



# Training and Testing of Emergency and Abnormal Procedures in Helicopters

FOR HELICOPTER INSTRUCTORS AND EXAMINERS

TRAINING LEAFLET



**HE 11**



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# 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)<sup>1</sup>.

— — Data from the European Safety Analysis Team (EHSAT) accident review confirms that a continuing significant number of helicopter accidents occur during the training or testing of emergency and abnormal procedures (EAP) in helicopters, where an instructor has allowed the student to exceed the helicopter limitations or put the aircraft into a position where the instructor was not able to recover the aircraft safely.

— — Whilst it is acknowledged it is preferable to teach EAP in an FSTD this may not always be possible, therefore the training and testing of EAP in an aircraft is a skill that the instructor and examiner must manage safely and effectively.

— — The aim of this leaflet is to provide guidance to instructors and examiners in order to improve the safety and delivery of instruction and assessment of aircraft EAP in flight.

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

# 1 TRAINING OF EMERGENCY AND ABNORMAL PROCEDURES (EAP) IN HELICOPTERS.

## 1.1 Theoretical Knowledge Training

Before practical EAP flight training can take place the instructor and student should be aware of, and be familiar with all of the relevant theoretical knowledge required to ensure a safe and effective flight.

Note for the purpose of this leaflet the following definitions are used:

*An emergency situation* is one in which the safety of the aircraft, or of persons on board, or on the ground, are endangered for any reason.

*An abnormal situation* is one in which it is no longer possible to continue the flight using normal procedures however the safety of the aircraft, or persons on board, or on the ground are not in danger.

### Helicopter Systems

Pilots are required to have a fundamental knowledge and understanding of the normal and abnormal operation of the helicopter systems in order to conduct safe and efficient operations, including the management of any emergency or abnormal situation. AMC1 FCL 725(a) 'Syllabus of Theoretical Knowledge' identifies the following aircraft theoretical knowledge elements as training requirements for the issue of a type rating:

- (a) Detailed listing for helicopter structure, transmissions, rotors equipment, normal and abnormal operation of systems.
- (b) Limitations
- (c) Performance, flight planning and monitoring.
- (d) Load, balance and servicing
- (e) Emergency procedures
- (f) Special requirements for extension for a type rating for instrument approaches down to a DH of less than 200feet.
- (g) Special requirements for helicopters with EFIS
- (h) Optional equipment.

### Pilot's Operating Handbook (POH)/Flight Manual (FM).

An operator shall provide operations staff and flight crew with an aircraft operating manual for the type being used, containing the normal and EAPs relating to the aircraft type. During training pilots should be shown how to use the POH/FM, including any relevant charts, to obtain the necessary information for the safe operation of the helicopter. Before EAP can be taught in the helicopter type both the instructor and the student must be familiar with the following elements of the FM/POH:

- The Limitation Section; which contains the required operating limitations, instrument markings and placards for the safe operation of the aircraft required for training EAPs.

- The Normal Procedures Section; contains the relevant information regarding the handling aspects and flight profiles for training flight occurrences such as autorotations and hydraulic failures.
- The Performance Section; which contains the relevant performance data for performance Class 1/2/3 and equivalent Group A and B performance together with the relevant training WAT charts for OEI operations.
- FM Supplements, which can contain specific guidance on training procedures to be used.
- Safety Tips & Notices, where available can provide advice on how to operate the aircraft safely.
- The Emergency Procedures Section, which describes the actions to be taken by the crew in relation to the various possible system failures that could occur. To assist the crew in their decision making process, some or all of the following recommendations and their associated definitions are normally found at the front of the Emergency Procedure section of the relevant POH/FM:
  - (a) Land Immediately
  - (b) Land as soon as possible
  - (c) Land as soon as practical/Limit duration of flight
  - (d) Continue flight

#### Aircraft Emergency or Abnormal Checklist (EAC)

An EAC is a checklist containing actions which are the initial response elements of the EAPs (also referred to as a Quick Reference Handbook (QRH)). The EAC is reproduced from the – and must be the same as - the POH/FM. The advantages of an EAC are;

- Reduces the risk of forgetting to carry out vital actions
- Ensures that actions are carried out in the correct sequence
- They are designed to be intuitive and ergonomic
- Encourage cooperation and cross-checking between crewmembers

In practice, immediate actions in response to certain emergency or abnormal situations (fire, engine failure) are carried out from memory; the actions taken are then confirmed by reference to the EAC. Pilots who make a concerted effort to follow EAC procedures reduce the risk of forgetting items, follow the correct sequence and are seldom surprised by an occurrence that was not anticipated.

#### Operational Evaluation Board (OEB) /Operational Safety Data (OSD)

The aircraft OEB/OSD will identify Training Areas of Special Emphasis (TASE) which are specific to the aircraft type and will give the instructor guidance on how they are to be taught safely in the aircraft.

### Accident and Occurrence Reports

Accident and occurrence reports can give examples of emergency and abnormal situations experienced by pilots flying similar aircraft types. These can be related to the training being undertaken with a discussion prior to the flight on the causes and the actions taken. During the flight the student can then view the gauges, indications and flight profile allowing him to practically apply the lessons learned from the scenario based discussions.

### EASA Airworthiness Directives/Manufactures Safety Information Notices

EASA and helicopter manufacturers often produce important safety and/or training bulletins that an ATO or individual can subscribe to in order to directly receive the latest relevant aircraft information.

### Helicopter Specific Emergencies

Specific areas of special emphasis for helicopter emergency training are identified as those areas where accidents can happen if the pilot is not appropriately trained and should include:

- (a) Autorotations
- (b) Dynamic rollover
- (c) Vortex ring state (settling with power)
- (d) Loss of tail rotor effectiveness (LTE)
- (e) Hydraulic Transparency
- (f) Automation abnormalities
- (g) Rotor energy management

### Approved Training Organisation (ATO) Training Manual

ATOs are required to conduct training risk assessments and as part of this process they may stipulate mitigations in the training of simulated emergencies in order to reduce the risk. An ATO may place additional limitations for when EAP training should, or should not take place, for example:

- (a) Weather conditions – cloud base, visibility, wind velocity etc
- (b) Heights – minimum heights for commencement and recovery of EAPs
- (c) Training areas – airspace, landing areas, sloping ground areas, etc
- (d) Aircraft – any limitations due aircraft equipment fit i.e. floats/cameras
- (e) Instructor's experience – newly qualified/FI(Restricted),CFI check flights prior to teaching EAPs (e.g. simulated engine off landings),

## 1.2 Human Factors

Prior to conducting EAP training a sound understanding of Human Factors (HF), Threat and Error Management (TEM), Risk Management, Crew Resource Management (CRM) and Aeronautical Decision Making (ADM) is crucial to providing effective training. Analysis of training accidents continues to highlight deficiencies in these areas.

### Threat and Error Management

Threats - are defined as events that occur beyond the influence of the flight crew, increase operational complexity, and which must be managed to maintain the margins of safety. Threats such as an aircraft malfunction can happen suddenly and without warning. In this case, flight crews must apply skills and knowledge acquired through training and operational experience.

Errors - are defined actions or inactions by the flight crew that lead to deviations from organisational or flight crew intentions or expectations. Unmanaged or mismanaged aircraft EAPs can reduce the margin of safety and frequently lead to undesired aircraft states. A typical error in an emergency or abnormal situation would be to forget or miss EAC items.

Undesired aircraft states - are flight crew induced aircraft position or speed deviations, misapplication of flight controls, or incorrect systems configuration. Undesired aircraft states that result from inappropriate reactions to a malfunction or emergency may lead to a compromising situation and reduce margins of safety in flight operations.

### Risk Management

Risk management is the culture, processes and structures put in place by an ATO to effectively manage potential risk and adverse effects. It is not possible to eliminate all risk in the training or testing of abnormal and emergencies; however an effective Safety Management System can mitigate risk by reducing it to an acceptable level and rejecting the unacceptable risks. Training and disciplined use of a risk assessment matrix in compliance with the ATO operations manual can provide educated decision making before undertaking EAP training.

### Risk Acceptability Matrix

- An example of a simple Risk Acceptability Matrix and the Risk Acceptance Actions for the training of EAPs is shown below:

Severity	Likelihood		
	Unlikely	Possible	Likely
Accident	Review	Review	Unacceptable
Incident	Review	Review	Unacceptable
Negligible	Acceptable	Acceptable	Review



Unacceptable	Risk intolerable - possibly use FSTD or ground brief only.
Review	Risk reduction/mitigation must be considered - who/ when/ what?
Acceptable	Risk is considered acceptable - however PIC must reassess before flight.

### Aeronautical Decision Making (ADM)

Decision making is the process of selecting from several choices, products or ideas and taking action in order to bring about a desired result. ADM is a systematic approach to the mental process used by pilots to consistently determine the best course of action in response to a given set of circumstances such as an emergency or abnormal situation. The DM process includes the following steps:

- Define the situation and the desired outcome
- Know your strengths, weaknesses and skills
- Identify alternatives, options and consequences
- Manage resources to ensure adequate information
- Evaluate options then select the best option
- Develop a plan of action and/or implement option
- Evaluate results
- Start again if results are not acceptable.

The 'Three P' model is an ADM process to perceive hazards, systematically, assess the risk associated with a hazard and determine the best course of action.



For example a possible application in the abnormal/emergency scenario is:

Perceive – an emergency or abnormal situation can be detected using any of the human senses e.g. auditory by hearing a warning horn/ unusual noises, visual by seeing a gauge/light indication, tactile by feeling a vibration or smell/taste as in the case of smoke/burning.

Process - once the emergency/abnormality is detected then the pilot must use CRM skills to gain all relevant information by cross checking for other aircraft indications, using crew members, passengers, ground observers, ATC, etc to gain as much information as possible before continuing onto the next stage.

Perform - once all the information is collated then a decision can be made to the appropriate course of action, which would normally be conducted in accordance with the relevant EAC. Once the action is taken this should be reviewed by and if appropriate then the actions adapted accordingly.

(Note EHEST leaflet HE 4 has further guidance on ADM for SPH operations).

### Situational Awareness (SA)

SA involves being aware of what is happening in the vicinity of aircraft to understand how information, events and one's own actions will impact goals and objectives both immediately and in the near future. SA is one of the best defences against errors. Being too absorbed in detail can lead to missing the 'bigger picture'.

Aids to SA when dealing with abnormal and emergency situations:

- Gather information from a variety of sources before making a decision.
- Take time (where available) to make decisions and avoid jumping to conclusions.
- Consider all possible interpretations of information before arriving at a conclusion.
- Evaluate and review actions.

A breakdown in SA can lead to difficulty in absorbing information and carrying out inappropriate actions. When this happens consideration should be given to using automation to reduce the work-load, therefore creating capacity for further detailed evaluation and actions.

### Crew Resource Management (CRM)

In malfunction and emergency training, CRM is the ability of the pilot in SPH, or the crew in MPH, to manage all the available resources (both internally and externally of the aircraft) in order to ensure a successful outcome to a simulated emergency or abnormal situation. This requires learning how to gather all the relevant information for the situation and analyse it in order to make the appropriate in flight decisions.

### Startle Effect

When facing an emergency or abnormal situation (especially if operating SP) it can be a frightening and traumatic experience. A natural reaction can be one of shock (surprise) or disbelief, which is called the startle effect. This is a completely normal and instantaneous phenomenon as the brain can absorb information about an emotionally significant event (such as fear) before we are consciously aware of it. This initial startle

effect can provoke a desire to try to resolve the situation quickly and a certain degree of mental (cognitive and emotional) confusion as well - perhaps leading to incorrect actions being taken. Therefore, a pilot should try to stay calm and above all continue to fly the aircraft. There are some situations which require immediate action but the majority will tolerate a short delay while gathering thoughts and assessing the situation.

### 1.3 Flight Training

#### Manoeuvre based training

Manoeuvre based training is critical in learning the basics of controlling the aircraft. In the teaching of in-flight EAPs, the instructor would normally demonstrate and explain the appropriate indications of an emergency or abnormality and show the student the effect of the appropriate actions. This would then be practiced by the student until the appropriate level of handling competence is displayed for example:

Air Exercise: Abnormal Situation Handling

**AIM:** To handle an abnormal situation in a safe and controlled manner

**AIRMANSHIP/TEM:** Lookout, EAC drills, Orientation

DEVELOPMENT	TEACHING POINTS
<p><b>Introduction:</b></p> <p>Teach handling of abnormal situation such as alternator failure</p>	<p>Instructor flies the helicopter.</p> <p>Emphasise need to lookout and maintain aircraft control throughout the exercise.</p> <p>Consider turning aircraft towards nearest airfield.</p> <p>Explain analysis of situation. Point out warning lights and gauge indications.</p> <p>Student finds appropriate drill in EAC and reads out actions. Instructor actions with 'touch-drills'.</p> <p>Instructor makes in-cockpit radio call.</p> <p>Repeat with student flying the helicopter and carrying out all actions having been pre-briefed which abnormal situation will occur.</p>
<p>Teach handling of critical emergency such as engine failure in SEH.</p>	<p>Instructor flies helicopter</p> <p>Emphasise need to lower the lever to maintain rotor RPM, achieve and maintain autorotation speed after engine failure.</p> <p>Emphasise that, before carrying out drills, taking the proper action will include selecting and flying towards a suitable field.</p> <p>Explain that analysis in this case must determine whether the engine restart procedure would be appropriate.</p> <p>Allow student to carry out appropriate touch-drills from memory.</p> <p>Remind student of need to continue flying the helicopter and assessing the forced landing site if appropriate.</p> <p>Teach the use of the checklist as a follow-up if time permits.</p> <p>Allow student to make the in-cockpit emergency call.</p> <p>Repeat with student flying the aircraft and carrying out all actions.</p>

— — Post flight discussion:

— — Emphasise the need to maintain aircraft control and lookout throughout. Point out those checks that should  
— — be performed from memory and those that require reference to a EAC. Emphasise how incorrect or hasty  
— — drills can often make matters worse and increase the hazards to the aircraft.

### — — Scenario Based Training

— — Scenario based training is a powerful instructional tool as it can incorporate real-world experiences to  
— — address a training objective. Once the student is competent at the manoeuvre based skills then specific  
— — emergency or abnormal scenarios can provide an opportunity to experience a situation that can occur during  
— — an in-flight emergency.

— — Scenario based training teaches systematic risk reduction and critical thinking skills. It is the most effective  
— — way to prepare the pilot to make safe decisions during emergency or abnormal situations. The training is  
— — effective in both aircraft and simulators; however simulators provide a medium for adding training situations  
— — that would be too risky in an aircraft. (Note: for further information on the use of simulators in training see  
— — EHEST leaflet HE 10 Training and Testing in FSTDs).

— — EAP training scenarios are situations that are set up to stimulate the student's ADM process in which the  
— — instructor responds to student behaviour in a manner that encourages safe judgements and decisions.  
— — Scenarios should also allow the student the opportunity to make (supervised, controlled) incorrect decisions  
— — and unsafe judgements. It is important for the student to recognise hazardous situations and unsafe  
— — tendencies and replace them with good judgements and safe behaviours. Good scenario based training  
— — requires research by the ATO if it is to be relevant and meaningful to the student (see previous paragraph on  
— — Accident and Occurrence Reports).

— — Prior to the flight an instructor should plan a number of simulated emergency or abnormal scenarios to be  
— — given at different stages of the flight which should be introduced to the pilot in a realistic manner consistent  
— — with the POH/FM. For example it is counterproductive for the instructor to say 'hydraulic failure', 'tail rotor  
— — failure' 'engine failure', where no such aircraft audio warning exists. It is better to physically replicate the  
— — symptoms (when safe to do so) or create the scenario by stating the prior indications to a failure of a system.  
— — The student should then be allowed to recognise the problem, execute the appropriate actions as far as is  
— — possible to the conclusion in order for the instructor to have confidence in his abilities.

## 2 ASSESSMENT OF EMERGENCY AND ABNORMAL PROCEDURES

### 2.1 Requirements

The aim of a skill test or check is to determine through practical demonstration that an applicant has acquired or maintained the required level of knowledge and skill or proficiency to operate the helicopter safely.

Part FCL Appendix 9C lists the specific requirements for the helicopter training, skill test and proficiency check items including the normal, abnormal and emergencies procedures.

ORO.FC 230 (B) requires each flight crew member to complete Operator Proficiency Checks (OPC) as part of the crew compliment to demonstrate competence in carrying out normal, abnormal and emergencies procedures. AMC1 ORO.FC.230 (b) (ii) identifies the specific helicopters abnormal/emergency procedures that should be tested.

Typically for helicopter skill tests and checks, the emergency/abnormal items for SEH/MEH (SP/MP) as appropriate can include:

- engine fire
- fuselage fire
- emergency operation of the undercarriage
- fuel dumping
- engine failure and relight
- hydraulic failure
- electrical failure
- engine failure during take-off before decision point
- engine failure during take-off after decision point
- engine failure during landing before decision point
- engine failure during landing after decision point
- flight and engine control system abnormalities
- recovery from unusual attitudes
- landing with one or more engines inoperative
- IMC autorotation techniques
- autorotation to designated area
- autorotative landings
- pilot incapacitation
- directional control failures and abnormalities
- other procedures outlined in the FM.

## 2.2 Scenario Based Testing

AMC 2 FCL.1015 states that a test or check is intended to simulate a practical flight. Therefore an examiner may set practical scenarios for an applicant whilst ensuring that the applicant is not confused and air safety is not compromised.

In the planning stage, the examiner must decide which EAPs he wants to see practically demonstrated in flight, as opposed to those he wishes to discuss in the classroom. As a general rule, - *'tell me what you would do'* should be reserved for the classroom and *'show me what you would do'* should be used in flight. To ensure the maximum benefit is gained from this element of the check, the candidate must be permitted to demonstrate all of his skills including diagnostic, problem solving, ADM/ TEM/ CRM, knowledge of POH/FM/SOPs etc and not just demonstrate the physical handling skills.

A scenario can be used to assess ADM using the Three P process:

- Perceive – the candidate is required to identify the emergency or abnormal situation which the examiner can simulate by a indicating a warning light/horn/gauge, unusual noises, smell of burning or introducing a vibration through the controls.
- Process – once the malfunction is detected then the candidate should use the appropriate CRM/ADM skills to gain all relevant information in order to carry out the correct course of action.
- Perform – the candidate should perform the correct actions (in accordance with the FM/POH/EAC) and then the actions reviewed and modified accordingly.

Whilst managing the above, the candidate is still required simultaneously to demonstrate his skills relevant to:

- Aviate (fly) – establish an appropriate safe flight profile for the specific malfunction which could be straight and level flight, autorotation, orbit, land, etc.
- Navigate – turn away from high ground, not enter controlled airspace, avoid DVE, select a landing site to conduct a precautionary landing or divert to an airfield as appropriate.
- Communicate (including appropriate MCC in MPH) – conduct a full simulated radio call to an appropriate agency to inform them of the emergency, the degree of urgency, proposed actions and gain any assistance available (i.e. it is not acceptable to just say *'I would do a radio call'*). Appropriate crew and passengers briefings should be practiced including the Brace Position for forced landings.

Once the candidate has conducted the above actions the exercise should be followed through, as much as is safely possible, to its conclusion. Where a particular malfunction requires that the pilot conduct a precautionary landing, the instructor should ensure that the candidate can fly the aircraft safely to an appropriate landing site, whilst carrying out all necessary actions, radio calls and landing site assessments.

The assessment of the HF elements, including the interaction with the crew and aircraft during a malfunction/emergency are regarded as fundamental to the test or check and CRM should be assessed throughout by observing, recording, interpreting and the questioning of the crews.

The basic concept for TEM is to timely detect the threat, error or undesired aircraft state and promptly respond to these. Although this sounds uncomplicated, examiners must obtain evidence to ensure that TEM is being practiced. Since observation is the sole means available to the examiner to obtain this evidence, it is important that the examiner actively questions the pilot before, during (if appropriate) and post flight to gain insight into the reasons why specific actions pertaining to TEM were taken. Whilst it might be appropriate for the candidate to talk through the process as they carry it out, it must be highlighted that questioning during flight must not distract the pilot. Examiners cannot assume that just because a pilot completed an emergency drill without faults that TEM was used.

On a flight test, emergency or abnormal scenarios will need to be created to allow proper assessment of TEM before and during flight. A competent pilot is unlikely to get into an undesired aircraft state or would quickly correct an undesired aircraft state (e.g. low approach speed) and therefore it could be necessary for the flight examiner to artificially create such a circumstance. For example:

- create a TEM scenario that will be analysed during the pre-flight briefing;
- when approaching a destination aerodrome simulate a thunderstorm over the airfield;
- simulate a radio failure approaching a reporting point or entering a control zone;
- simulate an aircraft abnormal or emergency malfunction requiring a precautionary or forced landing;

To assess TEM a matrix such as below could be used for assessing and dealing with abnormal/emergencies:

Objective	Not Yet Competent	Competent	Very competent
Can recognise, assess and manage potential abnormal/emergencies in the performance of the various task elements.	Is ignorant of potential abnormal/emergencies in the performance of the various task elements	Recognises, verbalises and assesses abnormal / emergencies.	Immediately recognises, verbalises and assesses all abnormal /emergencies.
Can avoid or trap errors which may occur in the performing of immediate/ subsequent actions	Takes no significant action to reduce or manage the potential impact of threats in the performance of the immediate/ subsequent actions	Takes reasonable action to reduce and manage the potential impact of threats in the performance of the immediate/ subsequent actions	Effectively manages potential threats and/or implements strategies to minimise the impact of potential threats in the performance of the immediate/ subsequent actions
Follows EAC with evident situational awareness to avoid and trap errors in the performance of the immediate/ subsequent actions	Limited adherence to EAC and procedures, poor situational awareness and/or no review of flight progress. Is ignorant of errors which occur in the performance of the immediate/ subsequent actions	EAC and procedures are followed, and good situational awareness evident to avoid and trap errors which may occur in the performance of the immediate/ subsequent actions	Strict adherence to EAC and procedures. Applies effective strategies to avoid and trap errors which may occur in the immediate/ subsequent actions

## 3 SPECIFIC HAZARDS INVOLVED IN SIMULATING SYSTEMS FAILURES AND MALFUNCTIONS IN HELICOPTERS DURING FLIGHT

It should be the aim of all instructors and examiners to return an aircraft back to the dispersal in the same state that they found it in! In order to do this they should use the principles of TEM to assess the possible threats they could encounter during the flight. In the case of teaching or testing EAPs the student/candidate and his actions (or inaction) could be considered as a source of threat and appropriate mitigations should be considered prior to and during the flight.

Flight instructors are required to have completed the Teaching and Learning Syllabus at AMC1FCL.930.FI. Item (i) of the syllabus is '*Specific hazards involved in simulating systems failures and malfunctions in aircraft during flight*', which lists the following items:

- (i) importance of touch drills
- (ii) situational awareness
- (iii) adherence to correct procedures.

### 3.1 Importance of Touch Drills

'Touch Drills' are used when an aircraft system is identified by touching (or being pointed to) without further action being taken. It is used to ensure that a pilot can in a timely manner correctly identify and reach a relevant system control without actually manipulating it and therefore preventing inadvertent de-selection (or selection) of the system. Prior to any flight where simulated emergency drills are to be performed it is essential that the instructor or examiner establishes the student's understanding of how, and when touch drills, are to be performed in the flight. The instructor/examiner should at all times monitor the student's actions to ensure that they do not inadvertently activate, or deactivate a system.

### 3.2 Situational Awareness

As the Instructor/Examiner is ultimately responsible for the safety of the aircraft he should ensure that it is not placed in a dangerous situation. An ongoing assessment of potential hazards should be conducted of the immediate operating environment to include:

- the proximity of obstacles (including the ground),
- other traffic (as avoiding action may not be possible), escape routes,
- the terrain over which is being operated (in case a landing is required),
- the weather (in particular the cloud base, wind velocity, visibility and temperature).
- aircraft operating limits.

During initial instruction and demonstrations the student will be concentrating on dealing with the emergency and consequently his situational awareness may be compromised. However as the training progresses, and during testing, situational awareness will be assessed.



### 3.3 Adherence to Procedures

The FM or ATO training manual will often state the conditions or techniques to be used for training which should be adhered to for example:

- WAT charts
- MAUM to be used
- max speeds to be used
- training limitations
- minimum heights
- crew composition
- areas/ground to be used



## 4 SAFETY TIPS FOR INSTRUCTORS/ EXAMINERS

### 4.1 Autorotations and Simulated Engine Off Landings (SEOL)

The teaching and testing of autorotations to a power recovery in a MEH and to a SEOL in SEH (sometimes referred to as touchdown autorotations or autorotative landings) is a requirement of EASA PPL/CPL/ATPL/FI/Type rating courses. Prior to conducting this exercise the following should be considered by the instructor/examiner:

#### Pre Flight

A risk assessment should be conducted in accordance with the ATO SMS to consider the following:

- weather – wind velocity, visibility, light levels, sun glare/shadow, precipitation
- the landing area surface - size/level/flat/firm/wet/dry.
- ATC/Airfield operations – ability to approach and land into wind (if different to the established circuit direction), other local traffic, availability of rescue and fire-fighting services
- the currency of the instructor/examiner – when last flown SEOL
- aircraft suitability – weight, equipment fit, insurance
- briefing – verbal commands, throttle/flight control lever (FCL) drills, touch drills, take over/go-around procedures and acceptable rate of descent (ROD).

#### Flight (prior to entry into autorotation)

The following should be considered

- Height – appropriate height above the ground to be able to establish a stable autorotation.
- Area – suitable area is identified and clear.
- Security – no loose articles in the cockpit that could move and jam the controls.
- Engine T&Ps- a check that all cockpit indications are normal, carburettor heat applied if applicable; engine air bleeds deselected if appropriate.
- Lookout – remains constant throughout the exercise especially, below the helicopter and into the landing area.
- Wind – too much, too little, gust spread, wind-shear, turbulence.
- Weight – light AUM - possible Nr decrease, heavy AUM - possible Nr increase and increased rate of descent.

#### Flight (in autorotation)

By at least 300ft agl **at the latest** the following should be considered and if not appropriate **a go-around should be initiated:**

- No slip!
- No drift!
- Rate of Descent within pre-defined limits!
- Rotor speed within limits!

- Airspeed within the recommended speed range!
- Going to make the landing area!

#### Flight (flare/check)

At the height and speed stated in the POH/FM the 'flare', 'check' and 'level' should be commenced (as appropriate to aircraft type) and the power reapplied for a MEH if not already applied..

#### Flight (touchdown)

The correct landing attitude should be maintained, whilst also maintaining the heading and lowering the collective lever where appropriate.

#### Safety tips for Instructors and Examiners conducting SEOLs

- Avoid no 'notice throttle chops' as they have little value and they can cause accidents!
- Always follow through on the controls!
- Do not do more autorotations/SEOLs than are required in one flight as it can lead to complacency!
- Consider completing a 'power recovery' prior to an EOL to gauge the conditions!
- During a test/check when unsure of candidates capabilities, consider completing an exercise such as a limited power running landing prior to a SEOL to ensure the candidate can gauge the landing attitude, keep the aircraft straight and lower the lever appropriately!
- In deciding a safe height for an engine re-engagement during a power recovery, consideration should be given to the delay in the response time for the engine to 'spool up', ROD, AUM and environmental conditions.



## 4.2 Student Operation of Helicopter Systems

Whilst the instructor demonstrates the immediate actions for a helicopter system malfunction there may be a requirement for the student to assist by deselecting or operating the system controls to simulate the failure of the systems. For example in a MEH whilst the instructor demonstrates the immediate action to an engine failure during a transition he may ask the student to manipulate the engine controls. In such cases it is important that a thorough briefing takes place before the flight to include:

- when the control is to be manipulated
- identification of the relevant control
- how the control is manipulated and by whom and by how much
- the process for resetting the control
- the appropriate verbal commands that will be used.

Before the flight exercise a re-brief and a practice on the ground should take place as appropriate. The student will identify the appropriate control to be operated and will only manipulate the control when he receives a confirmation and a verbal command from the instructor to do so.

## 4.3 Multi Engine Helicopter One Engine Inoperative (OEI) Operations

For those aircraft without engine failure training switches the following should be considered:

- During initial OEI flight training consider using torque sharing rather than retard an engine for the student practice i.e. if the OEI maximum torque limit is 140% TQ, then require the student to use no more than 70% on both engines.
- When flying close to ground or obstacles the controls need to be closely monitored by the instructor/examiner. When clear of the ground and below 500ft agl consideration should be given to one crew members hand being on the retarded engine control so it can be re-engaged if the other engine fails, or a limit is going to be exceeded.
- Use the correct standard terminology for the aircraft type i.e. TDP, LDP, CDP etc, and number 1/left number 2/right engine or system.
- Wheel brakes which are normally applied for helipad OEI landings should not be applied in training if sufficient space exists for a run on landing. By allowing a run on landing, damage to the aircraft can be prevented if the normal landing technique is mishandled.

## 4.4 Cockpit Gradient

A *Steep Cockpit Gradient* can exist where an instructor/examiner is teaching or testing a more senior or experienced pilot. As 'perceived ability' is often tied to status and experience this can lead to an instructor/examiner believing that a more experienced/senior student or candidate has more ability than he actually has. This in turn can lead to an attitude of 'he knows what he is doing' and a relaxation on the behalf of the instructor/examiner, this combined with a reluctance 'to take control' can result in an undesired aircraft state.

A *Shallow Cockpit Gradient* can exist where an instructor/examiner is training/testing a pilot of comparative ability, in particular, a work colleague or friend. This again can lead to a relaxation in SOPs and some cases an inadvertent element of competitiveness (e.g. who can do the best SEOL). This again combined with a reluctance to correct/take control can lead to an undesired aircraft state.

#### 4.5 Disengaging audio warnings

It may be necessary during training EAPs or when following the EAC to disengage an audio warning to complete the drills and enable communication with crew members. To ensure reselection of the warning system on completion of the training, the procedure of de-selection and re-selection of warning systems should be part of the pre-flight briefing. It should be stressed that whilst the disengagement of audio/visual warning may be carried out during training, it is not normally an acceptable practice in a real EAP.

#### 4.6 Modern Technology Helicopters (Glass Cockpit/Automation)



It can be difficult to realistically replicate abnormal indications in an aircraft equipped with a glass cockpit. It is possible with some prior preparation on the part of the instructor to have picture cards/ photographs of the engine/system displays (taken from a POH or a simulator) of the relevant screen indicating an abnormal

indication, which can be held up in front of the live display. The instructor/examiner can verbalise the associated audio warnings in order that the pilot can then diagnose and react to the event he has been shown.

It is a valuable exercise to practice flight using a multi-functional display in composite/reversionary mode. If this is done then the aircraft must be VMC throughout in case the displays do not revert back to the standard format.

The correct terminology must be used when referring to the autopilot modes and displays. Unless the manufacturer's terminology for the type and variant is used then the associated drills and EAC become difficult to use.

Discreet signals feed the Caution/Warning systems on complex aircraft. They are often prioritised by the manufacturer's philosophy and could sometimes lead to a misdiagnosis. It is strongly recommended that students are taught to spend time on the 'Perceive' stage of ADM process to ensure they have the 'complete picture' of the situation displayed before selecting and following the appropriate drills.

#### 4.7 Upset/Unusual Attitude Training

The training and testing for the recovery from inadvertent upset/unusual attitude (UA) should normally be conducted in good VMC conditions with the candidates visibility limited by screens or goggles. The following are safety considerations to be considered by the Instructor/Examiner as part of the TEM process;

- The simulated UA should be realistic and not too benign or too excessive.
- The recovery heading, speed and altitude to be achieved (including any safety attitude) should be briefed prior to the exercise.
- A full set of aircraft/lookout checks should be completed by the instructor/examiner prior to manoeuvring (see para 4.1).
- Situational awareness of the aircraft position in relation to controlled airspace should be maintained at all times.
- The flight controls should be monitored closely during the handover back to the candidate for the recovery phase to prevent excessive attitude changes or engine/rotor exceedance (especially pertinent in a teetering rotor with the dangers of mast bumping, tail striking or low G hazards).
- Recovery should be monitored to prevent the simulated UA developing into a real UA.
- Recovery should be monitored to ensure it is undertaken in the correct sequence to prevent Vortex Ring developing (e.g. power not being applied before a safe airspeed is achieved).

#### 4.8 Resetting the Aircraft State

When an EAP is completed it is important that the instructor/examiner verifies that any systems that were deselected to simulate the emergency are reset before continuing with the flight. The examiner should also inform the candidate that the 'emergency is complete' before continuing with the flight or subsequent EAPs.

## 4.9 Briefings

Full briefings before training or testing flights should include

- Division of responsibility, PIC responsibilities.
- Sequence of events.
- Actions in event of a real emergency.
- Throttle/FCL/engine manipulation.
- Touch drills.
- How a malfunction will be simulated.
- De-selection and re-selection of warning systems.
- Non-standard drills.
- Any special considerations (weather, circuit, terrain etc).

## 5 DEFINITIONS AND ABBREVIATIONS

### Definitions:

**Emergency Situation** - when the safety of the aircraft, or of persons on board or on the ground is endangered for any reason.

**Abnormal Situation** - when it is no longer possible to continue for flight using normal procedures but the safety of the aircraft or persons on board or on the ground is not in danger.

**Forced Landing** - an immediate landing necessitated by the inability to continue with further flight. A typical example is an engine failure in a SEH.

**Precautionary Landing** - a premeditated landing when further flight is possible, but inadvisable. Typical examples are DVE, being lost, fuel shortage and gradually developing engine trouble.

### Abbreviations

**ADM:** Airborne Decision Making

**CDP:** Critical Decision point

**CRM:** Crew (Cockpit) Resource management

**DM:** Decision Making

**DVE:** Deteriorating Visual Environment

**EAC:** Emergency and Abnormal Checklist

**EAP :** Emergency and Abnormal Procedures

**EOL:** Engine Off Landings

**FCL:** Fuel Control Lever

**FM:** Flight Manual

**HF:** Human Factors

**IR:** Implementation Recommendations

**LDP:** Landing decision Point

**LTE:** Loss of tail rotor Effectiveness

**MAUM:** Maximum All Up Mass

**MEH:** Multi Engine Helicopter

**MCC:** Multi Crew Cooperation

**MPH:** Multi Pilot Helicopter

**OEB:** Operational Evaluation Board

**OEI:** One Engine Inoperative

**OSD:** Operational Suitability Data

**PIC:** Pilot in Command

**POH:** Pilots Operating Handbook

**SEH:** Single Engine Helicopter

**SEOL:** Simulated Engine Off Landings

**SMS:** Safety Management System

**SOP:** Standard Operating Procedures

**SPH:** Single Pilot Helicopter

**TASE:** Training Areas of special Emphasis

**TDP:** Take Off Decision Point

**TEM:** Threat and Error Management

**WAT:** Weight Altitude Temperature





# IMPRINT

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### Download the EHEST leaflets:

#### EHEST HE 1 Training Leaflet – Safety considerations

<http://easa.europa.eu/HE1>

#### EHEST HE 2 Training Leaflet – Helicopter airmanship

<http://easa.europa.eu/HE2>

#### EHEST HE 3 Training Leaflet – Off airfield landing site operations

<http://easa.europa.eu/HE3>

#### EHEST HE 4 Training Leaflet – Decision making

<http://easa.europa.eu/HE4>

#### EHEST HE 5 Training Leaflet – Risk Management in Training

<http://easa.europa.eu/HE5>

#### EHEST HE 6 Training Leaflet – Advantages of simulators in Helicopter Flight Training

<http://easa.europa.eu/HE6>

#### EHEST HE 7 Training Leaflet – Techniques for Helicopter Operations in Hilly and Mountainous Terrain

<http://easa.europa.eu/HE7>

#### EHEST HE 8 Training Leaflet – The Principles of Threat and Error Management (TEM) for Helicopter Pilots, Instructors and Training Organisations

<https://easa.europa.eu/HE8>

#### EHEST HE 9 Training Leaflet – Automation and Flight Path Management

<https://easa.europa.eu/HE9>

#### EHEST HE 10 Training Leaflet – Teaching and Testing in Flight Simulation Training Devices (FSTD)

<https://easa.europa.eu/HE10>





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