Helicopter Handbook

VERSION 1.0

CRASH CREW

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Introduction to the Helicopter

The helicopter is an aircraft that is lifted and propelled by one or more horizontal rotors, each consisting of two or more rotor blades. Piloting a helicopter requires a great deal of training, skill, and attention.

Rotor System. The rotor system is the rotating part of a helicopter that generates lift.

Flight Controls. A helicopter in Arma has three flight control inputs: cyclic, collective, and antitorque pedals.

The **Cyclic** is similar to a joystick, and tilts the rotor disk in the direction of the input, resulting in the helicopter moving that direction. If the pilot pushes the cyclic forward, the rotor disk tilts forward, and the rotor produces a thrust in the forward direction.

In Arma 3, this is controlled with the *W*, *A*, *S*, and *D* keys (and mouse) by default.

The **Collective** controls the pitch of the main rotor blades, increasing or decreasing total lift or thrust, with the result of the helicopter increasing or decreasing in altitude or airspeed.

In Arma 3, this is controlled with the *LShift* and *Z* keys by default.

The **Antitorque Pedals** control the direction in which the nose of the aircraft is pointed (Yaw). Application of the of the pedal in a given direction causes the nose to yaw in the direction of the applied pedal.

In Arma 3, this is controlled with the *Q* and *E* keys by default.

Instruments. A helicopter typically has an airspeed indicator, attitude indicator, an altimeter, a turn indicator, a vertical speed indicator, and a magnetic compass. Arma 3 does not always model every function.

The **Airspeed Indicator** displays airspeed in kph (Arma 3 UI) or knots (MELB instrument gauge).

The **Attitude Indicator** displays the aircraft's pitch angle in degrees.

The **Altimeter** displays the aircraft's current altitude in meters above ground level (Arma 3 UI) or feet above mean sea level (MELB instrument gauge).

The **Turn Indicator** displays the direction of a turn and rate.

The **Vertical Speed Indicator** displays the rate of climb or descent in meters per minute (Arma 3 UI) or feet per minute (MELB instrument gauge).

The **Compass** displays the helicopter's current heading in degrees.

Aerodynamics of Flight

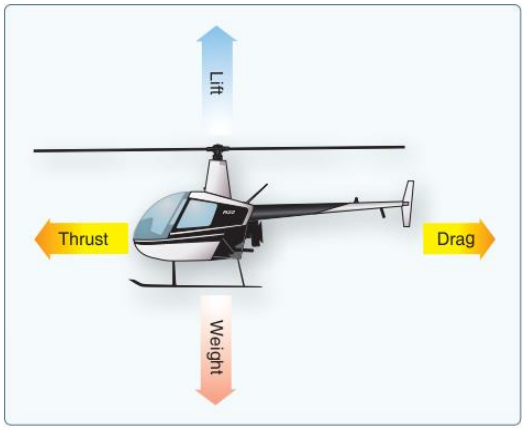
Once a helicopter leaves the ground, it is acted upon by four aerodynamic forces: thrust, drag, lift, and weight.

Thrust is the forward force produced by the power plant or rotor. It overcomes the force of drag.

Drag is a rearward and retarding force that opposes thrust.

Lift opposes the downward force of weight and is produced by the rotor blades.

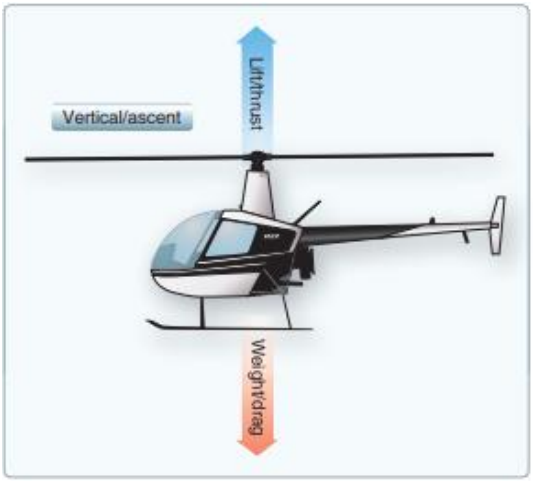
Weight is the combined load of the aircraft and pulls the aircraft downward. It opposes lift and acts vertically downward through the aircraft's center of gravity.



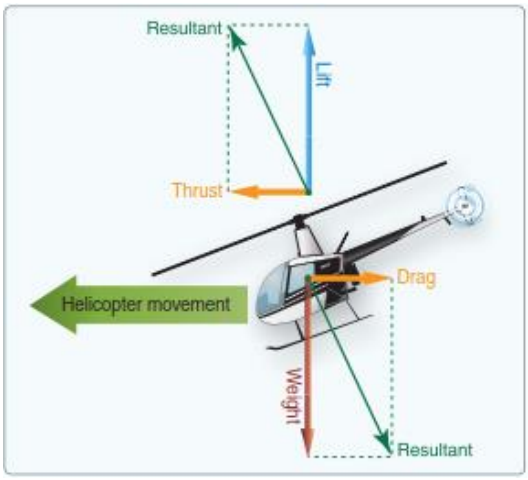
There are five types of **Powered Flight**: hovering, vertical, forward, sideward, or rearward.

In **Hovering Flight**, the cyclic is used to eliminate drift horizontally, the collective is used to maintain altitude, and the pedals are used to control nose direction or heading. During hovering flight, a helicopter maintains a constant position over a selected point.

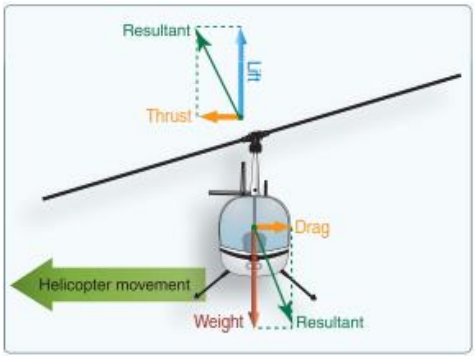
In **Vertical Flight**, increasing the collective generates additional lift and causes the helicopter to ascend and decreasing the pitch causes the helicopter to descend.



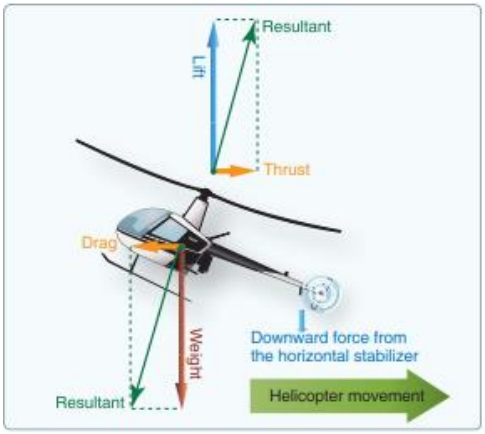
In **Forward Flight**, the four forces must be in balance. Once the helicopter is tilted forward, the total lift-thrust force is also tilted forward. With any changes in power or cyclic, the helicopter will begin to climb or descend.



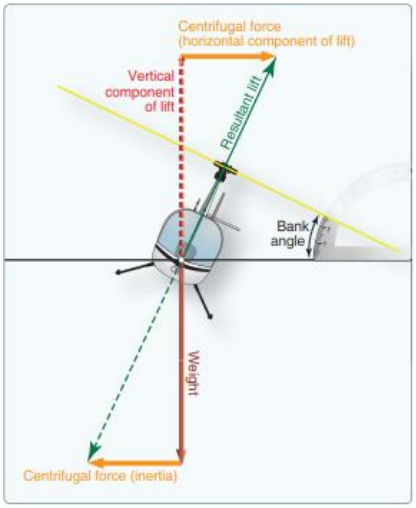
In **Sideward Flight**, the helicopter is tilted in the direction that flight is desired.



In **Rearward Flight**, the helicopter is tilted rearward.



In **Turning Flight**, when the helicopter is banked in forward flight, the rotor disk is tilted forward and sideward simultaneously.



Autorotation is the state of flight where the main rotor system is being turned by the action of air moving up through the rotor rather than engine power. If the engine fails, this is the means by which a helicopter can be landed safely.

Basic Flight Maneuvers

The following techniques describe maneuvers applicable to all helicopters in Arma.

Four Fundamentals

The four fundamentals of flight upon which all other maneuvers are based are **straight-and-level flight**, **turns**, **climbs**, and **descents**. If a pilot is able to perform these maneuvers well, the ability to perform any assigned maneuver is only a matter of obtaining a clear conception of it.

Anticipate the following characteristics during aggressive maneuvering:

- In steep turns, the nose drops. In most cases, airspeed must be traded to maintain altitude.
- The cyclic position relative to the horizon determines the helicopter's travel and attitude.
- Always leave a way out (of your current maneuver).
- Crew coordination is critical.

Vertical Takeoff to Hover. Involves flying the helicopter from the ground vertically to a skid height of approximately 1 meter, while maintaining a constant heading. Once the desired skid height is achieved, the helicopter should remain nearly motionless over a reference point at a constant altitude and on a constant heading.

Pilot should remain focused outside the aircraft. Co-pilot assists in clearing the aircraft and provides adequate warning of any obstacles and unannounced or unusual drift/altitude changes.

Increase collective very slowly until the helicopter becomes light on the skids or wheels.

Hovering. A maneuver in which the helicopter is maintained in nearly motionless flight over a reference point at a constant altitude and on a constant heading. Pilot should use sideview and peripheral vision to look for small changes in the attitude and altitude. The main area of visual attention needs to be some distance from the aircraft.

Hovering Turn. A maneuver performed at hovering altitude in which the nose of the helicopter is rotated either left or right while maintaining position over a reference point on the surface. The pilot should maintain a constant altitude and rate of turn.

Hovering-Forward Flight. Normally used to move a helicopter to a specific location and may begin from a stationary hover. The pilot should maintain constant groundspeed, altitude, and heading.

Hovering-Sideward Flight. May be necessary to move the helicopter to a specific area when conditions make it impossible to use forward flight. The pilot should maintain constant groundspeed, altitude, and heading.

Hovering-Rearward Flight. May be necessary to move the helicopter to a specific area when the situation is such that forward or sideward hovering flight cannot be used. The pilot should maintain constant groundspeed, altitude, and heading. Due to limited visibility behind a helicopter, it is important that the area behind the helicopter be cleared before beginning the maneuver.

Taxiing. Refers to operations on or near the surface of taxiways or other prescribed routes. Helicopters use three different types of taxiing:

> A **Hover Taxi** is used when operating below 8 m AGL. Hover taxi uses the same techniques as forward, sideward, or rearward hovering flight.
>
> An **Air Taxi** is preferred when movements require greater distances within an airport boundary. In this case, fly to the new location; however, it is expected that the helicopter will remain below 30 m AGL with an appropriate airspeed and will avoid overflight of other aircraft, vehicles, and personnel.
>
> A **Surface Taxi** is used to minimize the effects of rotor downwash and may be used with wheeled aircraft.

Normal Takeoff from Hover. An orderly transition to forward flight and is executed to increase altitude safely and expeditiously. During the takeoff, fly a profile that remains out of the cross-hatched or shaded areas of the height-velocity diagram.

Normal Takeoff from Surface. Used to move the helicopter from a position on the surface into a climb using a minimum amount of power.

Straight-and-level Flight. Flight in which constant altitude and heading are maintained. The attitude of the rotor disk relative to the horizon determines the airspeed. Altitude is primarily controlled by the collective.

Turns. A maneuver used to change the heading of the helicopter. Clear the area in the direction of the turn. Do not use the pedals to assist in the turn. Start the rollout before reaching the desired heading.

Normal Climb. A maneuver in which the helicopter gains altitude at a controlled rate in a controlled attitude. Increase the collective. Moving the collective up requires a slight aft movement of the cyclic to direct all of the increased power into lift and maintain the airspeed. Remember that a helicopter can climb with the nose down and descend with the nose up.

Normal Descent. A maneuver in which the helicopter loses altitude at a controlled rate in a controlled attitude. Lower the collective. If cruising airspeed is the same as or slightly above descending airspeed, simultaneously apply the necessary cyclic pressure to obtain the approximate descending attitude. If the pilot wants to decelerate, the cyclic must be moved aft. If the pilot desires to descend with increased airspeed, then forward cyclic is all that is required if airspeed remains under the limit.

Ground Reference Maneuvers. May be used as training exercises to help develop a division of attention between the flightpath and ground references. Prior to each maneuver, a clearing;l turn should be accomplished to ensure the area is free of conflicting traffic.

Turns Around a Point is a maneuver that requires flying constant radius turns around a preselected point on the ground using a bank angle of approximately 30° - 45°, while maintaining both a constant altitude and the same distance from the point throughout the maneuver. This maneuver should be performed between 150 and 250 m AGL.

Traffic Patterns. Promotes safety by establishing a common track to help pilots determining their landing order and provide common reference. A standard helicopter traffic pattern is flown at 150 m AGL and consists of right hand turns.

Approaches. The transition from pattern altitude to either a hover or to the surface. The approach should terminate at the hover altitude with the rate of descent and groundspeed reaching zero at the same time.

A **Normal Approach to Surface** or a no-hover landing uses a descent profile of between 7° and 12° starting at approximately 100-150 m AGL. At the recommended approach airspeed and at approximately 100 m AGL, the helicopter should be on the correct ground track for the intended landing site, but the axis of the helicopter does not have to be aligned until about 30 m AGL. Touchdown should occur with the skids level, zero groundspeed, and a rate of descent approaching zero.

A **Normal Approach to Hover** is the same as the normal approach to surface; however, instead of terminating at the surface, enter a hover at the recommended hover altitude.

Go-Around (Waveoff). A procedure for remaining airborne after an intended landing is discontinued. A go-around may be necessary when instructed by the FAC or the helicopter is in a position from which it is not safe to continue the approach. Any time an approach is uncomfortable, incorrect, or potentially dangerous, abandon the approach. When the decision is made, carry it out without hesitation. The first response is to increase collective to takeoff power, coordinated with pedal to control heading. Establish a climb attitude and maintain climb speed to go around for another approach.

Advanced Flight Maneuvers

LZ Reconnaissance Procedures. When planning to land or takeoff at an unfamiliar site, gather as much information as possible about the area.

A **High Reconnaissance** is used to determine a touchdown point, suitability of the landing area, approach and departure axes, and obstacles. A high reconnaissance should be flown at an altitude of 90 - 150 m AGL so that the pilot doesn't need to divide attention toward avoiding obstructions or terrain. A 45° angle of observation allows the best estimate of the height of barriers, the presence of obstacles, the size of the area, and the slope of the terrain.

A **Low Reconnaissance** is used during the approach to the landing area. When flying the approach, verify what was observed in the high reconnaissance and check for anything new that was missed at a higher altitude, such as wires. The pilot may terminate the landing to a hover to check the landing point more carefully, or the surface where the task is time sensitive.

A **Ground Reconnaissance** is completed from the ground in order to evaluate the takeoff site. Determine the best departure path and identify all hazards in the area.

Maximum Performance Takeoff. A maximum performance takeoff is used to climb at a steep angle to clear barriers. It can be used when taking off from small areas surrounded by high obstacles.

Running/Rolling Takeoff. A running takeoff is performed on an aircraft with skids and a rolling takeoff is performed on an aircraft with wheels. Maintain a low altitude and allow the airspeed to increase toward normal climb speed, then follow a normal climb profile.

Rapid Deceleration or Quick Stop. Maneuver used to decelerate from forward flight to a hover. It is often used to abort takeoffs or stop if something blocks the helicopter flightpath. Requires a high degree of coordination of all controls.

Should be practiced at an altitude that permits safe clearance between the tail rotor and the surface throughout the maneuver. The maneuver is performed slowly and smoothly with the emphasis on coordination.

Desired entry speed is approximately 80 kph. The altitude should be high enough to avoid danger to the tail rotor during the flare. Initiate the deceleration by applying aft cyclic to reduce forward groundspeed and simultaneously lowering the collective as necessary to counteract any climbing tendency. The timing must be exact.

After attaining the desired speed, initiate the recovery by lowering the nose and allowing the helicopter to descend to a normal hovering altitude in level flight and zero groundspeed. During the recovery, increase collective as necessary to stop the helicopter at normal hovering altitude.

Steep Approach. A steep approach is used when there are obstacles in the approach path that are too high to allow a normal approach or for pinnacle landings. An approach angle of 13° and 15° is considered a steep approach.

Shallow Approach and Running/Roll-On Landing. Use a shallow approach and running landing when a normal or steep approach cannot be made for performance or tactical reasons. The glide angle for a shallow approach is approximately 3° to 5°. Since the helicopter is sliding or rolling to a stop during this maneuver, the landing area should be smooth and landing gear must be aligned with the direction of travel (to prevent dynamic rollover). Do not touchdown at airspeeds greater than 80 kph.

Slope Operations

> **Slope Landings** should be conducted across a slope rather than with the slope. Landing with the helicopter facing downhill is not recommended because of the possibility of striking the tail rotor on the surface.
>
> **Slope Takeoffs** are the reverse of slope landings. After reaching a hover, avoid hitting the ground with the tail rotor by not turning the helicopter tail upslope.

Confined Area Operations. A confined area is an area where the flight of the helicopter is limited in some direction by terrain or the presence of natural or manmade obstructions (e.g., a clearing in the woods, a city street, a building roof, etc.). The pilot must maintain a clearance between the rotors and obstacles, with special consideration to the tail rotor since it is not always visible from the cockpit.

Pinnacle and Ridgeline Operations. A pinnacle is an area from which the surface drops away steeply on all sides and a ridgeline is an area where the surface drops away steeply on one or two sides.

> The **Approach and Landing** should be initiated parallel to the ridgeline as much as possible. Groundspeed is difficult to judge due to visual references being farther away than during approaches over trees or flat terrain.
>
> The **Takeoff** from a pinnacle is considered and airspeed over altitude maneuver which can be made from the ground or hover. Do not dive the helicopter down the slope after clearing a pinnacle unless the tactical situation warrants it.

Crew Coordination

The helicopter aircrew should function as a team and not as individuals. The most successful crews are those that know each other's strengths and weaknesses.

Radio Communications

- Directive comm starts with the aircraft being addressed ("Phantom 2, Break Left").
- Descriptive comm starts with the aircraft's own callsign ("Phantom 1, Contact the mark").
- Call acknowledgement may be by call sign only ("Phantom 2, Check Right"... "Phantom 2").
- Directive comm supersedes description comm.

Internal Communications

- Comm brevity is mandatory.
- Crew members should not communicate during incoming or outgoing radio comm unless a time critical situation exists.
- When a directive call is made to a crew member, the crew member should respond verbally. Do not assume that a task has been completed without confirmation.

Descriptive Terms are used to "talk-on" other crew or flight members to a point of interest.

OFF THE NOSE. References the nose of the aircraft.
CLOCK CODE. References the hour hand location (12 o'clock nose, 6 o'clock tail).
BEARING. References the bearing in degrees (360 nose, 180 tail).
HEADING. References the magnetic heading (360 north, 180 south).
TERRAIN. In relation to distinctive terrain.
TALLY/VISUAL. In relation to other threats or friendlies.

Crew Responsibilities. There are three categories of responsibility that may change multiple times throughout the flight: the Pilot at the Controls, the Pilot not at the Controls, and the Crew Chief / door gunner.

The **Pilot at the Controls (PAC)** is responsible for controlling the helicopter and avoiding obstacles. The pilot must keep a visual scan outside the helicopter and avoid distractions. The pilot should also report terrain and landmarks to the co-pilot to assist in navigation. The pilot must inform the entire crew which way the aircraft is about to turn and the planned movement of the tail of the helicopter.

The **Pilot not at the Controls (PNAC)** is responsible for accurate navigation, and must continuously inform the pilot of the route to be flown. The co-pilot should guide the pilot using identifiable terrain and provide only the information needed to move just beyond the next turning point. Heading information should be provided in clock code, terrain, or heading. The co-pilot may also use instructions such as "Turn right … Stop turn" to tell the pilot what to do. The co-pilot may also be responsible for operating a sensor, handling radio communications, or employing weapon systems.

The **Crew Chief (CC)** is an essential member of the crew and is responsible for clearing the aircraft of obstacles to the side and aft of the helicopter. The crew chief should also be ready to employ their weapons should the aircraft be engaged. The crew chief may also be used to assist with navigation or searching for targets.

Critical Skills

Decision Making. Ability to use logical and sound judgment based on information available.

Assertiveness. Willingness to actively participate. Ability to state and maintain position.

Mission Analysis. Ability to monitor the situation; and organize and plan for what will occur.

Communication. Ability to clearly and accurately send and acknowledge information, instructions, commands, etc.

Leadership. Ability to direct and coordinate activities of the crew, and stimulate them to work as a team.

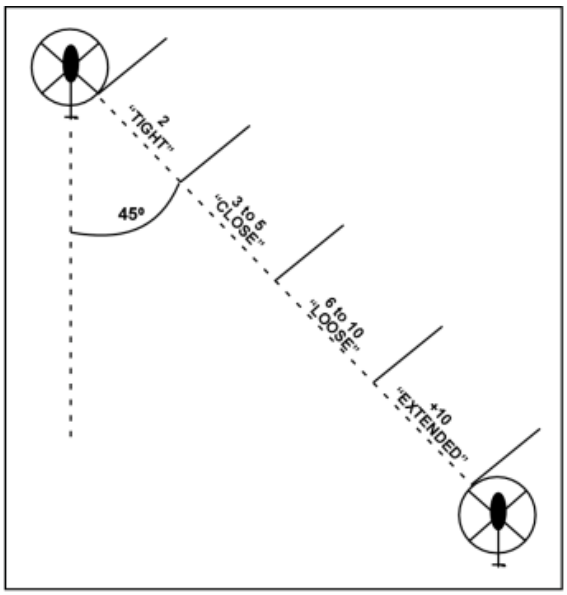
Adaptability/Flexibility. Ability to alter a course of action to meet situation demands.

Situational Awareness. Ability to detect and acknowledge potential problems and use all information to update and revise the flight. A measure of how closely your perception matches the reality of the situation.

Tactical Flight

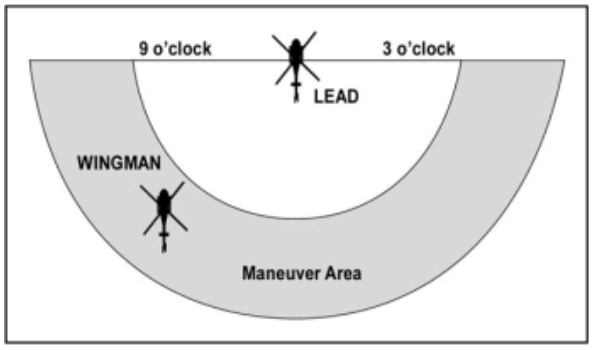
Aircrew must maintain high crew coordination and situational awareness when conducting tactical flight at low altitudes or in formation.

Tactical Maneuvering. When different types of aircraft operate in a formation, the flight should fly to the capabilities of the least capable aircraft. Formations allow lead to maintain formation integrity, yet maneuver with few restrictions. Wingmen must maintain a position that will not hamper lead's ability to maneuver while providing their own horizontal and vertical clearance.



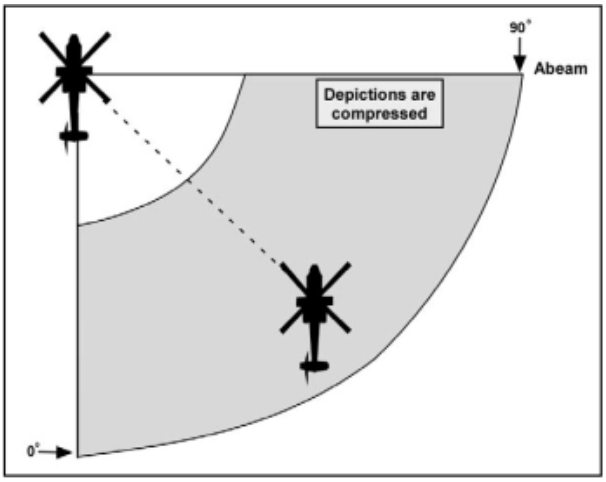
There are three basic tactical formations: Combat Cruise, Combat Cruise Right/Left, and Combat Spread.

Combat Cruise is used when flights wish to move quickly and maximize use of terrain for masking. It allows the wingman flexibility in maneuvering the aircraft left or right of the lead aircraft. The wingman should avoid prolonged flight directly in trail of lead's aircraft as it limits forward observation and the ability to provide suppressive fires for lead.

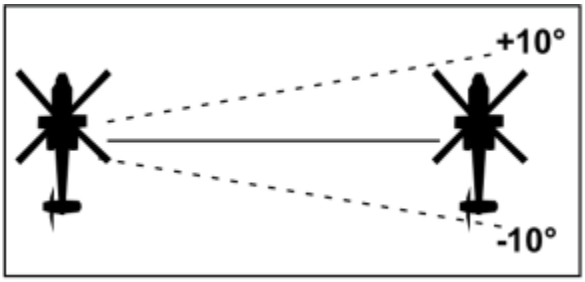


Combat Cruise Right/Left requires the wingman to remain in either right or left cruise and change sides only after coordinating with the lead aircraft. The wingman remains in an arc 0 to 90 degrees aft abeam of lead to the left or right side. Optimum position is 45 degrees.

Observation sectors are divided between lead and wing providing overlapping observation and fire.



Combat Spread provides maximum firepower forward and overlapping fields of view. When flight lead announces combat spread, he includes the command left or right. Wingmen move toward the abeam position. This requires a rapid scan to maintain SA of the other aircraft and approaching terrain.



Join-up. The flight may become separated during normal operations such as weapons delivery or after enemy contact. When this occurs, lead should establish a rendezvous point and altitude and establish a right-hand racetrack at 150 kph.

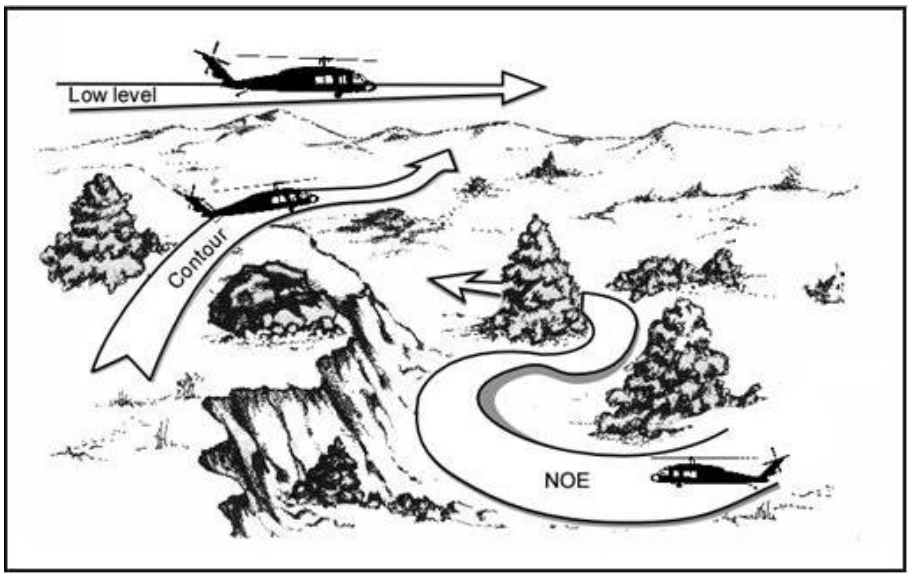
> **High to Low** join-ups are the standard. Wingmen should enter holding at 185 kph at lead's altitude plus 60 m. When wingmen can judge closure with lead, they should rejoin the formation and announce "HOLDING HANDS".

Terrain Flight (TERF) tactics allow helicopter aircrews to avoid detection or remain outside the effective range of threats by flying below 60 m AGL. As aircrews approach the target area, they fly lower and with increased caution to move undetected by the enemy. There are three terrain flight profiles: Low-Level, Contour, and Nap-of-the-Earth (NOE).

Low-Level flight is flown at a constant altitude (30 - 60 m AGL) and airspeed dictated by threat avoidance.

Contour flight is conducted at low altitude (15 - 30 m AGL) conforming to the earth's contours at varying airspeeds and altitude dictated by terrain and obstacles.

NOE flight is conducted at varying airspeeds as close to the earth's surface as vegetation and obstacles permit.



CAUTION

During TERF, the aircrews must contend with power lines and wires that are not always visible. The pilot should expect wires along roads and near towers and buildings, and make every effort to overfly the poles themselves as this is safest.

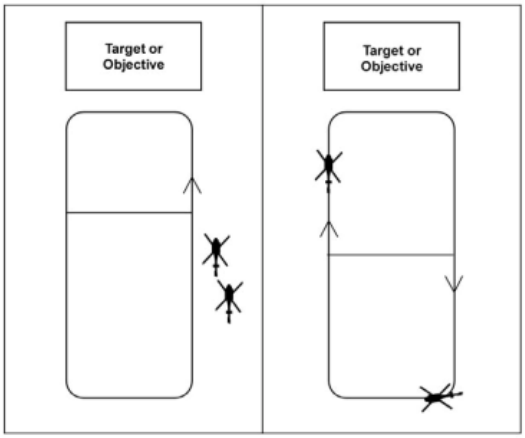
Weapons Employment

Aircrew must be proficient in employing their weapons system in order to be effective on the battlefield. Just as important as weapons employment is the use of the aircraft's sensor. Every crew member should approach every action from the standpoint of maximizing lethality and survivability.

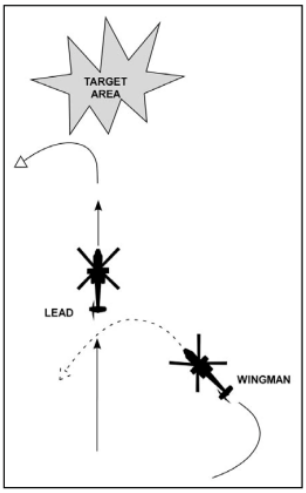
Flight Organization. The basic building block for a helicopter flight is the section (two helicopters). From the section, larger flights can be built (such as a division of 3-4 helicopters).

Attack Patterns. All attacks have specific goals, and there are multiple attack patterns that lend themselves to certain goals. The flight leader will take advantage of terrain and enemy weaknesses and select the appropriate attack pattern.

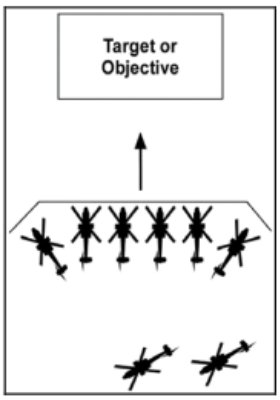
The **Racetrack Pattern** is the basic pattern from which all others are derived and is used to coordinate actions by each team member. It provides continuous fire on the target by any weapon and is flexible.



The **Offset Pattern** is most often used to cover one or both aircraft's climb (or "pop") and entails the wingman flying roughly 45 degrees offset from the lead on the opposite side of lead's pull-off. From this position, the wingman can provide suppression of the target area during both the climb and egress, as well as employ his own weapons



The **Static Pattern (On-Line)** maintains all aircraft in a line and is typically employed from a hover with standoff precision guided weapons (such as Hellfire or DAGR).



Weapons Delivery Techniques. The pilot or flight leader will select the specific attack tactic.

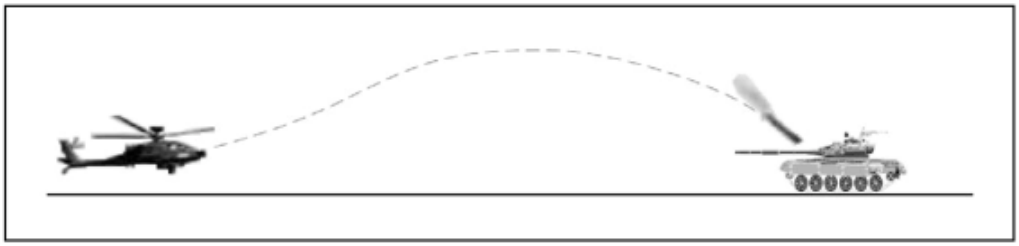
Hovering Fire is performed when the aircraft is stationary or has little forward motion. Aircrews perform hovering fire after unmasking from a defilade position or in standoff in a safe area. Aircrews maintain the hovering fire position only for **short periods** to prevent being targeted by enemy weapons. After delivering hovering fire, aircrews **remask or displace**. Hovering fire is the most effective profile for delivering precision guided munitions.

Running Fire is performed when the aircraft is in level forward flight. This adds stability and improves the accuracy of unguided ordnance. Running fire also reduces an aircrew's vulnerability to enemy weapons by providing a moving target.

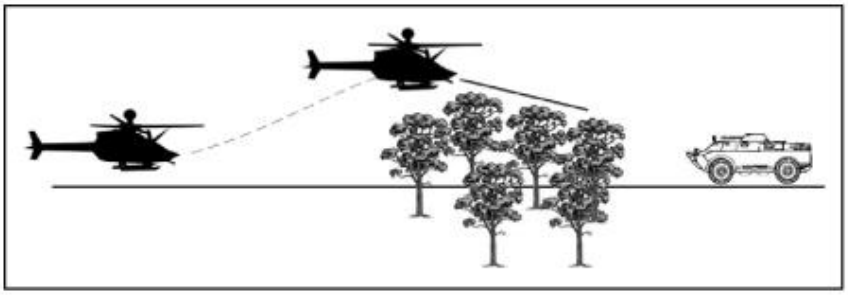
Diving Fire is delivered while the aircraft is at altitude and in descending forward flight. Diving fire produces the most **accurate results** for unguided ordnance. This is often employed from helicopters operating in an overhead position or as part of a **pop attack**.

Weapons Delivery Profiles. Aircrew may employ different attack profiles to engage the enemy.

Low-level attack is used when the aircraft is required to maintain low-level or NOE when engaging a target, and may be used during hover or running fire. The aircrew can maintain a lower profile that is masked, but there will be decreased accuracy and wider dispersion for unguided ordnance.



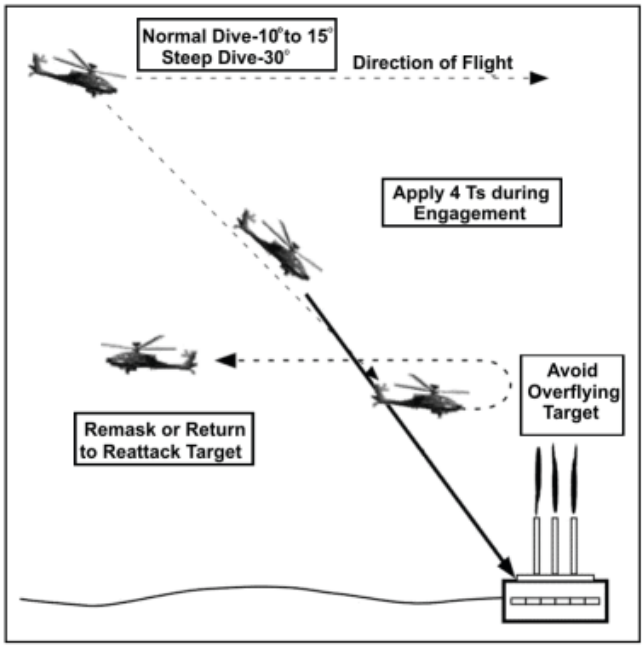
Pop attack is used to take advantage of terrain masking and is normally used during running fire, transitioning to diving fire. The aircrew pops up (typically 60 to 300 m above the starting altitude) prior to or during weapons engagement and returns to terrain flight. Dispersion of effects is decreased, target identification is easier, and aircraft momentum is maintained; however, the aircraft is silhouetted on the horizon during the pop.



A variation of this is the **running bump attack**, characterized by a more shallow climb (30 to 60 m above starting altitude).

A standard pop attack is entered at 60 m AGL or lower at an airspeed between 185 to 240 kph. The pop is commenced at around 1 to 1.5 km from the target to an altitude of 100 to 200 m AGL. A dive and roll-in is initiated for rocket / gun engagement and a pull-off is executed no closer than 300 m to the target.

High attack is used during diving fire when aircraft are required to maintain higher altitudes (normally greater than 300 m AGL). This technique is useful for following targets through urban areas, keeps aircrews out of range of small arms fire, and minimizes dispersion. Higher altitudes make the aircrews more vulnerable to enemy missiles.



A high attack dive delivery is typically entered at an altitude of 300 to 600 m AGL and 100 kph to produce a 10° to 30° dive. Pull-off is executed no closer than 300 m to the target.

The **Pull-off** is a break turn maneuver used to egress the target area safely. It is a maximum-performance three dimensional turn and may be combined with a climb or descent. Aircrews of helicopters equipped with door guns must balance the need to egress the target area quickly with the need to provide mutual support / suppression.

Weapons Conditions apply to the entire flight. The weapons conditions are set by the helicopter commander and are as follows:

WEAPONS FREE: Aircrews may fire at targets not identified as friendly.

WEAPONS TIGHT: Aircrews may fire at targets identified as hostile.

WEAPONS HOLD: Aircrews may not fire except in self-defense or if ordered to fire.

The pilot / co-pilot will use the following terms to control the firing of weapons.

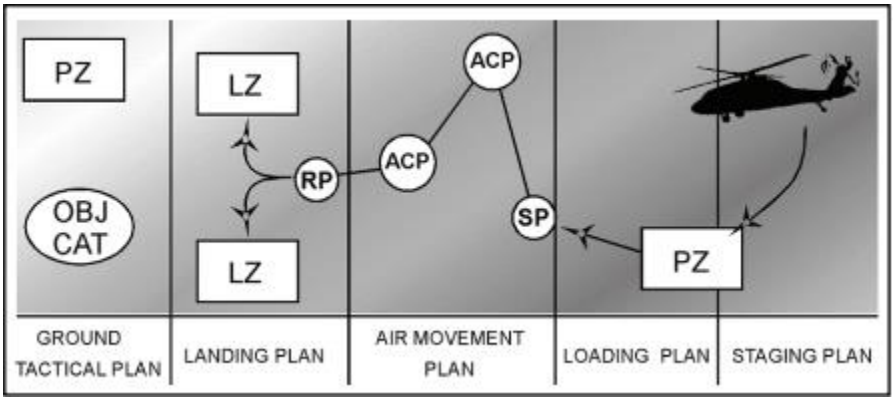
OPEN FIRE: A target may be engaged.

CEASE FIRE: All personnel terminate firing immediately.

This is what happens when you don't have a crew chief and do externals in a city

Air Assaults

The purpose of an air assault is to conduct an insertion of a ground force into a designated landing zone.



Planning

Air Assault planning begins with the **Ground Tactical Plan**. The ground commander must develop this plan first, as these are the actions on the objective that ultimately accomplish the mission. Capitalize on surprise, speed, and mobility to achieve mission success.

Once the ground tactical plan is complete, select the type of air assault to be conducted. There are three major types of air assaults.

X: Landing within effective small arms range of the objective (<300 m).
- Highest speed.
- Most difficult.
- Highest risk.

Y: Landing within effective heavy weapons range of the objective (300 m - 1,000 m).
- Balance between speed and threat.
- Used when small arms threat cannot be mitigated or no LZs exist within X.

Offset: Landing outside effective heavy weapons range of the objective (>1,000 m).
- Longest ground movement.
- Least difficult.
- Lowest risk.

The **Landing Plan** must support the ground tactical plan and integrate assault, escort, and ground units. The first consideration is the availability, location, and size of LZs. Primary and alternate LZs should be known ahead of time, so that ground units are prepared when they debark the aircraft.

Landing Zones. When selecting a landing zone (LZ) or pickup zone (PZ), aircrews, FACs, and ground commanders should select a safe site that is identifiable from the air and can be secured without interference from enemy fires. LZs should be free of hazards that include obstacles such as trees, buildings, and power lines; micro-terrain; and excessive slope.

Type	TDP Diameter
AH-6 / MH-6	10m
AH-1 / AH-64 / UH-1	20m
UH-60	25m
CH-47 / CH-53	35m

The LZ Controller (FAC or CO) should provide aircraft with an LZ Brief that should include the following information:

Zone Location: Map marker, GEOREF, grid coordinate.
ITG: Smoke, IR Strobe, Chem lights, Talk-on.
Obstacles: Power lines, trees, buildings.
Friendlies: Direction and distance from LZ.
Enemy: Direction and distance from LZ and type.
Remarks: Dimensions/slope, where to land relative to mark.

Winter / Devil Criteria. The ground commander should determine what level of enemy fire is acceptable to come under during ingress to the objective area. Acceptable criteria constitute a "WINTER" LZ that helicopters can land at. Unacceptable criteria constitute a "DEVIL" LZ and requires a waveoff, landing at an alternate LZ, or mission abort.

Geometry of Fires. Consideration should be made for door gunner sectors of fire and weapons conditions, as well as escort fires.

Initial Terminal Guidance (ITG). Everyone in leadership roles should be capable of performing ITG. ITG is the operation of signal devices that guide the initial helicopter waves from the initial point (IP) to the LZ.

Far ITG orients the flight to the LZ location as they are inbound.
Day: Pyro, flares, radio communications.
Night: IR Strobe, IR Laser (Sparkle), pyro, flares, radio communications.

Near ITG marks the actual landing points within the zone.
Day: Smoke, radio communications.
Night: Chem lights in NATO Y, radio communications.

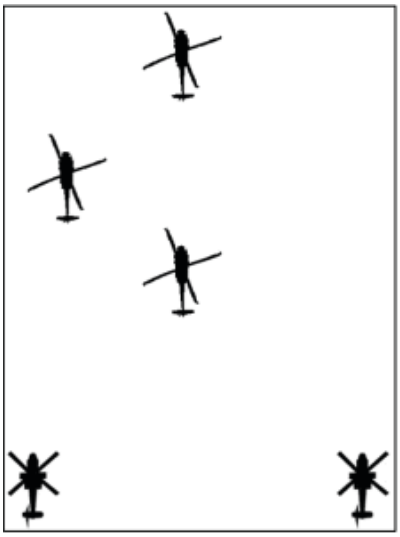
The **Air Movement Plan** is planned by the assault flight lead and FAC and covers the movement from the PZ to the LZ. It should include ingress and egress routing, initial point (5 - 10 km from the LZ), speeds, altitudes, and formations, to include the use of attack helicopter escorts.
The **Load / Stage Plan** assembles units in the PZ for loading and should be treated like an objective area. The squad leaders should run PZ operations. FACs should not be used for this role.

Execution
Execution is conducted in the reverse order that the mission was planned in.
During **Loading and Staging**, aircrew should turn-up with position lights on and check in on the appropriate frequencies.

> *"Phantom 1 flight, check in on TAD."*
> *"Phantom 2." [...]*

During **Air Movement**, flight lead sets the formation, airspeed, and altitude of the route. If NVGs are necessary, goggling will be initiated via radio call from the flight lead.

> If escorts are being utilized, the standard formation should be at the 5 o'clock and 7 o'clock positions of the assault flight in an "inverted Y". This allows the escort to scan the flanks of the formation and provide immediate suppressive fire if necessary.



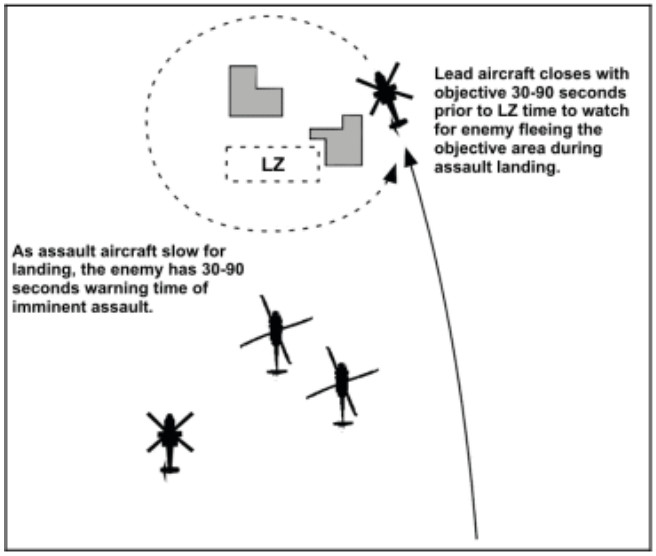
During **Landing**, prior to reaching the IP, the assault flight lead will call *"Phantom 1, CHECKPOINT PRIOR"* to the escort flight lead, FAC (if established), or ITG team to determine the status of the LZ. The escort flight lead, FAC, or ITG team will respond with *"LZ WINTER / DEVIL"*. If Winter, the assault flight lead will call *"Phantom 1, IP INBOUND."* The assault flight will not proceed past the IP until they receive a *"Phantom 1, CONTINUE"* call.

> ITG should be coordinated during this time and crew chiefs should provide a *"2 MINUTES FROM LZ"* call to embarked personnel. Door gunners should have sectors of fire to prevent fratricide and escorts should focus their fire beyond the LZ.
>
> The **standard approach** and transition to land is entered approximately 1 km from the LZ at 150 kph and 60 - 90 m AGL. By 500 m from the LZ, the helicopter should arrive at 90 kph and 30 m AGL. The landing phase is entered at 300 m from the LZ, at 55 kph and 20 m AGL. By 200 m from the LZ, the helicopter is flying at 45 kph and 15 m AGL. At 100 m from the LZ, 20 - 25 kph, and 15 m AGL, the pilot will execute the landing to the surface. This technique maximizes speed and surprise but does not permit the pilot to view the LZ prior to landing.

A second option is the **spiral approach**, which begins from a high altitude (450 - 900 m AGL), with airspeeds ranging from 110 - 185 kph and deceleration between 30 and 60 m AGL. This technique allows the pilot to view the LZ prior to landing but risks early detection by enemy forces during the descent.

A third option is the **switchback approach**, where the pilot maintains a high airspeed up to the turn point (near the LZ), which is dissipated in a performance turn to final approach. This technique may allow the pilot to view the LZ prior to landing while also minimizing the risk of early detection.

During low threat scenarios when surprise is paramount, the lead escort should push ahead of the assault aircraft to locate, destroy, and/or report enemy personnel attempting to leave the objective area.



Once all passengers have disembarked, the last aircraft in the formation will call *"Phantom 4, READY"*. On egress from the LZ, the assault flight lead will call *"LIFTING"* or *"WAVEOFF"* to alert the escort flight lead.

While the **Ground Tactical Plan** is being executed, assault aircraft may be desired to stay on station at a nearby holding area or laager point (holding on the deck) to minimize response time in the event of mission success or emergency extract.

The standard **holding pattern** is 100 m AGL, 150 kph, in right-hand turns.

Laager points are secure locations at which aircraft rendezvous, marshal, or position between missions. These points are also used while awaiting completion or activation of an assigned mission. Laager points can be isolated or at forward arming and refueling points (FARPs). While on deck, the flight lead should ensure that the formation is oriented to provide 360-degree security.

Assault support aircraft may also be tasked with conducting combat resupply, aerial delivery, reconnaissance, or CASEVAC while the mission is still in progress.

Brevity

ABORT. Cease action / attack / event / mission.

ANCHOR(ED). Orbit about a specific point.

AS FRAGGED. Unit will be performing exactly as briefed.

BINGO. Fuel state needed for recovery.

BITTERSWEET. Notification of potential for blue-on-blue (fratricide) or blue-on-neutral situation.

BLIND. No visual contact with FRIENDLY aircraft / ground position. Opposite of VISUAL.

BREAK (DIRECTION). Perform an immediate maximum performance turn in the indicated direction (default is a 90-degree turn).

BREAK(3x). Directive to clear comms for high priority transmissions

BUSTER. Directive to fly max continuous speed.

CAPTURED. Specified target / object has been acquired and is being tracked with an onboard sensor.

CEASE (activity). Discontinue stated activity.

CEASE FIRE. Discontinue firing / do not open fire.

CHAFF. Call for flight to expend countermeasure chaff.

CHECK (number, LEFT / RIGHT). Turn (number) degrees left or right and maintain new heading.

CHECK FIRE. Immediate pause of planned or current fires. See also BITTERSWEET.

CLOSING. Decreasing separation.

COLD. Defined area is not expected to receive fire.

COME OFF (direction). Maneuver as indicated to either regain mutual support or deconflict flight paths. Implies both VISUAL and TALLY.

CONTACT. Acknowledges sighting of a specified reference point (visually or via sensor).

DASH (#). Aircraft position within a flight.

DEFENSIVE. Aircraft is under attack, maneuvering defensively, and unable to ensure deconfliction or mutual support.

EXTEND / EXTENDING (direction). Short-term maneuver to gain energy, distance, or separation, with the intent of reengaging.

FEET WET / DRY. Flying over water / land.

FLARE. Deploy / deploying flares.

FLASH (system). Temporarily activate specified system for identification purposes (flare / lights).

FRIENDLY. A positively identified friendly aircraft or ground position.

GOGGLE / DEGOGGLE. Directive call for aircraft to put on / take off NVGs.

HOLDING HANDS. Aircraft in visual formation.

HOME PLATE. Home airfield or strip.

HOT. Defined area is expected to receive fire.

JINK. Perform an unpredictable maneuver to negate a tracking solution.

LASER ON. Start / acknowledge laser designation.

LASING. The speaker is firing the laser.

LOOKING. Aircrew does not have the ground object, reference point, or target in sight (opposite of CONTACT).

MARSHALL(ING). Establish / established at a specific point.

NO FACTOR. Not a threat.

NO JOY. Aircrew does not have visual contact with the target. Opposite of TALLY.

OFF (direction). Attack is terminated and maneuvering to the indicated direction.

OFFSET (direction). Maneuver in a specified direction with reference to the target.

PIGEONS (location). Magnetic bearing and range to HOME PLATE (or specific destination).
PLAYMATE. Cooperating aircraft.

POLAR BEAR. FRIENDLY aircraft has VISUAL / CONTACT on the FRIENDLY package and is joining.

POP. Starting climb for air-to-surface attack.

PRESS. Directive to continue the attack; mutual support will be maintained. Supportive role will be assumed.

PUSHING. Departing designated point.

REMINGTON. No ordnance remaining except gun or self-protect ammo.

RESUME. Resume last formation / route / mission ordered.

RIFLE. Friendly air-to-surface missile launch.

SHIFT (direction). Shift laser / IR / aimpoint.

SHOOTER. Aircraft / unit designated to employ ordnance.

SPARKLE. Mark / marking target by infrared pointer.

SPLASH. Target destroyed / weapons impact.

SPOT. Acquisition of laser designation.

STEER (direction). Set magnetic heading indicated.

TALLY. Sighting of a target or enemy position. Opposite of NO JOY.

TUMBLEWEED. I have limited situational awareness (e.g., NO JOY, BLIND) and request information.

UNABLE. Cannot comply as requested / directed.

VISUAL. Sighting of a friendly aircraft or ground position. Opposite of BLIND.

WEAPONS (status). (FREE) At targets not identified as FRIENDLY.
(TIGHT) At targets positively identified as HOSTILE.
(HOLD) In self-defense or in response to an order to fire.

WILCO. Will comply with received instructions.

WINCHESTER. No ordnance remaining.

Quick Reference Sheets

Vertical Takeoff to Hover		1 m AGL
Hovering-Sideward/Rearward Flight		≤ 5 kph
Hover Taxi		≤ 8 m AGL
Air Taxi		< 30 m AGL
Normal Takeoff from Hover / Surface		2 m AGL to 65 kph Climb to > 20 m and > 110 kph
Climb		Level off at 10% of climb rate in meters
Descent		Level off at 10% of descent rate in meters
Cruise		> 90 kph and 15 m AGL
Flight Profile		Avoid hovers between 4 - 150 m AGL Avoid airspeeds < 75 kph at 15 - 70 m AGL Avoid airspeeds < 75 - 100 kph at > 6 m AGL
Turns Around a Point		Bank angle of 30° - 45°
Traffic Pattern		150 m AGL, 150 kph, right turns
Normal Approach to Hover		Descent between 7° and 12° at 100-150 m AGL Aligned by 30 m AGL
Quick Stop		Entry at 80 kph
Altitudes	High	> 1,000 m AGL
	Medium	150 - 1,000 m AGL
	Low	< 150 m AGL
	Low Level	30 - 60 m AGL, constant airspeed and altitude
	Contour	15 - 30 m AGL, conforms to earth and vegetation
	NOE	As close to ground as permitted
Attacks	Low Level	Surface to 60 m AGL, Hover / Running fire
	Pop	Entry at < 60 m AGL and 185 - 240 kph Pop 60 - 300 m, Running / Diving Fire
	Bump	Pop 30 - 60 m
	High	Entry at > 300 m AGL and 100 kph Dive 10° - 30°

AH-6M

Takeoff

- Determine that hover area and takeoff path are clear.
- Follow normal helicopter takeoff procedures.
- Follow recommended takeoff profile shown in Height Velocity Diagram.

Climb

- Follow normal helicopter climb procedures.
- Speed for best rate of climb approximately 110 kph.

Cruise

- Above 90 kph and 15 m AGL.

Autorotation

- Increase collective pitch after establishing autorotation to prevent rotor overspeed.
- Conduct practice autorotation at 240 kph.
- Touchdown in a level attitude.
- Avoid use of aft cyclic control or rapid lowering of collective during initial ground contact.

Running Landing

- Maximum recommended ground contact speed is 55 kph for smooth hard surfaces.
- Avoid rapid lowering of collective after ground contact.
- Avoid the use of aft cyclic after ground contact.

Ordnance

AH-6M-H

1 x AGM-114K Hellfire
4 x DAGR
1300 x GAU-19/A .50 cal

AH-6M-M

19 x M261 70mm HE rockets
1300 x GAU-19/A .50 cal

AH-6M-L

14 x M260 70mm HE rockets
6000 x M134D-H 7.62mm

MH-6M/OH-6M

None

AH-64D

Ordnance

AH-64D (AA)

38 x LAU-61C/A 70mm HE rockets
8 x AGM-114L Hellfire II
2 x AIM-9X
1200 x M230 30mm

AH-64D (Close-Support)

16 x AGM-114L Hellfire II
1200 x M230 30mm

AH-64D (Ground-Suppression)

76 x LAU-61C/A 70mm HE rockets
1200 x M230 30mm

AH-64D (Multi-Role)

38 x LAU-61C/A 70mm rockets
8 x AGM-114L Hellfire II
1200 x M230 30mm

CH-47F

Ordnance

5000 x M134 Minigun 7.62mm
5000 x M134 Minigun 7.62mm

UH-60M

Ordnance

5000 x M134 Minigun 7.62mm (left crew chief)
5000 x M134 Minigun 7.62mm (right door gunner)

U.S. Marine Corps

AH-1Z

Ordnance

AH-1Z (Close-Support)
- 16 x AGM-114L Hellfire II
- 2 x AIM-9X
- 750 x M197 20mm SAPHEI-T

AH-1Z (Ground-Suppression)
- 76 x LAU-61C/A 70mm HE rockets
- 2 x AIM-9X
- 750 x M197 20mm SAPHEI-T

AH-1Z (Multi-Role)
- 38 x LAU-61C/A 70mm HE rockets
- 8 x AGM-114L Hellfire II
- 2 x AIM-9X
- 750 x M197 20mm SAPHEI-T

AH-1 'Boom-Boom'
- 38 x Hydra 70 rockets
- 200 x M129 40mm HE

AH-1 'Cobra'
- 4000 x M134 7.62mm (fixed-forward)
- 2000 x M134 7.62mm (nosegun)
- 4 x TOW missiles

AH-1 'Hydra 52'
- 52 x Hydra 70 rockets
- 2000 x M134 7.62mm (nosegun)

AH-1W 'SuperCobra Hydra'
- 38 x Hydra 70 rockets
- 4000 x M134 7.62mm (fixed-forward)
- 1000 x M197 20mm HE (nosegun)

AH-1W 'SuperCobra TOW'
- 4000 x M134 7.62mm (fixed-forward)
- 1000 x M197 20mm HE (nosegun)
- 8 x TOW missiles

UH-1Y

Ordnance

UH-1Y (FFAR)
- 14 x LAU-61C/A 70mm HE rockets

UH-1Y (FFAR/MG)
- 14 x LAU-61C/A 70mm HE rockets
- 5000 x M134 Minigun 7.62mm (left crew chief)
- 5000 x M134 Minigun 7.62mm (right door gunner)

UH-1Y (Ground-Suppression)
- 38 x LAU-61C/A 70mm HE rockets
- 5000 x M134 Minigun 7.62mm (left crew chief)
- 5000 x M134 Minigun 7.62mm (right door gunner)

UH-1Y 'Venom' .50Cal
- 14 x Hydra 70 rockets
- 1500 (500x3) x M2 .50 cal (left crew chief)
- 2000 x M134 Minigun 7.62mm (right door gunner)

UH-1Y 'Venom'
- 14 x Hydra 70 rockets
- 2000 x M134 Minigun 7.62mm (left door gunner)
- 2000 x M134 Minigun 7.62mm (right crew chief)

UH-1C 'Heavy Hog'
- 2000 x RCWS LMG 6.5mm Tracer
- 24 x Hydra 70mm HE rockets
- 2000 x PKT 7.62mm (left crew chief)
- 2000 x PKT 7.62mm (right door gunner)

UH-1C 'XM16-AS'
- 4000 x M60C 7.62mm
- 14 x Hydra 70mm HE rockets

UH-1C 'XM21-AS'
- 4000 x M134 Minigun 7.62mm
- 14 x Hydra 70mm HE rockets

British Armed Forces

Apache AH1

AH1 AT

12 x AGM-114L Longbow Hellfire (HEAT)
4 x AGM-114N Hellfire II (Thermobaric)
1200 x M230 30mm HEDP Tracer

AH1 CAS

76 x CRV7 HEISAP rockets

AH1 Multi

4 x AGM-114L Longbow Hellfire (HEAT)
4 x AGM-114N Hellfire II (Thermobaric)
38 x CRV7 HEISAP rockets
1200 x M230 30mm HEDP Tracer

NATO

UH-80 Ghost Hawk

Ordnance

2000 x M134 Minigun 7.62mm (left)
2000 x M134 Minigun 7.62mm (right)