Total IFR A Reference Guide

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1 Dedication

This guide is dedicated to my son, Aria, whose passion and skills of flying has been a source of immense joy and inspiration to me.

Fly Safe!

Shane Tedjarati

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2 Overview

Why an "IFR guide" when they are numerous training manuals, documents, online guides and audio-visual material?

The answer: A simple, comprehensive, easy to understand place to see the whole picture and how it all hangs together.

This guide is not a training manual. Neither is it designed to be a detail description of processes and procedures or the techniques in flying IFR. It is meant to gather together the entire system and explain it in one place to allow the IFR pilot and student alike to get a quick, yet comprehensive guide to everything that makes up flying by Instrument Flying Rules.

Like every piece of work, this guide would not be free from error, omissions and oversight. In all cases, these are mine and I provide this guide with full acknowledgment that it is inadequate and should not be used as anything but a general reference.

This Guide is written from a perspective of a general aviation pilot and does not take full cognizance of commercial and air carrier type operations.

2.1 IFR Philosophy

"Instrument" is a simple word, yet it is the most powerful rating a pilot can acquire on an airman's certificate. It allows you to fly "in the system" with the major leagues. It opens up a world of possibilities, reduces cancellations and delays due to marginal VFR weather and, if executed with diligence, it offers a safe and precise flying experience.

IFR flying is not a ticket to fly in "any weather". Far from it. The Instrument rated pilot begins to appreciate and work with the weather far more than the VFR pilot. A good instrument pilot respects the weather and over time becomes a mini meteorologist.

The main philosophy of IFR is to create a consistent and comprehensive system on the ground, in the air and in the cockpit, with standards, conventions and procedures that allow for safe, orderly and efficient execution of all the phases of a flight and to do so in good weather and in Instrument Meteorological Conditions (IMC).

As a pilot, you must be aware that you are NOT the only one "flying IFR". There is a whole system that flies with you -- I call that the "IFR System".

2.2 The IFR System

IFR flying is a "System". It comprises many constituent parts that need to work hand-in- hand together. Unlike VFR flying where a pilot can essentially takes to the skies with the most basic aircraft (even without basic radio albeit in uncontrolled airspace) and without any clearances from ATC (or even their knowledge at times), IFR flying is not a one-sided affair. It requires not only a reasonably well equipped aircraft, but also a working navigation and guidance system (ground or satellite based) and approach environments (instruments, lighting, etc.). But more importantly, every IFR flight starts with a "contract" between the pilot and the ATC.

2.2.1 Basic Equipment

To work with the "system" the IFR aircraft would have to be equipped with some basic equipment. Although today's aircraft are often equipped with the most modern and advanced avionics, it is possible to fly with this basic equipment.

Note that although it is possible to fly with this minimum equipment and every pilot must practice to fly complete IFR missions with these and even with some equipment mal- functioning, it is not recommended to embark on serious IFR flying without a much better equipped aircraft such as redundant communication and navigation, glideslope equipped VOR, GPS and auto-pilot.

This basic equipment would be:

- Attitude Indicator
- Airspeed Indicator
- Altimeter
- Vertical Speed Indicator
- Compass
- Turn Coordinator
- Clock
- Two-way communications
- Transponder (mode S in certain areas)
- VOR receiver

2.2.2 Connecting to the System

In contrast to VFR flights where a pilot is essentially playing in a single-man band, IFR flying requires a complex set of procedures and steps to "attach" and "detach" from the system. The following describes the steps to "connect" to and "disconnect" from the system:

2.2.2.1 IFR Flight Plan

Every IFR Flight requires a flight plan. These are usually filed well ahead of flight with proper consultation with FSS or other weather service providers.

An IFR flight plan should be seen as simply a "request". It does not entitle the pilot to fly, nor is it a permission or clearance of any sorts. These come in the next stages of the process.

2.2.2.2 IFR Clearance

Once the pilot has filed the flight plan and usually when the pilot has started the engine(s), a clearance is requested from the ATC for the filed flight plan. A clearance has the following components:

C- Clearance - This is the limit of the destination to which the ATC is clearing the pilot. It usually is the ultimate destination of flight, but sometimes it may be a fix or an intersection identifiable on the IFR charts due to air traffic congestion.

R- Route - The routing of the flight which usually comprises of VORs, Victor Airways, Fixes, STARS, etc. If the pilot has filed a standard or otherwise simple route, this part of the clearance may be identical to one filed in the plan. In that case, the ATC may say "As Filed" for all or part of the route.

A- Altitude - Altitude cleared and often follows by an expected altitude in a particular time period (maintain 3000 expect 4000 in 10 mins)

F- Frequency - ATC departure frequency to use after take off

T- Transponder - Transponder code to squawk during the flight

The clearance (CRAFT) must be written, accepted and read back to the ATC with a positive acknowledgment that it is "correct". Only then can the pilot continue with the rest of the System.

The IFR clearance is not an authorization to fly. It simply is a clearance IF the flight was going to take place. Next step describes authorization to fly.

EXAMPLE:

Pilot: "Potamac Clearance Delivery, Cessna Skylane N14205 at Leesburg, IFR to Morristown"

ATC: "N14205, standby to copy clearance .... N14205, are you ready to copy?"

Pilot: "Ready to copy, N14205"

ATC: "N14205 is CLEARED to KMMU airport VIA STILL, Martinsburg VOR, Victor 206, to East Texas VOR, Victor 33, then as filed. Maintain 3000; expect 4000, 10 minutes after take off. Initial Frequency is Washington departure 125.75. Squawk 5667"

Pilot: "N14205 is CLEARED to KMMU airport VIA STILL, Martinsburg VOR, Victor 206, to East Texas VOR, Victor 33, then as filed. Will MAINTAIN 3000 and expect 4000, 10 minutes after take off. Initial Frequency is Washington departure 125.75 and we will Squawk 5667. N14205"

ATC: "N14205, Readback correct. Inform when ready for release"

Pilot: "Wilco. Thank you. N14205"

Sometimes, the Route and Altitude is described in a Departure Procedure [DP] (Discussed below later). In this instance, you have to have a written version of the DP to execute the departure including the initial altitude.

Canadian Variance

If you are flying in Canada, you may receive a clearance via a SID (Standard Instrument Departure). In these instances, you will usually not receive an Altitude as that is included in the SID. For example, the Hamilton 5 departure requires you to keep runway heading and fly to 3000' and then await radar vectors to your route of flight. You must have the text of the departure with you and the controller would expect that you know this and not ask specifically for an altitude or heading.

2.2.2.3 IFR Release

Once a clearance is issued and the pilot has prepared the plane and passengers and crew for take off, he/she will ask the ATC for an "IFR Release". A "Release" is essentially the moment when a pilot is authorized to be "attached" to the system. It is the time when ATC actually reserves a chunk of airspace for that particular aircraft for a given period of time. It physically clears the system to accept a new aircraft. Typical release will have the following components:

- Current Time
- Take off window (start time and end time)
- Inform time - in case not taken off by end time, must inform ATC by this time

The pilot has the responsibility to ensure he/she takes off within the "window" provided above and if he/she fails to do so, to inform the ATC before the "inform time". Failure to do so, will result in prolonged "reservation" of the system and serious bottleneck and congestion.

This clearance is an authorization to fly and begin the IFR flight, but it is NOT a take-off clearance. The pilot has to obtain take-off clearance from either the Tower or in case of an uncontrolled airport, go through standard take off procedures. Remember that such clearance must be executed within the "window" timeframe above.

EXAMPLE:

Pilot: "Potamac Delivery: N14205, ready for IFR release."

ATC: "N14205, time now is 17:05. You are cleared for release between 17:08 and 17:12. If not off by 17:12, inform us on this frequency no later than 17:15"

Pilot: "Cleared between 17:08 and 17:12. Will inform if not off no later than 17:15. N14205."

Switch to advisory frequency or tower, get take off clearance and take off IF you can do it between 17:08 and 17:12. If not, then you have to call them before 17:15 with a simple "Clearance, N14205 unable to depart due to traffic. request new clearance release".

In some smaller airports or airports not in large, busy metropolitan areas, the ATC (tower in this instance) will typically get your release window and have you sequenced for take off and hand you over to the ATC departure control for attachment into the system.

In some parts of North America such as some remote parts of Canada where radar services do not exist, you may be released and asked to contact the ATC at a particular location when such services would be available.

2.2.2.4 "Radar Contact"

Soon after take-off, the pilot must switch to the initial contact frequency and inform the ATC that he has started the flight. This typically happens with a simple call as follows:

"New York Departure, N14205 at 1500 for 3000 with you"

The ATC controller would be expecting the call and normally responds with:

"N14205 radar contact ..." followed by any other directions such as "maintain 3000" or "turn heading 240" or "climb to 4000 and proceed direct to XXX". The watchword here is "Radar Contact". When you hear that, you know that you have finally "attached" yourself to the "system"!

Sometimes the controllers may ask you to ident (meaning squawk) with your transponder to ensure there is no confusion.

Once your umbilical chord is "attached" to the system, you remain in the system until either the completion and closure of the flight or your specific request to "cancel" IFR in flight.

2.2.2.5 IFR Cancellation

IFR cancellation can take place at pilot's sole discretion under the following circumstances:

- Pilot determines rest of flight can safely take place in VFR conditions and wishes to continue VFR
- Pilot decides to cancel during short final after ensuring safe landing possibility due to landing in an uncontrolled or remote airport which would make it difficult to close a flight plan by radio

If a pilot does not "cancel" IFR prior to landing, then the flight plan has to be explicitly closed.

In controlled airports, where the pilot is in constant discussion with ATC and tower, the IFR flight plan will be automatically closed after landing. In other instances, the pilot in command has to specifically close the plan.

EXAMPLE:

Pilot: "Washington Centre, N14205, We would like to cancel IFR at this point"

ATC: "N14205, Radar Services terminated. Remain on this squawk code and frequency. maintain own visual separation at all times. Good day."

Pilot: "Roger. Will remain VFR. Have a good day sir. N14205"

The above example is in a congested are and probably during a busy approach. In most circumstances the ATC will just ask you to "Squawk VFR" and bid you farewell.

2.2.2.6 Flight Closure

If an IFR flight has not been specifically canceled by a pilot in flight, then the flight plan will need to be closed. In controlled airports this usually happens by the tower after the aircraft has landed and taxied off the active runway. In uncontrolled airports, the pilot has to contact or call specific controlling agencies and request for the flight plan to be closed. Failure to do so will cause the airspace to continue to be "reserved" and may also trigger a search and rescue operation.

2.2.3 Airborne Filing

See also: "Pop Up" Clearance

IFR flight plan, clearance and release can also be filed and activated in the air. This is usually done through FSS, though, workload permitting, it is possible to ask a controller to process the clearance. Sometimes this is called a "pop up clearance". Every student learning IFR should learn how to do this as it will come in handy one day.

2.3 All About Numbers

Everything about IFR flying is about the "numbers". IFR flying is a precise task and requires much greater attention to numbers on the airways, charts and most importantly on the plane. Nothing on an IFR flight is left to chance or "discretion" (though sometimes that happens by specific instructions of the ATC). Every altitude, heading, intercept, etc. is agreed to between the pilot and the controller and is expected to be followed with a high degree of accuracy. For example, altitude assignments are supposed to be within +/- 100 feet but never over 200 ft. Heading are expected to be nearly perfect and intercepts to radials and localizers, etc. are expected to be executed with precision and often as published.

Example of numbers in the "system"

- Altitude assignments
- Heading vectors
- Victor airways
- VOR radial intercepts
- Holding pattern details (time, length, radial, etc.)
- Time coordinated compass turns (in case of partial panel)
- Procedure turn headings
- DME arc details
- Minimum Descent Altitude (MDA) or Decision Height (DH)
- Runway Visual Range (RVR) and visibility in miles

The pilot also learns to fly the aircraft with much greater degree of accuracy and by the "numbers". For example:

- Power and MP settings for cruise, descend, approach, etc.
- Pitch angle for climb, descend and approach
- Speed for approach procedures

The pilot should memorize all the basic configuration (Power, MP, Flaps, Pitch and Speed) combinations for Cruise, Climb, Descend, Approach and precision/non-precision descent.

3 Basic Flying Skills

IFR flying is done only by reference to instruments. Except in guaranteed bright, clear days for the duration of the flight (a very rare occurrence), the pilot should assume that at some or part of the flight, he/she would have to stop looking outside and fly the aircraft entirely by reference to instruments.

The IFR pilot knows that outside reference in IMC conditions is not only unreliable, but outright dangerous! Relying on one's inner ear or "feeling" is equally dangerous. Only by reference to instrument can the pilot be sure of the attitude of the airplane should outside visual references be lost.

If fact, one of the basic tenets of IFR flying is that you must trust your instruments above all and not succumb to outside reference or feelings and sensations.

3.1 Straight & Level

Wings level, pitch neutral. This could save your life one day. This is the most basic maneuver and requires skills to master. At first sign of entry into clouds and disorientation, the pilot should first fly level and then neutralize the pitch to fly straight. Double checking is also required with altimeter and heading indicator to ensure the aircraft is not turning or ascending/descending.

3.2 Turns

IFR is not a maximum maneuvering exercise. Turns are made in gentle banks of 15-30 degrees. Standard turns are 2 minutes at 30 degree bank. A 180 degree turn is 60 seconds on standard turn as indicated by turn-and- bank coordinator.

3.3 Climbs & Descends

These are achieved by setting the right power settings and pitch attitude while monitoring altimeter and vertical speed indicator. It should be noted that while IFR is about "gentle" maneuvers, pilots should ensure that their aircraft configuration (weight, altitude, power setting, etc.) can deliver at least 500 fpm climb or a notification to the ATC would be required. When ATC instructs a pilot to either climb or descend to a particular altitude, they expect that in a reasonable timeframe and as a rule of thumb, 500 fpm is the minimum the pilot should set for this.

3.4 Scans & Scans

Scans are everything. You must constantly master a scanning technique to ensure you are cross-verifying every maneuver. Often you must scan airspeed indicator, altimeter, heading indicator and attitude indicator in a constant and coordinated manner.

Depending on the maneuver, your scans will go back and forth to various gauges. In a typical "six pack" round dial steam gauge aircraft, it is best to have your "focal point" as the Attitude Indicator (or Artificial Horizon), and then move back and forth to each of the relevant gauges as required.

One symptom the pilot has to be weary of is "scan glut" -- that is being stuck in one dimension of scan to the point of ignoring the other gauges. The pilot has to constantly practice cross scanning to all the gauges in order to ensure no unusual attitudes are encountered due to scan glut.

3.5 Flying the Numbers

See also: All About Numbers

As indicated in the overview, IFR flying is all about numbers and no where is this more apparent than in the basic flying maneuvers of the aircraft. This is especially true for Climb, Cruise, Descend and Approach stages of flight.

The attached table depicts a typical table the pilot must create for each aircraft type. It is good practice for every IFR pilot to take the time to fly every aircraft type in these various configurations and record the information, such that these critical stages of flight become automatic in nature and attention is rightly given to aviating the aircraft.

Aircraft: **C-182**

	Manifold Pressure	RPM	Pitch Setting	Airspeed	VSI	Flaps
Climb	**24**	**2400**	**7**	**100**	**700-800**	**-**
Cruise	**23**	**2400**	**0**	**140**	**0**	**-**
Cruise Descent	**19**	**2400**	**-2.5**	**140**	**-500**	**-**
Approach	**17**	**2300**	**1**	**90**	**0**	**10**
Approach Descent	**12**	**1900**	**-2.5**	**90**	**-700**	**10**
Non-Precision Descent	**14**	**2200**	**-2**	**90**	**-400**	**10**

4 IFR Departure

Departing an airport IFR is quite different than in VFR conditions. In the section on "Connecting to the System" we have described the various stages of initiating and concluding an IFR flight from filing the flight plan to closing it. Departing the airport comes after filing has been done (except when departing VFR and then filing IFR en- route -- i.e. Pop-up clearance).

Regardless of whether you are in IMC conditions or not, departing IFR requires a specific set of procedures which must be followed. The following sections describe some of the elements. The first step is to obtain your IFR clearance.

4.1 Clearances

See also: IFR Clearance

Once the airplane is ready for taxiing, the pilot initiates a request for clearance. We have described the process in some detail above in the "IFR Clearance" section. Essentially, the clearance tells the pilot what the ATC has done with the flight plan request. Typically the pilot will call the "Clearance Delivery" frequency for this request. In case of a remote area where such service is not available, either the tower controller can relay the message or even in some cases the FSS can relay the clearance.

One thing is for certain: NO CLEARANCE, NO IFR FLIGHT. Period. Without a clearance, the ATC has not allocated a route, altitude, code, etc to that particular flight and a departure into IFR system is not possible. The clearance is a contract between the pilot and the ATC and must be read back and accepted by the pilot. It is not, however, permission to fly. That comes later.

Once a clearance is given, the pilot would then prepare the plane for take-off and do the run- up. When ready, the pilot will request a "RELEASE" (see above too). The Release will give the pilot a time slot to fly and connect to the system based on the pre-approved clearance.

4.2 "Pop Up" Clearance

Sometimes pilots take off in VFR conditions and either encounter IMC or want to file IFR along the way for other reasons. This is called "Pop Up" IFR. The only difference with a regular clearance/release is that this is done in one big string of steps with ATC or FSS en- route instead of "File, Clearance, Release and Contact". Every IFR student must insist that their instructor show them how a Pop-Up IFR is done.

4.3 SIDs

Some airports, especially larger ones (though many small ones too) have Standard Instrument Departure (SID) procedures. These SIDS are referred to as "DP" or "Departure Procedures" or simply "Departure" depending on context.

The SID is an established and "published" procedure to allow the aircraft to make orderly and safe departure from a busy airport and connect to the appropriate routing via one or more possible "branches". SIDs often have names such as "Morristown Five Departure". The number in the name signifies the version number of the departure as they get updated from time to time by the FAA.

SIDs usually have a chart and a textual message describing the departure. To be legal, an IFR pilot has to have at least the textual part in his/her possession before flying that departure procedure. In the rare case that the IFR pilot has not got the procedure in the plane, he/she must request and write down the text before accepting that departure procedure as part of a departure clearance.

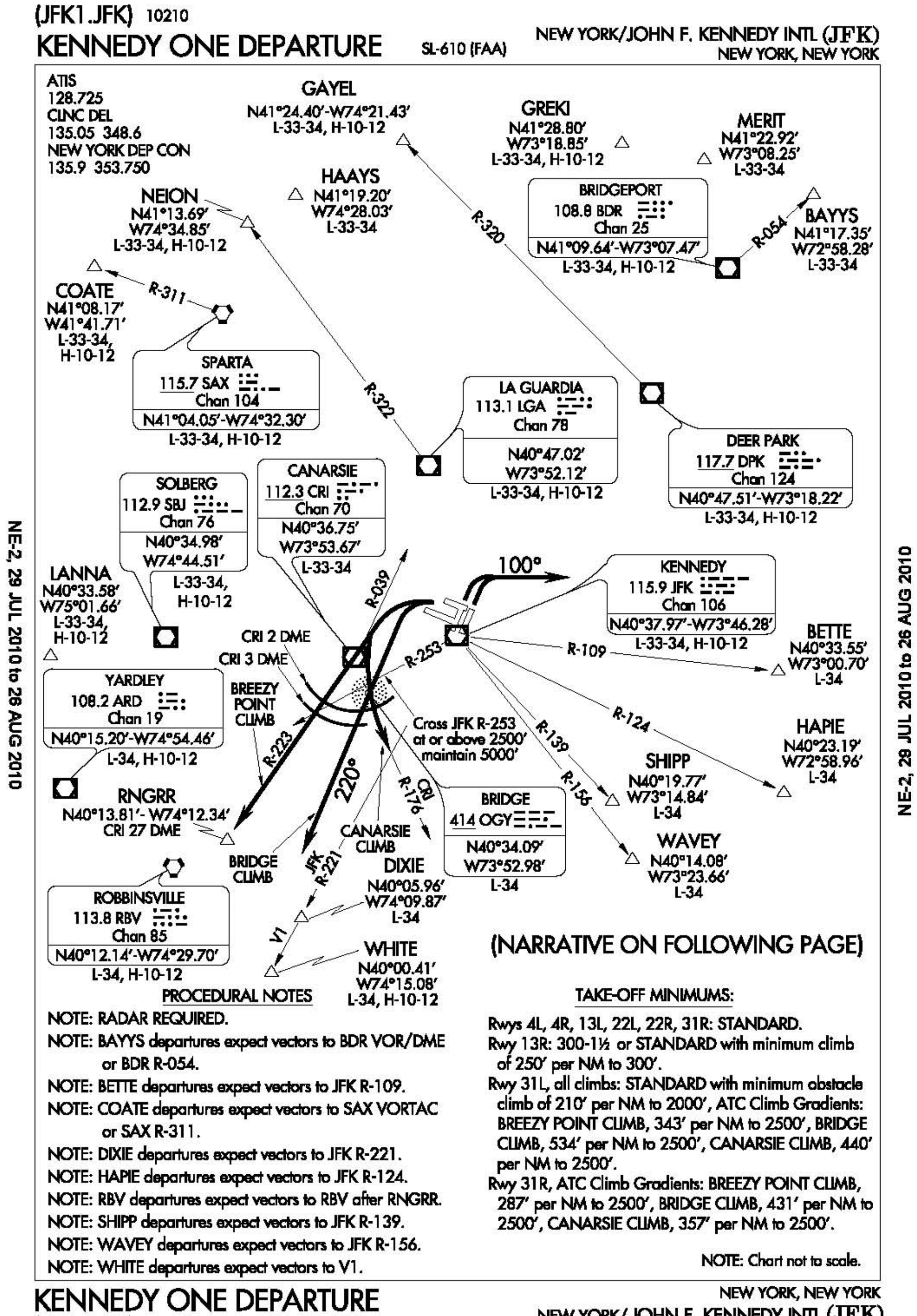
Examples of a departure procedure may be:

MORRISTOWN FIVE

RWY 32: "Climb Rwy Hdg to 1600, then left climbing turn 240 to 2000 then on established route"

SIDS will usually have many "branches" or "Transitions" to allow you to branch off in the direction of your desired flight. These are usually indicated by a further suffix such as "MORRISTOWN5.SPARTA" this means you will depart by the Morristown Five departure and transition via the SPARTA route to your en-route clearance.

The following is the first page of the KENNEDY ONE DEPARTURE.



4.4 Departing in IMC

Although commercial carriers and charters and some other operators maybe subject to minimum take-off limitations as stipulated in many airport charts, general aviation pilots have no basic minimum requirements for departing an airport in IMC conditions. Technically, a GA pilot can take off IFR in 0/0 conditions (0 visibility, 0 ceiling). This is highly discouraged and should not be attempted without understanding the risks.

A good flight planning process begins with the departure and any take off requires at least a "self briefing" by the pilot in command. These briefings can be very simple, but should include problems occurring during the take off roll, immediately after lift-off or shortly after lift-off and before full transition to en-route flight. These are taught differently in different flying clubs and schools, but the idea is to have a mental picture of what would happen if there is a loss of directional control, engine failure, fire or other emergencies during departure and how would the pilot respond to them. Single engine airplanes limit one's choice, but in a multi-engine aircraft the pilot is faced with many choices and that is often part of the problem.

How is that related to departing an airport in IMC conditions? Simply put, your choices will be severely curtailed during a take-off emergency if the weather is IFR with low ceilings. A self briefing becomes even more important and being totally alert to any signs of engine issues will be even more important.

Departing an airport in IMC conditions means that very shortly after take off, you will need to fly entirely by reference to instruments. Since the take-off roll is usually done visually, this transition will take a bit of getting used to, especially for new IFR pilots. Shortly after take-off, the pilot must stop looking outside and fly the aircraft solely with reference to the instruments. This can be a taxing exercise when departing busy airports with complex SIDs where controllers expect you to follow departure procedures precisely. Make sure you have your SID properly reviewed several times and the SID chart handy to navigate with as your en-route navigation chart would not be useful here. Also, it is a good idea to have all your NAV and COMM frequencies set, including VOR radial intercepts, etc. This is not the time to be looking at charts and entering frequencies. There is a lot going on and you want to have a smooth transition to IFR flying and follow your instruments without too much trouble.

4.5 Uncontrolled Airport

Departing IFR from uncontrolled airports need not be an unnerving exercise. In fact, it could be somewhat easier than departing from a busy airport in a big terminal area. Let's discuss two types of uncontrolled airports:

1. Uncontrolled airports within controlled airspace

In most cases, uncontrolled airports near bigger airports or within vicinity of big terminal areas, will have standard "clearance delivery" frequencies or a telephone number to call for clearance. Once airborne, you are likely to be able to get a departure frequency and "connect" to the system shortly after take off.

2. Uncontrolled airports outside of controlled airspace

If you are taking off IFR from a remote, uncontrolled airport, you would have to get your departure clearance most likely by a phone call, either to FSS or a special centre. In these cases, you will get a standard departure clearance and would have to be ready to jump back in your aircraft and fly within the given window. If after take-off, you are not able to talk to a controller due to being in uncontrolled airspace, you must realize that ALL separation from other aircraft will be your responsibility and you will receive no separation at all from either VFR or IFR traffic.

Once you are able to enter controlled airspace, then you would establish contact with ATC and connect to the IFR system as described before. Your clearance would most likely be to a fix as soon as you enter controlled airspace.

4.5.1 Canadian Variance

In certain parts of Canada (even near major metro areas), you may receive your clearance from an FSS radio but you may not be able to connect with an ATC soon after departure. This is because radar coverage may be inadequate. In such cases, you will be asked to contact ATC at a particular point such as a fix, a DME distance from a VOR or the like. For example, departing from Muskoka (CYQA) airport to Buttonville via YSO (Simcoe) VOR, you may be asked to call the Toronto Centre ATC 15 miles from YSO VOR. Therefore, from CYQA to 15 miles north of YSO, you are in IFR flight rules but have not been "radar contact" yet.

5 En Route

The en route portion of the flight typically starts from a navigation aid or a fix soon after departure which will set you up for following the "highways in the sky" as described below. Depending on a number of factors such as the weather, the traffic, the area of concern, etc. the controller would normally vector you and have you join one of the early fixes in your cleared route of flight and then let you cruise on. In doing so, you may be passed on from controller to controller and this will naturally occur as you progress along your route. Normally you will be given higher altitudes up to the max cleared altitude in your clearance as you begin the en route portion of your flight.

5.1 Navigation

Navigating IFR flights is typically easier than VFR. For one thing, you are not alone. Every IFR flight is a pre-planned contract between the pilot and the air traffic control and any deviation from that plan must be agreed to between the two parties, except during an emergency.

Navigating en route in IFR involved tracking navigational aids, be they NDBs, VOR's, an airway fix or a GPS track. Regardless of what aid you use, the basics of intercepting and tracking a course is all it takes during IFR en route flight.

The choice of what routes to take and how to plan the en route phase of the flight will be discussed in the flight planning section. Suffice it to say, that an IFR pilot must be very well versed in intercepting radials to and from VOR's, keeping accurate track of one's course and have total situational awareness of where the aircraft is without any physical reference to the landmarks around him. In fact strict course and altitude accuracy is expected from an IFR pilot to standards never even discussed during VFR training.

Highways in the Sky

In planning your routes, you will see that many low altitude "routes" are identified as "victor" airways. These are usually numbered such as "V224" or "Victor 224" and are typically between two or more VOR stations or airway fixes. Sometimes two or more victor airways merge and separate again like highways in the sky. Filing and flying by victor airways makes for simpler flight planning and better standardization, though it is not strictly necessary for you to file as such. However, when you have a sufficiently long cross country flight, you are bound to get some sort of victor airway to fly on, so be ready to learn how to fly them accurately.

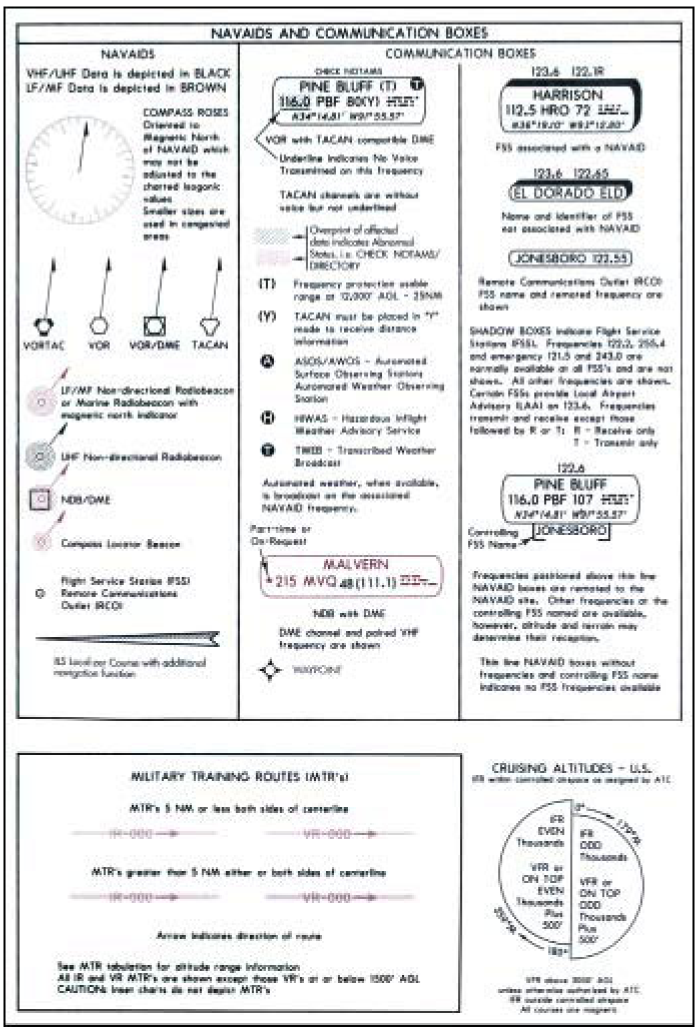
5.2 En Route IFR Charts

IFR en route navigation is basically accomplished with the aid of En Route Charts. There are two types: low altitude and high altitude (above 18,000'). We will discuss low altitude charts here which are typically used for general aviation.

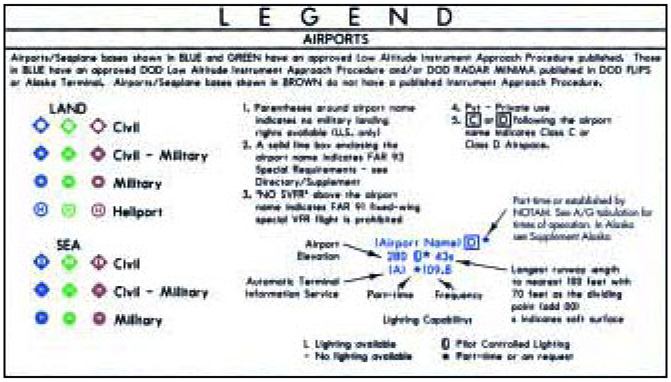
Low altitude en route charts consist of scaled depiction of all the radio facilities and fixes needed for navigation in the skies with reference only to instruments. In addition, they include all the "airways", special airspaces as well as a depiction of airports, albeit not to any level of detail to be useful beyond general identification.

There are two types of popular charts - NACO made by the government and Jeppesen which are slightly different, but mainly do the same thing.

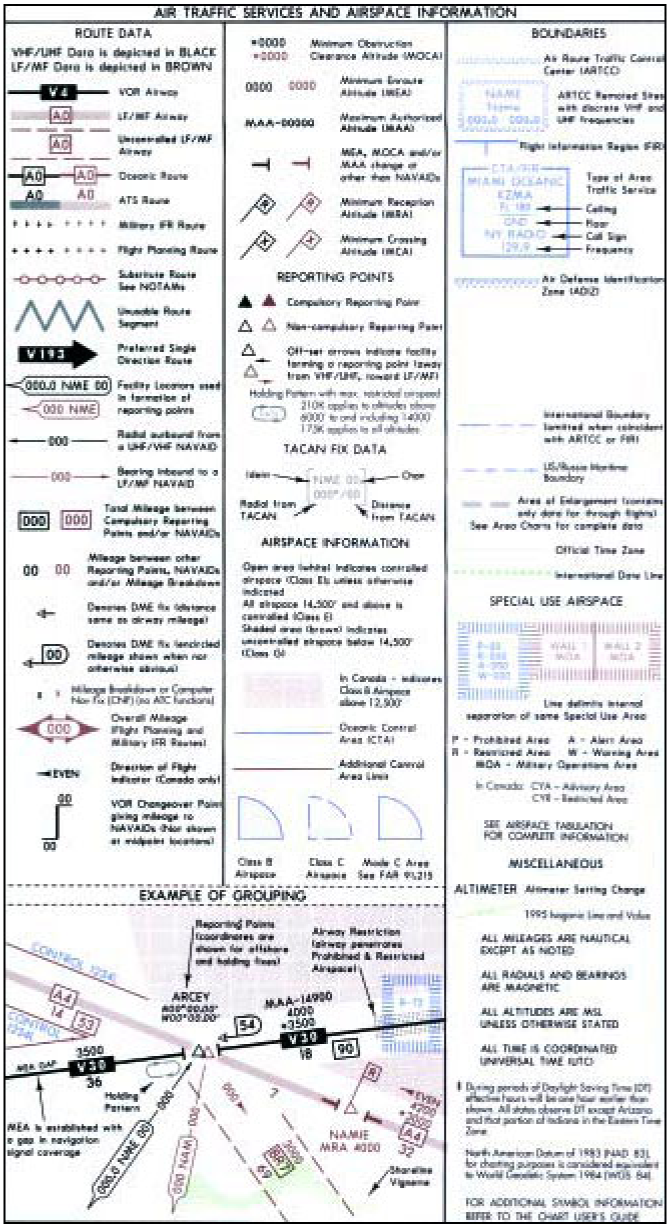
The following legend from the NACO charts shows some of the references to NAVAIDS and Communication in the Charts.



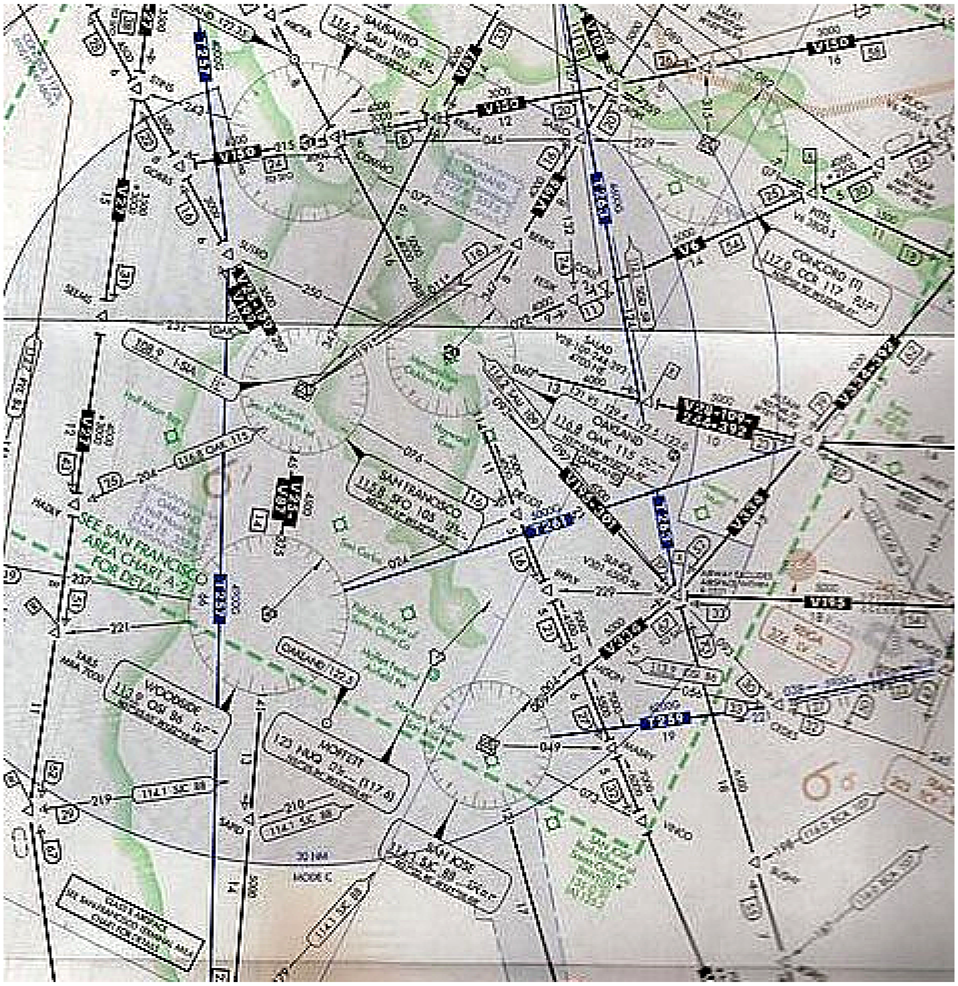
The following is a depiction of the airport reference guides in a NACO Chart:



The following is a reference guide for air traffic and airspace in a NACO chart:



The following is a section of an IFR low altitude chart covering the greater San Francisco area.



5.3 Altitudes

Altitude is everything. No quire, but almost. Altitude is the third dimension of the IFR flight which keeps the controllers from guessing and allows them to space you and often "sandwich" you between competing traffic of all kinds. When an altitude is assigned by ATC, it is expected that you adhere to it PRECISELY. As an IFR pilot, you should never allow yourself to deviate from altitude by more than 50' even though the tolerance in the system is higher than that. If you deviate by around 200', there is typically an alarm that would sound with the controller and you'd better correct back immediately. The reason for this strict adherence is that the basic assumption in IFR flight is that airplanes cannot "see" each other and the only way they can avoid an accident is by adhering to strict routes and altitude. Given the current "airway" system of victor airways and jet airways, most aircraft travel on the same routes. Therefore, it is very important to not deviate from the assigned altitude or the chance of mid-air encounter could even be higher than VFR flying!

There are many "minimum" altitudes to know and work with for IFR flying. Here, we mention just a few more important ones.

5.3.1 MEA

MEA stands for Minimum En Route Altitude. As the name suggests, it is the minimum altitude allowed en route on any IFR route, be it a victor airway, or just an airway between two navigational fixes or aids. The MEA ensures obstruction clearance of 1000 feet over the highest obstacle in non-mountainous regions and 2000' in mountainous regions. It ensures a navigational radio reception en route but not necessarily a communication reception.

5.3.2 MOCA

MOCA stands for Minimum Obstruction Clearance Altitude. It is the minimum altitude that guarantees you 1000' of obstruction clearance in non mountainous regions and 2000' in designated mountainous regions, but does not guarantee radio navigational reception. You should never fly below the MOCA. Acceptable navigation coverage will only be within 22 nm.

5.3.3 MCA

MCA is the Minimum Crossing Altitude and is used for crossing fixes or aids at a particular minimum altitude. Typically this is done because there will be an altitude change in the next route and the MCA is a "transition" altitude.

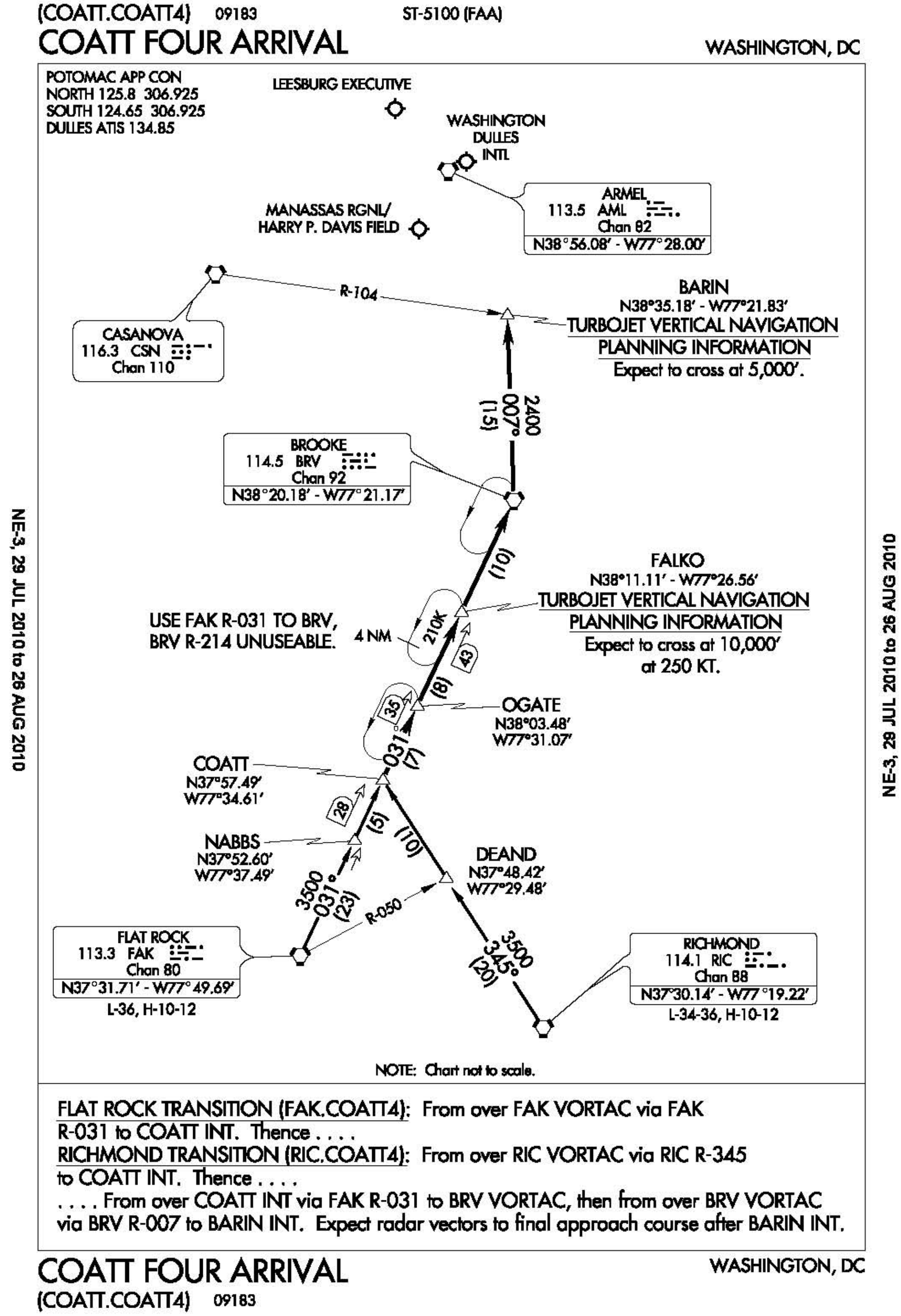
5.4 Cruise Clearance

Occasionally, ATC may clear the pilot with "Cruise to DEST at ALT". This clearance allows the pilot to choose any altitude from MEA up to and including the cleared altitude. It will also authorize the pilot to proceed to and make an approach at the destination.

6 Arrivals & STARs

STARs = Standard Terminal Arrival and is set of pre-planned, published procedures to arrive at busy terminal areas in the country. A STAR is typically referred to as an "Arrival" and is most widely used in flight planning. In fact, some STARs start from a far enough distance from a major metropolitan area that it could be a big part of a short cross-country flight. When filing and using a STAR, the pilot is expected to fly the STAR precisely to guide him or her to the airport of intended arrival. A typical STAR may have five or more airports within it and may have as many directions to enter it. It is basically a way to connect the airways to the network of tight routes that bring the pilot closer to a fix or a navigational aid to allow initiation of an IFR approach. In a sense, a STAR is a "connector" joint in a plumbing maze. Much like the SID was the connector to the "system", the STAR does the reverse job. It is, however, more elaborate and more delicate to fly than a SID which is often much simpler and involves usually a few instructions in terms of headings, altitudes, fixes, etc.

STARs have names and transitions such as the COATT4 arrival for Washing DC area with two transitions -- Flat Rock and Richmond.



6.1 Choosing STARs

When choosing a STAR, you have to consider direction of flight arrival, the particular approach you would be taking and also whether the STAR is relevant to the type of aircraft you will be flying. Some STARs are designed for larger aircraft with minimum speeds. STARs do simplify flight planning and expect to see them in your clearances.

6.2 Flying STARS

Flying STARs is similar to flying the en route charts. However, you will not find the details of the STARs in the charts. The STARs are found in the approach plate books and have detailed description and their own detailed charts.

7 IFR Approach

Perhaps the most demanding part of any IFR flight is the IFR approach. So much so, that the FAA's requirement for IFR currency is largely related to IFR approaches (6 Approaches in past six months, plus holds and intercepts).

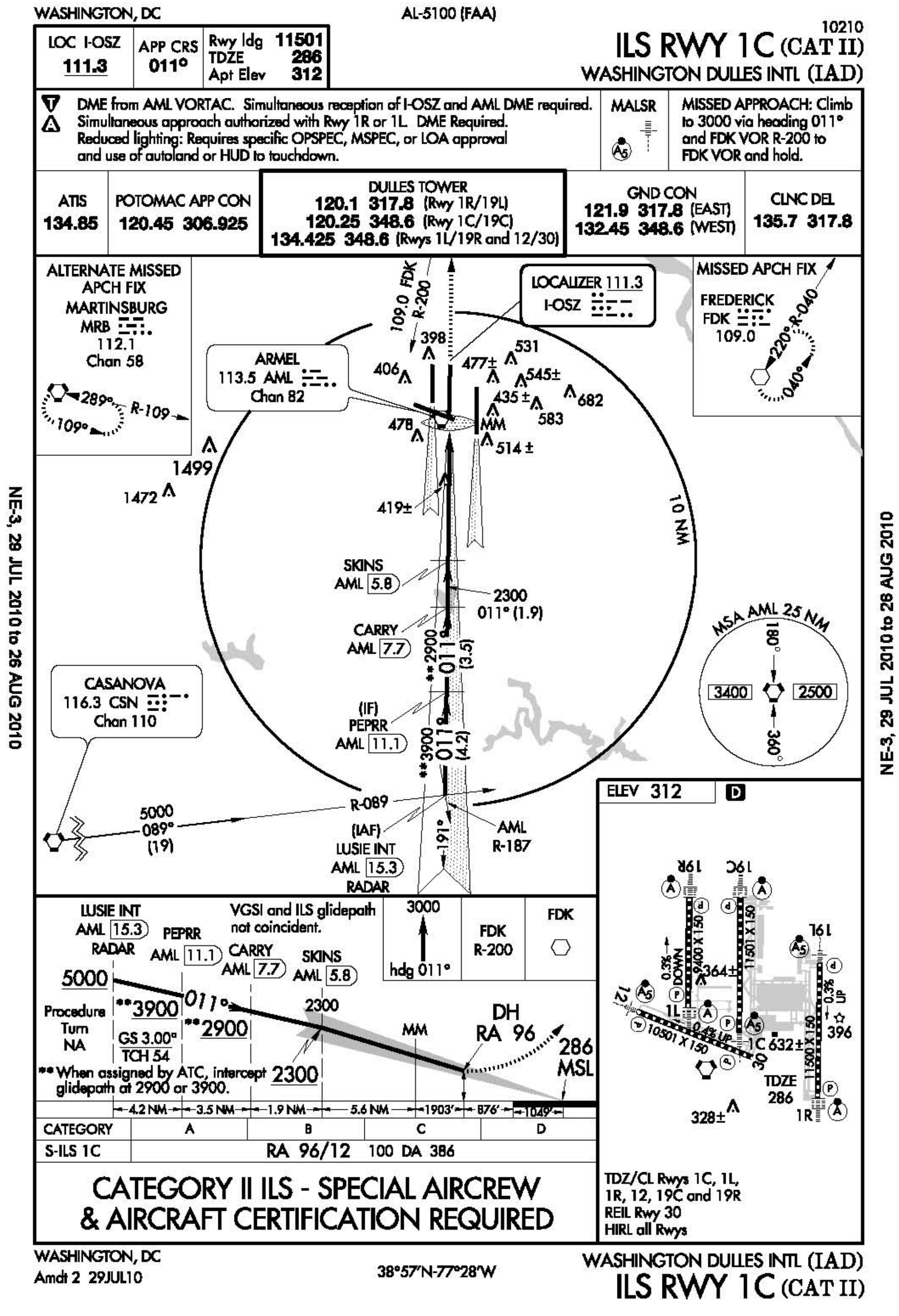
The IFR approach, especially in real IMC conditions, can be an unnerving experience for the unprepared pilot. If prepared and briefed properly, IFR approaches can be flown with precision, consistency and high degree of safety. There is no guessing left for the pilot. The approach is a very precise flying pattern which the pilot must execute in order to safely arrive at a point near the airport runway environment to either make a safe landing or execute a missed approach procedure. Like everything, practice makes perfect here.

Pilots typically use the verb "to shoot" when they refer to the act of flying an IFR approach. During training, you must "shoot" many different approaches over and over again in order to have enough sharpness to feel comfortable with different situations.

7.1 Approach Plates

Each IFR approach is fully described in detail on what is called an approach "plate". The approach plate is a compact single-page document which includes a combination of charts, profiles and data to fully describe to the pilot the entire procedure of shooting an approach.

The following is the ILS 1C approach plate into Washington's Dulles airport KIAD.

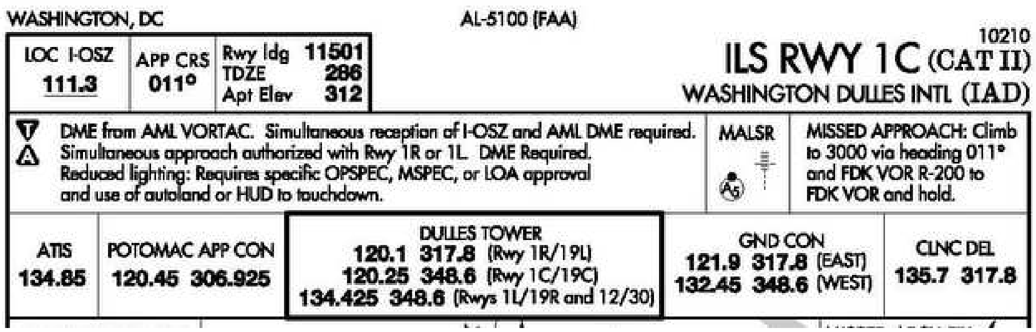


7.1.1 Components Of An Approach

The approach plates or charts are made by two sources: Jeppssen or NOAA (published by the government). Either can be used and both have similar components, although with minor variations.

7.1.1.1 Heading

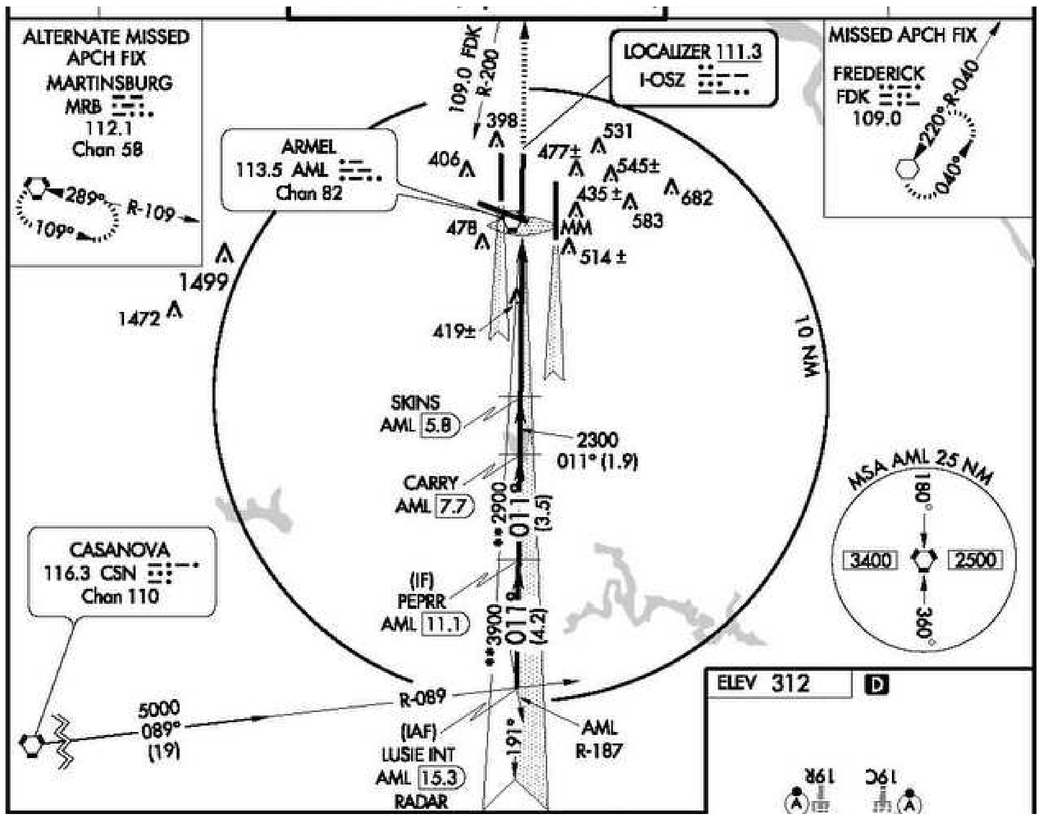
The header section is comprised of the identification and basic information about the approach. For example, the name of the airport, the type of approach, the frequencies to be used, any special instructions or limitations and the textual description of the missed approach procedure goes in this section.



7.1.1.2 Chart View

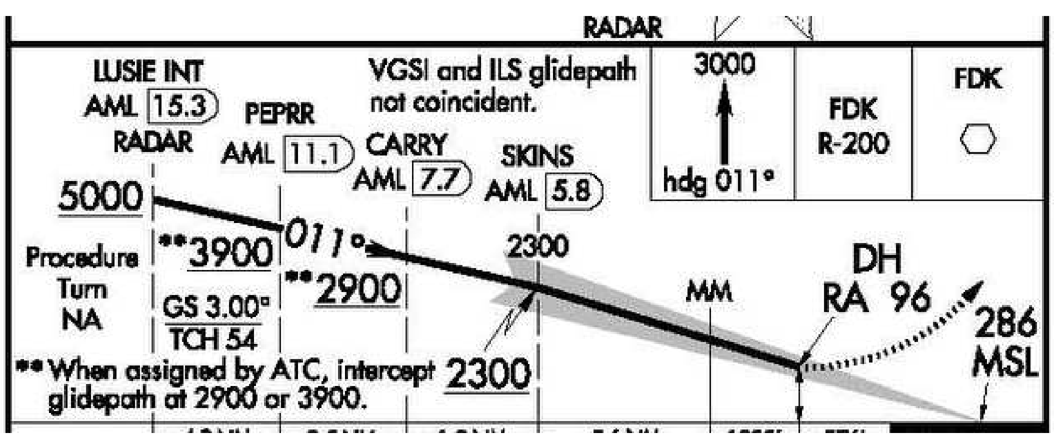
The chart or the plan view is essentially a map showing the route of the whole approach procedure. In addition to the map showing the beginning and end of the approach, including any procedure turns and the missed approach and holding path, it also includes Minimum Safe Altitudes (MSA) for each sector of the chart. The MSA guarantees obstruction clearance in the particular sector of the chart. The chart view is not drawn to scale.

There is usually a circle drawn in the chart view which is a supposed to be a 10nm radius around the airport. This is useful since the procedures and maneuvers are expected to be completed in the 10nm radius of the airport for obstruction clearance purposes.



7.1.1.3 Profile View

The profile view is used to compliment the chart view showing, from an "altitude" perspective, how an approach is supposed to be flown. It depicts exact altitudes to which you can descent in each of the stages and steps of the whole approach. It also clearly identifies the Final Approach Fix and the Missed Approach Point.



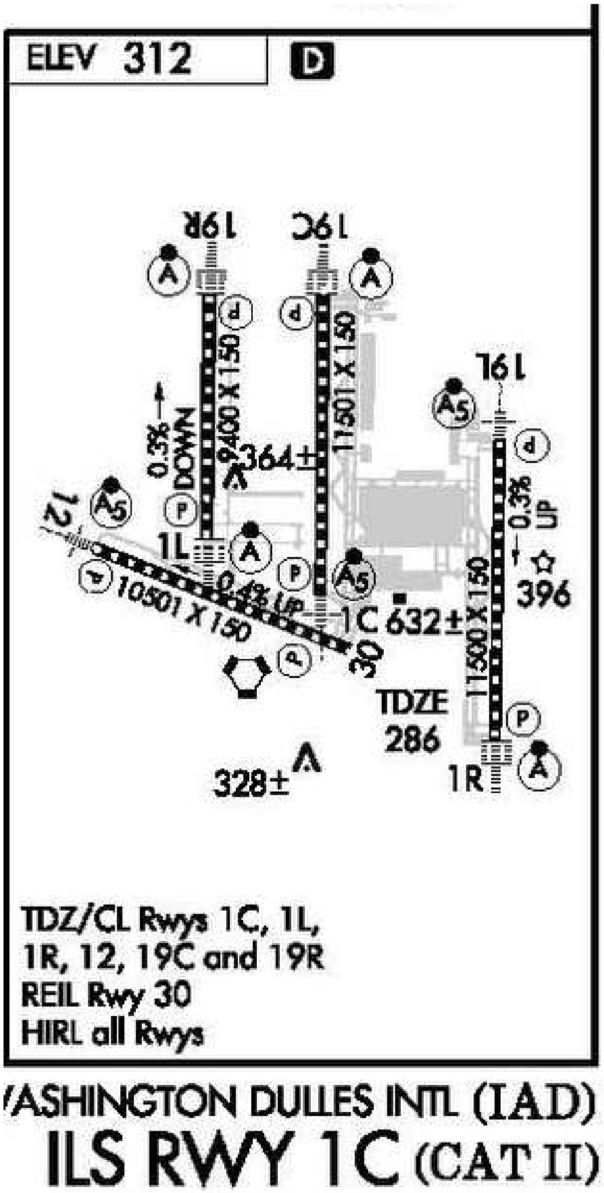
7.1.1.4 Missed Approach Procedure

The Missed Approach Procedure is a clearly defined procedure that depicts what the pilot should do when executing a missed approach. There is a textual description in the Header as described above. In the Profile View, there are usually a number of signs that graphically describe the procedure. It usually involves flying a particular heading to a particular altitude and then execute one or more turns to arrive at a fix or a navigational aid and then execute a hold.

Missed Approaches are depicted with dashed lines on both the chart view and the profile view.

7.1.1.5 Airport Diagram

There is a small airport diagram which is used in the bottom of the approach plates. This is useful to validate such things as runway threshold heights, lightings, etc.



7.1.1.6 Minimums

The sacred ground for any IFR approach is the "minimums". You do NOT bust the minimums, period. Make it a habit to yourself from day one. Your tolerance here should be zero. Your CFI's tolerance should be zero. If it is not, change your CFI. Your FAA examiner will most likely have zero tolerance here.

Why? Because in an IFR approach you are flying "blind" in and around an airport, near the ground at slow speed in landing configuration! That could be a very risky proposition. The approach is designed to bring you, through a carefully charted course, toward the airport and the runway and to a particular altitude which would allow you to continue to fly VISUALLY and land.

Unless you are flying military machines of the most sophisticated types, there is no such thing as a "zero zero" landing. The Minimums refer to the minimum altitude to which you may descend at which certain visual conditions must be met before you can continue your descent to land. The minimums are made up of an "altitude" and a visibility component such as "870 - 3/4 " which means 870 feet and 3/4 miles visibility. The visibility may be in miles or in RVR (runway visual range).

In precision approaches such as the ILS, the minimums are described in terms of a "Decision Altitude" or a DA, and in non-precision approaches they are called "Minimum Descent Altitude" or MDA. The reason for this distinction is that in precision approaches, you have a "glidepath" indicator which takes you through a precise glideslope aligned fully with the runway. When you reach the DA, you are at an altitude at which you must make a decision to either continue with the flight or execute the missed approach. There are no more waits. Decision Altitude requires immediate decision. The choices are clear. If you see the runway environment and can make a safe approach, you continue and land. If you don't, you immediately get out of there by executing the missed approach. The altitude for DA is usually only a few hundred feet above the runway and in most cases around only 200 feet above ground. This should make it very clear why quick decision is essential at this altitude.

To make precision approaches even more usable, there is also a "Decision Height" (or DH) to consider. This is the height above the runway threshold. If the pilot has arrived at the DA and has identified the runway approach lights, but has not yet fully seen the actual runway, he or she can continue to descend to the DH (which is usually only 100' above the touchdown threshold zone or TDZ). At that point, the runway environment as per the minimum visibility must be visible before attempting a touchdown.

In non-precision approaches, you descend through a series of "steps" in a non-precise fashion. Naturally, the tolerance of this altitude would be higher than in precision approaches. When the pilot arrives at the MDA, power is added and the altitude is kept precisely (or err on the safe side and remain a little higher). However, because of its non- precision nature, the pilot does not know whether he or she has arrived at a point where a decision to continue the approach or execute a missed approach. That determination can only be made by a combination of other inputs such as "time", DME fix or a navigation "marker" of sorts that identifies your arrival at the Missed Approach Point (MAP). Therefore, in non-precision approaches the pilot descends to the MDA, adds power and keeps that altitude, and when the other determination is made as to whether the plane is at the MAP, a decision is made to either continue with the approach and land or execute the missed approach procedure. This decision is made based on visual inspection that the airport and the landing runway is sufficiently in sight to allow a safe landing using standard (read minimum) maneuvers.

The minimums section usually has a number of possibilities such as "straight in", "circling" etc. They are also different for each category of aircraft speed (A, B, C or D). General aviation aircraft usually fall under category A and in some cases in category B.

2.6 NM — 3.4 — 1.8 — 3.4

CATEGORY	A	B	C	D
LPV DA	640-1 258 (300-1)			
LNAV/ VNAV DA	740-1¼ 358 (400-1¼)			
LNAV MDA	860-1 478 (500-1)		860-1¼ 478 (500-1¼)	860-1½ 478 (500-1½)
CIRCLING	860-1¼ 471 (500-1¼)		860-1½ 471 (500-1½)	1020-2 631 (700-2)

7.1.2 IAF

IAF stands for Initial Approach Fix and this refers to the initial point from which an approach is usually initiated. All approaches will have at least one IAF, though some may have two or more depending on which direction the aircraft is approaching the airport.

7.1.3 FAF

FAF or the Final Approach Fix is the point from which the final descent to the runway is executed. After the FAF, there may be other identifiers such as the "inner marker" or a DME fix, but this is the fix at which the ATC expects you to be fully configured for landing (including gears down) and reporting crossing this fix for the final descent into the runway. Naturally, the MAP is after the FAF. This fix is usually identified by a Maltese Cross on the approach plates.

7.1.4 MAP

MAP or the missed approach point is the point at which the pilot arrives before needing to make a decision to execute the missed approach. The missed approach point is arrived at either the Decision Height (DH) or when a combination of the MDA and MAP identifier (such as DME fix or a VOR intersection or time from FAF etc) is reached.

7.1.5 Procedure Turns

A procedure turn is a standard turn needed to position the aircraft for the final approach to landing. From the IAF's the plane is often not in the best position to continue with the approach without significant abrupt maneuvers. By definition, IFR flying should be made with gentle and non-abrupt maneuvers. This is the reason for Procedure Turns or PT on approach plates. The PT is either depicted like a regular holding pattern in which case it is a course reversal mechanism and should be entered like any holding track (direct, teardrop, parallel), or the procedure turn may be to either side of the final approach course with roughly a 30 degree angle outbound and inbound, making for a nice and smooth intercept angle back to the final approach course.

In some cases, from certain IAFs, the angle of intercept with the final approach course is good enough that a procedure turn would not make sense. In these instances a "No PT" is written next to the IAF, meaning no procedure turn is needed for approach from this fix.

Also, when ATC is given vectors to the pilot for the approach, the procedure turn is usually not needed unless the ATC specifically asks for it for spacing purposes.

7.2 Choosing an Approach

The primary input for deciding the approach you will use is the weather and the prevailing wind conditions. Until you have the weather, the choice of runway is not clear. Once that is determined, then the approach plates for that runway are consulted for choosing an appropriate approach.

To choose an approach to a runway a number of things should be considered. Here again, the weather is the main determinant. If the weather conditions are down to minimums, choosing a precision approach such as an ILS or a WAAS enabled GPS with glidepath indicator may be wiser than a VOR approach with a need to circle to land.

The type of equipment on board the plane is also an important factor. In choosing a GPS approach for example, you will notice that your minimums change depending on the sophistication of your equipment and the software.

Careful pre-planning is needed to determine if any of the approaches at the airport of destination or the alternate are inoperative, either fully or partially. These are found in the Airport NOTAMs, usually in the FDC NOTAMS section. For example, if an "ILS or LOC" approach is desired at an airport such as KMRB, a look at the FDC NOTAM could reveal that the glideslope indicator for this approach is inoperative and the approach can only be flown as a localizer approach in a non-precision mode, yielding much higher minimums. This is very useful information to consider before you begin your flight.

7.3 Briefing an Approach

Briefing and setting up an approach is a very important preparation before shooting the approach. This should be done immediately after you've chosen the approach and the ATC has informed you that you could expect it or that you will be given it.

To brief the approach, use the "waterfall" method, i.e. go from the top to the bottom of the approach plate and at the same time set up all your frequencies for COMM and NAV as well as note your minimums, etc.

Start at the top:

1. Verify the approach. It is important to read out the name of the airport and the approach type clearly to make sure you are using the right approach plate.

2. Set the frequencies: for COMM, NAV, etc. you need in the approach. Make sure you identify the NAV frequencies appropriately.

3. Review the plan view and determine your direction to the approach and your potential IAF choices.

4. Take note of any procedure turns, DME arcs, etc.

5. Look at the profile view and review your altitudes, the steps and the FAF crossing altitude

6. Record your minimums

7. Review the entire missed approach procedure and memorize the first two steps (e.g. fly runway heading to 600' and then turn right to 160).

8. Review airport diagram for familiarization, including lighting requirements. Take note of pilot operated lights if required. Also, take note of circling requirements to orient the intended landing runway in your mind.

Once done and you feel comfortable with the approach, lay it nicely on your lap, on your notepad or clip it to the control column as you like. The approach plate should be readily accessible during approach to landing.

7.4 Approach Types

There are many approach types. Here we only discuss the most popular ones.

7.4.1 ILS

ILS or Instrument Landing System is the most popular and most widely used precision approach worldwide. There are many components to an ILS approach, but for simplicity, we can think of it as consisting of a Localizer and a Glideslope.

The Localizer is a radio beacon sent from the runway centreline (usually at the end of the runway) in a cone shape which gives an indication of alignment to the runway centreline. If the localizer is showing a deviation to the left, then a slight left turn is needed to bring it back to the centre. The localizer works like a VOR needle and the same VOR is used for flying it, but it is much more sensitive than a VOR. The closer you are to the runway, the more sensitive it becomes. The trick is to make small, gentle adjustments soon to continue to keep the airplane aligned with the runway.

The Glideslope is another signal which is sent from the runway (usually near the threshold) which shows an appropriate glide path to the runway. It is usually depicted by a horizontal line on the VOR receiver. The idea is the same as the localizer in that the needle should be in the middle and should be adjusted gently to keep it there. The Glideslope usually gives you a gentle 3 degree

The idea in an ILS is to keep both needles centered. That would give you a guarantee of being on the correct runway alignment and approach path throughout the approach.

Traditionally, the ILS approach has 3 "marker beacons":

- OM or Outer Marker
- MM or Middle Marker
- IM or Inner Marker

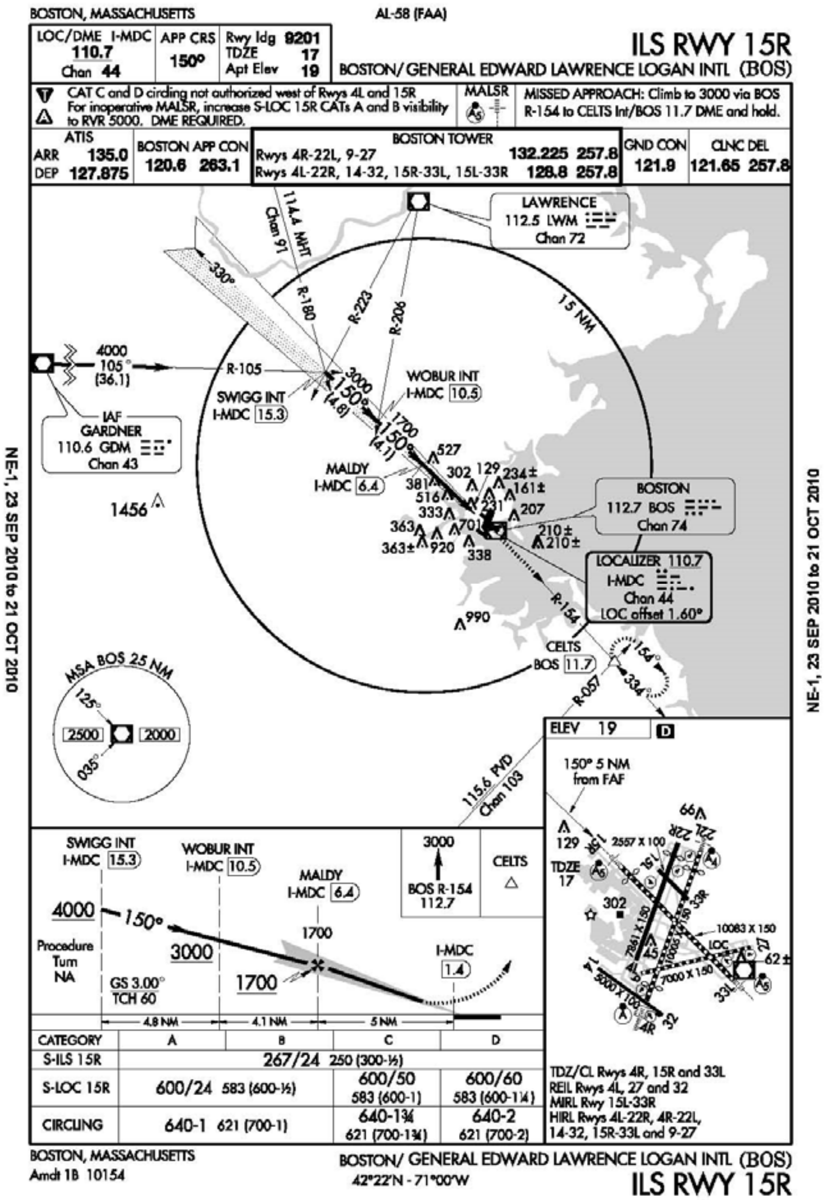
When you cross over each of these markers, the appropriate marker beacon light on the panel will come on and you will hear the identifier for the beacon.

In the example below, you see the ILS 15R for KBOS (Boston's Logan Int'l). Note that in the minimums section, there are three different minimums:

S-ILS 15R - Straight in ILS - This is the standard straight in approach

S-LOC 15R - In case the glideslope is not functional, an ILS can work like a localizer. In order to make use of this feature, you would have to use another component to determine when to execute a missed approach. In this case, it will be the 1.4 DME of I-MDC localizer. In some cases, it would be a time from the FAF.

Circling - In case you would shoot this approach, but circle to land on a different runway for wind or other purposes, you would use this section for minimums.

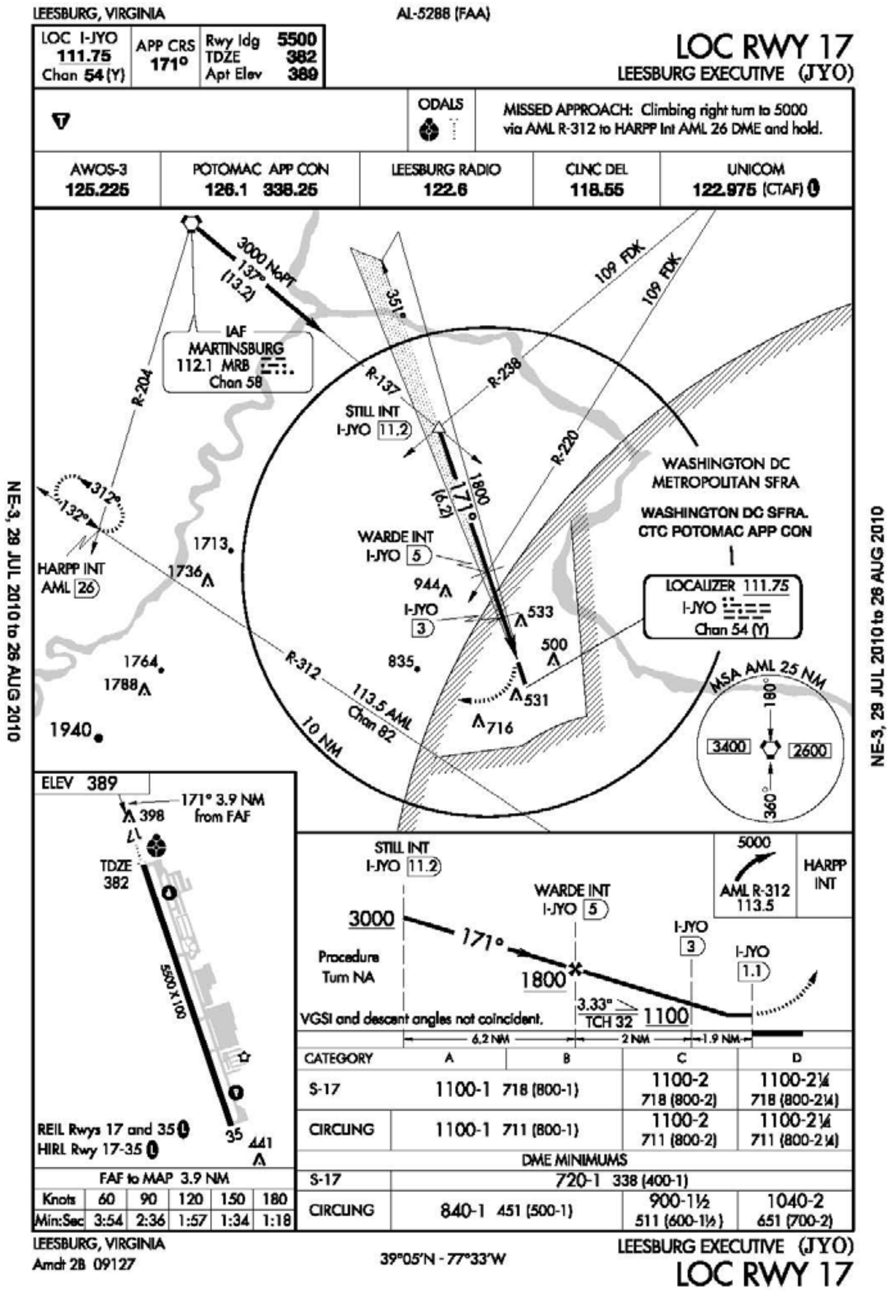


CATEGORY	A	B	C	D
S-ILS 15R	267/24 250 (300-½)			
S-LOC 15R	600/24 583 (600-½)		600/50 583 (600-1)	600/60 583 (600-1¼)
CIRCLING	640-1 621 (700-1)		640-1¾ 621 (700-1¾)	640-2 621 (700-2)

7.4.2 LOC

LOC is a localizer only approach. Think of it as an ILS without the Glideslope indicator. It is a non-precision approach and requires you to "step" down through the approach course in a series of altitudes identified by certain fixes such as a VOR radial, NDB beacon or even a DME fix, in which case it could be a LOC/DME approach.

In this approach, notice that the Minimums section has two distinct areas -- one to be used in conjunction with a timer from FAF (which in this case is WARDE). For example, if your approach speed is 90 Knots, you would have 2 minutes and 36 seconds from WARDE before reaching your missed approach point (MAP) and at that state your minimum altitude would be 1100 feet. The second section is called DME minimums. In this section, if you have a functioning DME or equivalent GPS indicator, you may descend to 720 feet all the way to 1.1 DME of the I-JYO localizer. Notice also that the circling minimums are also different when you operate with or without the DME. Some LOC approaches maybe a LOC-DME where a DME is required and these would be marked accordingly.



CATEGORY	A	B	C	D
S-17	1100-1 718 (800-1)		1100-2 718 (800-2)	1100-2¼ 718 (800-2¼)
CIRCLING	1100-1 711 (800-1)		1100-2 711 (800-2)	1100-2¼ 711 (800-2¼)
DME MINIMUMS				
S-17	720-1 338 (400-1)			
CIRCLING	840-1 451 (500-1)		900-1½ 511 (600-1½)	1040-2 651 (700-2)

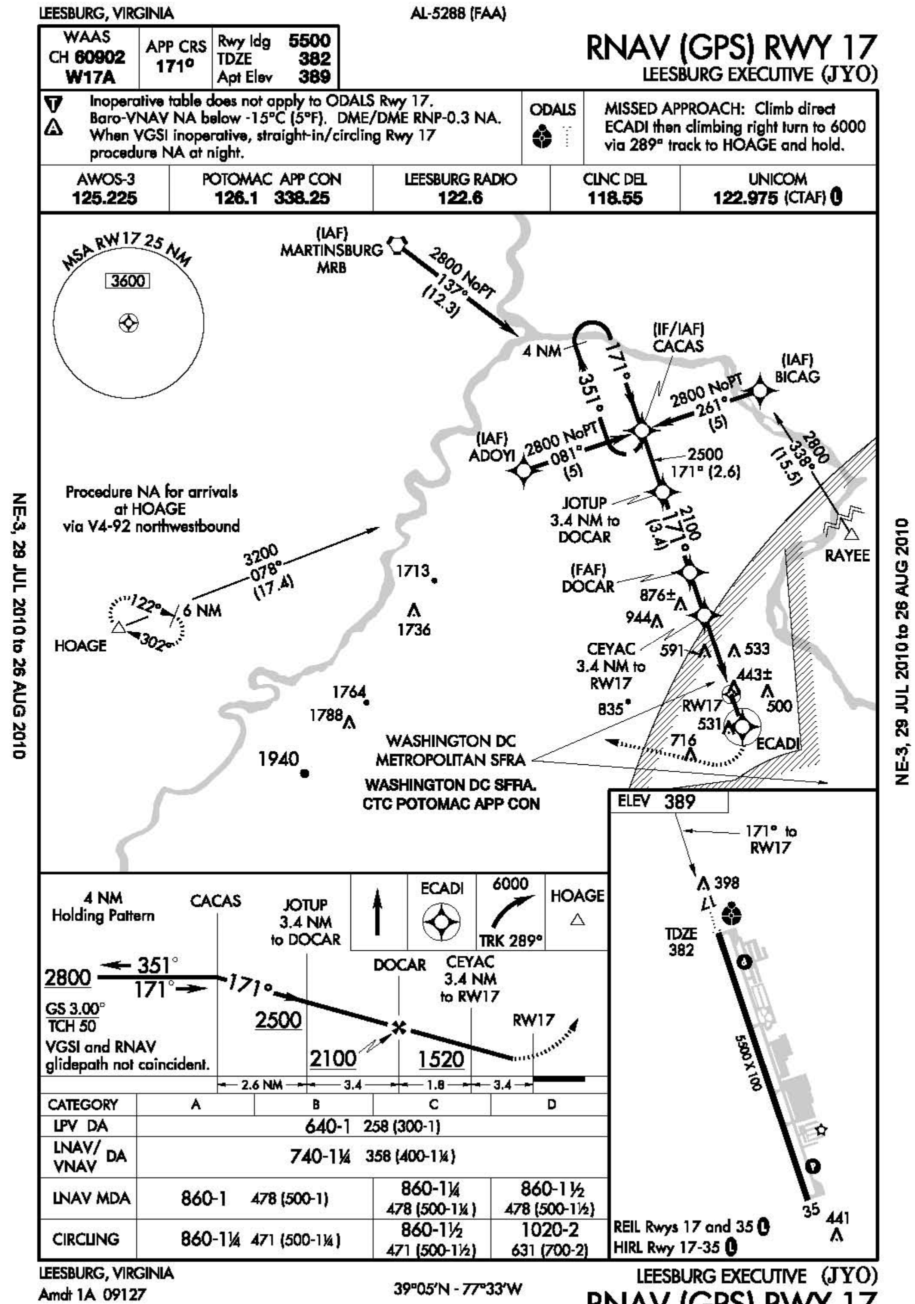
Knots	60	90	120	150	180
Min:Sec	3:54	2:36	1:57	1:34	1:18

7.4.3 GPS

GPS approaches are becoming very common across the whole country. They have various degrees of precision depending on the equipment used both on the ground and on board the airplane.

Sophisticated WAAS (Wide Area Augmentation System) enabled GPS systems, can fly much like an ILS with a "glide path" indicator (distinct from Glideslope for clarity).

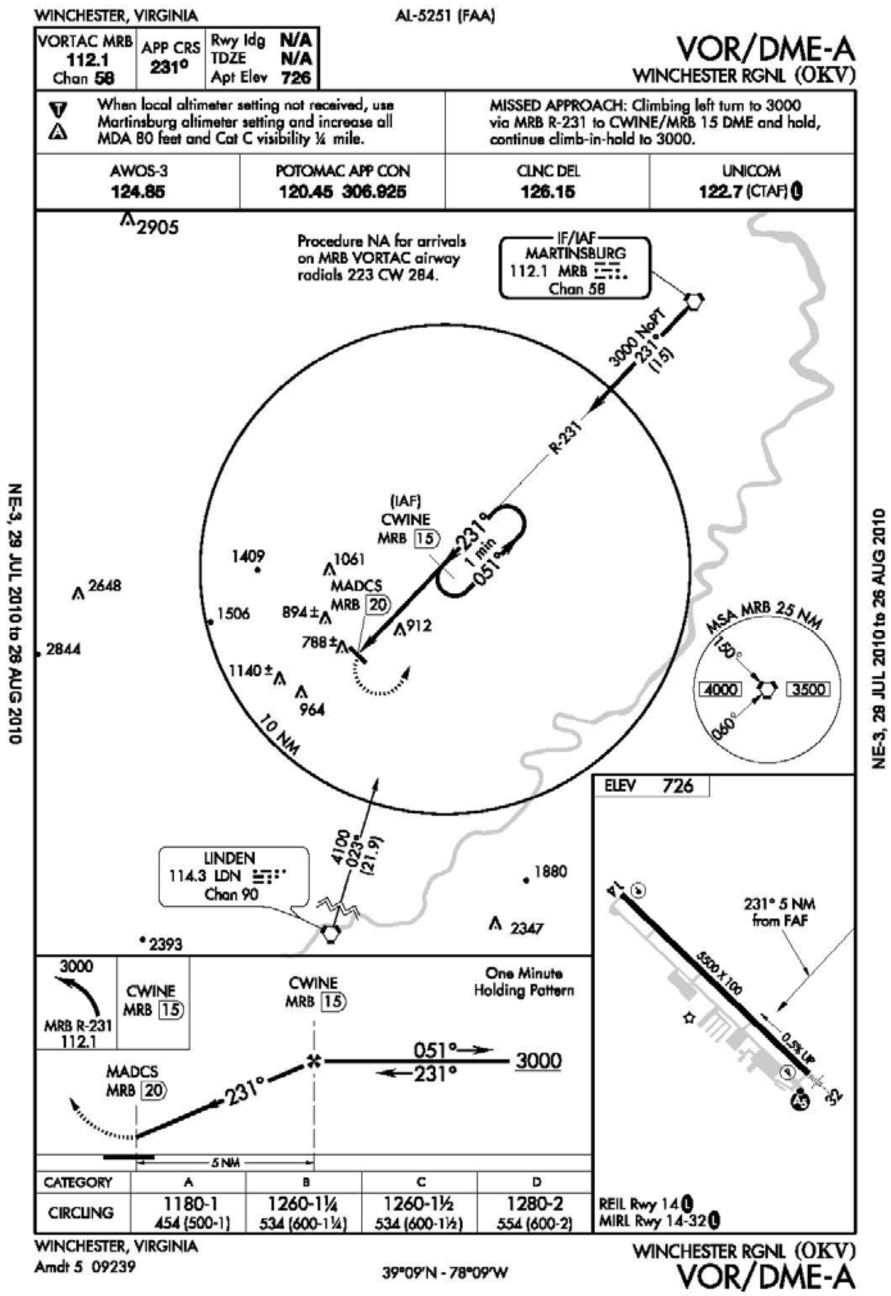
A GPS approach is usually laid out in a big "T". There are usually three possible IAF's at either ends of the top of the "T" or at the intersection of the horizontal and vertical lines of the "T". The aircraft is flown through the IAF with a turn to the final course depicted by the vertical "T" line. Once on that course, the approach is shot like a Localizer or an ILS depending on WAAS capability. To determine the minimums, you must know the equipment on board your aircraft and use the appropriate minimums from the approach plate.



7.4.4 VOR

VOR approach is a non-precision approach using a VOR as a main NAVAID. The VOR is also often both the IAF and the FAF. Sometimes the VOR is on the airport and sometimes it is nearby. These are a little more tricky to shoot. Most VOR approaches require Procedure Turns and they are often at an angle to the runway. If the angle is more than 30 degrees, then the VOR would not be for a particular runway and would only be used in a "circling" mode. In these cases a letter identification is given after the approach such as VOR-A.

To fly a VOR approach from the IAF, you would need to make the procedure turn or course reversal and then set the desired approach course and fly the approach with keeping the needle centered like any VOR navigation. Altitude step downs are similar to the Localizer approach, though it is often less precise unless it had a DME component in which case it would be identified as a VOR/DME.

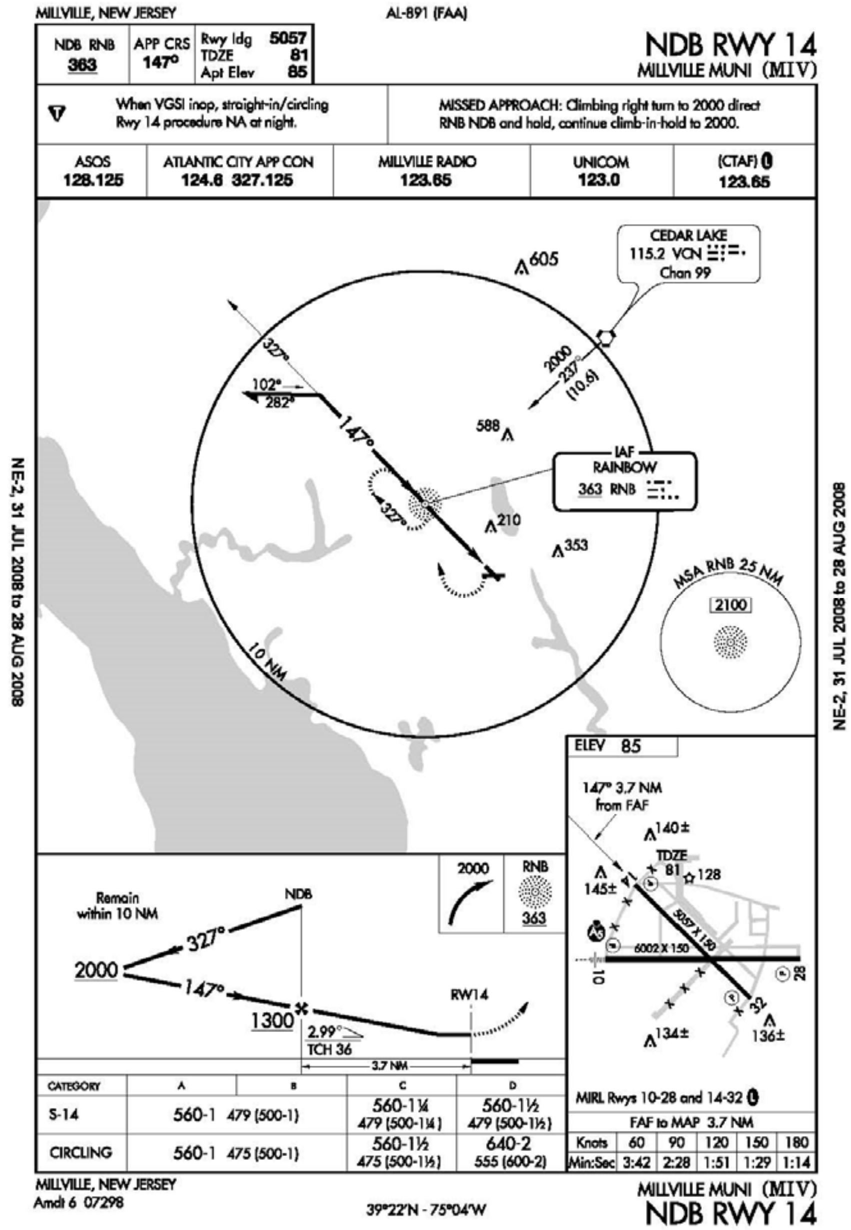


7.4.5 NDB

NDB or Non-Directional Beacons are disappearing across the US, but these types of approaches are still quite popular in many countries including in many places across Canada.

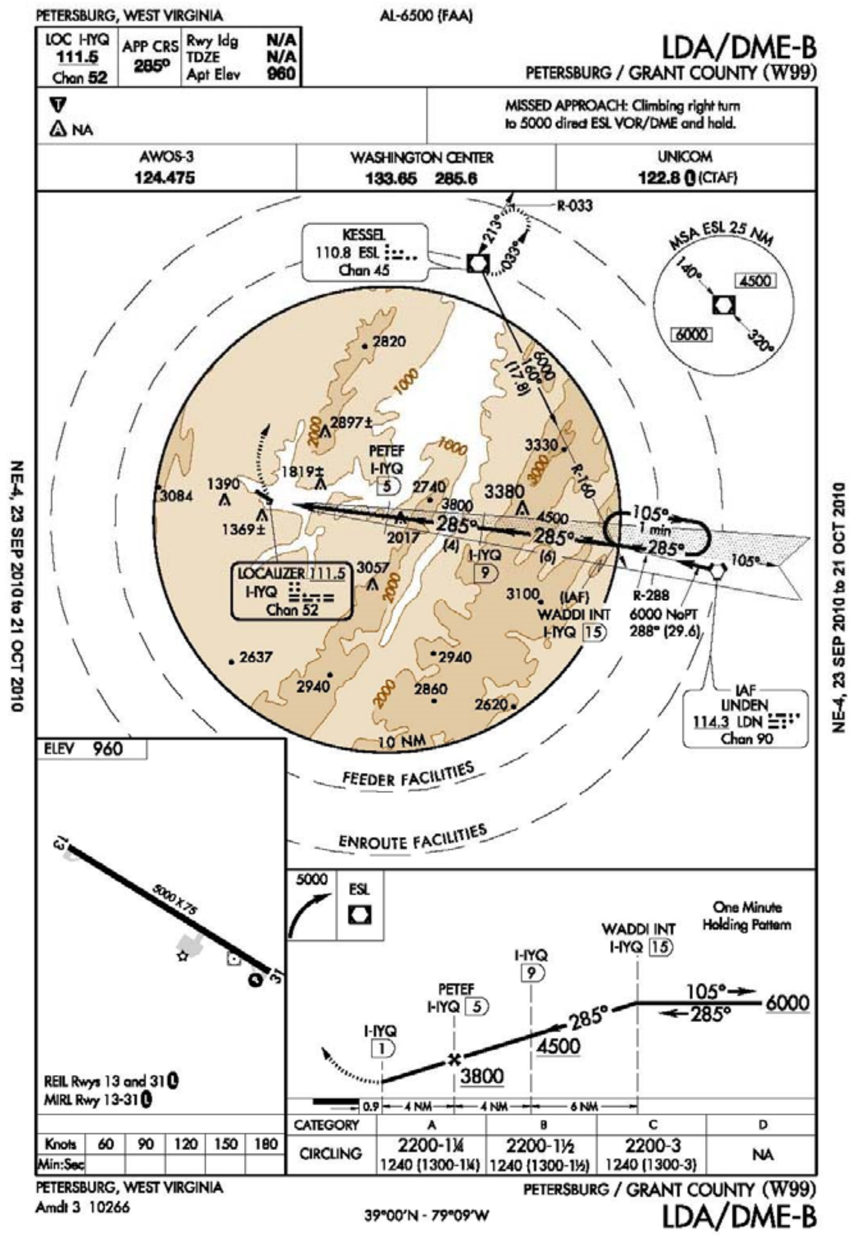
NDB is a non-precision approach which uses the NDB as the primary guide. It is less precise than even VOR approaches and is usually flown by flying overhead the NDB, followed by a procedure turn if required and then setting a course from the NDB toward the airport. Sometimes the NDB may be on the airfield, in which case you fly for two minutes from the NDB in the opposite course and make a procedure turn back to the course. Naturally, the minimums for an NDB approach are much higher than other forms of approaches with more precision.

Note that in an NDB approach, much like a Localizer or a VOR approach, the time element is invoked. In the following approach, if your speed is 90 knots, you would have two minutes and 28 seconds from passing the NDB (FAF) to the Missed Approach Point (MAP) at which place you cannot be below 560 feet.



7.4.6 LDA

An LDA or a Localizer type Directional Aid approach is similar to the ILS or LOC approaches with one big difference -- the approach path is at an angle to the runway. Naturally, these are non-precision approaches and their minimums are higher since certain maneuvers and turns need to be made before making the final alignment with the runway for landing. These approaches are mostly found in mountainous terrains where a direct approach to the runway is not possible. Flying these approaches according to the book is very important for this matter. The LDA approach at W99 (Grand County Airport) in Petersburg, West Virginia is one such approach which also has a Glideslope. It is necessitated by the surrounding mountains and the angle of the runway in relation to the mountains. Its minimums are high and the pilot usually arrives over the field high and at a 30 degree angle, requiring a circling maneuver.



7.4.7 SDF

An SDF or Simplified Directional Facility approach is similar to a LOC approach with a few differences. First, it may not be completely aligned with the runway (typically 30 degrees or less). Second, the course may be wider than a LOC approach, making this a less precise approach.

7.4.8 Others

There are other approaches such as MSL and others and these should be studies for completeness.

7.5 Circling

If you need to maneuver more than 30 degrees to land on a runway, then a circling approach has to be made. Circling or "circle to land" can be part of any approach and is used for many reasons such as a non-precision approach at a high angle (even 90 degrees sometime such as the VOR to KOKV), wind directions requiring a switch to the opposite runway or an existing traffic pattern and runway usage which may prompt the pilot to circle and join the VFR traffic pattern. Whatever the reason, the circling procedure has to be done within close proximity of the airport at low altitude (circling minimums) in full landing configuration at slow speed! You can quickly realize that a circling approach is inherently a risky maneuver.

To execute the circling approach, you shoot an approach to circling minimums, add power and never descend below that altitude until you are absolutely assured of landing using normal maneuvers. For most GA aircraft, the max distance away from the airport is 1.3 nm arc from the edges of each runway. In a circling approach, the pilot must keep the runway in sight at all times. If the runway is lost, even for a brief moment, a missed approach should be executed immediately. Failure could result in disorientation which could lead to controlled flight into terrain or loss of control or stall, all of which have disastrous consequences.

Circle to land approaches are common and should not be feared, however, execute them with care. Many expert commercial pilots with thousands of hours of IFR flying experience openly say that they would never shoot a circling approach in IFR conditions at night. That combination is just simply too risky. If you are faced with that and you are in an unfamiliar environment and have not flown that maneuver many times before and you don't feel 100% on top of it, do not risk it. Go to another airport and live to tell the tale another day.

7.6 Missed Approach

See also: Minimums

The Missed Approach is the "go around" or "overshoot" component of the IFR approach. It is a very important part of the approach and though it is rarely used, it must be practiced and mastered during your training. Your mental orientation for EVERY approach should be that it will end up in a missed approach. If it does not and you can continue to land, then it is a bonus!

This mindset will let you prepare for the approach well in advance and be ready to execute the missed approach with confidence and without hesitation. If you are totally prepared to execute it, you are more likely not to hesitate and not make a foolish mistake of continuing an approach beyond minimums just to take "peek" to see if you can find the runway. This is a recipe for disaster.

Have no doubt. Hesitate not. If you get to the MAP and you are unable to visually land with 100% certainty, then execute the missed approach at once.

The procedure is simple and is done using the 3 C's:

- CRAM - Full power; mixture and prop (these should have been forward already).
- CLIMB - Pitch up and establish a positive rate of climb.
- CLEAN - Flaps UP and Gears UP.

You then follow the Missed Approach Procedure for the particular approach. In the briefing you would have memorized the first two steps, so when you establish the airplane on a positive climb, with full power and in clean mode, you would have time to continue the missed approach and look at the rest of the procedure. When you feel comfortable that the plane is under control, tell the ATC that you have "gone missed" and say your intentions. At this point, you may have options such as coming back for another attempt, going to another runway, going to your alternate or to another airport. The ATC will work with you to help you set that up.

However, every missed approach procedure ends up with a "hold". You should expect to fly the entire approach all the way to the hold each time, though the ATC may vector you to your next approach before that.

For a full discussion on the various altitudes and heights for execution of the missed approach, see the "Minimums" sections of the Components of An Approach discussion above.

7.6.1 MAP

See also: MAP

MAP is the missed approach point as discussed above.

7.6.2 MDA

MDA is the Minimum Descent Altitude on non-precision approaches. A full discussion is given above in the "Minimums" sections of the Components of An Approach discussion.

7.6.3 DA

DA is the Decision Altitude in precision approaches such as the ILS. A full discussion is given above in the "Minimums" sections of the Components of An Approach discussion.

7.6.4 DH

DH is the Decision Height which is the height above runway threshold elevation. A full discussion is given above in the "Minimums" sections of the Components of An Approach discussion.

To determine the DH, you must look at the airport diagram, identify the runway you are approaching and look at the TDZE (or touch down zone elevation). The DH is the height above this number. Remember that the TDZE may be different than airport elevation.

8 Flight Planning

Flight planning for an IFR flight is even more important than for a VFR flight. An IFR plan is a plan of exacting accuracies for departure, route of flight, altitude, arrivals, alternates and fuel requirements. Every IFR plan is the basis of a contract between the pilot in command and the air traffic control -- and not just the immediate ATC, but the entire air traffic "system". All these precautions are based on the assumption that for part of all of the flight, the conditions would be IMC. However, even in totally perfect VFR days, an IFR flight plan would need to have similar rigor and discipline.

8.1 Charts & Docs

At the outset of any flight planning exercise, you would need a complete set of charts, plates and other material to do your plan. Some of these are described above as well. For completeness, we will describe them here:

1. En Route IFR Charts - Typically low altitude charts would be used by General Aviation pilots. You need up-to-date versions for every sector of the flight.

2. VFR Sectionals and TAC - Although not strictly required, it is highly recommended that in addition to the IFR charts, you have VFR charts available, especially in case of electrical systems failure so you can navigate and proceed in VFR to a destination safely.

3. Approach Plates - These are published for every state or a group of states and in the case of Canada for each province. You must have the approach plates for each airport in your route as well as airports along the way in case you need to divert for any reason. Without valid approach plates you will not be able to complete an IFR approach. Also, departure procedures and STARS are listed in these plates plus a full size airport diagram. A must in the airplane.

4. Airport Facility Directory: These are more detail airport directory for each state and in Canada it includes the whole country. You will need these for specific information about the airport such as type of lighting, FBO's, Customs, etc. Also found here would be published Preferred and ATC Routes as discussed below.

8.1.1 EFB

EFB's or Electronic Flight Bags are devices such as the Bendix King AV8OR ACE or others that offer a complete set of flight planning tools as well as all the necessary charts such as En Route IFR and VFR, Approach Plates, Airport Diagrams, SIDs and STARs. Some of these are made with "georeferencing" capability, showing your aircraft on all the charts while moving on the ground on in the air. They make life much easier and if you keep them updated, they make the requirement for carrying all the charts less pertinent. However, it is still highly recommended that you do carry charts with you since these devices are typically less versatile than a chart and depend on battery power and could fail.

8.2 Alternate

Just remember **1-2-3.**

That's right:

- If for 1 hour before AND 1 hour after arrival at your destination, the weather is NOT:

- 2000 feet ceiling

- 3 miles visibility

Then you will need to identify an alternate airport as a backup in case you are unable to land at your destination.

To consider an alternate you have to look at the entire weather system and choose a sufficiently close airport that would be potentially out of any adverse weather that your destination is subject to. Furthermore, you need to ensure that the airport approach you would be using is valid for planning an alternate. This is clearly depicted in the approach plates.

The minimums for alternate planning are:

- 800' ceiling and 2 miles visibility for non-precision approach availability
- 600' ceiling and 2 statute mile visibility for precision approach availability

When a black triangle with a white "A" appears in the notes section of the approach plate, it indicates that a different alternate minimums are used in this airport. If "NA" appears, it means this airport cannot be used as an alternate.

These are all for planning purposes. However, if you have to divert to your alternate, the minimums for any approach used would be the published minimums for that particular approach.

8.2.1 Canadian Variation

Every IFR flight plan in Canada requires an alternate. In some ways, this simplifies the matter. The minimums for choosing and shooting approaches for alternate airports is the same as the US.

8.3 Navigation

See also: Navigation

As described above, IFR navigation is somewhat easier that VFR. There are no requirements for visual reference in planning the flight. The entire route is done through navigational aids and typically within airways. Basic skills in intercepting radials and course and following navigational aids such as VOR, NDB, etc. are required in every step of the flight. Even with GPS equipped airplanes, victor airways are used between VORs and fixes which would be programmed into the GPS and their use are similar in nature.

8.4 Fuel Planning

Fuel planning is much more critical in IFR flights than in VFR. Fuel shortage or starvation in IMC conditions could be fatal and every attempt has to be made to be conservative here.

For legal planning purposes total fuel requirement for IFR flight the total amount needed for:

- Taxiing
- Climb out
- Cruise
- Approach
- Diversion & Approach at Alternate airport (if needed)

+ 45 minutes

It is important to plan the Climb and Approach since some SIDs and STARS may take you through special paths and add valuable minutes to that leg of flight. Also, fuel consumption in climb out is much higher than in normal cruise. Taxiing is usually not a big issue except when you are flying on a busy day from a busy terminal area airport such as a Friday afternoon departure from Morristown where you could be waiting for an hour and your departure could take a lot of fuel before you are established on cruise.

Most experienced pilots reserve at least 1 hour of fuel instead of the 45 minutes legal minimum.

8.5 Routes

In planning your flight, it makes good sense to use as direct a path as possible and although you can either make up your own path or choose a GPS direct most of the times, in most big metro areas, there are commonly used routes between major airports that you should use. If these are used, the IFR clearance would typically be very close or identical to what is filed.

Routes of flight for planning purposes should use

- SID
- Route
- STAR

The actual approach is not in a flight plan since it is determined by weather and can only be ascertained nearer to the destination.

8.5.1 Preferred Routes

These are pre-planned routes between major and popular destinations in most busy and highly populated areas of the country. They simplify flight planning and, if used, make for easier clearances. They can be found in the approach plate book under each airport.

8.5.2 ATC Routes

ATC routes are similar to preferred routes, except that they are for destinations near large airports that could allow for routes that remain entirely within an ATC sector and does not need to be handed over the en route area and radar controllers.

8.6 Altitudes

Selecting your IFR altitude is a very important part of the planning purposes. We have discussed the MEA, MOCA and MCA above. These are especially important for planning in non-flat terrain.

For planning purposes, you should choose and altitude that would be odd thousands for easterly routes and even thousands for westerly routes and that would be at least as high as MEA. These, however, are indicative and the ATC could assign any altitude to the pilot during any phase of the flight, up to clearance for final approach.

A clear consideration for altitude planning is weather and specially icing conditions. These will be discussed in the weather section.

8.7 Weather Briefings

Weather is a very serious consideration in every IFR flight and for that purpose, we will discuss it in a whole section by itself. By now you know that IFR flying does not equate to all-weather flying. Before planning the flight, a full weather briefing should be completed by one or more sources. You can obtain that at the nearest FSS or by consulting widely available web sites and services dedicated to aviation weather.

The biggest consideration for weather for GA pilots are thunderstorms, icing and ceilings/visibility at destination and alternate airports.

There are many great resources for weather briefings:

- 1800 WX BRIEF (992 7433) (1-866 in Canada) will give you a full briefing with a live briefer
- Numerous websites such as fltplan.com, DUATS, intellicast, etc. provide big/detailed picture of the weather
- Numerous apps on mobile devices also provide weather briefing

The trick is that the Pilot-in-Command must ensure he/she uses all of these sources to fully satisfy himself/herself that a good picture of the weather has been formed and that he/she is comfortable to execute the entire flight safely. Failing that, the PIC should not launch.

8.8 NOTAMS

A full weather briefing should also include a review of all relevant NOTAMS for your airports, route of flight, etc. Once again, since IFR flying could be all done in IMC conditions, it is imperative that you are well aware of NOTAMS that could affect your flight.

8.9 TFRs

TFRs or Temporary Flight Restrictions are also an important check for flight planning, especially in the post 9/11 environment. Throughout the whole country, there are numerous TFRs at any given time and a quick glance at tfr.faa.gov would ensure that you are not facing any such restricted areas along your route and allow you to plan around them.

8.10 FDC - SO IMPORTANT

FDC NOTAMS which are provided at the end of any comprehensive briefing such as DUATS full briefing are very critical to check for IFR flights. The main reason is that these NOTAMS often contain critical information that could affect the flight. Watch out especially for inoperative VOR's, airport lights and various approach components. For example, if you were planning to shoot a precision approach to minimums at Martinsburg (KMRB) on a foggy night, it would be very critical to know whether the Glideslope for the ILS-LOC approach is inoperative, in which case your minimums would be raised significantly.

9 Procedures

9.1 Intercepts

Intercepts are an important part of IFR flying and is most often associated with VOR radials. A full discussion on that is beyond the scope of this guide, but the concept is to be able to identify and connect to a particular "course" in all stages of flight. Intercepts could be for bearings to an NDB, for a final approach course to landing, a VOR radial or the like. To intercept a VOR radial, the pilot must have situational awareness as to where his or her plane is with respect to the VOR station. This can be done by identifying the station and ascertaining your position by either a radial/DME fix or by cross-referencing with another VOR. Once your position is roughly identified, then an intercept to particular radial can be executed more efficiently. For example, if you are on a 180 radial heading north and are asked to intercept the 090 radial and then proceed eastbound, the best angle may very well be a 45 degree turn to the east initially until you are closer and then reduce it to a 30 degree intercept angle till you intercept the radial. However, if you are on a 110 degree eastbound and are asked for the same thing, you may decide to take a much smaller left hand turn to intercept the 090 radial and continue on.

For final approach intercepts and usually during vectors to final, the ATC will usually position you for a 30 degree intercept angle with the final approach course.

9.2 Holds

Holds are parking spaces in the air. They could be published for execution or given by ATC to you at any phase of the flight (though more likely closer to approach portion) on an ad-hoc basis. Holds are elliptical patterns around VORs, fixes, intersections or the like. Their standard published path is to the right, though they may be published or requested in both directions. Holds may be in minutes (1-5 minutes usually) or in distance (2-20 nm typically). They could be timed (such as hold for 25 minutes) or just executed indefinitely (such as a missed approach hold) till the pilot and/or ATC decide next course of action.

Hold instructions include a particular fix, altitude, direction, length (time or nm) and duration of the hold. They have to be read back for confirmation.

Entering a hold is done through three modes:

- Direct entry when angle of entry allows it
- Teardrop entry when angle caters for 30 degree deviation
- Parallel entry in other times.

9.3 DME Arcs

DME Arcs are what the name actually suggests -- flying on a circular arc around a VOR/TAC with a defined DME distance. This is used largely for flying STARs and Instrument Approaches. The reason for the need to fly an ARC could be for traffic separation or terrain avoidance. DME Arcs are flown by first intercepting an initial fix (IF) from which to commence the "Arc". This fix is usually on the Arc and from there the pilot is expected to keep the distance from VOR constant in the direction of the arc.

The technique to flying the DME Arc is to visualize the tip of your aircraft wing always pointing at the VOR (left or right wing depending on direction of the arc). Of course you would have to apply and constantly correct for the wind direction. The technique is to fly along the arc and as you deviate away or toward the VOR by even .5 nm, then to correct the heading to get back and keep on the arc.

DME Arcs are usually merged with Final Approach Course to landing on a radial intercept. This is typically marked on the arc with a radial to turn ahead of the intercept to allow for a smooth transition from the arc to the straight course and to avoid overshooting the intercept course.

9.4 Procedure Turns

Procedure turns are found in Instrument Approach Procedure (IAP) plates to help with course reversal and traffic management. They can look like a holding pattern in which case, it would be a course reversal or a typical procedure turn whereby the pilot flies in the opposite direction of the final approach course (usually for 2 mins) and then turns left or right about 45 degrees for 1 minute outbound and then 1 minute inbound to intercept the final approach course. The pilot is expected to complete the procedure turn within 10nm of the airport.

Sometimes when the approach to the final course is made from certain fixes that allow a smooth intercept angle, procedure turns may not be needed. In these cases, a "NoPT" would be indicated near the fix. In these cases, procedure turn is not allowed. Also, when the pilot is being vectored to the final course, no procedure turn is needed.

When being radar vectored to final, the ATC often does not expect you to execute the procedure turn as you will be aligned with the final approach course. If in doubt, ask specifically whether you should execute it or not.

10 Failures & Emergencies

Emergencies in IFR conditions are a serious matter and one should be well prepared for it. If there is an emergency, the PIC should not hesitate to declare and emergency and work with the ATC to deal with it. When you declare an emergency, the ATC will give you top priority over all other aircraft. This carries a responsibility and in most cases will require some paperwork afterwards, but you should not hesitate to declare an emergency if you feel the execution of the flight is in danger.

Many things such as a partial equipment failure may not constitute an emergency. Others such as engine failure, electrical fire or fuel shortage would constitute emergencies and should be dealt with accordingly.

If you suspect any instruments proper functioning, or if a critical instrument has failed and "recovered", do not take a chance and do not launch on the flight. Partial panel flying in actual IMC conditions and shooting an IFR approach to minimums in these conditions is not an easy task for even a current and seasoned pilot.

Remember that early recognition of each of the possible failures is as important, or even more so, as the skills necessary to aviate with partial equipment to safety. Therefore, make regular scanning of all these systems (vacuum, electric system [alternators] and pitot static system) a routing part of your flying whether IFR or VFR. You want to detect and correct the situation before it becomes an uncontrollable emergency.

10.1 Vacuum Pump Failure

The most common and acute failure causing an emergency in IFR would be a total vacuum pump failure. A total vacuum pump failure is a real emergency and should be treated as such.

Typically to fly serious IFR, you should have dual vacuum system with redundancy built in, making a total vacuum failure and real rarity. You may also invest in an electric backup system for your HI and AI. This is a worthwhile investment if you are to make regular IFR trips. Vacuum systems fail eventually. Fly enough on one plane and you will experience a vacuum system failure. However, if and when it happens, a vacuum failure will affect the following instruments: Heading Indicator, Attitude Indicator or the Artificial Horizon. As you can see, without these instruments, you must rely on very skillful partial-panel flying.

- Airspeed indicator will become your primary pitch control
- Turn coordinator for bank info
- Compass for heading.

You will also use the Altimeter and VSI as secondary pitch control as needed. This is a challenge. If you have a total vacuum failure in IMC conditions, you must first stabilize and control the aircraft and then carefully get yourself into VFR conditions. Tell the ATC your condition and get all the help you can. If they offer a radar approach into an airport, take it.

10.2 Electric System Failure

It is possible to conduct safe IFR flight with the electric system failure if you still have a functioning pitot static system and a functioning vacuum pump. In glass cockpit planes, you would likely have to rely entirely on your backup instruments to continue your flight. These are usually good enough for basic control and for getting you out of the IMC conditions, but not for shooting an instrument approach.

Electric systems fail slowly due to alternator discharge or problems. If you make it a regular habit of scanning the alternator charging, you will detect this early. If detected, reduce all non- essential electric loads, keep communication to a minimum and land as soon as practicable.

10.3 Pitot Static Failure

In thunderstorms, severe turbulence and icing conditions, pitot static system could either be blocked or become unreliable due to radical pressure differences. Hopefully, you would not have launched on any flight (much less an IFR one) with the pitot cover still on! Do check the pitot heat as your standard IFR pre-flight, especially during the winter months or if you will be flying at altitudes which are always "freezing".

You may need to use "alternate air" or even break the VSI indicator for an alternate source of air to remedy the situation with the understanding that in this case, the Airspeed Indicator and Altimeter will read higher and the VSI will falsely indicate a climb.

10.4 Unusual Attitudes

An unusual attitude is not an emergency, but it can quickly end in disaster if not corrected immediately. The PIC must feel confident that he/she is current with recovery from unusual attitudes (stall, spiral, etc.) quickly with reference only to instruments. This should be honed during IFR training. An airplane could even fall into an unusual attitude when a correctly functioning auto-pilot is engaged. For example, when there is severe turbulence and the airplane enters turbulent clouds, the AP may either have difficulty maintaining attitude or may over-correct for sudden movements. The PIC must be especially alert in these circumstance to take over and control the aircraft.

The pilot should practice methodically:

1) Recognize unusual attitude

2) Recover from unusual attitude

Typically, an unusual attitude would have either a nose high or a nose low aspect to it. Consideration must be given to whether you are in a turn or a spin. However, the following generally applies to recovery:

a) Nose High:

1) Recognize:

- Horizon showing nose high (more blue)
- airspeed decreasing
- altitude/vsi cross-check

2) Recover: (all done almost at the same time)

- Increase power (appropriate to level of airspeed decrease)
- Lower nose
- Level wings

b) Nose Low:

1) Recognize:

- Horizon showing nose low (more brown)
- airspeed increasing
- altitude/vsi cross-check

2) Recover: (all done almost at the same time)

- Decrease power (appropriate to level of airspeed decrease)
- Level wings
- Raise the nose

Note: TRUST YOUR INSTRUMENTS. NEVER RECOVER BASED ON YOUR SENSORY FEELINGS.

10.5 Partial Panel

As discussed above, if one or more systems fail, there is usually adequate alternatives to fly an airplane safely in IMC conditions using the remaining instruments. This is called partial panel flying and should be practiced regularly. It is a big part of the IFR checkride and frankly if you do not feel comfortable flying partial panel and shooting complex approaches with them, you should not take on serious IFR flying until you do so.

Pitch instruments - partial panel

- altimeter (ALT)
- airspeed indicator (ASI)
- vertical speed indicator (VSI)

Bank instruments - partial panel

- turn coordinator (TC)
- magnetic compass (MC)

Power instruments - partial panel

- airspeed indicator (ASI)
- engine instruments
- manifold pressure gauge (MP)
- tachometer (RPM)

1) Recognize unusual attitude

a) Nose High Unusual Attitude Partial Panel

- Airspeed too slow, decreasing (ASI)
- ALT increasing
- TC shows turn
- VSI positive rate, climb

b) Nose Low Unusual Attitude Partial Panel

- Airspeed too fast, increasing (ASI)
- ALT decreasing
- TC shows turn
- VSI negative rate, descent

2) Recover using ASI, TC, ALT, VSI (and ignoring AI and HI, which may have failed), so full and partial panel recoveries are the same

a) Nose high recovery

- Add power
- Lower nose
- Level wings

b) Nose low recovery

- Reduce power
- Level wings
- Raise nose

10.6 Compass Turns

The Compass is one instrument that usually fails the least in an airplane. It is your ultimate heading backup. Without a HI, the instrument pilot will have severe difficulty continuing an IFR flight and executing on ATC instructions. The compass provides that in the case of HI failure. Compass turns are a bit tricky depending on where you are (northern or southern hemisphere) and which direction of flight you are going and which direction you will be turning.

It is possible, with some basic practice, to execute near precise flying with reference to the compass as your HI. You must ensure you are well versed in this with the assistance of your instructor or a safety pilot.

Bear in mind the following points when making turns to magnetic compass headings or when using the magnetic compass as a reference for setting the heading indicator:

1. If you are on a northerly heading and you start a turn to the east or west, the compass indication lags, or shows a turn in the opposite direction.

2. If you are on a southerly heading and you start a turn toward the east or west, the compass indication precedes the turn, showing a greater amount of turn than is actually occurring.

3. When you are on an east or west heading, the compass indicates correctly as you start a turn in either direction.

4. If you are on an easterly or westerly heading, acceleration results in a northerly turn indication; deceleration results in a southerly turn indication.

5. If you maintain a north or south heading, no error results from diving, climbing, or changing airspeed.

With an angle of bank between 15 and 18, the amount of lead or lag to be used when turning to northerly or southerly headings varies with, and is approximately equal to, the latitude of the locality over which the turn is being made. When turning to a heading of north, the lead for roll-out must include the number of degrees of your latitude, plus the lead you normally use in recovery from turns. During a turn to a south heading, maintain the turn until the compass passes south the number of degrees of your latitude, minus your normal roll-out lead. (Source: pilotoutlook.com)

10.7 Lost Communications

Lost communications present a real challenge for the IFR pilot. In such cases, the investment in a handheld two-way radio would seem the best value for money. It is highly recommended. Without communicating with ATC, IFR flying becomes more stressful and challenging. However, there are precise rules which, if followed by the PIC, are well expected by the ATC and would make for safe conclusion of the flight without communication.

- Once it is determined that there is really a communications failure:
    - Follow last clearance received and readback; if you received the clearance but didn't read it back or get a "readback correct" confirmation, then the previous clearance is still in effect.
    - If ATC gave an expected further clearance, follow that.
    - Altitude - Highest of assigned altitude, expected altitude, MEA.
    - In a hold. - Leave the hold at the EFC time and proceed to fly the approach, or continue on with the assigned route.
    - Use common sense; FARs can't possibly address every possible situation.

- If in VFR conditions, continue the flight in VFR conditions; land as soon as practicable; contact ATC and inform them of the situation.

- In IFR conditions, squawk 7700 for 1 minute, then 7600.
- Is it an emergency?
  - Probably not, but it could be; Pilot's discretion to declare (even though unable to communicate it) an emergency,

10.8 Multi-Engine Dilemma

A full Discussion of multi-engine operation is beyond the scope of this brief guide. However, as many pilots soon discover, the piece of mind that comes with the second engine is often accompanied with far greater sense of responsibility and awareness of one's options and nowhere is this more pertinent than in emergency situations in IFR flight.

The operative word which most describes the dilemma of a multi-engine operation is "choice". In a single-engine emergency related to the engine, the pilot has very few options and this makes for simpler decision making. Depending on the situation, you can attempt to re-start an engine and if all else fails, land in the most suitable location. In a multi-engine aircraft, you have choices and that's where good judgment and experience comes into play.

You must be fully aware of this and give yourself the typical full multi-engine briefing before each take-off (loss of engine, directional control or fire during take-off roll, just after lift-off but before gear up, and after take off and gear up). Extra attention must be made to IFR consideration. For example, you may not be able to just go around and land in case of an engine failure on take-off if you are departing in IMC conditions. You would need to come back and shoot an IFR approach into either your airport of departure or another suitable airport nearby.

Another major consideration is knowing your aircraft performance characteristics in single- engine conditions. Most aircraft would not be able to hold altitude high enough with only one engine operational. If you are flying over mountains or high terrain, be aware that your second engine is not an insurance and could in fact give you significant challenges. During missed approach too, executing a single-engine climb requires extremely sharp skills. In most aircraft you must clean up the aircraft (flaps up, gear up) before any real climb can be attempted at full power. As always, if you encounter an engine loss, AVIATE first. Get the aircraft under control and then assess your situation carefully. A single engine loss is always an emergency.

10.9 Your Three Best Friends

Always remember that **AIRSPEED, ALTITUDE** and **STABILITY** are your three best friends. If you get into trouble, as long as you know your MOCA and MEA you can recover and be under control.

Don't ever allow yourself to be distracted to the point where any of these three friends are out of control. Airspeed is critical, especially during climb outs and approach. Your altitude is essential whenever you are in uncontrolled airspace or if you have lost communication. You must pay constant and conscious attention to MEA and MOCA to ensure you are always going to be in the "air". Stability is critical since anything that contributes to lack of a stable flight can take you out of control quickly.

10.10 Declaring an Emergency

Never be hesitant to declare an emergency if in your judgment it is justified. If you declare an emergency, the controller will give you the highest priority and will clear everything around you in order to allow you room to get safely on the ground.

So, what would constitute an emergency? That is typically at pilot's discretion. There are general guides such as extreme fuel shortage, inoperative systems within the aircraft such as the landing gears and the control surfaces, total electric or vacuum failure, a critically ill passenger, etc. In brief, any situation which would either endanger the safe operation of the flight or the passengers, could be an emergency. To declare an emergency, you would have to specifically declare it with the ATC and not be fuzzy about your request. By just saying you are low on fuel, you may not get the right attention. If you say that you are declaring a fuel emergency, you'll get top priority for descend and landing.

Such a situation is serious enough that you would usually be required to fill some paperwork by the controller. But as one pilot reminded me, it is better that you fill the paperwork than the coroner filling your paperwork all night.

11 Weather

As described before, the IFR pilot needs to become the consummate weatherman. The biggest mistake an IFR pilot can make is to assume that he is an "all weather" pilot. Nothing can be further from the truth. Many factors affect the flight, including weather severity, aircraft capability and pilot ability. For example, an aircraft should never be flowing into a thunderstorm regardless of aircraft capability or pilot sharpness. However, an aircraft equipped with de-icing and approved for flight into knowing icing (FIKI) may be flown into an icing condition. That too is dependant on many factors such as duration of flight, severity of icing conditions and pilot capability.

11.1 Big Picture

A pilot must have a mental picture of the weather patterns acting not only along his route of flight, but the bigger system affecting the greater area. This big picture is extremely important in anticipating sudden changes to weather which occurs in many parts of the United States and Canada. It is important to get a good feel for the frontal systems at play, the high and low pressure systems and any convective activities in the continent. Also important would be any developing systems over the ocean which could move inland and affect the route of flight.

11.2 Thunderstorms

Thunderstorms are perhaps the most dangerous enemy of any airborne aircraft regardless of size or speed. A thunderstorm should be avoided at all costs. You should never take off into the direction of an incoming thunderstorm or fly in clouds or at night in an area of known thunderstorms without on board radar.

In the northeast area of the United States, thunderstorms are very common during summer time, especially in the afternoons. Of all the weather conditions, thunderstorms should be respected as enemy number one!

If you have to divert to avoid a thunderstorm, ensure that you are laterally away from a thunderstorm by at least 20NM.

Never attempt to overfly, duck under or fly through a thunderstorm. Make that a solemn vow with yourself and never break it.

11.3 Icing

Accumulated icing on control surfaces and wings of an aircraft can be extremely dangerous and will significantly affect aircraft performance. Flying into known icing conditions without de-icing or anti-icing equipment onboard the aircraft is a foolish act. If you notice ice accumulation in any part of the aircraft, you must take it seriously, get out of the moist, icing condition and land as soon as practicable. An aircraft will behave extremely erratically if enough ice is accumulated on it. In certain conditions such as super-cooled droplets in low temperatures, icing can be formed extremely rapidly.

To ensure you avoid situation of icing, do a thorough job of weather briefing. There are many online tools that show icing conditions at each level of flight. However, nothing replaces good pilot reports in this area. Get the PIREPs before take off and also ask for them en-route if you suspect any icing during the flight. Remember that descending does not necessarily get you to warmer weather and out of icing. Sometimes you may descend, only to find yourself in worsening icing conditions. Ask for PIREPs and stay vigilant. Ice can kill.

12 Keeping It All Together

Flying IFR requires that you understand how the whole system hangs together, that you acquire the requisite proficiency in both the technical aspect of flying the aircraft as well as function effectively within the system. It further requires constant practice to stay ahead of the curve and remain sharp. To this end, the FAA and other authorities around the world have minimal requirements for "staying current". Experience has shown that this minimal requirement is just that -- minimal. To take on serious IFR flying in IMC conditions, you will find this inadequate.

In this section we will briefly describe some features to help you "keep it all together" -- from good cockpit management, to developing good judgment before and during flight. These are especially important in the case of single-pilot General Aviation IFR flight where the pilot is does not have the benefit of a whole support organization, a second co-pilot and is typically flying as a hobby rather than a constant daily profession. Many thanks to all the friends and colleagues such as Raymond de Haan and Brian Davis who have contributed much to my experience in this area.

12.1 Staying Current

According to the FAA, you must have in your logbook entry for the past six months:

1) Six IFR approaches to minimums

2) 1 Intercept

3) 1 Hold

In order to remain current. The FAA gives you a grace period of six months during which you may become current again with a safety pilot in the airplane while you use a view- limiting device to shoot the approaches and perform the intercept and the hold. If your grace period expires, then you must do an Instrument Proficiency Check (IPC) with a qualified instructor.

My general rule is that if I have not flown within the IFR system for 90 days, I would book my CFI and fly for 1-1.5 hours and practice some approaches into unfamiliar airports. This "remember me" flight is well worth the effort. Most flying clubs consider anything from 30-90 days as being current for VFR flying, how much more for IFR! Staying conservative here is the right attitude.

12.2 Cockpit Management

Many experienced pilots will tell you that cockpit management is a critically important part of flying -- VFR or IFR. In IFR flying, it becomes even more important since you mostlly don't have reference to outside the cockpit, and therefore the environment within the cockpit becomes even more important.

- **Develop a "Clean System"** - Keep the cockpit clean and organized for the "next event." Always stay one step ahead. Examples of suggestions from some experienced pilots:
    1. Keep a small kneepad. I found kneepads that are A5 size, lined and slightly yellow in background are best. Also, if you can strap the kneepad, it would make it easier. I usually write a few items on the pad to remember me to fill it up systematically: Date, time and dep/arr airport on top; engine start/end times, tac time and take off time all on top right; then comes ATIS for departure airport; then I write the letters C R A F T on each line with two spaces after "R" for my CRAFT clearance.
    2. Keep the departure airport diagram on the left hand chart holder, with the arrival diagram neatly clipped underneath.The SID is clipped to the yoke and the current utilized arrival at the departure airport underneath in case there is an issue and you have to return to the airport. Then the STAR and possible approaches for arrival airport are clipped neatly under that with the alternates beneath that. This is 6 charts to take out and prepare, but it is not an overkill as you will need them and you'd better have them properly placed rather than struggling to find them while in IMC conditions in a missed approach, emergency, turbulence or even in intense normal IFR.
    3. The en-route charts should be folded neatly along the route of flight. You may also highlight some of the key fixes and VOR's on the chart. To do so, you may use a colored tape which is used for this purpose and can be easily removed. The VFR sectional chart should also be folded and neatly placed underneath.
    4. Mark important items such as MOCA and restricted areas so that if all fails, you know what your minimum altitudes are and you never have to worry about flying into terrain.
    5. Touch the gauge after your set it. This encourages you to double check and confirm. For example, when you set the altimeter, touch the gauge as a confirmation and also touch it just before hitting the minimum.
    6. Always set the next nav-com frequencies in the standby radio and use the toggle switch to go back and forth. Also, always write the new frequency on your pad.
- **Keep A Sterile Cockpit**:
    1. Brief the passengers: There should be no discussion in the cockpit other than matters related to the flight, esp during take off and landing. The only times when non-flight related conversation could be initiated is during cruise and only when pilot-in-command initiates it.
    2. Tell passengers what they should expect ahead of time such as turbulence, entering clouds, etc. Ask them to keep quiet at all times. Some aircraft have separate intercom for passengers and that may be a good way to allow them to speak to one another without disturbing the pilot.
    3. Turn off the strobes when you enter clouds, especially at night. It usually terrifies the passengers who are not familiar with it.x

12.3 Developing Good Judgment

There are many debates about whether judgment can be taught and how one develops it. In my opinion, judgment can definitely be taught and is mostly done by an instructor who is conscious to explain the details of every decision and the rationale for any action to the student pilot. From the very first flight, the student should be asked what they think about the weather and how do they "judge" the situation for today's flight. Then the student should be guided not to just look outside and consult the right tools and make the right calls. Even a beginner student should feel he or she is fully involved in all the critical decision- making processes of the flight.

Judgment can be developed over time with experience, provided that the pilot uses every flight as a platform for learning and making one's experience richer. After each flight, it would be a good idea to pause and write down on your kneepad one or two points that you specifically learned on this flight.

12.4 Go - No Go

One of the biggest temptations for a newly minted IFR pilot is to feel he or she can just simply "go". As described before, nothing is further from the truth. Every flight begins with an analysis of the situation which requires the PIC and only the PIC to make a judgment call whether or not to initiate an IFR flight.

Before we discuss the decision process, I'd like to propose a controversial but safe "mind set" -- your orientation should be to find any reason to cancel the flight as opposed to finding reasons to make the flight happen. This is a subtle difference, but if you look vigilantly for reasons why you should not fly, then chances are that you may actually find one that is compelling. If your orientation is to "go", you will likely convince yourself to go even if you have issues which should keep you on the ground.

The PIC must use all the knowledge and skills and everything which is available to him before the flight to make a determination as to whether the flight can be fully completed safely. If there is any doubt about the complete safety of the flight, the flight should not be initiated. However, determining that is not always straight forward. There are many factors that play, including the weather, the plane, the pilot and other external environmental factors.

Some people use the acronym PAVE to assess the viability of every flight:

1. **P - Pilot** - You've got to be a 100% before you get in a small plane, single pilot with your family or friends in total IFR conditions. Beyond being "current", you must feel "sharp" for the flight. Are you on your game? Are you feeling healthy? Do you suffer from fatigue, sinus congestion, cold or anything that may cause discomfort or disorientation? Night flying is especially taxing on the single-pilot IFR. Stay awake and stay alive for the next hour of flight.
2. **A - Aircraft** - Is the aircraft 100% ready for this flight? Beyond the basics of air worthiness and IFR minimum readiness, ensure everything you need is in perfect working condition. Special attention to all external and internal lighting should be made for any flight that might take you into night conditions.
3. **V - enVironment** - Weather and everything that pertains to it are dynamic and they change all the time. You must keep it in mind right to the point of take off and be completely aware of it all the way throughout the flight. Other issues related to the environment is the airports and routes of flight. Will you be departing a high-altitude airport on a hot day? Will you be flying over mountains or large body of water? Will you be flying in remote parts of the country, extreme northern parts of Canada and Alaska? All of these may require special training and endorsement and you should not take them on without adequate preparation.
4. **E - External Factors** - Do you have an important meeting to go to? An anniversary or a birthday? Do you have people in the plane who you could be impressing with your skills? Never never allow such external factors to come between you and the critical judgment of whether to take off or not. Do not box yourself in a situation where your better judgment is a hostage to an external factor.

The following should be taken as a basic guide:

1) If your path of flight will take you into thunderstorm of any sort, do not take off or ensure that you can divert around it very safely. Generally, if there are thunderstorms in the region and you are not equipped with onboard weather radar, do not take off

2) If there is a chance of icing and you would be in clouds or freezing rain for anything longer than a few minutes, do not take off. Unless you have de-icing onboard, flying into icing conditions can be deadly.

3) If the weather is significantly below what you have experienced in the past, reconsider to fly another day. Shooting an approach to minimums in rain, fog and with high- crosswinds is not something you want to try for the first time on your own.

4) If you feel "boxed" -- need to get somewhere for any reason and you feel this is pressuring you mentally and the weather or conditions are marginal, do not fly. It is always best to have a plan B. Nothing is as important as your safety and the safety of your passengers. Everyone will understand if you explain you made a decision based on safety.

5) Finally, do your pre-flight thoroughly, assess the situation, do not cut corners. But if you still have doubts about your ability to complete the flight successfully, do not go.

Remember that until the wheels of the aircraft have not left the ground, your chances of a mishap are minimal and until the wheels of the aircraft have touched down safely and you have secured the plane, your risks of the flight are not fully mitigated.

12.5 Your Personal Minimums

Any flight has "minimums" -- VFR or IFR. Most are defined by weather. However, there are others dictated by equipment on board and functioning of the equipment in space and on the ground. Strictly speaking, if you are not flying commercially and are operating in Part 91 (private operation), regardless of your license, the minimums are very low indeed. For example, there are no take off minimums under Part 91! You can essentially take off in zero- zero weather. In 10 out of 10 cases, I would recommend against that.

In Canada take offs are regulated by visibility for all aircraft.

When it comes to landings, the minimums are described in a previous section (remember 1- 2- 3) and also specific approach minimums to each airport. Typically, an ILS would have minimums of about 200' AGL and around 1 statute mile. Is that something you feel comfortable shooting today?

It is absolutely essential that you set your own personal minimums and stick to it. Make it simple and make it binary. It is either go or no go. You may over time change those minimums as you get more experience and more confidence. Here are good minimums you can set if you are a low-time IFR pilot:

1) Thunderstorms or icing in path or vicinity of flight - NO GO

2) Take off minimums: 1000' ceiling and 2 miles visibility

3) Approach minimums: 1000' ceiling and 2 miles visibility; same for alternate

4) Backup GPS receiver

5) Backup two-way communications device

6) Two sets of flashlights for night operation

The above will give you a reasonable set of conditions to start from and would not unduly strain a well trained and current pilot. Any deficiency in terms of training, currency, health, etc. should have a direct impact on these and you should never hesitate to cancel a flight if you do not feel 100% up to it.

13 Resources & References

Web Site	Description
Reference	
www.pilotfriend.com/training/flight_training/nav/ifr_instr.htm	A good reference for IFR flying
www.aviationkb.com	
www.prococpit.com	
www.pilotoutlook.com	
http://iacra.faa.gov	FAA pilot licensing site
www.faasafety.gov	FAA reference guide for flight safety
Flight Planning	
www.fltplan.com	Complete flight planning tool with ability to file IFR & VFR plans. Includes suggested routes, maps, weather, etc.
www.flightaware.com	Used to track all IFR flights including commercial flights. Also has a flight planning tool.
www.duats.com	Get weather and file flight plans in the most basic text format.
www.duat.com	DTC DUAT is another version of basic flight planning tool.
www.navcanada.com	Canadian flight planning and weather services
www.aopa.org	Aircraft Owners and Pilots Association. For members, it has full flight planning, weather, filing and training services.
www.skyvector.com	Charts, flight planning and more.
www.airnav.com	search information on all airports in the US including FBO information.
www.faa.gov	FAA main site
http://tfr.faa.gov	Temporary Flight Restrictions (Important)
www.skybrary.aero/landingpage/	

Weather and Others	
www.intellicast.com	Satellite services
www.aviationweather.gov	Complete Aviation Weather
http://weather.noaa.gov	FAA Aviation Weather
https://eapis.cbp.dhs.gov	Customs & Border Protection site. Must use this if you want to fly to/from the USA from/to another country (including Canada and Mexico).

Books & Others	**Description**
Books	
Flying IFR - Richard Collins	One of the best and most comprehensive books on IFR flying by the legendary Pilot and Writer
Instrument Flying Refresher - Richard Collins	A great small refresher for IFR flying
IFR for VFR pilots - Richard Taylor	As the title suggests, it is IFR for VFR pilots
Cleared for Approach - Cessna Pilot Centre	Comprehensive IFR reference book. Compendium to the DVD set by the same name.
Others	
Cleared for Approach - Cessna Pilot Centre	A complete 24+ DVD set for IFR training. This is increasing becoming the standard for IFR training across the nation.

14 Summary

IFR flying is serious business. It requires a full appreciation of the whole system and competency for much more accurate flying of the aircraft with reference only to instruments, but it also requires much more than that.

Regardless of the length and nature of the flight, the approach to every IFR flight must be that of a true professional. Stay on course with procedures, checklists, personal minimums, equipment, training and the like.

As I write these final words to this brief guide for IFR flying for my son's benefit, my hope is that this guide, however inadequate it may be, is able to help every reader's understanding of the entire IFR system and hopefully assist you in becoming a safer and more competent pilot.

Enjoy every flight and be safe!

Shane Tedjarati

31 August 2010

Luoyang, China