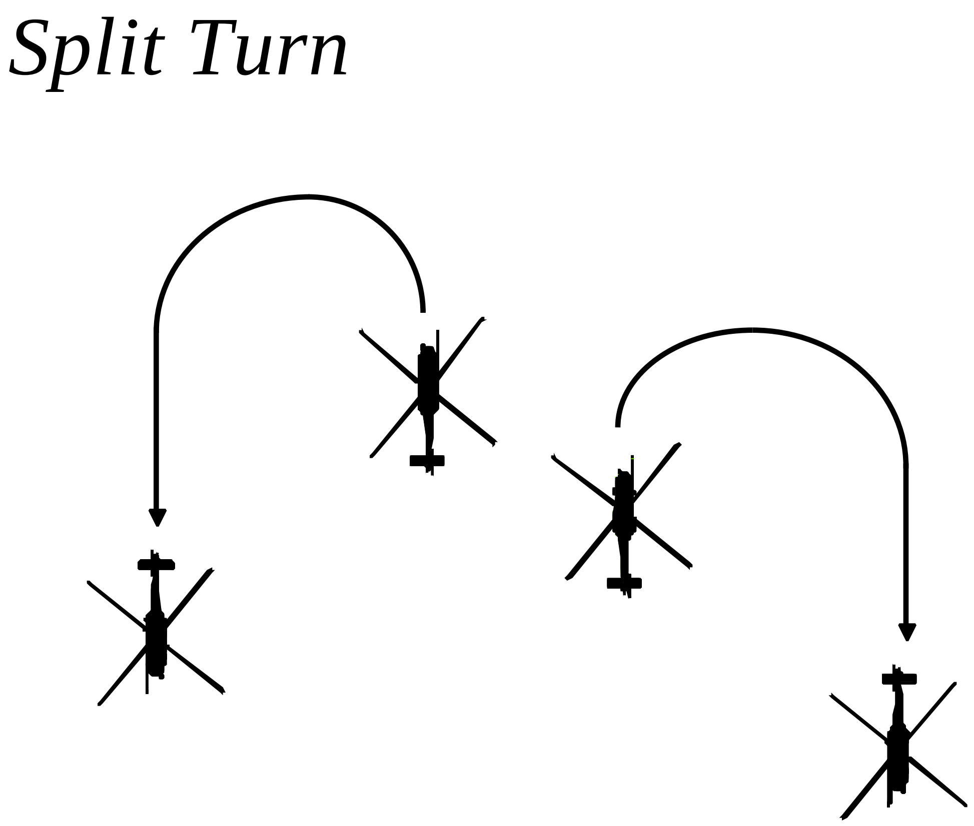


Figure 7.12. Center Turn.

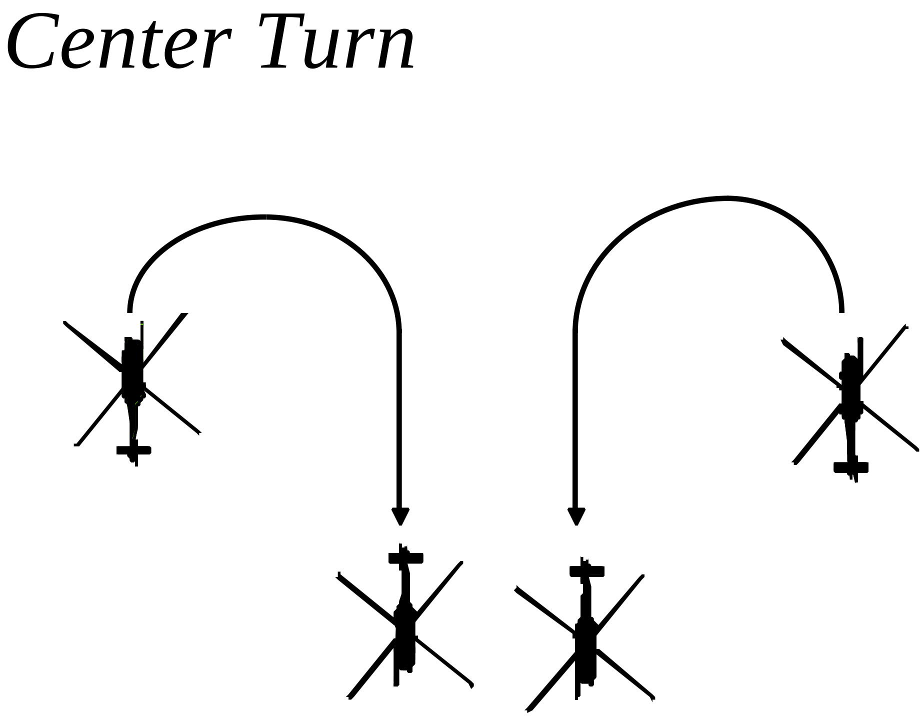
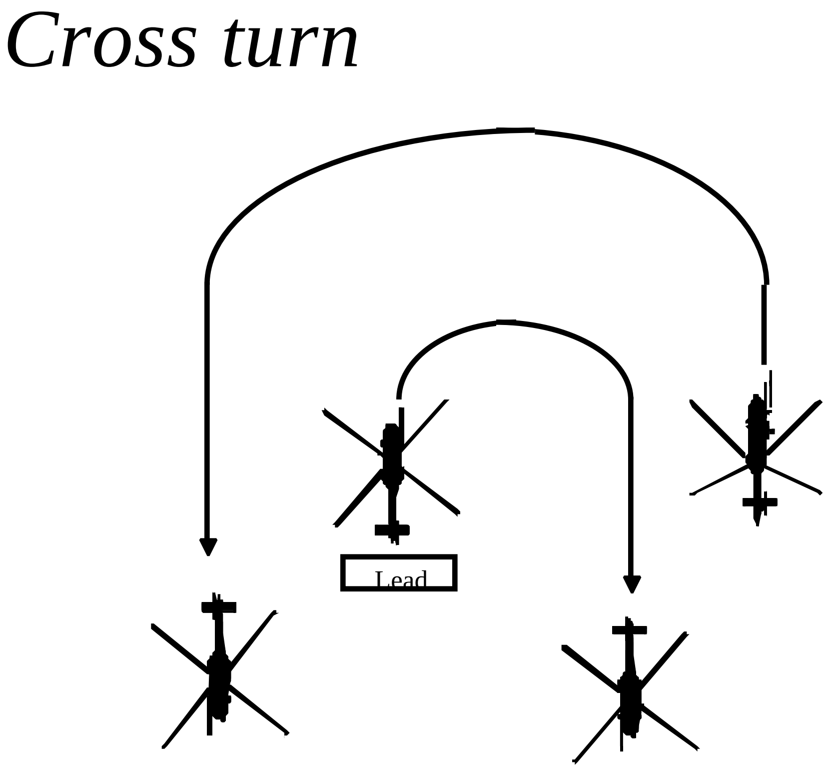
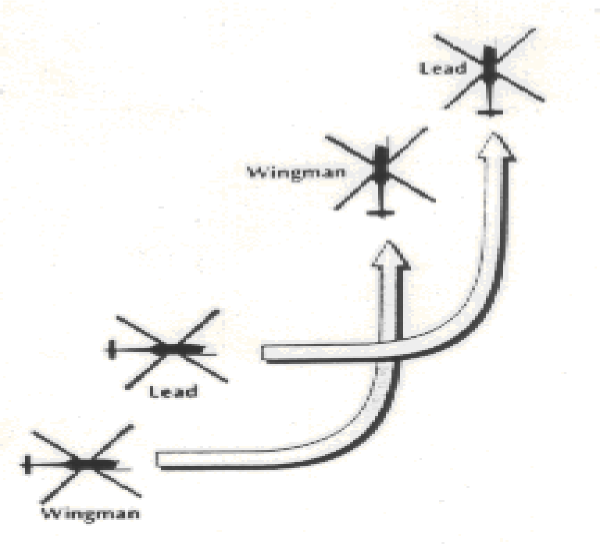


Figure 7.13. Cross Turn.



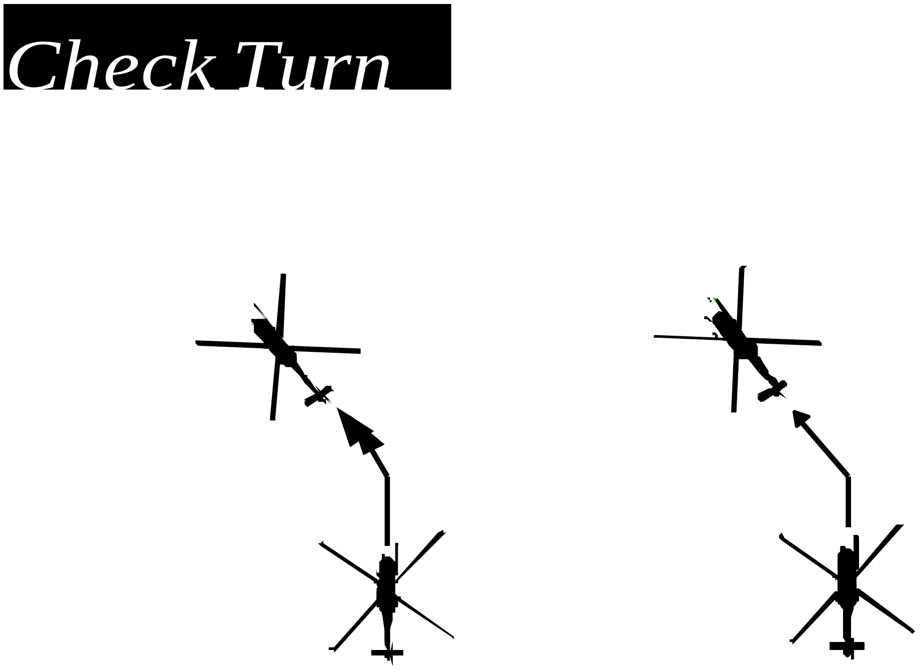
7.18.3.8. Break turns (figure 7.14) are maximum aircraft performance maneuvers which orient the flight or aircraft toward or away from a particular threat. They are normally sharp 90 degree turns, and they require extreme caution when executed at close spacing. They are initiated with the radio command, "Jolly flight, break right (or left)." If the flight is spaced too close break turns have the potential for collisions. If the lateral separation is too close the potential exists that the aircraft on the outside of the first turn may be faced with an expanding separation with lead which make take many miles to close.

Fig 7.14 Break Turn



7.18.3.9. Check turns (see figure 7.15) are simultaneous formation turns that change the formation heading up to 90^0. The radio command is, "Jolly Flight, Check Right 30." Check turns can be performed from either combat cruise, line abreast, or loose fluid trail. Both aircraft turn the appropriate direction the correct number of degrees and continue. The check turn is used for minor heading changes or to reposition the wingman from line abreast to combat cruise or back.

Figure 7.15. Check Turn.



7.18.3.10. Cover. The radio command, "Jolly Flight, Cover" can be added to any of the other formation maneuvers to tell the wingman to break horizontal plane with lead by either increasing or decreasing altitude. If lead desires to break plane the call would be, "Jolly Flight, Check Left 30, and Cover, Lead's High." This maneuver is particularly useful in breaking plane with formation aircraft and thus avoiding becoming a linear target when encountering a threat.

Chapter 8

REMOTE OPERATIONS (NON-TACTICAL)

8.1. Introduction. A large part of our job, by the nature of what we fly, involves going into remote areas to perform a variety of missions in a non-tactical environment. This chapter serves as a foundation to allow you to accomplish those missions in the safest, most effective, and most efficient manner possible. The discipline gained from the application of these techniques and procedures will also serve the aircrew well in conducting tactical operations.

8.1.2. The final decision to accomplish the approach or landing always rests with the aircraft commander. Remember, also, that safety of flight must not be jeopardized for mission accomplishment.

8.2. Purpose. This chapter provides guidance for the successful accomplishment of remote site operations. The term "remote site" includes any landing site that is not an airfield maintained for continuing aircraft operations. Approved transition slide areas are not considered remote sites. The techniques and procedures in this chapter are intended to be applied when operating in these areas in a non-tactical environment. Obviously, not every remote operations scenario can be accomplished without some modification to these techniques. However, they have been developed and refined over many years in an effort to increase the aircrew's situational awareness (SA). Through good crew coordination and management techniques, each crewmember's SA can be elevated as high as possible. This chapter will cover techniques and procedures to be used for remote sites and operational landing sites in the day, night unaided, and NVG environments.

8.3. Unprepared Remote Site Operations. There are a wide variety of missions which involve operating in unprepared remote sites. Peacetime SAR, VIP, range support, and cargo sling operations are just a few examples. Each mission and area of operations is unique and, therefore, involves special considerations. There are, however, common elements of all missions which can be planned and organized for in order to enhance the aircrew's SA and allow them to better focus on the peculiarities of each mission. Most of these missions can be divided into the following phases (each of these phases will be discussed separately):

8.3.1. Preflight.

8.3.2. Mission planning.

8.3.3. Enroute.

8.3.4. Search

8.3.5. Site evaluation.

8.3.6. High reconnaissance.

8.3.7. Low reconnaissance.

8.3.8. Approach.

8.3.9. Crew duties at the site.

8.3.10. Takeoff.

8.4. Unprepared Remote Site Procedures. Many of the procedures in this section also apply to tactical operations. Aircrew should consider the tactical situation, and apply as many of the remote operation techniques to their tactical procedures as possible. For instance if a crew is operating in a low threat environment, they may want to consider over flying the site and accomplishing as many reconnaissance procedures as possible.

8.4.1. Preflight. The amount of preflight activity is dependent on several factors. A life-or-death situation obviously calls for rapid response. Such missions do not, however, justify hasty mission execution, which leads to taking unnecessary risks. Every effort will be made by supervisory personnel and controlling agencies to ascertain the validity of a life-or-death situation so as not to place the crew in a situation of unnecessary risk. The crew must continue to evaluate such situations as the mission progresses.

8.4.1.1. A short amount of time enroute to the site may require the crew to conduct most or all of the required briefings prior to takeoff. A longer enroute time would obviously allow the crew to delay some of the briefings until the enroute phase. Care must be taken in the latter case, however, to ensure that either all required information is known or communications are adequate for the crew to obtain the necessary information. It is often advisable to complete the more "standard" portions of certain briefings/checklists to save time upon arrival on scene. For example, it could save time during the actual site evaluation when you anticipate you will have to perform an AIE, and have already completed that portion of the AIE Briefing that discusses Emergency Procedures.

8.4.2. Mission planning. During premission preparation, use all available information to ensure aircraft and crew limitations are not exceeded. This is the time to perform risk analysis. Consider crew qualification and experience as well as the environment in which the operation will be conducted. Those factors affecting the operation that are known prior to takeoff should be reviewed in order to properly configure the aircraft and provide better SA upon reaching the site. Information that is not available for the site of intended operation will require evaluation on scene. Planning considerations should include the following items as a minimum:

8.4.2.1. Mission requirements.

8.4.2.2. Aircraft configuration/weight and balance considerations.

8.4.2.3. Fuel requirements, equipment, and personnel required to safely accomplish the mission.

8.4.2.4. Crew qualification/experience.

8.4.2.5. Navigation.

8.4.2.6. Maps and charts.

8.4.2.7. Route of flight.

8.4.2.8. Weather.

8.4.2.9. Pressure Altitude (PA) and temperature.

8.4.2.10. Accurate wind information; this is probably more difficult to obtain and more variable than other planning data. Do not count on having beneficial winds at the site when calculating site TOLD.

8.4.2.11. Communications.

8.4.2.12. Performance/Takeoff and Landing Data (TOLD).

8.4.2.12.1. Worst case versus actual conditions: Calculate worst case TOLD in the event you don't have time upon arrival on scene to calculate actual TOLD. Actual TOLD will provide the crew more accurate information as to how the aircraft should perform on the approach and in the LZ.

8.4.2.12.2. All factors pertaining to the objective area (High/Low Reconnaissance items).

8.4.2.13. Crew briefing. Due to pre-mission duties and time constraints, some crewmembers may not be available for briefing prior to arrival at the aircraft. Therefore, ensure all crewmembers are fully briefed prior to starting checklists. Also, ensure all passengers and scanners are appropriately briefed.

8.4.2.13.1. Search briefing. Conduct IAW MCI 11-HH60G, Vol 3, Attachment 1.

8.4.2.13.2. AIE briefing. Conduct IAW MCI 11-HH60G, Vol 3, Attachment 1. If time permits, have the pararescuemen devise a plan of action if their employment is anticipated.

8.4.2.13.3. Sling briefing. If a cargo sling is required conduct the briefing IAW AFI 11-2-HH60G, Vol 3, Attachment 1.

8.4.3. Enroute.

8.4.3.1. In-flight HIT check. Perform IAW the flight manual.

8.4.3.2. Site TOLD. Review/calculate worst case TOLD in the event you don't have time upon arrival on scene to calculate actual TOLD. Actual TOLD will provide the crew more accurate information as to how the aircraft should perform on the approach and in the LZ. The CDU calculate page is accurate and can be used to compute hover power required very quickly.

8.4.3.3. Search briefing. If a search is required, conduct/finish the search briefing as soon as practical. If a significant amount of time has passed since conducting the briefing, consider reviewing key elements and crew duties.

8.4.4. Site evaluation. This section covers general information and considerations for the site evaluation. The actual evaluation starts upon initial sighting of the objective and continues until the aircraft has departed the site. Conduct as many High and Low reconnaissance as necessary to determine the information you need to safely accomplish the mission. A pinnacle landing area may require flying around it at a constant altitude to afford you a look at the site from all possible angles. This reconnaissance may also provide you areas of up and down drafts indicating wind speed and direction.

8.4.5. Crew duties during site evaluations. It is recommended that the Pilot Flying go through the complete reconnaissance without interruption, unless a crewmember feels immediate input is necessary, and request crew input after covering all items.

8.4.5.1. Pilot Flying (PF). Perform and verbalize the site evaluation.

8.4.5.2. Pilot not flying (PNF). 1) Assist the Pilot Flying as required. 2) Confirm all TOLD when required.

8.4.5.3. Flight Engineer (FE). 1) Compute TOLD for landing site to include power available and power required for the anticipated hover height. 2) Attempt to have cabin configured in advance of arriving for the operation/reconnaissance so your attention can be focused on the site evaluation. 3) Be prepared to add to/clarify what you see vs. what the pilot is verbalizing.

8.4.5.4. Pararescuemen and/or Scanners. Make additional inputs to the crew as necessary.

8.4.6. Initial pass. Regardless of your intentions upon arrival at the site, you will always make an initial pass. Use this opportunity to determine the parameters to be used for the high reconnaissance. While it is often difficult to ascertain the actual elevation of a site before over-flight, the crew should attempt to fly over the site at no less than 300 feet above site elevation (ASE). The pilot should also keep the airspeed above safe single engine airspeed. Crew duties/coordination are as follows:

8.4.6.1. Pilot Flying. Verbalize the items to be accomplished.

8.4.6.2. Pilot not flying. Confirm the site elevation and PA.

8.4.6.3. Flight Engineer. Assist in determining wind direction/velocity and accomplish Before Landing Checklist. Confirm TOLD and recompute as necessary.

8.4.6.4. Pararescuemen and/or Scanners. Make additional inputs to the crew as necessary.

8.4.6.5. Items to be covered during initial pass: Winds, Elevation, Before Landing Checklist (WEB).

8.4.6.5.1. Winds. Wind is the most variable of all factors and must be constantly evaluated. Prior to descent for a high reconnaissance, the pilot should have a general idea of wind direction and velocity. There are several methods of determining wind direction and velocity. Some examples are:

8.4.6.5.1.1. Smoke generators are the most reliable, but they may constitute a fire hazard when used in areas covered with combustible vegetation. Use caution when using smoke devices as they pose a fire hazard in some areas.

8.4.6.5.1.2. Helicopter drift. As the site is approached, roll into a turn to pass directly over the site at a constant airspeed and angle of bank. After completion of a 360° turn, note your position. The wind is blowing from the site to your position.

8.4.6.5.1.3. Streamer deployment over a known position with visual tracking of the streamer to the ground.

8.4.6.5.1.4. Foliage, ripples on water, blowing sand, snow, or dust.

8.4.6.5.1.5. The doppler/INS/GPS may also be used to determine wind direction and velocity

8.4.6.6. Elevation. Determine the actual elevation of the site. This will allow the PF to set up a 300 feet AGL traffic pattern. It will also allow the PNF to observe or calculate the PA. Set 29.92 in the PNF's altimeter to get actual site PA.

8.4.6.7. Before Landing Checklist. Accomplishing it early decrease the workload at the site.

8.4.7. High reconnaissance.

8.4.7.1. Parameters. 1) Approximately 300 feet AHO. 2) Along intended approach path (usually into wind unless terrain, obstacles, emergency landing areas, or other factors dictate a different approach path). 3) Flown offset to the side of the site to allow the pilot flying the approach to conduct a good site evaluation. 4) Right-hand rectangular pattern to maintain better SA, if practical.

8.4.7.2. Crew duties/coordination:

8.4.7.2.1. Pilot Flying. The PF will verbalize the site evaluation and plan of action and request input from other crewmembers.

8.4.7.2.2. Pilot not flying. Make inputs as necessary.

8.4.7.2.3. Flight Engineer. Make inputs as necessary.

8.4.7.2.4. Pararescuemen and/or Scanners. Make inputs as necessary.

8.4.7.3. Items to be covered: Approach and departure route, Approach angle, Suitability, Winds & Turbulence, Escape routes & Go/No-go point, Elevation, Temperature, & PA, Target/Touchdown Point, Power Available vs. Power Required (A^2SWEETP).

8.4.7.3.1. Approach and departure route. 1) Wind considerations 2) Terrain considerations.

8.4.7.3.2. Approach angle. Recommend a normal approach, if possible.

8.4.7.3.3. Suitability (Size, Shape, Slope, Surface).

8.4.7.3.4. Winds and turbulence. Consider the winds and their effects. Test your assumptions of wind effects while performing the reconnaissance. If a crosswind must be accepted on final, choose right or left based on terrain and power margin. If you have greater than a 10% power margin and terrain allows, plan for a right crosswind so you can abort into the wind. A left crosswind would be preferable if the aircraft is in a marginal power situation (power margin of 10% or less) due to the fact that the aircraft will tend to weathervane into the wind and holding right pedal to keep the nose straight takes less power than the right crosswind which requires the left pedal. Any landing site with obstacles on the upwind side (e.g. a confined area) will subject the helicopter to a null area (an area of no wind or, in some cases, a downdraft). It is important to avoid this null area if marginal performance capabilities are anticipated.

8.4.7.3.5. Escape routes and go/no-go point. Plan an abort route, preferably down-hill and/or into the wind without climbing. If it is necessary to turn during an abort, a right turn is preferable (terrain permitting) due to the fact that less power is require to perform a right turn than a left turn.

8.4.7.3.6. Elevation, temperature and PA.

8.4.7.3.7. Target/touchdown point. Be very specific (e.g. "25 meters left of the big tree").

8.4.7.3.8. Power available vs. power required. Refer to MCI 11-HH60G, Vol 3, for operational and training power requirements for clear and/or restricted escape routes.. Remember to consider added weight and the need to get out of the site. The power required performance charts in the flight manual are based on a hover over level, non-porous surfaces. When landing in unprepared sites, aircrew should be aware of increased power requirements when hovering over tall grass, slopes, and obstacles in close proximity to the aircraft. Consider increasing required power margins if the aircraft must be placed in a situation requiring a vertical climb-out to clear obstacles. If the power margin is marginal or unacceptable, consider the following possibilities to improve conditions: 1) Download at an alternate landing site to decrease aircraft gross weight. 2) Fuel dumping. 3) Locate a more suitable area. 4) Abandon the mission.

8.4.8. Low reconnaissance.

8.4.8.1 Parameters. The low reconnaissance serves as a "practice approach" to determine the safest final approach and refinement of items noted in the high reconnaissance. Fly the low reconnaissance as nearly as possible on the same approach angle and route selected for the final approach. If the selected approach route or angle is not satisfactory, select another route or angle and execute another low reconnaissance. Descend on the selected angle, to a minimum of approximately 50 feet above the highest obstacle along the flight path. Fly the low reconnaissance above minimum safe single engine airspeed or translational lift, whichever is greater. Fly offset to the side of the site to allow the pilot flying the approach to conduct a good site evaluation. Recommend using a right hand rectangular pattern to maintain better SA during the low reconnaissance.

8.4.8.2. Items to be covered: Approach & departure route, Approach angle, Suitability, Winds & Turbulence, Escape routes & Go/No-go point, Elevation, Temperature, & PA, Target/Touchdown Point, Power Available vs. Power Required (A^{2}SWEETP).

8.4.8.2.1. Approach and departure route. 1) Wind considerations 2) Terrain considerations.

8.4.8.2.2. Approach angle. All approach angles are apparent and the exact angle cannot be dictated. Aircrews should attempt to establish a specific final approach entry altitude of 300 feet ASE prior to attempting an approach so they are using a familiar sight picture. The normal approach should be considered for use in almost all cases. The steep approach requires the pilot to stop the rate of descent at the same time the helicopter is coming out of translational lift, which may require more power than is available. However, a steep approach may be required for adequate clearance of obstacles, downdrafts, and null areas (due to wind). A steep approach may also be preferred to ensure landing in the area in the event of power loss on short final. A shallower than normal approach allows the rate of descent to be stopped prior to the loss of translational lift. The type of approach flown must take into account balancing the need to assure a safe landing or go-round while staying in the green area of the Height-Velocity (H-V) diagram (refer to flight manual), insofar as practical. The green area of the H-V diagram doesn't guarantee the safest approach. Rather, it merely shows where a safe landing can be made to a flat surface in the event of an engine failure.

8.4.8.2.3. Suitability (Size, Shape, Slope, Surface).

8.4.8.2.4. Winds and turbulence. What is the effect of the wind during the approach?

8.4.8.2.5. Escape routes and go/no-go point. Brief abort route and go/no-go decision points and intentions.

8.4.8.2.6. Elevation, temperature and PA.

8.4.8.2.7. Target/touchdown point. Be very specific (e.g. "25 meters left of the big tree").

8.4.8.2.8. Power available vs. power required. Is ground effect assured at the landing or hover site?

8.4.9. Approach. The approach you fly should be on the same approach path and angle as your low reconnaissance. All approach angles are apparent and the exact angle cannot be dictated. Aircrews should attempt to establish a specific final approach entry altitude of 300 feet ASE so they are using a familiar sight picture. Remote site approaches require an aircrew to be alert and keep a comparison of indicated airspeed and ground speed prior to actual touchdown with a go-around planned at all times. The crew must continue to maintain the selected angle and control the rate of descent, especially during the last 100 feet. Prior to decelerating below translational lift/safe single engine airspeed, the pilot should consider altitude remaining and ensure the approach can be safely completed on the selected angle. Once translational lift is lost, the possibility of a go-around is marginal or nonexistent. On short final, before the helicopter is committed to land, analyze these three variables: proper rate of closure in relation to translational lift; rate of descent under control; power smoothly increasing, but below hover power. If more than hover power is being applied to hold your approach angle you should suspect that something is wrong. It is possible that the aircraft is heavier than planned, you have a cross or tailwind, you have encountered turbulence, your closure rate or rate of descent is too high, your power required computations have been miscalculated, or something else is wrong. In this case, it may be necessary to execute a go-round to re-evaluate your conditions.

8.4.9.1. Types of approaches. The normal approach should be considered for use in almost all cases. The steep approach requires the pilot to stop the rate of descent at the same time the helicopter is coming out of translational lift, which may require more power than is available. However, a steeper than normal approach may be required for adequate clearance of obstacles and avoiding null areas (due to wind). A shallower than normal approach allows the rate of descent to be stopped prior to the loss of translational lift. This allows the ground cushion to be picked up with the pilot in full control of the sequence of events. The approaches defined here may be used in any situation with the exception of night or water operations which are covered elsewhere. There are three types of approaches: traffic pattern approach, turning approach, and tactical approach.

8.4.9.1.1. Traffic pattern approach. This approach is normally flown from a rectangular or modified rectangular pattern where level flight can be established on the initial segment of the final approach prior to starting a descent. It is particularly applicable for fixed base operations, pinnacle approaches, student training, and where depth perception is a problem.

8.4.9.1.2 Turning approach. This type of approach may be entered from any position in relation to the landing and/or hover area. Maneuver and descend as necessary to a point on final where a controlled straight-in approach can be flown to the site. The point of roll-out on final varies with the entry point altitude and power reserve, but should be accomplished high enough to avoid the need for rapid flares, abrupt control movements, or large collective input. Avoid low airspeeds while on downwind, especially in strong winds. Avoid high angle of bank turns. Improperly executed descending turns under such conditions can result in rapid loss of lift from which there may be insufficient altitude and/or power to recover.

8.4.9.1.3. Confined area. A confined area approach should be no steeper than any other type of approach. Some confined areas with high barriers will not allow the touchdown point to be kept in sight during the approach without using an excessively steep approach angle. A common problem associated with a steep approach over a barrier is that translational lift may be lost when the helicopter is possibly 100 to 200 feet AGL. This places the helicopter in a pre-settling with power or full settling with power condition, depending on the sink rate. The confined area approach should use a normal approach angle using the top of the nearest obstacles as a simulated touchdown point. This gives a precise point to plan the approach. The approach is done as though an actual landing will be made above the obstacle. The approach is continued until the actual touchdown point, in the forward usable third of the area, is in sight. At this point, the rate of descent should be very low (less than 300 FPM), and the power should be steadily increasing. The final portion of the approach is completed by flying down to a touchdown or hover, avoiding any additional rate of descent.

8.4.9.2. Visual illusions. During an approach, you must be aware that uneven terrain surrounding the landing site gives poor visual cues as to actual aircraft altitude and rate of closure. Where the terrain slopes up to the landing site, a visual illusion occurs, giving you the feeling the aircraft is too high and the rate of closure is too slow. If the terrain slopes down to the landing site, you will experience the feeling that the aircraft is too low and the rate of closure is too fast. You must be aware of these illusions and overcome the temptation to make unnecessary control movements. Reference to flight instruments during the approach is necessary to ensure a safe approach. Simply meeting the parameters of the type of approach flown does not guarantee the success of the approach. The crew must continue to maintain the selected angle and control the rate of descent, especially during the last 100 feet. Prior to decelerating below translational lift, the pilot should consider altitude remaining and ensure the approach can be safely completed on the selected angle. Once translational lift is lost, the possibility of a go-around is marginal or nonexistent.

8.4.10. Hover. Upon arriving at a hover over an intended landing area, allow helicopter movement to stabilize. Hovering over trees and uneven terrain requires additional power because full ground effect is not realized. Survey the landing area and determine the best landing spot. Small branches and bushes flatten with rotor wash, but could spring up into the rotor blades after shutdown. Check for stumps, rocks, or depressions which could be hidden by grass. Keep in mind there is very little clearance between the bottom of the aircraft and the ground.

8.4.10.1. If the condition of the landing zone cannot be determined from the helicopter, it may be advisable to hoist a crewmember to the ground to perform a survey. This crewmember could also be used to improve the landing area and aid the pilot during aircraft touchdown If this option is used, ensure you have the appropriate crew compliment to allow you to either recover the crewmember or complete the operation with a deployed crewmember.

8.4.10.2. When hovering over loose snow or dust, be prepared for an immediate takeoff. Blowing dust or snow may cause loss of visual references and spatial disorientation. If visual references are lost, a vertical instrument take-off (ITO) should be made until clear of the cloud. Establishing a normal hover attitude will ensure a vertical climb, whereas a level attitude on the HSI will cause a forward-right drift.

8.4.11. Landing. Maintain rotor RPM and slowly decrease collective pitch. Be ready for an immediate takeoff if the helicopter starts to tip. Be aware of your aircraft slope limitations IAW the flight manual.

8.4.11.1. White-out/Brown-out landings. Landing in white-out or brown-out conditions requires extra care. When landing on a prepared surface, a running landing can be accomplished. Touch-down speed should be just fast enough to keep the sand or snow cloud aft of the cockpit at touchdown. Always be alert for obstacles that can damage the FLIR and/or VHF antenna. Ground roll should be minimized on rough terrain. If a running landing or approach to a high hover is not feasible, a well planned approach to a clearly visible marker may be possible. The best objects are ones that are naturally located on the ground such as a bush or vegetation. Using objects thrown out of the helicopter such as chem lights can be hazardous because they tend to be blown by rotor down wash on short final. When using a ground reference fly the approach so the object will be at a 45^0 angle out the pilot flyings door, just outside the rotorpath. Ensure the pilot not flying also has some references. Approach speed should gradually decrease to touchdown at zero forward speed. The flight engineer and/or scanner must inform the pilot as the snow/dust cloud approaches and envelopes the aircraft. Call cloud starting to form, at the tail, at the cabin door, etc., to advise the pilot of impending white/brown-out. The aircraft should be in a position to land, that is, minimum forward speed, no side drift, gear about to touch and marker in sight as the cloud comes forward of the cockpit. If any of these criteria are not met, strong consideration should be given to a go-around. Initiate a go around by establishing a hover attitude on the attitude indicator and adding power to ensure a vertical climb. A level attitude on the attitude indicator should be avoided as it will usually result in right forward drift and slower vertical climb.

8.4.12. Crew duties at the site.

8.4.12.1. General aircrew. During an approach, if the aircraft or crewmembers are not performing as expected, call "go-around." Circumstances permitting, the pilot flying should initiate a go-around immediately and the situation discussed and clarified later. Aircrews should be aware of the need for a rapid response to a "go-around" call. Rather than call out a specific condition or parameter (i.e., "800 FPM"), the PNF, or other crewmember, should call "go around".

8.4.12.2. Triangle technique. This technique is a call sequence where most of the calls are initiated by the PNF, followed by the FE, then the left scanner. When the PF begins the approach, he makes an "on the approach" call. This is followed by the FE with a "clear down right" call followed by the left scanner calling "left" (implies clear down left). The PNF initiates the triangle with an altitude call (and other parameters if desired: airspeed, sink rate, torque, rotor RPM, etc.), followed by the "clear down right/left" sequence. This triangle is typically repeated at 50-foot intervals during the approach. On short final, the pilot should specify when he wants the FE to start providing approach direction by making a specific call such as "losing sight of LZ", "doors", "go hot mike", etc. If the approach will terminate with a landing, the triangle stops and approach direction calls are initiated by the FE and echoed "left" by the left scanner. If the approach terminates in a hover, the "triangle" continues with the PNF initiating with radar altimeter calls, typically in 10-foot intervals.

8.4.12.3. Pilot flying. Fly the aircraft using the parameters for transition maneuvers. That is, if a normal approach is briefed, all normal approach transition parameters apply. The pilot will advise the crew anytime sight of the landing area is lost and request directional input. Once below the level of the obstacles, the pilot should not move the aircraft in any direction that cannot be cleared.

8.4.12.4. Pilot not flying. Take an active part in providing accurate and timely input to the pilot flying. Monitor the approach, landing, and takeoff. This includes the approach angle, approach path, airspeed, vertical velocity, attitude, and altitude. Make advisory calls for deviations. Be aware of the power available versus power required (power margin). On short final or as hover power is approached, inform the pilot flying of the amount of power being applied. In the landing area, monitor engine instruments, and help maintain adequate blade tip clearance.

8.4.12.5. Flight engineer. Monitor approach angle, obstacle clearance, altitude, and closure rates to the specific landing area. Clear the aircraft of all obstacles. If in the flight engineer station, monitor engine instruments, altitude, rate of descent, etc.

8.4.12.6. Pararescuemen and/or scanners. Monitor approach angle, obstacle clearance, altitude, and closure rate to the specific landing area. Clear the aircraft of all obstacles.

8.4.13. Takeoff. Recompute or confirm adequate power required to hover (i.e. TOLD) if you have added personnel or other weight to the helicopter.

8.4.13.1. Departure route/wind check. Recheck the wind direction and velocity. Determine the best departure route consistent with the wind direction and select a takeoff abort point. Be sure to state your abort point/intentions.

8.4.13.2. Under certain combinations of limited area, high upwind obstacles and limited power available, the best takeoff route may be crosswind. Even though this is a departure from the cardinal rule of "takeoff into the wind," it may be the proper solution when all factors are considered.

8.4.13.3. Performing the takeoff. Use transition parameters for all takeoffs from remote sites. If takeoff power is reduced prematurely, safe obstacle clearance may be jeopardized. The null area is of particular concern in making a takeoff from a confined area. Under a heavy load or limited power conditions, it is desirable to achieve translational lift, before encountering a null area and prior to climbing, so the overall climb performance is improved. In the vicinity of the null, a nearly vertical downdraft may be encountered, further reducing climb rate. When obstacle clearance is of primary concern, the pilot's attention is concentrated outside the aircraft. These circumstances require increased crew coordination.

8.5. NVG Remote Operations. Conduct NVG remote operations in the same manner as day remote operations. Consider factors and techniques presented in the night operations chapter. One major difference to day remote operations is area/site visual references on scene. Consider light sources where natural references are a problem. Use of chemlights will aid in identifying the specific area of operation, aid in determining excessive rates of closure or descent, and provide hover references. Additionally, they will aid in detecting sideward drift.

8.5.1. The following guidance is useful in accomplishing NVG remote operations.

8.5.2. External infrared lighting may be useful during NVG remote terminal operations.

CAUTION*:* Use of IR lighting in brownout/whiteout conditions can seriously degrade visibility. When these conditions are anticipated, IR lighting, if used, should be dimmed to the lowest level necessary to safely accomplish the landing. The pilot must be prepared to immediately extinguish the light if encountered conditions warrant. Extreme caution must be used to ensure that non-IR white lights are not illuminated accidentally during an approach. Other artificial light sources can also aid the crew in accomplishing NVG terminal operations (i.e. ground lighting patterns).

8.5.3. Lighting patterns may be established in blowing snow, dust, tall grass, and similar environments by a variety of methods. Using bundles of chemlights are the most common and useful.

8.5.3.1. The crew should make a low pass over the LZ to throw out the marking devices at a prescribed time and interval from both sides of the aircraft. This technique is similar to the NVG water operations pattern for chemlight deployment. When using chemlights, aircrews must be aware that rotor wash may move these lights when the aircraft comes to a hover or is on short final. For this reason, aircrews should not use these lights for hover references or for landing cues during the last 30 feet of an approach.

8.5.3.2. Use the ground lights to establish the aircraft on final and initiate the approach. Light references will provide the aircrew cues for transitioning to a landing attitude. If the crew has not picked up sufficient visual cues to land the aircraft by 30 feet consider a go around.

Figure 8.1. Approaches to Lighted T-Pattern in Landing Zone.

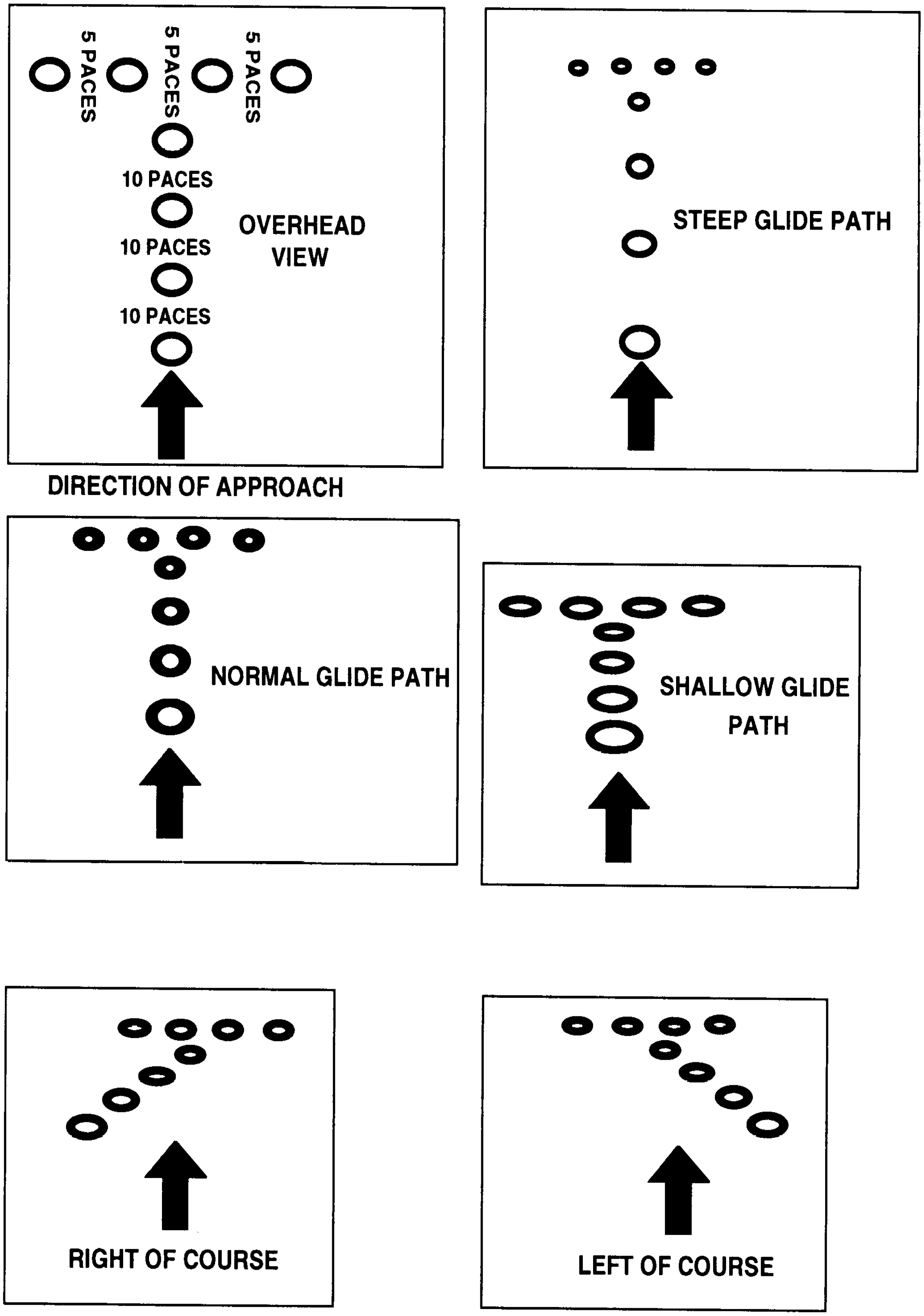
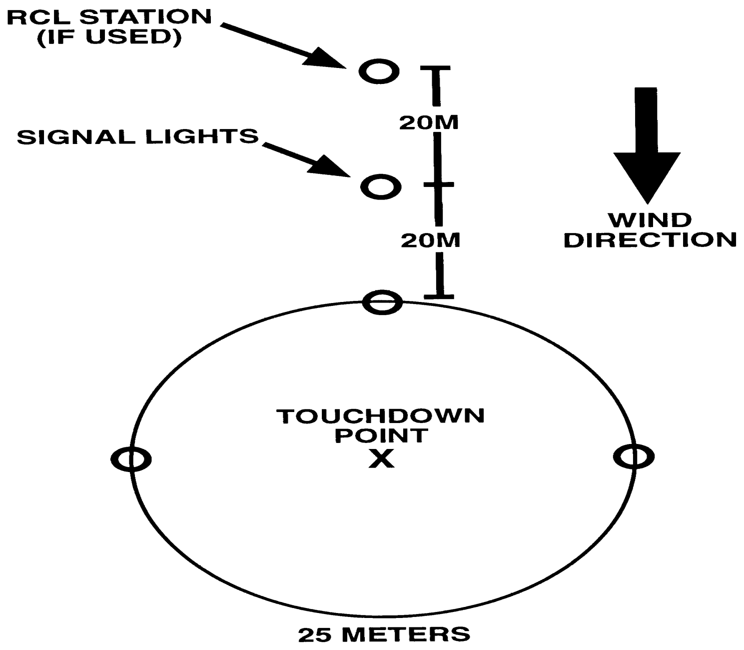


Figure 8.2. Helicopter Landing Zone Pattern For Night Operations (Inverted Y).



8.6. Wind Determination. One of the most difficult and important tasks to accomplish during remote operations is to determine the winds. Techniques for confirming area winds and wind strength are:

8.6.1. Cloverleaf method. Using the site as a target, fly the aircraft on a cardinal heading at 300 feet AGL and in trim. Note the drift; this narrows wind direction down to a 180° arc. Turn 270° away from the wind. Fly, in trim, at 90° across the first intended track and note drift. The wind direction can now be determined within a 90° arc. Turn away from the wind again and fly towards the site to bisect the 90° arc. Maintaining aircraft trim, make small adjustments in heading to nullify drift. The aircraft should now be flying directly into wind. Continue to evaluate winds at lower altitudes, because they may change unexpectedly.

8.6.2. Modified cloverleaf. The cloverleaf method can be time-consuming and need only be used if, on arrival at the site, forecast winds appear to be erroneous and no other method of area wind assessment is available. However, if consistent drift has been noted enroute to the site, a modified cloverleaf can be used. Use the site as a target and fly the aircraft in trim towards the site. Continue to adjust aircraft heading until no drift is noted. Turn through 90° to confirm wind direction by noting drift.

8.6.3. 360° Drift check. As the site is approached, roll into a turn to pass directly over the site at a constant airspeed and angle of bank. After completion of a 360° turn, note your position; the wind is blowing from the site to your position.

8.6.4. Streamer deployment. Just like dropping streamers for pararescuemen jumps, deploy a streamer over a known position with visual tracking of the streamer to the ground.

8.6.5. Wind strength check. A rough assessment of wind strength can be made by flying at 90° to the wind and noting the number of degrees of drift over a one mile leg. At 60 knots, one degree equals one knot. At 120 knots, one degree equals two knots.

8.6.6. Ground speed/airspeed comparison. When constrained within the sides of a valley or other obstructions, fly a constant airspeed into and out of the valley and note the groundspeed. This may give you an idea of wind direction and speed.

8.6.7. Navigation system. The navigation system can provide accurate wind information provided the system was configured properly. Wind information taken from the navigation system should be confirmed.

8.7. Site Winds. Topographical features can influence area winds, in some cases severely. Other weather conditions, like temperature, can change a site wind 180° in a short period of time. Site winds can be evaluated by using area wind methods and the following methods:

8.7.1. Smoke. If available, a smoke generator is the most reliable indicator because it will yield wind direction and wind strength information. It can be used both on the site and on any feature close to the site which could affect the approach or takeoff. Use caution when deploying smoke devices because they pose a fire hazard in areas covered with combustible vegetation.

8.7.2. Clouds. Clouds above a landing site may indicate the possibility of downdrafts which could affect the site.

8.7.3. Vegetation. Vegetation around a site can give an accurate wind assessment, both during reconnaissance and up to the last seconds of an approach. Watch which way branches and leaves are swaying. This indicates the direction the wind is blowing from.

8.7.4. Water. The surface of water can form wind lanes (direction and strength) and ruffled water (signs of down drafting). Large bodies of water in rough conditions usually generate a froth that will appear to align into the wind-line. Waves generally roll perpendicular to the wind and any foam on their surface will slide into the wind. Small bodies of water generally have calm areas near the edge or shoreline showing the direction from which the wind is blowing (calm area is upwind).

WARNING: *Winds, especially light winds, can change direction at any time during an approach or takeoff. Never assume that winds will be constant. Changes in wind direction can seriously reduce power margins.*

8.8. Wind speed Considerations.

8.8.1. Light winds. Light winds normally follow contours with predictable updraft and downdraft areas and little or no turbulence. Modification of these winds by temperature generated heated and cooled airflow of up to 20 knots can cause wind reversal and turbulence. Compounded with high temperatures, wind flowing upslope can be amplified on the upwind side and reversed on the leeward side. Turbulence can occur in the area where the winds meet. The reverse is true of cooler airflow, except that turbulence may occur on the valley floor. Light winds, normally, will allow you to take advantage of the best approach path based on terrain and obstacles. However, marginal power approaches, coupled with light and variable winds, can result in the pilot inadvertently placing the aircraft in a vortex ring state. Light and variable wind conditions could result in a tailwind component on final approach causing the pilot to add additional aft cyclic thus placing the aircraft in a regime for which power is insufficient. Due to the insidious onset of vortex ring state under these conditions, pilots must ensure airspeed is maintained above translational lift until committed to a landing and/or hover.

8.8.2. Moderate/strong winds. Areas of updrafting/level airflow and down drafting over a feature are separated by a plane called the demarcation plane (line). As wind speed increases, the plane increases in angle, and its point of contact on the feature moves forward towards the upwind edge. The same effect is found with increasingly sharp features. The demarcation plane can be assessed by experience, knowing the strength of the wind, and by power requirements for a given airspeed noted during reconnaissance and approaches. Another key factor in mountain flying is that in low airspeed situations, updrafting air gives an added power margin, making a safer approach or takeoff. Moderate to strong winds normally will require you to use a steeper than normal approach angle to be into the wind and avoid the null area and associated turbulence downwind of a ridgeline or pinnacle. Use these winds to assist you in maintaining translational lift and prevent you from encountering the loss of translational lift normally associated with steep approaches. Remember, a 10-knot wind blowing down a 5° slope will result in a downdraft component of approximately 88 feet per minute (FPM). A 40-knot wind blowing down a 30° slope will result in a downdraft component of approximately 2,025 FPM. This can easily exceed your aircraft's rate of climb. Do not allow the aircraft to fly through this downwind downslope condition when below translational lift.

WARNING: *Changes in wind direction or speed can vary the demarcation plane. Constant assessment of power required during an approach is necessary to ensure that the last stages of an approach are maintained in updrafting air.*

8.9. Mountain Flying Operations. Mountain flying and operations in high density altitude require knowledge and consideration of factors which affect aircraft performance, power available and power required. No standard type of mountain approach exists. Ideally, the approach should be made into the wind using a constant angle of descent if the terrain will allow. The flight manual contains techniques and consideration for many types of mountain approaches. Generally, operations in density altitudes (DA) above 7,000 feet require a detailed knowledge of the hazards associated with high altitude operations. These problems can be encountered at altitudes below 7,000 feet DA under certain conditions and these factors must be considered. Factors to consider for high DA operations are power settling, premature loss of translational lift, higher power required and less power available, slower control response, potential for blade stall, and loss of tail rotor authority and/or effectiveness. A deliberate site evaluation is an absolute necessity for enhanced safety margin when performing mountain flying operations. Consideration must be given for the loss of power associated with operation of the heater and engine anti-ice systems. If conditions allow, ensure these systems are off when power margins are questionable. Flight with these systems on may decrease or nullify any power margin you had. Consider power, escape routes, the pattern, line and angle of approach, and the use of updrafting air when performing a site evaluation.

8.9.1. Power considerations. At low altitudes and normal gross weights power margins are normally sufficient with modern helicopters. As altitude increases, margins decrease. An in-flight HIT check should be performed enroute to a site if any possibility exists of being power limited prior to arriving at the area or operation. This affords time to calculate aircraft weight changes and accomplish weight reducing actions. Winds should not figure in power calculations. Specific power requirements vary based on many factors. Calculations should always be conservative and should take into account local temperatures modified by possible bubble effect or the constraints of a jungle clearing when temperatures may be higher than suspected. Colder temperatures due to catabolic winds formed on cold surfaces, for example glaciers, can be expected but may not be guaranteed and therefore should not be used in computations. The bottom line is, take into account the worst possible situation, compute carefully and confirm computations.

8.9.2. Escape routes. When transiting through mountains or when operating at a specific site, selecting an escape route should be a prime consideration. Selection of a clear escape route will reduce parameters required for the approach. Escape routes to the right are preferred because less tail rotor power is required. There may be situations when an escape route cannot be utilized during the last few feet of an approach to a mountain site. Also the site surface/slope cannot always be positively ascertained during low reconnaissance. Reserve enough power to hover while a final site evaluation is made. If the site is unfit for use go around and go to your backup plan.

8.9.3. Pattern. High and low reconnaissance should be flown using parameters outlined in this section. Orient your pattern after careful consideration of up/downdrafts, turbulence, and wind direction throughout the pattern. If your intended approach path changes due to problems encountered during the reconnaissance, fly another low reconnaissance using your new approach path.

8.9.4. Line of approach: These considerations may enhance your selection of a good approach path:

8.9.4.1. Wind. The optimum line of approach is into the wind. Nevertheless, should a line be chosen out of the wind, the amount of right or left tail pedal required to swing the aircraft into the wind (during the latter stages of the approach) should be considered in your power margin computations. A right-turning approach uses less power.

8.9.4.2. Demarcation plane (line). In strong winds with a steep demarcation plane, the angle of approach can be modified by approaching across the plane. Thus, a steep approach can be avoided.

8.9.4.3. Escape routes. Accepting an out-of-wind approach line to provide adequate escape routes could be necessary. An approach at right angles (perpendicular) to a ridge should not be made since escape routes are very poor. Angled approaches provide escape routes, both left and right.

8.9.4.4. Local terrain features. The line of approach may have to take into account rising ground in the area of the site. This is especially the case on shoulders, spurs and in valleys. Pattern shape may have to be modified from the classic rectangular pattern.

8.9.4.5 Landing site conditions. When deciding on a line of approach, take into account the size, shape and obstacles at a particular site. Conduct site evaluations outlined earlier in this chapter. Trees and other surrounding obstructions may make it necessary to make adjustments to the approach, either steepening toward the end of an approach as the landing site comes into view, or coming to an OGE hover over the clearing before starting a vertical descent.

8.9.5. Typical sequence of events:

8.9.5.1. In-flight HIT check (if required). This check can be carried out enroute at the same altitude as the site or in the vicinity of the site. Be sure to take into account local heating (bubble effect) when power computations are made.

8.9.5.2. Wind assessment. A continuous assessment should be made. Changes in wind speed and direction can influence all aspects of an approach (power, line and angle of approach, escape routes, areas of drafting and turbulence).

8.9.5.3. Pattern. Orientation of the pattern is determined by wind, escape routes, terrain, and the site location.

8.9.5.4. High/Low reconnaissance. Performed to culminate a crew effort that confirms the risk and defines a plan of action to yield the safest option or method to conduct operations in the remote area.

8.9.5.5. Approach. Try to think of your approach as a practice approach, which can be converted into a real approach if everything goes well. This encourages a mind set to accept a go-around early rather than late. Crewmembers should be alert to call "go-around" if: the approach briefed is not being properly executed, power applied is consistently within 5 percent of maximum power available, vertical velocity limits are exceeded, or the parameters for vortex ring state are encountered.

8.9.6. Approach techniques.

8.9.6.1. Pinnacle approach. Pinnacle operations can be particularly demanding. The following information should make pinnacle operations somewhat easier to execute.

8.9.6.1.1. Pattern. The pattern should be flown at the appropriate altitude above the site. Reference to the barometric altimeter should be made continuously because it is easy to get low while flying the pattern (particularly on base). Downwind should continue to keep the site in view and promote an unhurried final approach. The final leg should include a cross check to ensure proper altitude and speed parameters are set.

8.9.6.1.2. Final approach. Confirm altitude and airspeed for the approach to be flown. If you have an accurate navigation system with groundspeed indication, use it to remain consistent. If groundspeed indications are not available, remember that a higher IAS must be flown to compensate for strong headwinds. Initially, the pilot will have the illusion that the helicopter is too high and that rate of closure is too slow. A glance at the ground out to the side will offer an indication of closure. Fly the approach with a controlled rate of closure (controlled vertical descent and groundspeed).

8.9.6.1.3. Descent. If established approach parameters are not met, abort the approach. Attempt to fly a constant angle with consistent deceleration. A slight overarc in the final stages is acceptable if power is within limits. A constant angle can be maintained using the "boresight" technique: Keep the pinnacle landing site constant to a reference point in the valley or terrain behind the pinnacle. If more of the valley appears, the pilot is flying above the desired angle, or overarcing; if the valley is disappearing, the pilot is flying below the desired angle, and underarcing. An underarc is potentially dangerous because escape options are limited and higher power will be demanded.

8.9.6.1.4. Perception of closure. Closure rate is difficult to judge, even during the last stages of the approach. The best method to gain closure information is to scan terrain in the three or nine o'clock position. Crew coordination and FE "approach dialogue" will help with closure information, especially when the pilot momentarily loses sight of the landing area.

8.9.6.1.5. Late final to hover. This is the most critical part of the approach. Monitor rate of closure and control it. A properly flown approach should not require any more power than that predicted to hover. If you are using more power, consider a go around, especially if underarcing. A slight overarch just prior to the loss of translational lift will ensure termination is directly over the landing area. Then if you run out of power, you are in a better position to land. Another advantage of over-arcing the approach is that it provides an escape option.

8.9.6.1.6. Wind shear. For a pinnacle, the most likely shear encountered will be a headwind shearing to a tailwind or a calm. Be alert for unexpected decrease in IAS and increasing sink rate. Expect to begin under-arcing. Translational lift will be lost earlier and if OGE power is not available, escape may not be possible.

8.9.6.2. Ridgeline approach. Flying at an angle across the demarcation plane (versus along the plane) can lessen the steepness of the approach angle and also provide excellent escape options. A turning approach during the latter part of the approach will be required. A right turn is preferred to maximize power margins. Hovering into the wind can normally be maintained but landing may not be possible on a sharp feature. A single-wheel touchdown may be practical but care should be taken to avoid cyclic control movements which could induce ground resonance or dynamic rollover conditions. When operating over a series of ridgelines, it is possible for "rotors" to form between the ridges which could cause downdrafts where the opposite might be expected. Illusions covered in the pinnacle approach can also pertain to ridgeline approaches. When flying a pattern away from the ridgeline, cross reference instruments to maintain pattern parameters. Anticipate updrafting air currents and plan accordingly.

8.9.6.3. Spur/Shoulder approach. A spur or shoulder terrain feature is generally located on the end or edge of a ridge. Beware of downdrafts that may be caused by the associated, larger, terrain feature which could preclude a safe landing. In this case, assess the area for a safer landing area. If strong updrafts are encountered, power requirements will decrease and rate of descent will slow. Beware that the updraft can stop at any moment and the aspects of the approach will dramatically change. A shallow approach may be more effective under updraft conditions. Spurs often generate local areas of drafting or turbulence. If updrafting air is not turbulent, an approach to a hover near the feature with a good escape route can be used to provide a closer look at the site prior to an approach direct to the site. (OGE power will be required and high and low reconnaissance must be accomplished in both situations).

8.9.6.4. Valley approach. Conduct a careful reconnaissance before committing to an approach to a site located in a valley landing site where wind could cause up/downdrafts. With a wind blowing directly across/over the valley, downdrafts may be minimal or nonexistent on the valley floor. If the wind is blowing directly up a valley, an approach using the length of the valley is recommended, if practical. Otherwise modification of your pattern and use of a turning approach may be needed. If a site is located on the side of a valley, an approach can be made from a hover point close to the LZ and preferably above, to enhance escape routes. Beware of power requirements when these modifications are executed. Pad your approach with extra altitude if upslope terrain exists to the site.

8.9.6.5. Bowl approach. Bowl approaches amplify problems associated with valley flying. The maneuver can be accomplished safely if wind conditions are good and the bowl is large enough for the airspeed/bank angle combination required to carry out safe recons. and approaches. Some bowls are just too small. If the wind is coming across the top of the bowl, down drafts may preclude a landing. With a wind blowing into the bowl, consider the following: 1) An approach can be made close to the mouth of the bowl and the aircraft hover-taxied to the LZ. Overfly the site and ascertain that the bowl is not generating turbulence which could force an unsafe landing. Flying a corkscrew pattern around the inside of the bowl may alert you to drafting and turbulence. Maintain airspeed and a power margin to escape. Become familiar with unique visual illusions during the reconnaissance. The common tendency is for a profound difficulty in stopping a climb without reference to instruments. 2) Escape routes are generally better if selected with a right turn (a clockwise pattern). 3) An approach over the lip of the bowl and down to the LZ may be possible. This could be an extremely steep approach and it is easy to over-fly the site. In strong winds, it may be difficult to establish a rate of descent. Weather conditions in a bowl may be highly variable. Constantly evaluate changing wind conditions to prevent unrecoverable flight regimes.

8.9.7. Landing and takeoff. The landing and takeoff are generally the most critical stages of flight under any circumstances. High altitude, mountainous landing zones are often less than ideal and accompanied with limited escape routes. Aircrews should consider and plan for problems and make the best use of site conditions.

8.9.7.1. Landing. The specific landing spot chosen during the low reconnaissance may have to be modified due to unforeseen obstructions or slopes. Ideally, the approach should terminate in a hover over a flat area where an immediate landing can be made if required. If a hover is possible, care should be taken to maneuver to a spot giving firm support and least slope. After touchdown, reduce power gradually to avoid sinking into what could be soft ground. If necessary, keep some power in to keep from sinking. Take into account effects of crosswind/tailwind component when hovering. Generally, hover references are available at normal distances from the aircraft; in some instances, over a sharp pinnacle or ridge, the nearest hover reference may be a considerable distance away. The "boresight" technique described in the approach to a pinnacle can be used to get information on lateral and vertical helicopter movement. Other crewmembers may be in a better position to reference and relay hover information.

8.9.7.2. Takeoff. Scan the selected departure path decided upon during the site reconnaissance. A detailed inspection of the LZ may be required to make best use of available space, especially if power is limited. Reconfirm power requirements. Ground effect will be lost quickly as the aircraft moves forward over a slope. If obstacles require an OGE takeoff, climb angle should be sufficient to clear the obstacles, then, attitude should be modified to gain forward airspeed. Factors affecting takeoff are exactly the same as for an approach. Accurate computation of TOLD is extremely important, only one attempt at takeoff may be available. Every effort should be made to get the aircraft into a safe flight regime as early as possible.

8.9.8. Marginal power operations. What can you do if, given your aircraft, its configuration and the required landing spot, OGE power is not available? How much margin is enough? When do you make the decision to go home? What techniques will help you stay out of trouble? How do you expand your options and increase your safety margin? Consider this scenario: You wish to land at a high altitude site and have applied the information/techniques mentioned previously in this section. You have lightened the helicopter by removing non-essential equipment and passengers and dumping fuel. When you return to the site, you find that OGE power is not available. How much power margin is enough? The last thing you want to do is commit the helicopter to any environment without knowing you can safely accomplish the maneuver. If practiced routinely, good habit patterns can be established that set limits and build familiarity for conditions posed by the environment.

8.9.8.1. Land/Go-around point: If the go-around is initiated at an airspeed above translational lift, hover power is adequate, down to a fairly low altitude (approximately 50 - 100 feet AGL).

8.9.8.2. If the helicopter decelerates below translational lift, hover power may not be adequate for a go-around as high as 200 feet AGL. This is another reason to have a good escape route. You must have an option other than being committed to land from your approach, and you should recognize when a go-around is necessary.

8.9.8.3. Below translational lift, the power required for a go-around increases significantly. The decision should be made before decelerating below translational lift that the approach will terminate on the desired landing spot.

8.9.8.4. Making your land/go-around decision prior to decelerating below translational lift ensures that you will have adequate power for a go-around.

8.9.9. True approach angle. Our approach procedures call for apparent approach angles of 10°, 30° and 45°. How do these really relate geometrically to the terrain? Practice your shallow approach to a runway with a VASI operating. Most of us see red over red all the way to touchdown. Since VASI angles are normally set between 2.5° and 3.0°, you can see that an apparent 10° angle and a real 10° angle are different. A steep approach is defined as an apparent 45° angle. Geometrically a true 45° angle has a base/height relationship of one-to-one. For an example of a true 45° angle, fly over a runway at 1000 feet AGL. Observe when directly over one of the 1000-foot runway markers, then look down at the next marker. The angle you see at this point is a true 45° angle and you'll see that there is a significant difference between an apparent and actual 45° angle. Compare apparent angles to actual angles by looking out the side windows in 30° or 45° bank turns for confirmation. A 30° apparent angle is really 3° to 6° and an apparent 45° angle is less than 10°. Specific numbers are not as important to us as how we perceive our selected angle relative to sloping terrain is critical. Another way to confirm actual angles is by using the autorotational distance/altitude chart. Helicopters have a glide angle (during full autorotation) somewhere between 9° and 15°. During marginal power operations, even a subtle terrain slope can cause misinterpretation of altitude and can result in dangerous situations.

8.9.10. Visual illusions. Because we operate close to the ground, we are closely attuned to apparent groundspeed. Misperception of either airspeed or altitude can cause mishaps during marginal power operations. During pinnacle and ridgeline approaches, when the terrain slopes more gradually, we may not perceive a need for such precise approach entry points. If the terrain slopes a few degrees up or down, our visual perception can be significantly affected. We look at 2° to 5° of terrain slope and call it "flat," thinking it will be negligible during our 30° apparent angle approach, but, that is not always the case. A 3° upslope of terrain will result in a 100-160 foot discrepancy between actual altitude above the site and perceived, or radar altitude. This results in a shallow angle and may become critical when the helicopter decelerates below translation lift and the available power margin is less than that required for OGE hover. The same type of phenomenon occurs when landing downhill. If landing downhill over a 3° ground slope, it may appear to be flat. Although the angle selected for the approach appears to be normal relative to the ground, you may find that the rate of descent is high for the apparent closure rate. You will also have to fight the tendency to overarc and will notice that less power is applied throughout the approach. At the bottom of the approach there will be a tendency to be too high, slow, and settling fast. With a limited power margin, large power inputs at this point could be catastrophic. If conditions preclude a normal approach entry altitude, be aware of the effects of visual illusions.

8.9.11. Apparent groundspeed. Monitor airspeed more carefully when operating with a limited power margin. If the helicopter is flown at low airspeeds (e.g. 60 knots) during a search or reconnaissance pass, with a strong headwind (e.g. 30 knots), the pilot perceives a relative groundspeed of 30 knots (airspeed minus wind speed). If the pilot desires to make a 180° turn and maintain an airspeed of 60 knots, then the apparent groundspeed must become 90 knots (airspeed plus wind speed). Note that is a three-fold increase in groundspeed. This 60-knot increase feels unnatural and the unsuspecting pilot raises the nose to try to maintain a more comfortable groundspeed. In order to maintain the apparent ground speed of 30 knots, as perceived prior to the turn, the pilot must reduce airspeed to zero knots; in other words, an OGE hover. If power required for an OGE hover is not available, the helicopter will settle. Even if, for this example, apparent groundspeed is doubled during the turn (30 knots wind speed plus 30 knots airspeed), the helicopter is still close to translational lift. Be sure to keep safe single engine minimum airspeeds in mind when operating in these conditions.

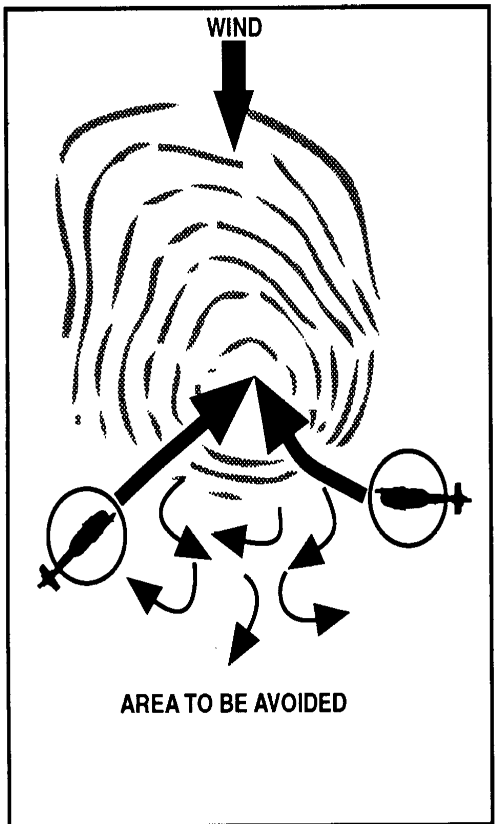
8.9.12. Single engine considerations. Planning ahead for single-engine failures can mean the difference between success or failure. How we use the remaining engine power can significantly increase our safety margin. Basic tenets for single engine operation include: 1) If single engine capability exists at the takeoff altitude and single-engine airspeed is attained during takeoff, the aircraft will continue to fly. 2) Level flight can be maintained if a single engine go-around is initiated above minimum safe single engine airspeed.

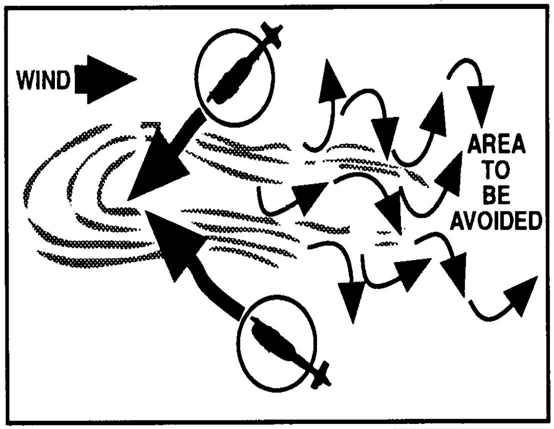
8.10 High Density Altitude Factors.

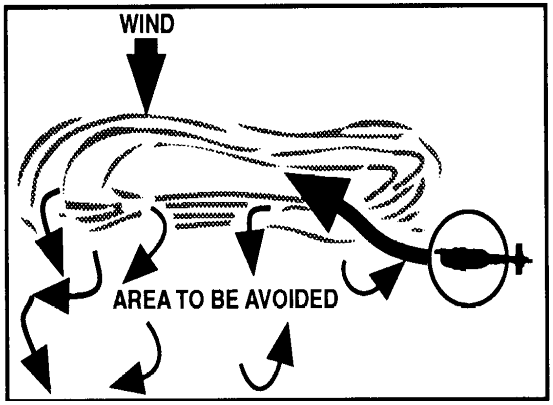
8.10.1. Bubble effect. Temperature, terrain and weather can significantly affect surface temperatures. High density altitude, clear skies, and vegetation can cause a bubble effect on mountain tops that can result in surface temperatures 8 to 15 degrees C warmer than the same elevation outside the bubble. The best potential for a bubble effect is high mountain vegetated terrain under high pressure. If you suspect the presence of the bubble effect, plan your power considerations for the higher temperature.

8.10.2. Temperature has the greatest effect on density altitude. For every 1°C increase in temperature, density altitude increases approximately 120 feet. The appropriate flight manual section concerning high DA operations should be referenced.

Figure 8.3. Approach Paths and Areas To Avoid.







8.11. Landing Zone Lighting. (Not required for NVG operation.) Some type of landing zone lighting aid will be used to assist the pilot in locating and identifying the landing zone and making a landing at night. Lighting aids, including sophisticated terminal guidance systems, expeditionary lights, flare illumination, and makeshift light sources, such as vehicle lights, flashlights, strobe lights, bonfires, and smudge pots, have been used successfully. Landing zone lighting should: be visible to the pilot, identify an area free of obstacles and safe for hovering and landing, employ 3 or more lights at least 15 feet apart to prevent autokinetic illusions, provide orientation along an obstacle-free corridor for landings and takeoffs, and when practical, employ a standard landing zone lighting pattern.

8.12. Landing Zone Lighting Patterns. Since a variety of landing zone lighting patterns are in use, the pilot should anticipate diversity in lighting patterns when participating in joint and/or combined operations. Figures 18.1. and 18.2. present examples of lighting patterns.

8.12.1. The lighted T pattern can be effectively used for all aircraft. Lights at the head of the T must be at least 5 paces apart and the lights in the stem must be at least 10 paces apart to indicate the wind line. The head of the T should be positioned to the windward side. When set up in this fashion, the lighted T provides visual cues to determine the correctness of the glide angle by observing the apparent distance between the lights in the stem of the T (Figure 8.1). If the lights in the stem appear merged into a single light, a shallow glide angle is indicated. If the lights in the stem appear to increase in distance apart, the approach is becoming steeper. Approach path lineup corrections can be made using the stem of the T. If the stem points to the left, the helicopter is right of course and should correct to the left; if it points to the right, the helicopter is left of course and should correct to the right. The overall advantages of the T are:

8.12.1.1. It provides excellent acquisition of the landing zone from a distance.

8.12.1.2. Spacing of lights at the head of the T simplifies identification of approach direction.

8.12.1.3. It provides glide slope, course alignment, and wind drift information.

8.12.1.4. It provides at least 2 reference lights at all times to decrease the chance of spatial disorientation on approach and final landing.

8.12.2. The Y light system is an excellent means of identifying landing zones. (Other marking systems are identified in USREDCOM 10-3, or FM 31-20.) Lights for the inverted Y should normally be spaced in compliance with Figure 18.2. The following guidance applies:

8.12.2.1. The direction of the approach is into the open end of the Y.

8.12.2.2. When compatible with the approach path, wind direction will be along the stem of the Y.

8.12.2.3. The touchdown area is outlined by the triangle formed by the 3 lights marking the open end of the Y.

8.13. Cargo Sling Operations. It is not practical or necessary to publish separate aircrew procedures for every possible sling load helicopters may be tasked to carry. Problems regarding sling loads primarily involve improper preparation of the load. If the load is configured correctly, the procedures are the same, whatever the load may be. The aircraft commander is responsible for selection of the hookup and release point. Coordination with the unit requesting the airlift and the unit furnishing support is necessary. The hookup and release areas should be selected to avoid flight over people, vehicles, buildings, or congested areas and to provide optimum safety. The surface should be relatively level and free of vertical obstructions. Areas of dust, mud, snow, or ice should be avoided. Mark the hookup and release point for easy identification. Determine wind direction and estimated velocity prior to conducting cargo sling operations; however, to allow for a margin of safety, wind is not considered in computations for power required to hover. Preposition loads to expedite hookup. Thoroughly brief all personnel concerned with the mission on their duties and responsibilities during the operation. Give particular attention to the increased rotor down wash and its effect on loose equipment, personnel, and debris.

8.14 Sling Procedures. Prior to cargo sling/hook operations, thoroughly preflight all cargo sling/hook components IAW flight manual procedures.

8.14.1. Cargo Pickup. Hookup to the cargo load is accomplished using interphone instructions between the flight engineer and the pilot and, when required, hand signals between flight engineer and hookup person. Brief the hookup person on hookup procedures to include hook grounding, ingress/egress routes, hand signals, and emergency procedures.

8.14.2. Accomplish an in-flight HIT check prior to sling operations. Compare computed power required to lift the load with power available to ensure an adequate margin is available.

8.14.3. Hookups may be accomplished by landing near the load or hovering over the load, depending on the availability of personnel to perform hookup duties.

8.14.4. When landing next to the load, hover or ground taxi the helicopter into a position near the load and place the collective at flat pitch. Maintain adequate rotor and/or aircraft clearance with the load. Route the lift strap and/or cable around the landing gear/skid allowing sufficient slack so it will not be taut when the helicopter is raised to a hover. The FE will monitor the lift strap/cable during the takeoff to a hover and direct the helicopter to a position over the load.

8.14.5. When securing the load from a hover, hover the helicopter into the wind and position it over the load. The pilot can best control the approach until the pickup point can no longer be observed. When the pilot can no longer observe the load, the FE directs the pilot to a position to accomplish the hookup. As soon as the load is securely attached to the cargo hook, the hookup person will clear the area directly beneath the helicopter and the FE will notify the pilot the load is ready to lift. Ensure sufficient power is available to takeoff by slowly increasing collective pitch to take up any slack in the sling and center the helicopter over the load. When operating in sandy or dusty conditions, avoid abrupt power changes in order to minimize the possibility of reduced visibility. Objects which take on water should be allowed to drain while the helicopter is in a hover prior to takeoff. During takeoff and climb out, the FE informs the pilot of the towing characteristics being encountered. If the load begins to develop undesirable or abnormal aerodynamic characteristics, reduce forward speed to a point where the load is stable and continue the mission. If the airspeed to stabilize is too slow, it may be necessary to return to the pickup point and secure spoilers or reconfigure the load. Spoilers may be drag chutes, sandbags, or other material which distort the airflow.

8.14.6. The radar altimeter can be of great value during sling operations. A recommended procedure when operating over level terrain with a 40-foot sling is to set the radar altimeter pointer on 50 feet and use that altitude as a level off point until the FE in the cabin has sight of the load. During pickups where the ground personnel attach the sling to the helicopter, a radar altimeter setting of 20 feet is a good minimum until the hover is established and the pilot starts receiving directions (use of the radar altimeter is optional).

8.14.7. Inflight. Each sling load has different aerodynamic characteristics in both a hover as well as in forward flight. Limit forward flight to an airspeed commensurate with the aerodynamic stability of the load.

8.14.8. Avoid flying over personnel, buildings, or equipment unless they are too numerous to avoid.

8.14.9. Flight with a sling load in turbulent air can result in severe oscillations and possible loss of aircraft control. Avoid areas of known or suspected turbulence.

8.14.10. Under normal circumstances, flight controls should not be transferred while the cargo sling is armed. If a requirement exists to transfer controls with the sling armed, extreme caution should be taken by the pilot assuming control.

8.14.11. If the cargo sling is armed, use extreme caution when using cyclic stick switches to preclude inadvertent load release.

8.14.12. Delivery. Closely monitor power requirements and anticipate power changes. The key to successful sling approaches is smooth and positive aircraft control. Use care to prevent dragging the load on the ground. Normally, hover with the load on the surface at which time it is released. Certain sling loads can cause the radar altimeter to give an erroneous reading throughout flight. When load interference is not a factor, the radar altimeter set pointer should be set at a value equal to the sling length + 10 feet. This provides adequate ground clearance upon load deliver. Use care to prevent dragging the load on the ground.

8.14.13. Interphone Procedures. Use the terms "load hooked" for completion of hookup and "load released" when cargo is unhooked to inform the pilot of the cargo condition. The FE provides additional information, including cargo ground clearance, during approach or hover and the condition of cargo in flight.

8.15. Cargo Sling Safety Procedures. The following procedures will apply to all cargo sling missions:

8.15.1. At the AC's discretion, the hookup person may be positioned at the 2 o'clock position until cleared in for the hookup. Position the hookup person at the load to effect an immediate hookup. After the hookup, the hookup person egresses at the 2 to 3 o'clock position. Egress can be made at the 10 to 11 o'clock position if necessary.

8.15.2. The hookup person must wear goggles or helmet with visor down for eye protection.

8.15.3. Check all lift straps/cables for proper condition prior to picking up a sling load.

8.15.4. Move all cargo sling loads slightly before pickup to ensure they are not frozen or otherwise held fast to the surface.

8.15.5. Lights should be turned off and retracted if they could distract the hookup person or interfere with the hookup.

8.16. Cargo Sling Emergency Procedures. It is not practical to publish all emergency situations that could occur during cargo sling operations. Good training habits and sound judgment by all concerned should eliminate problems when emergencies do occur. The following guidance is given when using ground hookup personnel:

8.16.1. If complete loss of power occurs prior to hookup, execute a hovering autorotation to the left of the load. Hold sufficient pitch and left cyclic after autorotation is entered to clear the load. Once clear of the load, execute a normal hovering autorotation.

8.16.2. After hookup, should engine failure or loss of power occur over the load, make every attempt to release the load and execute a hovering autorotation (if required) to the left of the load.

8.16.3. If engine failure or loss of power occurs, the ground crew should consider the following:

8.16.3.1. Marshaller. Turn away from the aircraft and lie face down on the ground, covering head with both arms to protect from flying objects, should the aircraft crash.

8.16.3.2. Hookup Person. Take action prebriefed with the crew, for example, hug the load, dive clear to the right, etc.

8.16.3.3. If an inflight emergency is encountered, external loads should be jettisoned when/if necessary.

Chapter 9

TACTICAL CONSIDERATIONS

9.1. Purpose. This chapter is intended to expand on various unclassified techniques to be considered when participating in tactical missions and operations. It is to augment MCM 3-1, Vol 24. Understand that these techniques are not to be construed as procedures or mandatory. The techniques are based upon past combat experience, recent test and training events, and up until now, undocumented ways of conducting helicopter tactical operations.

9.2. Expanded Items from the H-60 Combat Ingress Checklist.

9.2.1. Radio Responsibilities/Secure Voice-Confirm. Ensure all communication equipment is set to planned or anticipated nets, in the appropriate operating setting, and IAW with kneeboard cards or mission comm plan.

9.2.2. Performance Data-Compute/Confirm. The CLC page on the CDU is a fine tool to use both on the ground and in-flight. In-flight HIT checks, if required, should also be discussed and accomplished at this time.

9.2.3. Mission Capable Fuel Time. This is an often misunderstood item. IAW MCM 3-1, Vol 1, Brevity Codes, this is best correlated to JOKER fuel. That is, the fuel required to accomplish the mission and return via the planned route with reserve. This is NOT Bingo fuel. To make this match our fuel time we need to assess if we have "Joker" fuel and attach a time to it.

9.2.4. Bingo Fuel-Confirm. Self-explanatory.

9.2.5. IFF-Set IAW Theater SPINS.

9.2.6. TACAN-Set. Use of the TACAN should be prebriefed. Consider setting up the TACAN so that it can quickly be used to maintain SA on wingman, escorts, etc. Be aware of the high potential for DF and meaconing when using the TACAN.

9.2.7. Navigation Equipment-Checked and Set. Ensure navigation equipment is set correctly. Activate the flight plan, select the navigation mode, and ensure both pilots are aware of what mode is being used. Some helpful techniques are to use Non-consecutive or Consecutive for your primary routing and having Direct reserved for the survivor location, SARDOT, or Bull's Eye. This will allow easy manipulation for threat calls or survivor routing. Additionally, ensure all maps for the KG-10 are organized and available for easy access.

9.2.8. Weather Radar-As Required. Don't assume this should always be turned off. If launching from long-distances and the potential for the enemy air defenses being activated by its use doesn't outweigh the necessity to use the radar to penetrate weather or paint coastlines, islands, or vessels consider using it. To assist the pilot flying with a head's up on navigation consider going to Test and Nav which will not radiate energy significantly, but will overlay the general flight plan on the screen.

9.2.9. Interior/ Exterior Lights-Set. Per the scenario/mission. In an out of one's operating area/ runway, ship, etc. may require you to display some external lighting for the initial portion of your mission (training is always IAW AFI 11-206 or MAJCOM waivers).

9.2.10. Hoist Operator's Pre-pickup Checklist. Be prepared to use the hoist on every tactical mission and have it set as required. If the mission length or distance to the objective area is great you may want to leave the backup pump in auto and run the checklist again when your closer to the objective.

9.2.11. Body Armor-as required. Body Armor shouldn't be worn during over water operations.

9.2.12. Chemical Warfare Gear-as required. Self-explanatory.

9.2.13. Armor Wings-As Required. If small arms fire is anticipated-bring them forward. A good rule of thumb is that if you are wearing body armor, then your armor wings should be forward.

9.2.14. Shoulder Harness-As Required. For training/low-threat scenarios consider staying unlocked. You may even elect to keep it unlocked for the majority of your mission. A consideration however is that having them locked during increased potential of small arms or AAA fire will prevent slumping over controls/etc. in the event one of the pilots becomes incapacitated or injured.

9.2.15. Guns/Chaff- As Required. Ensure you have the required weapons/ordnance, and that chaff settings are in their proper configuration/positions.

9.2.16. RWR/IRCM- Ensure the systems operate with correct settings/self-tests prior to takeoff. If possible have the RWR "Squirted" by maintenance. The decision to use full or terse for audio is dependent upon crew desires and anticipated threat encounters.

9.2.17. Before Landing Checklist-Complete. Self explanatory.

9.3. Fence Check. The fence check is similar to the ingress checklist. This should be accomplished prior to penetrating enemy territory or when the possibility exists for potential enemy contact. This check supplements the Combat Ingress and is a re-check of critical in-flight items (many of the ingress checks may have been conducted several hours ago prior to takeoff).

9.3.1. **F**-Fire Control. Arm weapons and establish/reconfirm the aircraft and formations weapons' conditions. Test fire the weapons as required.

9.3.2. **E**-EMITTERS.

9.3.2.3. Weather radar to test, Nav, or standby as the situation dictates.

9.3.2.4. Lights reconfigured for day/night mission requirements.

9.3.2.5. TACAN: Receive only, or AA if you anticipate having problems maintaining the position of your wingman/escorts and the threat of interception or meaconing is low.

9.3.2.6. Radar altimeters: consider the small RF footprint of the HH-60 radar altimeter and contrast this with the potential for obstacle clearance problems without it. Recommend using the radar altimeter unless intelligence has forecasted a sophisticated threat, and threat avoidance is more of a concern than obstacle avoidance.

9.3.2.7. IFF: Ensure modes and codes are set to correct digits at the correct times IAW spins.

9.3.2.8. Doppler: consider putting the Doppler in test to reduce emissions. Be aware that when operating in test and the backup pump is cycled on to operate the hoist, the Doppler will run a self test and then automatically go to NAV. If the backup pump is activated you have to manually put the Doppler back to test. Like many items, the crew must decide if the emissions detection ability of the enemy outweighs the necessity of having a third navigation source.

9.3.9. **N**-Navigation equipment. As required. Ensure the navigation equipment is tight, if in IN back it up with a position from the GPS or map. Ensure the flight plan configuration is as planned and briefed. Consider not using pure GP to prevent possible GPS runoff. If using the KG-10 configure it and its maps (to include any Special maps) to the proper settings (scale, map order, etc.). Consider having a KG-10 for the back of the aircraft for a quick S.A. builder for the entire crew.

9.3.4. **C**-Communication Equipment. Set as required. All our radios are emitters and can alert our adversaries of our presence and/or provide them with tactical information. Limit radio transmissions and make use of Have Quick, secure voice, brevity codes, and visual signals. Know the radio capabilities of all support aircraft and agencies.

9.3.5. **E**-Electronic Protection. Arm chaff, turn on IRCM, and if not all ready accomplished ensure your FLIR is in the appropriate mode (FPV for terrain avoidance, SCN if in a search, SPT and FLIR

9.3.6. Other Considerations. Have the hoist ready and configured with Hoist Power on, Back Up Pump on, and devices attached. Experience has shown that in the midst of a comm intensive environment, as would be expected in a SARTF, the hoist routinely gets forgotten about until short final--causing crews to scramble to accomplish checklist when they should be concentrating on the approach or manning weapon stations.

9.4. Communications. Consider what nets you will monitor and use for C2, Survivor, Strike, AR, Escort, etc. During the terminal operations or final run in phases trying to monitor and decipher the important information and listen to all nets is nearly impossible. Consider delegating C2 and strike frequencies to your wingman, and have him pass on valid information. During the final phases of a CSAR the pickup aircraft needs to devote 80% of its comm to the survivor frequency and 20% to the escort. If the pickup aircraft feels it must monitor all nets consider having pin switches turned down for the FE and pilot flying. Someone in the flight needs to monitor C2 to keep S.A. on potential threat calls, having the Bull's-eye in a Direct flight plan and plotted on a chart with azimuth/ranges depicted will keep S.A. high. Threat calls will come from the Bull's-eye….not the SARDOT.

9.5. Weapons Conditions. Weapons conditions are addressed in MCM 3-1, Vol 24. Be aware that these conditions will probably change by formation, side of aircraft, and phase of operation. A good rule of thumb for planning for ordnance delivery is that 25% should be allocated for the ingress, 50% for the terminal phase, and 25% for the egress phase.

9.6. Laser devices. Refer to MCM 3-1, Vol 24, for guidance on the use of laser pointing/aiming devices. Experience has shown that the use of such devices are effective in building S.A. and reducing communications. The AIM-1 aiming device attached to a crew-served weapon provides shooters and escorts a picture (if they use NVDS's) of where the H-60 is pointing its weapons. They can project out several hundred meters beyond the max effective range of our weapons and can be used to point out terrain, targets, and threats. Small hand held laser pointers can be used by aircrews, and ground teams to assist with identifying terrain, obstacles, turn points, LZ's, etc.

9.7 AN/AAQ-16 Infrared Detector. The FLIR on the H-60 is an outstanding piece of equipment. Day or night it can be a valuable asset. Primarily in FPV it provides terrain avoidance assistance in periods of reduced illumination. In conjunction with 4949 NVD's it provides the H-60 with the best night capability of any asset involved in a CSAR. SPT can be used to store points of interest, look at LZ's, or scan areas to verify activity. AT can be used in the same fashion for both airborne and ground targets.

9.7.1. Knowing FLIR limitations is important. During isothermal crossover (1.5 hours prior to and after sunrise/sunset) or in high moisture areas its effectiveness may be reduced. All weather shops can provide the forecasted times for these phenomenon. FLIR is not better than NVD's, nor are NVD's better than FLIR. Knowing when each is best utilized should be planned for. All players should know when and where these mission factors may come into play.

9.7.2. If terrain avoidance is vital during reduced illumination flight lead should be in FPV, and delegate all other uses of the FLIR to the wingman. Much of FLIR usage is technique. Some pilots use AHD for over water or on short final to minimize the picture jump at varying airspeeds. The key is to know how to use the FLIR; know how it complements NVD's, and have a plan on how you will use it prior to executing the mission. Another contentious issue is that of using the FLIR in the LAFS mode. This is not as desirable, but if MUX isn't working LAFS can provide the aircrew with FLIR imagery. Because there is a difference in symbology, switchology, and capability the LAFS mode should only be used as a backup..

9.8. H-60 Navigation Systems. The best technique to use when attempting to precisely navigate in a threat/tactical environment and have confidence in your equipment is to initially begin every mission in IN letting the GPS and Doppler "navigate along" for occasional PPOS Compares. At a significant geographical point with known coordinates (prior to penetrating enemy territory), or anywhere prior to getting busy with the details of a mission, get a good navigation update and compare your position on the INS. The decision to accept, or not accept the update is your call. This practice of getting an independent update of all three navigation sources allows you to make the best decision on what navigation source you desire.

9.8.9. Using the Doppler in a DF-rich environment may not be desirable. The crew must determine if the DF potential is greater than the potential need for Doppler navigation?

9.8.10. Operating in IG opens the opportunity for GPS runoff. For all missions, where it is practical (not over water or in vast featureless desert), the key is to keep up with the map/chart no matter what navigation source you are using. This prevents over-reliance on the navigation system and ensures the crew will not get into major problems if the navigation system fails.

9.9. LZ Options. The best course of action given a preplanned scenario is to draw out LZ diagrams and have the landing options included in the plan. However, because we are CSAR crews who may launch off alert, we must have standard preplanned landing options that can be used by Flight Lead to direct the terminal operations portion of the mission. MCM 3-1, Vol 24., contains detailed descriptions of landing options that should be practiced and used by all H-60 CSAR crews.

9.9.1 All options require a plan…the sooner the better. The use of spider routes / SARDOT/ Bull's-eye references for holding or rendezvous points makes the plans easier. If we know the survivor(s) condition we can forecast potential PJ requirements and modify our option plans accordingly.

9.9.2. Always assume other RESCORT participants do not know our options. We should know their capabilities and weapons load outs so that we can articulate our intentions to them.

9.10. Lightweight Airborne Recovery System (LARS). The LARS/PLS is a good tool for use during both peacetime and CSAR missions. In the CAF's, only the HH-60 and a limited number of A-10's have this capability. If not being utilized for survivor comm and location, the LARS is useful as an unsecure UHF radio.

9.10.1. One of the key techniques involved with operating the LARS radio in a combat environment is knowing when to interrogate, and deciding who in the formation should accomplish the interrogation. Use of burst interrogation is normally recommended over continuous interrogation, because the survivor's radio frequency is jammed during continuous interrogation. This is not to suggest that continuous interrogation is never a choice, but understand that using it may cause other problems by limiting available communications on the survivor frequency.

9.10.2. Navigational errors. Experience has shown that even with a good "lock" on the survivor's radio, navigation may be off by 400 feet. This may be accurate enough for operations in open terrain, but in dense foliage the margin of error can be to great for locating the survivor.

9.10.3. Effective range of the LARS is limited by Line of Sight (LOS). At low altitudes crews may not pickup a useable LARS signal until they are too close to the survivor for the LARS to be useful.

9.10.4. The LARS can be a helpful tool, but it has several limitations that must be understood by the users. Accurate survivor coordinates and a good description of the survivors location is the most critical and helpful information. Once the helicopters are in the vicinity of the pickup the crew cannot spend time orbiting to obtain LARS cuts on the survivor.

9.11. Authentication. One common problem is that we often over-authenticate. If the survivor has been authenticated by RESCORT, you should accept this authentication and not reaccomplish it when you are on final. Survivors need to be treated with suspicion, and aircrew must always be alert for ambushes at the pickup site, but over-authenticating increases radio transmissions and can increase aircrew exposure in the LZ.

9.12. Mission Precedence. Mission precedence is basically a concept of how much risk the JFACC is willing to take to successfully make a CSAR recovery. The levels of precedence are listed in MCM 3-1, Vol 24. These should be known, and the crews at each unit in a theater need to know what mission precedence exists for each mission they undertake.

9.13. CONOPS. Each theater and MAJCOM has a Rescue CONOPS. There are misconceptions as to what these mean in the order of limitations or procedures. According to Joint Doctrine, CONOPS or Concept of Operations, is a broad outline of a commander's assumptions of intent in regard to an operation or series of operations. Also called Commander's Concept, it is designed to give an overall picture of the operation. The point is that the CONOPS is not a set of directives as to what you will or will not do. It is a general idea of what will go on or is expected

9.14. Tactical Approaches. Tactical approaches during simulated or actual combat conditions are more hazardous than normal remote operations. The necessity to get the aircraft on the ground, make the pickup, and depart the area as quickly as possible leaves a greater potential for a mishap. This is evidenced by our higher rate of FLIR and blade strike damage during tactical training. To counter the increased risk, crews must make use of all available premission planning information such as detailed maps, satellite photographs, diagrams, etc. If time permits crews must accomplish detailed studies of the pickup area and develop a plan for the terminal operation. If launched off alert, crews should learn as many details about the landing area as possible while enroute.

9.14.1. The level of threat will dictate the type of approach required at the site. Crews should tailor the terminal operations to balance the enemy threat with the increased risk of tactical approaches. Crews should use as many of the techniques used for remote operations (See Chapter 8) as necessary/possible. If the threat is low the crew may elect to overfly the site and accomplish a quick reconnaissance of the area. If there is an increased threat the crew will want to plan and set up their approach to get on the ground as quickly as possible.

9.14.2. Tactical Approach Techniques. The following techniques are for use during training operations to pre-surveyed landing zones (See MCI 11-HH60G Vol. 3, Para. 3.7), and/or operational CSAR missions.

These techniques are for use in simulated or actual increased threat areas where the crew wants to minimize exposure in the LZ. These techniques are to be used in conjunction with the procedures used during normal remote operations (i.e. approach calls, power computations, etc.).

9.14.2.3. Premission planning and/or information passed to the aircrew during the Sandy prepickup briefing should give the crew enough information to select a final approach heading that provides the best approach and landing into the site.

9.14.2.4. With the approach direction determined, and threat permitting, the crew should attempt to get the aircraft aligned with the landing direction after passing the IP. Accurate coordinates and a good NAV system can greatly aid in aligning the aircraft. If possible the aircraft should be slowed to a maximum of 100 kts after passing the IP. The crew should continue to fly toward the site using the NAV system until acquiring the LZ. At .5 NM from the site the pilot should initiate the approach by reducing power and establishing an approximate 10 ^{0} nose high pitch attitude. At this point the crew would begin making advisory calls (Triangle Technique) as outlined in paragraph 8.4.12.2. The pilot flying will adjust rate of descent with power and rate of closure with pitch as necessary. Verbal inputs from the crew, ground speed indications from the NAV system, and visual cues must all be used when making tactical approaches to unfamiliar locations. The best visual cues for rate of closure for the pilot will be at a 45^0 - 90^0 angle out the side of the aircraft. The pilot will need to develop a scan from the LZ for alignment, and to the side for closure. The pilot not flying must make the advisory calls, altitude (Radar Altimeter) and airspeed are the most critical, but torque and sink rate need to be added as necessary. The Flight Engineer must be able to acquire the site and maintain SA on its location, monitor approach angle, obstacle clearance, altitude, and airspeed. The FE must be able to verbally direct the aircraft while manning the gun station, operating the hoist, and preparing for team deployment (if applicable). The left scanner is responsible for clearing the left side of the aircraft and manning the gun station. The left scanner must call out obstacles and inputs on rate of closure and altitude as required. Go arounds during tactical approaches are the same as described in chapter 8.

9.14.2.5. On short final the crew will need to carefully monitor power and position the aircraft for touchdown or hover over the survivor. Although time is critical in a tactical environment, crews must ensure they have sufficient obstacle clearance at all times.

9.14.2.6. Exercise care when decelerating in a low level environment. During a low level deceleration above 50 feet, it is permissible to rotate the helicopter around the transmission. However, when flying a terrain profile and maintaining 50 feet obstacle clearance, pilots should rotate the helicopter around the tail rotor. Extreme caution must be used when descending below 50 feet to prevent tail rotor to ground contact. Figure 9.1. depicts tail rotor clearance.

9.14.2.5. The departure from the LZ should be in a direction that minimizes the threat and gives the aircrew the best options (clearance, wind, etc.). On departure the pilot should accelerate above maximum turn rate airspeed as soon as possible. Figure 9.2 depicts main rotor clearance in a turn.

9.14.2.6. See MCM 3-1, Vol. 24, for more information on tactical operations and LZ options.

9.15. Weapons Employment. The weapon systems installed on the HH-60G are primarily designed for defensive fire, as necessary, during combat operations. The weapons are used as a fire suppressive deterrent to ground troops and soft target areas, during CSAR operations. Armed helicopters used in support of ground troops or employed in a mutual support role are extremely effective. Their success is highlighted by flexibility and their ability to deliver immediate ordnance very close to friendly forces.

Figure 9.1. H-60 Tail Rotor Clearance.

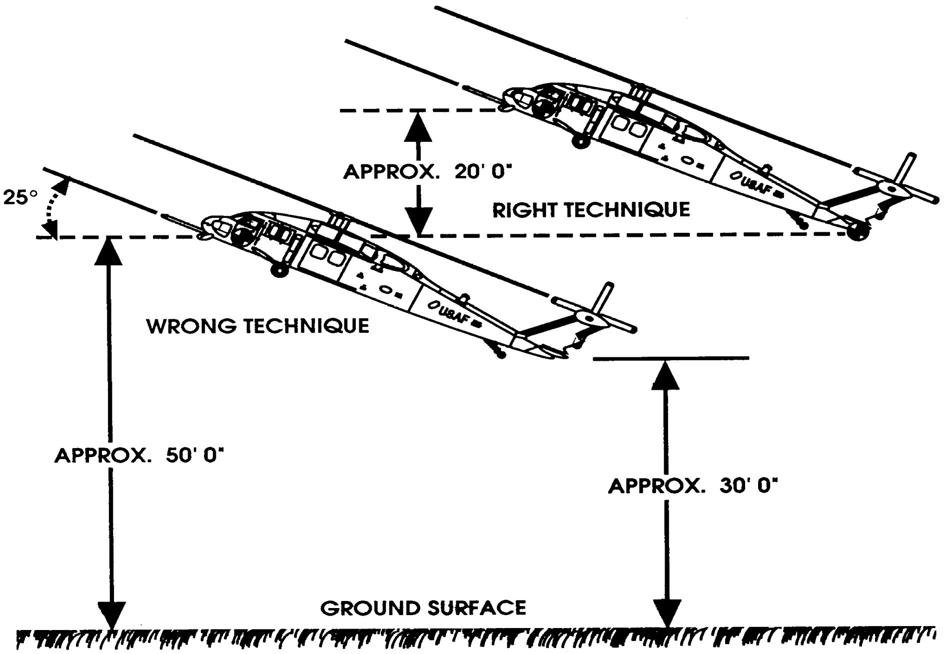
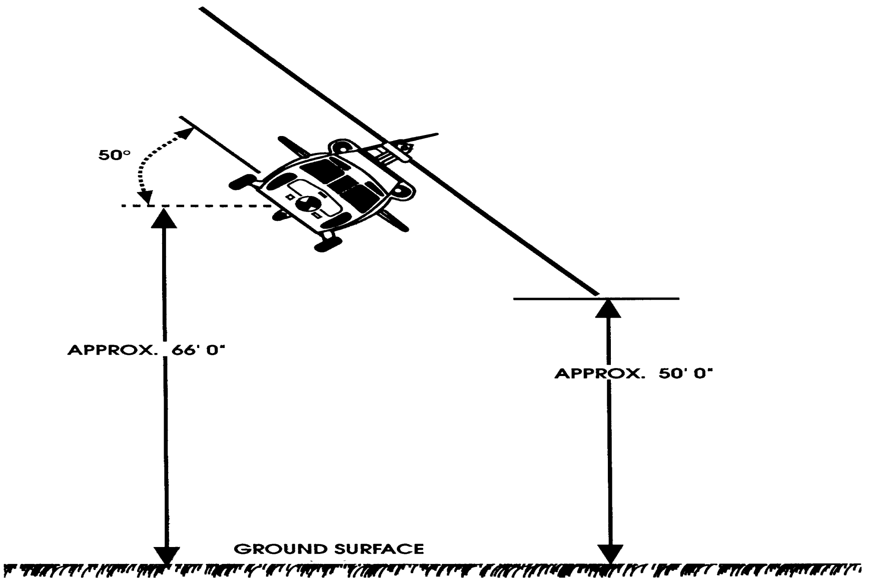


Figure 9.2. H-60 Main Rotor Clearance in a Turn



9.15.1. The fundamentals described here, in conjunction with the guidance found in T.O. 1H-60(U)A-1, MCM 3-1, Volume 24 (S), AFI 11-214, and applicable supplements are the planning and execution sources for HH-60G weapons employment. Each situation may require some degree of modification. Flight integrity and air discipline are paramount.

9.15.2. Unit weapons/training officers should ensure that weapon systems employment-specific learning objectives and training standards are included in the unit weapons and tactics training program. Construct realistic training scenarios for weapons employment IAW AFI 11-214, to cover all phases of an operational mission (i.e., enroute, approaches, terminal operations, and AIE. procedures).

9.15.3. Gunners (flight engineers/pararescuemen), to be effective, must be thoroughly briefed on the mission. The gunners must know the enemy situation, the friendly situation, the formations to be flown, and the specific objective of the mission. The pilot's briefing to the gunners will include all applicable rules of engagement and any local operating procedures/restrictions.

9.15.4. When possible gunners should test fire their weapons prior to any potential engagement. This can be accomplished over open fields or bodies of water, carefully avoiding inhabited areas. When in formation, prior to test fire, the aircraft commander will request clearance from flight lead. On training missions, weapons will only be fired when on an approved weapons range.

9.15.5. Gunners should keep expended brass and links policed from the cabin area. Not only does the expended brass and links cause precarious footing, but it has the potential of jamming the flight controls and damaging other aircraft systems. On training missions, expended brass and links will be policed prior to departing the range.

9.15.6. Gunners need to keep the rest of the crew informed on the status of their weapon by immediately calling out gun malfunctions.

9.15.7. Gunners need to maintain SA on the location of other aircraft in the formation. When flying in trail formation the lead aircraft should not fire aft of the 4 - 8 line and the trail aircraft should not fire forward of the 10 - 2 line.

9.15.8. Established Rules for Armed Helicopter Employment. Factors affecting the employment of armed helicopters are: Mission, Enemy, Terrain, Troops, and Time (METT-T). The following established rules are combat proven guides which enhance mission success and increase survivability in the combat environment.

9.15.8.1. Avoid Target Over flight. Armed helicopters do not have the speed to survive in the vicinity of hostile anti-aircraft fire. Two steps in avoiding target over flight are:

9.15.8.1.1. Engaging the target at maximum effective range.

9.15.8.1.2. Disengage the target before reaching the enemy's effective range.

9.15.8.2. Avoid Flight In the ZAP Zone:

9.15.8.2.1. The ZAP zone is the airspace where most aircraft hits occur. The limits of the zone are governed by the enemy ground-to-air firepower capability.

9.15.8.2.2. The ZAP zone is also that airspace which provides the best air-to-ground observation. For this reason, it is not always possible to meet the requirements for reconnaissance and remain out of the zone.

9.15.8.3. Avoid Flying the Trail Position:

9.15.8.3.1. When both the formation lead and the wingman fly the same ground track, the following unacceptable conditions result:

9.15.8.3.2. Observation as a team is reduced.

9.15.8.3.3. Enemy gunners can place raking fire across the entire formation.

9.15.8.3.4. The hostile force is alerted by the first helicopter, and can place fire on the second aircraft.

9.15.8.4. To properly employ fire power, the lead aircraft should establish the axis of advance over the most favorable terrain for the entire element.

9.15.8.4.1. Make a High Reconnaissance First. Circumstances that can prevent a high reconnaissance include weather, the tactical situation, or situations when mission security would be jeopardized.

9.15.8.4.2. Always Assume the Area is Hostile. The assumption that an area is safe just because no hostile fire has been received, especially in guerrilla conflicts, can be fatal. A reconnaissance by fire with negative results is not a guarantee that the area is safe.

9.15.8.4.3. Locate the Friendly Forces. Armed helicopter crews should not return hostile fire until the friendly positions are known. Constant visual and radio contact should be maintained with friendly forces, whenever possible.

9.15.8.4.4. Avoid Flying Parallel to Terrain Features. Continually flying parallel to terrain features establishes a pattern. Flight over linear terrain features should be conducted at maximum speed and at varying angles more nearly perpendicular.

9.15.8.4.5. Conserve Ammunition. Ammunition should be conserved for contingencies such as rescuing downed crewmembers. One method of conserving ammunition is to regularly reserve a certain percentage of the ammunition load for contingencies.

9.15.8.4.6. Know the Tactical Situation.

9.15.8.4.7. Weapons Employment Brevity Codes and Terms. The purpose of the following brevity codes and terms, in conjunction with the ones found in AFI 11-214 and MCM 3-1, are to standardize communications, enhance crew coordination, and improve SA during CSAR missions.

9.15.8.4.7.1. AFT STOP. The weapon has reached its maximum aft firing azimuth.

9.15.8.4.7.2. BENT GUN. Weapon malfunction or unsafe until further notice. Should be followed by gun position, i.e., "LEFT/RIGHT SIDE."

9.15.8.4.7.3. CEASE FIRE. Discontinue firing immediately or do not open fire. Usually used due to a safety problem. Can be directed at specific weapons.

9.15.8.4.7.4. CLEARED HOT. Ordnance release is authorized. Can be directed at specific weapons.

9.15.8.4.7.5. COLD. The Area/LZ/Objective is not expected to receive enemy fire. Can also mean friendly weapons are not firing.

9.15.8.4.7.6. HOSTILE. A contact positively identified as an enemy in accordance with theater rules of engagement, and may be engaged.

9.15.8.4.7.7. HOT. An Area/LZ/Objective is receiving, or expected to receive, enemy fire. Can also mean friendly weapons are firing.

9.15.8.4.7.8. NO JOY. The aircrew does not have visual contact with the downed crewmember/target/team/landmark. Opposite of the term "TALLY".

9.15.8.4.7.9. PADLOCKED. Informative call indicating that the aircrew cannot take their eyes off of the downed crewmember/target/team/landmark without the risk of losing tally (visual).

9.15.8.4.7.10. PLATFORM. Gunner's request for a change of aircraft attitude because the current attitude prevents the weapon from engaging the target.

9.15.8.4.7.11. SIDE FIRE. Side firing weapons are engaging the target.

9.15.8.4.7.12. TALLY. The downed crewmember/target/team/landmark location has been positively identified in relation to the aircraft. Should be followed by a clock position and a distance. Opposite of the term "NO JOY".

9.15.8.4.7.13. VISUAL. Sighting of a friendly aircraft/ground position. Opposite of the term "BLIND".

9.15.8.4.7.14. WEAPONS FREE. Cleared to fire only at targets not identified as friendly in accordance with current ROE.

9.15.8.4.7.15. WEAPONS HOLD/SAFE. Fire only in self defense or in response to a formal order.

9.15.8.4.7.16. WEAPONS TIGHT. Fire only at targets positively identified as hostile in accordance with current ROE.

9.15.8.4.7.17. WINCHESTER. No ordnance/ammunition remaining

Chapter 10

PEACETIME SEARCH AND RESCUE TECHNIQUES

10.1. Mission Management. Rescue missions often involve commitment based upon calculated risks that require maximum consideration of all safety factors. Timely reaction to all search missions is essential. Do not jeopardize safety of personnel or equipment by inadequate preparation or shortcuts to expedite takeoff or arrival at the search areas. Aircrews must comply with all applicable directives. Refer to Joint Pub 3-50, National SAR Manual, for more information. A Search And Rescue (SAR) is by definition, the use of available resources to assist persons and property in potential or actual distress.

10.1.1. The positions of responsibility in a SAR mission are:

10.1.1.1. SAR Coordinator (SC). The SC mandates SAR mission organization, assigning the responsibility and interrelationships of the SAR Mission Coordinator (SMC), On Scene Commander (OSC), and Search and Rescue Units (SRUs) for any mission.

10.1.1.2. Rescue Coordination Centers (RCCs). Designated by the SC to coordinate SAR operations within an assigned area. An RCC controller will automatically act as an SMC for all SAR missions until relieved, or until another SMC is assigned. One more than one service operates the RCC it is referred to as the Joint Search and Rescue Center (JSRC).

10.1.1.3. SAR Mission Coordinator (SMC). Designated by the SAR coordinator to manage a specific SAR mission.

10.1.1.4. On-Scene Commander (OSC). Designated by the SMC to manage the SAR mission at the scene.

10.1.1.5. Search and Rescue Unit (SRU). A resource, (person or team, aircraft or flight, vehicle or team of vehicles, ship or ships), made available by a parent organization to perform search, rescue or similar operations.

10.1.1.6. Search and Rescue Liaison Officer (SARLO). A rated officer with an operational background in SAR who serves as a liaison between a Rescue Coordination Center and the Combat Operations Center in a contingency or wartime operation.

10.1.1.7. Airborne Mission Commander (AMC). The AMC serves as an extension of the Rescue Coordination Center or SMC. An AMC will be designated anytime multiple active-duty and/or gained aircraft are involved in a SAR.

10.1.2. The rescue aircraft commander finding himself the first on-scene and the only person with any knowledge of a SAR incident has the responsibility of the SMC, OSC, and SRV. The helicopter first on-scene should pass on OSC and SMC duties to someone with a greater capability to manage them as soon as practical. OSC duties belong to a fixed wing aircraft over a helicopter, a multi-engine airplane over a single engine airplane and a ship over an airplane. SMC duties are normally handled by a rescue coordination center.

10.2. Mission Planning. Civil SAR missions involve a number of factors which unit supervisory personnel must consider in order to safely prosecute the mission. While many rescue units may have locally-oriented unique Quick Reaction Checklist's (QRCs), it is vital to obtain as much information as possible concerning the mission prior to committing SAR resources. SAR requests should normally be made through the RCC/JSRC in order to ensure the best SAR assets are utilized. If civilian authorities contact the SRU directly , the RCC/JSRC should be contacted. Mission planning should begin at the first indication a SAR mission exists. The mission commander determines appropriate procedures for search missions. The aircraft commander assumes this responsibility if the mission commander is not available at the start of the mission. Ensure complete predeparture flight planning, except for scramble missions. On scramble missions, essential flight planning may be completed prior to or shortly after takeoff.

10.2.1. Aircrew Briefings. Prior to launching a search mission, the entire crew should be thoroughly briefed. For urgent missions using scramble procedures, the Operations Duty Officer or Supervisor of Flying will usually brief the AC while the crew prepares for the scramble. The AC will brief crew procedures and duties for the mission using the search briefing (MCI 11-HH60G, Vol 3, Attachment 1).

10.2.2. An important aspect of mission planning is the gathering of information pertinent to the SAR objective. The following specific areas should be reviewed:

10.2.2.1 Weather conditions.

10.2.2.2. Terrain characteristics.

10.2.2.3. Time of day.

10.2.2.4. Signal aids available to survivor(s).

10.2.2.5. Size, shape, color contrast, etc., of objects.

10.2.2.6. Status of objective (overdue, lost, crashed, or ditched).

10.2.2.7. Estimated location of objective. The most probable position of a distress incident may be determined by a fix, position report at the time of an incident, or dead reckoning estimate from the last known position of the craft in distress. Consider movement of the object, such as parachute or raft drift, when establishing the search area.

10.2.2.8. Determine the size of the area to be searched and plot it on your map.

10.2.2.9. Fuel requirements. Determine bingo fuel and the amount of time available for the search. Include known contingencies for weather and recovery, and the required fuel reserve in your planning. If operations into civil airports are anticipated, ensure fuel type, amount, and hours of operation allow for their use.

10.2.3. Search Methods. The two basic methods of aerial search are visual and electronic.

10.2.3.1. Use visual search as the primary method when visibility permits.

10.2.3.2. Use electronic search when searching for survivors and space vehicles with transceivers/radio beacons. Monitor distress or preplanned beacon frequencies and home on the signal. Monitor applicable distress frequencies at all times while on search missions, except during required transmissions.

NOTE: Civilian-used emergency locator transmitters (ELTs) may broadcast on both 243.0 UHF and 121.5 VHF. Military emergency beacons broadcast only on 243.0 UHF.

10.2.4. Intensity of Coverage. The intensity of search coverage is determined by the size of the search area, number of search aircraft available, and the probability of finding the objective. For determining parachute drift distances, refer to Table 10.3. Two types of search coverage used are preliminary and concentrated:

10.2.4.1. Preliminary search coverage is used during the initial phases of a mission, electronic searches, and during all night searches when NVGs are not used. It permits rapid and reasonably thorough coverage of the primary area. Use this search if the search objective can be easily sighted or contacted. Use route, parallel, and/or creeping line search patterns with higher altitudes, faster airspeeds, and greater track spacing.

10.2.4.2. Concentrated search coverage is used during the maximum effort phase of a mission or when attempting to locate a sighting or objective whose location is fairly well known. This type coverage ensures a thorough search of the objective area. Use square, rectangular, parallel, creeping line, or sector search patterns at low altitudes, slow airspeeds, and smaller track spacing.

10.2.5. Determine the search pattern. Select a search pattern suited to the situation. The search patterns listed below are provided as basic examples and may be modified as necessary.

10.2.5.1. Employ a route search when the only information available is the known or intended track or route. The route search should be accomplished first, since it can be assumed the objective is on or adjacent to its intended track, will be easily discernible, or possesses electronic detection aids.

10.2.5.2. Use a parallel search to cover large, rectangular areas where the objective is expected to be between 2 points and possibly off track due to navigation error. It can be used simultaneously with or immediately after a route search. Navigational accuracy is increased by long search legs.

10.2.5.3. If several aircraft are available, a creeping line version of the parallel search may be used in conjunction with or immediately after a route search. The creeping line search may be a substitute for an expanding square search during concentrated coverage when time is not a factor. It is more accurate and provides the same coverage.

10.2.5.4. Use an expanding square search for concentrated search of a small area where a sighting or search objective has been reported.

10.2.5.5. The expanding rectangle search may be substituted for an expanding square if error in the position is suspected or for moving or drifting objects.

10.2.5.6. Use the sector search when the position of distress is known within close limits and the search area to be searched is not extensive. It provides greater navigational accuracy, increased scanning opportunity, and more flexibility than the expanding square.

10.2.5.7. Use the contour search to search mountains or hilly terrain.

10.2.6. Track Spacing. Determine the track spacing that permits the best chance of objective detection and most economic use of search resources (Table 10.4). Normally, use greater track spacing during preliminary search than during concentrated search. For concentrated searches, assuming adequate time is available to search the area, track spacing should not exceed twice the expected visual detection range. For example, an individual in a life jacket is almost impossible to detect unless a signaling device is used; therefore, a detection range of one-fifth NM should be used under this or similar circumstances. Another method to determine track space is to ask the scanners how far they think they can detect the search objective given the existing conditions (i.e. dense forest, low light, snow etc.)

10.2.7. Search Altitude. Base search altitude on the object of search, weather, location aids used, and any other known factors (Table 10.5). Lower search altitudes afford a better chance of seeing an object. For preliminary searches, use higher altitudes to detect possible signals at greater distances.

10.2.8. Search Speed:

10.2.8.1. During preliminary searches, use recommended cruise airspeed computed from the flight manual. This allows the maximum area coverage for the least fuel.

10.2.8.2. During concentrated searches, consider the time available to search the area in determining a search airspeed. Use of maximum endurance airspeed maximizes the time available, but a slower airspeed may be desired, depending on the visibility, vegetation, and size of the search object. Maintain above 50 knots if possible. Refer to the aircraft flight manual for single-engine capability and, if higher, use it as a minimum airspeed. If required to go below 50 knots for search reasons, ensure you have an escape route available should an emergency occur. A good technique in order to more easily document the area searched is to fly a 60 knot ground speed when practical.

10.2.8.3. During any search, Avoid continuous flight at any altitude and airspeed when a safe autorotation or single-engine go-around cannot be made.

10.2.9. Other Search Vehicles. If other search vehicles are involved, the OSC should coordinate search areas and altitudes. You must know the altitudes of search vehicles flying in adjacent search areas. With more than one aircraft involved in a search, the knowledge of these aircraft location is important. Be sure to not allow concentration on the search objective to interfere with clearing of turns or "see and avoid."

10.3. On Scene Procedures.

10.3.1. Maintain vertical and horizontal separation of all aircraft in the search area. Helicopters are normally assigned the lower altitude in a joint search with fixed-wing aircraft.

10.3.2. Operation normal (position) reports are usually transmitted each hour or as required by the controlling agency.

10.3.3. Compute bingo time as soon as possible after takeoff and relay the information to the rescue coordination center and/or mission commander.

NOTE: The pilot flying the aircraft during a search mission will devote full attention to controlling the aircraft and maintaining terrain/obstacle clearance.

10.3.4. Report all deviations from planned search procedures to the on-scene commander or mission commander.

10.3.5. Thoroughly investigate sightings and report findings immediately. Have a marking device readily available to jettison. Initiate recovery action/assistance when the objectives are located. Keep appropriate agencies informed of progress.

10.3.6. The copilot will assist in checking the timing to conform with planned search pattern, plot the search pattern on an aeronautical chart, record sighting information (time, location, and details of the sighting).

10.3.7. All crewmembers in the cargo compartment will assist as scanners. Scanners should be alternated periodically to prevent fatigue. The pilot flying the aircraft will devote full attention to flying the pattern and coordinating the crew's activities.

10.3.8. Wind and Sea State Determinations. Over a land mass, available smoke and smoke markers provide the most accurate wind information. Over water, the crestlines of waves are perpendicular to the direction of the wind. Ripples and waves break away from the wind (downwind). The foam of the whitecaps formed by breaking waves always appears to slide into the wind (upwind).

10.4. Search Patterns Selection of the search pattern is an important aspect of mission planning; however, if the search area involves unfamiliar terrain or conditions, selection of a search pattern should be made after a preliminary inflight survey of the area. There are several types of search patterns with numerous variations. Each has certain advantages and disadvantages which need to be considered when selecting the right search pattern to be flown. Table 10.1 summarizes these characteristics. While conducting any search, if possible, use a combination of visual and electronic sensors.

10.4.1. Creeping Line Patterns. To assist in planning the turns to roll out on track, Table 10.2 shows the relationship between TAS and turn radius.

Table 10.1 Search Pattern Characteristics.

SEARCH PATTERN		ADVANTAGES		DISADVANTAGES
Expanding Square		Starts at datum		Many turns
		Easy NAV		Turns in middle
				No NAV update
Sector Search		Concentrates on datum		Under searches outside
		Easy NAV after start		Difficult to set up
		NAV DR only		Follow-on search difficult
		Many NAV updates		
Creeping Line Search		Each NAV		Starts at corner
		Versatile		Only one NAV update
		Long, straight legs		
		Follow-on search easy		
Parallel Arc		Accurate track spacing		Requires nearby NAVAID

		Versatile		
		Easy NAV, easy flying		

Table 10.2 Relationship Between TAS and Turn Radius. (Distance Traveled Perpendicular to Track in 180-Degree Standard Rate and Half Standard Rate Turn).

AIRSPEED	***DISTANCE S/R***	***1/2S/R***	***AIRSPEED***	***DISTANCE S/R***	***1/2S/R***
60	*.7*	*1.3*	*110*	*1.2*	*2.3*
70	*.8*	*1.5*	*120*	*1.3*	*2.6*
80	*.9*	*1.7*	*130*	*1.4*	*2.8*
90	*1.0*	*1.9*	*140*	*1.5*	*3.0*
100	*1.1*	*2.1*	*150*	*1.6*	*3.2*

10.4.1.1. Route Search:

10.4.1.1.1. Route search consists of one search leg along a given track.

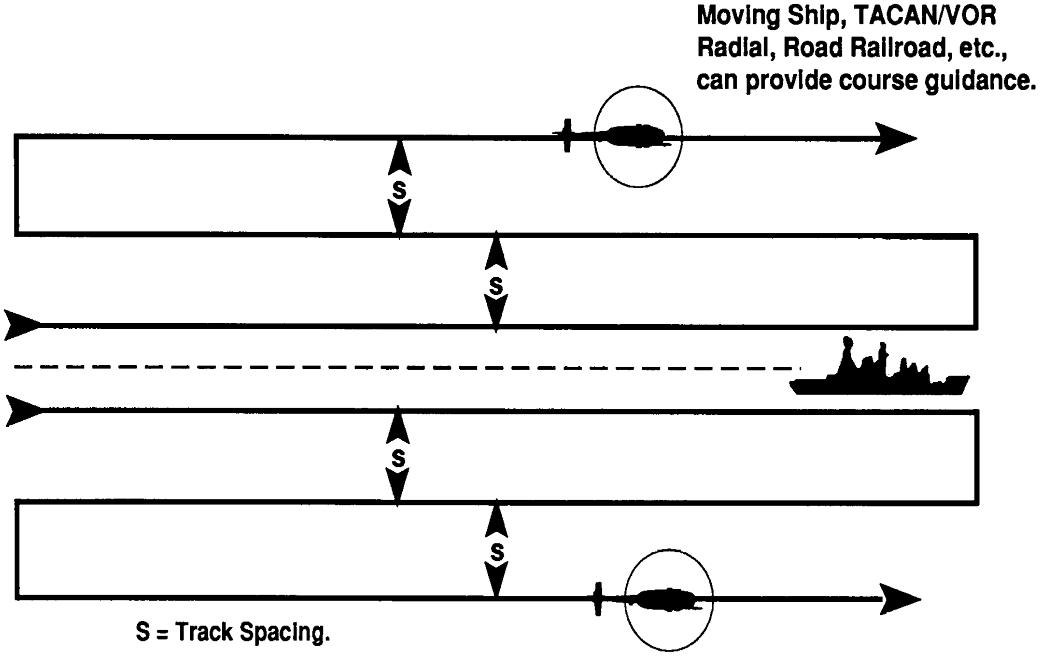
10.4.1.1.2. Start the search leg at the point nearest the search aircraft's departure base and search along the proposed route of the missing objective between the last known position (LKP) and the intended destination. If the LKP is the last position report received from the mission objective, search between the LKP and the point where the next report was due. Extend the track to allow for navigation error on the part of the missing aircraft.

10.4.1.2. Parallel Search (Figure 10.1):

10.4.1.2.1. The parallel search is a series of parallel legs (tracks) advancing from one side of an area to the other. The longer search legs parallel the objective's intended track or the long side of a rectangular search area. The short legs (cross leg) of a parallel search are the computed track spacing.

10.4.1.2.2. The parallel search may be used to cover the area on each side of the search objective's intended track. Begin the parallel search at one end of the route. Search and advance the pattern away from the objective's intended track. Allow for navigational error or drift of the new search objective.

Figure 10.1. Parallel Search Pattern.

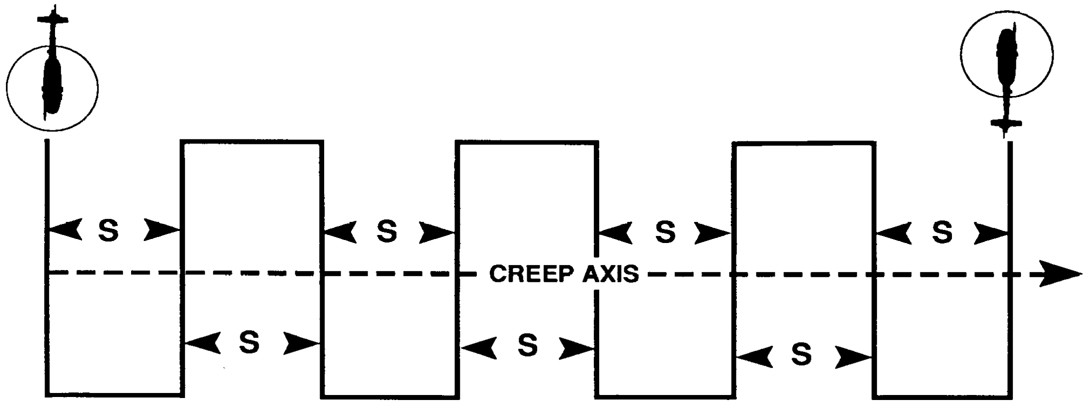


10.4.1.3. Creeping Line Search (Figure 10.2). The creeping line search is a series of parallel tracks advancing along a given axis. The longer legs are perpendicular to the creep axis and are sufficient in length to cover the search objective area. The cross legs of a creeping line search are the computed track spacing.

10.4.1.4. Multiple and Coordinated Creeping Line Searches (Figure 10.3). The creeping line pattern may be modified to provide mutual navigation assistance between multiple SRVs. Preplanning is essential to ensure safety, accurate search, and coordinated effort. Any combination of patterns is acceptable, as long as the search objectives of area and track spacing are met.

10.4.1.5. The contour search (Figure 10.4) is used to search mountainous or hilly terrain. The search legs may be flown around a peak or back and forth along the side of the mountain, depending upon the size and accessibility of the area to be searched. Start searching above the highest peak or ridge and search from top to bottom. Descend at the end of each leg. Use extreme care during the search. Do not fly this type of search when terrain conditions, high winds, turbulence, visibility, or other weather conditions create a hazard to safe flight. Monitor and evaluate these conditions constantly throughout the search. The pilot flying the aircraft must devote full attention to evaluating terrain for clearance and hazards to flight. All other crewmembers should aid in clearing power lines, cables, etc. Exercise extreme caution when searching in canyons and valleys. Assure adequate clearance before entering the area. Always maintain an "out." Plan ahead and know which way to turn in the event of an emergency.

Figure 10.2. Creeping Line Search Pattern.



S = Track Spacing.

NOTE: In other than no-wind conditions, drift and ground speed corrections are necessary to accurately fly this pattern. Use Doppler, INS or ground mapping radar if available.

10.4.2. Expanding Square Search (Figure 10.5):

10.4.2.1. The expanding square search is a series of right angle search legs which expand outward forming a square pattern. The first and second legs are equal in length to track spacing and each 2 succeeding legs are increased in length by the computed track spacing.

10.4.2.2. Begin the search at the center point of the area of highest probability. To minimize navigational error, plan upwind, downwind and crosswind legs. Use cardinal headings if wind is negligible or time does not permit detailed preplanning.

10.4.2.3. The pattern is easily modified to give an expanding rectangle pattern, if required.

10.4.3. Sector Search (Figure 10.6):

10.4.3.1. The sector search is a series of legs which radiate from a datum point (center of most probable position). Each long leg is equal to the diameter of the area where the objective is most likely to be found and the cross legs are equal to radius. If two patterns are flown offset subsequent pattern by 30 degrees.

10.4.3.2. Begin the search at the datum point. Drop smoke signals or other suitable reference markers at the datum point as a reference for precise search legs. When planning the search, align the first leg with the search objective's most probable direction of movement or drift. If the movements or drift are not determining factor, start on the heading inbound to the datum point.

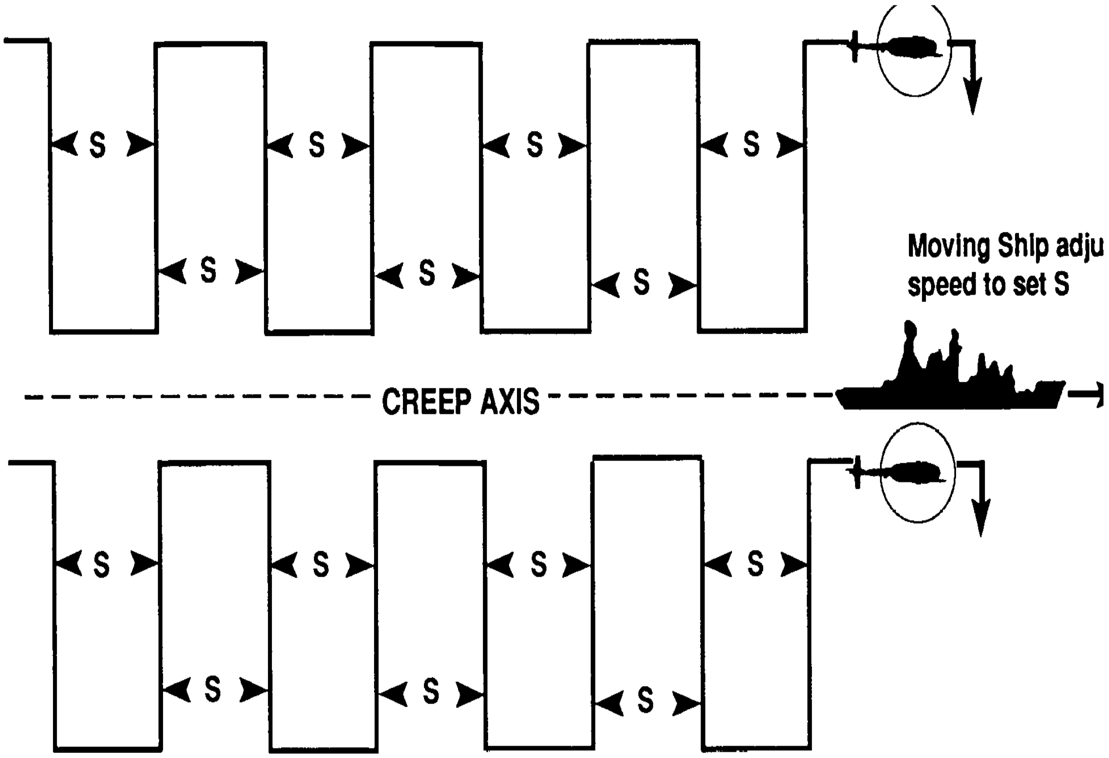
10.4.3.3. Remark the datum point periodically for continuous reference.

10.4.3.4. The heading of each leg is found by adding 120 degrees to the last heading flown.

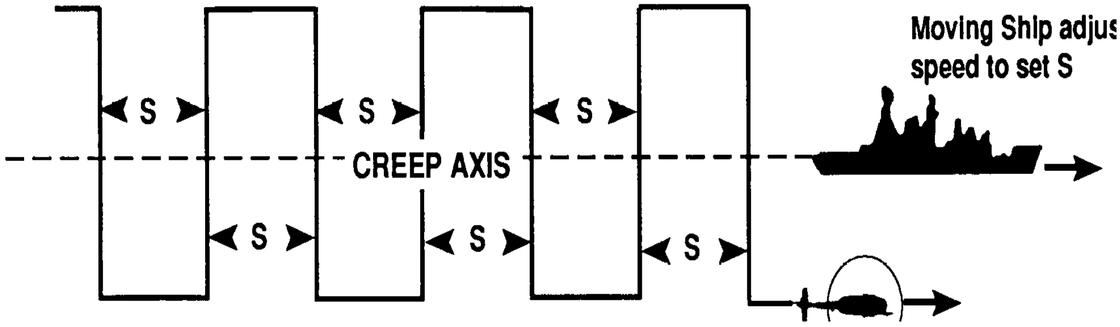
10.4.3.5. Make all turns to the right for a clockwise search.

10.4.4. Parallel Arc. This pattern is used by search aircraft for areas which have DME, TACAN, VORTAC, or similar distance navigation net coverage. It gives the benefit of accurate track guidance and is also particularly useful in areas wherein the terrain is flat and homogeneous (i.e., all trees, barren or snow covered). Areas with excessive winds make some of the DR search patterns difficult to navigate also lend themselves to this type of search pattern.

Figure 10.3. Multiple, Coordinated Creeping Line Patterns.



Two Helicopters, single ship.



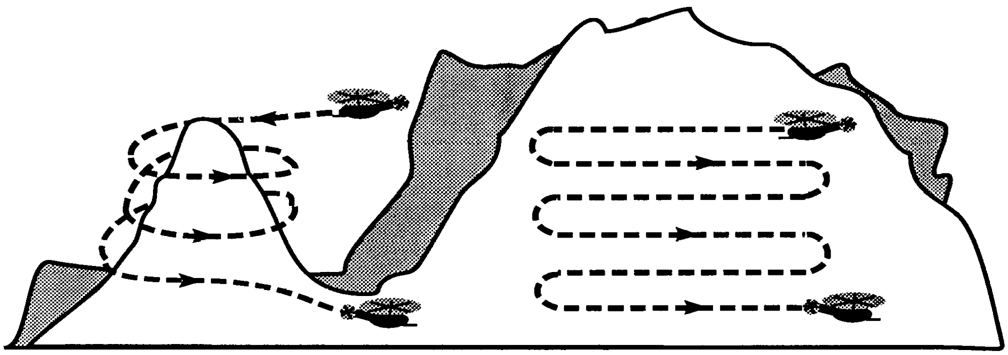
10.4.4.1. The parallel arc consists of a series of DME arcs flown between the 2 radials bounding the search area. Track spacing, in miles, is equal to the increase or decrease in DME on successive arcs.

10.4.4.2. Once the search area is plotted, 4 radial and/or DME fixes can be determined to define its boundaries. The pattern is flown from radial to radial along the selected arcs.

10.5. Scanning Techniques. Precise scanning is the very heart of a search. Crewmembers in the cargo compartment are the primary scanners.

10.5.1. Use a routine scanning pattern. The eyes should move and pause each 3 or 4 degrees to cover 10 degrees in approximately 10 seconds. Start scan at a distance and work back toward the aircraft. Avoid turning away from the scanning pattern, closing your eyes, or focusing short of the scanning area.

Figure 10.4. Contour Search Pattern.

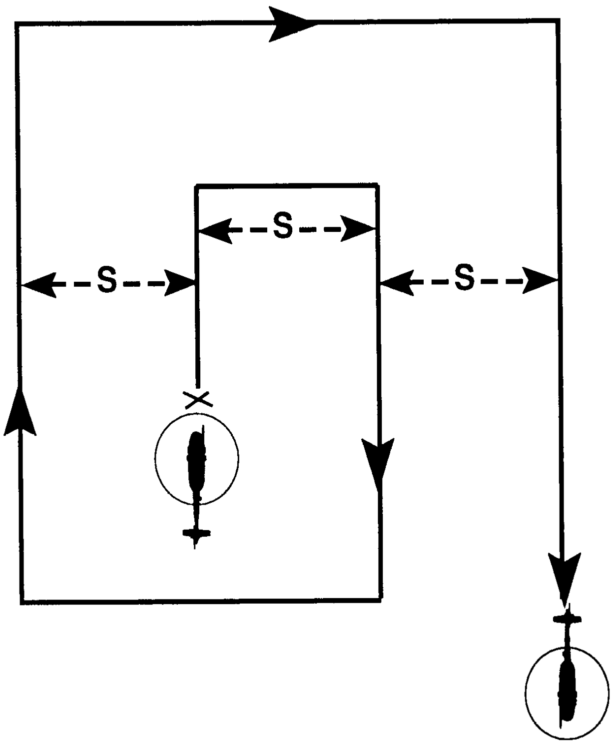


10.5.2. Scanning is tiring and requires periodic rest. With 2 scanners available, limit scanning to 30 minutes and alternate from one side of the aircraft to the other. With 3 scanners, switch positions each 30 minutes; i.e., left side, right side, rest.

10.5.3. Telltale signs to look for:

10.5.3.1. Water Searches. Oil slicks, debris, wakes, life boats, rafts. Debris is normally found downwind of oil slicks, and rafts or boats are found downwind of debris.

Figure 10.5. Expanding Square Search Pattern.



NOTE: In other than no-wind conditions, drift and ground speed corrections are necessary to accurately fly this pattern. Use Doppler, INS or ground mapping radar if available.

10.5.3.2. Land Searches. Smoke, broken or scarred trees, shiny metal, fires, freshly burned out areas, parachutes, signals.

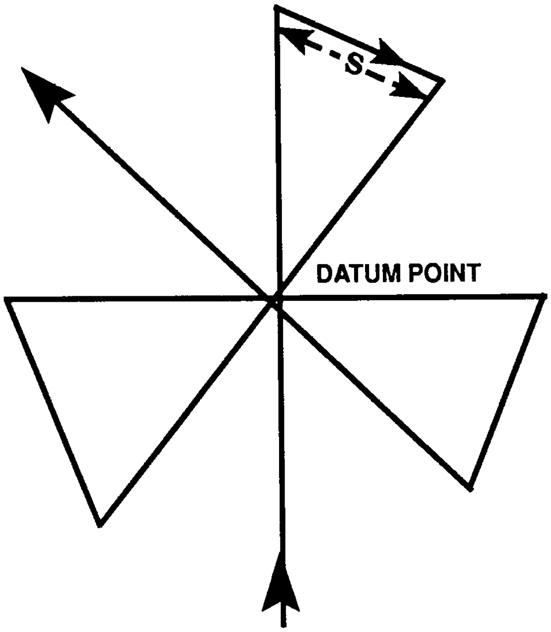
10.6. Sighting Techniques/Considerations.

10.6.1. When a sighting is made, notify the rest of the crew using the clock system and estimated distance to indicate the position of the sighting.

10.6.2. Immediately upon making a sighting, mark the approximate location with an appropriate marking device and/or with the GPS/NU. The marker will assist in returning to the search pattern if the sighting was false. If the sighting is lost prior to confirmation, a return to the marker can assist in reacquiring the objective. Use caution when dropping a smoke device over a wooded area to prevent a forest fire.

10.6.3. If the scanner can keep the objective in sight, turn in the direction of the objective. The scanner will continue to call out the target position and distance for orientation. As the turn progresses, the pilot or copilot should be able to see the target.

Figure 10.6. Typical Sector Search (8 Sections).



10.7. SAR On-Scene Procedures.

10.7.1. Survivor's Report. Report survivors' conditions, without mentioning name's. State condition of the objective, if applicable, to on-scene aircraft commander.

10.7.2. Human Remains. DOD personnel will not normally remove human remains from crash or incident sites. However, factors such as the remoteness or inaccessibility of the areas, weather conditions, darkness, or the like may prompt a request from appropriate local authorities for removal of remains. The mission approving and/or releasing authority is responsible for the safety of resources and should not jeopardize them for body recovery. The mission approving and/or releasing authority is responsible for compliance with all directions given by local civil authorities concerning the proper removal and handling of remains in that jurisdiction.

10.7.2.1. Military Personnel. If the crash or incident site is on a military reservation or within military jurisdiction, the remains of military personnel shall be removed only with the approval of a medical officer. In the absence of a medical officer at the crash or incident site, approval must be obtained from the proper military medical authority prior to removal of remains. If the crash or incident site is not within military control, jurisdiction over the remains rests with the local civil authorities. In such cases, do not remove remains unless authorized by the appropriate civil official (usually the local coroner or medical examiner). Authorizations to remove remains should be written unless it is not practicable under the circumstances, then the authorization may be verbal followed by written authorization. Use Figure 10.7 as an example.

Figure 10.7. Example Authorization to Remove Human Remains.

AUTHORIZATION TO REMOVE HUMAN REMAINS

1. I, ___*(Your Name)*___ under the authority granted me as _*(Position)*_, of ___*(Jurisdiction Where Position Held)*, hereby authorize this __XX__day of *(Month)*, *(Year)* ***or*** hereby did authorize the _____XX_____day of ___*(Month)* ____, *(Year)*, the United States Government to remove any and all human remains located near __________*(Location)*__________and certify I have provided or did provide these representatives with all necessary directions for the proper removal and handling of human remains under the applicable laws and regulations of this jurisdiction.

____*(Signature)*______ ____________*(Date)*______

____*(Name Printed)*______

2. Verbal permission received per telecon on __*(Date)*___ by

____*(Name and Position)*______ for SAR mission _____*(Number)*____

10.8. Additional Mission Planning Information. Tables 10.3 through 10.5 provide additional information and planning considerations for peacetime SAR missions. Aircraft Commanders may use the checklist contained in figures 10.8 and 10.9 to supplement MCI 11-HH60G Vol 3, Attachment 1.

Table 10.3. Parachute Drift Distance.

PARACHUTE DRIFT DISTANCE (*ZERO GLIDE RATIO*)

Distance in miles for landing position downwind from position of parachute opening

	Climb Wind In Knots						
Parachute Opening Height	***10***	***20***	***30***	***40***	***50***	***60***	***70***
30,000 ft (9,000 m)	3.7	7.4	11.1	14.7	18.4	22.1	25.8
20,000 ft (6,000 m)	2.7	5.3	8.0	10.7	13.3	16.0	18.7
14,000 ft (4,300 m)	1.9	3.8	5.7	7.7	9.5	11.4	13.3
10,000 ft (3,050 m)	1.4	2.8	4.2	5.7	7.0	8.3	9.7
8,000 ft (2,400 m)	1.2	2.3	3.5	4.6	5.8	6.9	8.1
6,000 ft (1,800 m)	0.9	1.7	2.6	3.5	4.4	5.2	6.1
4,000 ft (1,200 m)	0.6	1.2	1.8	2.4	3.0	3.5	4.1
2,000 ft (600 m)	0.3	0.6	0.9	1.2	1.5	1.8	2.1

Figure 10.8. SAR Prosecution Checklist. (Part 1)

SITUATION BRIEFING

A. Circumstances Of The Distress, Number Of Personnel Involved, Color Of Clothing, Medical Problems.
B. Survival Equipment.
C. Description Of Search Targets And Any Possible Secondary Targets, Including Visual Or Electronic Distress Signals.
D. The Last Known Position Of The Search Object.
E. All Participating SAR Agencies.
F. SMC Plans Should Target Be Located.

WEATHER BRIEFING

A. Weather Previous To Operations.
B. The Expected On Scene Weather.
C. The Weather Forecast For The Area.
D. Special Meteorological Information That Might Affect Operations Or Safety.
E. Moon Illumination/Rise/Set, If NVD Use Is Anticipated.

SEARCH AREA BRIEFING

A. SEARCH AREA DESIGNATIONS AND GEOGRAPHICAL COORDINATES.
B. Adjacent Search Areas.
C. Known Terrain Hazards And The Probability Of Unknown Hazards, Such As Towers, Power/ Telephone Lines Across Valleys,
High Bridges In River/Harbor Areas, Or Coastal Oil Towers.
D. SAR Airspace Reservation, And The Limitations Of That Protection.
E. Areas Previously Searched, As Well As The Current Search Area, Including The Rational For Selection And Size.
F. En Route Search Requirements.
G. En Route And Search Area Navigational Charts, As Necessary.

SEARCH PATTERN BRIEFING

A. Search Pattern Designation, Track Spacing And Search Altitude.
B. Navigation Aids In The Search Area. Communication Briefing
C. Primary, Secondary And Tertiary Frequencies Assigned By The SMC, On Scene And Command And Control Channels.
D. En Route Frequencies Assigned By Parent Agencies.
E. Monitor Channels, Depending On Type Of Emergency Radios Or ELTs Available To The Survivors.
F. Frequencies And Channels Of News Media, If Heavy Coverage Is Expected.
G. Air To Air TACAN Channels.
H. Radio Call Signs.
I. Identification Of The Survivor
J. Recovery Vehicles Operating In The Area.
K. Collective Call Sign Of The OSC Operating In The Area.

COORDINATION BRIEFING

A. SMC Assignment.
B. OSC Assignment.
C. OSC Change Of Operational Control, If Anticipated.
D. OPS Normal Reports.
E. Position Reports.
F. Sighting Reports.
G. Marking Sightings.
H. Flight Plan Remarks.
I. Flight Hazards.

Figure 10.9. SAR Prosecution Checklist. (Part 2)

LOOKOUT/SCANNER BRIEFING

A Scanning Techniques.
B. Description/Drawings Of The Distressed Vehicle And Survival Rafts/Boats.
C. Proper Methods For Reporting Sightings.
D. Instructional/Motivational Handouts, If Available.
E Maximum Detection Range For Primary Target.
F. Binoculars Or Gyrostabilized Binocular Use And Issuance.

LOST PERSON BRIEFING/CHECKLIST

A. Physical Description.
B. Clothing And Equipment.
C. Physical Condition.
D. Mental Condition. Behavioral Traits.
E. Vital Concerns-Medicine, Etc.
F. Subjects Trip Plans.
G. Any Terrain, Hazards, Etc., In Assigned Search Area.
H. Weather In Search Area.
I. Equipment Needed By Searchers-Clothing, Food, Water, Recording Equipment, Specialized Equipment.
J. Communication Details-Call Signs, Use Of Codes, Compatibility Of Radios.
K. Transportation Details.
L. Length Of Team Deployment.
M. Overview Of Search Progress.
N. Names And Locations Of Relatives And Close Associates.
O. Media Procedures-Authorized Release Personnel, Media Location, Procedures If Contacted By The Media.
P. Explicit Instructions For Team-
    1. Area To Commence Search
    2. Search Pattern
    3. Track Spacing
    4. Marking Procedures
    5. Adjacent Teams
    6. When To Start/Stop Searching
    7. Action Upon Sighting/Finding Survivor
    8. Instructions For Protecting The Scene
    9. Debriefing Instructions.

Table 10.4. Visual Detection Ranges in NM.

Equipment Item	Down Sun	Cross Sun	Up Sun	Overcast	Night
Yellow Life Raft (1- or 7- Man)	1.9	1.4	1.1	1.0	--
Signaling Mirror	6.3	7.0	4.8	--	--
Dye Marker	3.8	2.5	2.2	--	--
Smoke	8.3	7.4	7.1	6.7	--
Life Jacket	0.2	0.18	0.16	0.15	--
Life Jacket Light	--	--	--	--	0.5
2-Cell Flashlight	--	--	--	--	2.4
Hand-held Star Signal	--	--	--	--	32.0
Very Cartridge	--	--	--	--	17.5

Table 10.5. Recommended Search Altitudes.

Over Water	
500 ft and below	Survivor without raft or dye marker
500 ft to 1000 ft	Survivor in raft without dye marker or signal device
1000 ft to 2500 ft	If survivor has dye marker
1000 ft to 3000 ft	If survivor has signaling device/ radar reflector
2000 ft to 3000 ft	When expecting to find wreckage during initial phase of mission
500 ft to 2000 ft	During night over water
Over Land	
1000 ft foliage	Survivors of an aircraft incident over level terrain with little
500 ft foliage	Survivors of an aircraft incident over level terrain with heavy
500 ft to 1000 ft	Survivors of an aircraft incident in mountainous terrain
2000 ft	When expecting to find wreckage
1000 ft to 2000 ft	Over land at night
Electronic Beacons	
8000 ft or higher	

Chapter 11

HH-60G AIRCRAFT HANDLING CHARACTERISTICS (AHC) TRAINING

11.1. Purpose. The number one factor influencing the ability to maneuver the aircraft smart and safe is the aircrew. The purpose of aircraft handling characteristics training is to educate the aircrew on the performance capabilities, limitations, and handling qualities of the HH-60G. It is designed to develop confidence and a "heads out feel" while maneuvering through various flight envelopes. In the helicopter world, we have primarily concerned ourselves with the aircraft capabilities and performance during the takeoff and landing phase of flight (hence TOLD information), and we have all but ignored the inflight maneuvering capability of our aircraft. Historically, in the helicopter we have let the inflight maneuvering envelopes be defined by blanket regulations regardless of aircraft gross weight and environmental conditions. This has led to a complete lack of understanding of the true safe flight envelope for actual aircraft and environmental conditions. Aircraft Handling Characteristics training is designed to provide aircrew the knowledge to prevent putting the aircraft in an unsafe flight envelope or placing undue stresses on the aircraft that could ultimately result in a catastrophic event. Understanding and knowledge of the enroute maneuvering capabilities and limitations of the aircraft is the only true way to ensure the aircraft remains in a safe flight envelope. The information in this chapter provides the ground training and description of flight maneuvers to accomplish the AHC training prescribed in MCI 11-HH60G, Vol. 1.

11.2. Background. Today, we operate the HH-60G at weights and under conditions at which it was not designed to operate. Additionally, the low altitudes we operate at are unforgiving to small mistakes. For these reasons, we need to be smart and avoid exposing ourselves to unsafe flight envelopes and prevent placing undue stresses on our aircraft. "Seat of the pants flying" is no longer acceptable. A thorough and complete understanding of the Energy Maneuverability diagrams is the only way to understand the enroute maneuvering capabilities, limitations, and the flight envelopes of the aircraft. The purpose of this training is to clearly describe the HH-60G Aircraft Handling Characteristics (AHC) sortie maneuvers to include the purpose behind each maneuver, the desired learning objective, the proper execution, and potential tactical application. This training will educate aircrews on how to remain within safe operating limits and aircraft loads during maneuvering flight. This training program assumes a thorough knowledge of energy maneuverability (EM) charts. Crewmembers should be comfortable computing maximum sustainable angles of bank for any airspeed, onset of blade stall angle of bank for any airspeed (using both EM charts and the flight manual), and turn rate and radius for varying combinations of airspeed and sustained angles of bank. If the reader is unable to make these computations or is not familiar with the charts, then they should not perform the described maneuvers and need further training by a certified AHC instructor.

11.3 Pre-Mission Planning. Pre-mission planning for a tactical sortie must include worst case EM diagram analysis to define maneuvering flight envelopes. No regulation or chart in the flight manual gives sustainable maneuvering flight parameters and the impact of maneuvering beyond those parameters for a given set of conditions. It must be understood that the EM diagrams are a snapshot in time and for a given set of conditions, and therefore the EM chart used for this pre-mission planning should be for the worst case anticipated during the low level maneuvering portion of the sortie. If there is a dramatic change in altitude or aircraft gross weight during the flight, then it might be necessary to have several sets of maneuvering performance numbers.

11.4. AHC Maneuvers:

11.4.1. Simulated maximum power/collective position determination

11.4.2. Pitch up and pitch down maneuvering

11.4.3. Transient torque (G, roll, and pedal application induced)

11.4.4. Onset of bladestall

11.4.5. Maximum sustainable bank

11.4.6. Overbank

11.4.7. Low G

11.4.8. Leading the level-off

11.4.9. 2 step climbing turn

11.4.10. Course reversal

11.4.11. Bunt

11.4.12. Level Quickstop

11.4.13. Acceleration to maximum turn rate EVM

11.4.14. Enroute maximum turn rate EVM

11.4.15. Enroute maximum displacement turn EVM

11.4.16. Enroute climbing turn EVM

11.5. Maneuver Descriptions/Examples. The AHC maneuver performance examples will use numbers from the EM diagram: HH-60G, 701, 18000 lbs, 4000 feet, 35 degrees. Crews should reference this EM diagram during the example discussion. Entry parameters are IAW MCI 11-HH60G Vol. 3.

11.5.1. Simulated Maximum Power/Collective Position Determination.

11.5.1.1. Purpose: Establish artificial performance parameters that allow maneuvering with a built in margin of safety.

11.5.1.2. Desired Learning Objective: First provide the crew with a method for determining a simulated maximum power available for any given Ps contour line. Second, develop a heads out feel for the collective position associated with the simulated maximum power. This simulated maximum and collective position are useful when the crew would like to practice energy management, tactical maneuvering and evasive maneuvers, yet not maneuver the aircraft at or near aerodynamic or structural limitations such as retreating blade stall or engine/transmission limitations. Once the simulated maximum power available is established for the given contour line, that contour becomes the simulated Ps=0 line for energy management and evasive maneuvering. All simulated maximum performance parameters will now be taken from this new simulated Ps=0 line for the AHC maneuver or tactical sortie.

11.5.1.3. Execution: To determine the simulated maximum power available, follow the desired Ps contour line down to where it intercepts the horizontal axis (airspeed). It is usually desirable to choose the highest Ps line that remains well clear of the onset of blade stall line. If the contour line intercepts the airspeed axis in two locations, choose the higher airspeed. The airspeed will be the simulated Vh and once in-flight, the torque required and associated collective position to maintain straight and level flight at this airspeed is the simulated maximum available. To determine that torque value prior to flight, use the flight manual cruise charts. By matching the aircraft gross weight and environmental conditions, the cruise charts provide the power required for any airspeed. After determining a simulated maximum power available, energy management techniques and evasive maneuvering training can be demonstrated at relatively benign aircraft attitudes and structural loads.

11.5.1.4. Example Performance: Looking at the example EM diagram, the +1000 foot Ps line keeps the aircraft under the bladestall throughout the various airspeeds. In order to establish this line as the simulated maximum power Ps=0, you must determine the torque to be used as the simulated maximum power. During pre-mission planning, out of the flight manual cruise charts the forecast torque that will give you a straight and level airspeed of 130 KIAS is approximately 82%. To confirm this, establish straight and level flight at 130 KIAS at as close as possible to the chart conditions. 82% torque would now be your simulated maximum power for your tactical and evasive training maneuvering. From the EM chart with the +1000 Ps line as the simulated Ps=0, 82% torque is your maximum power, the maximum sustainable bank at 70 KIAS is almost 50 degrees, and at 110 KIAS it is 40 degrees. Now, once these simulated maximums have been established, other AHC maneuvers can be accomplished using these parameters. This will demonstrate the same aerodynamic phenomena without flying the aircraft at or near aircraft limitations. Remember, if you limit your torque to the +1000 fpm contour simulated maximum, then you must use the airspeed and bank angle FOR THAT LINE. A common mistake is to complete the determination of the simulated maximum power correctly then use the original bank angle for Ps=0. Of course, this is now an overbank condition because the Ps=0 line is based on applying the actual maximum power available (within aircraft limitations).

11.5.1.6. Tactical Application: with the completion of this AHC element, the aircrew can now plan and fly a tactical sortie with some enroute simulated maximum performance capabilities numbers and a collective feel that will help ensure flight is kept within a safe aircraft and performance envelope and a safety margin is built in as the actual maximum numbers are not being used.

11.5.2. Pitch Up and Pitch Down Maneuvering.

11.5.2.1. Purpose: Establish sight pictures that define a safe flight envelope.

11.5.2.2. Desired Learning Objective: Provide the crew with a visual "out the window" sight picture of maneuvering about the pitch axis. In addition, demonstrate aircraft handling and performance characteristics at aggressive pitch attitudes from relatively benign altitudes. Developing the sight pictures and what happens when you operate at them will allow the crewmember heads out recognition of these pitch attitudes while flying low level.

11.5.2.3. Execution: Establish straight and level flight at an altitude above 500 feet AGL and with enough forward airspeed to complete the following pitch up maneuvers without bleeding the airspeed below translational lift. Begin by increasing the aircraft pitch to ten degrees nose up while maintaining a constant power setting. The crew should note the changes in sight picture from each crew position and the rate of deceleration. After a moment to make the observation, increase pitch to twenty degrees nose up, again noting the sight picture and the increased rate of deceleration. Finally, pitch up to thirty degrees and make the same observation. After making the last nose up observation, recover using basic instrument manual unusual attitude recovery procedures. Note: only a momentary stop is possible at each attitude, if the pilot delays too long at each attitude, airspeed will quickly bleed to zero. If more time is needed at each attitude, recover after twenty degrees nose up, reestablish airspeed and then go directly to thirty.

11.5.2.3.1. For pitch down maneuvering establish an entry altitude not lower than 1500 feet AGL and complete recovery no lower than 500 feet AGL. The Voice Altitude Warning System (VAWS) should be used to assist in maintaining minimum altitudes. Airspeed at entry should be relatively low (60 - 80 KIAS) to allow for the anticipated acceleration and recovery, while remaining below any airspeed limitations. Similar to the pitch up, the pitch down is accomplished by maneuvering the aircraft to -15, -25, and -35 degrees nose low, each time noting the sight picture and aircraft performance. Again, the more time spent at each attitude the higher the airspeed prior to recovery. Recovery should be in accordance with basic instrument manual for nose low unusual attitude recoveries. During the recovery, pilots must make smooth control inputs and take care to avoid rapid aft cyclic inputs at high airspeeds and rates of decent which might induce the onset of retreating blade stall. A reduction in collective during the recovery will help in avoiding blade stall. Usually, a recovery is required after the -25 degree attitude, due to high airspeed. After the airspeed is reestablished, the -35 degree attitude should be attained smoothly and quickly to allow sufficient time for observation and recovery above 500 feet AGL and prior to reaching any airspeed limits. While performing the pitch down maneuver, there is a tendency for the aircraft to go out of trim as your airspeed increases in the decent. Avoid out of trim conditions with proper pedal application.

11.5.2.3.2. The pilot flying will tend to focus inside to ensure they are precisely establishing the proper attitude. The pilot not flying and the rest of the crew should be looking outside. Remember the purpose is to build "out the window" visual cues. Pilots and flight engineers should make reference to the horizon and where it intersects structural members such as window cross bars and glare shields.

11.5.2.4. Tactical Application: when maneuvering low level, nose attitude is critical as rates of decent can develop that are unrecoverable. Those visual references developed can then be used by crews to keep an outside reference and anticipate aircraft handling and performance when maneuvering. Having a good outside reference for aircraft pitch attitudes will ensure you maintain safe aircraft flight envelope.

11.5.3. Transient Torque.

11.5.3.1. Purpose: Identify flight conditions that will result in a torque spike situation in order to prevent undue aircraft stresses.

11.5.3.2. Desired Learning Objective: Familiarize crews with rotary-wing transient torque characteristics. These characteristics can be induced by changes in g-loading, accelerations about the roll axis and during pedal application. It is very important to learn the helicopter maneuvering characteristics that could generate stresses beyond aircraft limits. Torque spikes above maximum power available generate one of these stresses. Understanding when torque spikes occur while maneuvering the helicopter and how to control these torque spikes will develop positive habits so that when the aircrew is operating near maximum power, they can maneuver the aircraft without placing undue stresses on the helicopter. Experienced aircrews who observed transient torque spikes on previous AHC sorties will not accomplish the demonstration on subsequent flights; however they must practice techniques for limiting transient torque.

11.5.3.3. Execution: To demonstrate transient torque excursions due to g-load, establish straight and level flight at cruise airspeed and note the steady state torque setting. Fix the collective and apply a moderate amount of aft cyclic to generate a slight increase in g-loading while maintaining a level bank angle. Maintaining a level bank angle will eliminate the effects of roll on torque, so we can isolate the effects of g-loading. When g-load increases, the rotor disk will cone slightly. The coning reduces the rotors moment of inertia. In response, the rotor disk will increase angular velocity so that angular momentum is conserved. The engine fuel control senses this increase in RPM and reduces fuel flow. The result is a momentary reduction in torque applied to the rotor system. Unloading the rotor (decreasing g-load) from a steady condition will cause the opposite effect, slightly increasing the rotor moment of inertia, decreasing RPM, and increasing torque as the engine fuel control attempts to maintain 100% RPM. Aircraft equipped with digital fuel control units will be less susceptible to large transients because of faster reaction times which limit the initial rotor RPM increase or decrease. It may be difficult to detect this phenomena with small g-load changes in aircraft with digital fuel control units. Remember, these are transient effects, aircrews often have trouble separating this effect from their intuitive understanding that an increase in sustained g-loading requires more torque to maintain level flight. We are not trying to demonstrate sustained performance, only the engine and drive train's response to the aerodynamic effect of momentarily increasing or decreasing the g-load on the aircraft. This understanding is important because of the impact transient torque spikes on the aircraft structure.

11.5.3.3.1. Transient torque characteristics due to accelerations about the roll axis are much more dramatic than those due to g-loading. To demonstrate these effects, establish straight and level flight at a cruise airspeed and note the steady state torque. Fix the collective and gently apply left cyclic. Note a small increase in torque. This increase occurs due to the drive train attempting to compensate for the induced drag created on the advancing blade during a left roll. It is important to note that the retreating blade experiences a decrease in induced drag, but since drag is proportional to the blade's velocity squared, the effect of the advancing blade is much greater. When the roll rate is stopped, the torque returns to its original value. Rolling to the right, the opposite effect should also be noted. If more aggressive application of the cyclic was applied there would be a corresponding increase and decrease in torque proportional to the roll rate acceleration. This occurs as larger blade angles of attack are required to produce greater rolling moments, the induced drag is increases proportionally.

11.5.3.3.2. Pilots must be keenly aware of these characteristics while aggressively maneuvering the aircraft. Collective manipulation is critical during aggressive maneuvering, especially when performing maximum performance turns with high roll rates or roll reversals. The pilot must ensure that if operating at high power settings, the collective is reduced prior to initiating a left roll. The rate and amount of collective reduction should be proportional to the application of left cyclic. Pilots tend to learn this technique rather quickly because it happens very early in a maneuver, prior to the possibility of task saturation during the maneuver. The most common place to forget the technique is when reversing a right roll or rolling out of a high power right turn. Remember that the torque spike is proportional to the left rolling moment, which tends to be highest when reversing from right roll to a left. Additionally, during high power right turns, the pilot's attention tends to become channelized on whatever caused the maneuver to be necessary in the first place, usually the threat or an obstacle. This channelized attention can lead to rollouts from the right turn (left rolling moment) without the necessary reduction in collective. Aggressive left rolls can easily cause torque spikes 20 to 30% above that already applied to the system. The bottom line is that any time a pilot makes a left cyclic input, he should be aware of potential torque spikes.

11.5.3.3.3. These torque spikes are transitory in nature and many times by the time you look inside, the torque spike has already occurred with potential damage done. This phenomenon plays a large part in one of only two known loading modes capable of exceeding HH-60 structural design endurance limits. The component which testing has shown appears most affected by the rapid left rolls is the graphite/epoxy tail rotor blade spars. The tail rotors blades experience very high bending moments during left rolling accelerations. In addition, to the very high bending moments caused by the torque spikes, the left roll creates additional bending moments on the tail rotor blades due to gyroscopic forces (the tail rotor acts as a gyroscope under an angular acceleration). During testing, it has been shown that the spar endurance limit can be exceeded if torque spikes are allowed to develop beyond flight manual torque limits. The phenomenon is accentuated by out of trim conditions (left pedal increases the tail rotor bending moment). The most common flight condition that can induce high tail rotor spar bending moments is a high power left roll with left pedal inputs. Pilots should always attempt to keep the aircraft in trim while maneuvering. Out of trim conditions decrease aircraft performance and can reduce aircraft component life.

11.5.3.3.4. Demonstrating torque spikes due to pedal application should be done from a hover. There are two ways to demonstrate this phenomenon. The first method is accomplished in a hover, note the torque required and keep the collective fixed, then simply apply right pedal to start a right rotation. You will note that the torque will initially decrease with the right pedal application. Then, through 90 degrees of rotation, apply left pedal to stop the right rotation. You will note the torque will momentarily spike to greater than that initially required to hover. If your initial hover power was maximum power available, then the left pedal application will cause a decent or the possibility of exceeding aircraft limitations. The second method that will demonstrate the same torque spike due to pedal application is when executing a pedal turn escape out of an LZ. Once established in the hover, the tactical situation requires an immediate escape from the LZ back out the same flight path on which the approach was made. Traditionally, helicopter crews have been taught to make an escape to the right, since it takes less power when operating at or near the maximum. While this is correct, crews must be aware of the increase in power required when it comes time to stop the right turn. Depending on the rate of the right turn and how quickly the pilot attempts to stop the turn, increases of 15 to 20 percent torque required can be generated. This can often exceed the power available and cause an unplanned descent or loss of rotor RPM. Crews should practice this maneuver starting with very low turn rates and recoveries to observe the spike in power required. Crews should anticipate the spike and plan for it. One technique is to establish a simulated maximum power available 5 percent above that required for OGE and practice the maneuver attempting to egress the LZ as quickly as possible without exceeding the simulated maximum power available.

11.5.3.4. Tactical Application: when maneuvering tactically at high power settings or when performing EVMs, the knowledge of the situations that cause torque spikes and the way to prevent them will allow heads out flying ensuring you maintain a safe aircraft flight envelope.

11.5.4. Onset of Blade Stall.

11.5.4.1. Purpose: Identify flight cues crews can use as an indicator to decrease the severity of the maneuver to prevent undue aircraft stresses.

11.5.4.2. Desired Learning Objective: Demonstrate to crews the indications of the onset of retreating blade stall so that they develop the knowledge and feel to avoid this phenomenon. (Emphasis will be placed on the initial indications and avoidance techniques. Crews will not operate for a extended period of time experiencing the onset of blade stall nor fly deeper into blade stall). Additionally, demonstrate that flight manual and EM charted blade stall numbers are for sustained maneuvering only, and the onset of blade stall is dependent on g-loading (not necessarily bank angle) and can occur above and/or below the charted angle of bank.

11.5.4.2.1. Before we discuss execution, a moment of explanation. The whole concept of the ONSET of blade stall is very nebulous. What is meant by "onset"? When am I in blade stall? Your onset of blade stall is different than my onset of blade stall. From our basic helicopter aerodynamics from flight school, we all know that in forward flight at any given time there are portions of our blades that are experiencing stall. After all, we have wings going forwards and backwards. In forward flight an area of reverse flow is generated on our retreating blade and as we go faster, this area gets larger. To compensate for this the angle of attack is increased on the retreating blade. Additionally, as the angle of attack is increased on the retreating blade, a stall region develops starting at the blade tip. When the pitch on the retreating blade cannot compensate for the area of reverse flow and the stall region from the retreating blade tip gets too large, the aircraft experiences blade stall, and the aircraft will pitch up and left. However, the H-60 has NEVER experienced the classic pitch up and left. So what are we to rely on to give us an indication that we are experiencing the "onset of blade stall" and why is it important to avoid this? The important concept that has been left out of our basic understanding of helicopter aerodynamics is that prior to the pitch up and left roll there are stresses placed on the retreating blade and the pitch control assemblies caused by the lack of lift on the retreating blade. Anytime we maneuver the aircraft and increase the G-load with either bank or aft cyclic, we increase the stresses experienced by the components on the retreating blade. With this knowledge, we can alter our flying techniques to accomplish the same maneuvers while minimizing the stresses placed on aircraft components. In order to accomplish this, we must have something to tell us we are placing undue stress on these components. We do. Just like fixed wing pilots rely on a buffet or stall horn to tell them they are approaching an aerodynamic limit, we have the 4 per vibration. When loading our aircraft, this 4 per vibration lets us know the stall region is large enough that our retreating blade is experiencing undue stresses trying to compensate for the lack of lift in this region. Just like fixed wing aircraft, this is our indication to decrease the severity of the maneuver.

11.5.4.3. Execution: Establish straight and level flight at a cruise airspeed. Roll the aircraft to an angle of bank approximately 10 degrees less than the charted onset of blade stall value. Then apply aft cyclic to gently increase g-loading. The onset of retreating blade stall will be indicated by a light four per revolution vibration in the rotor. This four-per vibration is the pilot's indication to reduce the severity of the maneuver. Continued operation at that level or beyond into blade stall will significantly reduce the life of many aircraft components. One technique to reinforce the presence of the four-per vibration is to reduce the angle of bank approximately five degrees. The vibration should immediately cease. Then increase the bank angle to where the four per just began, the very light buffet should again just be noticeable. The maneuver is then terminated by rolling wings level.

11.5.4.3.1. Flight loads experienced during moderate to heavy blade stall is the second loading mode that can exceed the design endurance limits of the HH-60G. The primary effected component is the pitch change rod bearings.

11.5.4.3.2. Emphasis must be placed on the fact that blade stall can be induced at angles of bank well below the charted value. In fact, it is the g-loading associated with the sustained angle of bank on the charts that is the actual parameter causing the onset of blade stall. For example, from the flight manual and your EM chart, you obtain a blade stall bank angle of 45 degrees at 100 KIAS for a given day. A sustained 45 degree AOB turn equals 1.41 g's. Now, if you were to fly 100 KIAS straight and level and apply enough aft cyclic to generate 1.41 g's, you would experience the same onset of blade stall vibration. Conversely, you may roll to 70 degrees AOB, but allow the nose of the aircraft to fall through the horizon, not adding enough back pressure to generate 1.41 g's and you would not feel the vibration. Crews should demonstrate a representative sample of these maneuvers on each aircraft handling sortie.

11.5.4.4. Tactical Application: when maneuvering the aircraft, we must be aware of the undue stresses we are placing on our aircraft. Today, our combat loaded H-60s are flying at weights that it was not designed to operate. For this reason, understanding when to decrease the severity of the maneuver will help prevent placing undue stress on the aircraft components.

11.5.5. Maximum Sustainable Bank.

11.5.5.1. Desired Learning Objective: Demonstrate and build proficiency in obtaining maximum performance turns from the HH-60G. The specific areas of concentration include "out the window" sight pictures and aircraft "feel", precise execution of prebriefed airspeed, angle of bank (AOB), power settings, and crew coordination in communicating those parameters to the pilot flying.

11.5.5.2. Execution: For this maneuver, choose a Ps contour line that will ensure you remain below the onset of blade stall line off the EM chart or a line that will keep your bank below the flight manual blade stall bank for the airspeed to be used. Establish the simulated maximum power for that line and the maneuver as described earlier. Use the performance parameters off that Ps contour for this maneuver. Select your best maneuvering airspeed and maximum sustainable angle of bank for that contour line. For example, you determine that 75 KIAS will allow you to maintain the highest sustainable angle of bank. At that speed, the Ps=0 line indicates you can maintain 58 degrees AOB, however, the chart also indicates the onset of blade stall at 56 degrees AOB. By dropping down to the +500 ft Ps contour line, we find the maximum AOB of 52 degrees. So, by using the procedures in maneuver #1 to establish a simulated maximum power setting, you can fly a simulated maximum performance turn at 52 degrees AOB, 75 KIAS, and maintain the simulated maximum power available and remain below the onset of blade stall AOB and g-loading. Inflight, establish straight and level flight at your prebriefed best maneuvering airspeed. Smoothly roll the aircraft to the briefed AOB, increasing power commensurate with the AOB to the actual or simulated maximum. Once established in the turn, attempt to maintain the parameters for at least one 360 degree turn. Develop the heads out sight picture required to sustain this bank. Pitch control is critical during this maneuver and crews should become aware of the tendency of the nose to drop.

11.5.5.2.1. All the factors that effect the precise execution of this maneuver should be stressed using the EM charts to clarify the impact of each one on aircraft performance. For example, if precise pitch control is not maintained, airspeed may begin to increase, pushing the aircraft closer to the onset of blade stall (show on chart), in addition, a rate of descent will develop and increase as the aircraft moves away from its best maneuver speed. Additionally, in correcting the situation a pilot may want to increase back pressure, but if his airspeed has built up enough, this additional g-loading will probably be enough to initiate the 4 per vibration indicating the onset of blade stall. The only solution is to decrease bank angle reestablish entry parameters and then roll back into the turn. If the pilot insists on maintaining the high bank angle, the aircraft will continue to descend or the pilot will increase the G-load and fly into blade stall and cause stress fatigue. Another example is pitch control, the airspeed decays to approximately 20 knots below the "bucket." The aircraft has actually moved further away from blade stall, but now finds itself on the -700 FPM Ps contour line and a rate of descent develops. Maintaining the AOB and g-load will rapidly decay the airspeed to zero or initiate a very rapidly increasing rate of descent. Once again the only solution is to decrease bank angle reestablish entry parameters and then roll back into the turn. In addition to pitch control, power, AOB, and trim should all be discussed in preflight briefings and debriefed with reference to the EM charts and heads down display video tape recordings.

11.5.6. Overbank:

11.5.6.1. Desired Learning Objective: Reinforce EM awareness, specifically that sustained flight beyond the maximum conditions specified in the EM charts is impossible and will produce high rates of descent. In addition, pilots attempting to use g-loading to maintain altitude in an overbank condition will cause large stresses being placed on rotor components.

11.5.6.2. Execution: Determine which Ps contour line you will use for your simulated or actual maximum performance and your best maneuvering airspeed and angle of bank for that contour line. Inflight, establish straight and level flight at cruise airspeed and an altitude no lower than 1500 feet AGL so that a recovery can be accomplished no lower than 500 feet AGL. Smoothly roll the aircraft to an AOB 5 to 10 degrees beyond the maximum sustainable for your airspeed and for that Ps line, increasing power commensurate with the AOB to the actual or simulated maximum available.

CAUTION: Rapid application of aft cyclic at very high angles of bank will induce the rapid onset of g-loading which could cause blade stall.

NOTE: Do not intentionally fly the aircraft into blade stall, if required use lower simulated maximum power available figure to remain clear of the onset of blade stall.

11.5.6.2.1. The aircraft will experience one or more of the following. First, if the g-loading required to maintain level flight exceeds that required for the onset of blade stall, the aircraft will experience the 4 per vibration indicating the onset of blade stall. Second, if the g-loading to maintain level flight is not greater than that required to induce blade stall, then airspeed will rapidly decay as altitude is maintained with aft cyclic. Third, if the pilot chooses to maintain cruise airspeed, the aircraft will descend. Pilots must be aware of the natural tendency to rapidly apply aft cyclic to maintain altitude. At the 4 per vibration, onset of blade stall, aft cyclic pressure MUST be relaxed. The learning objective is not enhanced further by continued flight with the 4 per vibration where dynamic component life can be adversely affected. It must also be emphasized that after a rate of descent has been established and the aircraft flight path vector is heading down, any application of remaining power will likely increase the rate of descent as airspeed is increased in a descent. The only way to recover from an overbank condition is to rollout. When rolling out however, pilots must remember the effects of transient torque, and if you are already at max power and roll out of a right turn, an overtorque condition can occur, rotor RPM may decay, and blade stall only worsens.

11.5.7. Low G Maneuver.

11.5.7.1. Desired Learning Objective: Demonstrate HH-60G handling characteristics in low g flight. Specifically demonstrate how the H-60 rotor system allows for some roll control authority even in low G flight. The aircraft will respond to roll inputs but without a lift vector, the aircraft will not track across the ground. In other words, the aircraft heading will not change.

11.5.7.2. Execution: Establish straight and level flight at a cruise airspeed and note aircraft heading or a geographic reference off the nose. Lower the nose slightly to increase airspeed, then increase pitch to approximately 10-20 degrees nose up. Smoothly displace the cyclic forward and laterally to produce a low G condition with approximately 30-45 degrees AOB (you should feel "light in your seat", not "forced to the ceiling" zero G). Note that you are able to roll to an AOB but that the heading of the aircraft is not changing. After you've maintained a momentary low g bank, reestablish 1 g flight by smoothly adding back pressure to the cyclic. The aircraft will immediately begin changing heading and track across the ground. Terminate by rolling wings level.

11.5.7.2.1. Emphasis should be placed on smooth control inputs, especially when using cyclic to establish and recover from the low G condition. Additionally, crews may want to perform left and right rolls to approximately 30 degrees AOB while at low G. This will show the relatively slow response when rolling moments are produced solely by hinge offset control forces.

11.5.8. Leading the Level Off.

11.5.8.1. Desired Learning Objective: Demonstrate the effectiveness of level-off points and their assumptions in order to increase the awareness of the required altitude management and aircraft control necessary to recover from high rates of decent.

11.5.8.2. Execution: To demonstrate the proper level-off techniques, establish straight and level flight at an altitude that will allow the performance of the maneuver with a recovery no lower than 500 feet AGL. Fix the collective at a cruise setting. Note the aircraft pitch and heading. Choose a target heading 90 to 180 degrees off the nose and a target altitude at least 500 feet below the current aircraft altitude. Initiate a descending turn in the direction of the target heading. Roll the aircraft wings level upon reaching the target heading and initiate a level-off at the appropriate level-off point using the 10 percent rule (lead your descent level off by 10 percent of your rate of decent) by bringing the nose back to the straight and level pitch attitude. As proficiency develops increase the aggressiveness of the descending turn. With higher rates of decent, be aware of the potential to experience the 4 per vibration during the level off portion of this maneuver. If this occurs, decrease the G-load on the aircraft. Maintain trimmed flight throughout the maneuver.

11.5.8.2.1. Remember the 10 percent rule for determining level-off points assume the aircraft reacquires the straight and level attitude. If pilots aggressively bring the nose above the initial pitch attitude, the aircraft will level off faster, resulting in leveling off above the target altitude. Conversely, delaying the nose up adjustment will cause the aircraft to descend below the target. With proficiency this maneuver can be performed without the pilot referencing instruments, only using outside visual cues and crew coordination (pilot not flying calls).

11.5.9. 2-Step Climbing Turn.

11.5.9.1. Desired Learning Objective: Demonstrate the equivalence of energy states along any given Ps contour line and generate a predicted EM chart climb. This maneuver is initially demonstrated as a 2 step process, getting to an airspeed and a bank then generating a climb. The object is to understand the maximum banks that can be achieved and still generate a climb.

11.5.9.2. Execution: Note: the parameters used in this description are for example only. Develop your own numbers based on local conditions using the concepts described here and the EM chart for the given conditions. Establish straight and level flight at a cruise airspeed of 100 to 120 KIAS. The selected airspeed should correspond to the intersection of a Ps contour line and the horizontal (airspeed) axis of the chart. Additionally, that contour line should not be the Ps=0 line but something less. For this example, let's assume the +2000 FPM Ps line intersects the horizontal axis of the chart at 110 KIAS. So, this maneuver would begin by determining the power required to maintain 110 KIAS straight and level (see Maneuver 1). That power should be held constant. Then, smoothly roll the aircraft to an AOB that corresponds to the same Ps line at best maneuvering airspeed. For our example, the parameters are 45 degrees AOB and 80 KIAS. The pilot can choose to let the airspeed slowly bleed back to the charted value while maintaining altitude, or establish the airspeed more quickly by raising the nose and climbing in the turn. The aircraft should end up in a level, 45 degree AOB turn at the same power setting required for straight and level flight and the higher airspeed. Realize that energetically the two flight conditions are equivalent and that Ps contour lines on EM charts represent flight conditions all requiring the same power. Finally, while established in the level turn, the pilot should apply the remaining power to the actual maximum available or a simulated maximum power. The aircraft should produce the rate of climb associated with the contour line or the difference in climb rate between that contour line and the simulated maximum power contour line. For this example, approximately 2000 FPM. It is important to realize that the aircraft is rarely at the exact charted conditions. Therefore, minor deviations from the predicted rate of climb should be expected. Crews should be able to account for these deviations. Additionally, nose control during the maneuver is important as there is a tendency for the nose to tuck as you pull power and airspeed will increase causing you to not generate the predicted climb. This maneuver will be combined together in a tactical application maneuver--the Climbing Turn EVM.

11.5.10. Course Reversal.

11.5.10.1. Desired Learning Objective: Reinforce the concept of maneuvering under conditions of positive and negative Ps. Specifically that time spent maneuvering with positive Ps will result in a net gain of altitude or airspeed and time spent with a negative Ps will result in a loss of altitude or airspeed. Pilots should be able to manage their energy state while maneuvering the aircraft. The overall objective of the maneuver is to start at a given altitude, airspeed and power setting, then perform a 180 degree course reversal and end up back at the same altitude and airspeed with no power changes.

11.5.10.2. Execution: Note: the parameters used in this description are for example only, crews must develop their own numbers based on local conditions using the concepts described here. This maneuver will be flown with the same aircraft parameters used for the Climbing Turn. Note the initial airspeed and altitude prior to initiating the maneuver. The maneuver should terminate at the same conditions. Begin the maneuver in straight and level flight at cruise airspeed and at an altitude not lower than 1000 feet AGL, (for this example 110 KIAS). Smoothly pitch the nose up approximately 20 degrees while maintaining the constant power setting. As the airspeed bleeds off to approximately 10 knots above the best maneuvering airspeed, begin a left or right 180 degree turn. Simultaneously let the nose begin to fall to the horizon at a rate such that the aircraft reaches the desired angle of bank, the best maneuvering airspeed, and nose at or near the horizon at the same time, 45 degrees AOB and 80 KIAS. The pilot could hold the parameters above and maintain a level turn. The pilot should allow the nose to continue to fall through the horizon to approximately 20 degrees nose down (approximately 90 degrees through the turn). Subsequently, the airspeed will increase and the aircraft will descend. As the airspeed increases maintain the AOB for 180 degrees of turn. Raise the nose of the aircraft to the horizon to level off at the initial altitude. Instructors must emphasize the energetics throughout the maneuver. Specifically, when the aircraft has positive Ps (is gaining energy), when Ps equals zero (is maintaining energy), and when Ps is negative (is losing energy). Crews should review all the charts before flight, so that the actual performance of the maneuvers reinforces the EM chart and builds an intuitive understanding of energy management in flight. With proficiency, the gain in energy initially can be matched exactly to the loss in energy on the back side of the turn so as to roll out after 180 degrees of turn at precisely the same altitude and airspeed the aircraft started the maneuver. The tactical application of intuitive energy management is nearly limitless. Defensive maneuvers, mountain flying, and flight lead and wingman consideration can all be performed better and safer when the crew is armed with this knowledge.

11.5.11. Bunt.

11.5.11.1. Desired Learning Objective: Build proficiency in the correct method of crossing linear obstacles such as ridgelines or power lines. Emphasizing the need to maintain a high energy state.

11.5.11.2. Execution: Establish low-level cruise flight in the vicinity of a linear obstacle. Approach the obstacle at an approximate 45 degree angle at cruise power. The angle allows crews to clear the back side of the obstacle for threats and obstructions prior to committing to the crossing. When required for safe clearance, increase collective such that a climb over the obstacle is possible without losing airspeed. The crews tactical options are preserved by maintaining airspeed. The additional energy can be used for an emergency climb to clear an unseen obstacle, for turn rate to evade a threat, or any other maneuver requiring high aircraft energy. In addition, during conditions requiring close formation flight, constant airspeed reduces the workload dramatically for wingmen. After clearing the flight path at the crest of the obstacle, the pilot may use AOB or low g flight to rapidly descend back to terrain flight altitude, but the power should be maintained at cruise power or higher until reestablished at the terrain altitude. Lowering the collective to reestablish terrain altitudes should be a last resort. In addition to the loss of energy (and thus tactical options in response to an unseen obstacle or threat), lowering the collective will cause a reduction in engine speed. Like any turbine engine, that speed cannot be regained instantaneously, causing a delay in the reapplication of engine power if needed. This characteristic is exaggerated at high density altitudes. It is also important to keep the aircraft in trim while performing the bunt as out of trim conditions at high airspeeds can place extremely high torsion and bending loads on the tailboom, therefore, intentional out of trim conditions should be avoided at high airspeeds. The bottom portion of the bunt is nothing more than the leading the level-off maneuver discussed earlier.

11.5.12. Quickstop.

11.5.12.1. Desired Learning Objective: Demonstrate the correct method of performing rapid low altitude decelerations while maintaining all portions of the aircraft above the minimum enroute altitude.

11.5.12.2. Execution: Establish final approach at no lower than 50 feet AGL and at approach airspeed (80 KIAS) with enough power available to allow a safe approach and hover/landing. At the appropriate distance from the hover area, execute the initial flare by rotating the aircraft about the tail rotor. This requires a small increase in collective prior to an application of aft cyclic. To avoid ballooning, the collective can be reduced as soon as adequate tail rotor clearance has been assured. As airspeed decreases below transational lift, an increase in collective will be required to maintain altitude. The goal is to start at 50 feet AGL and end up in a 50 foot hover without having dipped any portion of the helicopter below 50 feet AGL. Ensure crews have mastered this technique prior to allowing an increase in the aggressiveness of the Quickstop**.** New AHC students should perform this maneuver at higher altitudes until proficiency is demonstrated.

11.6. Tactical Application Maneuver Descriptions/Examples. Establish a simulated maximum power available for all the tactical application maneuvers, with the simulated Ps equals zero line established at the highest line available that keeps the aircraft clear of the onset of blade stall. This prevents unnecessary wear and tear on the aircraft and provides a margin of safety at low altitude while still teaching all the applicable aerodynamic and energy management concepts. In addition, instructors should consider establishing higher minimum altitudes depending on crew proficiency and environmental conditions. Instructors must also reemphasize the need to maintain best maneuvering airspeed or higher when maneuvering at low altitude. Best maneuvering airspeed must be briefed prior to every flight.

11.6.1. Acceleration to Maximum Turn Rate EVM.

11.6.1.1. Desired Learning Objective: Build proficiency in performing maximum performance low altitude maneuvering and recognizing when the aircraft is approaching maximum performance limits. Following takeoff from an LZ, terrain or a threat forces a minimum turn radius or maximum turn rate turn.

11.6.1.2. Execution: From an OGE hover pull power to simulated maximum power and to the best maneuvering airspeed. As soon as that airspeed is attained execute a bank to the maximum bank angle for the simulated maximum Ps contour line and perform a 180-degree level turn. Pre-flight EM chart study is required to establish the parameters for this turn. Instructors should stress the importance of maintaining a level turn at low altitude. Just as in the maximum sustainable turn at altitude, if any parameter (airspeed, AOB, power applied, or trim) is not maintained precisely, the only remedy is to reduce the angle of bank and reestablish the maximum performance parameters. All crewmembers should be aware of sight pictures for maximum performance maneuvers and the pilot not flying should reinforce those sight pictures with timely performance parameter calls. This maneuver and the rest of the low altitude turns can be initiated by any variety of threat calls from the crew.

11.6.2. Enroute Maximum Turn Rate EVM.

11.6.2.1. Desired Learning Objective: From an enroute airspeed, demonstrate a maximum performance turn using minimum turn radius and maximum turn rate EVM.

11.6.2.2. Execution: Establish low altitude cruise flight. Initiate the maneuver by simulating flight in a narrow valley and a crewmember calls an air threat at the six o'clock position. The pilot should initiate a maximum performance turn using the minimum turn radius possible. This is performed by applying the simulated or actual maximum power available and applying aft cyclic to trade airspeed for altitude. As the airspeed decreases to best maneuvering airspeed, roll the aircraft to the maximum sustainable angle of bank and execute the minimum radius turn through 180 degrees. Note that the aircraft will perform a very rapid turn in a small area with all excess airspeed (kinetic energy) turned into altitude (potential energy). The extra altitude can now be used to accelerate and/or defeat the threat with three dimensional jinking maneuvers.

11.6.3. Enroute Maximum Displacement Turn EVM.

11.6.3.1. Desired Learning Objective: Build proficiency in performing maximum performance low altitude maneuvering and recognizing when the aircraft is approaching maximum performance limits. Demonstrate from an enroute airspeed a 180 degree level turn allowing displacement across the ground.

11.6.3.2. Execution: Establish low altitude cruise flight. Initiate the maneuver by simulating flight in relatively open terrain and a crewmember calls an air threat at the six o'clock position. The pilot should initiate a maximum performance turn using the maximum displacement and turn rate possible. This is performed by applying the simulated or actual maximum power available and rolling to the maximum sustainable angle of bank for cruise airspeed. This maneuver will maintain airspeed, which will maximize displacement over the ground, while providing the maximum sustainable turn rate for the higher airspeed. This maneuver is useful when trying to escape from an air or ground threat to nearby terrain where high turn rate and airspeed are required to minimize exposure time. Instructors can also use a modification to this maneuver to demonstrate the appropriate use of an overbank. If displacement is not a tactical necessity, but instead absolute maximum turn rate is desired with no gain in altitude, the pilot can use a slight overbank to increase turn rate temporarily. Of course, the aircraft cannot be allowed to descend at low altitudes, so airspeed must be bled off to maintain a level turn. The amount of overbank will determine the rate at which airspeed is bled off. Note: do not intentionally fly the aircraft into blade stall, if required use lower simulated maximum power available figure to remain clear of the onset of blade stall. The most important item for instructors to teach on this modification is that upon reaching the best maneuvering airspeed, the pilot has no more excess airspeed to bleed off. If the pilot does not roll out to the maximum sustainable with a reasonable lead on the decaying airspeed, the airspeed will rapidly bleed to zero and the aircraft will descend. Finish the remainder of the 180 degree turn at the maximum sustainable parameters.

11.6.4. Enroute Climbing Turn EVM.

11.6.4.1. Desired Learning Objective: Build proficiency in performing maximum performance low altitude maneuvering and recognizing when the aircraft is approaching maximum performance limits. Demonstrate from an enroute airspeed a climbing 360 degree turn with maximum turn rate simulating the need to climb and convert to a bandits 6 o'clock. The object is to understand the maximum banks that can be achieved and still generate a climb and the need to adjust the angle of bank to increase climb.

11.6.4.2. Execution: The execution of this maneuver is nearly identical to the 2 step climbing turn except it is no longer done in 2 steps. Note: the parameters used in this description are for example only. Develop your own numbers based on local conditions using the concepts described here and the EM chart for the given conditions. Establish straight and level flight at a cruise airspeed of 100 to 120 KIAS. Using the example chart 701, 18,000 lbs, 4000 ft, and 35 deg, establish the simulated maximum power for the +1000 Ps line. This will be the simulated maximum power for this maneuver. With premission planning using the chart note that if you use the +1000 Ps line as simulated maximum power, your maximum forward airspeed will be 130 KIAS, and maximum sustainable bank at 70 KIAS is almost 50 degrees. Since that bank will produce no climb with simulated power pulled in, you need to pick a bank angle less than 50 degrees at 70 KIAS in order to generate a climb. For this example, we choose the angle of bank corresponding to the +2000 ft Ps line or about 35 degrees. This bank with simulated maximum power should give produce a +1000 fpm climb while turning (if all available power is used a +2000 fpm climb would be generated), but since power is limited to the +1000 ft Ps line then the difference between the +2000 ft Ps line and the +1000 ft Ps line is the climb you would expect to generate). The maneuver is executed by simulating a threat at 6 o'clock with a desire to climb as you are turning. From an enroute airspeed power up to simulated max power, bring the cyclic aft to begin the climb and deceleration to the planned maneuvering airspeed of 70 KIAS. At the same time, bank to the planned 35 degrees and as airspeed decreases to the maneuvering speed of 70 KIAS, lower nose a little to sustain 70 KIAS. As you initiate the maneuver, the rate of climb will initially be greater than the anticipated +1000 fpm this is due to the fact that you are also trading airspeed for rate of climb. The climb rate can be increased by decreasing angle of bank a little or the turn rate can be increased (at the sacrifice of climb rate) by increasing the angle of bank a little. After one complete 360 degree turn roll out. This simulates you have completed the conversion on to your adversaries 6 o'clock. It is important to realize that the aircraft is rarely at the exact charted conditions. Therefore, minor deviations from the predicted rate of climb should be expected. Crews should be able to account for these deviations. Additionally, nose control during the maneuver is important as there is a tendency for the nose to tuck as you pull power and airspeed will increase causing you to not generate the predicted climb.

11.6.4.3. Tactical Application: this maneuver simulates that you have been jumped by a rotary wing aggressor from behind, you have a climbing advantage under certain conditions and you are trying to deny him the ability to employ his weapons by attempting to climb to rotor mask and at the same time convert on his 6 o'clock position allowing you the opportunity to call for supporting arms. There are several other applications when you may want to turn and climb at the same time. Knowing the angle of banks that will allow you to still generate a climb while turning is important both tactically and in day to day flying.

Attachment 1

GLOSSARY OF ABBREVIATIONS, ACRONYMS, AND TERMS

Abbreviations and Acronyms

A/A	Air-to-Air
A/C	Aircraft
AC	Aircraft Commander
A/R	Air Refueling
A/S	Airspeed / Air-to-Surface
AAA	Anti-Aircraft Artillery
ABC	Airborne Commander
ABNCP	Airborne Command Post
AABNCP	Advanced Airborne Command Post
ABCCC	Airborne Battlefield Command & Control Center
ACBT	Air Combat Training
ACC	Air Component Commander / Air Combat Command
ACE	Airborne Command Element
ACFT	Aircraft
ACM	Air Combat Maneuvers
AFTO	Air Force Technical Order
AGL	Above Ground Level
AHC	Aircraft or Advanced Handling Characteristics
AIE	Alternate Insertion/Extraction
ALT	Altitude
ALS	Above Landing Site
ARCT	Air Refueling Control Time
AF	Air Force
AFAC	Airborne Forward Air Controller
AFM	Air Force Manual
AFRC	Air Force Reserve Command
ALQ	Airborne ECM Jammer
ANG	Air National Guard
ANGELS	Aircraft altitude in thousands of feet
ANVIS	Aviator Night Vision Imaging System
AOO	Area of Operations
AOB	Air Order of Battle
AR	Air Refueling
ARCP	Air Refueling Control Point
ARCT	Air Refueling Control Time
AREP	Air Refueling Exit Point
ARIP	Air Refueling Initial Point
ARTC	Air Route Traffic Control
ARTCC	Air Route Traffic Control Center
ATC	Air Traffic Control
ATE	Actual Time Enroute
ATO	Air Tasking Order
AWACS	Airborne Warning and Control System
BITE	Built In Test Equipment
C2	Command and Control
C3	Command, Control, & Communications
C3I	Command, Control, & Communications Intelligence
CAF	Combat Air Forces
CAL	Calibrated
CAP	Combat Air Patrol
CAS	Close Air Support / Calibrated Airspeed
CASEVAC	Casualty Evacuation
CC	Commander
CCCS	Command, Control, and Communications Systems
CCM	Counter Countermeasures
CCT	Combat Control Team

CG	Center of Gravity
CHOP	Change of Operational Control
CHUM	Chart Updating Manual
CINC	Commander-in-Chief
COMM	Communications
COMSEC	Communications Security
CONOPS	Concept of Operations
CONUS	Continental United States
CP	Copilot
CRCC	Combined Rescue Coordination Center
CSAR	Combat Search and Rescue
CSARTF	Combat Search and Rescue Task Force
DACBT	Dissimilar Air Combat Training
DACM	Dissimilar Air Combat Maneuvering
DCA	Defensive Counter Air
DF	Direction Finding
DMA	Defense Mapping Agency
DOD	Department of Defense
DR	Dead Reckoning
E & E	Escape and Evasion
EC	Electronic Combat
ECCM	Electronic Counter Countermeasures
ECM	Electronic Countermeasures
EM	Energy Maneuverability
EMCON	Emissions Control
EP	Emergency Procedure
EPA	Evasion Plan of Action
EOB	Electronic Order of Battle
EW	Electronic Warfare
FE	Flight Engineer
FEBA	Forward Edge of the Battle Area
FL	Flight Lead
FLIGHT	Formation of Two or more Aircraft
FLIR	Forward Looking Infrared
FM	Frequency Modulation
FOB	Forward Operating Base
FOV	Field of View
FPS	Feet Per Second
FS	Flight Surgeon / Fighter Squadron
FTU	Formal Training Unit
G	Total G on Aircraft (34FT/SEC2)
GCC	Ground Component Commander
GCI	Ground Controlled Intercept
GPS	Global Positioning System
GS	Ground Speed
HF	High Frequency
HHQ	Higher Headquarters
HUD	Heads-Up Display
IADS	Integrated Air Defense System
IAF	Initial Approach Fix
IAS	Indicated Airspeed
IAW	In Accordance With
ID	Identification
IF	Instructor Flight Engineer
IFF	Identification Friend or Foe
IMC	Instrument Meteorological Conditions
INS	Inertial Navigation System
IP	Initial Point / Instructor Pilot
IR	Infrared
IRCCM	Infrared Counter Countermeasures
IRCM	Infrared Countermeasures
ISOPREP	Isolated Personnel Report

JFACC	Joint Forces Air Component Commander
JSRC	Joint Search and Rescue Center
KCAS	Knots Calibrated Airspeed
KIAS	Knots Indicated Airspeed
KTS	Knots (airspeed)
LAT	Latitude
LF	Low Frequency
LOC	Line of Communication
LONG	Longitude
LOS	Line of Sight
MAJCOM	Major Command
MANPAD	Man-Transportable Air Defense
MARSA	Military Assumes Responsibility for Separation of Aircraft
MC	Mission Capable / Mission Copilot
MCC	Mission Crew Commander
MCM	Multi-Command Manual
MDS	Mission Design Series
MEA	Minimum Enroute Altitude
MEDEVAC	Medical Evacuation
MF	Mission Flight Engineer
MOB	Missile Order of Battle
MP	Mission Pilot
MR	Mission Ready
MS	Mission Support
MSN	Mission
MWR	Missile Warning Receiver
N/A	Not Applicable
NATOPS	Naval Air Training and Operations Program
NAF	Numbered Air Force
NAV	Navigation
NGB	National Guard Bureau
NIB	Navigation Information Block
NLT	No Later Than
NM	Nautical Mile
NORDO	No Operative Radio
NVD	Night Vision Device
NVG	Night Vision Goggle
OAT	Outside Air Temperature
OPCON	Operational Control
OPLAN	Operational Plan
OPORD	Operational Order
OPR	Office of Primary Responsibility
OPS	Operations
OPREP	Operational Report
OPSEC	Operational Security
OSC	On Scene Commander
PACAF	U.S. Air Force, Pacific
PIREP	Pilot Reported Weather Conditions
PJ	Pararescueman
PS	Specific Excess Power / Probability of Survival
PSY OPS	Psychological Operations
RC	Reserve Component
RCC	Rescue Coordination Center
RCO	Range Control Officer
RDZ	Rendezvous
RECON	Reconnaissance
RESCAP	Rescue Combat Air Patrol
RESCORT	Rescue Escort
RF	Radio Frequency
ROE	Rules of Engagement
RP	Rendezvous Point
RT	Radio Transmission / Radio Terminology

RTB	Return to Base
RTE	Route
RWR	Radar Warning Receiver
SAM	Surface to Air Missile
SAR	Search and Rescue
SATCOM	Satellite Communications
SERE	Survival, Evasion, Resistance and Escape
SID	Standard Instrument Departure
SOF	Supervisor of Flying
SPINS	Special Instructions
SQ/CC	Squadron Commander
TACAN	Tactical Air Navigation
TACC	Tactical Air Control/Command Center
TACS	Tactical Air Control System
TAS	True Airspeed
TBD	To Be Determined
TD	Tactical Deception
TD & E	Tactics Development And Evaluation
TO	Technical Order
TOC	Tactical Operations Center
TOT	Time On Target
UHF	Ultra High Frequency
US	United States
USA	United States Army
USAF	United States Air Force
USAFR	United States Air Force Reserve
USMC	United States Marine Corps
USN	United States Navy
VID	Visual Identification
VMC	Visual Meteorological Conditions
VTR	Video Tape Recorder
WG	Wing
WOC	Wing Operations Center
WOPS	Water Operations
WX	Weather

Terms

Air Refueling Time	Planned lapsed time from ARCT to end AR.
Air Refueling Track	A flight path designated for air refueling.
Arcing	Flying a circular flight path which allows another aircraft the use of cutoff to gain closure.
Armament Safety Check	Action taken by an aircrew member to review armament selection switches to preclude the inadvertent launch/release of armament (switches safe).
Aspect Angle	Angle between defender's longitudinal axis and the line of sight to the attacker. The angle is measured from the defender's 6 o'clock. The attacker's heading is irrelevant.
Breakaway	Tanker/receiver call indicating immediate vertical and horizontal separation between the tanker and receiver is required.
Buffer Zone (BZ)	Airspace of defined dimensions and adjacent to or near borders which may have special restrictions.
Cell	Two or more tankers/bombers flying in formation.
Center of Gravity (CG)	That point along the horizontal axis, fore and aft, of which airplane weight is equal.
Chaff	Chaff is a passive form of electronic countermeasures used to deceive airborne or ground based radar.
Closure	Relative velocity of one aircraft in relation to another.
Collision Course	A flight path along which an aircraft is directed towards a point at which it will collide with another aircraft.
Contingency Mission	A mission operated in direct support of an OPLAN, Operation Order, disaster, or emergency.
Defensive Maneuvering	Maneuvers designed to negate the attack/ordnance of a threat.
Defensive Turn	A planned turn designed to prevent an attacker from entering/remaining in the defender's vulnerable cone.
Doppler Radar	A radar that makes use of the Doppler effect by measuring the shift in frequency of a signal caused by movement of a target.
Element	A flight of two aircraft.
Frag	Fragmentary order (ATO).
Have Quick	A UHF jam-resistant radio.
Hostile	A contact positively identified as enemy in accordance with (IAW) operational command ROE.
Hunter-Killer	Flight mix of F-4G Wild Weasel and other aircraft employed in SEAD operations.
Infrared	Missile depends on energy (heat) radiated from the target.

Jinking	Aircraft maneuvers designed to change the flight path of the aircraft in all planes at random intervals (usually to negate a gun attack).
Joint	US/Multi-Service.
Landing Zone (LZ)	An area of sufficient size to allow insertion or extraction of personnel by touchdown or hover.
Line of Sight	A line from the pilot's eye to the object (usually target) being viewed.
Maneuverability	The ability to change direction and/or magnitude of the velocity vector.
Maximum Performance	The best possible performance without exceeding aircraft limitations.
Maximum Rate Turn	That turn at which the maximum number of degrees per second is achieved.
MEDEVAC	Medical Evacuation.
Military Crest the	A position along a ridge or hill two-thirds the distance from the base to summit.
Mission Capable Fuel	The minimum fuel required to complete the mission, as planned, and land at the destination with the required fuel reserves.
Mission Capable Fuel Time	The latest time that the mission must begin based on the Mission Capable Fuel. If the mission does not commence at the specified time, refueling is required.
On-Station	In position, ready for mission employment.
Ops Check	Periodic check of aircraft systems performed by the aircrew (including fuel) for safety of flight.
Rate of Turn	Rate of change of heading, normally measured in degrees per second.
Relative Wind	The oncoming, instantaneous wind. For practical purposes, the direction of the relative wind is exactly opposite the flight path of the aircraft.
Sanitize	Area clear of threats.
Scramble	Takeoff as quickly as possible.
Specific Energy	Total mechanical energy per pound. Can be loosely described as an airplane's total energy resulting from airspeed and altitude.
Specific Excess Power (Ps)	A measure of an airplane's ability to gain or lose energy in terms of altitude, airspeed, or combination thereof. Also called energy rate and expressed in feet per second or knots per second.
Station Time	Specified time(s) at which aircrew, passengers, and material are to be in the aircraft and prepared for flight.
TACON	Tactical Control.
Target	Object being attacked.
Time On Target	Specified time at which the aircraft is on the ground or established in the hover and ready to perform the required event (e.g. insertion or survivor pickup).

WILLY PETE	A white phosphorous smoke, rocket, grenade, or artillery round used to provide a ground reference. Can be employed as a bomb to provide a smoke screen.