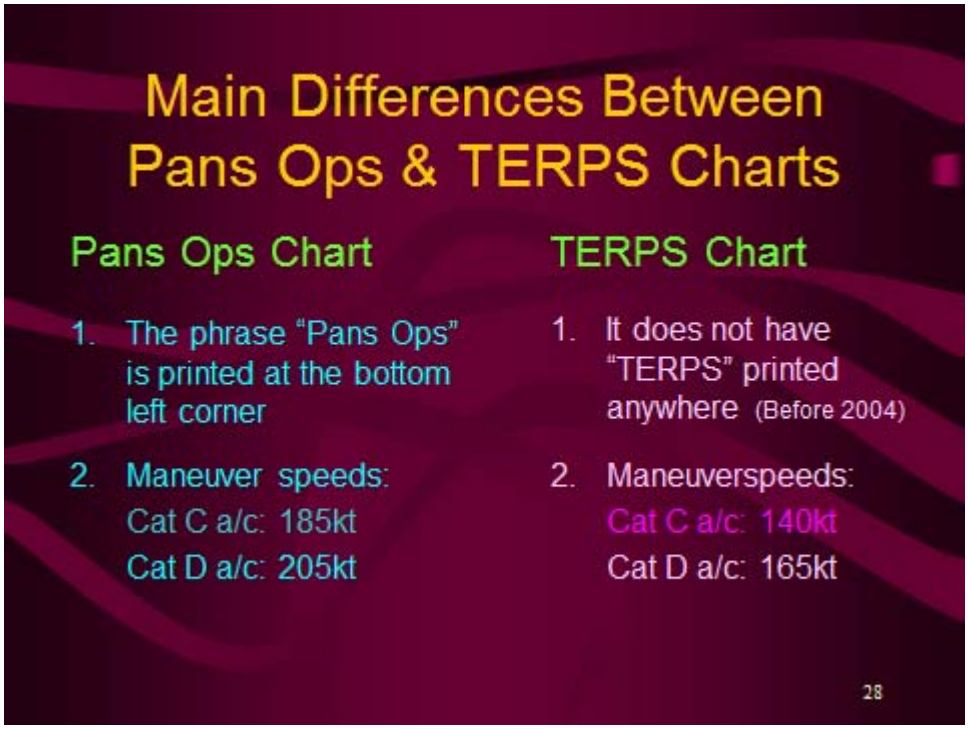
Terps vs. Pans-Ops

Circling Approaches



Missed approach criteria - TERPS

To optimize procedures with regard to aircraft performance, aircraft are divided into categories based on V_{at} (knots *IAS*):

Aircraft category	V_{at}	Max speed for takeoff	Range of speeds for initial approach	Range of speeds for final approach	Max speed for circling	Max speed for missed approach	
						Intermediate	Final
A	<91	121	90/150 (110*)	70/100	100	100	110
B	91/120	165	120/180 (140*)	85/130	135	130	150
C	121/140	264	160/240	115/160	180	160	240
D	141/165	292	185/250	130/185	205	185	265
E	166/210	303	185/250	155/230	240	230	275

V_{at} = Speed at threshold based on 1.3 times stall speed in the landing configuration at maximum *certificated* landing mass

*** Maximum speed for reversal and racetrack procedures**

Pans-Ops

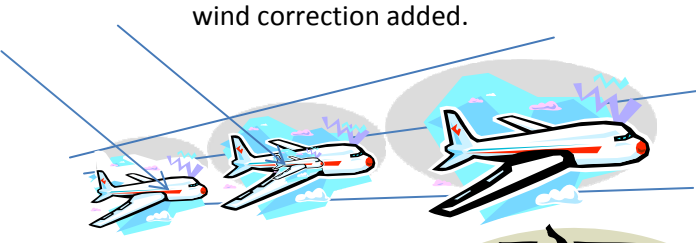
Before a procedure is designed, all speeds above are converted to TAS for the procedure altitude.

Temp: ISA for the altitude

Pressure: Standard 1013.2 hPa

Temperature lapse rate: 2° per thousand feet (note: the procedures are normally designed for temps of +15° C, but in warmer climates higher temps are considered.

Winds: the procedure is adjusted for omni-directional winds. In other words, the most negatively affectual wind and no wind correction added.



Protected airspace is available for an omnidirectional wind along track allowing for drift with no correction. The further away from the beginning point, the larger the protected airspace

Outer boundary - omnidirectional wind spiral increasing protected airspace with distance from the base fix. Same principal as described for circling airspace is used to determine outer boundary in turns.

WIND SPEEDS

Statistical winds are used when available. Otherwise, Pans-Ops uses the following criteria:

Initial Approach Segment: 47 kts + 2xAltitude (Pressure altitude 4,000'. Wind = 47 + (4X2) = 55 kts)

Missed Approach Segment: To determine MAP - 10 kt tailwind

Otherwise: 30 kts

Mountainous terrain: Winds > 20 kts that move over mountainous terrain may cause altimeter error as well as control problems. These effects are considered in Pans-Ops and terrain clearance should be increased by as much as 100%. The PIC should consider making corrections for wind effects in mountainous terrain just as he should for colder temperatures.

Wind Speed at 98 Feet (30 Meters) Kts	Altimeter Error (ft)
20	53
40	201
60	455
80	812

Remember Bernoulli's principle? The effect can be seen here.

"***The faster a fluid or gas (air) moves past an object, the lower it's pressure is against that object***."

Remember the old weather adage?

"High to a low, look out below!"

Departure procedures:

Correct crossing restrictions for low temps. Approximately 4% per 10° below standard or the temp tables for temp comp approaches. The tables are valid for sea level, so compensate for higher altitudes.

Holding:

Right turns are specified whenever possible.

Outbound times, still air:	</= 14,000' (4,250m)	1 min	
	> 14.000' (4,250m)	1.5 min	
Speeds:	< 14,000' Cat C/D	230 Kts normal	280 kts turbulence *
	14,001-20,000'	240 kts normal **	280 kts/.8 Mach, whichever is less
	20,001-34,000'	265 kts normal **	"
	34,0001+	.83 Mach	.83 Mach

* With ATC approval

** Whenever possible, 280 kts should be used also for holding procedures associated with airways

Rate of turn: Bank angle - 25° or 3° per second, whichever is less bank

Minimum sector altitudes: Generally 300 meters (984') of vertical protection but the designers may add in another 300 meters to compensate for high winds/turbulence.

Correct for low temperatures!!

Re: Jeppesen approach plates…

1.2.1.2 Procedures developed in accordance with the ICAO Procedures are indicated with a margin notation "PANS-OPS", "PANS-OPS 3", "PANS-OPS 4" or "PANS-OPS 5".

PANS OPS

indicates that the State has specified that the approach procedure complies with ICAO Document 8168, Volume II, First or Second Edition.

PANS-OPS 3

further indicates that holding speeds to be used are those specified in ICAO Document 8168, Volume II, Third Edition.

> **Note:**
>
> For applying the correct holding speed, refer to the respective State RULES AND PROCEDURES page.

PANS-OPS 4

further indicates that the acceleration segment criteria have been deleted, as formerly published in ICAO Document 8168, Volume II, First, Second and Third Editions.

> **Note:**
>
> Acceleration Segment criteria published in previous editions of Document 8168 are contained in Appendix 1.

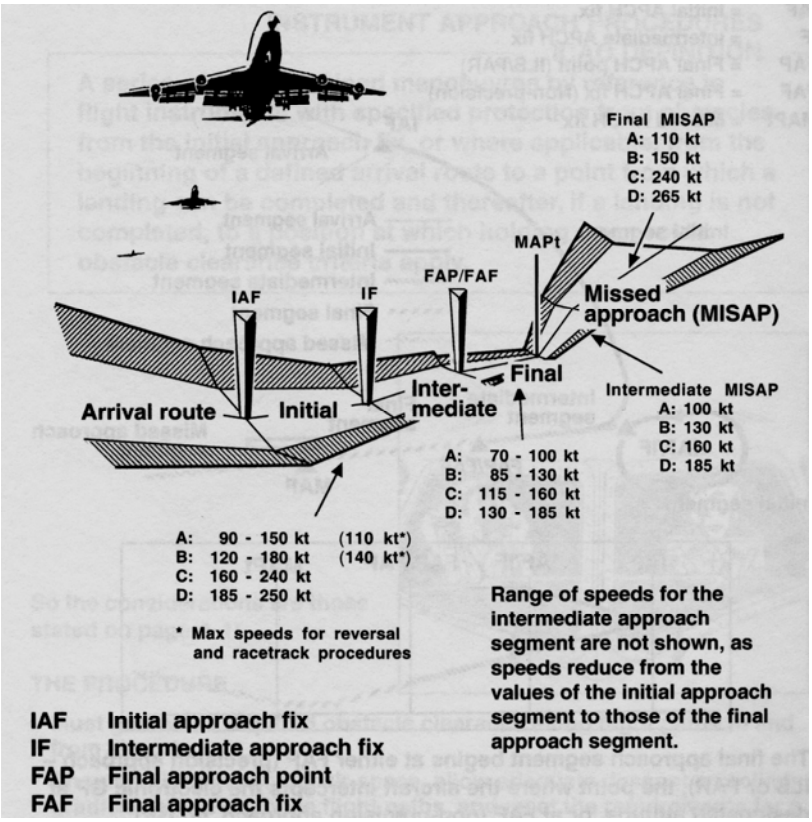
PANS-OPS 5

further describes APV and VNAV operations, ACAS procedures and CDFA including vertical path control methods.

APV=Approach procedure with Vertical guidance

ACAS=Airborne Collision and Alerting System

CDFA = Continuous Descent Final Approach



Approach speeds:

Initial Approach Segment Reversal Procedures:

PANS-OPS

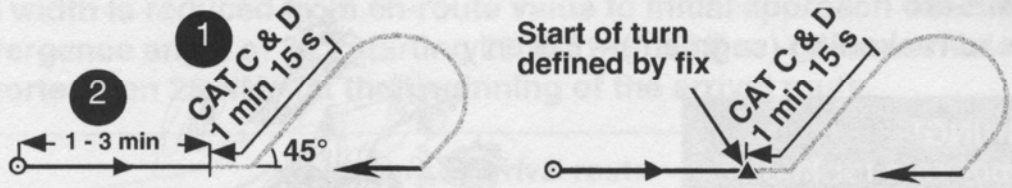
INITIAL APPROACH SEGMENT, REVERSAL PROCEDURES

This is a type of procedure designed to enable aircraft to reverse their flight direction 180° during the initial approach.

Outbound times are given for still air. Adjust times for wind conditions!

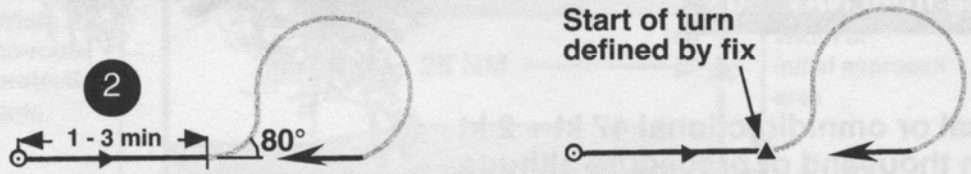
There are three types of reversal procedures

45°/180° PROCEDURE TURN



1 **Cat A & B: 1 min. These times are not shown in approach charts**

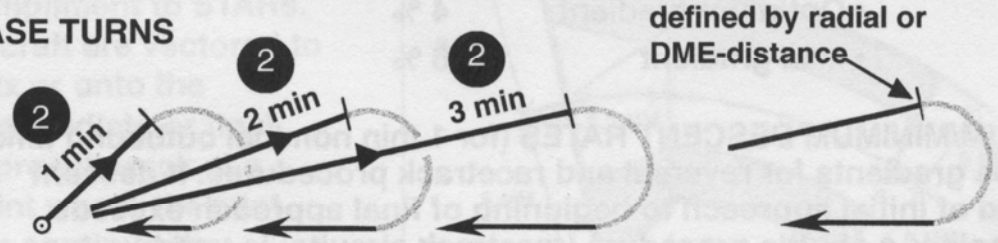
80°/260° PROCEDURE TURN



Immediately after 80° turn completed, turn 260° in opposite direction to intercept inbound track

Unless otherwise stated on the approach chart, the above procedure turns are alternatives to each other and the pilot may freely choose which type of procedure turn to use.

BASE TURNS

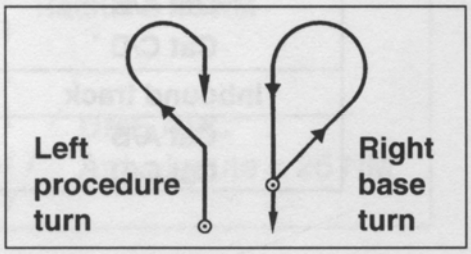


Track guidance

No track guidance

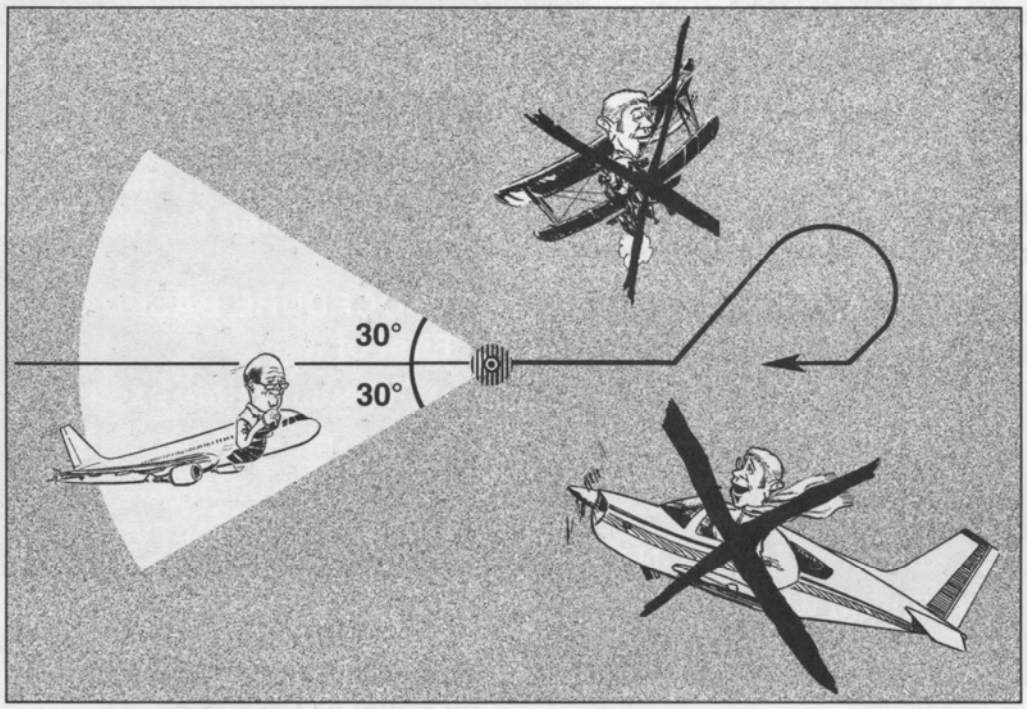
2 **Time and outbound track shown on approach charts**

Procedure turns are designated "left" or "right" depending on the direction of the *first* turn when flying outbound.

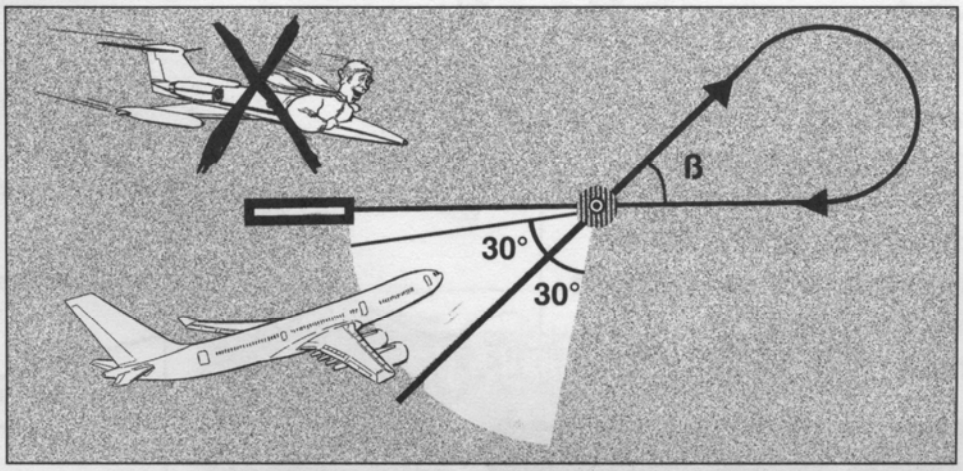


NO OMNIDIRECTIONAL ENTRY!
Unless otherwise specified, a reversal procedure shall be entered only via the entry sector shown below!

PROCEDURE TURN



BASE TURN
When ß > 30°, the entry sector is extended to include the reciprocal of the final approach track (as shown).

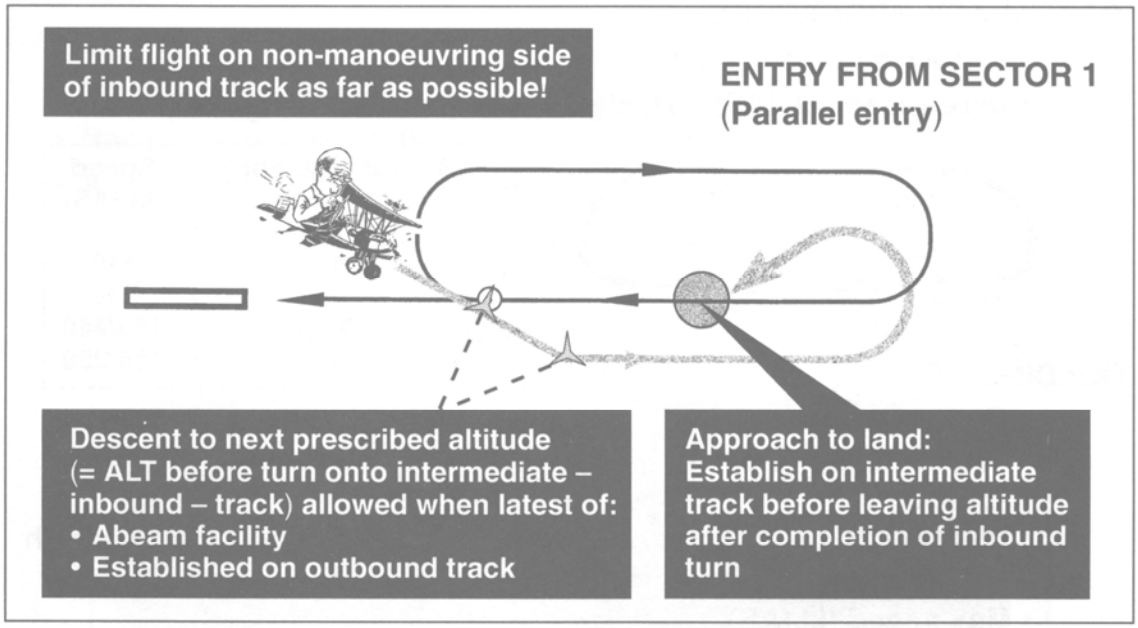


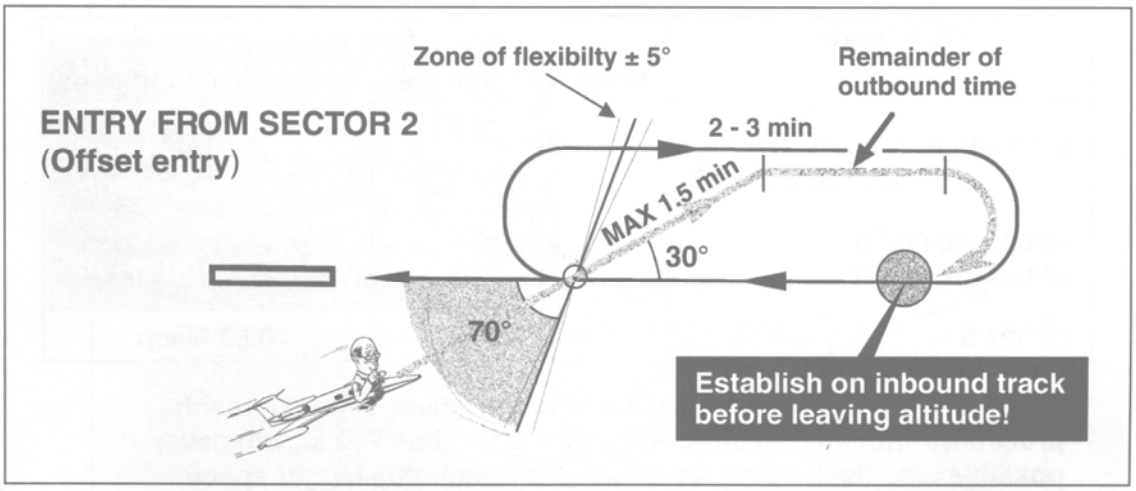
Should an omnidirectional entry be required and no racetrack procedure has been developed, entry into the reversal procedure could be made from a suitably located holding into the reversal procedure´s entry sector.

Racetrack procedures are used to permit omnidirectional entries from various directions, and when too high to conduct a straight in. Also used when a straight segment would not permit the required loss of altitude due to maximum permitted descent rates in the procedure design. (Shuttle procedure)

Initial Approach Segment – racetrack procedures entry

The procedures for entry into a racetrack or a holding are identical except for entry from sector 1 and 2.





You are "established" when within:

- ILS and VOR
  1/2 full scale deflection:
  - ILS ± 1.25° - VOR ± 5°
- NDB ± 5°

Note that entry procedures for all sectors except #1 and #2 are the same. Entry for 1 and 2 are shown above.

The protected airspace for a racetrack is larger than that of the procedure turn.

Outbound time: 1.5 min

Procedure altitude: 3,000’

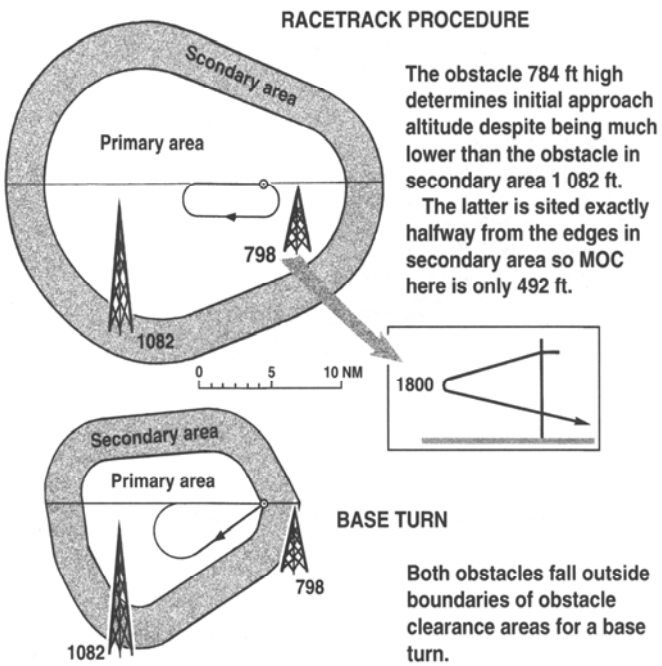
Speed 210 kt IAS (225 TAS)

Obstacle Clearance:

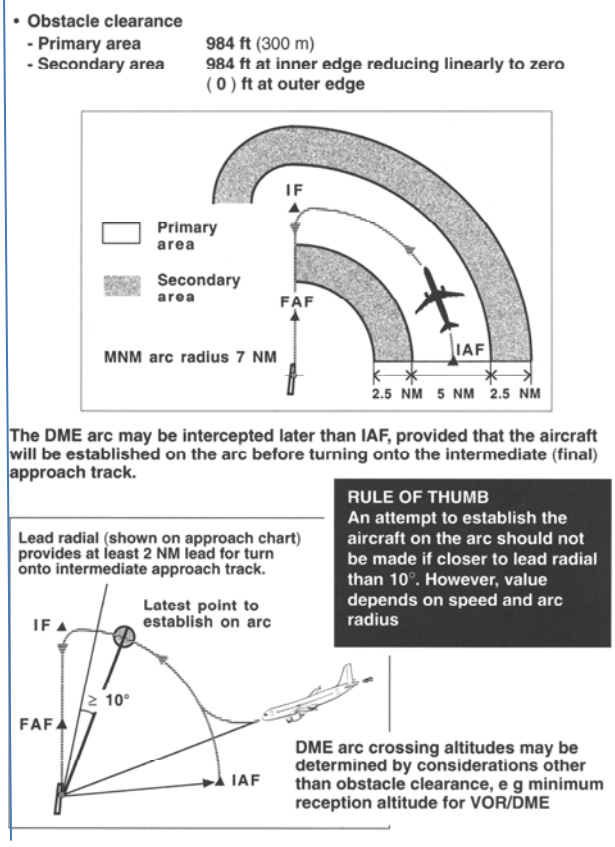
Primary area: 984’ (300 m)

Secondary area: 984’ at inner edge reducing to zero (0) ft at outer edge

Width of secondary area 2.5 nm



DME Arc protected airspace:



Intermediate approach segment:

In the intermediate segment, position, speed and configuration adjustments are made for entry to the final segment. The intermediate segment is normally aligned with the final segment.

Descent gradient: preferably flat, max 5% (2.86 deg)

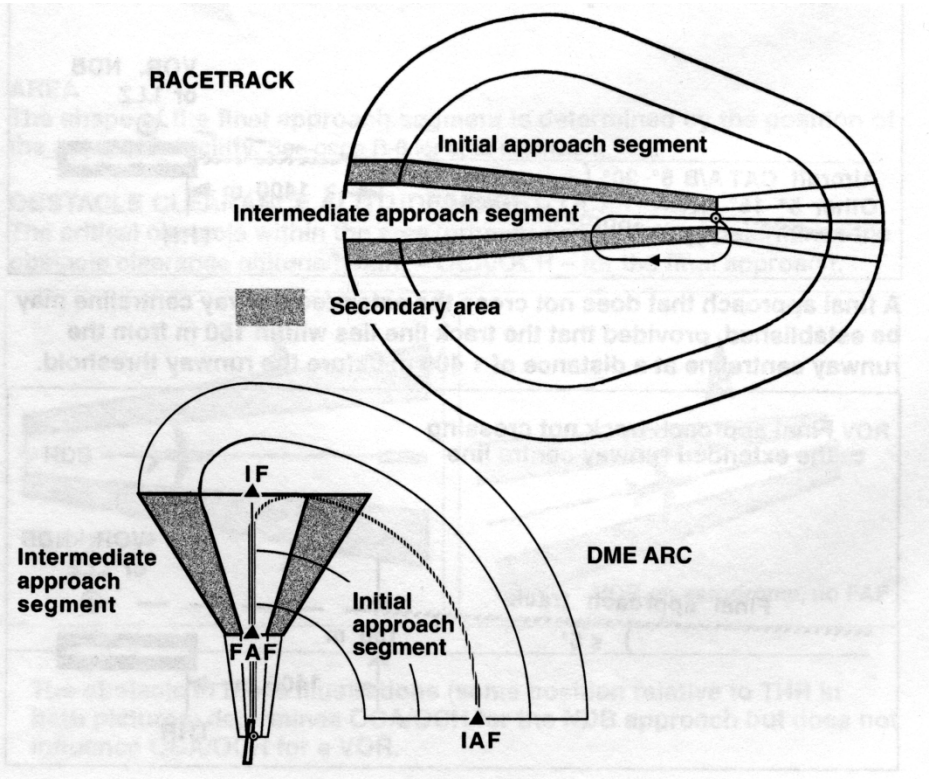
Max descent rate for a reversal or racetrack procedure (1 min outbound):

Inbound track	Maximum	Minimum
Cat A/B	655’ (200m)	394’ (120m)
Cat C/D	1000’ (305m)	590’ (180m)

Obstacle clearance:

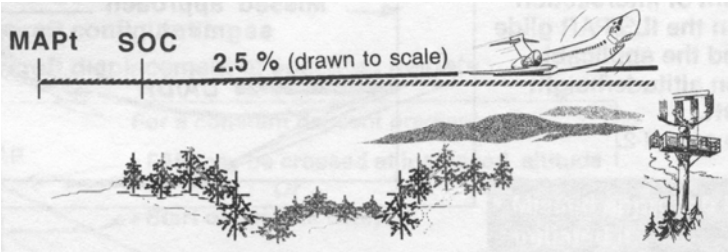
-Primary area 492’ (150m)

-Secondary area 492’ at inner edge reducing linearly to zero at outer edge

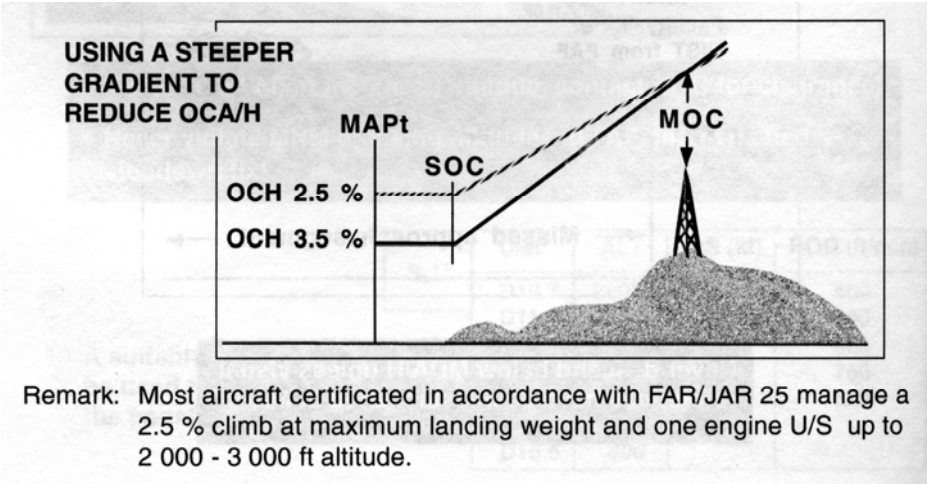


Missed approach segment:

Because the airplane doesn’t start the climb immediately during a missed approach due to changes in configuration, attitude and altitude, the design criteria includes a period of level flight from the MAP to SOC (start of climb). Distance to SOC in level flight is 15 s with the highest TAS for the final approach at ISA +15C and a 10 kt tailwind.



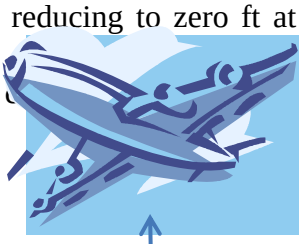
Climb gradient is normally 2.5%. When obstacles in the missed approach area determine OCA/H, a steeper gradient gives a lower OCA/H. This steeper gradient is stated in the approach chart.

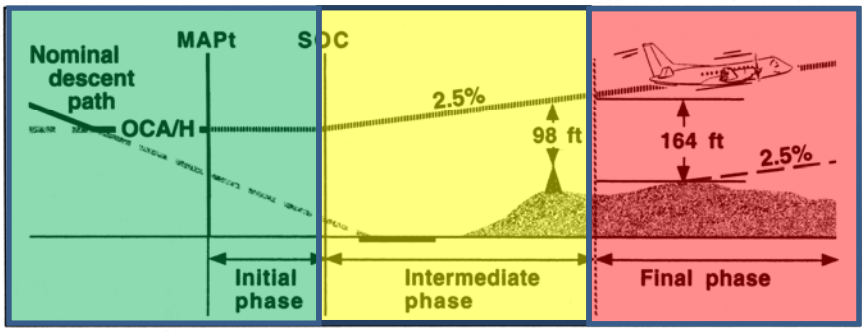


Missed approach Segment, Phases and Minimum Obstacle Clearance

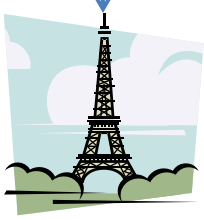
3 phases of the missed approach:

- Initial Phase
  - Extension — From MAP to SOC
  - MOC — Same as for final approach
- Intermediate Phase
  - Extension — From SOC to the point whwere MOC is 164' (50m) is first reached and can be maintained
  - MOC — In primary area minimum of 98' (30m) reducing to zero ft at outer edge
- Final Phase
  - Extension — From a point where 164' MOC is first reached and is maintained to a point where a new approach, holding or en-route flight is initiated
  - MOC — Primary area-minimum 164' reducing to zero ft at outer edge
- Note: no turns until 164' obstacle clearance is reached and

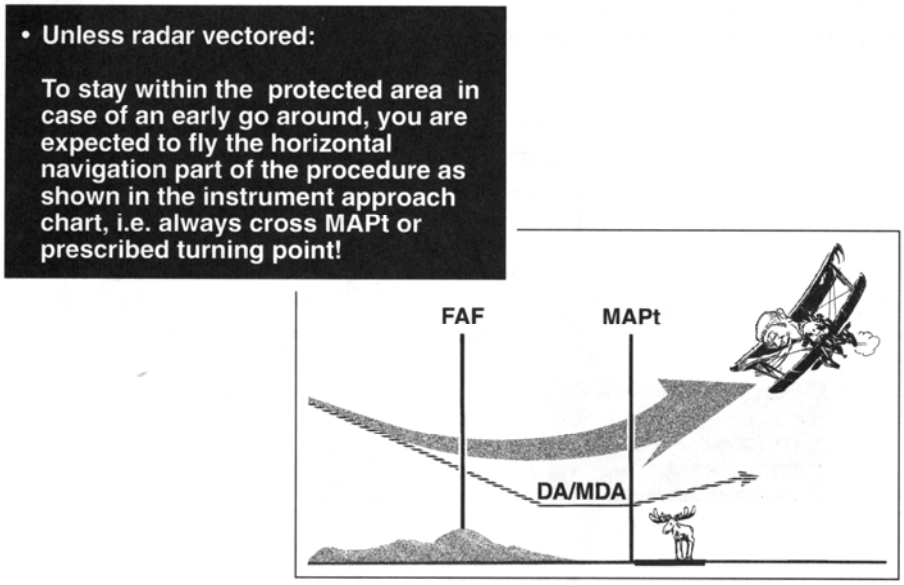


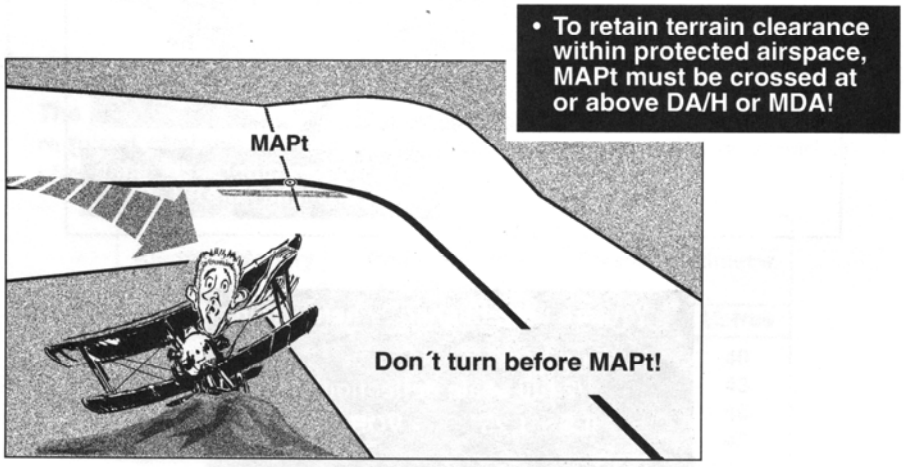


Min 164 feet

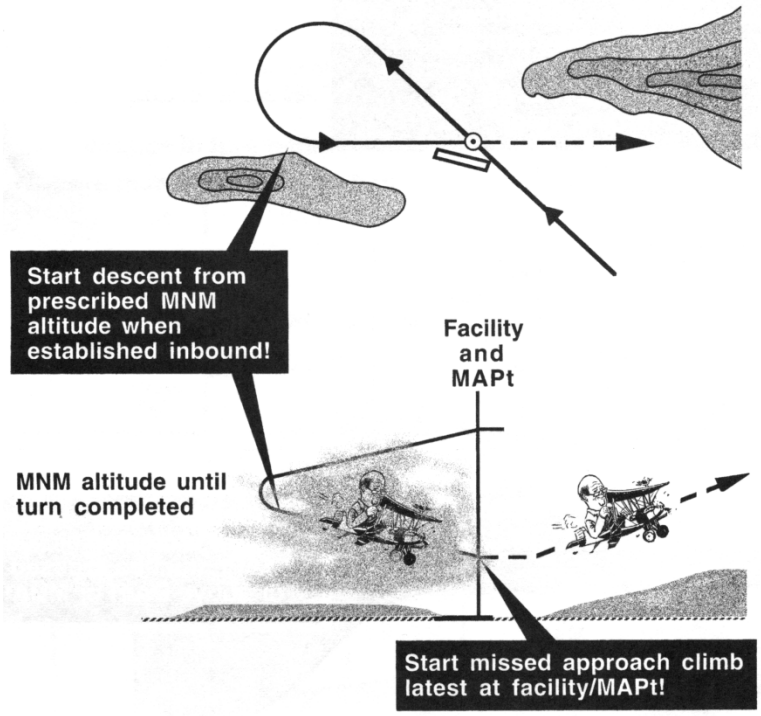


Early missed approach:

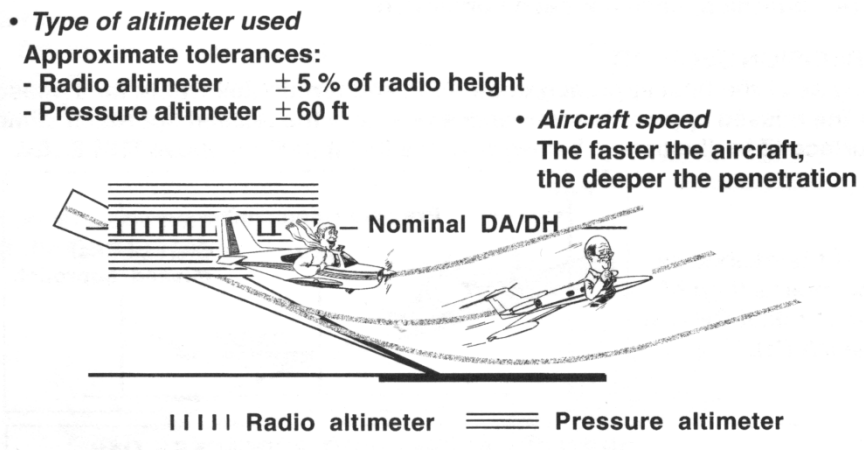




A non-precision approach based on a single facility sited on or close to the airport, has no FAF. The aircraft enters directly from the initial approach segment into the final approach segment when establishing on the final approach track.



ILS approaches:



Decision to land or go around is made at DA/DH. This means that the airplane WILL descend through DA/DH before starting to climb. So, obstacle clearance is determined by:

Glideslope: 2.5 deg-3.5 deg. Optimal 3.0 deg.

ILS sector width at threshold: 210m.