Helicopter Association International

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HAI Training Working Group White Paper

HAI Decision-Making and IIMC

A Training Reference Guide for Aircrews

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Language and Style

An international team was involved in the development of this document. As a result, language and writing style may not consistently reflect US language conventions.

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Any errors or adjustments or suggested changes to the document can be directed to the HAI director of education at education@rotor.org.

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1.4 List of Abbreviations

Abbreviation	Description
AANCA	Announce – Aviate – Navigate – Communicate - Activate
AGL	Above Ground Level
AH	Artificial Horizon
AI	Attitude Indicator
ALT	Altitude
AMSL	Above Mean Sea Level
ASI	Airspeed Indicator
ATC	Air Traffic Control
ATSB	Australian Transport Safety Bureau
AUW	All-Up Weight or Aircraft Gross Weight
CAVOK	Cloud and Visibility OK
CAVU	Cloud and Visibility Unlimited
DG	Directional Gyro
EDT	Enroute Decision Trigger
EFB	Electronic Flight Bag
FBO	Fixed-Base Operator
ft	Feet
HDG	Heading
HLS	Helicopter Landing Site
HSI	Horizontal Situation Indicator
IAS	Indicated Airspeed
ICAO	International Civil Aviation Organization
IFR	Instrument Flight Rules

Abbreviation	Description
IIMC	Inadvertent Instrument Meteorological Conditions
IMC	Instrument Meteorological Conditions
KIAS	Knots-Indicated Air Speed
km	Kilometer
kt	Knots
LSALT	Lowest Safe Altitude
m	Meter
MFD	Multi-Function Display
MP	Manifold Pressure
MSA	Minimum Safe Altitude
NM	Nautical Mile
NTSB	National Transportation Safety Board
NVIS	Night Vision Imaging System
OEM	Original Equipment Manufacturer
PAB	Power-Attitude-Balance
PIC	Pilot-in-Command
RFM	Rotorcraft Flight Manual
ROC	Rate of Climb
ROD	Rate of Descent
SARTIME	Search-and-Rescue Time
SM	Statute Mile
SVFR	Special VFR
TQ	Torque
VFR	Visual Flight Rules

Abbreviation	Description
VMC	Visual Meteorological Conditions
VSI	Vertical Situation Indicator

2 Introduction

Helicopter pilots flying under visual flight rules (VFR) into marginal weather conditions are a cause of fatal accidents.

Key Abbreviations	
VFR = Visual Flight Rules	VMC = Visual Meteorological Conditions
IFR = Instrument Flight Rules	IMC = Instrument Meteorological Conditions
IIMC = Inadvertent Instrument Meteorological Conditions	

Introduction

Regardless of whether a pilot is VFR or IFR rated, if they are **planning** to fly **VFR**, they are responsible for doing what is required to remain in visual meteorological conditions (VMC). Flying into IIMC should not be considered an option unless the pilot-in-command is a current IFR pilot in an IFR-certificated aircraft.

Prior preparation and planning, before any flight, allows pilots and crew to make better decisions while en route. Preparation and planning will provide options so that if the helicopter is **inadvertently** flown from VMC into IMC there is a plan in place and the crew have something to fall back on for recovery.

The simple definition of IMC is **any weather condition or atmospheric conditions (smoke, dust, etc.) in which the standards for VMC cannot be maintained**. It is not just when you are in clouds. Whenever you lack the prescribed distance from clouds and visibility for the airspace, as described within the VFR for the country you are operating in, you are in IMC. This will be explained in detail within this document.

Marginal VMC

IMC

Unplanned flight from VMC into IMC is commonly referred to as **inadvertent IMC (IIMC)**. Other terms have been used to mean the same thing, such as **unintended IMC (UIMC)** and **accidental IMC (AIMC)**. Regardless of the term you are familiar with, this document refers to the condition as **IIMC**.

The best way to avoid unplanned flight into IMC is to avoid the possibility of IMC in the first place. This means applying VFR and maintaining VMC. The moment this looks like it is not possible, you risk breaking VFR and putting the aircraft and its occupants in danger.

Any IIMC recovery procedure is a set of skills applied as the last resort following a long line of decisions that should have been made **earlier** to avoid IIMC.

This reference material will cover both

- preparation, planning, and decisions that should be made to avoid IIMC; and
- recommended recovery techniques and procedures should the event progress to the point that IMC is unavoidable.

2.1 Visual versus Instrument Flight

Flying in VMC, where the pilot and crew use visual references outside the cockpit to fly the helicopter, is a different skill set compared with flying in nonvisual or instrument meteorological conditions (IMC). In IMC, the pilot and crew can no longer rely on external visual cues; instead, they rely solely on instruments to maintain control. Flying under instrument flight rules (IFR) and in IMC is a skill set that needs regular practice to maintain proficiency.

Pilots, whether VFR with some instrument training or IFR, planning to fly in marginal VMC within VFR must make sure

- the aircraft is suitably equipped, and
- they are prepared for the unplanned transition from visual flight to instrument flight.

Unplanned flight into IMC requires a pilot with a high cognitive capacity to create an entire recovery plan on the fly, in an instant, to achieve recovery. Many pilots, however, instead react instinctively and lose spatial awareness and, ultimately, control of the aircraft. For more information on spatial awareness, please refer to the United States Helicopter Safety Team (USHST) reference material titled

- *56 Seconds to Live*, and
- *HSE127 Spatial Disorientation.*

IFR-Rated Pilots

There is a misconception that IFR-rated pilots or instrument-certificated flight instructors automatically have the skills to recover from an IIMC event and the ability to easily transition from visual flying to instrument flying. Unfortunately, pilots who received instrument training years ago may put themselves at greater risk because of a false sense of their own ability.

Instrument skills are perishable; in other words, if you are not using them regularly, you will lose them. Further, if a pilot has departed with the mindset that this is a simple VFR flight and they are not expecting to encounter IMC, then even a trained IFR pilot is at risk of losing control of the situation.

Regularly flying an IFR aircraft on set IFR routes is a reasonably simple task done daily without incident. The flight is controlled by detailed company procedures and is planned with a trained crew in a routine environment and in a suitably equipped aircraft. Additionally, most IFR flights are interactive, which means they are continually monitored and assisted by ATC. In some ways, an IFR flight is easier than a VFR flight over the same route.

A VFR pilot with little or no instrument experience must do whatever is required to remain outside of IMC, and so **should an IFR pilot on a VFR flight,** and this is the key.

The problem is entering IMC conditions by mistake and unprepared.

2.2 Planned IMC versus Unplanned IMC

There are two forms of flight into IMC.

Flight into IMC is either **planned** or **unplanned**.

A planned IMC flight always seems to have a good outcome (barring some other emergency), whereas an unplanned IMC flight often has a tragic ending. This tragic outcome occurs regardless of

- the certification and configuration of the aircraft, and
- whether the pilot or crew are trained/qualified for instrument flight.

There are effectively three different scenarios to consider:

- planned IMC, the safest option
- inadvertent IMC with a planned recovery, which can be considered a risk mitigator to bad weather, and
- inadvertent IMC with no plan for a recovery, the worst of all possible outcomes.

So, what is the difference between planned flight into IMC and unplanned flight into IMC?

2.2.1 Planned IMC

You can only **plan** to fly into IMC under instrument flight rules (IFR).

Flight under IFR requires detailed planning, where the pilot will

- plan the departure, route, destination, and alternates,
- calculate a lowest safe altitude (LSALT) or minimum safe altitude (MSA) for the route,
- identify and plan for the airspace requirements,
- research the airport instrument approach plates,
- plan fuel including extra fuel for contingencies and alternates, and
- file a flight plan with ATC so that the flight is expected and planned for within the airspace system.

While ceiling and visibility are important in determining compliance with takeoff and destination procedural minimums, visibility conditions along the route are mostly irrelevant since the pilot is conducting a fully planned and managed flight from departure to destination. This requires specific training, currency in the activity, and specific aircraft certification requiring additional navigation and stabilization equipment (autopilot).

Any flight that **may result** in flight into IMC should be planned in the same manner as an IFR flight. This includes VFR activities where an IIMC encounter could be possible due to the type of operation and/or the possibility of unforeseen low visibility caused by fog, dust, haze, smoke, flat light, or clouds. Any flight at night or when using NVIS requires planning, so that if IIMC occurs, there is a plan in place to recover from it.

Planned flight into IMC, whether under IFR or VFR where IIMC could occur, requires the flight crew to be prepared, trained, and appropriately equipped.

2.2.2 Unplanned IMC

VFR flight often involves less detailed planning prior to departure. Instead, pilots rely on local knowledge and the fact that they can see where they are going to complete the flight. Pilots manage the aircraft visually, relying on “see and avoid,” often with the aid of a GPS. Because there is no intent to fly into IMC, there is no detailed planning on what to do if the helicopter inadvertently encounters reduced visibility. There is no requirement to file a flight plan with ATC and no requirement to have additional instrumentation or training.

If applying VFR **by day** and maintaining the minimum required VMC, it should be practically impossible to inadvertently enter IMC. If the helicopter does enter IMC, the pilot and crew have **deliberately deviated from VFR, which has led to an unplanned flight into IMC**. This means that, even just prior to the IIMC event, the crew were **not in control of the situation** and are now at a very high risk of **losing control of the aircraft**.

When flying under VFR at night, or if using NVIS, it is more likely to inadvertently enter IMC because the clouds or reduced visibility may not have been visible to the crew. Most professional crews and well-trained private pilots recognize this and plan accordingly; they are proactive and set up the aircraft with the equipment available in preparation.

It does not matter if you are an IFR-rated pilot in an IFR-certificated aircraft or a VFR pilot in a VFR-certificated aircraft; the risk of losing control by **inadvertently** flying into IMC without any plan to recover is likely to be tragic.

2.3 Prior Preparation and Planning

Like all things in aviation, **prior preparation and planning will prevent poor performance**.

This prior preparation will be assisted by

- rules, regulations, and best practice recommendations;
- preparing an IIMC recovery plan;
- activating an IIMC recovery plan; and
- training in basic instrument flying and how to carry out the IIMC recovery plan.

The following sections consider each of these aspects in more detail.

3 Rules, Regulations, and Best Practices

3.1 What Are VFR?

Visual flight rules (VFR) are a set of rules, mandated by a country's regulator, by which operators and pilots must abide. The rules are generally common across borders, with each country interpreting and following the same International Civil Aviation Organization (ICAO) standards.

These rules set out (among other things):

- the aircraft equipment required for flight under VFR,
- the minimum training required by the pilot,
- the minimum flying conditions that must exist for a VFR pilot to be able to commence and **continue** a flight, and
- the minimum heights above the ground a VFR pilot must maintain while en route.

VFR can vary depending on whether it is day or night, the class of airspace, and the type of operation the pilot may be conducting.

Any reduction in the application of the VFR is considered an **intentional deviation from VFR, which could lead to an unplanned flight into IMC and a subsequent loss of control of the aircraft**.

3.1.1 HAI VFR Best Practices

Because VFR can vary from country to country, HAI has published *HAI VFR Best Practices,* a set of visual flight rules helicopter operators and pilots can apply as a minimum industry standard promoting safe flight regardless of country of operation.

3.1.2 Special VFR

An important aspect of VFR is the ability to operate under reduced weather conditions within the tolerances of special VFR.

By definition, a **special VFR clearance** is an ATC authorization for a **VFR** aircraft to operate in weather that is less than the basic **VFR** minimums for the airspace. The **clearance** will usually contain an at-or-below altitude to separate the **SVFR** from the IFR traffic and still allow the pilot to maneuver clear of clouds. This allows the pilot to complete a landing or departure within controlled airspace in reduced VMC once given permission by ATC.

Everyone recognizes that there will be times when the weather deteriorates unexpectedly and flights that have already begun may still want to enter and/or leave the controlled airspace. This can be done legally after all stakeholders have been made aware of the additional risks, a pilot asks ATC for a special VFR clearance, and ATC agrees to give it. It is important to emphasize that to get a special VFR clearance, the pilot is required to ask for it. ATC will not automatically give SVFR clearances.

Example

Using the *HAI VFR Recommended Best Practices* minimums:

A pilot is flying outside controlled airspace over an unpopulated area. VFR allows ½ mile (800 m) visibility, clear of clouds, and not below 500 ft AGL in sight of the ground or water at a reduced speed that allows maneuvering.

Looking ahead, the pilot estimates the current weather as

> Cloud overcast at 1200 ft AMSL and a flight visibility of 2 SM, and the airport is surrounded by houses requiring a flight of not lower than 1000 ft AGL.

The pilot wants to enter Class C controlled airspace to land, where the VMC minimums increase to

- 3 SM (5000 m) visibility,
- 1000 ft vertically from clouds, and
- 1 mile (1500 m) horizontally from clouds.

The pilot cannot enter unless they have asked for and received a special VFR clearance from ATC allowing the lower special VMC minimums within the controlled airspace.

The greater minimums for VMC in controlled airspace are in place because helicopters are mixing with often faster, less maneuverable fixed wing aircraft. Therefore, ATC and the pilots of the various aircraft need larger tolerances to see and then, if necessary, avoid each other.

The process requires ATC to look at the current traffic congestion and project forward a plan to deconflict the aircraft. This may require ATC instructing the pilot to remain outside the controlled airspace until a slot frees up or to enter the airspace whereby both the pilot and ATC accept that there will be a reduced visibility or a reduced distance from clouds, allowing the pilot to complete the landing. Sometimes due to traffic demands, ATC may not give the special VFR clearance, and the pilot will have to remain outside controlled airspace and come up with another plan.

3.2 What Is VMC

VMC is the **minimum** meteorological conditions (the minimum distance from clouds and the minimum required visibility) that must exist for a pilot to operate an aircraft under VFR.

Anything less than these minimums means the aircraft is operating in IMC and the pilot must either:

- divert (turn, descend, and/or reduce speed) to maintain VMC;
- in the famous words of Matt Zuccaro, **"Land the damn helicopter and live"**;
- change category to IFR, if that is an option;
- if in controlled airspace, ask for a special VFR clearance; or perhaps; or
- if the pilot had done some better planning, not have departed in the first place!

3.3 What Is IMC

It is important to understand that IMC is not simply being in clouds and VMC is not simply being able to see the ground. **IMC is anything less than the minimum VMC** required within VFR within a particular class of airspace.

The images below demonstrate examples of VMC, deteriorating VMC, and IMC.

VMC Regardless of Airspace

Regardless of whether the helicopter in Figure 1 is in or outside controlled airspace, these conditions would be considered VMC and indicate a great day for flying under VFR.

Figure 1 Example of VMC

VMC could be referred to as

CAVOK Cloud and visibility OK, defined as visibility greater than 6 SM (10 km) and no significant clouds below 5000 ft; or

CAVU Cloud and visibility unlimited, defined as visibility to the horizon and no significant clouds.

IMC Regardless of Airspace

Regardless of whether the helicopter in Figure 2 is in or outside controlled airspace, these conditions would be considered IMC and indicate it is not a day for flying under VFR.

Figure 2 Example of IMC

VMC in Class C Controlled Airspace

Assuming the helicopter in Figure 3 has departed from an inner-city airport and is in Class C controlled airspace, the pilot should be asking for a special VFR clearance due to clouds. This is regardless of the good visibility.

The reasoning behind this is that the pilot is about to fly over a populated area and is required to climb to 1000 ft AGL. Looking ahead, it should be clear that the helicopter cannot maintain the required distance from the clouds and cannot maintain VMC for the airspace.

Asking for a special VFR clearance alerts ATC that the separation distances required for approaching aircraft cannot be maintained by the pilot.

Figure 3 Example of VMC in Class C controlled airspace

Marginal and Deteriorating VMC

Figure 4 illustrates marginal and deteriorating VMC in rising terrain outside controlled airspace.

The pilot is currently maintaining 500 ft AGL, has at least ½ mile visibility, and is staying clear of clouds but is flying into rising terrain. The next set of choices will determine whether the outcome is good or bad. Regardless of experience or training, this pilot should consider an alternate plan of action or, at the very least, have an escape route.

Figure 4 Example of marginal and deteriorating VMC

IMC with Ground Visibility

Figure 5 illustrates marginal and deteriorating VMC that has progressed to IMC outside controlled airspace. The pilot cannot maintain 500 ft AGL, the visibility is reducing to below ½ mile (800 m), and the ability to remain clear of clouds has become marginal. Although the ground can be seen, the pilot is flying in IMC conditions and should not be there.

This is the area pilots get caught in thinking that they are in VMC because the ground is still visible, when they are actually in IMC.

This pilot should have chosen an alternate plan of action earlier in the flight while they were still able to maintain VMC with more options.

Figure 5 Example of IMC with ground visibility

Figure 6 depicts another example of IMC with ground visibility.

Figure 6 Example of IMC with ground visibility

Figure 7 shows yet a third example of IMC with ground visibility.

It is IMC because the pilot cannot maintain the recommended 500 ft AGL (an *HAI VFR* r*ecommended* b*est* p*ractice*) due to the lowering cloud base, an important trigger for the crew to come up with an alternative course of action. In this case, the pilot is in a turn and diverting to land to wait out the bad weather. They avoided an IIMC event through good decision-making.

Figure 7 Example of IMC with ground visibility

3.4 Minimum VMC and HAI VFR Recommended Best Practices

The minimum VMC required for flight are documented in the regulations. The regulations, where prescriptive minimums are promulgated, are not up for debate or interpretation. However, the prescriptive minimums are perceived and estimated by the pilots and crew once in the air, and this interpretation is not as clear.

It is one thing to have a regulation with a prescriptive minimum, but it is another to apply this to a helicopter flying close to the ground at over 100mph in deteriorating weather.

The question to consider is: what are the minimum weather conditions a pilot is going to accept?

The common answer given is "whatever the pilot is comfortable with," but the reality is there is a lot more to consider than just what you are comfortable with.

The minimum VMC may vary based on the rules within an individual country, type of airspace, and type of operation, as well as height AGL or AMSL. It must be measured subjectively by the pilot at the time. Although pilots have access to weather reports and forecasts, ultimately, once in the air, the pilot can simply decide what they think the weather is based on what they see or what they perceive to see, and what they see can change from one minute to the next.

HAI has the following two resources to assist in determining the minimum VMC for a VFR flight:

- *HAI VFR Best Practices*
- *HAI Estimating Distance*

The diagram in Figure 8 summarizes *HAI*'s *VFR recommended best practices* and illustrates the minimum VMC criteria for the airspace.

The diagram does not show the recommended VFR of a minimum height of 500 ft AGL over an unpopulated area or 1000 ft AGL over a populated area. The pilot must factor in this requirement within the VMC minimums for each flight separately.

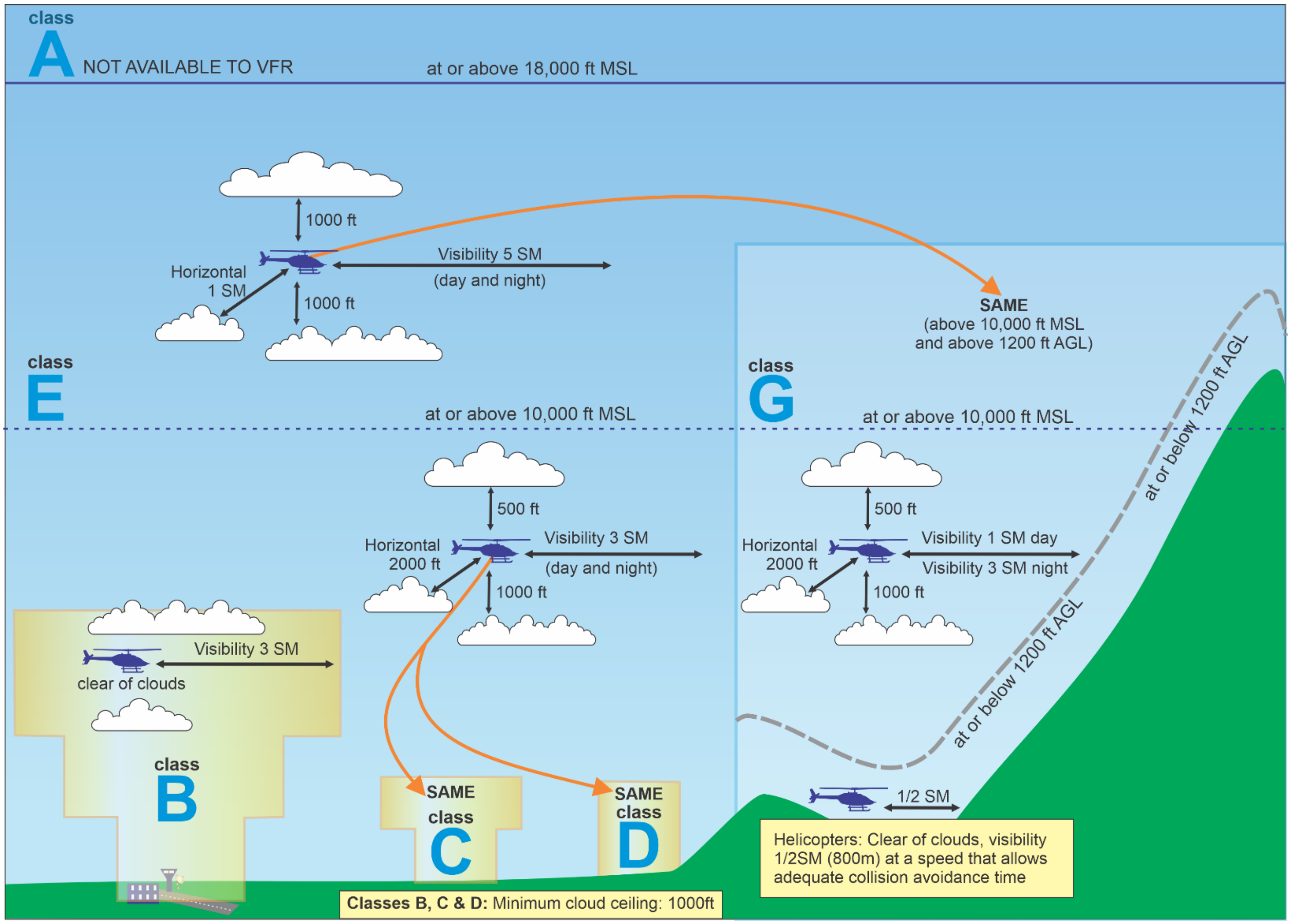


Figure 8 HAI VFR/VMC best practices based on airspace

3.5 Enroute Decision Triggers (EDTs) and Personal Minimums

The purpose of the enroute decision triggers (EDTs) concept is to avoid an IIMC event before the possibility of encountering it. This allows the pilot to remain in VMC, or if appropriately trained and equipped, empowers a decision to maintain control of the situation, which may include a change of category to IFR and entering IMC on purpose.

The EDT concept is similar to that used by the National EMS Pilots Association, in which a limit on speed or altitude is determined by the crew prior to the flight as a decision point to divert or land.

The EDT concept described in this document expands on the concept of deciding on various triggers prior to the flight so that they are available not only to the pilot(s) but also to crew and passengers who are looking outside as well and may be a valuable resource while in flight.

EDTs are a set of limitations to assist in decision-making; for example, the crew may have a predetermined **minimum**

- airspeed,
- height AGL,
- distance from clouds, and
- visibility,

with each individual item being a **trigger** for decision-making while en route.

It is prudent for the crew to nominate and agree to limitations due to weather and visibility to assist in decision-making. The limitations set can depend on the rule set of the country, the certification of the aircraft, and the experience of the operator or pilot.

These limitations may be captured within a company's operations manual or standard operating procedures (SOPs) as a policy for company pilots to follow. Pilots operating within the guidance of a company may establish their own personal minimums based on their own experience, local conditions, and comfort levels which could be higher than the legal, HAI, or company recommended minimums, but never lower.

If a pilot reaches a predetermined regulatory, company, or personal EDT, then this triggers a response by the pilot to **make a decision** and alter the current flight activity, regardless of what their personal preference or that of the passengers may be. This may require a diversion, an unplanned landing, or change of flight category to IFR.

For example:

> A pilot is flying a VFR R44 on an air tour. Prior to flight, the following minimums were decided upon by the pilot and communicated to the passengers:
>
> - a minimum airspeed of 55 kt due to reducing visibility,
> - a minimum height AGL of 500 ft due to a lowering cloud base,
> - a minimum forward visibility of 2 SM,
> - a minimum distance below the clouds of 300 ft.
>
> Therefore, if the pilot encounters deteriorating weather, and is **approaching any one of these triggers**, they must do what is required to remain in VMC and not allow the situation to worsen.

Note: In the example above, it may be noted that 300 ft below the clouds outside controlled airspace is above what is legally required (clear of clouds); however, some would argue that in a VFR helicopter with a very low cloud base even 500 ft below the clouds may not be enough to avoid accidentally flying into IMC. Setting realistic minimums for the airspace and the type of operation matched with the instruments on board and the experience level of the pilot is important in determining the EDTs.

4 Preparing an IIMC Recovery Plan

There is no doubt that prior preparation and planning will prevent poor performance (The 6 Ps).

Yes, the extra time in creating a plan can be time-consuming, but as helicopter pilots, we have several things going for us:

- We often operate in the same area and have good local knowledge. This a great advantage that we can capitalize on.
- Doing the plan once sets a template for doing it again much faster; you simply get into the habit of updating it based on the flight for the day. This means there is always an IIMC recovery plan churning away in the back of your mind. It makes you a better prepared pilot, as this is now a built-in part of your basic skill set.

In essence, you are always going to be prepared for the eventuality because you have always planned for it.

4.1 Components of an IIMC Recovery Plan

The IIMC recovery plan is really a holistic way of thinking ahead for a particular flight and consists of the following:

- Using checklists to ensure consistency and structure in your planning and preparation (see ***Checklists***),
- Obtaining and interpreting the weather (see ***Prepare a Weather Brief***),
- Determining the best/preferred route or general operating area, determining the airspace requirements, and noting radio frequencies and controlled airspace levels,[1]
- Calculating a **L**owest **S**afe **Alt**itude (LSALT) or a **M**inimum **S**afe **A**ltitude (MSA) (which are different names for the same thing) based on the local terrain and noting it (see ***Calculating LSALT/MSA***),
- Determining the minimum fuel required for the leg plus reserves and then projecting an allowable payload (see ***Plan Your Fuel***),
- Considering your options if you should experience adverse conditions (see ***Consider Your Options***),
- Capturing important information about the flight on a mud map (see ***Draw a Mud Map***),
- Filing a flight plan (see ***File a Flight Plan***), and
- Briefing your crew and passengers (see ***Brief Your Crew and Passengers***).

[1] *Note: These fundamental navigation requirements are not covered in this document but are available through helicopter flight schools.*

4.2 When to Prepare an IMC Recovery Plan

The table below suggests when to prepare an IIMC recovery plan.

Situation	Guidance
VFR flight planning to depart when the weather at departure, en route, or destination is reported or forecast **at or below** VFR minimums for the airspace	Indicates an easy **NO-GO** decision prior to departure
Any weather forecast with a possibility of fog, dust, haze, smoke, flat light, thunderstorms, or other adverse weather that may quickly change the operating conditions during the flight	Requires an IIMC recovery plan
Any flight, regardless of the forecast, to be conducted in an area of potential reduced visibility or low contrast such as a fire ground, snow, mountains, desert, or over water	Requires an IIMC recovery plan
VFR at night, regardless of the forecast	Requires an IIMC recovery plan
NVIS, regardless of the forecast	Requires an IIMC recovery plan
Any flight where a weather report or forecast is not available	Requires an IIMC recovery plan
Any VFR flight that does not meet the above criteria (meaning, the weather forecast at departure, en route, and destination is reported or forecast above, and is likely to remain above, VFR minimums for the airspace to be operated in, and there is no possibility of adverse weather or operating conditions that may reduce visibility)	Does not require an IIMC recovery plan

4.3 Checklists

Checklists are a great way to assist aircrew to complete tasks with structure and consistency. They have often been put together by operators over a long period of time, based on experience.

When planning a flight, different things may need to be considered based on the rules being applied or the operational task to be completed. It is recommended that aircrew and operators come up with their own checklists that may be more specific to their operations and that can be used to assist in planning.

The *Flight Planning Guide*[2] below (Figure 9) is an example of a structured set of checklists used by an operator to guide aircrew during the planning stages of a flight based on the type of operation (day VFR, night VFR, NVIS, and IFR).

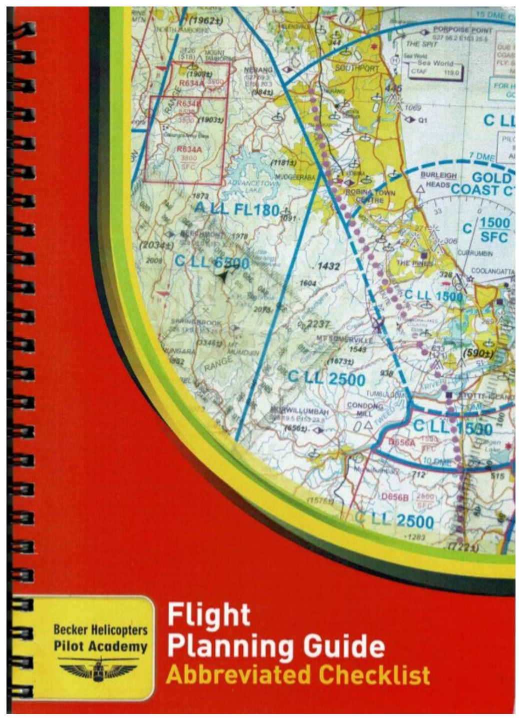


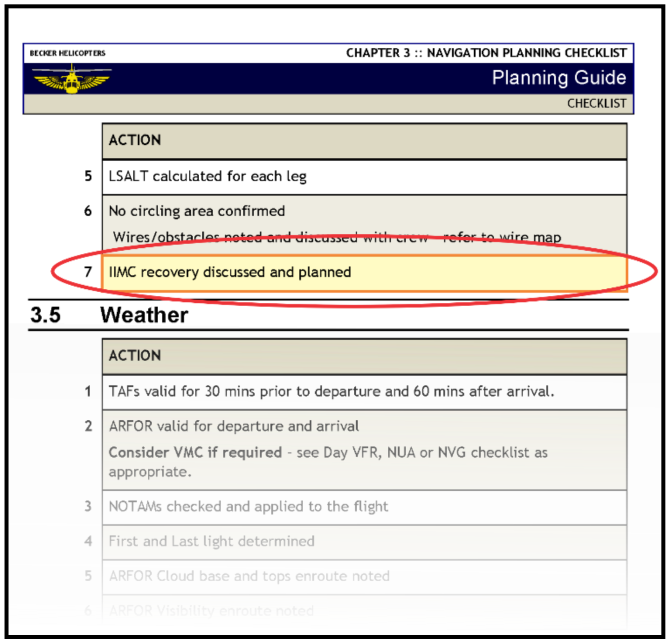
Figure 9 Flight Planning Guide Abbreviated Checklist

The checklist pictured in Figure 10 considers the following:

- the aircraft
- the crew
- the mission/operation or activity
- the route to be flown
- the weather
- flight planning
- a pre-flight briefing
- a post-flight briefing

[2] *The Flight Planning Guide has been referenced with the permission of Becker Helicopters Pilot Academy.*

Within this checklist, there is a line item under both the “Route to Be Flown” and “Flight Planning” sections asking that IIMC be considered, planned for, and briefed (Figure 10).



BECKER HELICOPTERS CHAPTER 3 :: NAVIGATION PLANNING CHECKLIST

Planning Guide

CHECKLIST

	ACTION
5	LSALT calculated for each leg
6	No circling area confirmed Wires/obstacles noted and discussed with crew – refer to wire map
7	IIMC recovery discussed and planned

3.5 Weather

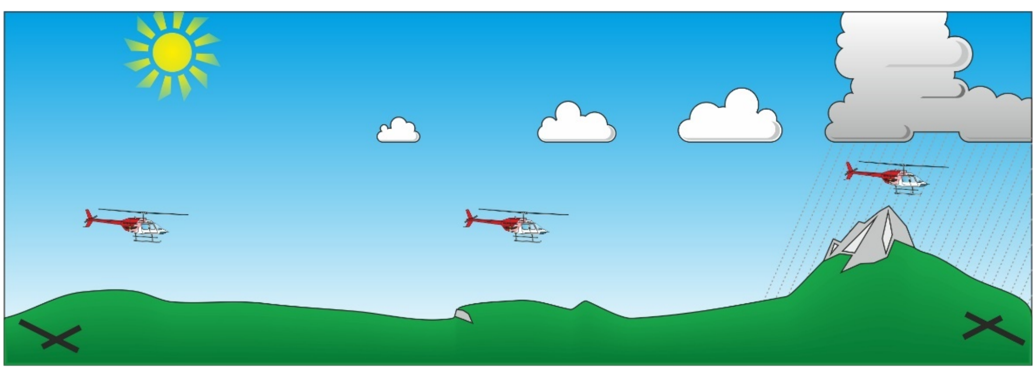
	ACTION
1	TAFs valid for 30 mins prior to departure and 60 mins after arrival.
2	ARFOR valid for departure and arrival **Consider VMC if required** - see Day VFR, NUA or NVG checklist as appropriate.
3	NOTAMs checked and applied to the flight
4	First and Last light determined
5	ARFOR Cloud base and tops enroute noted
6	ARFOR Visibility enroute noted

Figure 10 Excerpt from Flight Planning Guide Abbreviated Checklist

4.4 Prepare a Weather Brief

An important step in flight planning is obtaining and interpreting the weather. Prior to every flight, the pilot is required to take the time to study and understand the weather along the intended route.

Understanding the weather is very important for a cross-country flight, as the aircraft is going to travel some distance, so the weather at the departure airdrome may not be what it is en route or at the destination.



Information can be obtained from a range of weather information services, forecasts, and charts. For example:

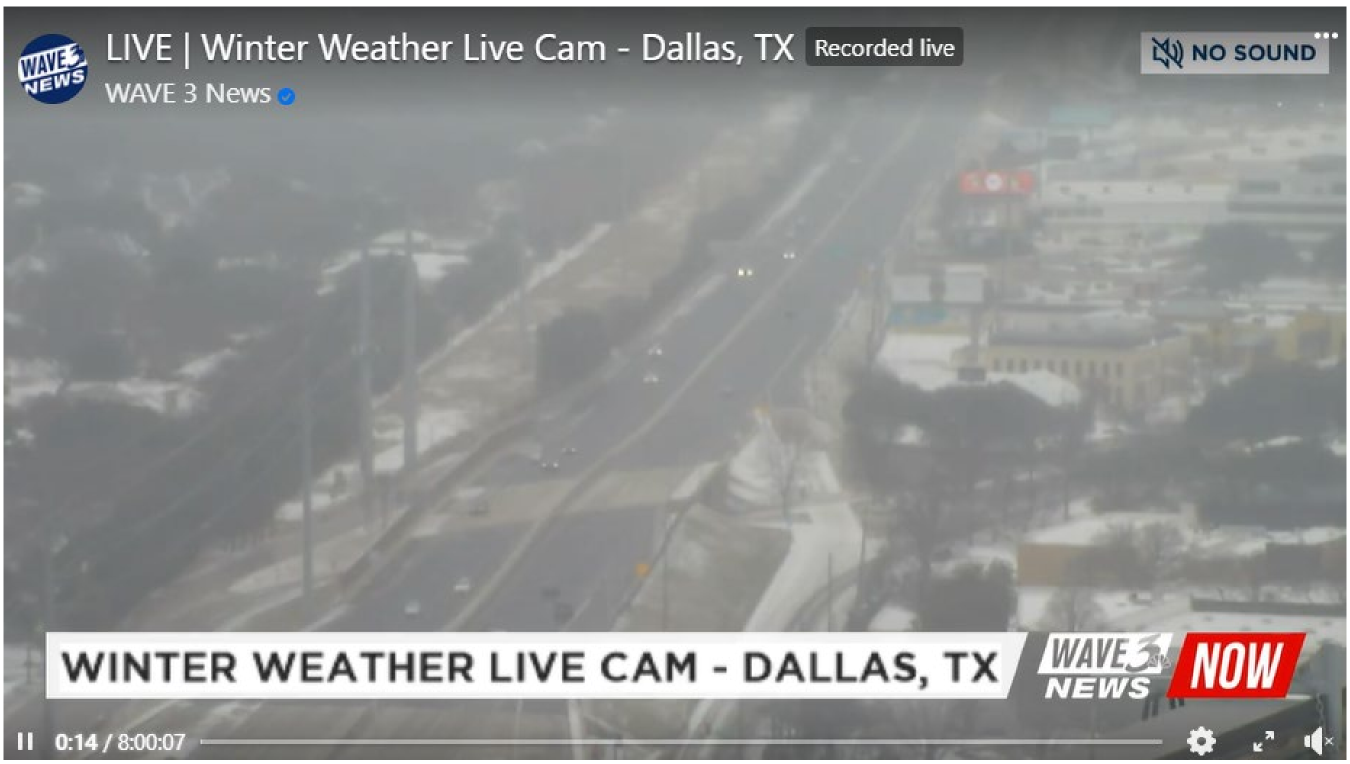
- A synoptic chart,
- Graphical Area Forecasts (GAF) or Graphical Forecast Area (GFA),
- TAFs (Terminal Aerodrome Forecasts),
- METARs (Meteorological Aerodrome Reports),
- Winds and temperatures,
- First and last light,
- Moon position and illumination,

- NOTAM (Notices to Airmen), and
- Any other information that is available about the departure, route, and destination that may be relevant for the flight and can be included in the weather brief.

The point is to get some information and be informed.

- Use the EFB or an app for access to aviation weather information.
- Use weather radar, web cams, weather channel, or similar weather reporting tools. While many of these weather services do not use airports as their points of reference, for cross-country flying you can sometimes get a better idea of the total weather picture using them to check cities along your route of flight.
- Perhaps call someone you know en route or at the destination.
- At the very least, have a look outside!

Information is power for decision-making.



[1]

4.4.1 Weather Briefing Format

A weather brief is usually obtained from a meteorological provider. For aviation purposes, it consists of codes, words, and numbers in varying formats that the pilot has to interpret into a meaningful picture of the weather for the flight. This is not easy to do and requires practice. It is a subject that is covered in the meteorology theory and final exam during your training. However, the practical application and teaching at schools in the real world is often lacking.

To resolve this, it is often easier in the beginning to simply sketch out what the weather may look like based on the words being read. This does take a bit of practice but once the concept is learned it is a very easy and quick thing to do.

For example:

Consider the following TAF as an example of a forecast at a destination:

MURRAY BRIDGE (YMBD)

TAF YMBD 041851Z 0420/0508

14018KT 9999 ISO SHOWERS OF LIGHT RAIN with TWR CU BLW070 BKN010 SCT020 BKN030

To make the weather "real," sketch a picture of the words and then place the helicopter (you) within the picture (Figure 11).

This sketch should be brief and to the point, containing only the information relevant to the weather of the day and for the flight. This helps the pilot visualize the weather conditions and inform decision-making before and during the flight.

Figure 11 Example of a weather briefing sketch

This is a common tool used during flight school to help pilots create a picture of the weather. Night VFR and NVIS flights also utilize this technique during planning in preparing for an IIMC event.

It is not suggested that this be used for every flight, but it is a good tool to have available in your pilot toolbox.

With the advent of the electronic flight bag (EFB), computers, and apps, some countries also have available automated weather interpretation abilities (Figure 12).

This means a software program can take a weather forecast and interpret it, and then display it on a screen as a picture in a similar manner to the sketch above.

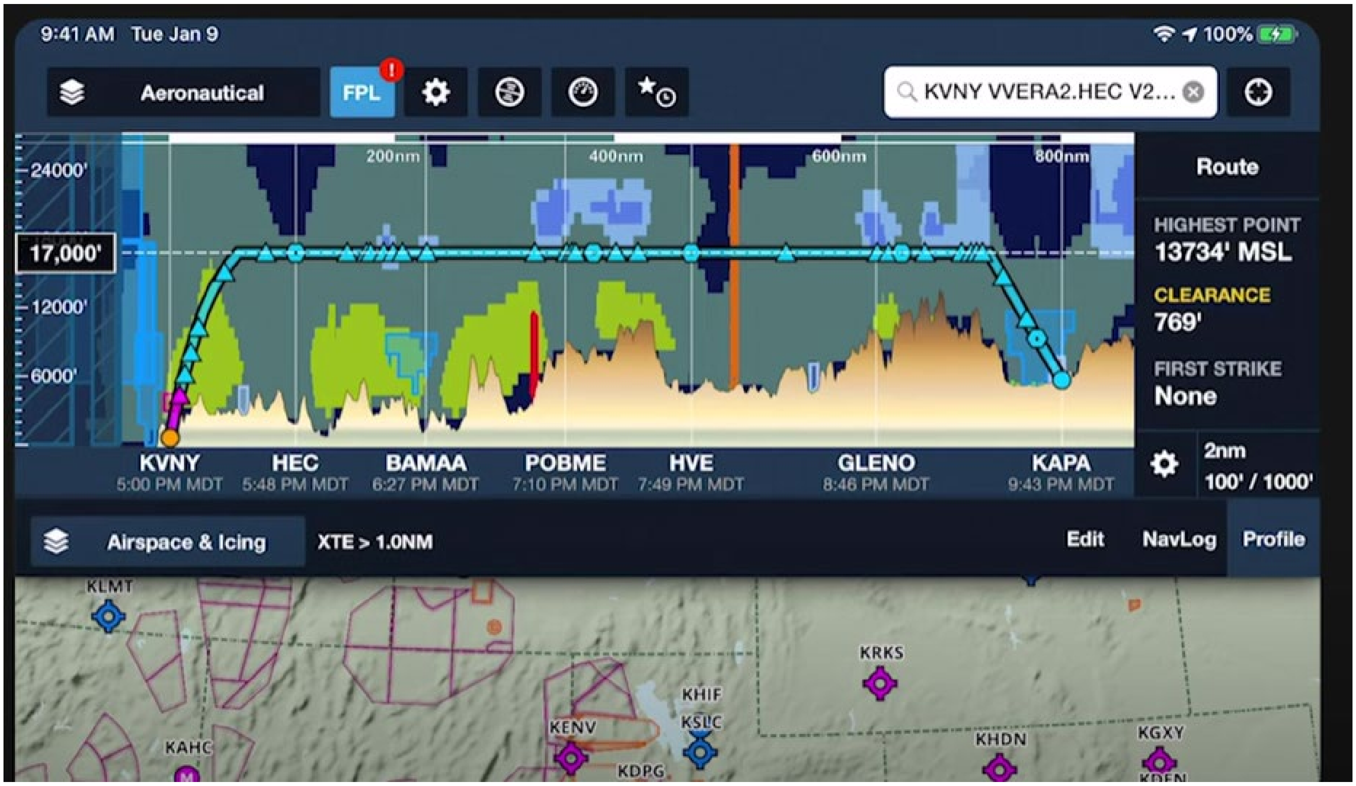


Figure 8 Example created within the ForeFlight flight app [2]

4.5 Calculating LSALTs/MSAs

There are multiple methods to calculate an LSALT/MSA. Choose one that works for you based on what you have been taught or used in the past, your skill set, the equipment available, and the situation.

Remember, there may be several LSALTs/MSAs based on each leg or even at different stages of the same leg.

The following are three methods of calculating LSALTs/MSAs:

- Manually
- Using the GPS
- Using an electronic flight bag (EFB)

Unmarked Obstacles

In most countries, an obstacle does not have to be marked, lit, or advised if it is below 360 ft AGL (this height may vary in individual countries). With wind towers, mobile phone communication towers, and power line installations, you simply do not know what is on top of that high point, unless you have recently had a look.

When planning a flight for an area that you have limited local knowledge of, consider the possibility of an unmarked obstacle on top of each high point and allow for an extra 360 ft AGL. This is a consideration that is often overlooked.

Manually Calculating LSALTs/MSAs

One method to calculate an LSALT/MSA (Figure 13) is to

- identify the highest point of the route within:
  - a **10 NM radius**; or
  - 5 NM either side of track if using an approved GPS; and then
- add 1000 ft; and
- add 350 ft for any unknown obstacles.

Figure 9 Calculating the LSALT allowing for unknown obstacles

Other Sources of LSALTs/MSAs

During IFR training, IFR pilots learn how to interpret various plates and charts used for IFR planning and while en route. These plates and charts have all the surveyed and approved information displayed in a technical manner to allow for a safe IFR flight.

However, for VFR pilots who are not familiar with these plates and charts, the information is not obvious to interpret. Therefore, obtaining the relevant information may not be clear until you have been taken through how to read them by a knowledgeable person.

IFR plates and charts are a valuable tool to have available when planning a flight and, in particular, preparing an IIMC recovery plan.

Options to calculate LSALT/MSA using IFR plates and charts include checking

- the 10 NM and 25 NM MSAs (minimum safe altitudes) from an airport approach plate (Figure 14), or
- a surveyed IFR route on a low-level en route chart used for instrument flying (Figure 15), if available.

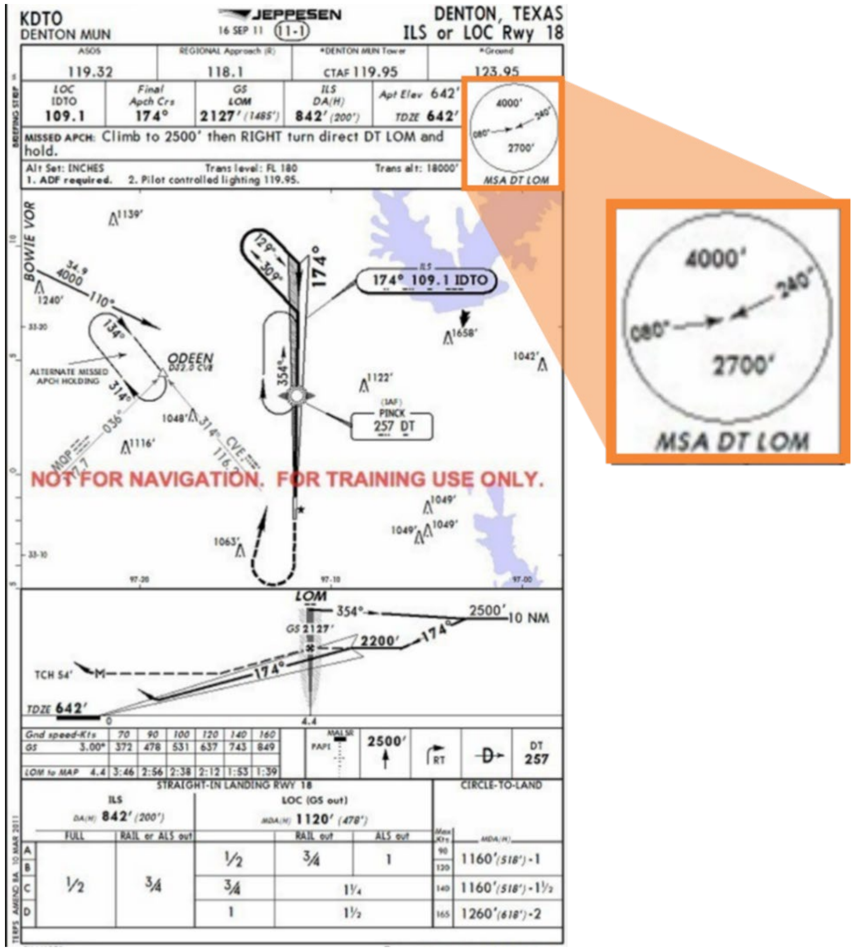


Figure 10 Example of an airport approach plate

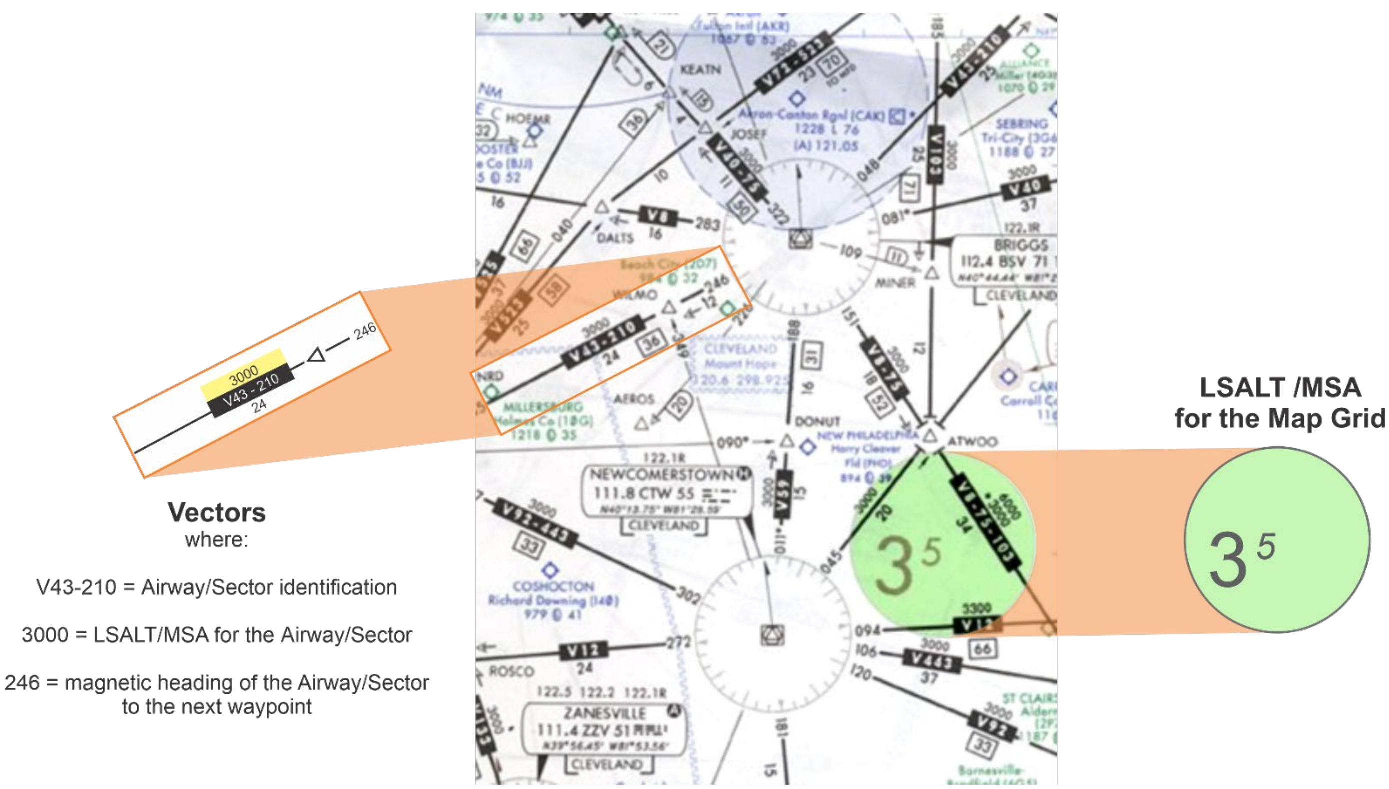


Figure 11 Example of a low-level en route chart

GPS LSALT/MSA

Most GPS units have an option to display the grid LSALT or MSA (Figure 16). Prior to the flight, select this option from the menu as a permanent part of your radio set up. The MSA will then be constantly updated and available to you as you travel.

Figure 12 GPS displaying MSA (LSALT)

Electronic Flight Bag (EFB) LSALT/MSA

Most EFBs have the option to calculate LSALT/MSA based on the route flown. Activate this option so it is always available to you. Figure 17 shows all spot heights within the red line used to calculate an LSALT/MSA.

Figure 13 EFB calculating LSALT/MSA

4.6 Plan Your Fuel

Fuel is important, as any IIMC recovery plan requires extra fuel. The original flight may have simply been a 30-minute point to point where minimum fuel was planned for maximum payload. However, if going out on a day that requires an IIMC recovery plan, then the pilot will have to allow for extra fuel and ensure that this is not used except when activating the IIMC recovery plan. This may necessitate a lesser payload on a bad weather day to give the helicopter more ability to carry that extra fuel.

The extra fuel required shall include enough to climb and then divert before completing the recovery, plus any reserves. This could be an extra 60 minutes of fuel on top of the 30-minute flight and the original fixed reserves. Remember, if there is not enough fuel in the tanks, then going into IMC is simply not a good idea.

4.7 Consider Your Options

Make a conscious decision, prior to the flight, to consider your options if you experience adverse conditions:

1. **Make your go/no-go decision.**

   This will be determined based on different criteria due to your personal limits, the operation, and the practicality of maintaining VMC based on all available information. The ability to avoid IMC must be assured. There should never be anything inadvertent about flying into IMC.

2. **Set the enroute decision triggers (EDTs).**

   Even with the best planning, conditions can change. Before departing, set some limits (see section 3.5). This ensures that when the time comes, there will be no doubt about what decision to make and whether you will have crew and/or passenger buy-in (see section 4.10).

3. **Plan a course of action—nominate a recovery airfield or location.**

   Plan a course of action and how it is going to be managed. This may include returning to the departure HLS or diverting to an airfield en route. Remember, a helicopter always has the option of landing in a remote location, like the one in Figure 18.

Figure 14 Example of a safe precautionary landing due to weather

4. Plan to transition to IFR.

For a current IFR pilot in an IFR-certificated aircraft, transitioning to IFR may be an option. It is very important to plan for this possibility in advance.

- Review the airspace and consider what conditions may be entered when climbing to the LSALT/MSA.
- Review the instrument approach plate for the field you are going to recover to and have it available during the flight.
- Configure the helicopter for IFR prior to liftoff.
  - Preset the navigation aids and the radio frequencies.
  - Always set the heading bug and VSI so that activation of the autopilot will configure the helicopter into a climb to LSALT in the current direction.

4.8 Draw a Mud Map

Just like the sketch done for the weather brief, a "mud map" is a sketch of the route.

Although not always required, it is a great tool when learning the concept and preparing an IIMC recovery plan. NVFR and NVIS pilots use it especially for areas they are not familiar with.

The mud-map gives easy access to information you may need in a hurry in an easy-to-read format.

On the mud map, put high points, LSALTs/MSAs for each leg, radio frequencies with a distance along the route and any other notes that you think may be relevant or quickly required.

Figure 19 shows a detailed flight plan prepared on an EFB. Key information from this flight plan has been captured in the mud map shown in Figure 20.

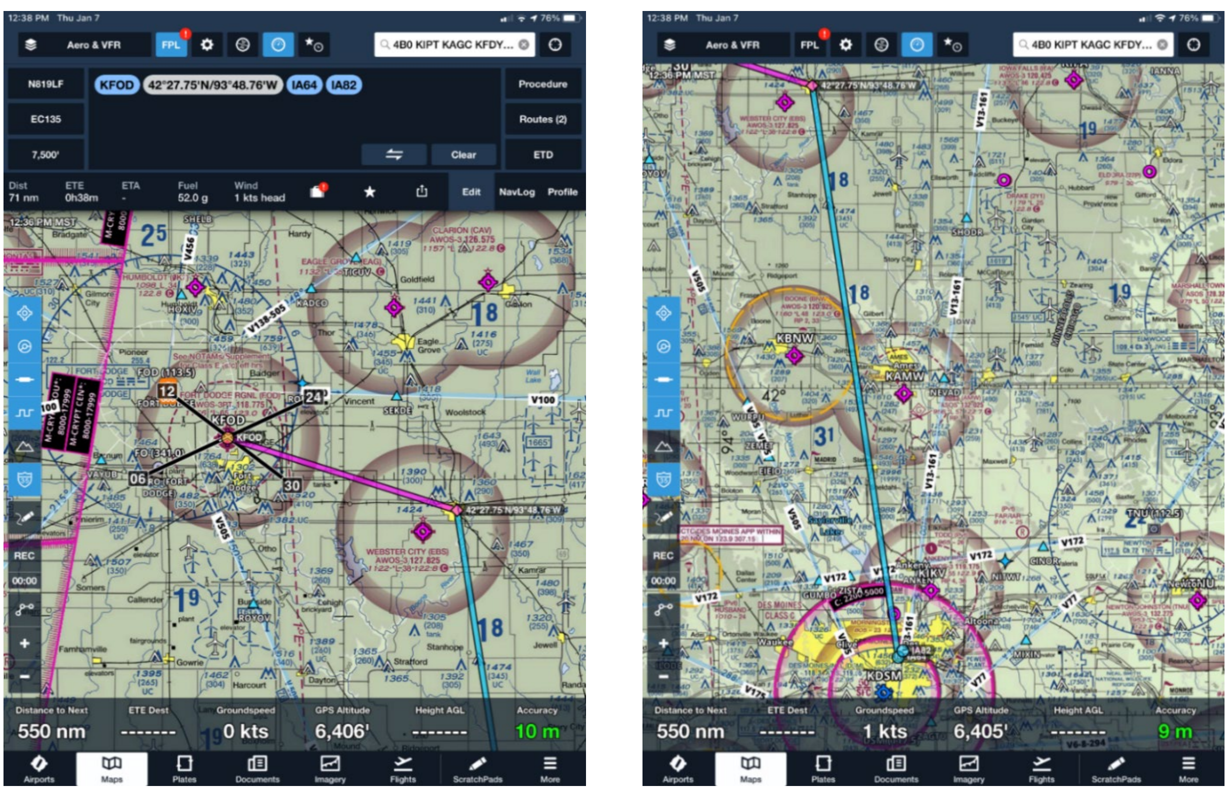


Figure 19 Example of a flight plan on ForeFlight

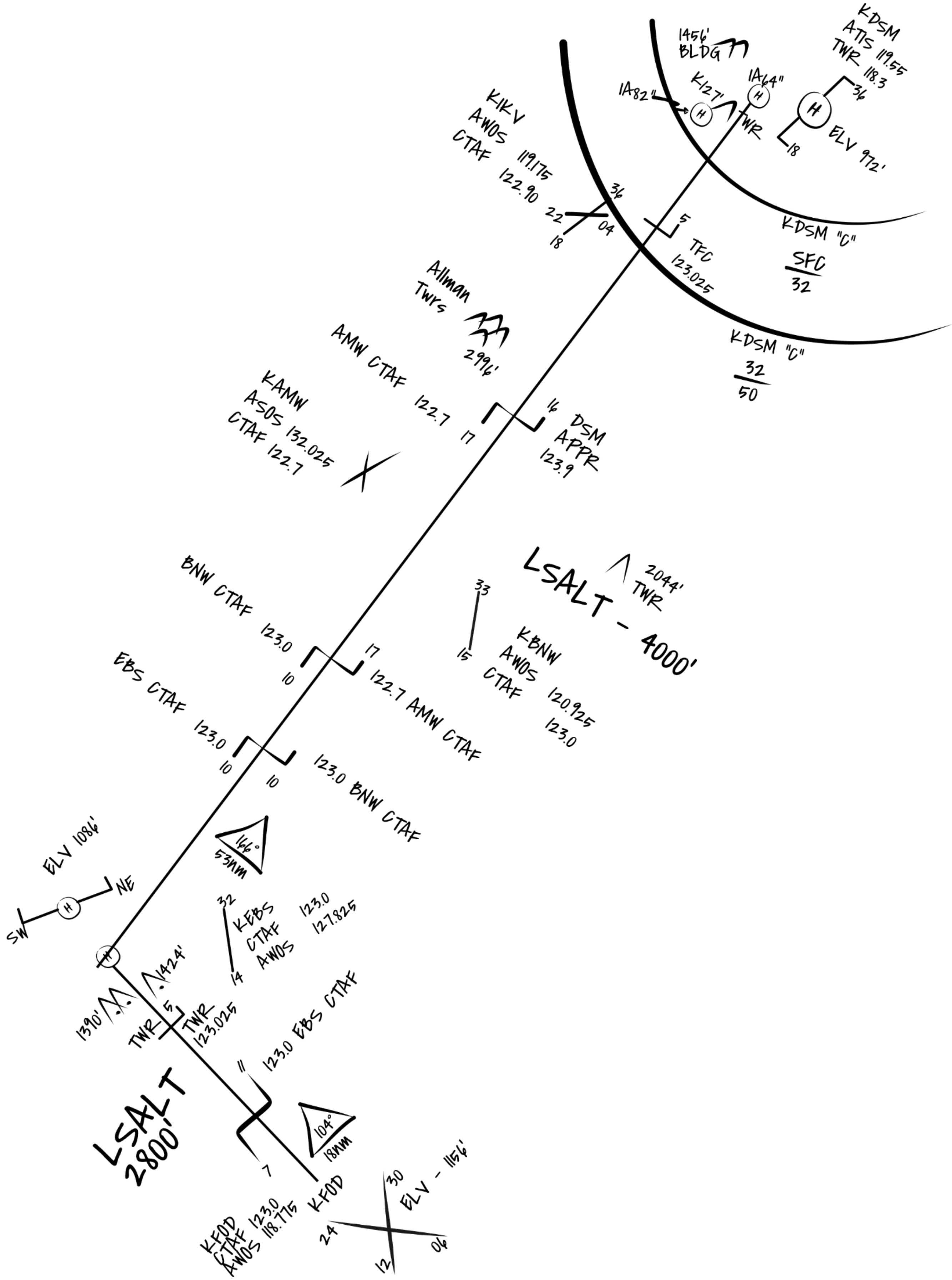


Figure 15 Example of a mud map for the same flight from KFOD to KDSM.

4.9 File a Flight Plan

Although filing a flight plan is not a requirement for most VFR flights, in marginal weather it is a good idea. It can save you a lot of time when dealing with ATC. A flight plan for a VFR flight can be simple with no SARTIME (Search and Rescue Time). The point is that the aircraft and pilot details will be in the air traffic management system, so that when experiencing difficulties due to weather and calling ATC, unnecessary time and pilot concentration (let's call this cognitive capacity to deal with multiple stressful events occurring at the same time) are not wasted on explaining who you are and what you are doing. If you do not need ATC during the flight and the plan is not actually used, no one cares, as it is a flight notification only with no SARTIME, but you have just saved yourself a whole lot of hurt if it is needed. Unfortunately, individual countries may have varying rules and requirements regarding a VFR flight plan, so the pilot will have to determine what is possible within their airspace system.

4.10 Brief Your Crew and Passengers

Discuss the EDTs and plan of action with your crew and, in turn, brief your passengers. Having everyone aware of the limits expands your situational awareness and provides you with other people in the aircraft working to help you manage the flight.

Although there will be times when passengers are not conducive to helping, having them aware of the triggers that may force a decision will help you when it comes time to give them the bad news that they are not going to make their destination. Sometimes having a flight nurse in the back mentioning that the visibility is reducing to near one of the EDT limits will trigger the decision to activate the plan. The same applies with high-profile passengers who have been informed prior to the flight what is going to make you turn around and land. There is no longer any debate as you have now reached one of your EDTs.

Brief your Passengers

Prior to any flight where you have passengers, it is the pilot-in-command's (PIC's) responsibility to give or delegate the passenger's safety brief. All too often this is not given enough care and attention and we simply cover the basics: don't go near the tail, keep your seat belts on and doors closed, don't talk to me if I am busy, and the rest is on the card.

A good passenger brief is your chance to set the client's expectations. Do not cut corners on this requirement.

If departing on a day or night when the weather is not so good, add this information into the brief. Tell them the weather is marginal and you are happy to depart, but if the weather gets worse, you may have to make a decision to divert, return home, or make a remote landing. Getting to the destination today as a VFR flight is not guaranteed. Set them up so that they are not pressing you for information while you are concentrating on managing the aircraft in bad weather. Set them up so they know you are in control, have their safety in mind, and will make the best decision to ensure a safe outcome. No one complains about that, and this also empowers you as the PIC to make the best decision based on what you encounter rather than trying to press on because the passengers need to get to a destination.

5 Basic Instrument Flying

As a pilot flying an inherently unstable helicopter by day and in sight of the ground, you are primarily using **visual** cues to ensure your aircraft is flying at the height and speed and in the direction that you want. A glance at the pictures below tells enough to be aware of your situation.

Whether operating IFR, NVFR, in marginal weather, or IMC, the attitude information, normally obtainable by looking outside at the natural horizon, will be that much harder to perceive. At night or in IMC, we lose these primary visual cues and cannot rely on our balance and “seat of the pants” cues to let us know what the aircraft is doing. Therefore, we must be able to fly by sole reference to the instruments.

5.1 The Instrument Cockpit

Helicopters and airplanes are very similar in their basic instrument requirements.

Look at the picture to the right. What cues are you using to determine the flight characteristics of the helicopter?

The angle of the horizon, relative to the aircraft and its position, show us that we are banked to the **left** and have a descending or accelerating attitude. We do not need instruments to tell us this; we can see it by looking outside.

In clouds, we would merely see the picture to the right. This is when our ability to interpret the instruments becomes vital.

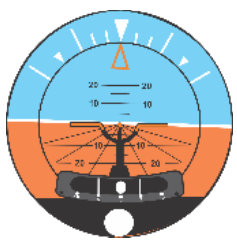
Clearly, our most important instrument would be the **artificial horizon (AH)** or **attitude indicator (AI)**.

AH and AI Instruments

The artificial horizon (AH) is a gyroscopic instrument. In its simplest form, this is a spinning wheel, powered by air or an electric motor that tries to keep its position in space. The gyroscope is mounted on gimbals, so that the aircraft can move around it in three directions. One of the gimbals is connected to an artificial horizon card to show the pilot the position of the horizon relative to the aircraft.

The attitude indicator (AI) is an electronic instrument that does everything the AH does but without mechanical gimbals, instead relying on smart electronic and programmed systems. For the purposes of piloting, they can be considered the same instrument, and when referring to the AH, we also mean the AI.

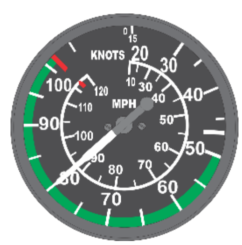
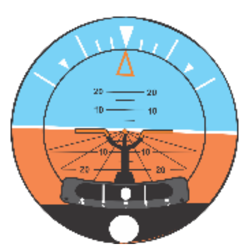
Legacy artificial horizon (AH) [analog]

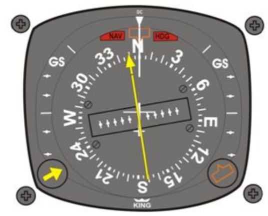
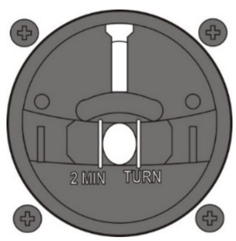


Modern attitude indicator (AI) [digital]

5.1.1 Full Instrument Panel

A full instrument panel consists of the following instruments:

Instrument	Name	Image
ASI	Airspeed Indicator	
AI	Attitude Indicator	

Instrument	Name	Image
HSI	Horizontal Situation Indicator	
Alt	Altimeter	
T&B	Turn and Bank	
Balance	Balance or slip ball	
VSI	Vertical Speed Indicator	

Compass, Directional Gyro, and Horizontal Situation Indicator

In an aircraft, the magnetic or wet compass is the primary heading indicator and is a mandatory item for certification in all aircraft. However, it is a difficult instrument to read, has many errors, and has to be positioned away from the instrument panel so it does not suffer from electrical interference. Because of this, aircraft flying in IMC are fitted with either a directional gyro, which is an older legacy instrument, or a newer horizontal situation indicator (HSI), which can be either analog or digital. In a standard instrument layout for instrument flying, this HSI is used instead of the compass as the primary means of determining heading.

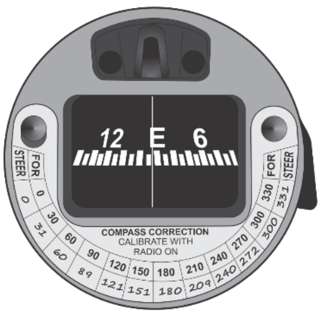
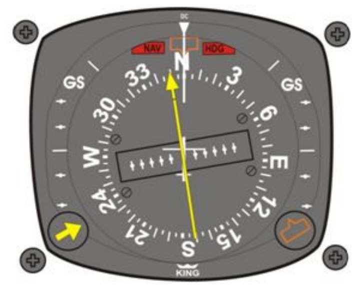
Magnetic compass	DG	HSI
		

Figure 21 illustrates a full legacy instrument panel in a Bell206 Jet Ranger using mechanical gyros.

Figure 16 Instrument panel with analog instruments with a standby AH and DG

5.1.2 Limited or Partial Instrument Panel

When one or more of the required instruments in the full panel have failed, it is now considered a limited or partial panel (Figure 22). If instrument flight is to be continued with the remaining limited/partial panel, the pilot must interpret other instruments to derive the missing information as outlined in the table below.

Figure 17 Limited/Partial instrument panel with failed ASI covered

Failed instrument	Shift your focus to the
ASI	Power setting and AI to determine speed (*power* + *attitude* = *performance*)
AH/AI	Standby AH/AI. This will require you to set up a new scan pattern because the standby AH/AI is usually offset to one side. Alternatively, use the VSI, altimeter, and ASI to determine the pitch, and the turn and bank, heading indication, and balance ball to determine bank or roll
ALT	AI to maintain straight and level while using the VSI and time interval to determine a change in altitude
Turn and Bank	AI to determine bank
DG	Magnetic compass, or you could also use the turn and bank and conduct timed turns (3° per second)
VSI	AI to determine pitch and the altimeter and time to determine rate of change

5.2 Scanning

Scanning is simply **what** we look at on the instrument panel and **how** we look at it.

When flying visually, we do not need the instruments, so our scan focuses primarily on the outside with small glances inside.

For example:

Consider the scan when driving a car.

Observation	Thought process
Road ahead	looks clear, bend in the distance
Rear view mirror	nobody behind me
Road ahead	looks clear, bend getting closer
Speedometer	doing 80 kph
Road ahead	looks clear, bend getting closer
Fuel gauge	under a quarter full
Road ahead	car coming; start slowing for bend; must get some gas at the next service station
Rearview mirror	nobody behind me

Notice that the center of attention is the road ahead. You take a quick glimpse away to an instrument, and then your eyes are back to the road ahead.

Scanning When Flying a Helicopter

We use the same sort of scan when flying a helicopter visually and use the information that the natural horizon gives us to maintain the aircraft attitude.

When flying IMC, our outside scan moves inside, and we have to adjust our technique accordingly.

Since the AI/AH is so important to a helicopter pilot, when flying in clouds or at night, it becomes the center of our attention. It is positioned directly in front of the pilot, where possible, with the other key instruments positioned close by (Figure 23).

Figure 18 Instrument panel showing a digital (Aspen) glass cockpit with a standby AH and altimeter

Note the position of the attitude indicator (AI) and the instruments that surround it. These are the key instrument flight instruments: the airspeed indicator (ASI), the altimeter, the horizontal situation indicator (HSI), the vertical speed indicator (VSI), and the turn indicator and slip/balance (ball).

Other important gauges—the RPM, power instruments, engine temperatures, and pressures—are close by.

5.2.1 Standard T Layout

The layout of the flight instruments is standardized for most aircraft, so that you can swap from one type to another without having to relearn your scanning technique.

The airspeed indicator (ASI) is normally to the left of the artificial horizon, the altimeter to the right, and the heading indicator beneath it. This is called the "standard **T**" layout.

The primary instruments are often arranged in the **T** pattern to allow the pilot to efficiently scan the instruments. Figure 24 shows the standard **T** layout with analog instruments.

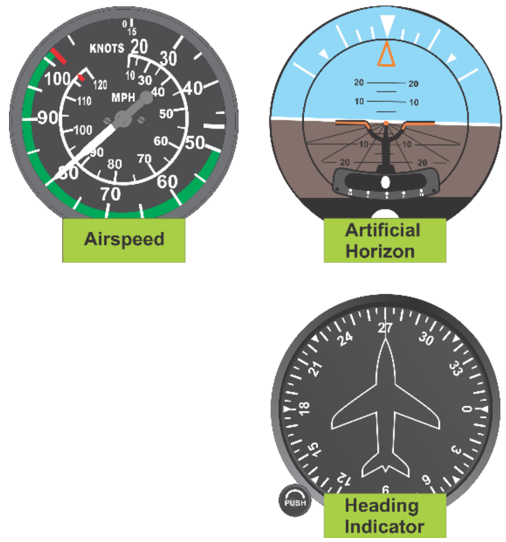


Figure 19 Standard T layout of primary instruments (analog)

Important Note:

*Not all helicopters have been designed for instrument flight, and therefore, may not have the standard **T** layout for instruments.*

*For example, Figure 25 shows a typical R22 cockpit, where the primary flight instruments are provided, but are not arranged in the standard **T** layout, which makes scanning during instrument flight less consistent.*

Figure 20 R22 instrument panel

This standard **T** pattern is also reflected in the design of digital instrument displays, as shown in Figure 26.

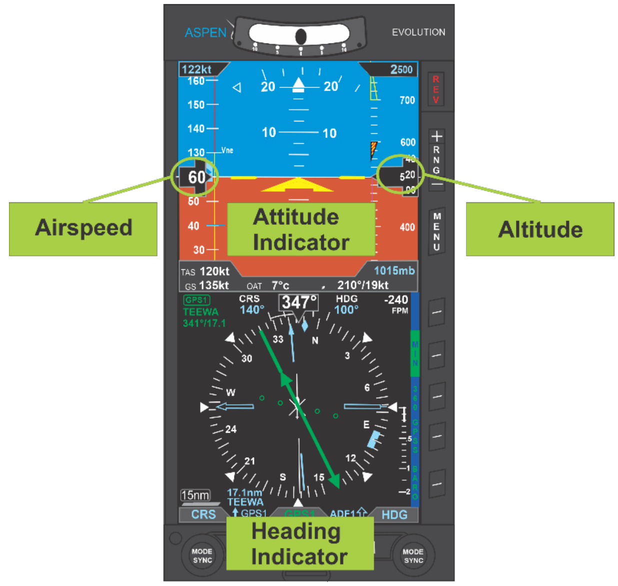


Figure 21 Standard T layout of primary instruments (digital)

There are two basic types of scan in common use by instrument pilots: the **radial scan** and the **selective radial scan**.

5.2.2 Radial Scan

The radial scan centers around the one instrument that gives the greatest information to the pilot: the attitude indicator (AI) or the artificial horizon (AH). Because of its importance, the AI is referred to as the **primary instrument**. The secondary instruments necessary to provide performance information are called **supporting instruments**.

The expression “radial” is the description of the scan technique where the primary instrument is the center of the scan (like the center of a wheel) with the scan moving outward (radially outward like the spokes of a wheel) to each of the support instruments before moving directly back to the AI (Figure 27).

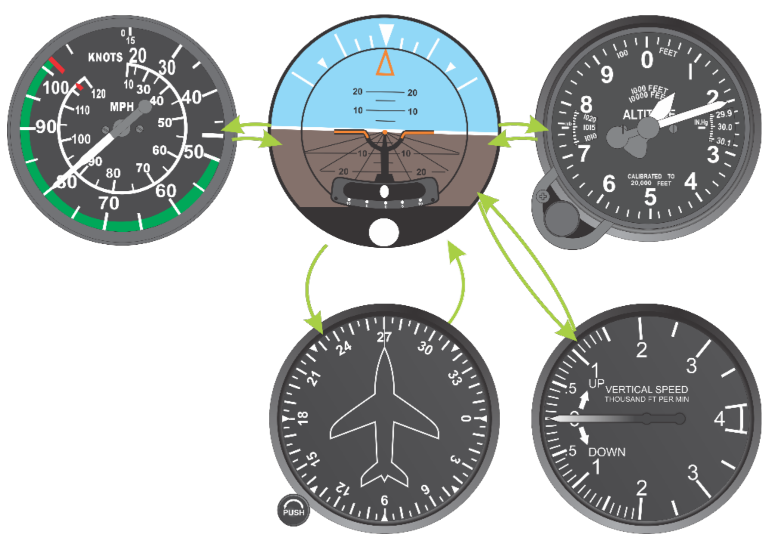


Figure 22 Radial scan

How does this compare with our "driving" scan?

Observation	Thought Process
AI	Wings are level and on the horizon. I wonder how the speed is doing?
ASI	90 kt
AI	Wings still level. 90 kt was what was asked for, so that's OK. How's my height getting on?
ALT	1900 ft
AI	Slight right wing low, so bring that level. 1900 ft, supposed to be at 2000 ft so a bit low. Small aft cyclic to fine-tune the altitude. Small pitch up just above the horizon.
ALT	2000 ft
AI	Wings level, small pitch down on the horizon. Wonder what the speed's doing?
ASI	85 kt but accelerating again.
AI	Wings level, on the horizon. Wonder what the heading's doing?
HSI	070
AI	Wings level, on the horizon. Heading is correct at 070.

5.2.3 Selective Radial Scan

The basis of the selective radial scan is that the eye moves from the primary instrument to one of the support instruments that provides additional information **relevant to the maneuver** at the time and then quickly back to the primary instrument, then onto another supporting instrument, then back to the primary instrument, and so on.

In this method, a process evolves to take in each of the supporting instruments according to the amount of information that the instrument can provide during the maneuver.

Most importantly, the scan always returns to the primary instrument before selectively moving on to another supporting instrument. In this way, no two support instruments are scanned in succession, the frequent return to the primary instrument allows the pilot to stay on top of any change in the attitude.

5.2.4 Common Errors in the Instrument Scan

In instrument flying, an attitude is maintained by reference to the instruments, which produces the desired performance result. Due to human error, instrument error, and helicopter performance differences in various atmospheric conditions, it is difficult to establish an attitude and have performance remain constant for a long period of time. These variables make it necessary for you to constantly check the instruments and make appropriate changes in the helicopter's attitude.

The actual scanning technique may vary depending on what instruments are installed, where they are installed, your experience and proficiency level, and the type of maneuvers being conducted.

The following scan faults are common to pilots new to instrument flying.

The Blank Scan

At first, you may have a tendency to scan rapidly, looking directly at the instruments without actually knowing what information you are seeking or seeing (the old "looking but not seeing" scenario). However, with familiarity and practice, the instrument scan will reveal definite trends during specific flight conditions. These trends help you control the helicopter as it makes a transition from one flight condition to another.

Movement of Time

When concentrating on your instruments, the brain tends to ignore time. You may have been on a particular heading and then be concentrating on holding altitude only to find that the aircraft is in a 45º turn off the desired heading after only a "few seconds." In reality, you were concentrating on the attitude for maybe a minute or more, but the brain did not register the passage of time.

Fixation

If you apply your full concentration to a single instrument, you will encounter a problem called "fixation." This is due to a natural human inclination to observe a specific instrument carefully and accurately, often to the exclusion of other instruments. Fixation on a single instrument results in poor control.

For example:

While performing a turn, you may tend to watch the heading indicator, monitoring the turn, and forget to include the other instruments in your scan. This fixation on the heading may lead to a loss or gain in altitude through poor pitch and bank control.

You should look at each instrument only long enough to understand the information it presents, act accordingly, and then continue to the next one.

Omission

Leaving an instrument out of the scan is a common fault, which may occur by a failure on your behalf to anticipate the significant changes the instruments will show during maneuvers. For example, you may commence a roll-out onto a desired heading and monitor the AI to return to straight and level but neglect to monitor the heading on the DG.

Emphasis

Particularly during the early stages of instrument flying, it is all too easy to channel all of your energy into one or more instruments only. You will quite naturally tend to rely on the instrument that you understand the most, even when it is not capable of providing all the information necessary.

Stress will lead to fixations and omissions.

5.3 Aircraft Control

Aircraft control is the term used to describe the **sequence, magnitude, and rate** at which a pilot moves the flight controls to achieve a desired performance. The control movement will be based on how a pilot interprets the instruments.

During daytime VFR flight, the pilot is subconsciously controlling the helicopter by reference to the natural horizon, while the pilot flying using the instruments as an aid must derive their control stimulus from inside the cockpit. The amount of control input required to manipulate the helicopter will depend on the pilot’s ability to interpret these instruments. Misinterpretation can result in improper control inputs.

Performance (often referred to as desired performance) refers to the state you want the helicopter to be in.

That is, straight and level, climbing, descending, or turning.

It is up to the pilot to look inside at the appropriate instruments and set the desired **power** and **attitude** while in **balance** to achieve the desired **performance**.

To do this, we use the acronym **PAB:**

P = Power
A = Attitude
B = Balance

Therefore, the initial response when in IMC is to go back to the basics and set:

A Power and an Attitude while in Balance to maintain a desired performance

5.3.1.1 A Note about Balance and Trim

The terms **balance** and **trim** have some historical context in how they have been used in aviation and how they relate to helicopters.

In this document, we have used the word balance, but if you are more familiar with the word trim, then simply take it that they both mean the same thing for the purpose of flying and that the difference is simply terminology in differing countries.

Where you see the word balance use trim, or if you see the word trim, use balance at your convenience.

Note: Trim versus Balance

For those interested, the actual definitions of trim and balance are given below along with how they relate to fixed-wing aircraft and helicopters.

Trim

The original definition of trim is based on nautical terms for ships, for which it means to modify the angle of a vessel to the water by shifting cargo or ballast to adjust for sailing, to assume or cause a vessel to assume a certain position or trim in the water.

This applies directly to fixed-wing aircraft, as a fixed wing is simply a vessel in a fluid (air), so the properties regarding trim are identical to those of a ship. The definition of trim for a fixed wing is to adjust the aerodynamic forces on the control surfaces (wing, rudder, aileron) so that the aircraft maintains the set attitude without any control input. This is achieved by having some form of pitch and yaw trim incorporated into their design.

Balance

The definition of balance is a state in which opposing forces harmonize equilibrium.

This is not to be confused with weight and balance!

So, a helicopter pilot is required to balance the opposing forces between engine and blade rotation (torque) with the tail rotor and cyclic to balance out the tail rotor drift and roll, which are also caused by the tail rotor and the engine’s torque. There are no design features that allow pilots to “trim” the helicopter so they can let go of the controls. The helicopter has no stability (ignoring the installation of an autopilot), so it is up to the pilot to be constantly moving the controls to keep the helicopter (and its opposing forces) balanced!

Additionally, some helicopters do have an ability to trim the fuselage or trim a control. This is often done by using electric motors or levers to activate springs to offset control forces or, in some cases, tabs on elevators to adjust fuselage trim.

To the detail-oriented pilot, balance and trim for a helicopter can mean different things!

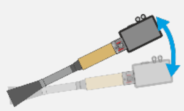
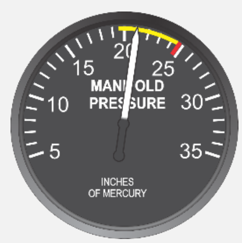
5.3.2 Reviewing the Performance Equation

From your basic training, you will remember the performance equation where:

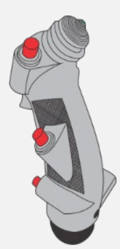
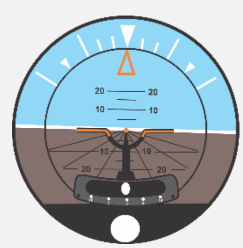
$$\frac{\text{POWER} + \text{ATTITUDE}}{\text{BALANCE}} = \text{PERFORMANCE}$$

Note: This document uses traditional instrumentation to illustrate the discussion. If your aircraft has more sophisticated digital or glass cockpit instrumentation and you know how to use it, then you are at an advantage.

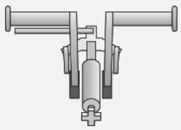
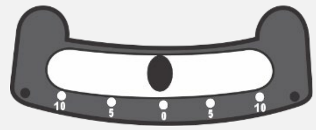
Power is adjusted by using the collective and is measured as manifold pressure (MP) in a piston engine and torque in a turbine engine (ignoring N1 or engine temperature at this point).

	Adjusted using		Measured by	
Power	Collective 		Piston: Manifold Pressure (MP) 	Turbine: Torque (TQ) 

Attitude is adjusted by the cyclic and is displayed in the cockpit by the attitude indicator (pitch and roll)

	Adjusted using		Measured by
Attitude	Cyclic 		Artificial Horizon (AH) 

Balance is adjusted by the pedals and is displayed in the cockpit when in forward flight by the balance ball.

	Adjusted using		**Measured by**
Balance	Pedals 		Balance Ball 

Performance is monitored in the cockpit, primarily by the pilot viewing the heading indicator (straight or turning), altimeter (level, climbing, or descending), and airspeed indicator (cruise, climb, and descent).

HSI

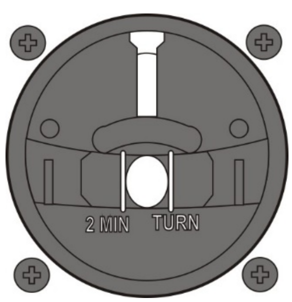
Altimeter

Airspeed Indicator

Secondary instruments, if available, give additional information, including the vertical speed indicator (VSI), turn indicator, and directional gyro (DG) or compass.

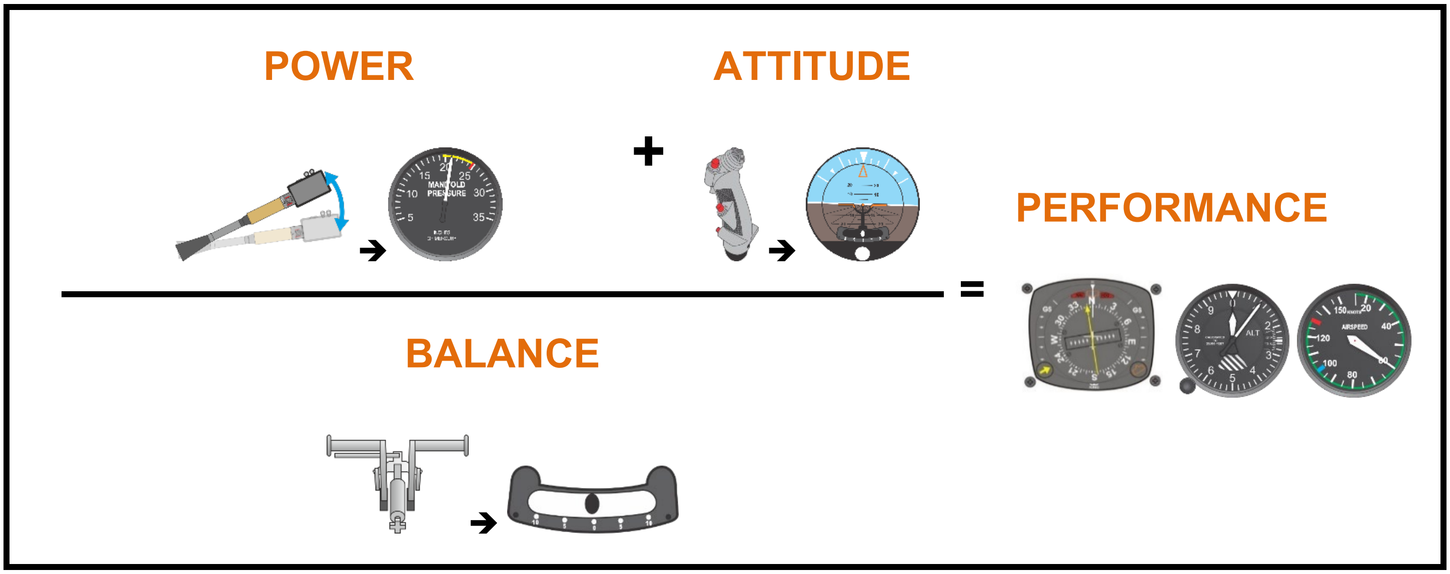
Vertical Speed Indicator (VSI)

Turn Indicator



Directional Gyro (DG)

Summary

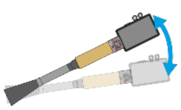


5.3.3 Power-Attitude-Balance (PAB) Drill

The **Power-Attitude-Balance (PAB)** drill is used to focus the mind and lead the pilot through the required actions to maintain control of the aircraft when no visual cues are available outside.

The **PAB** methodology is already used for visual flying and is the basis of controlling the helicopter; it is simply not verbalized or standardized as the pilot is able to automatically and without thinking move the controls in the correct manner when visual.

Power

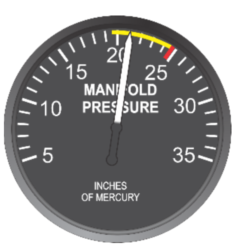


Set cruise power for the helicopter.

If the indication is

- high, lower some collective;
- low, raise some collective; or
- where you expect it to be, then leave the collective alone.

Piston example



Turbine example

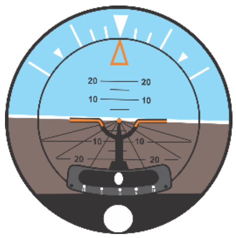
Attitude

Set the AH/AI to wings level and on the horizon line.

Correct any

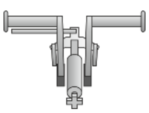
- **roll** first, then
- **pitch** second.

Artificial horizon (AH) [analog]



Attitude indicator (AI) [digital]

Balance



Ball in the middle.

If the ball is out to the

- left, push **left** pedal to bring it to the middle; or
- right, push **right** pedal to bring it to the middle

After the initial response, the pilot then only needs to use a selective radial scan to cross check the altimeter to determine **level** or the heading indicator to determine **straight**.

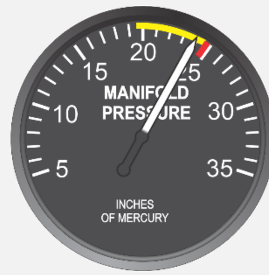
If the aircraft is

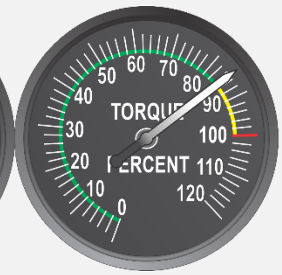
- climbing or descending, fix with a minor **pitch** adjustment referencing the AI.
- turning, fix with a minor **roll** adjustment referencing the AI.

5.3.3.1 To Initiate a Climb

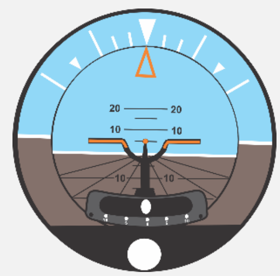
To commence a climb using the instruments:

P **Power** Set climb power for the helicopter.

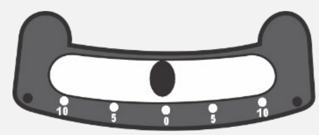




A **Attitude** Set the wings level and pitch up to the +5-degree line to initiate a climb.

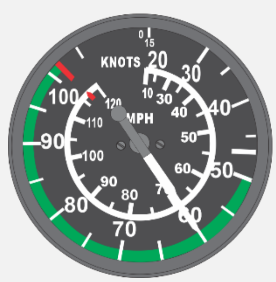


B **Balance** Maintain balance.



= **Desired Performance**

ASI = 60 KIAS[3]



Heading constant

Altitude increasing

[3] *Note: The ASI should be set to the climb speed recommended for the particular helicopter type.*

5.3.3.2 To Initiate a Descent

In a helicopter, there are two options available to commence a descent using instruments.

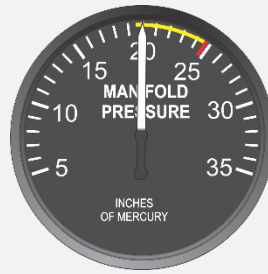
- It is possible to simply do what fixed-wing pilots do: drop the nose and pitch forward using some cyclic. Depending on the situation, this may work well, but there will be an increase in airspeed, and this may not be desirable in a helicopter due to controllability and aerodynamic factors.
- Instead, the preferred method for better control during instrument flight in a helicopter is to use power to control the descent while maintaining a constant attitude and airspeed as described below.

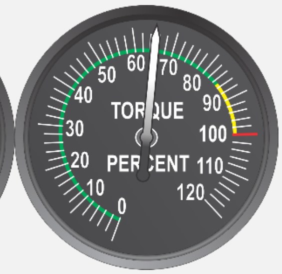
P **Power**

Set descent power for 500 ft per minute.

In a piston, this usually requires a 2″ reduction in MP from cruise.

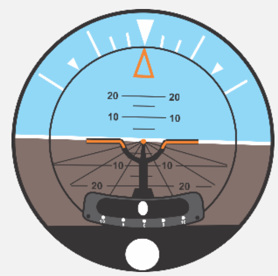
In a turbine, this usually requires a 10% reduction in torque from cruise.





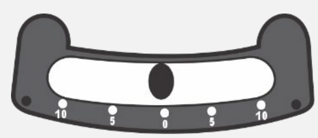
A **Attitude**

Maintain the wings level and on the horizon line.



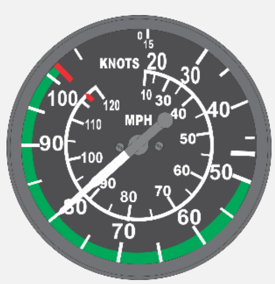
B **Balance**

Maintain balance.



= **Desired Performance**

ASI = 80 KIAS[4]



Heading constant

Altitude decreasing

[4] *Note: The ASI should be set to the descent speed recommended for the particular helicopter type.*

5.3.3.3 To Level Out from a Climb or a Descent

As with all levelling out from either a climb or a descent, the pilot should first **anticipate** the levelling off and **accelerate** before going through the **PAB** drill.

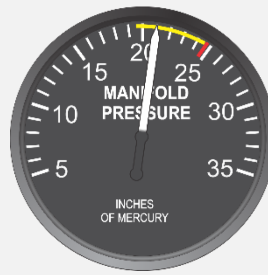
From a Climb:

100 ft before reaching the target altitude, start to gently ease the cyclic forward to anticipate the level off and allow the helicopter to start accelerating while at the higher power setting, then **PAB** as per below.

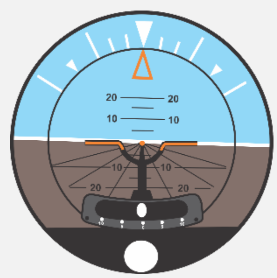
From a Descent:

100 ft before reaching the target altitude, start to gently raise the collective to arrest the rate of descent, maintain a constant airspeed, and use cyclic to level and further assist in managing speed then **PAB** as per below.

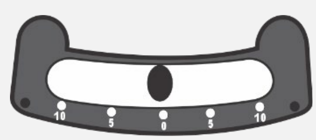
P **Power** Set cruise power for the helicopter.




A **Attitude** Set the wings level and on the horizon line.

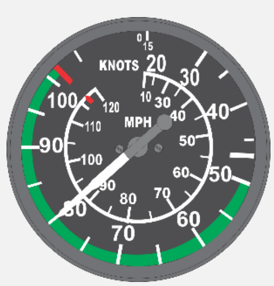


B **Balance** Maintain balance.



= **Desired performance**

ASI = 80 KIAS[5]



Heading constant

Altitude at the correct level

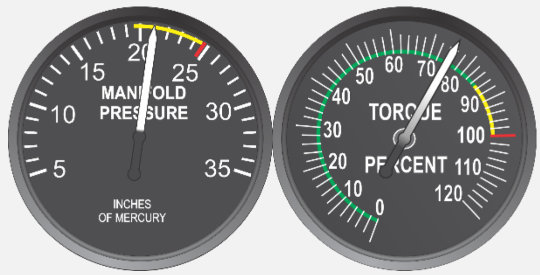
[5] *Note: The ASI should be set to the cruise speed recommended for the particular helicopter type.*

5.3.3.4 To Initiate a Turn

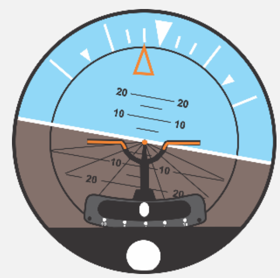
Altering heading from straight flight is achieved by conducting a standard or rate 1 turn giving a 360-degree turn in 2 minutes. (180 degrees in 60 seconds, 90 degrees in 30 seconds, 3 degrees per second)

If you do not know what the angle of bank is for your helicopter to conduct a standard rate turn, then simply use a 10-degree angle of bank on the AI for any speeds between 60 and 120 kt.

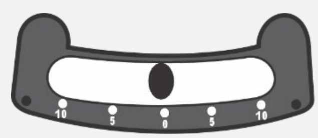
P **Power** Maintain cruise power for the helicopter.



A **Attitude** Maintain the center dot of the AI wings on the horizon line. With cyclic, roll the helicopter until achieving and then maintaining a 10-degree angle of bank.

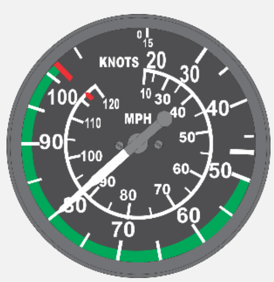


B **Balance** Maintain balance.



= **Desired Performance**

ASI = 80 KIAS[6]



Heading turning

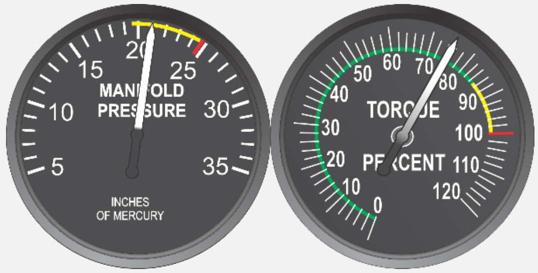
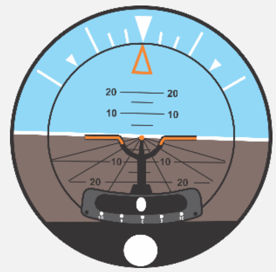
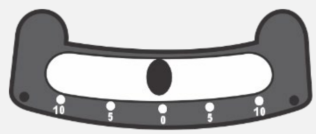
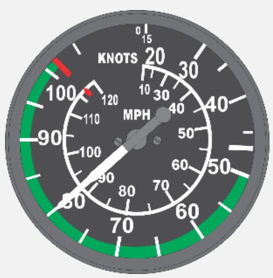
Altitude constant

5.3.3.5 To Level Out from a Turn

To level out from a turn, the pilot should first **anticipate** the levelling off before going through the **PAB** drill.

To level off: 10 degrees prior to reaching the target heading, use a small amount of opposite cyclic to the turn to level the wings then **PAB** as per below.

[6] *Note: The speed may vary depending on aircraft type, power setting, AUW, and density altitude.*

P	**Power**	Maintain cruise power for the helicopter.	
A	**Attitude**	Roll wings level on the horizon line.	
B	**Balance**	Maintain balance.	
=	**Desired Performance**	ASI = 80 KIAS[7] 	Heading constant  — Altitude constant 

[7] *Note: The speed may vary depending on the aircraft type, power setting, AUW, and density altitude.*

5.4 Airspeed

Key Abbreviations
ASI = Airspeed Indicator (The actual instrument)
IAS = Indicated Airspeed (What the instrument is reading/indicating)

For the helicopter pilot to be able to successfully fly in IMC, airspeed requires a special mention and explanation. This topic is not normally covered until a pilot transitions onto a more sophisticated type during instrument rating training using an autopilot, or when learning the principles and philosophy of multi-engine helicopters.

A fixed-wing pilot must take great care in managing airspeed, committing to memory important speeds that relate to multiple flight configurations including, but not limited to, minimum takeoff, stall, flap extension, landing gear, and the **minimum flight speed for controllability**.

Many of these speeds have names based on the **V** codes. The most familiar to VFR helicopter pilots is V_{NE}, the Velocity Never Exceed speed. Below (Figure 28) is an example of some speeds that a fixed-wing pilot may be familiar with in a Cessna 172.

Cessna 172 Speeds

1974–75 MODEL

Note: All airspeeds are in Indicated Airspeed (IAS) and are based on the aircraft at maximum gross weight unless otherwise noted.

PUBLISHED V-SPEEDS		
V-Speed Symbol	**Speed Value**	**What Is It?**
V_{SO}	54 MPH	Stall speed or minimum steady flight speed in the landing configuration (flaps fully extended)
V_{S1}	61 MPH	Stall speed or minimum steady flight speed in the clean configuration (flaps fully retracted)
V_R	60 MPH	Rotation Speed: the speed at which the nosewheel is lifted from the runway during takeoff
V_X	75 MPH	Best Angle Speed: in a climb, it provided the maximum gain in altitude for the *distance* traveled forward
V_Y	91 MPH, Sea Level 80 MPH, 10,000′ MSL	Best Rate Speed: in a climb, it provides the maximum gain in altitude per unit of *time* traveled
$V_{ENROUTE\ CLIMB}$	80–90 MPH	In a climb, it provides increased forward visibility and engine cooling
$V_{BEST\ GLIDE}$	80 MPH, 2,300 LBS.	In a glide, it provides the maximum distance traveled forward with the minimum altitude lost
V_{FE}	110 MPH	Full flaps extended speed: maximum speed at which the flaps may be fully extended
V_A	112 MPH, 2,300 LBS.	Design Maneuvering Speed: maximum speed at which full, abrupt deflection of the controls can be made without causing structural damage; reduce speed to this value when in rough air
V_{NO}	145 MPH	Maximum Structural Cruising Speed: do not exceed this speed except in *smooth* air
V_{NE}	182 MPH	Never Exceed Speed: Do not exceed this speed under any circumstances
Max. Demonstrated Crosswind	17 MPH (15 KTS	Maximum crosswind component during which the aircraft has been landed by the manufacturer test pilot

Figure 23 Cessna 172 airspeeds (V-speeds)

To help the fixed-wing pilot, the airspeed indicator may have various colors and markings relating to the various speeds (Figure 29). Compare this with a similar helicopter where the airspeed indicator is reasonably simple (Figure 30 and Figure 31).

Cessna 172	**Airspeed indicator with blue line mark**	**Airspeed indicator with barber's pole mark**
 *Figure 29 Cessna 172 airspeed indicator*	 *Figure 24 Helicopter airspeed indicator with blue line mark*	 *Figure 25 Helicopter airspeed indicator with barber's pole mark*

In VFR helicopters, the requirement to maintain an accurate airspeed is not as important as it is with fixed-wing aircraft.

Typically, there are only 4 speeds that VFR pilots concern themselves with:

- the speed at which a helicopter passes through translational lift,
- climb speed,
- autorotation speed, and
- V_{NE}.

Some helicopters also have a maximum maneuvering speed or maximum autorotation speed, which displays as a blue line (Figure 30) or a red-and-white barber's pole (Figure 31) on the ASI.

Interestingly, helicopters do not have a designated cruise speed; instead, pilots accept whatever speed they can achieve based on a power setting and fuel consumption. This means the cruise speed for the same power setting can vary significantly depending on the density altitude (DA) and all-up weight (AUW) of the aircraft.

The speed for translational lift does not rely on the ASI, instead it is something a pilot develops a feel for. Most ASIs are not accurate below 20 kt IAS anyway, so for a transition from hover to forward flight and back, which is at approximately 15 kt airspeed, the ASI is not reliable, merely an indication of a trend.

The climb speed is reasonably standard as it is based on the power available versus the total drag and can sit somewhere between 45 and 75 kt depending on the helicopter design. In most cases, pilots choose a speed that gives good speed across the ground as well as a rate of climb (ROC) to achieve an altitude over time, and usually to avoid or minimize the time flying through the Height Velocity Diagram or "Dead Man's Curve." Again, the accuracy of the speed has no significant critical implications, although good airmanship and accuracy in training would suggest a pilot be able to maintain a set climb speed when required to.

The autorotation speed is similar to the climb speed. The maximum autorotation speed is marked as a blue line or red and white barber's pole and can be similar to the maximum autorotation glide speed for range as well as the maximum maneuvering speed for powered flight.

The V_{NE} varies with density altitude and all-up weight and is stated on a placard in the cockpit. Again, for VFR pilots, it is rare to get anywhere near this limit, so it is not something they often consider unless operating in more extreme conditions.

Helicopter pilots typically learn by hands-on experience and fly the helicopter by feel and seat of the pants. Although this is completely acceptable when flying visually, it is impossible to do when in IMC.

Speed, therefore, plays a vital role in helicopter stability and controllability.

From basic training, you may also recall the speed versus control sensitivity graph (Figure 32).

When at hover, at zero speed, the tail rotor pedals control the way the nose points. At this stage of flight, the balance ball has no purpose and only starts to come into play when the helicopter accelerates through translational lift or when the pilot decides to bring the helicopter into balance at a height AGL that the pilot no longer needs the skids to be aligned with the takeoff path.

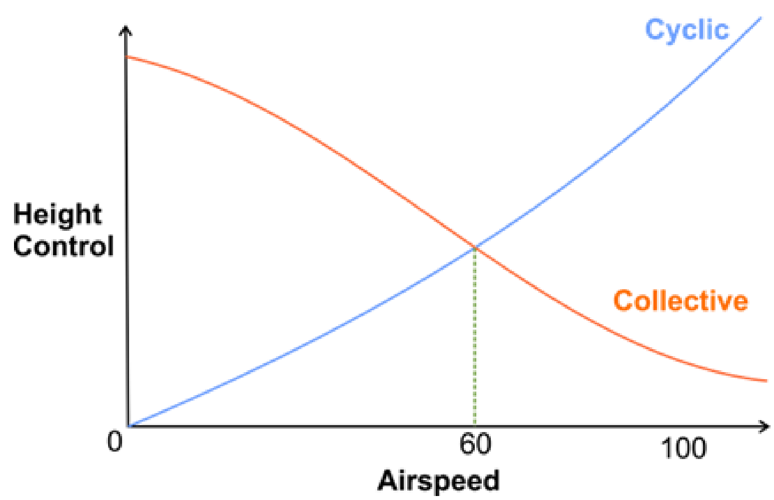


Figure 26 Speed versus control sensitivity graph for a Bell 206B III

The collective controls height AGL, while the cyclic controls attitude and aircraft position over the ground. This requires a very fine balance of control input by the pilot and is truly done by visually looking outside and having that good “feel” for the helicopter.

As the helicopter starts to accelerate and transitions into forward flight, the sensitivities of these controls begin to change and their ability to have secondary effects comes into play.

The collective, although still able to control power, has less of an immediate effect on altitude. Instead, the cyclic can now start to be used to make minor altitude and speed changes. The pedals are required less as the weathervane effect of the fuselage and the vertical fins keeps the tail nicely behind the moving helicopter.

As speed increases, the helicopter becomes more stable and easier to fly, allowing the pilot to be able to take a hand off the collective and use it now to change radio frequencies, write on a notepad, or make adjustments to instruments.

There is a sweet spot in every helicopter where, if maintaining a minimum forward speed, the helicopter maintains some stability. This speed is referred to as the minimum safety speed or VMIN.

The minimum safety speed is well documented for fixed wing, but it only comes into play in multi-engine helicopters or helicopters approved for instrument flight that have an autopilot that relies on a minimum speed to operate, when it is referred to as VMINI (velocity minimum control speed for instrument).

Any flight into IMC requires a pilot to maintain a minimum forward speed, but this documented number is not commonly (or ever) documented for a VFR-certificated helicopter. The reasoning by the OEM (original equipment manufacturer) and the regulator is that these VFR-certificated helicopters are never supposed to need it, because they are never allowed to enter IMC, therefore a VMIN is not relevant.

The danger, then, is that upon entering IMC, the VFR pilot increases power to climb; this action alone creates a flapback of the disk and a pitch up of the nose, which goes unnoticed by the pilot if not flying on instruments.

Add to this that the pilot may also use the aft cyclic to quickly assist in the climb due to stress and the uncertainty of where the ground is. This normally results in an over control and a rapid loss of airspeed. With a loss of airspeed comes a transition in how the controls function and a loss of aircraft stability, which in turn translates into a loss of control and spatial disorientation.

[3]

It is therefore up to the pilot to nominate a **minimum airspeed** for sustained controlled flight in IMC

If this number has not been documented within the rotorcraft flight manual (RFM), then as a rule of thumb, at a minimum, the pilot should not allow airspeed to drop below the best rate of climb speed as given in the RFM for the particular type being flown.

The V_{MIN} nominated by the pilot is also the minimum airspeed that can be used as a trigger when deciding a speed limit within the EDTs as part of the prefight planning. This may be equal to or greater than V_{MIN},

In Summary

When in IMC, it is imperative that the pilot controls airspeed to be no less than a documented or pilot nominated V_{MIN} or V_{MINI} and no greater than V_{NE}.

Below are several examples of a suggested V_{MIN} for a type. These numbers may have either been pilot nominated or published in the RFM.

Note: These numbers are approximate and shall not constitute the actual V_{MIN} for the aircraft unless verified by the OEM.

Helicopter Type	Nominated VMIN
R22	55
R44	55
R66	55

Helicopter Type	Nominated VMIN
B206	55
B407	55
B205	55

Helicopter Type	Nominated VMIN
B212	55
B412	60
H125	60

5.5 Recovery from an Unusual Attitude

With the basics under control, it is important to now consider recovering from an unusual attitude.

The first question to answer is “what constitutes an unusual attitude?”

An unusual attitude is experienced when the helicopter is at a pitch, roll, or yaw attitude or an airspeed[8] that is unexpected or not intended by the pilot. This means the helicopter’s attitude is now deviating from the pilot-intended one. It does not necessarily mean that the aircraft is upside down, in a steep descending turn, or in a dive. An unusual attitude may start innocuously with an incorrect power setting, half a ball out of balance, or a slight gentle turn when the pilot is trying to maintain straight and level flight. Recognizing the change and being able to correct it early is the key to recovery.

When a VFR pilot is able to look outside, it is very easy for them to see when things are not normal, and the situation can be quickly corrected.

Once inside a cloud, all those visual cues are removed, and an unusual attitude is normally first discovered when the instruments just do not seem right, followed by a change in the seat of the pants or noise levels, or when everything just stops behaving normally.

When first going IIMC, or even just prior, it is common to experience an unusual attitude. Spatial disorientation, loss of visual cues, attention diversion can all lead to a temporary loss of control, causing the helicopter to enter an unusual attitude. (For more detailed information on spatial disorientation, refer to the *USHST’s HSE127, Spatial Disorientation.*)

There are courses available on unusual attitude recovery (this is also referred to as upset recovery training). Further, you should have completed some recoveries during basic training; however, this is a perishable skill and should be done regularly with a flight instructor to remain proficient. So, go and get some training.

If a pilot has lost all visual cues and is experiencing an unusual attitude, they need to quickly go right back to the basics of flying the helicopter. Unlike a fixed wing, **the helicopter has no inherent stability**, so everything rests on the pilot’s shoulders and relies on the pilot’s control inputs to regain control.

Using the Power-Attitude-Balance (**PAB**) drill and a selective radial scan will assist in recovering and maintaining control of the helicopter in reduced visibility conditions.

[8] Note: Airspeed is included in the definition for an unusual attitude in a helicopter because a helicopter can have zero airspeed and still be flying.

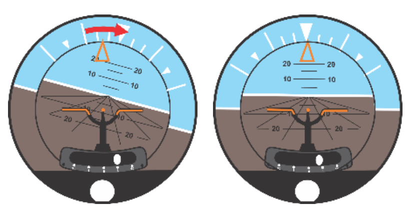
For example:

Consider a helicopter that has inadvertently entered IMC at an initial altitude of 2500 ft on the altimeter, at 80 kt IAS, on a heading of 270 degrees. In this example, we will also assume 2500 ft is the nominated LSALT/MSA for the leg.

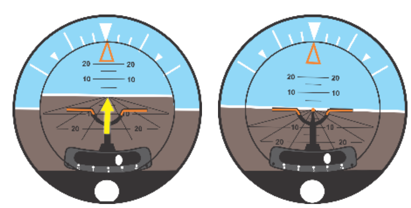
Once in clouds, the pilot quickly experiences spatial disorientation and enters an unusual attitude as shown by the instruments.

Fix Roll and Then Pitch

To recover, the pilot needs to move their eyes inside to the AI and immediately fix **roll** and then **pitch**.



First, fix **roll** by applying some right cyclic to wings level



Then, fix **pitch** by applying some aft cyclic to wings on the horizon

Straight and Level

Once the pilot has restored the attitude, use **PAB** as a sequence to complete the recovery to straight and level flight.

P	**Power**	For level: set power to cruise for the aircraft type
A	**Attitude**	For straight: set AI wings level and on the horizon line
B	**Balance**	For balanced: return ball to center
=	**Desired Performance**	ALT = Constant VSI = Zero HDG = Constant ASI = Constant above V_{MIN}

This will immediately stabilize the helicopter and return it to a straight and level state.

Yes, we are now closer to the ground and the danger of inadvertently hitting the ground has increased, but in this scenario, let's solve one problem at a time, because now, at least you are back in control.

If in VMC

If the pilot is lucky, the loss of 1400 ft may have returned the helicopter to VMC.

In which case, remain VMC and divert to the nearest landing site and kiss the ground.

[4]

If Still in IMC

If still in IMC, the IIMC below LSALT recovery plan must be implemented.

In this example, the helicopter needs to climb to the last safe area of 2500 ft, on a heading of 270 degrees. This should help restore situational awareness and give you a good idea of the current location. You will start to feel much better with yourself now that you are getting on top of the situation.

You will again use **PAB**, but **you only want to do one maneuver at a time**. That is, either climb or turn, not both at the same time.

The reason we do one maneuver at a time is to avoid spatial disorientation and give the pilot cognitive capacity to do one thing well at a time. There is nothing physically stopping two maneuvers at a time; rather, it is all about retaining control and taking it slowly with an aircraft and pilot that are not equipped for IMC.

Climb to the Recovery Altitude

In this scenario, we will climb first and then level off at 2500 ft before turning onto our desired heading of 270 degrees.

The only time this may vary is if you know there is a mountain or obstacle in front of you and the current heading is not safe; therefore, the priority is given to the heading maneuver .

P	**Power**	For climb: set power to climb power for the helicopter type
A	**Attitude**	For climb: on the AI, maintain wings level but set the pitch to 5 degrees nose up
B	**Balance**	For balance: ball remains in the center
=	**Desired Performance**	ASI = 60 KIAS HDG = Constant VSI = ROC ALT = Increasing

This will obviously take some time, so it is important that the pilot utilize an instrument scan to ensure the aircraft continues to remain under control.

Level Off

To level off, you again go back to the VFR basics of anticipating the level off by 100 ft and accelerating. This means that passing through 2400 ft the pilot will put the AI wings back on the horizon line and the helicopter will start to reduce its ROC and accelerate. On reaching the altitude, **PAB** back to level.

P	**Power**	For level: set power to cruise for the aircraft type
A	**Attitude**	For level: set AI wings level and on the horizon
B	**Balance**	For balance: ball remains in the center
=	**Desired Performance**	VSI = Zero ASI = Constant HDG = Constant ALT = Constant

Level Turn

Once you have levelled off at 2500 ft, it is time to return to the original heading of 270. To do this, use **PAB** to conduct a level turn.

P	**Power**	For level: set power to cruise for the aircraft type
A	**Attitude**	To turn: maintain the center dot of the AI wings on the horizon line. With cyclic, roll the helicopter until achieving and maintaining a 10-degree angle of bank.
B	**Balance**	For balance: ball remains in the center
=	**Desired Performance**	VSI = Zero ALT = Constant ASI = Constant HDG = Changing (increasing to the right, decreasing to the left)

Return to Straight and Level

As you are approaching the required heading, anticipate by 10 degrees and commence to level the wings with cyclic, then use **PAB.**

P	**Power**	For level: set power to cruise for the aircraft type
A	**Attitude**	To straighten: maintain the center dot of the AI wings on the horizon line. Roll cyclic opposite to the turn to bring the wings level with the horizon.
B	**Balance**	For balance: ball remains in the center
=	**Desired Performance**	ASI = Constant VSI = Zero ALT = Constant HDG = 270 degrees

6 Activating the IIMC Recovery Plan while in Flight

6.1 AANCA Drill

To give the crew structure in any emergency, the AANCA drill has been created to help prompt the crew to remember to respond in the correct order. This drill can be applied to a wide range of emergencies and malfunctions, and in this document, it has been applied to the IIMC recovery plan.

If acting as a single pilot, the acronym AANCA does **not** have to be spoken aloud; instead, the corresponding action that each letter in the AANCA acronym refers to shall be conducted.

If operating as part of a multi-crew flight, again, the acronym AANCA does not have to be spoken, but each corresponding item that is implemented shall be announced so that no member of the crew is working in isolation.

A	**Announce**	Identify, announce, and acknowledge the situation to yourself and the crew.
A	**Aviate**	Maintain/restore control of the helicopter.
N	**Navigate**	Maneuver and navigate the helicopter to a suitable safe altitude, safe heading, or safe landing area.
C	**Communicate**	Communicate with ATC, declare an emergency, and notify them of the situation, potentially seeking assistance to recover from the situation.
A	**Activate**	Activate the IIMC recovery plan and/or checklist items to recover the helicopter back to VMC.

Guide Only

It is important to note that the AANCA drill will not follow the same logical flow for every emergency and malfunction. Instead, the crew will have to work together to achieve the best outcome given the circumstances. The AANCA drill is a guide that helps focus priorities.

The following sections consider each stage of the AANCA drill in more detail as it relates to the IIMC event.

6.2 Announce: Identify and Acknowledge the Situation

This section discusses the **A**nnounce stage of the AANCA drill.

The crew member who becomes aware of the deteriorating situation or the emergency first is to state aloud what the emergency is so that all crew are made aware and trained responses are applied.

This may be in graduating stages when referring to the IIMC event, as the conditions usually deteriorate over time until eventually the actual IMC event occurs.

For example, the crew may state

- "Reached EDT for speed/visibility/height/clouds,"
- "Deteriorating/Marginal VMC,"
- "Reached minimum VMC,"
- "Loss of visual reference," or, finally,
- "IMC, IMC, IMC!"

Verbalizing the situation has huge psychological benefits in setting the pilot and the crew up for managing a recovery.

Announcing is already used for other emergencies such as "DITCHING, DITCHING, DITCHING," "BRACE BRACE BRACE," or "FIRE FIRE FIRE," so this is simply adding to this methodology.

In the above example, the crew actually had four opportunities to discuss, make a decision, and take action to avoid the IMC event. This is key in managing internal communication of any situation.

If you are a single pilot, then learn to talk to yourself and become your own crew.

This is where the angel/devil on your shoulder plays out. Who wins?

6.3 Aviate: Maintain/Restore Control of the Helicopter

This section discusses the **A**viate stage of the AANCA drill.

The crew's primary and first responsibility is to maintain/restore control of the helicopter.

There is no advantage in starting the checklist actions or making radio calls when the flying pilot cannot control the helicopter. Radio calls and checklists come after the helicopter is stable.

Concentrate on flying the helicopter first and maintaining control. If IMC is unavoidable, then transition from VMC to IMC using basic instrument skills, the **PAB** drill, and the selective radial scan to recover from an unusual attitude if encountered.

6.3.1 Transitioning from Visual to Instrument Flight

6.3.1.1 When to Transition

When to transition from visual outside references to internal instrument references is a topic that has a wide range of opinions and triggers. Unfortunately, there is no definitive answer to this question as there are too many variables and even more opinions.

Some argue that pilots do not transition to the instruments soon enough; others say pilots do it too early without exhausting the opportunities to remain in VMC.

This is one decision you are going to have to make based on your individual circumstances.

A VFR pilot in a VFR helicopter should never allow the helicopter to get into a situation where an IIMC event occurs and should manage the helicopter with that in mind.

Avoidance is better than recovery!
Electing to land and live is better than attempting flight in IMC!

A VFR or IFR pilot in a VFR helicopter with some instruments and having received some very specific training may encounter IIMC when conducting a specific operation. This may happen on a night flight, a NVIS flight, on a fire ground, or if conducting some other operation where, working near conditions conducive to IMC, an IIMC event may have been unavoidable. In these circumstances, professional crews should be well trained in their responses and have an IIMC recovery plan. Although avoidance is still the preferred option, if unavoidable, then transitioning to instruments and activating the IIMC recovery plan early has a better outcome than leaving it too late.

An IFR pilot in an IFR helicopter has many more options if those options have been considered prior to the flight. If they have not been considered before the flight, then this pilot is in the same situation as the VFR pilot in the VFR helicopter.

If you have failed to plan, you have planned to fail!

An IFR pilot in an IFR helicopter with a plan may decide to change flight category from VFR to IFR and transition to instruments even before going IMC in order to stay ahead of the situation.

As a general rule, the following guidelines may be considered.

Pilot	Helicopter	Category	Transition
VFR/IFR with no plan	VFR with no instruments	VFR	**Avoid IMC. Land.** In extreme cases, it is better to hover for a period close to the ground while visual and then land as the reduced visibility changes over time. Under no circumstances enter the clouds.
VFR/IFR with training and a plan	VFR with basic instruments	VFR	**Avoid IMC. Land.** If conditions are deteriorating, then start to include instruments in your scan and set up for IMC but do everything to avoid it. If IMC is unavoidable, commit to the instruments **early** and treat the remaining flight as an instrument flight.
IFR with training	IFR	VFR	**Avoid IMC.** If conditions are deteriorating, then start to include instruments in your scan and set up for IMC. Change category to IFR **early** and then commit to the instruments.

If operating under VFR, stay away from IMC,
but if unavoidable, commit to the instruments early.

6.3.1.2 How to Transition

The following discusses transitioning from visual to instrument flight and assumes that

- the helicopter is not fitted with an autopilot and has only a minimum of instruments including an
    - AI,
    - altimeter,
    - heading indicator, and
    - balance ball, and
- the pilot has received only minimal instrument training and does not hold an instrument rating.

On admitting that the visual references outside are deteriorating to a level that you

- have no visible horizon, and/or
- are unsure of where the ground is even if you think you can see it, and/or
- are losing the ability to appreciate movement of the helicopter over the ground,

then your eyes must immediately move to focus on the attitude instruments.

This is the most **critical** time in maintaining control of the helicopter and is the time you will be most at risk. It is important to now **trust your instruments**, regardless of what your body and mind are telling you. You have placed yourself in this situation, you now need the discipline and calm presence of mind to get out of it. Continuing to attempt to control the helicopter visually after visual references have degraded below minimum VMC is a direct cause of spatial disorientation.

Composure, Composure, Composure

6.3.2 Transitioning from Instrument Back to Visual Flight

There may be times when visibility improves or appears to improve, where the ground may come in and out of view, and you may be tempted to transition back from instrument to visual flight.

This is a very difficult topic to attempt to discuss here as it is a double-edged sword.

On one hand, if you can become visual with the ground again, do so, but on the other you may not be seeing what you think you are seeing.

Maintain a continued focus on the instruments, enhanced with a sneak peek outside looking for those external visual references. If the outside picture corresponds to the attitude inside and you can positively see the ground to effect a recovery, then yes, transitioning back may be possible.

6.4 Navigate: Achieve LSALT/MSA and a Safe Heading

In the previous stage, you recovered and/or maintained control of the helicopter. This section discusses the **N**avigate stage of the AANCA drill, where the goal is to attain or stay above the LSALT/MSA and maintain or turn on to a safe heading. Obviously, if you are below the determined LSALT/MSA, you will have to climb. If at or above the determined LSALT/MSA, then you can simply maintain the altitude that you are currently at and focus on other things.

After transitioning to IMC from VMC, with the aircraft back under the pilot's control but still in IMC, the next stage is for the pilot to selectively fix each of the other remaining problems with speed, altitude, and heading before working though the next stages of the IIMC recovery plan.

Is your heading safe?	Because you …	Then, you …
Yes	know there is nothing in front of you for the next 5 NM,	▪ maintain the current heading while climbing to the LSALT/MSA and levelling off at a **VFR level** to help avoid conflict with other IFR aircraft that may already be at an IFR level in your area.
No	know there is terrain in front of you, or do not know what terrain is in front of you.	▪ alter your heading to something safe, for example, turn around back the way you came, then, ▪ climb to at or above LSALT/MSA and level off at a VFR level.

6.5 Communicate: Contacting ATC

This section focuses on the **C**ommunicate stage of the AANCA drill, where you contact ATC or, if ATC is not contactable, you can communicate with others in your vicinity to notify them of the situation and potentially seek assistance to recover from the situation.

Remember, helicopters are often operating in remote areas where ATC has no services; however, there may still be IFR aircraft transiting through, so communicating on the area frequency is important.

ATC expects a request for something out of the norm and non-standard when communicating with a helicopter pilot, so never be afraid to use common language and speak your mind. Better to say what you can and cannot do and ask for what you want and get that, or turn around and go home, or “land and live” to fight another day.

However, just because ATC gives you what you ask for does not mean that you can and should do it. Remember, ATC is there to manage multiple aircraft within an airspace management system. They are not there to tell you what rules you should be abiding by. ATC cannot see what you can or cannot see, so it is up to you to manage the safety of your aircraft and not blindly follow a clearance simply because you have asked for it and they have given it. ATC giving you a clearance does not absolve you from breaking rules nor does it absolve you from putting yourself at further risk because they ask you to do something. In saying this, you are able to break any rule in an emergency, so simply focus on a safe recovery, whatever that takes.

For some reason, pilots are afraid to make a MAYDAY or PAN call, unless the engine stops, the helicopter is on fire, or they are about to ditch. Often, this is explained by

- a misbelief they will get into trouble with the regulator,
- the amount of paperwork involved afterward,
- the possibility the NTSB/ATSB will get involved, resulting in possibly losing their job,
- a lack of time to make a call and manage the aircraft before contact with the ground, or
- the pilot’s inexperience making such a call, so they have no idea what to say or how to say it.

ATC is there to help and assist any pilot who has gotten into trouble. Think of the poor controller talking to a pilot one minute and the next minute the helicopter falls off the radar screen and is lost. That controller suffers real anxiety and can feel responsible for the loss. If they help you get on the ground safely after an event, they go home happy and feel good about themselves. It is a highlight of their day.


[5]

It is also important to consider the pilot going IIMC and the other innocent aircraft up there flying IFR with no idea that there is this rogue aircraft now heading into their airspace. Making the call early is the safest thing to do for all involved.

6.5.1 Declare an Emergency

It is mandatory to declare an emergency if going IIMC.

The type of emergency call will be at the discretion of the pilot and their specific circumstances.

A VFR pilot in a VFR helicopter will more than likely make a MAYDAY call.

An IFR pilot in an IFR helicopter that had not planned to go IMC may make a PAN PAN call to give the call some urgency in changing flight category.

6.5.1.1 MAYDAY

It is a mandatory MAYDAY call when IIMC under VFR.

> ***"MAYDAY MAYDAY MAYDAY this is N12XYZ, N12XYZ N12XYZ approximately 25 SM west of Austin. I am inadvertent IMC on climb to 4500 heading 123 degrees 4 POB request immediate assistance."***

Initially, go for a VFR level at or above LSALT/MSA in the hope of not encountering an actual IFR aircraft at an IFR level.

Your full concentration is then to continue to focus on the instruments and maintain control of the aircraft.

PAB

Maintain a wings-level attitude straight ahead; however, using the **PAB** drill, you may be required to climb to a safe altitude or turn onto a safe heading first.

ATC will quickly come back to you and ask some questions. At that point you must decide what is **important** and what is **urgent**.

- What is **urgent** and nagging at you is to respond to the radio call and do what they have asked you, but that may just kill you as you could lose concentration on what is important.
- What is **important** is maintaining control of the helicopter and climbing to the LSALT/MSA on a safe heading. This action takes priority over the radio.

Once you have control of the aircraft and have some spare mental space to respond to the call, you can do so, but not before. Often, the first response back to ATC can be a simple "**standby**" and then get on with flying the helicopter.

When ready, go back to ATC and either ask them to go ahead or respond to the questions, which usually include:

- Squawk IDENT on the transponder.
- Confirm in-flight conditions.
- What is your position altitude and intentions?
- Are you instrument trained?

Transponder:

Often, ATC may ask you to change the transponder from the standard VFR setting of 1200 to the emergency change-of-level setting 7700, or they may give you a discrete transponder code and ask you to change to that. Be very careful how you do this, as too much attention given to switching a transponder code is all it takes to lose control of the helicopter. You are not obligated to do it. **Aviate first**. If able, do as requested. If unable, tell them you are too busy for that and just hit the IDENT button on whatever code you currently have displayed on your transponder.

In-flight Conditions:

Confirming in-flight conditions is about you telling them you are in clouds. They really don't know, as you could have flown into clouds and popped out on top or it could be raining, in which case they may help by telling you where the freezing level is. Again, if it's too much, ignore the question. Only respond with what you are able. They are simply trying to build a picture of your circumstances and project forward any potential conflicts with other aircraft so they can be rerouted.

Position and Intentions:

Your altitude and position should be easy to read off the instruments if you have the cognitive capacity (mental space) to do that. The moving map on the EFB or the GPS in most helicopters these days makes that portion of the emergency easy. At the very least, you should be able to give out a very rough estimate. Whatever you do, **do not** attempt to look at a map that is not within your instrument scan.

If you do not know where you are, say so. However, take a big breath and think where you were about 10, 30, or 60 minutes ago. It is very easy to say you are about 20 SM east or west of a place at an altitude. You do not have to be overly accurate by giving coordinates or a street address.

A common tool given to pilots when in a stressful situation is to go from a big picture to a smaller one to find an answer. Just doing this gives comfort and builds confidence. Once the brain starts correctly finding answers to questions, other answers come easier. It is the same technique used when a pilot thinks they are lost on a navigation (in reality, they are not lost, they are simply temporarily uncertain of their position!).

For example:

Consider a pilot who is asked their current position and they have no idea how to answer and cannot pull up the GPS or EFB and do not want to look at their map in fear of losing control.

Start with the easy questions to get the easy answers.

- I am on planet Earth, 3rd rock from the sun (not lost).
- I am in the Northern hemisphere (not lost).
- I am on the continent of the United States (see not really that lost in the big scheme of things and starting to feel better about myself, finding some answers in the chaos).
- I am in Colorado (not lost).
- I left Denver Airport 60 minutes ago on a heading of 270 degrees and I am going about 100 kt (not lost).
- I was positively over Idaho Springs about 30 minutes ago (definitely not lost).
- I am about 30 minutes west of Idaho Springs (I know where I am).

- At 100 kt, that's about 50 SM west of Idaho Springs (I found my position).

"My position is approximately 50 SM west of Idaho Springs at 4500 ft."

If you were VMC and lost, now would be a good time to find a landing spot. Set down and pull out the map and mark where you think you are, then start looking out for some identifiable features. Take a breather and reset the internal compass.

However, because you are IMC, you cannot do this, but you do have an approximate idea where you are and can pass that along.

Instrument Trained:

If you are instrument trained, ATC will expect you to be able to do certain things for them when asked. As the pilot, you must also consider the type of helicopter you are flying and what it is equipped with. Being instrument trained does not mean you will be able to do all that ATC asks, because the helicopter may not be equipped. You will have to clarify this when you give ATC your answer about being instrument trained.

If instrument trained and in an IFR helicopter, or in a VFR helicopter that has instrumentation and systems that you can use for flight while in IMC, then inform ATC of this.

"Yes, instrument trained and in a helicopter with instruments."

If IFR trained, but not in a suitable helicopter, then also tell them that, so that they can assist you accordingly and do not have a higher expectation of your capabilities.

"Yes, instrument trained but the helicopter is not equipped for IMC."

If you are not instrument trained, then ATC will pull out all the stops to help you and guide you through a recovery. All you have to do is maintain control.

"No, I am not instrument trained and the helicopter is not equipped for IMC."

If you have an IIMC recovery plan, put it into action and notify ATC what you want to do. They will help you implement your plan.

If you have no idea what to do and have no plan, then you are not in a good space. Inform ATC and ask for their help to talk you down. **ATC is there to help*.***

6.5.1.2 PAN PAN

If you are an IFR pilot in an IFR aircraft and have an IIMC recovery plan, then it would be appropriate to make a PAN PAN call (unless of course you properly changed category to IFR before entering IMC). Because you are qualified and able to fly in IMC, this conveys urgency and will get ATC's attention without the added complication that you are in immediate danger. You should have the skills to control the aircraft and have a level of comfort in what you are doing. This can be conveyed in the confidence of the call and the order in which you conduct the recovery.

If you do not have this confidence, then go back to the MAYDAY call.

The reason it is a PAN PAN call is because you are now in unplanned IMC while operating under VFR and you may come in conflict with other IFR aircraft that are operating in IMC. They need to know.

The actions are the same. Conduct the **PAB** drill and climb to a VFR level above the LSALT/MSA on a safe heading. Squawk transponder code 7700, make the call, and respond to questions.

> ***"PAN PAN, PAN PAN, PAN PAN this is N12XYZ, N12XYZ, N12XYZ approximately 25 miles west of Austin. I am inadvertent IMC on climb to 4500 heading 123 degrees 4 POB. I request a change of category to IFR and traffic."***

Remember, if you are an IFR pilot in an aircraft that is not certificated for IFR, you cannot change category to IFR, but you can state your intentions and conduct the IIMC recovery plan with ATC assistance.

6.5.1.3 Change Category

If you are an IFR pilot in an IFR-certificated aircraft, then instead of making a PAN PAN call, you have the option to change category due to deteriorating weather and continue as an IFR flight. This should be done early **before** entering IMC. Having the EDTs in place should facilitate an early decision if pre-planned.

> ***"Austin Approach this is N12XYZ with a request."***

"N12XYZ this is Austin Approach go ahead."

> ***"Austin Approach, N12XYZ is approximately 25 SM west of Austin tracking 123 degrees maintaining 2500. Request a change of category to IFR due to deteriorating weather, a climb to 6000 ft, code and traffic."***

The calls will then continue in IFR format, which you should be familiar with.

Additionally, an IFR-trained pilot may be given additional options by ATC to maintain their own obstacle clearance to a certain altitude. Pilots may elect to take on this responsibility but must ensure their current flight path and ability to achieve a climb rate to be clear of any terrain or obstacles is assured.

If this is in doubt, then choosing to remain VMC, land, and live might be the better option.

If you have already entered IMC, then you should be making a PAN PAN call at the same time as asking for a change in category, in order to expedite the request.

> ***"PAN PAN, PAN PAN, PAN PAN this is N12XYZ, N12XYZ, N12XYZ approximately 25 SM west of Austin. I am inadvertent IMC passing 2500 ft on climb to 6000 heading 123 degrees. Request a change of category to IFR, code and traffic."***

Once received, the PAN PAN would be cancelled upon ATC issuing the IFR clearance, and you will continue as an IFR flight. Any changes to heading and altitude required to deconflict with traffic will then very quickly be conveyed to you.

If you have all the up-to-date instrument maps, instrument approach plates, and additional fuel and are current in your instrument rating, this is a natural option, and we would assume one you had planned on taking prior to the flight if encountering adverse weather.

If, however, you had not planned on this option and any one of the aforementioned items (maps, plates, fuel, instrument currency) is not available, then you are back to the original PAN PAN call as this is an unplanned flight into IMC.

If there is paperwork at the end of the flight and the regulator comes and asks questions, at least you and your passengers are alive to answer, and they cannot hang you out to dry for doing the right thing and getting the right outcome, regardless of how you got into that predicament in the first place.

Changing category from VFR to IFR and vice versa is a very common and easy thing to do for those who are trained and frequently do it.

6.6 Activate: Recover to VMC

Having experienced an IIMC event, successfully maintained control, and achieved the LSALT/MSA, you now must effect a recovery back to VMC and land. The last stage of the AANCA drill is to **A**ctivate the IIMC recovery plan to return to VMC and conduct a safe landing. This part is often not considered or trained for in any depth.

Unfortunately, there is no one plan that fits all.

The considerations that impact the options available include

- the local weather conditions;
- fuel remaining;
- pilot ability;
- aircraft capability;
- the available services at hand including ATC, instrument approaches, and airports; and
- the terrain or water in the vicinity.

Some of the options to consider for getting the helicopter back into VMC include

- ATC assistance;
- flying to a known clear area;
- descending, climbing, or turning;
- conducting a no-aid let-down; and
- conducting a full instrument approach, if an option.

6.6.1 ATC Assistance

Once an emergency is declared, ATC will direct you to fly to an area where they believe you can become visual again. Often, the bad weather you have flown into is localized and ATC can find a clear area based on their radar coverage. They can offer radar vectors, updated weather, and terrain avoidance. If you maintain control and have sufficient fuel in the tanks, they will be able to talk you down.

6.6.2 Flying to a Known Clear Area

Some options for getting to an area you know is clear may include

- flying in a direction where you know the weather is clear to effect your own recovery;
- from mountainous regions, flying toward coastal areas often sees a weather change and improvement;
- using the weather radar on the EFB, when available;
- asking other aircraft in the vicinity, when available;
- using local knowledge or prior knowledge of having just come from a clear area.

6.6.3 Options to Consider in Decision-Making

Depending on the weather conditions and your situation, it may be possible to maneuver the helicopter to recover to VMC reasonably quickly, which may include

- turning,

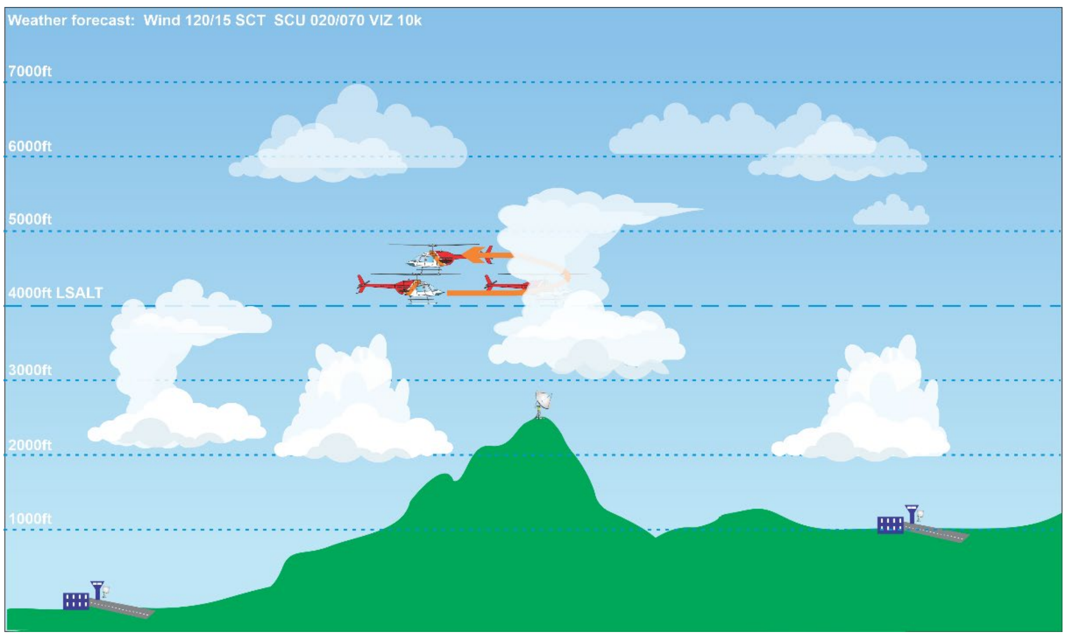
- maintaining straight and level,
- climbing, or
- descending.

Any of the following options are acceptable and can be chosen based on the circumstances and the comfort levels you have in your abilities.

Turning: Fly Back out of the Clouds

Turning is often the easiest way back to VMC, as you more than likely flew into the deteriorating weather, so logically it should be better behind you. This may not always be the case, but it is a good option to consider.

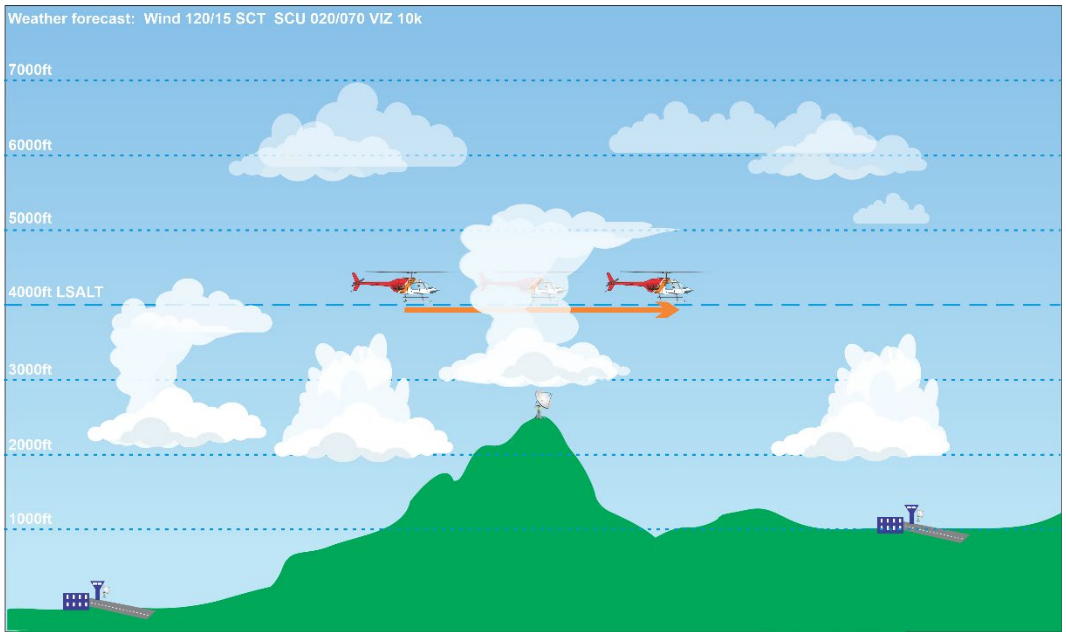
After establishing control, conduct a standard rate (rate 1) turn to the left or right through 180 degrees and, hopefully, fly back out of the clouds.



Maintain Straight and Level

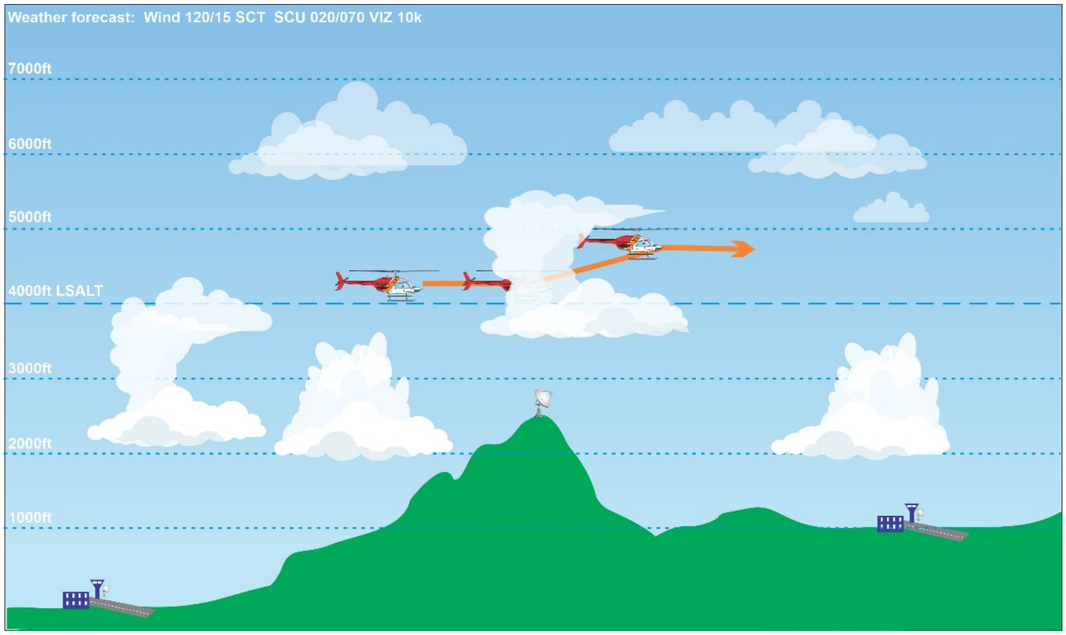
If the clouds were forecast to be broken or less, then half the sky or less is covered in clouds, but half the sky or more is clear. Therefore, if you do nothing but maintain straight and level, then you should eventually pop out of the clouds back into VMC. Often drawing a picture of the forecast during your pre-flight preparation can help you understand the atmosphere you are flying in a little better (see **Prepare a Weather Brief**).

Also just maintaining the helicopter in its current configuration should be more achievable than the skill required to turn, climb, or descend.

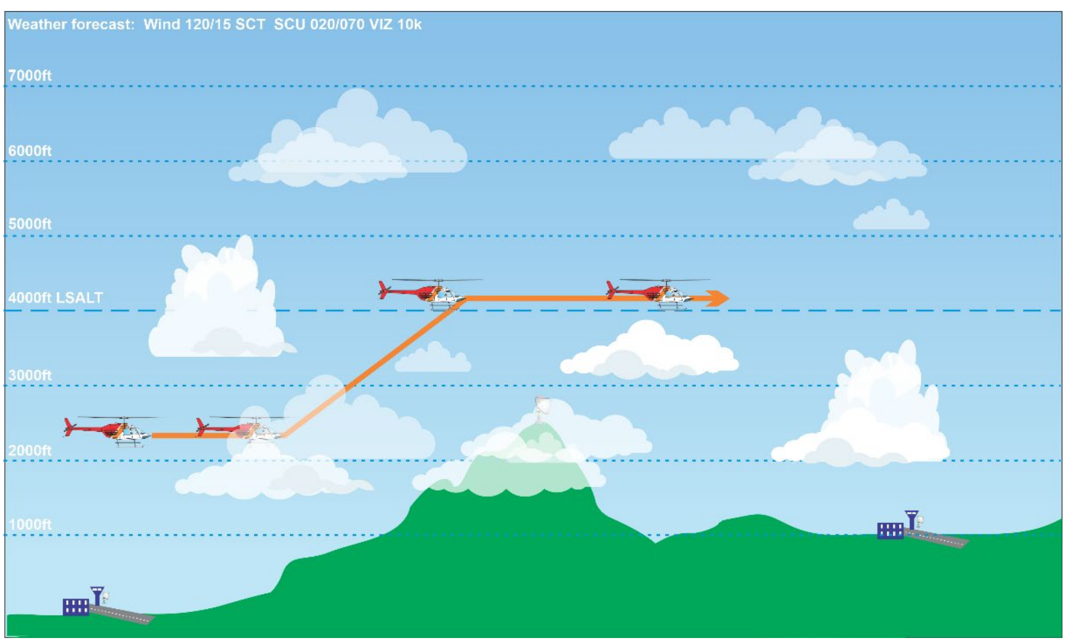


Climbing

Climbing is always an option to become visual, but be mindful that, for a helicopter, anything above 10,000 ft or above the freezing level while in the clouds becomes problematic. If you do climb and come out on top, you still have to make a descent at some point, but once above the clouds, it is easier to find holes in the cloud cover or see clear areas that you can fly to and descend through.



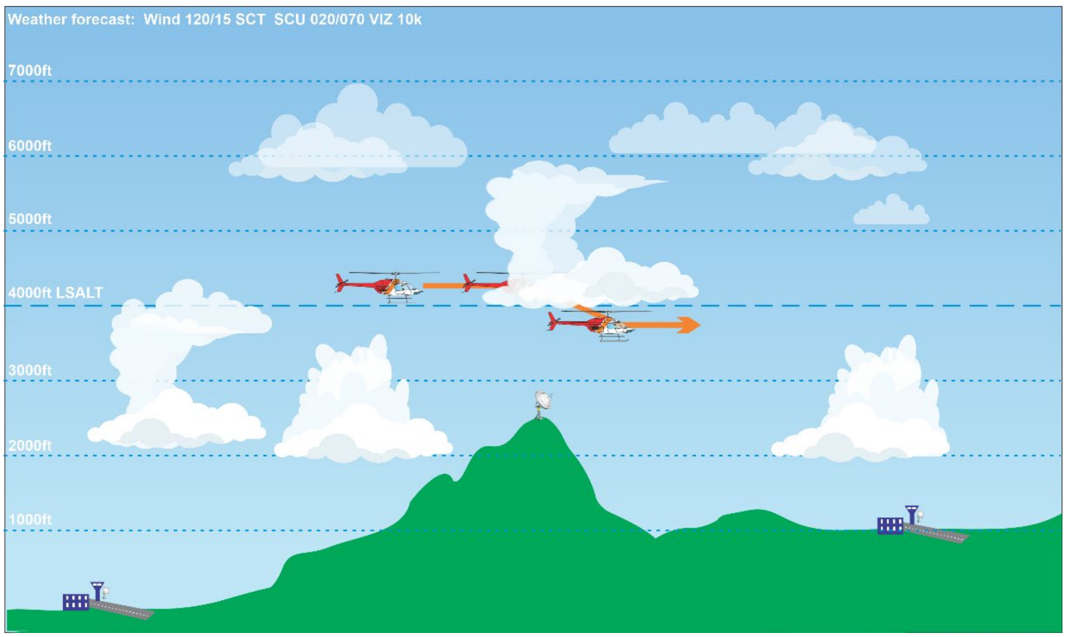
If below the LSALT/MSA on entry into the clouds and knowing where the terrain is, climbing is the first thing to do. If you are lucky, you may actually climb out of the clouds; if not, then once you are above the LSALT/MSA, you can initiate a recovery.



Descending

Descending is always problematic, as you can no longer see the terrain. If you know where you are and can descend while maintaining flight above the LSALT/MSA, then a descent may be appropriate. Otherwise, it should be avoided, unless setting the aircraft up for a no-aid let-down or on an instrument approach.

Additionally, if you know that you entered the cloud at its base and are aware of the height of the terrain underneath you, then you could commence a slow rate of descent by lowering the collective by 2–3″ MP or 10–15% TQ. Ensure the ROD does not exceed 500 ft per minute and maintain the speed at a lower manageable speed for the type (typically between 60–80 kt) but not below V_{MIN}. Allow the helicopter to come down no more than 500 ft above any terrain or obstacle. At some point, if lucky, you may become visual; if not, then you will again have to climb to the LSALT/MSA and work through a recovery.



6.6.4 Conducting a No-Aid Let-Down

A no-aid let-down is a procedure a pilot can use to commence a descent while in IMC to get below, or at least attempt to get below, the clouds. In the worst-case scenario, a no-aid let-down can be used to control a descent all the way to the ground. This may be the only option if low on fuel or encountering adverse weather such as icing conditions.

For example:

Consider a pilot who has inadvertently entered IMC at 300 ft AGL at an altitude of 1500 ft (on the altimeter). The nearest airport is 60 SM away with terrain of 5000 ft in between. The freezing level is 3000 ft and you only have 15 minutes of usable fuel remaining in the tanks, plus a 20-minute reserve.

The area is remote so there is no ATC assistance. The ground underneath was reasonably flat with trees. You believe the cloud base is 300 ft AGL and you are currently at 1800 ft AMSL (as displayed on the altimeter), so hopefully if you descend about 300 ft to 400 ft, you will again become visual.

You really do not have any option but to commence a descent and at the very worst control a crash onto the ground. Climbing to LSALT/MSA is not an option for the following two reasons:

- you will fly into icing conditions; and
- you will run out of fuel before you can effect a recovery anywhere; further, doing an autorotation in IMC is not an option you are willing to consider.

Your only option is to conduct a "no-aid let-down".

6.6.4.1 Requirements for Conducting a No-Aid Let-Down

A no-aid let-down requires

- a topographical map, preferably displayed on an EFB or MFD;
- a terrain page on the GPS; and
- a radar altimeter, if available.

It also requires the pilot to be situationally aware and confident in the procedure.

Topographical Map

A topographical map is simply there to give situational awareness of rising terrain or, more importantly, where the lower flatter terrain is and any obvious obstacles.

Reading a paper-based map is almost impossible as a single pilot in a helicopter, especially when concentrating on helicopter control in IMC. However, a moving map on an electronic flight bag (EFB) or a multi-function display (MFD) provides a good resource that is easy to access, read, and scan.

EFB	MFD
	

Terrain Page

A no-aid let-down requires the pilot to fly away from rising terrain or mountains toward lower falling terrain.

To do this, a pilot can activate the terrain features on the GPS (Figure 33), MFB (Figure 34), and EFB (Figure 35) to have an idea of what they are flying over and toward.

Figure 27 Terrain page on a GPS

Figure 28 Terrain feature on an MFD

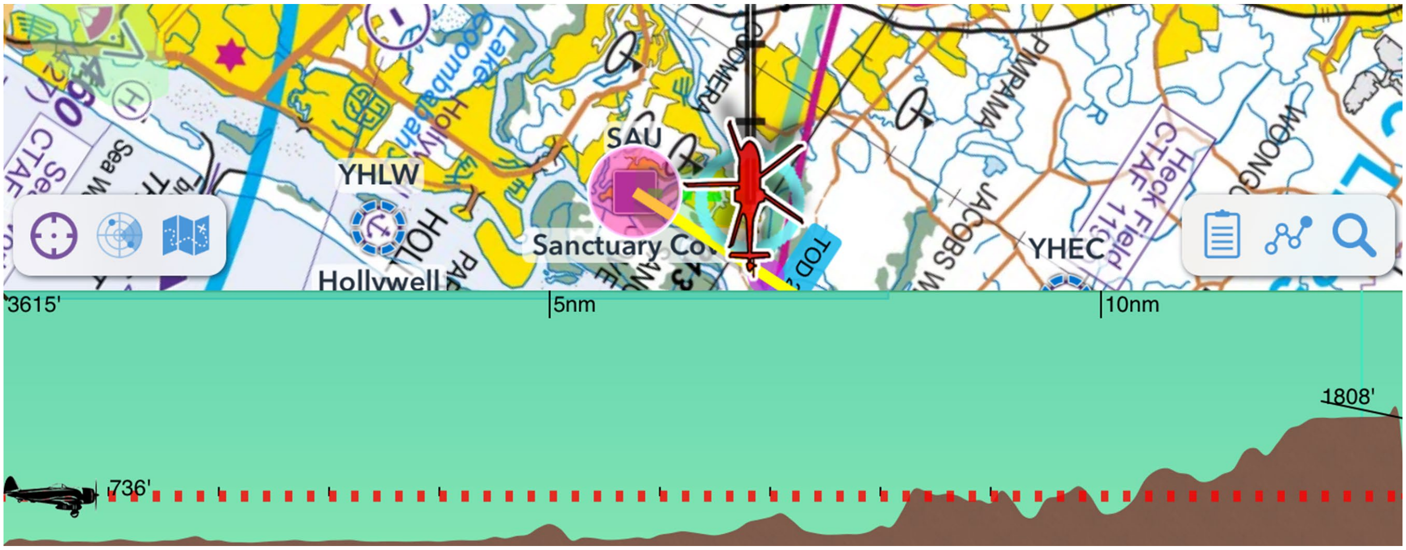


Figure 29 Terrain feature on an EFB

Procedure

Step	Action
1	Using the topographical map feature on the EFB or MFD, fly to a suitable area. Away from rising terrain, pick a valley or flatter looking area with no obvious obstacles such as wires.
2	Select the terrain page on the GPS, EFB, and/or MFD. On the terrain page, make sure you are flying away from **red** and **yellow** areas and toward green or black (this depends on the color coding used by different devices). Remember that as you get closer to the ground, even the green areas will start to go yellow and red as a proximity warning to the ground.
3	Select a target descent direction ▪ where the terrain is falling, away from rising terrain or mountains; over water is preferred; and ▪ that is directly into wind or at least has a headwind component; avoid downwind.
4	If available, set the radar altimeter (Figure 36) to give an aural warning at 100 ft AGL.  Figure 30 Radar altimeter

<table>
<tr><th>Step</th><th>Action</th></tr>
<tr><td>5</td><td>Commence a slow descent at a steady descent speed. This is typically
250fpm, maximum 500fpm, and
at V_{MIN} for the type.</td></tr>
<tr><td>6</td><td>Fly the descent to 200 ft AGL.

Once at 200 ft AGL, it is important to have “sneak peeks” outside to start looking for and transitioning to the ground. Never give up on the instrument scan, but every cycle of the scan, take a quick look outside to look for the ground.</td></tr>
<tr><td>7</td><td>Decision point at 200 ft AGL:
<table>
<tr><th>If…</th><th>And have…</th><th>Then…</th></tr>
<tr><td>visual</td><td>the ground in sight</td><td>keep the ground in sight, transition back to visual flying and land.</td></tr>
<tr><td>not visual</td><td>sufficient fuel</td><td>climb again and come up with another plan.</td></tr>
<tr><td>not visual</td><td>insufficient fuel</td><td>continue all the way to the ground in a controlled manner (see Step 8).</td></tr>
</table></td></tr>
<tr><td>8</td><td>If continuing below 200 ft AGL and still in IMC but have no other option but to land, then commence a descent with a
descent rate no greater than 250fpm, and
forward speed as low as possible for the aircraft to maintain stable positive control, that is, V_{MIN} for the type.
Once visual with the ground, then speed can reduce in the normal manner to complete a landing.

The common danger here is that pilots bring the speed back below V_{MIN} early while still in IMC, stop and start to drift backwards, losing control and not understanding why.

Prepare to settle the helicopter onto the ground and accept the possibility that you may sustain some damage as you may not be landing on a suitable area. You are, in effect, controlling a crash.

Even in thick fog the ground will eventually come into view. The key is to be in control of the helicopter when it does.</td></tr>
</table>

6.6.5 Conducting a Full Instrument Approach

If you are IFR trained, or you have the knowledge and ability to be aided by ATC, simply fly to the nearest airport and conduct a full instrument approach to become visual.

In this material, we will not discuss how to fly a full instrument approach, as that requires specific training at an instrument flight school.

7 Putting It All Together

The best way to now put all this information together is to give an example of a flight.

Flight Brief

A flight from KCIN (Carroll, IA) and KHNR (Harlan, IA). The flight has full ATC coverage.

Weather

The weather is:

KCIN Observation: 008 OVC, 4SM BR, 20/19.

KHNR Observation: 009 BKN, 020 OVC, 5SM BR, 19/17.

The Area Forecast Graphic indicates prevailing visibility of 5SM and ceilings of 1000 ft with rain possible.

Pilot Qualifications

You are a qualified CPL(H) with no instrument rating. You have approximately 1200 hours with only 12 hours at night in the circuit and over a city. You have 300 in the R44 and are familiar with the instruments radios and systems.

Aircraft Configuration

You are flying a Robinson R44 helicopter, which is certificated VFR and, therefore, not authorized to enter IMC. The instruments on board are shown below and include an AH, VSI, altimeter, and turn coordinator as well as the magnetic compass on the center pillar (not shown in the image). The helicopter also has a Garmin 430 GPS with the ability to display a MSA and a terrain page.

Preparation and Planning

Based on the weather, you know that you could encounter some adverse weather en route, so you plan to have some extra fuel on board and brief the passengers that there is a possibility that you may have to return, divert, or land due to the weather. You have no intention of going into IMC and on departure are sure that you can reach your destination, unless the weather is worse than forecast.

You have left a flight note with the fixed-base operator (FBO) you are departing from.

Because of the bad weather, you have set the following personal limits to help in creating your own enroute decision triggers (EDTs). If any one of the triggers are met, you will either return to base, divert, or land. Which decision you make will depend on where you are en route and the decisions required to be made based on your current circumstances. You will remain flexible until it is decision time.

Your personal limits are:

- Reducing airspeed to 55 kt due to visibility of less than 2 SM
- Height AGL of 500 ft due to a lowering cloud base
- Turbulence or thunderstorm activity within 5 SM of the aircraft
- Developing fog dust, haze, smoke, or flat light
- On the ground 1 hour before last light

IIMC Recovery Plan

Your IIMC recovery plan template consists of:

VMIN	55 kt
LSALT	3500
Freezing level	10,000
Last light	1848 local

<table>
<tr><td>Weather sketch</td><td colspan="2">Create your own weather sketch</td></tr>
<tr><td>Landing sites</td><td colspan="2">Nearest airports:
▪ KADU (Audubon, Iowa)
Alternative landing sites:
There are several suitable sites for an emergency helicopter landing in the form of sports fields and schools, such as in the town of Manning, Iowa, which is about 3 NM right of the planned route, about 15 NM after takeoff.</td></tr>
<tr><td>Fuel</td><td colspan="2">Sufficient to make any one of the landing sites from the route.</td></tr>
<tr><td rowspan="5">AANCA</td><td>Announce</td><td>“Reducing visibility”
(First stage trigger to divert, or land)
“EDT due cloud/visibility/speed or altitude”
(Second trigger must land)
“IMC IMC IMC”</td></tr>
<tr><td>Aviate</td><td>PAB</td></tr>
<tr><td>Navigate</td><td>Climb to 3500 ft on a safe heading</td></tr>
<tr><td>Communicate</td><td>Contact ATC – MAYDAY, squawk 7700</td></tr>
<tr><td>Activate</td><td>Recover to VMC and divert to safely land</td></tr>
</table>

Mud Map	Create your own mud map

En Route Scenario

En route, the weather seems worse than forecast. Visibility is reducing, so you slow down to 60 kt. You can see where you are going now, but due to the slower airspeed the rain is sticking to the windscreen, making visibility even harder. You know there is a windfarm out here somewhere and the clouds seem to be getting lower … . Or is the terrain getting higher? You are down to 500 ft AGL and the terrain is still rising.

You passed an open field 5 minutes ago, and the weather does seem to be better behind you; however, you think you can see a bit of daylight up ahead as the sky is lighter. This will mean descending to 300 ft to get past the rising terrain, but it is an area you have no local knowledge of.

Questions

- What are you going to do and why?
- Could you have anticipated the rising terrain along the route becoming a problem?
- What does it mean when temperature and dew point are so close?

8 Training for an IIMC Event

8.1 Training for Basic Attitude Instrument Flying Skills

Pilots intending to use their instrument skills need to do a minimum of 30 minutes of practice on basic instrument flying every 90 days to remain proficient. This currency can be conducted in a simulator or an aircraft.

This practice should include, with sole reference to the instruments and no outside assistance,

- maintaining straight and level flight,
- conducting a rate 1 turn (standard rate) to the left and right,
- climbing and descending at a constant speed at no more than 500 ft per minute rate of climb (ROC) or rate of descent (ROD),
- recovering from an unusual attitude, and
- practicing making a radio call to ATC asking for assistance.

Basic instrument training is available at most helicopter flight schools or via company check and training. Although not essential, it is beneficial that pilots get some experience and practice in the model of helicopter they will be flying.

[6]

8.2 Training for an IIMC Event

Training for an IIMC event is an interesting concept and is separate from basic instrument training in the same way that a full instrument rating is additional to the basic skill of instrument flying.

It is important to understand that the IIMC event is not going to be the root cause of the pilot losing control of the aircraft. It is simply the flight condition that has been inadvertently entered into. The helicopter does not care if it is day or night, VMC, or IMC, but the pilot obviously does.

Losing all visual references confuses the brain and is the root cause of a pilot losing control. The eyes give 80% of the information required to understand our position, orientation, and movement. Without this information, the brain can no longer clarify any ambiguity with information received from the rest of the vestibular system (inner ear, sensation of movement, touch, and smell). The brain is furiously trying to compute this new environment.

Even though the pilot knows they may need to transition inside to look at the instruments, the brain is simply not responding to the stressful situation quickly enough to make that happen. Therefore, there is a short period of time when inadvertently entering IMC from visual conditions before the pilot loses control.

To fully train for an IIMC event, a pilot needs to complete several pieces of training in the IIMC puzzle, including the following:

- Ground training to develop understanding and work through scenarios. (This reference material is an example.)
- Simulation training for practicing basic instrument skills, drills, and procedures in a safe environment over several hours while not under duress.
- Airtime in a simulated IMC environment.
- Finally, experiencing an actual IIMC event during dedicating training sessions with a qualified flight instructor and making a successful recovery.

In the past, we have relied on doing unusual attitude (UA) recovery training in a helicopter using foggles or a hood to reduce the pilot's outside view. This enables some basic instrument training on maintaining an attitude, completing a turn, climbing and descending, and managing speed, thinking this will put us in a good position if we ever went IIMC.

Alternatively, we practice in a simulator where we can push the envelope a bit more, in complete safety; but in the simulated environment, we often do not experience the same stresses and vestibular confusion that would be experienced in a real aircraft.

Additionally, in a training environment, you are expecting to lose visual reference, you have an instructor sitting beside you, and you are in an aircraft that is equipped. You are prepared, often entering the world of limited outside visual refences and transition on to the instruments slowly, as part of the training sortie.

You are not worried about hitting anything, there is no stress regarding fuel remaining, and you are not anxious about dying. There is nothing **"inadvertent"** about to happen.

So, how do you train for an IIMC recovery?

- The first step is to do all the above basic instrument training so that the basic skills are cemented in.
- The second step is to have an IIMC recovery plan in place.
- The third step is to experience an IIMC event. This is the hard part, as to practice legally and safely, it needs to be controlled and supervised by a certificated flight instructor in an IFR aircraft.

Once the foundation training is completed, the aim of the third step is to be placed in an IIMC situation and run through the entire recovery procedure. The workload is high. The concentration levels are high. The learning advantages are enormous.

The likelihood of successfully applying this training in a real IIMC situation is low unless the pilot is a professional who is constantly training for such an occurrence and is constantly in and out of IMC situations while regularly flying in an IFR-type environment.

Doing a real IIMC drill once is often enough for pilots to realize that they need to have greater personal limits, and make sure they never get into it for real, because even with training, the probability of a successful outcome is low.

The safest place to do this for the first few times is in a simulator, as the instructor can control the environment as you learn the skill of transitioning from outside visual cues to inside instrument cues.

Another method is to use technology in the cockpit that simulates IMC, which is now becoming available. Products, such as the one shown in Figure 37, use foggles that can be controlled from an iPad, where the visibility through the foggles can be varied by an instructor. It can be set to be transparent or can go to a complete whiteout in an instant, and everything in between.

The advantage of this system is it can simulate an IIMC event in a real aircraft without actually going IMC. This means we can fool your vestibular system so that you truly experience the sensations and the stress involved in an IIMC event.

Figure 31 ATC device controlled by tablet (Image courtesy of AT Systems)

8.3 Summary

In summary, any training starts with the availability of good reference material and ends with live training of the maneuver to competency.

Constant practice, repetition, and rehearsal lead to competency.

Any flight into IMC requires prior preparation.

Any inadvertent flight into IMC is to be avoided through good decision-making,

but if encountered, recovered by good training.

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