



OFF AIRFIELD LANDING SITE OPERATIONS

METHODS TO IMPROVE HELICOPTER PILOTS' SAFETY

TRAINING LEAFLET



HE 3



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Introduction

The helicopter's ability to approach, manoeuvre, land and take-off from an off-airfield Landing Site (LS) or unprepared Landing Site is one of the most important aspects of helicopter operations. Pilots will want at some stage to fly passengers to various landing sites such as hotels, golf courses, sporting venues, etc. Whilst all these sites can vary in their dimensions, approaches, hazards, elevation, and location, the same basic principles should be employed. A LS that has obstructions that require a steeper than normal approach, where the manoeuvring space in the ground cushion is limited, or whenever obstructions force a steeper than normal climb-out angle is often defined as 'Confined Area'. Although a helicopter pilot can land at a Confined Area, he still has to apply all the basic principles.

Landing sites that are remote from an airfield offer various challenges to the pilot and consequently have resulted in a significant number of accidents. Unlike at an airfield there is generally little or no assistance in the assessment of wind, guidance on appropriate approach directions or information on other traffic. Hazards not normally experienced at an airfield such as wires, obstructions, uneven landing ground, trees, Foreign Object Damage, livestock and pedestrians are quite likely to be found and require a heightened degree of situational awareness by the pilot who needs to **expect the unexpected!**

It should be noted that a 'precautionary' or 'forced' landing that is made in response to an aircraft malfunction/emergency or deteriorating weather, will invariably be an 'off-airfield' landing therefore the techniques prescribed for the rescue, approach and departure should be utilised even if in an abbreviated format.

1. PLANNING AND PREPARATION

The basic principles of planning and preparation as outlined in the EHEST HE1 Safety Considerations Leaflet still apply. However landing at a site which is remote from an airfield offers the pilot extra considerations that may require additional information, some of which are highlighted below in a '**MATED**' brief

MET >>

As the site may be remote from an airfield and associated met facilities, the pilot will be required to interpolate the information provided in the synoptic charts, TAFs, and METARs. If possible, a telephone call to speak to somebody at the LS for a local weather observation is advised. Information should be collated for both the outbound and return flight, including the anticipated dusk time - in case of a delay. It is important to carry a telephone number/'app' for a met service so that updated weather forecasts can be collected from the LS.

AIRCRAFT >>

Take off weight, C of G, and performance calculations will be required for the arrival and departure at the LS, especially if there is a difference in density altitude from the initial departure site and if passengers or cargo are being picked up or dropped off. Fuel is unlikely to be available at a remote site so a fuel diversion may be required – important if planned performance calculations require a reduced fuel load for the landing/take-off. The remainder of the aircraft documents should be checked as normal.

(Note for Commercial Operations there will be extra EASA Ops/legal performance criteria to consider).

ATC >>

Whilst airfield information and NOTAMs for en-route/departure/diversion airfields will be available through the normal channels, information for a remote LS may require further research, either in a LS directory or by speaking to the site operator/owner. If the LS is being used as part of an event, it is likely that there will formalised routes/procedures to follow and it may be subject to a temporary NOTAM or restrictions. Invariably a LS will require prior permission before it can be used, often in writing. Do not rely on the passengers for details as they may not be 'aviation aware', it is better to speak directly to the site operator to receive any last minute briefing on hazards, livestock, avoids, other activity – and possible landing fees!

Check to see whether the site has a radio frequency – some countries have a common radio frequency to use at unmanned site¹. Remember if communicating with an ATC service to report when landing, if not on the radio then by telephone or overdue action could be initiated.

EXERCISES >> A flight into a LS will not only require the skills associated with confined area techniques but also those with: navigation of maps of various scales at various heights, advanced transitions, limited power, and sloping ground operations.

DUTIES >> Although the flight is likely to be conducted as single pilot operation and the pilot will be conducting all the duties himself, passengers, if briefed correctly may be able to assist in lookout - especially for hazards at the LS such as wires, obstacles, FOD, livestock, people and objects likely to be affected by the helicopter down wash such as tables, chairs, sun shades, tents etc.

Note:

- (i) Always carry a mobile telephone and a driving licence just in case a car hire is required to get home due to adverse weather or night – do not be forced into flying in adverse weather just to return home.
- (ii) If possible confirm with the site owner just before takeoff to update on changes, conditions, hazards livestock etc at the LS.
- (iii) If it is important to get to the destination always have an alternative plan in case the weather is not suitable – do not be pressurised into flying in adverse conditions or beyond your capabilities!

¹ e.g. in the UK a SAFETYCOM radio frequency of 135.475 is specified for use at sites where no specific radio frequency is notified

2. LANDING SITE IDENTIFICATION

It is unlikely that the LS will be marked or obvious and consequently it may be difficult to identify from the air. Therefore it may be necessary to employ some of the following techniques to make sure you land in the right place – it should be noted that any co-ordinates given to the pilot should be double checked before use!

PASSENGERS The passenger may be familiar with the destination - however be aware once in the air it is not unknown for passengers not to recognise their own homes!

MAPS Larger scale maps will have individual buildings and fields marked.

GPS GPS can be accurate down to 100 m and so able to get you to the area but they are unlikely to identify an individual LS even with a Lat/Long reference.

PHOTOGRAPHS A regularly used site may have a photograph in a brochure or an LS directory.

GOOGLE EARTH A satellite generated picture has the advantage of giving a plan view from the air, but it may be outdated.

LS DIRECTORY More commonly used sites can be found in a published LS Directory which normally has the advantage of containing aviation related advice including. LS elevation, frequencies, local hazards, avoids areas, recommend approach paths, etc.

SITE OWNER/ OPERATOR A telephone call to the site owner prior to take off who may be able to describe the LS in detail and any local avoids, hazards and livestock. However be aware they may not be 'aviation aware' so may not consider wires as a hazard.

OTHER PILOTS Speaking to a pilot who has previous been to an LS has the advantage of them being able to describe the site and the best approach and any aviation hazards.

MARKERS An LS may have an 'H', helipad or a windsock indicating the location – however if temporary markers are being used ensure they are secured and not able to be blown into the disc by the aircraft downwash.

3. LANDING SITE RECCE

3.1 Introduction

An airborne recce of an LS is required, even if the site has been previously used, to assess the suitability of the site for the individual pilot/aircraft capability, the given wind velocity, the best approach/departure path, and local hazards.

When conducting the recce, it is necessary to minimise the noise/disturbance to the public, and also to fly at a height/speed combination that will offer the best possible chance of a successful landing in the event of engine failure. Therefore as a principle:

Always fly environmentally and defensively and never lower or slower than is necessary!

SPEED The recce should be flown at a nominal speed close to V_y , but not normally slower than 40Kts or VTOSS, especially when flying crosswind/downwind as this will alleviate the possibility of Loss of Tail Rotor Effectiveness (LTE), Vortex Ring and help maintain rotor energy in the event of an engine failure (*see EHEST HE1 Safety Considerations Leaflet, Methods To Improve Helicopter Pilots' Capabilities*).

HEIGHT The recce should not be flown any lower than is necessary and ideally not less than 500ft agl or the height specified in the RFM 'avoid curve/height velocity diagram' in case of an engine failure and to avoid unnecessary disturbance of the local population. Whilst a recce of an LS can normally be completed from a safe height with the minimum number of circuits, in cases of difficult terrain, built up areas, or a complex landing site it may be necessary to conduct a 'high' followed by a 'low' recce and possibly a dummy approach.

It should be noted that an airborne recce of an LS requires a high degree of situational awareness. A number of accidents have resulted where pilots have become distracted by the increased workload associated with conducting an LS recce and allowed the airspeed to reduce and/or allowed a Rate Of Descent (ROD) to build up which has led to VORTEX RING STATE or LTE.



3.2 Types of Recce

Several styles of recce can be utilised:

ORBITAL This is normally the easiest technique to fly. It involves flying an orbit around the landing site, usually with the landing site on the ‘pilot’s side’ therefore allowing maximum visibility of the site. However it requires the pilot to identify safe precautionary landing sites as he flies the recce around the LS in case of engine failure. It can be difficult to fly accurately around a very small site or in strong wind conditions. **(SEE FIGURE 1)**

FLYBY If it is not possible to fly an orbital recce safely all around the LS (e.g. if the terrain on one side is unsuitable for an emergency landing) it may be possible to fly past the LS over a suitable area – ideally with the LS on the pilot’s side to complete the recce elements. It may be then necessary to reposition for a second or third ‘fly by’ which can be achieved by flying the downwind elements away from the LS over terrain more suitable for an emergency landing. **(SEE FIGURE 2)**

HOVER As a last resort it may be possible to bring the helicopter to an ‘out of ground effect’ high hover to recce the LS. **However this technique requires training and skilful handling by the pilot as it requires an increased awareness of power margins, avoid curve/height velocity diagram, wind velocity, escape routes, prior identification of an appropriate emergency landing site in the event of an engine failure whilst in the high hover. (SEE FIGURE 3)**

FINAL APPROACH An experienced pilot, or a pilot who is very familiar with a landing site (and has previously conducted a recce of the site), may be able to update his previous recce during flying a long final approach into the site.

3.3 The Recce

The recce should identify the following points (often referred to as the 5 S’s), in order to determine the best approach path and missed approach route:

SIZE Is the LS big enough for me (at my experience level) – to get this size aircraft in (aircraft dimensions) – and what type of approach shall be required to fly (e.g. a large area – single angle approach, a medium sized area – a double angle approach, or a small area – a vertical approach) and what type of taking-off I will decide to perform?

FIGURE 1
ORBITAL

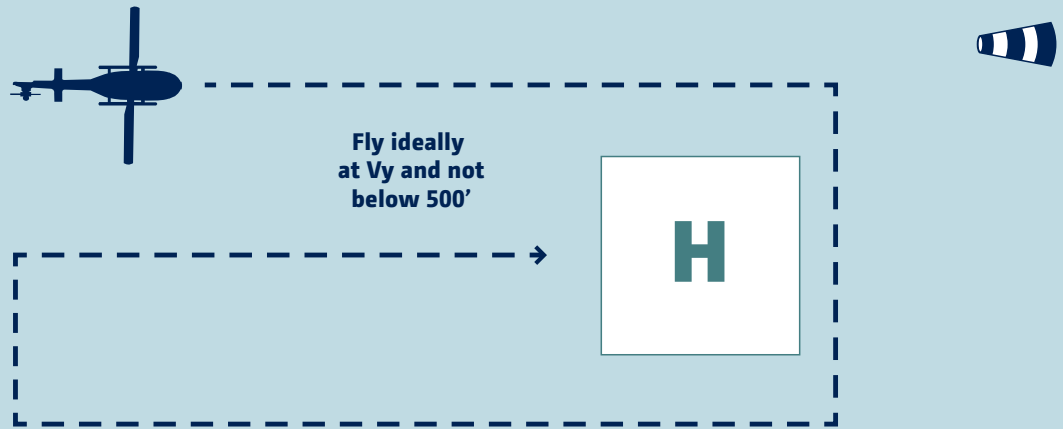


FIGURE 2
FLYBY

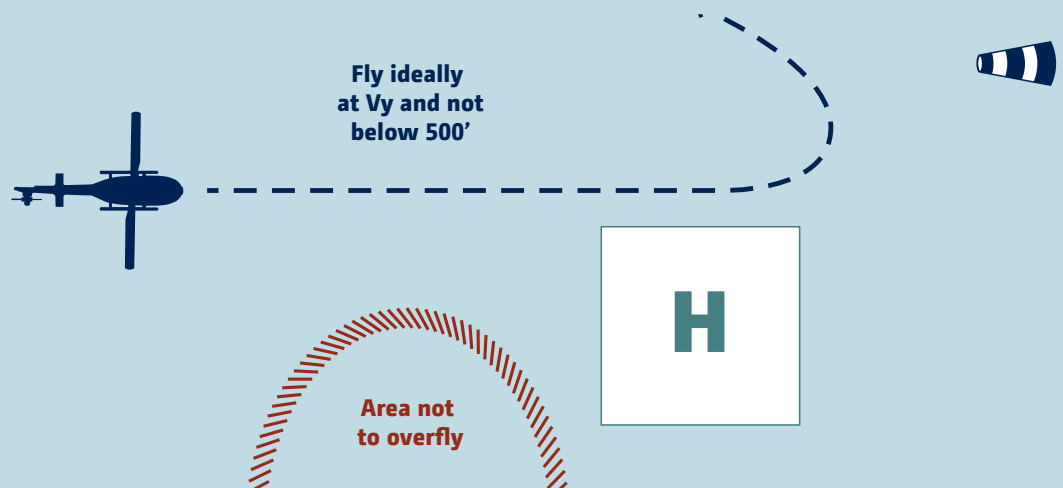
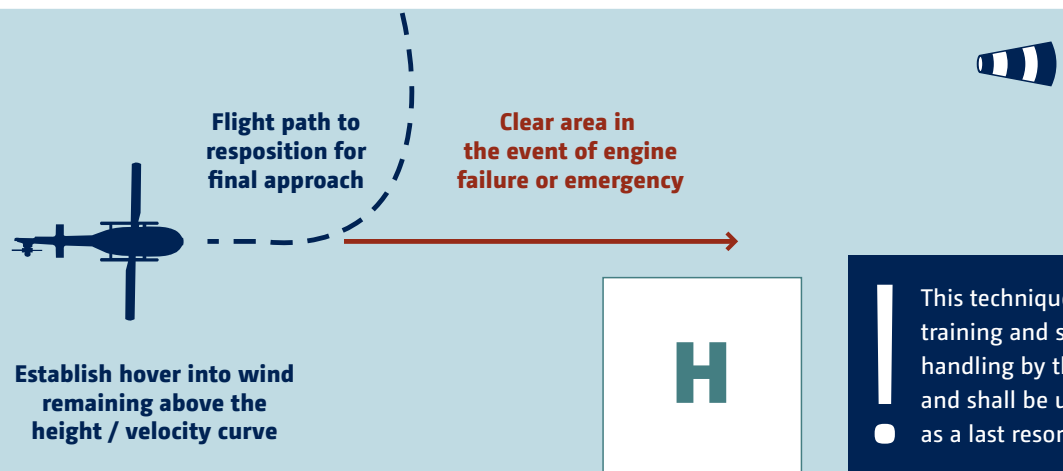


FIGURE 3
HOVER



! This technique requires training and skilful handling by the pilot and shall be used only as a last resort.

SHAPE What shape is the LS in relation to the wind velocity (w/v) or direction of approach/departure, *Note:* in light wind conditions it may not be necessary for the wind to dictate the direction of approach/departure and a safer approach/departure route may be identified avoiding built up areas, wooded areas. Pilots should be cautious about flying into reduced visibility caused sun glare or shadows cast in the LS.

SURROUNDS **OUTER** – Establishing a safe area to fly over (defensively and environmentally) whilst conducting the recce, including establishing any markers to be used for the circuit.
INNER – Establish the hazards in the immediate LS area and any forward and lateral markers to be used in the LS to establish the centre of the area for the manoeuvring /landing especially if a vertical approach is to be used.

SLOPE Identify any perceivable slope in the LS. This is normally confirmed by coming to a slightly higher than normal hover whilst manoeuvrings in the LS. It is advisable to assume the ground is uneven and use sloping ground techniques when landing on any unprepared surface.

SURFACE Identify the nature of the LS surface to ensure suitability for landing including checking sufficient aircraft ground clearance - long grass can hide obstacles such as tree stumps which are hazardous to low skidded aircraft. This is normally confirmed by coming to a slightly higher than normal hover whilst manoeuvring in the LS. Extreme caution should be used when landing on surfaces covered by loose snow or sand which normally required specialised landing techniques such as a 'zero speed' landing.

Once a pilot is competent at conducting a LS recce it should be possible to obtain all the necessary information from a safe height in as a few orbits as possible. However for an inexperienced pilot or when faced with a more complex LS, it may be necessary to conduct a 'high recce' followed by a 'low recce'.

High Recce

- 1 >> Orbit, speed V_y , at a height that would permit an autorotation to a clear area in the event of an engine failure.
- 2 >> Considered Size, Shape, Surrounds, w/v
- 3 >> Decide best approach/overshoot/climb out path.
- 4 >> Decide circuit direction – choose markers for low recce/circuit/approach – check for wires and cables.
- 5 >> Make any radio calls to ATC advising of intention to land and close any flight plans.

Low Recce

- 1 >> Orbit/Flyby/Hover, speed V_y , at a height that would permit an autorotation to a clear area in the event of an engine failure, normally not below 500 ft AGL and be aware of the avoid curve/height velocity diagram.
- 2 >> Confirm/reselect the best approach path, type of approach, overshoot path, departure path and circuit.
- 3 >> Look inside confined area to check Surface, Slope, Obstruction, wires, FOD, etc.
- 4 >> Select forward and lateral markers for a landing point in the centre of the area.
- 5 >> Cross check radar altimeter/map to the barometric alt to establish the LS elevation.

Circuit

- 1 >> Choose the circuit direction, sometimes it is not possible with the landing site on the 'pilot's side'.
- 2 >> Fly using markers, speed V_y and at a height that would permit an autorotation to a clear area in the event of an engine failure.
- 3 >> Conduct power check as appropriate to aircraft type (if not already conducted on the high/low recce) and verify the power margin available is sufficient for the appropriate approach/take off technique.
- 4 >> Conduct pre-landing checks.

Final Approach/Landing

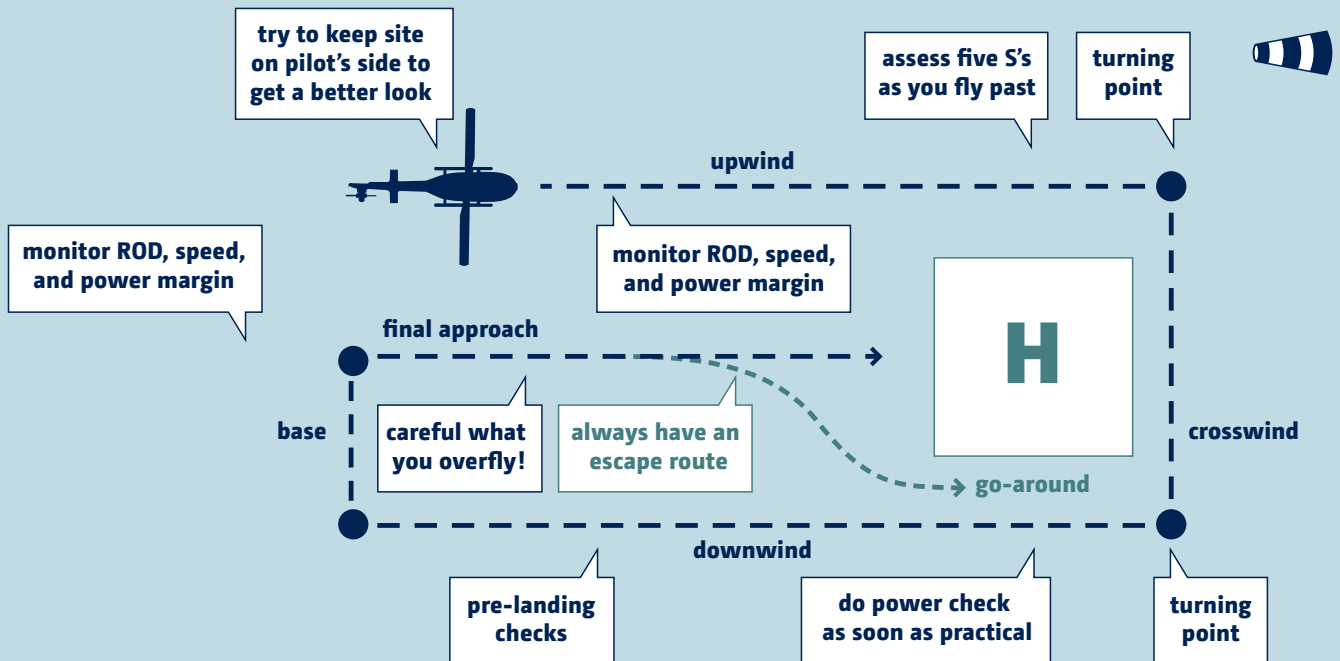
- 1 >> Turn onto finals – maintaining initially V_y until the turn is finished **beware LTE**.
- 2 >> Monitor ROD/Speed/Power margin and – beware **VORTEX RING STATE**.
- 3 >> Note escape routes, emergency landing areas, wind shear and turbulence and consider a go around using the planned overshoot path if:
 - any yaw deviation from selected approach heading cannot be safely corrected.
 - the power 'in hand'/power margin is insufficient to safely continue the approach.
 - the rate of descent becomes excessive.
 - the closing speed becomes excessive (especially with a rear cyclic application which may indicate a downwind component).
 - the airspeed falls below 30kts with an excessively high rate of descent
- 4 >> Check again Surface, Slope, Obstruction, wires, FOD, to verify the accuracy of the information gained in the recce (some obstacles might not be visible from certain height).
- 5 >> Reduce groundspeed in final stages ensuring a safe clearance from obstacles.
- 6 >> Maintain a constant angle approach, ideally to a spot a third of the way into the confined area.
- 7 >> Ensure tail clearance by use of a lateral marker if required.
- 8 >> Establish slightly higher than normal hover whilst checking surface and slope.
- 9 >> Land using sloping ground technique.

Dummy Approach

If the recce identifies concerns with w/v, turbulence, power margins, obstacles, etc, especially when attempting to land in a smaller LS, then a Dummy Approach should be considered. For this an approach is flown to a predetermined point or height above the LS, maintaining airspeed/ translational lift, whilst monitoring the power margins, ROD, turbulence etc with the intention of overshooting to go around and re-positioning for another approach.... however also keeping open an option to continue with the landing if judged safe to do so. (Note: In certain States it is not permissible to descend below 500 feet except for take-off and landing, however if the site proves unsuitable on the approach a go-around may be permissible since it was your initial intention to land).

3.4 The Circuit

Below is a typical example of a circuit.





4. TYPES OF APPROACH

4.1 Single Angle Approach

- Maintain height until touchdown point is seen.
- Hold line of sight with small collective movements.
- Maintain a steady, controlled ROD with power/ speed combination to avoid Vortex Ring State and also to avoid excessive rates of descent that may require large/rapid collective inputs to arrest the ROD.
- In later stages reduce speed to slow apparent ground speed.
- Descend to establish a ground cushion at slightly higher than normal hover.

4.2 Double Angle Approach

- Initially a shallow angle may be flown to a point on the other side of the LS until the landing area is visible.
- Once the touchdown point is visible the angle is steepened for final approach to hover.
- Hold line of sight with small collective movements.
- Maintain a steady, controlled ROD with power/speed combination to avoid Vortex Ring and also to avoid excessive rates of descent that may require large/rapid collective inputs to arrest the ROD.
- In later stages reduce speed to slow apparent ground speed.
- Descend to establish a ground cushion at slightly higher than normal hover.

4.3 Vertical Approach

- Shallow approach to a out of ground effect hover over the centre of the LS, note increased power requirement and ensure sufficient power margin for controlled descent.
- Descend vertically maintaining ground position by use of lateral markers.
- Maintain a steady, controlled ROD with power/ speed combination to avoid Vortex Ring and also to avoid excessive rates of descent that may require large/rapid collective inputs to arrest the ROD.
- Descend to establish a ground cushion at slightly higher than normal hover

FIGURE 5

SINGLE ANGLE APPROACH

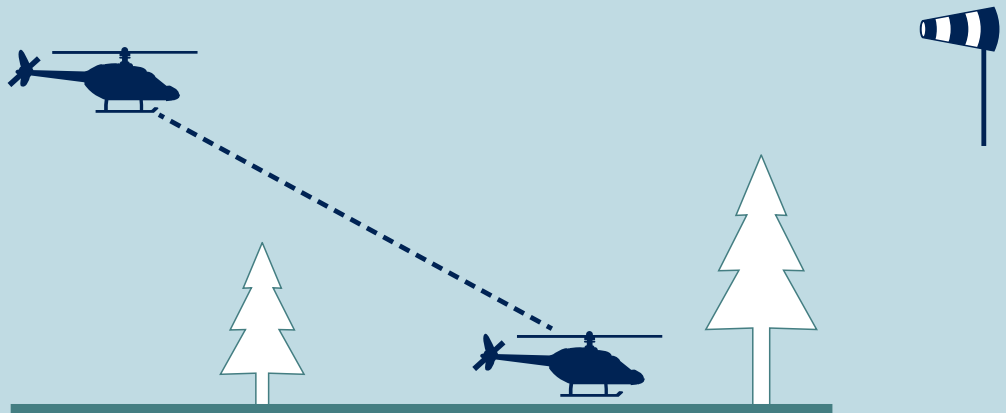


FIGURE 6

DOUBLE ANGLE APPROACH

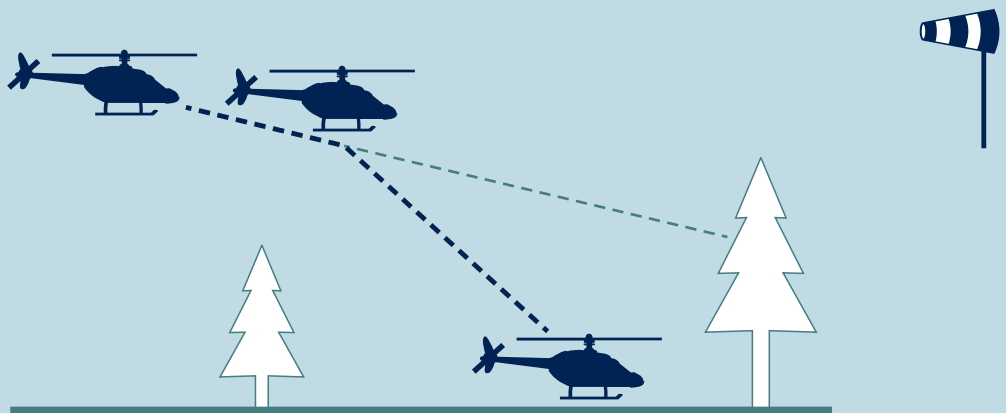
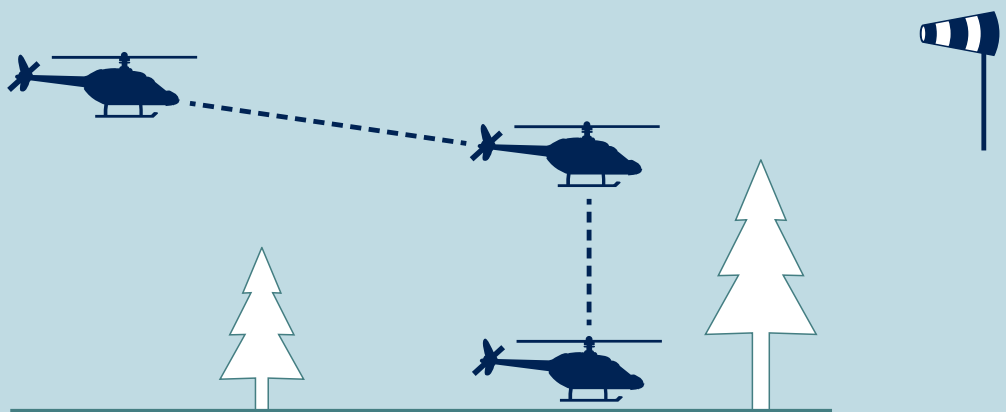


FIGURE 7

VERTICAL APPROACH



5. MANOEUVRING IN THE LANDING SITE

Due to danger of blade strike/tail strike/FOD, manoeuvring within a LS should only be conducted when it is entirely necessary to do so. If it is necessary to manoeuvre, either to park the aircraft or reposition in preparation for a take-off, then extreme caution should be used and it may be advisable to taxi slightly higher and slower than normal keeping a good look out.

When landing or taking off on an 'unprepared site' it is always advisable to use sloping ground techniques, especially in long grass where the surface may be obscured. When landing in long grass pilots should also be aware of the risk of causing a fire especially in dry conditions, with aircraft that have an exhaust close to ground.

Be aware of possible FOD, blowing sand, straw, snow, etc. that can cause brown out or white out conditions.

Turn About the Tail

- Adopt a slightly higher than normal hover.
- Maintain the tail over the same ground position.
- Turn the aircraft in the direction the pilot can see (i.e., pilots side).
- Look out throughout the turn for obstructions.
- Monitor the blade tips and be aware of overhanging branches

Sideward Movement (Box Turn)

- Adopt a slightly higher than normal hover.
- Hover taxi sideward whilst maintaining heading, at least an aircraft length in the direction the pilot can see (i.e., pilots side).
- Spot turn through 90 degrees so that the tail is now in the known clear area where the aircraft was positioned.
- Repeat (if required) until back onto original heading.
- Look out throughout the turn for obstructions.
- Monitor the blade tips and be aware of overhanging branches.

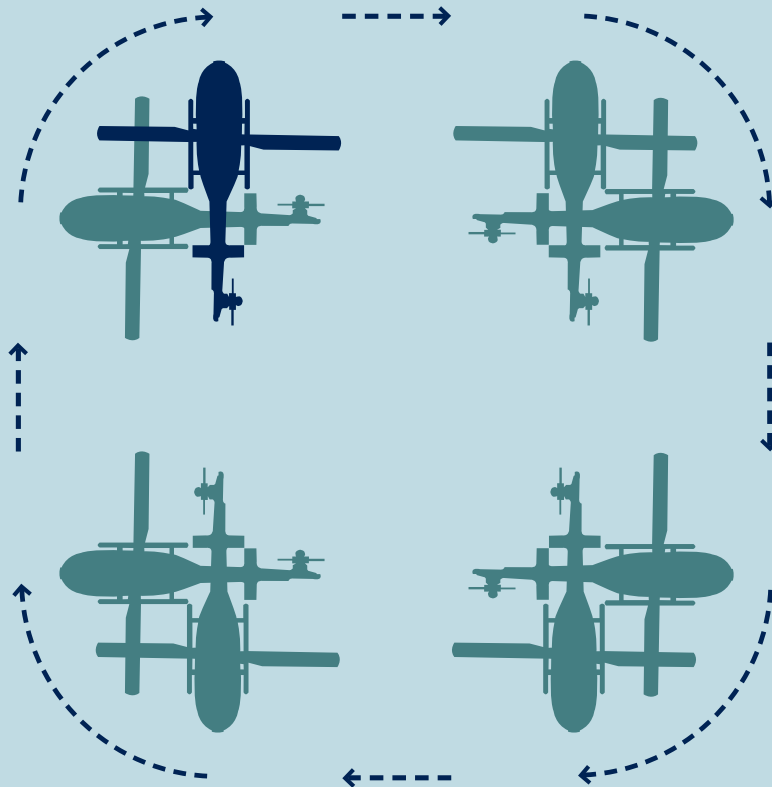
FIGURE 8

TURN ABOUT
THE TAIL



FIGURE 9

SIDEWARD
MOVEMENT



6. DEPARTURE

Prior to the departure from an LS, a thorough 'recce' of the landing site should be undertaken noting hazards, obstacles, wind velocity, sun position and possible safe departure routes. A power margin calculation from the RFM may be required as may a hover power check as a confirmation to establish the exact power margin available. Special attention should be paid to the re-calculation of C of G, weight and loading if passengers/cargo have been off loaded or picked up.

The pilot should then establish the climb out path from the LS by asking himself 'what is the safest way out of here?'

Considerations should include:

- Obstacles in the immediate area/climb out route.
- Wind velocity.
- Sun position.
- Power margin.
- Safe emergency escape routes/landing areas.
- Habitation, livestock, people, buildings in climb out path.
- Any commercial operations/aircraft restrictions.

Note: If the wind is light then the exit route may well be the same as the entry route! If power limited and space permits it may be advisable to back track in order to gain translational lift during the transition.

Vertical climbs which necessitate prolonged periods in the height/velocity diagram should only be used as a last resort.

Suggested sequence for takeoff and departure from an LS:

- Pre-take-off checks.
- Lookout – take-off using sloping ground techniques.
- After take-off checks to include power check
- Confirm or reselect take-off path.
- Reposition within area if required.
- Select forward and lateral markers as appropriate.
- Lookout above – check for overhead obstructions.
- Transition using appropriate technique.
- Thorough lookout on lifting from the confined area especially for any aircraft overflying arriving/departing the LS.



6.1 Towering Take Off

- Position the aircraft in a low hover at the maximum possible distance from forward obstacles.
- Smoothly apply power up to maximum power available and climb vertically whilst maintaining heading.
- Before climb stops assess height in relation to forward obstacles and if a safe margin start a gentle transition (exchanging ground effect for translational lift).
- Aim the aircraft at highest point, but do not increase acceleration towards obstacle until at least level with top of obstacle and the helicopter is still climbing.
- When level with top of obstacle increase speed to best angle of climb speed to clear the obstacle.

Note: If insufficient power to maintain the climb and clear the obstacles then a transition should not be attempted and the aircraft landed back inside the LS.

6.2 Vertical Climb (to outside ground effect)

- Establish low hover in centre of LS.
- Identify forward and lateral markers to ensure no forwards/sideward/rearward movement during climb.
- Smoothly apply power up to maximum power available and climb vertically whilst maintaining heading.
- Note initial rate of climb decreases with height.
- When clear of obstacles, maintaining a rate of climb, adopt a gentle transition forward to prevent height loss

Note: If insufficient power to maintain the climb then descend vertically and land back inside the LS.

7. PILOT ERRORS

The following are common pilot errors that have occurred at off airfield landing sites of which some have resulted in accidents:

- Loss of airspeed whilst turning cross/downwind during an LS recce resulting in LTE.
- Turning onto final approach too high/too fast/too close leading to an excessive ROD, with low airspeed and power applied resulting in Vortex Ring.
- Incorrect wind w/v identification resulting in downwind approach with hard landings and/or excessive power demands.
- Blade strike/tail strike on unseen obstacles/foreign object damage in the LS.
- Persons being hit by tail/main rotor blades.
- Damage to underside of aircraft due to landing on unseen obstruction.
- Aircraft rolling over because sloping ground technique not used for landing/take off.

SUMMARY

The freedom to fly to and land at a chosen destination without the requirement for an airfield or runway utilises the unique abilities of the helicopter as they were originally designed to be used. As well as very convenient, it can be extremely challenging and rewarding to land as close as is safely possible to your destination.

However it must be remembered that there are always inherent risks associated at landing at an 'off airfield site' that requires a high degree of piloting skills, a thorough knowledge of the aircraft performance and a spatial awareness of the changing environment, if this ability is to be used safely.



IMPRINT

Acronyms

ATC	Air Traffic Controls	NOTAM	Notification to Airman
CAT	Commercial Air Transport	RECCE	Reconnaissance
C OF G	Centre of Gravity	RFM	Rotorcraft Flight Manual
EHEST	European Helicopter Safety Team	ROD	Rate of Descent
FOD	Foreign Object Damage	TAF	Terminal Aerodrome Forecast
LTE	Loss of Tail Rotor Effectiveness	VTSS	take off safety speed
LS	Landing Site	Vy	Best Rate of Climb Speed
METAR	Meteorological Aviation Routine Weather Report	W/V	wind velocity

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Graphics

Sarah Bowen

Contact details for enquiries:

European Helicopter Safety Team

E-mail: ehest@easa.europa.eu, www.easa.europa.eu/essi/ehest



EUROPEAN HELICOPTER SAFETY TEAM (EHEST)
Component of ESSI

European Aviation Safety Agency (EASA)
Safety Analysis and Research Department
Ottoplatz 1, 50679 Köln, Germany

Mail ehest@easa.europa.eu

Web www.easa.europa.eu/essi/ehest

