



ON TRACK



Articles of Interest for the Professional Aviator

ICP Flight - Central Flying School

INTERNATIONAL CIVIL AVIATION ORGANIZATION (ICAO) PROCEDURES

Introduction. The ICAO is composed of over 180 member nations, and is a part of the United Nations. Unlike Transport Canada, whose regulations are directive, ICAO is essentially an advisory organization that jointly agrees on procedural criteria. These criteria are published in a document called Procedures for Air Navigation Services-Aircraft Operations (PANS-OPS). Individual ICAO member nations may then comply with all, a part of, or none of the criteria published in PANS-OPS. A specific nation's adoption of ICAO criteria makes that criteria directive in that country. The information provided in this document is based on PANS-OPS and US Air Force Manual 11-217 Vol I.

General. All ICAO procedures must be flown as they are depicted. Procedures are based on 25° of bank or the bank angle giving a rate of turn of 3° per second, whichever is less. And, when determining when you can start descent to the next altitude on an approach, ICAO defines "established on course" as being within half full-scale deflection for an ILS or VOR/TACAN and within $\pm 5^\circ$ of the required bearing for the NDB. Being outside these tolerances could place your aircraft near the edge of the protected airspace where loss of required obstacle clearance can occur. In cold weather, apply temperature correction procedures just as you would in Canada. When under radar vectoring, ATC will issue altitude clearances taking the temperature correction into account. But, of course, it's always a good idea to do the calculations yourself, just to make sure.

Departure Procedures

Climb Gradient. ICAO gradients are the same as in Canada, but they are expressed as percent gradients instead of ft/NM. ICAO departure procedures assume a minimum climb gradient of 3.3% (200 feet/NM) unless published otherwise.

Basic Rules for All Departures. PANS-OPS uses the same basic departure concept as Canadian TERPs. Unless the procedure specifies otherwise, climb on runway heading at a minimum of 200 feet/NM (3.3%) until reaching 400 feet above the departure end of the runway (DER). Continue to climb at a minimum of 200 feet/NM until reaching a safe enroute altitude.

Omnidirectional Departures. The PANS-OPS Omnidirectional Departure is somewhat similar to a Canadian Diverse Departure. It is a departure procedure without any track guidance provided. An Omnidirectional Departure may be published even though obstacles penetrate the 40:1 Obstacle Identification Surface. The standard case allows you to turn in any direction once you reach 400' above DER. However, the procedure can specify a higher altitude than 400' for the turn, a higher climb gradient before turning, or can limit the turn to certain directions or sectors.

Standard Instrument Departures. PANS-OPS uses the term Standard Instrument Departure (SID) to refer to departures using track guidance. Minimum climb gradients may apply. Whenever possible, a straight departure will be specified. A departure is considered "straight" if the track is aligned within 15° of the runway centerline. For turning departures, maximum speed limits apply. These maximum speeds may be published by category or by a note ("Departure limited to CAT C Aircraft" or "Departure turn limited to 220 KIAS max.") If the departure is limited to specific aircraft categories, the applicable speeds are:

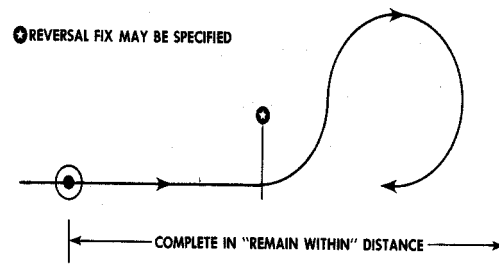
Aircraft Category	Max Airspeed (KIAS)
A	120
B	165
C	265
D	290
E	300

Low Altitude Approach Procedures

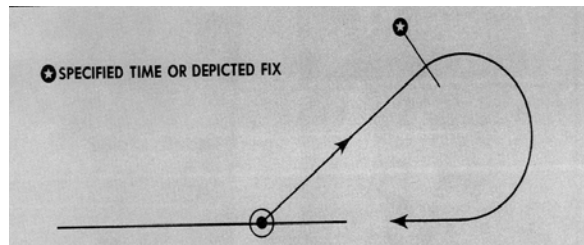
Reversal Procedures. ICAO “Reversal Procedures” are similar in concept to procedure turns. ICAO recognizes three different methods of performing a reversal procedure, each with its own airspace characteristics.

The 45°/180° Procedure Turn. This is the standard hockey stick manoeuvre except for the timing methodology. Time outbound for the desired duration, restart your clock before initiating the turn to the 45° leg, then time on this leg for 1 minute for categories A and B aircraft and 1 minute 15 seconds for categories C, D and E aircraft;

The 80°/260° Procedure Turn. This procedure consists of a straight leg with track guidance, either timed outbound or limited by DME distance; an 80° turn toward the protected side followed immediately by a 260° turn in the opposite direction to intercept the inbound track. The 45°/180° and the 80°/260° manoeuvres are inter-changeable—if one is depicted on the approach plate, it is permissible to fly the other manoeuvre at the pilot’s discretion. This is not true of the base turn procedure.

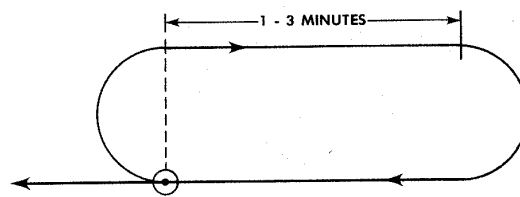


The Base Turn. This procedure consists of flying a Specified outbound track, timing from the facility or proceeding to a specified fix, followed by a turn to intercept the inbound track. The base turn procedure is not optional. **You may not fly one of the “procedure turns” described above instead of the depicted base turn.** More than one track may be depicted depending on aircraft category.



The Racetrack. Normally a racetrack procedure is used when aircraft arrive overhead the fix from various directions or where sufficient distance is not available in a straight segment to accommodate the required loss of altitude. Entry procedures for a racetrack are the same as entry procedures for holding patterns with a few exceptions:

- The teardrop offset will not exceed 30° from the inbound course.
- The offset entry is limited to 1 1/2 minutes wings level on the 30° offset track, after which the pilot is expected to turn to a heading to parallel the outbound track for the remainder of the outbound time. If the outbound time is only 1 minute, the time on the 30° offset track will be 1 minute also.
- Parallel entries may not return directly to the facility without first intercepting the inbound track.
- All manoeuvring will be done as much as practical on the manoeuvring side of the inbound track.

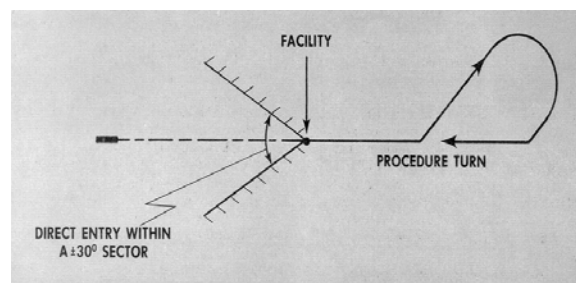


Reversal Procedure Entry Sector. Unless the procedure specifies particular entry restrictions, the $45^\circ/180^\circ$, $80^\circ/260^\circ$, and base turn reversal procedures must be entered from a track within $\pm 30^\circ$ of the outbound reversal track. There is no entry sector for racetracks. If the $\pm 30^\circ$ entry sector does not include the reciprocal of the inbound track, the entry sector is expanded to include the reciprocal.

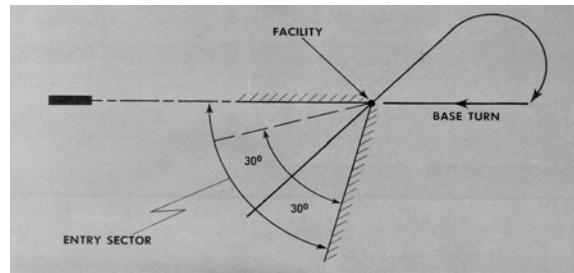
If the aircraft's arrival track is not within the entry sector:

- Comply with the published entry restrictions or arrival routing; or
- If there is a suitable arrival holding pattern published, request a turn in holding to get properly aligned; or
- If there is no published routing or suitable holding pattern, get clearance for manoeuvring airspace to get into the entry sector.

Procedure Turn Entry Sector ($45^\circ/180^\circ$ or $80^\circ/260^\circ$)



Base Turn Entry Sector



The 30° Entry Sector. The reason PANS-OPS specifies this entry sector is because, unlike in Canada, the course reversal protected airspace may not include any airspace except that on the outbound side of the procedure turn fix. In Canada, protected airspace includes a large “entry zone” surrounding the fix.

ICAO vs. standard Canadian Protected Airspace for a Procedure Turn	
<p>Standard Canadian protected airspace for a procedure turn is shown in white, with the ICAO airspace in grey. Note that there is no primary protected airspace to the west of the IAF under PANS-OPS criteria.</p>	

What if you Arrive From Outside the Entry Sector?

Arrival Routing. There is often a published arrival routing into the IAF, such as a STAR, feeder routing, or arrival airway. This arrival routing may not fall into the 30° entry sector. Such arrival routes will be blended into the reversal approach, and protected airspace is provided to allow the pilot to turn onto the outbound reversal track. Pilots need not request “maneuvering airspace” to perform an alignment maneuver. Such requests are often met with confusion by ATC. You should remain within protected airspace on the published arrival routing, whether or not that happens to align you with the 30° entry sector.

Using the Arrival Holding Pattern. On most ICAO course reversals, a holding pattern is published at or near the IAF to accommodate arrivals from outside the 30° sector and not on a published arrival routing. PANS-OPS directs pilots arriving from outside the entry sector to enter holding prior to the reversal procedure. In most cases, the holding pattern will align you for the approach. Obviously, you must get clearance from ATC for the hold prior to executing it.

Off-airway Arrivals. What if there is no suitable holding pattern? The danger arises when attempting to perform the course reversal when arriving into the IAF from a direction not anticipated by the approach designer, such as when you request to proceed direct to the fix from a point off the arrival airway. Sometimes there is no holding pattern published for your alignment, or there is a holding pattern that does not turn you into the entry sector. In this case, you will need to maneuver into the entry sector somehow. You must understand how small the protected airspace is, especially when compared to a standard Canadian procedure turn. You may be operating completely outside of protected airspace while proceeding to the IAF, and terrain and obstacle clearance may be totally up to you. Use good judgment, consider the published minimum safe/sector altitudes, and do not rely solely on ATC to keep you safe.

Descent. When a descent is depicted at the IAF, start descent when abeam or past the IAF and on a parallel or intercept heading to the depicted outbound track.

Remaining Within Protected Airspace. Most ICAO course reversals specify a fix or a time to start the reversal turn, instead of a “remain within” distance. Comply with all guidance on the IAP. Do not automatically assume you can treat an ICAO course reversal maneuver the same way as you would a procedure turn in Canada.

Airspeed Restrictions. If the procedure is limited to specific aircraft categories, these are the applicable speeds:

Category	Max Speed (KIAS)
A	110
B	140
C	240
D	250
E	250

The actual ICAO aircraft category speeds are the same as the Canadian speeds but approach designers allow some leeway to fly faster than your category speed when flying an instrument approach. That is what is depicted in the table above.

Circling Procedures. ICAO circling protected airspace is essentially the same as in Canada. One important distinction to make is between the terms “runway environment” and “airport environment.” While circling using an ICAO-designed procedure, you must maintain visual contact with the runway environment throughout the entire circling maneuver. In Canada, you are only required to maintain visual contact with the airport environment while circling to land.

Holding

Bank Angle. Make all turns at a bank angle of 25° or at a rate of 3° per second, whichever requires the lesser bank. ICAO procedures do not allow correcting for winds by adjusting bank angle. Attempt to correct both heading and timing to compensate for the effects of wind to ensure the inbound track is regained before passing the holding fix inbound.

Limiting Radial. When holding away from a NAVAID, where the distance from the holding fix to the NAVAID is short, a limiting radial may be specified. A limiting radial may also be specified where airspace conservation is essential. If you encounter the limiting radial first, initiate a turn onto the radial until you turn inbound. Do not exceed the limiting DME distance, if published.

Holding Entry Procedure. The ICAO holding entry procedure is a mandatory procedure and is the same as Canadian entry procedures.

Airspeeds. There is little standardization of maximum holding airspeeds in PANS-OPS. There are three different PANS-OPS tables of holding airspeeds that an approach designer could have used, depending on when the holding pattern was constructed. Plus, many countries publish their own holding pattern airspeeds. This information is supposed to be published, but it may be difficult for you to find it. Maximum holding airspeeds are defined by PANS-OPS or the host country. They define the quantity of protected airspace and have no relation to the holding speed specified in the aircraft flight manual. The table below shows the airspeeds from the Second Edition of PANS-OPS, and is the most common table used.

ALTITUDE	AIRSPEED	AIRSPEED
	Normal Conditions	Turbulence*
0-14,000' (CAT A and B)	170	170
0-14,000' (CAT C and D)	230	280
14,001' – 20,000'	240	280 or 0.8 Mach, whichever is less
20,001' – 34,000'	265	280 or 0.8 Mach, whichever is less
34,001' and above	0.83 Mach	0.83 Mach

NOTE: *The speeds published for turbulent conditions shall be used for holding only after prior clearance with ATC, unless the relevant publications indicate that the holding area can accommodate aircraft flying at these high holding speeds.

Holding Pattern Lengths. On the second and subsequent arrivals over the fix, turn and fly an outbound track that will most appropriately position the aircraft for the turn onto the inbound track. If not specified, the timing should be 1 minute outbound at or below 14,000 feet MSL, or 1 1/2 minutes outbound above 14,000 feet MSL.

ICAO Altimeter Setting Procedures

There are three different methods of reporting the altimeter measurements. The practice used in Canada is to report the altimeter setting in inches of mercury (IN HG). In most other parts of the world, the metric system is used and you will hear the setting in millibars (MB) or hectopascals (HPa), but ATC may provide a setting in IN HG upon request. Millibars and hectopascals are the same and can be used interchangeably. For aircraft that have only one type of altimeter scale, both the GPH 205 and DoD's Flight Information Handbook provide conversion tables.

QNH Settings. A QNH altimeter setting represents the pressure that would, in theory, exist at sea level at that location by measuring the surface pressure and correcting it to sea level pressure for a standard day. Set the reported QNH when descending through or operating below the published Transition Level. With the proper QNH set, the altimeter will indicate your height above Mean Sea Level (MSL). All Canadian approach criteria are based upon using QNH altimeter settings.

QNE Settings. QNE is used to indicate your height above an imaginary plane called the standard datum plane, also known as FL 0. The established altimeter setting at FL 0 is 29.92 inches of mercury, or 1013.2 millibars or hectopascals. Set QNE (29.92) when climbing through, or operating above the Transition Altitude.

QFE Settings. QFE is the altimeter setting issued to aircraft to indicate the AGL height above the airport. With the proper QFE set, your altimeter should indicate "0" on the ground. QFE is commonly used by the Royal Air Force and the Royal Navy in the United Kingdom, and in many parts of the Pacific and Eastern Europe.

Transition Altitude. This is the altitude at which you change from whatever the local altimeter setting is to QNE (29.92) when you are climbing. The transition altitude is the highest usable altitude at which you can fly. Above the TA you set QNE, below the TA, you set QNH or QFE, whichever is appropriate. The transition altitude can be the same throughout a country (like in the US) or it can differ by region (like in Canada) or it can differ from airfield to airfield (like in the UK). Transition altitude will not normally be below 3,000 feet HAA and must be published on the appropriate charts.

Transition Level. This is the lowest usable flight level. Transition level is usually passed to the aircraft during the approach or landing clearances. The transition level may be published, or it may be supplied by ATC or ATIS. Half flight levels may be used: for example, "FL 45".