EHEST
Component of ESSI
European Helicopter Safety Team

# Helicopter Performance

FOR HELICOPTER PILOTS

TRAINING LEAFLET


HE 12

# CONTENT

# INTRODUCTION

This leaflet was developed by the European Helicopter Safety Implementation Team (EHSIT), a component of the European Helicopter Safety Team (EHEST). The EHSIT is tasked to process the Implementation Recommendations (IRs) identified from the analysis of accidents performed by the European Helicopter Safety Analysis Team (EHSAT) [1]

Data from the European Safety Analysis Team (EHSAT) accident review confirms that a continuing significant number of helicopter accidents are performance related. The accident circumstances usually show that the pilot had not ensured there was sufficient power available for the intended manoeuvre, in the prevailing conditions.

The aim of this leaflet is to examine the factors affecting aircraft performance and provide guidance to help pilots ensure that a proposed operation can be safely accomplished.


# ACKNOWLEDGEMENT

EHEST wishes to acknowledge the cooperation of the New Zealand Civil Aviation Safety Authority in the production of the leaflet. Some changes have been incorporated to reflect EASA terminology and regulations.


1 Refer to the EHEST Analysis reports of 2006-2010 and 2000-2005 European Helicopter Accidents

# DEFINITIONS

| | |
|---|---|
| AGL | Above Ground Level |
| AMSL | Above mean sea level |
| CG | Center of Gravity |
| DA | Density Altitude |
| IGE | In Ground Effect |
| HTAWS | Helicopter Terrain Awareness Warning System |
| OAT | Outside Air Temperature |
| OGE | Out of Ground Effect |
| POM | Pilot's Operating Handbook |
| RFM | Rotorcraft Flight Manual |
| **ISA** | **International Standard Atmosphere.**<br><br>An International Standard Atmosphere has been established to enable comparison of aircraft performance, calibration of altimeters, and other practical uses. In the ISA, a particular pressure and temperature distribution with height is assumed. At sea level the pressure is taken to be 1013.2 hPa, and the temperature 15°C. ISA also assumes dry air |
| **PA** | **Pressure Altitude**<br><br>In ISA, any pressure level has a standard corresponding altitude called the pressure altitude, based on a lapse rate of approximately one hPa per 30 feet at lower levels. Pressure altitude is the height that will register on a sensitive altimeter whenever its sub-scale is set to 1013.2 hPa. At any ISA pressure level, there is also a corresponding temperature called the ISA temperature. In ISA, temperature falls off with height at a rate of 1.98°C per 1000 feet up to 36,090 feet, above which it is assumed to be constant (see Figure 1). Warm air is less dense than cold air. Thus, when the temperature at a given altitude is higher than the standard atmospheric temperature, the air at that altitude will be less dense. |

Helicopters have the unique ability to take-off and land almost anywhere. It is the responsibility of the pilot to determine if a safe take-off and landing is possible and the availability of sufficient power. Unfortunately, a significant number of helicopter accidents are performance related, with the majority of these accidents occurring during the take-off or landing phases of flight. Many of these accidents occurred when the helicopters were being operated from sites that were elevated, out of wind, restricted by terrain, sloping, or had rough surfaces. Often the helicopters were being operated at high all up mass, in high ambient temperatures and high density altitude These accidents may have been prevented had the pilots been fully aware of the prevailing conditions, and determined the performance capabilities of their helicopter before commencing flight. Such accident prevention relies on thorough pre-flight preparation, of which Flight Manual performance chart calculations are an integral part. Because the ambient conditions at the intended point of operation can be quite different from those planned for, calculated values must always be validated by an actual power check at the operating site. This leaflet provides an overview on the major factors that influence performance and provide tools and checklists to the pilot to safely plan and perform a flight.

# 1. EXAMPLES OF PERFORMANCE RELATED TOPICS

## 1.1 Example of a performance related accident

The following examples illustrates how a series of events can compound to result in an accident in which a lack of performance becomes a key causal factor.

### 1.1.1 Synopsis

A passenger who wished to be flown to a hut in the mountains, approached a friend who was the owner of a single piston-engined helicopter, advising him that the hut was at an elevation of 1450 feet above mean sea level. The pilot assigned to the flight flew the helicopter to the airport where the passenger waited. The pilot assessed the weight of the passenger, pack, helicopter, and fuel and considered them to be within the limit of the helicopter to operate at the elevation of the hut. Some items from the passenger's pack were stowed under the seat, and the pack was placed at his feet. The pilot did an *in-ground-effect* hover check, and found that there was a sufficient power margin for the hover. The passenger guided the pilot to the hut, which turned out to be at a much greater elevation than expected. The pilot did not perform an in-flight power check and elected to land on a nearby site.

He approached the landing site obliquely to allow for an escape route, and flew the helicopter in a shallow approach. At about 15 feet above the landing site, the pilot noticed the rpm was decaying to the bottom of the normal range and opened the throttle fully. No more power was available, and believing a landing was inevitable, the pilot tried to control the flight path by increasing collective pitch. He could not arrest the helicopter forward motion by applying full aft cyclic, and the helicopter began to rotate, touching down heavily. The helicopter then pitched slowly onto its nose and fell onto its right side.

### 1.1.2 Analysis

Overall, this flight was unlikely to be successfully carried out, although there were numerous opportunities for the pilot to have rectified the situation along the way.

The passenger had misled the pilot about the correct site elevation, and used a map, which showed the heights in metres and not feet. The altitude of the hut was 1,450 metres AMSL (4,750 feet), not 1,450 feet as the passenger reported. Another significant factor was the helicopter mass and balance. Using the weights the pilot estimated, the actual helicopter take-off mass was over the maximum permitted for the aircraft. Moreover, by placing the pack at the passenger's feet, the helicopter was probably loaded outside its forward CG limits. This would have added to the difficulties of using cyclic to arrest the helicopter forward motion. Lack of a power margin was inevitable given the helicopter mass and the density altitude at the landing site, but the pilot did not recognise the shortfall in power. Had the pilot carried out a performance calculation prior to flight which could have been confirmed with an in-flight power check, he would have realized that he had insufficient power to land at that density altitude. A no-go situation would then have been evident. After recognising that there was insufficient power available, the pilot should have used the correct go around technique.

On final approach to the landing site and when he recognized he had insufficient power he should have accelerated the helicopter towards to a pre identified escape route to avoid ground contact.

## 1.2 Example of a performance chart use for a landing in a mountainous area

The following example illustrates how proper planning and a correct use of performance charts can help to prevent an accident.

### 1.2.1 Synopsis

During a mountain training course, my instructor ask me to land on a pass in a mountain area. The first step of this mountain training flight was to set our altimeter at 1013 HPa. With this altimeter setting and with the outside temperature, I first check the HOGE performance chart of my helicopter at the estimated altitude of the landing site, with the actual weight of my helicopter, that includes crew, equipment on board (including a survival bag) and the remaining fuel.

Then I performed an orbit at about 500Ft above the landing site altitude, to check the ground and flight hazards and to find the lift side of the mountain.

After estimating the wind, I carry out 2 recon low passes, on two different axes with a front wind, in order to confirm the wind, check the available power and the security on the landing site.

After choosing the approach direction, I inform the instructor about the type of approach I'll intend to perform (high bank to keep the pass with the background, the touch down area, the type of take-off, and the clear way in case of aborting take-off).

I executed the approach according of my decision and we landed on the pass. We checked the power during a short hovering before landing the helicopter.

### 1.2.2 Analysis

Regardless the full recon procedure using to land in a mountainous area, the most important here is the use of the appropriate performance chart, with the right altimeter setting and to check then during a recon low pass that the performances of the engine are in accordance with the performance chart.

# 2. PILOT IN COMMAND RESPONSIBILITY

Annex IV 1.c. to Regulation (EC) No 216/2008 and Annex VIII Part NCO.GEN.105 states that *"....The pilot in command must be responsible for the operation and safety of the aircraft and for the safety of all crew members, passengers and cargo on board"*. Additionally the Annex IV 2.a.3. to Regulation (EC) No 216/2008 specifies:

- (iv) the mass of the aircraft and centre of gravity location are such that the flight can be conducted within limits prescribed in the airworthiness documentation;
- (v) all cabin baggage, hold luggage and cargo is properly loaded and secured; and
- (vi) the aircraft operating limitations as specified in point 4 will not be exceeded at any time during the flight.

Additionally the paragraph 4 of the same Annex states:

- 4.a. An aircraft must be operated in accordance with its airworthiness documentation and all related operating procedures and limitations as expressed in its approved flight manual or equivalent documentation, as the case may be. The flight manual or equivalent documentation must be available to the crew and kept up to date for each aircraft.
- 4.c. A flight must not be commenced or continued unless the aircraft's scheduled performance, considering all factors which significantly affect its performance level, allows all phases of flight to be executed within the applicable distances/areas and obstacle clearances at the planned operating mass. Performance factors which significantly affect take-off, en-route and approach/landing are, particularly:

    - (i) operational procedures;
    - (ii) pressure altitude of the aerodrome;
    - (iii) temperature;
    - (iv) wind;
    - (v) size, slope and condition of the take-off/landing area; and
    - (vi) the condition of the airframe, the power plant or the systems, taking into account possible deterioration.

- 4.c.1. Such factors must be taken into account directly as operational parameters or indirectly by means of allowances or margins, which may be provided in the scheduling of performance data, as appropriate to the type of operation.

## 2.1 How to Comply

Compliance with these rules can be achieved by using the performance data graphs contained in the RFM. Use the graph and trace the applicable data to determine the performance capabilities for the given conditions – and then confirm those values with the applicable in-flight power check applicable for helicopter type. Flight Manuals have graphs for determining density altitude, IGE and OGE hover ceilings, take-off distances, and rate-of-climb performance. It should be noted that different helicopter types have considerable variation in the standard of information presented in these graphs. The use of these graphs is discussed, with worked examples, later in this booklet.

# 3. PERFORMANCE FACTORS

In this section we discuss how various physical and environmental factors can adversely affect helicopter performance. We have tried to avoid using rule-of-thumb performance methods, because there are differences between helicopter types. – the application of a simplified rule could be either misleading if not unsafe. Instead, we have given a number of performance examples from a range of helicopter types to illustrate how each performance factor affects performance capability. Refer to your RFM or operating procedures, or ask your chief pilot or instructor for the specific performance information that applies to your helicopter. Please note that the performance values derived for the following examples may be significantly better than what the helicopter can actually achieve. All examples have been derived from RFM performance graphs only, and they would normally be validated by an actual power check, if applicable, under the ambient conditions existing at the point of intended operation. Some RFM contain performance charts that have minor variations (e.g., generator on/off, sand filter fitted, bleed air on/off, etc.). You must use the correct variant so that accurate performance data is obtained.

## 3.1 Mass

What can be seen is that the greater the gross mass of the helicopter the greater the lift (rotor thrust) required for hovering or climbing. The available lift is proportional to the collective setting and the associated rotor blade angle of attack. The power available determines the maximum collective pitch setting that can be maintained at the optimum rotor rpm. The heavier the helicopter the greater the power required to hover (and for flight in general), and the smaller the margin between the power required and the power available. The higher the gross mass the lower the hover ceiling, and therefore the more restricted the helicopter will be in where it can operate. This can be seen from the following example.

Effect of increasing mass on IGE hover ceiling example: Schweizer 269C
Temperature: +27°C at sea level
QNH: 1013 hPa

| Gross mass | Gross mass 725 kg | Gross mass 910 kg |
|---|---|---|
| Hover ceiling | 11,350 feet P alt. | 5,400 feet P alt. |

Pilots must ensure that they always use an established method to accurately determine the gross mass of the helicopter prior to flight.

## 3.2 Air Density

As air density affects engine (particularly normally aspirated piston engines) and aerodynamic performance (rotor thrust and tail rotor thrust).

The density is influenced by:

- Pressure;
- Temperature;
- Humidity

**Density Altitude**: Density Altitude represents the combined effect of pressure altitude and temperature. DA is defined as the height in the standard atmosphere that has a density corresponding to the density at the particular location (on the ground or in the air) at which the density altitude is being measured.

A graph (See Figure 1) provided in the RFM allows us to calculate DA easily. To use the graph we must be flying at a PA (i.e. with 1013 set on our altimeter subscale). Entering the graph with our altitude and OAT we can calculate our DA. When conditions are standard (ISA), DA = PA.

As a DA increases the helicopter performances decreases and vice versa.

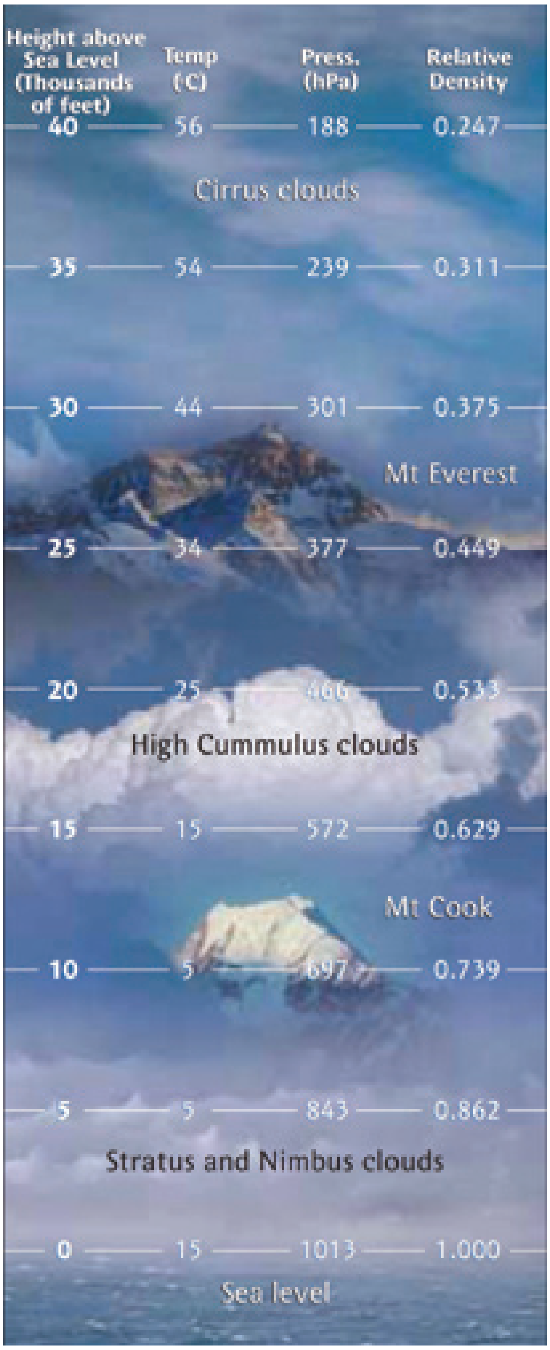
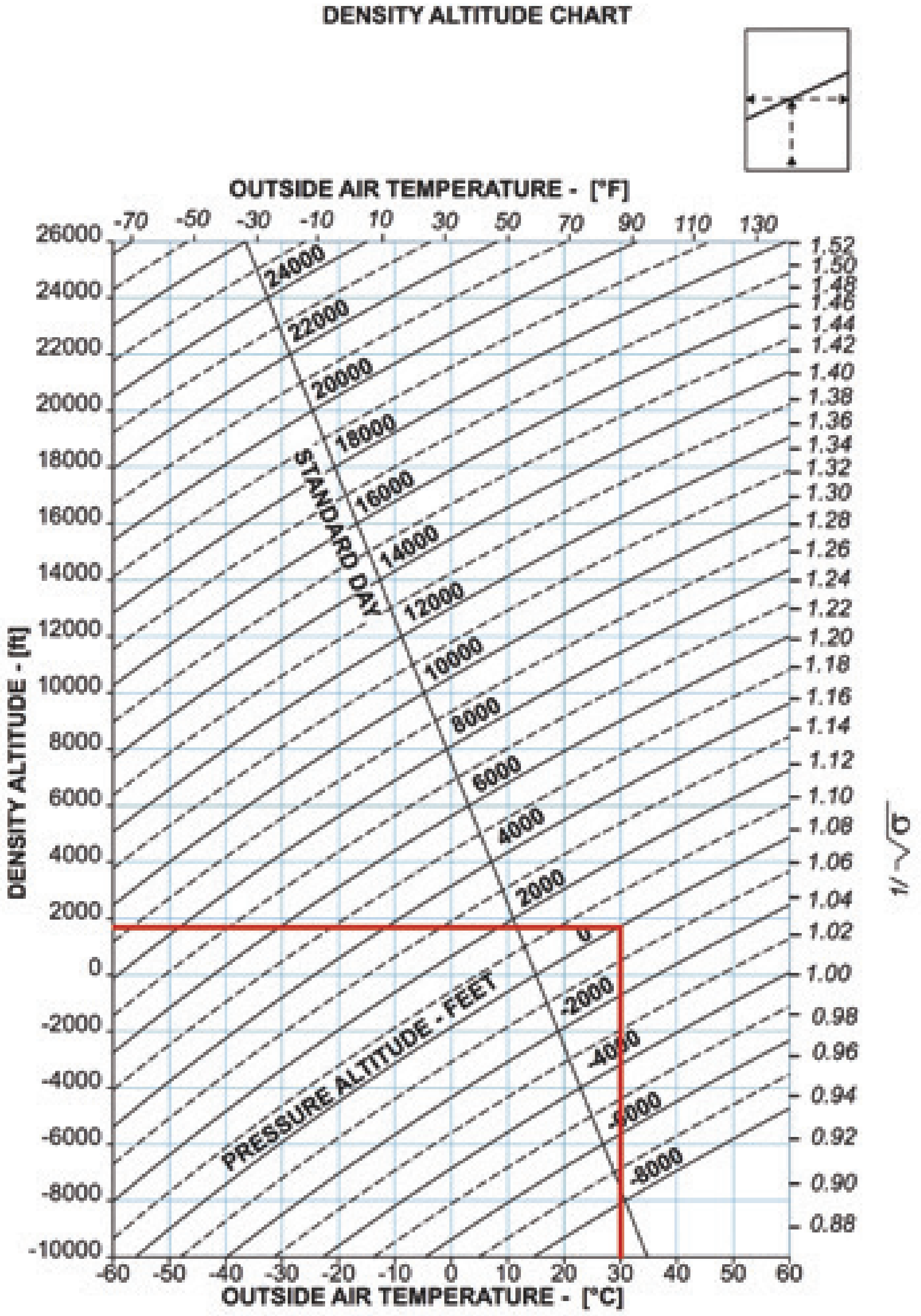


Figure (1)

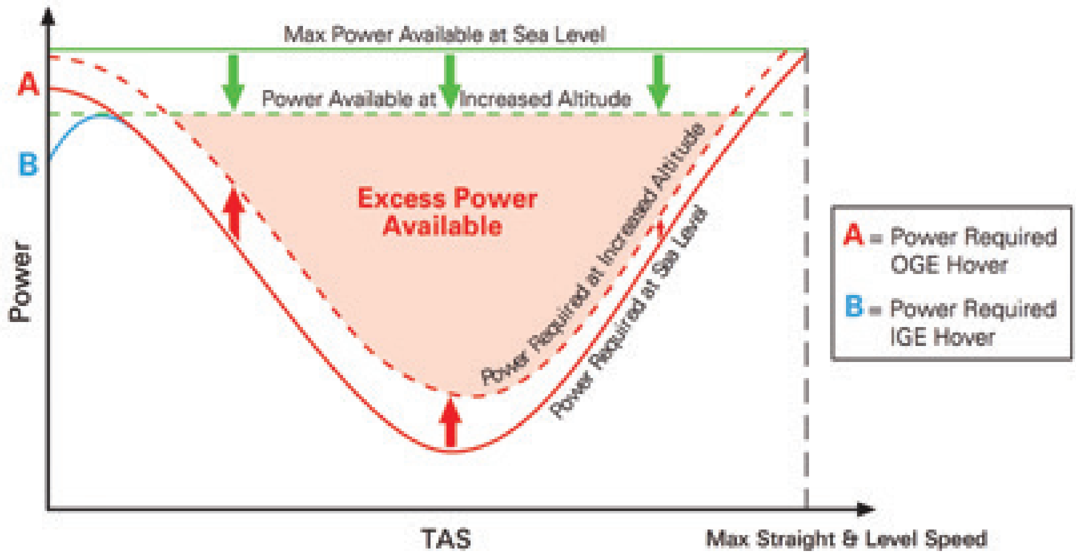
E.g.: Temperature: 30°C; PA: = 0 Ft; DA: = 1800 Ft

DA, therefore, provides a basis for relating air density to ISA, so that comparative helicopter performance can be readily determined. Operating in high density condition can be perilous, so your performance calculations have to be continuously accurate.



The margin between available power and the power required to hover at high gross mass and high density altitudes is often small for helicopters (see Figure 2).

The Figure below shows the effect of the power when the Air Density increases




In practical terms for the pilot, an increase in density altitude has a number of effects on helicopter performance:

Reduced hover ceiling – means the choice of take-off and landing sites available to the pilot becomes limited.

Reduced operating margins – means reduced payloads.

Reduced rate-of-climb performance – means obstacle clearance can be adversely affected.

### 3.2.1 Take-Off

For any given mass, the higher the density altitude at the departure point, the more the power required to hover, because of reduced rotor efficiency. With engine performance already reduced, the amount of excess power available to hover can be small. Under certain conditions, a helicopter may not have sufficient power available to take off in such a way that satisfactory obstacle clearance can be assured.

### 3.2.2 Landing

Given that a normal landing is preceded by a hover, the limited power available at high density altitudes can be just as much of a problem when landing. If the landing site has a high density altitude, sufficient power may not be available to hover at your operating mass and a loss of directional stability may be experienced due to lack of tail rotor authority.

In this case, if we reach the maximum power a subsequent increase in collective will cause a droop in rotor RPM as a result of Overpitching. In this condition the efficiency of the main and tail rotors will decay producing an increase in the rate of descend and a loss of yaw directional control. Recovery from such a condition will be difficult if not catastrophic.

Alternative landing techniques should be considered that do not require a hover (e.g. running landing or no hover landing).

## 3.3 Wind

Headwind components provide a benefit in terms of improved rotor efficiency and therefore performance, conversely being out of headwind reduces rotor efficiency and helicopter performances.

Knowing which direction the wind is coming from is very important – especially in light wind conditions. Some RFM performance graphs (i.e., Bell 206B3) have a critical wind azimuth area, in which adequate control of the helicopter is not assured when the wind is from anywhere within the specified azimuth area – consequently hover ceiling will be reduced.

## 3.4 Ground Effect

While in ground effect the power required is less than required while hovering out of ground effect-

OGE hover ceiling is considerably lower than IGE hover ceiling.

Most helicopter Flight Manuals provide performance graphs to calculate IGE hover ceiling. Remember that an IGE hover is based on hovering over a flat and relatively smooth surface.

The hover-ceiling charts (HIGE, HOGE) are used to determine the helicopter performance capabilities.

## 3.5 Slope and surface

Hovering above sloping ground will require more power than that needed to hover over a flat surface.

Any surface that absorbs or disrupts the downwash from the rotor blades (i.e. surface with long grass, uneven surface, rough water, rocky river beds etc.) will reduce the benefits of ground effect, which will require more power to maintain hover and consequently will reduce the IGE ceiling.

## 3.6 Other Factors

### 3.6.1 Overpitching (Low Rotor RPM)

As previously mentioned (3.2.2) Overpitching is a dangerous situation; at high collective pitch settings the power system may no longer provide enough power to overcome the rotor drag and then produce the required lift. The result is a reduction in rotor RPM, lift, and centrifugal force, which in turn reduces the effective lifting area of the rotor disc.

An adequate planning, an attentive smooth pilotage and a power check at the operating site, will help preventing this condition. If you encounter it, a quick RPM recovery action must be initiated by the pilot slightly lowering the collective and adopt an attitude that will minimize the consequence of a possible hard landing

Remember, if you are close to the ground, there may be insufficient height to recover.

### 3.6.2 Rotor condition

Deposits on the main or tail rotor blades can disrupt the laminar airflow and significantly reduce the lift production.

### 3.6.3 Loss of Tail Rotor Effectiveness (LTE)

As already described in the "HE1 – Safety Considerations", the LTE is generally encountered at low forward airspeed, normally less than 30kt, where:

- the tail fin has low aerodynamic efficiency;
- the airflow and downwash generated by the main rotor interferes with the airflow entering the tail rotor;
- a high power setting requires a yaw pedal position which is close to its full travel;
- an adverse wind condition increases the tail rotor thrust requirement;
- turbulent wind conditions require large and rapid collective and yaw inputs.

Recovery actions will vary according to the circumstances, if height permits, attaining forward airspeed without increasing power (if possible reducing power) will normally resolve the situation. Therefore, as these actions may involve a considerable loss of altitude, it is recommended that pilots identify a clear escape route.

### 3.6.4 Retreating Blade Stall

High DA, high AUW, turbulent air and rough /abrupt or excessive control movements can aggravate retreating blade stall.

Indications can be a pitch up tendency followed by a roll to the retreating side. Recovery action will depend on the in-flight conditions however it will normally be to reduce speed, reduce collective lever, reduce manoeuvre or a combination of these actions together.

### 3.6.5 Contingencies

Even after having worked out your helicopter take-off, landing or lifting performance, it is prudent to add a contingency to allow for other factors that you may have overlooked. For example, the engine may not be performing as well as expected, you might encounter an unexpected lull or shift in the wind, the air temperature at the landing site might be higher than anticipated because of surface heating.

Most performance-related accidents can be prevented, provided that the pilot maintains a good situational awareness, knows the performance limitations of the helicopter, and apply basic performance calculations; if necessary the results may be validated with a power check at the actual landing or T/O site.

# 4. FLIGHT PREPARATION

Most performance-related accidents can be prevented, provided that the pilot maintains a good situational awareness, knows the performance limitations of the helicopter, and apply basic performance calculations; if necessary the results may be validated with a power check at the actual landing or T/O site.

## 4.1 Performance Calculation

Talking about performance the first step for a safe flight preparation is to determine the performance of our helicopter. In the RFM are made available tables and graphs that help the pilot in this duty.

## 4.2 Power Check

Conditions at take-off and landing sites may differ from what has been used for RFM performance calculations. In order to take this into account, and to confirm the amount of power available, the pilot should make an operational assessment by carrying out a power check, in accordance with the RFM, before committing to a take-off or a landing.

The power check shall be carried out in accordance with the information provided by Manufacturer.

# 5. THREAT ASSESSMENT

Pre–flight planning shall include performances calculations for all phases of flight.

## 5.1 Hazards

For all helicopters but especially for single engine helicopters, there may be hazards associated to insufficient performance calculation, following are reported some examples (not exhaustive list):

A. Presence of obstacle;
B. Weather;
C. Wrong or no calculation of performance;
D. Engine power check;
E. Wrong or no calculation of mass and balance;
F. Use of wrong or no use of performance chart;
G. Difference in the elevation of the landing site;
H. Routine / Complacency (Internal Pressure);
I. Economical pressure (External pressure);
J. Change in helicopter configuration;
K. Different performance due to optional equipment;
L. Other.

The above hazards can have different impact if we consider different types of operations (i.e. Corporate, Private, Training, Pleasure flights etc.)

In case of lack or wrong performance calculations we remove barriers and we face with this type of Risk assessment MATRIX:

| RISK | RISK SEVERITY | | | | |
|---|---|---|---|---|---|
| PROBABILITY | Negligible (A) | Minor (B) | Major (C) | Hazardous (D) | Catastrophic (E) |
| Frequent (5) | 5 A | 5 B | 5 C | 5 D | 5 E |
| Occasional (4) | 4 A | 4 B | 4 C | 4 D | 4 E |
| Remote (3) | 3 A | 3 B | 3 C | 3 D | 3 E |
| Improbable (2) | 2 A | 2 B | 2 C | 2 D | 2 E |
| Extremely Improbable (1) | 1 A | 1 B | 1 C | 1 D | 1 E |

For the criteria used in the Risk Matrix refers to “HE5 Risk Management in training”

## 5.2 Mitigation

Possible mitigating measure that can be adopted may be:

### 5.2.1 Obstacles

This types of flight, most of the time, are conducted in areas where the environment is known or protected in terms of obstacles (See “HE 3 Off Airfield Landing Operations”). In case of doubt an accurate analysis of the charts or the availability on board of terrain avoidance systems (HTAWS) may prevent the risk of ground contact. If is not possible to consult charts or the helicopter is not equipped with this devices, the presence of ground personnel, in conjunction with a RECCE, may help the pilot to prevent an accident.

If necessary change the take-off path to clear obstacles or decrease the mass to have additional margin.

If it not safe **REJECT TAKE OFF**

While en-route, for single engine helicopter is important to identify an escape route or identify a suitable landing place in case of engine failure.

During landing we may face with different landing site condition or the information in our hand ore not correct. In this case do not execute a rush approach, execute an accurate RECCE or collect information from ground personnel and select the most appropriate approach path. If necessary verify on the WAT chart the capability to land of the helicopter.

If It is not safe **GO AROUND**.

### 5.2.2 Weather:

(From HE2) Ensure you get an aviation weather forecast from an authorised source, heed what it says, (decodes are available on the internet) and make a carefully reasoned GO/NO GO decision.

Do not let self-induced or passenger pressure influence your judgement. The necessity to get home (Homeitis) has been a frequent casual course of accidents. Establish clearly in your mind the en-route conditions, the forecast, and possible diversions in case of deteriorating weather. Have a planned detour route if you are likely to fly over high ground which may be cloud covered. In piston engine helicopters be aware of the conditions that lead to the formation of engine icing, comply with the RFM / Pilot's Operating Handbook (POM) instructions regarding the use of Carb heat or Engine anti-ice and remember to include Carb Air Temp and OAT in your regular instrument scan. In wet weather beware of misting of windshield and windows, especially when carrying passengers with wet clothes and carry a cloth to assist demisting the windshield prior to take-off.

### 5.2.3 Power Check:

The execution of the power assurance check as described in the RFM by the Manufacturer, provide the actual status of the engine of our helicopter, missing this check or not adequately consider the result of the check may lead the possibility to carry-out a safe operations.

### 5.2.4 Wrong or no calculation of performance / Wrong or no calculation of mass and balance:

To be certain of the actual mass of the helicopter is the first step to avoid accidents. In case of doubt or if you are not sure of the mass that the passengers are embarking on board the helicopter, do not hesitate to ask for clarification. If necessary, perform a weight check of the material and / or passengers.

### 5.2.5 Use of wrong or no use of performance chart / Different performance due to optional equipment:

The tables or graphs available in the RFM usually reports the performance in case of installation of particular equipment (i.e. particle separator, Anti Ice etc.). Some supplementary equipment are not computed by Manufacturer with a specific chart, in this case, for each supplementary equipment, a penalty factor is provided in the RFM in order to determine the effect of the performance on the helicopter. Be sure and take your time to identify and **use** the correct chart.

### 5.2.6 Internal / External pressure:

Sometimes the Routine or the Complacency (Internal pressure – Press On Itis) or the pressure of the Management can push the crew to not consider the actual status of the helicopter and the related performances. We must be aware of the pressure that we are having at the moment (internal or external) and react accordingly.

Although in most cases it is not necessary, sometimes we have to also do an informative action to the Management, so as to inform them about the risks to which you are going to meet, and to the negative effect that might be on the company. The need is to instil a flight safety culture at all levels.

### 5.2.7 Change in helicopter configuration:

Sometimes there is a need to change the configuration of the helicopter to be adapted at the different operation to be carried out. In this case an effective communication between the Technical and Operational department is deemed necessary. The pilot shall be aware if change in the configuration occurs, and he shall consider the changes in the performance calculation.

With the correct consideration about performance, the Assessment Matrix below now shows that we can operates in the acceptable green area.

| RISK PROBABILITY | RISK SEVERITY | | | | |
|---|---|---|---|---|---|
| | Negligible (A) | Minor (B) | Major (C) | Hazardous (D) | Catastrophic (E) |
| Frequent (5) | 5 A | 5 B | 5 C | 5 D | 5 E |
| Occasional (4) | 4 A | 4 B | 4 C | 4 D | 4 E |
| Remote (3) | 3 A | 3 B | 3 C | 3 D | 3 E |
| Improbable (2) | 2 A | 2 B | 2 C | 2 D | 2 E |
| Extremely Improbable (1) | 1 A | 1 B | 1 C | 1 D | 1 E |

# 6. CONCLUSION

Take-off, landing and hovering are all potentially risky phases of helicopter flight. The more that we can do as pilots to minimise these risks – especially when operating at high gross mass, from challenging sites, with high density altitudes – the safer we will be.

Most performance-related accidents can be prevented, provided that the pilot maintains a good awareness of the surrounding conditions, knows the performance limitations of the helicopter, always does a power check before committing to a marginal situation, and is disciplined enough to 'give it away early' if the odds are stacking up against getting the job done safely.

If you ever have any doubts about the ability of your helicopter to perform the task at hand, then the prudent thing to do is to take the time to apply basic performance calculations, and validate these with a power check at the actual site. This takes the **'it'll be alright'** out of the situation.

*Always make performance calculations part of your flight preparation.*

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